MILITARY SPECIFICATION

AUTOMATED ACCEPTANCE INSPECTION EQUIPMENT FOR NON-ELECTRONIC COMPONENTS, DESIGN, TESTING AND APPROVAL, OF

This specification is approved for use within the U.S. Army Armament, Munitions and Chemical Command, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification prescribes requirements for design, testing and design approval of Automated Acceptance Inspection Equipment (AAIE) systems. This specification is applicable to government and contractor owned equipment which is used to assure that supplies offered for Government acceptance conform to contract requirements. This specification is intended to be used in conjunction with existing Quality Assurance documentation and in conjunction with equipment Technical Specifications or purchase descriptions for procurement. The design approval requirements apply on a one-time basis for each design while the testing requirements apply to all equipment being delivered.

1.2 Equipment applicability. This specification applies to all automated systems performing the following tests:

a. Dimensional inspection: contact

b. Dimensional inspection: non-contact

c. Functional tests

d. Non-destructive evaluation (NDE)

This specification does not apply to the inspection or testing of electronic components.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Armament, Munitions and Chemical Command, Attn: AMSMC-QA, Dover, New Jersey 07801-5001 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5220

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-I-45607 - Inspection Equipment, Design, Acquisition, Maintenance and Disposition of

STANDARDS

MILITARY

MIL-STD-109 - Quality Assurance Terms and Definitions
MIL-STD-120 - Gage Inspection
MIL-STD-129 - Marking for Shipment and Storage
MIL-STD-45662 - Calibration System Requirements
DOD-STD-2167 - Defense Systems Software Development

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. As detailed in this specification, MIL-I-45607 and the contract, prior written government approval is required for all AAIE systems utilized for assuring that supplies offered for Government acceptance conform to contract requirements. This approval shall consist of a Design Qualification Review as noted below. All of the design requirements herein may not be applicable to certain types of AAIE. It is the responsibility of the equipment designer to submit all design information which is applicable to the specific equipment. The final decision regarding applicability of the requirements of this specification shall be made by the Government.

3.2 Design qualification review. In accordance with contract requirements the AAIE design shall include the following:

a. A concept design which clearly defines the basis for the equipment detail design.

b. A detailed proposed design submitted and approved prior to fabrication which provides detail design of equipment.

c. A final design which contains the final as-built Technical Data Package (TDP), (as required), results of all tests, and documentation as specified herein.

3.2.1 Concept designs. This design shall include as a minimum but not be limited to:

a. Theory of system operation including plans for calibration, verification, operation, recall, control of Units Under Test (UUTs), data collection and processing.

b. Theory of equipment operation including rate of operation, flow of UUT's, equipment configuration, fail-safe features, built-in-test features, sketches of inspecting elements and control functions. DOD-STD-2167 with Software Requirements Specification and Software Top Level Design Document Data Item Descriptions (DIDs) shall be used as a guide in preparing the software descriptions

c. Proposals for Government data rights and proprietary data and a draft software configuration management plan.

d. Description of calibration and verification standards.

e. A draft plan for performing acceptance tests.

f. Apportionment of system reliability, considering required reliability, decision making reliability, handling and inspection accuracy, calibration/verification cycles and recall prodedures.

g. Descriptions of the following shall be required for design concept review.

(1) Data bus
(2) Input/Output (I/O) ports and communication interfaces
(3) American Standard Code for Information Interchange (ASCII) character set for data
(4) Storage media (type, compatibility, integrity)
(5) Read Only Memory (ROM), Programmable Read Only Memory (PROM) and Random Access Memory (RAM) characteristics
(6) Self-test features
(7) Programming language
(8) Temperature and humidity limitations
(9) Accessibility of data channels for statistical analysis

3.2.2 Detail proposed designs. The detail proposed design shall include:

a. Equipment layout.

b. Drawings of inspecting elements.

c. Details of government rights to data and proprietory data.

d. Description and operation of built in test features.

e. Draft plans for set-up, calibration, verification, operation and recall.

f. Description of interfaces, both hardware and software. DOD-STD-2167 with Interface Requirements Specification DID shall be used as a guide for the software descriptions.

g. Schematic/block diagrams of test and measuring circuits.

h. Description of data collection and management.

i. Identification of all commercial and government-furnished hardware/software being utilized.

j. Detailed acceptance test plan for all hardware/software testing. DOD-STD-2167 with Software Test Plan, Software Test Description and Software Test Procedure DID's shall be used as a guide for preparing the software portion of the test plan.

k. Draft software design documents and software listings (or commercial equivalent) including cross-reference to all inspection requirements as specified on Form DD 1423 and in accordance with the contract. DOD-STD-2167 with Software Product Specification shall be used as a guide in preparing the documentation.

l. Acceptance Test Plan - A plan for performing an acceptance test to determine the inspection performance (accuracy and decision making reliability) including test preparation, procedures and reporting required. If system reliability apportionment has been made, details as to the manner in which limits for acceptance of the equipment are to be determined shall be included.

3.2.3 Final designs. The final design shall include as a minimum:

a. Acceptance test report including results of tests, data generated, sample data outputs (printouts, diskettes, or other mediums as applicable), definition of set-up, variable parameters, acceptance limits, verification results, demonstrated reliability and accuracy, and a determination of acceptability.

b. Final software design documents and listings including cross-reference to all inspection requirements.(see 3.2.2.k)

c. "As-built" equipment designs to the extent specified in the contract.

d. Final set-up and Operation, Verification, Calibration, and Recall (OVCR) procedures.

e. Final designs of calibration and verification standards.

3.3 Design requirements. The following design requirements will be complied with unless written approval is obtained from the contracting officer.

3.3.1 Fail safe design. All equipment shall utilize fail safe design. The decision-making logic and the material handling devices (when part of the equipment) shall be normally in a reject mode. A series of correct signals shall be required in a given sequence to change to the accept mode. The lack of any of these signals or an incorrect signal shall cause the systems to remain in the reject mode. (e.g. parts present in the equipment during startup shall be rejected since the entire cycle is not seen.)

For equipment including material handling there shall be a confirmatory signal that any rejected Unit Under Test (UUT) has in fact been cycled out the reject device. If the confirmatory signal is not activated, the system will immediately discontinue inspection and indicate a fault. It is desirable that accept gates be located before reject gates.

3.3.2 Calibration standards. All equipment shall use calibration standards maintained in accordance with MIL-STD-45662. Calibration standards used to calibrate the system need not represent all features of the UUT but only those being tested or inspected by each piece of AAIE.

3.3.2.1 Quantitative gaging. For quantitative gaging and testing calibration standards shall be certifiable to two significant digits more than the part tolerance. (e.g. Part Dimension 6.005 $\pm$ .002 shall have a calibration standard certified to X.XXXXX or pressure 30,000psi $\pm$ 3000 psi shall have a calibration standard certified to xx psi.)

3.3.2.2 Non-destructive examination. For Non-destructive Examination (NDE) the calibration standard designs shall normally be developed by the Government and provided as part of the contractual documentation. In the remaining cases, envelope drawings or design concepts will be provided and the contractor will complete the design to those requirements and obtain Government approval.

3.3.3 Verification standards. - All equipment shall use verification standards maintained in accordance with MIL-STD-45662. Verification standards may also serve as calibration standards when economically feasible. However, when this occurs, the stricter tolerancing of the calibration standard shall be used. Verification standards which are periodically cycled through the system shall represent the shape of the UUT and shall be sufficiently durable to withstand repeated cycling in the normal automatic mode through the AAIE as well as the production material handling system from the point of entry to the point of exit of the standard. The design features of the standard (e.g. hardness, material, automatic or manual handling, wear rates, frequency of replacement) shall be chosen to provide the lowest overall life cycle cost while not compromising inspection accuracy. This standard shall be clearly identified to preclude being mistaken for a production part. When system design requires the use of fixed verification standards which are not cyclable through the system, they shall be so designed that they represent the UUT in all features which affect the AAIE inspection function. Any automatic equipment used to insert these standards into and remove them from the inspection station shall not be part of or have any effect on the inspection function.

3.3.3.1 Quantitive inspection. For quantitative inspection, verification standards shall be certifiable to one significant digit more than the part tolerance. (e.g. part dimension 6.005±.002 shall have a verification standard certified to X.XXXX or pressure 30,000 psi ± 3000 psi shall have a verification standard certified to xxx psi). When the UUT does not require orientation for inspection, the verification standard shall be designed so that the tolerances noted above are held regardless of the orientation of the standard in the inspection machine. When a presence or positional characteristic in an assembly is being inspected on the UUT, the verification standard shall be based on the positional tolerance, not the individual component tolerance. For toleranced characteristics (either bilateral or unilateral) standards are required, one at the maximum and one at the minimum of the tolerance band. If one machine is measuring multiple characteristics, these may be combined on the standards. For characteristics with only one limit (Max., Min.) one standard is required. All standards shall be within the normal measuring range of the AAIE.

3.3.3.2 Non-destructive examination. Manufacturing requirements of verification standard designs for NDE will be based on the design requirements for the NDE calibration standards and will comply with the functional requirements of 3.3.3.1 as applicable.

3.3.3.3 Requirements for variations. Variations from the above requirements may be necessitated due to very small manufacturing tolerances, unique characteristics of the UUT, the inspection equipment or to advances in technology. Such variations require prior written government approval before being incorporated in the design.

3.3.4 Decision-making. The AAIE may use either a variable or non-variable output from the inspection element for the decision-making process unless the specification requirements for the UUT require a variable reading. It is highly desirable that variables output be utilized unless it is proven to be not cost-effective. A variable output is defined as an output (voltage, pressure, etc.) from a sensor which is proportional to the stimulation of that sensor. This variable output may be processed either to indicate a discrete value or be compared to a threshold. A non-variable output is defined only as an event signal which indicates the UUT has passed into (or not passed into) an inspection device of rigid mechanical configuration.

3.3.4.1 Variable-quantitative inspection. For variable output quantitative inspection, all set-up, calibration and verification shall be done utilizing the variable output. If the specification requirement for the UUT only requires an attribute decision then the ACC/REJ signal in the operating mode may be by attribute. The computer architecture however, shall be designed so that the variable outputs are externally accessible for verification, calibration, set-up etc. The structure of this accessibility depends on the overall system design (i.e., if the system requires transfer of all feature size data to a host computer then the AAIE computer shall require sufficient memory and processing capacity to accommodate this). As a minimum all AAIE shall provide sufficient memory and processing capacity to provide the actual values of all characteristics being inspected on demand for set-up, calibration and verification. This may take the form of CRT, digital displays or other acceptable methods, which can be recorded on diskettes, printouts, or other medium as required by the approved system design for record-keeping purposes. (See 6.5)

3.3.4.1.1 Processor sensitivity during inspection. The number of significant digits used by the processor for decision-making during automatic inspection shall not exceed one more than the number of significant digits in the tolerance for the characteristic. If the AAIE is inspecting more than one characteristic and it is advantageous to standardize on the number of significant digits, the largest number for all characteristics shall be used. When the AAIE computer carries more significant digits these digits shall be truncated in lieu of rounding off.

3.3.4.1.2 Processor sensitivity during calibration. During calibration the processor for decision making shall use no more than three significant digits more than the number of significant digits in the tolerance.

3.3.4.1.3 Digital output. Visible readouts and computer memory of inspection results shall not exceed the number of significant digits required by 3.3.4.1.1. Visible readouts and computer memory of calibration readings shall not exceed the number of digits required by 3.3.4.1.2.

3.3.4.1.4 Processor sensitivity during calculations. If the capability for statistical analysis is provided in the internal processor, this shall be done to one additional significant digit than that required by 3.3.4.1.1 in order to maintain accuracy of calculation.

3.3.4.2 Non-destruction examination. For variables output non-destructive examination the requirements are the same as for quantitative inspection (see 3.3.4.1) except that the actual variables outputs, response curves, settings for gain and threshold, shall be accessible.

3.3.4.3 Non-variable inspection. For non-variables inspection there are no specific output-management requirements unless attribute data processing is part of the system design.

3.3.5 Data management. Design of data collection, storage, processing and management shall be dependent on the system requirements within the following guidelines:

3.3.5.1 Computer hardware architecture. The AAIE computer hardware architecture shall be so designed that the CPU shall not be tasked with or hindered by performing peripheral I/O. A typical method would include "channels" (special purpose processors) to perform external I/O. The ability to interface with standard output devices (e.g., RS-232C interfaces to printer, high speed modems) to facilitate external processing shall be supplied as required by the system design.

3.3.5.2 Computer software architecture. The AAIE shall be so designed that no inputs, commands or combinations of instruction other than those necessary for maintenance, test, troubleshooting or repair, can be provided which would in any way alter, restructure or override the automatic decision-making process such that rejectable material is accepted when the equipment is in the "run" mode.

3.3.5.3 Documentation language. All software module documentation shall be in the English language.

3.3.6 System access. The AAIE shall be so designed that the control system will be divided into lockable levels of physical access. Those controls needed by the operator for operation and verification shall be separately locked. Controls for calibration, troubleshooting, and set-up, shall be locked and access denied during operation.

3.3.7 Built-in test. Unless otherwise specified in the contract the Automatic Acceptance Inspection Equipment (AAIE) shall contain built-in-test (BIT) which will provide the means for monitoring system performance and the detection of hardware failures which affect decision-making. The BIT design and implementation shall be to ensure the integrity of the AAIE by providing the operator a confidence level of at least ninety percent (90%) that the AAIE functions as intended. It shall be a design goal to detect ninety-five percent (95%) of all AAIE failures through BIT. The design shall take into consideration component failure rates and the identification of components/functions critical to the proper functioning of the AAIE system and will design the proper BIT for detecting and isolating (reporting) any failures in that component/function. This shall, as a minimum include ROM (checksum tests or other means of assuring the program is not changed), RAM, interface circuits, and microprocessor testing in the design of AAIE BIT.

3.3.8 Gage head design. For AAIE using contact heads, the contacts shall be designed to be insensitive to all surface finish variations permitted by the drawing for the UUT.

3.3.9 Scan design. For AAIE used for NDE applications where sensors are scanning, a minimum of one hundred percent (100%) coverage of the UUT is required, e.g. the pitch of scanning helix shall overlap.

3.3.10 Foreign matter contamination. AAIE design shall consider any foreign matter contamination created by the manufacturing system. Units under test shall be cleaned adequately so that any contamination does not result in erroneous readings.

3.3.11 Inspection method. For given types of dimensional measurements certain methods are preferred.

3.3.11.1 Cylindrical parts. For cylindrical parts, either rotation or inspection at multiple points.

3.3.11.2 Straight parts. For long, straight sections, either continuous sensing or multiple points.

3.3.11.3 Thicknesses. For thicknesses, measuring devices should be immediately opposite each other (unless a one-sided measuring system such as ultrasonic testing is used).

3.3.12 Operation, verification, calibration and recall procedure. For all AAIE systems, operation verification, calibration and recall procedures shall be prepared and submitted for Government approval.

3.3.12.1 Operation procedures. Operating procedures shall define all activities required to operate the equipment properly. They shall include maintaining an operator's log book and a maintenance log book unless otherwise specified in the contract.

3.3.12.2 Verification procedures. Verification procedures shall provide all information needed for verification including record keeping.

3.3.12.3 Calibration procedures. Calibration procedures shall provide all information needed for calibration including record keeping.

3.3.12.4 Recall procedures. Recall procedure for AAIE shall include only those actions performed by the AAIE operator in a recall process. A separate, plant-wide recall procedure requiring on-site government approval only is not part of this specification.

3.3.13 Operational requirements. AAIE operational hardware and software systems which measure and provide values of verification standards shall be the same systems which perform normal inspection. Subsystems and processors used for material handling of the verification standards and recording of the results may be unique. Initiation of the verification cycle shall be through a single command from the operator's controls with the equipment in the "run" mode. No inspection shall be completed until the verification cycle is terminated. Incorporation of fully automatic verification without operator input requires written prior government approval.

3.4 Inspection performance. Inspection performance shall be assured by determining the accuracy and the decision-making reliability of the AAIE and by establishing acceptance limits to the proper level.

3.4.1 Variable inspection of quantitative characteristics. For variables inspection of quantitative characteristics the accuracy shall be determined by calculating the precision and bias for each characteristic being inspected. The decision making reliability shall be determined as a function of system design and UUT requirements and demonstrated during the acceptance test (see paragraphs 3.2.2.1 and 3.2.3.a). The acceptance limits shall be established using the precision and bias. Normally the acceptance limits shall be set:

a. Inside the tolerance limits by two times the precision.

b. By shifting the reject points by the amount of defined bias.

If acceptance limits are set based on system reliability apportionment the calculations shall be documented and reported in the Final Design package.

3.4.2 Variable inspection for non-destructive examination. For variables inspection in non-destructive examination (NDE) the accuracy shall be defined as the variation of the magnitude of the signal generated when testing the reject standard from the average of all signal magnitudes. It is a design goal that this shall not exceed ten percent (10%). Regardless of the actual variation, the smallest defect signal in the standard shall always be at least ten percent (10%) greater than the maximum threshold value. The requirements for decision-making reliability shall be the same as those respective requirements for dimensional inspection as specified in 3.4.1. Maximum noise shall not be greater than twenty-five percent (25%) of the smallest defect signal.

3.4.3 Non-variable inspection. For non-variables inspection the accuracy shall be determined through measurement and certification of the inspection fixture as specified in MIL-STD-45662. The requirements for decision-making reliability shall be the same as those respective requirements for dimensional inspection as specified in 3.4.1.

3.5 Workmanship. The AAIE shall be designed and constructed using standard commercial practices and the following:

3.5.1 Surface preparation. Unless specified in the contract, all surfaces shall be protected against corrosion, using good commercial practice.

3.5.2 Burr. No part shall have a burr which might interfere with the assembly or function of the AAIE or which might be injurious to personnel using the AAIE.

3.5.3 Foreign matter. No part of assembly shall contain dirt, grease, chips, rust, corrosion or other foreign matter which might interfere with the function of the AAIE.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection

requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Quality assurance and technical terms and definitions. Reference shall be made to MIL-STD-109 and to Section 6 of this specification to define the terms used.

4.2 Quality assurance provisions.

4.2.1 Design submission. In general the design submissions will be made in either 2 or 3 phases. For complex designs the three phases of 3.2 shall be followed. For less complex equipment the concept and detailed design phases may be combined however the details of each shall be presented. Contractors are encouraged to make partial submissions against each phase as data becomes available. Submissions should include remaining actions to be accomplished for each phase approval. All designs shall comply with 3.2 and 3.3. Exceptions to the design criteria herein shall be submitted with supporting documentation at the earliest phase.

4.2.2 Acceptance test (general). As required in 3.2.3 all AAIE shall pass an acceptance test. The test shall be performed at the users facility with the AAIE fully integrated into the manufacturing system. The contractor shall notify the responsible Government technical agency a minimum of 5 working days prior to testing to allow time for Government witnessing of the test by the technical agency. The contractor shall perform the test per the Government approved test plan, analyze the results and submit a report for Government approval per the contract. Only clearly rejectable production parts shall be utilized for any testing which requires reject production parts. Any parts which are determined to be "borderline" by the government shall be removed from the test and any data which was generated with these parts shall be considered a "no test". (See 6.2 Definitions)

4.2.2.1 Qualification test (variables - quantitative) The qualification test for all equipment utilizing variables outputs for quantitative inspection shall cover two basic areas, accuracy and decision-making reliability.

4.2.2.1.1 Accuracy test. The accuracy test shall be performed dynamically, (i.e. the full automatic run mode) using both verification standards and production parts. The verification standards are cycled through the AAIE in the automatic mode such that at least thirty data points are established for each characteristic being inspected. Means and standard deviations are calculated for use with 3.4.1 to determine the values for setting the acceptance limits inside the tolerance limits. Data shall also be collected to confirm the readings obtained with the verification standards by using production parts. In the case of explosive components, inert components may be substituted. If normal production parts are not available, then special parts which closely resemble the characteristics (e.g. surface finish, hardness, consistency) may be utilized if prior government approval is obtained. These parts shall be cycled in the same fashion as the verification standards and the precision and bias shall be calculated. Features of the production and special parts will be measured to determine bias. In the case where the production or special parts cannot be cycled repeatedly (i.e. soft parts which become damaged) then at least 50 individual parts will be inspected both by the AAIE and manually and the bias determined. Other alternate methods may be used providing prior government approval is obtained. If statistically significant differences are obtained the data acquired with the standards and that obtained with the production/special parts, the design of the equipment shall be corrected to eliminate the differences, or the acceptance limits shall be changed to correspond with them as specified in 3.4.1.

4.2.2.1.2 Decision-making reliability test. The decision-making reliability portion of the test shall be performed using production parts and verification standards modified and properly identified as known rejects. If normal production parts are not available at time of the acceptance test, parts specially made to represent normal production may be used for purposes of testing. Inert components may be substituted for explosive components. It is desirable that every inspected characteristic be represented by a high and low reject if possible. The test shall be run by continuously cycling the production parts at design rate under normal production conditions, both acceptable and rejectable, and observing that the rejectable parts are properly ejected out the rejection device and acceptable parts out the acceptable device. The duration of the test and the number

of times the reject standards are cycled shall be determined to demonstrate the system requirements of 3.4.1 at a ninety percent (90%) confidence level and submitted for government approval in the acceptance test plan. Records shall be kept of the sequence of introduction of the reject parts and standards and the respective acc/rej. results. Additionally, when the standards are being tested the actual variables data being obtained for those standards shall be recorded. Requirements for rejection of acceptable parts shall be included in the acceptance test plan. Data from the standards shall be compared to the limits on the calibration charts to determine what, if any, drift is occuring. If drift occurs to the extent that reject parts are accepted it shall constitute a failure. Scheduled adjustments for drift during the test are permitted if detailed in the operating procedures before the test begins. No other assessment of accuracy is required in this phase.

4.2.2.1.3 Cleanliness. During the performance of the accuracy test, the AAIE and test parts will be kept as clean as possible. During the decision-making reliability test only those cleanliness procedures intended for normal production shall be employed.

4.2.2.2 Qualification test (variables - NDE) The qualification test for all equipment utilizing variables output for non-dimensional inspection shall cover two basic areas, repeatability and decision-making reliability.

4.2.2.2.1 Repeatability test. The repeatability test shall be performed dynamically. The approved reject standards shall be cycled through the equipment at least 100 consecutive times. The values of the output signals shall be recorded, the mean calculated and the variation from the mean determined. This test shall be performed in the operational mode and a hard copy record (e.g. diskette/printout) of all the runs shall be made. The results shall be analyzed for compliance with 3.4.2.

4.2.2.2.2 Decision-making reliability test. The decision making reliability portion shall be conducted using normal production parts and reject standards. If normal production parts are not available at time of the acceptance test, parts specially made to represent normal production may be used for purposes of testing. Inert components may be substituted for explosive components. At least ten percent of the production parts shall be known rejects from previous testing which are serialized. The test shall be run by continuously cycling the production parts at design rate under normal production conditions with the reject parts and the reject standards randomly included. At least ten percent of the parts cycled through shall be the reject parts.

Observation shall be made throughout the test for the correct accept/reject decisions and the results, which include the sequence in which the parts were introduced as well as the accept/reject results, shall be recorded and analyzed against requirements. The duration of the test and the number of times the reject standards are cycled shall be determined to demonstrate the requirements of 3.4.2 to a ninety percent (90%) confidence level and shall be submitted for Government approval as part of the acceptance test plan. In addition the actual signal data shall be recorded as follows:

a. For all reject parts and all reject standards data will be collected for the first ten times through the machine and again for ten times near the end of the test.

b. This same data will be collected for five known (and identified) acceptable parts at the beginning and near the end of the test.

These groups of data will be analyzed to determine any degradation of performance by determining if the variation from the mean requirements of 3.4.2 are still being met.

4.2.2.3 Qualification test - non-variable. The qualification test for all equipment utilizing non-variables output for dimensional inspection shall cover two basic areas accuracy and decision-making reliability.

4.2.2.3.1 Accuracy test. The accuracy test shall consist of measurement of the fixed inspection devices and providing the results traceable to NBS standards. This shall also be done at the conclusion of the decision-making reliability test and the results compared to determine if any changes have occurred.

4.2.2.3.2 Decision-making test. The decision-making test shall consist of running production parts through the equipment at design rate under normal production conditions with at least ten percent of the parts configured to be rejectable and so identified. The test shall be run at rate in the operational mode with the rejectable parts introduced randomly. Observation shall be made for the correct decisions. The sequence in which the parts were introduced as well as the accept/reject decisions shall be recorded. The duration of the test shall be determined to demonstrate the requirements of 3.4.3 at a ninety percent (90%) confidence level and shall be submitted for government approval as part of the acceptance test plan.

5. PACKAGING

5.1 Preservation and packaging. All AAIE being prepared for delivery to the Government or being installed in a Government facility shall be preserved and packaged to insure safe arrival and to withstand the environment of the installation.

5.2 Marking. In addition to any special marking required by the contract, shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. This specification is to be used as the basis for the establishment of required procedures for the design, testing and approval of AAIE.

6.1.1 Contractual applications. This specification may be used as part of contractual documents, by reference in the contract, within a contractor's facility or a Government-owned contractor-operated facility and between the contractor and his subcontractors.

6.1.2 In-house Government developments. This specification shall be used within Government facilities and between Government offices and contractors.

6.2 Definitions.

a. Accuracy. A term which describes the closeness of test measurements to the true (lab) measurement. For quantitative data, accuracy is normally defined by two factors, systematic error (or bias) and precision (repeatability).

1. Systematic Error (bias) is the difference between the average (mean) reading in a series of measurements and the true (lab) measurement.

2. Precision (repeatability) is a measure of the closeness of a series of measurements. For purposes of this effort the precision will be defined as the standard deviation of a group of readings of a given characteristic.

b. Automated Acceptance Inspection Equipment. (AAIE) Automatic and semi-automatic equipment in which the inspection and acceptance determination of the product is performed automatically.

c. Automatic decision. The determination of acceptability/rejectability by the equipment without human intervention. The output of the equipment is an accept/reject signal which may be used to trigger lights, alarms, material handling devices.

d. "Borderline" Part. A production part which has been selected for test purposes but which has demonstrated features such that the AAIE may accept or reject the part on subsequent test. This may be due to causes such as irregular surface finish, minor damage, taper, ovality, or other part irregularities of a marginal nature. Such parts shall not be used for test purposes when repeatability is necessary.

e. Calibration. The process of inserting a standard of known value of the characteristics into the AAIE and adjusting the equipment to provide a desired readout.

f. Calibration chart. A document which records exactly the tolerance limit to which each acceptance channel of the AAIE is set at any given time and establishes limits for calibration and verification values.

g. Calibration standard. A device of known size and characteristics, which need not resemble the unit under test (UUT), used to calibrate the AAIE.

h. Control, repair and requalification plan for AAIE - (CRRP). A planning and execution document which defines:

1. The organization responsible for the integrity of the AAIE, including:

(a) Responsibilities
(b) Preparation of control procedures
(c) Execution of control procedures
(d) Hardware/software configuration management

2. Types of repairs not requiring prior government approval

3. Requalification needed after these repairs

4. Plan for repairs and requalifications not covered above and which do require prior government approval.

5. Surveillance test plan.

i. Decision point. That place and time at which a unit of product is considered acceptable because a successful verification has been performed subsequent to the inspection of that unit of product. This applies only to product determined to be acceptable by the AAIE and depends on individual system design and verification intervals.

j. Integrity of AAIE. The condition of the AAIE such that it is capable of functioning as intended and making the correct decisions.

k. Program printout. A printout of the software program and programmable values that may be obtained by the operator but controlled only by qualified calibration or repair technicians.

l. Quality system plan (QSP). A planning document usually incorporated as part of the Quality Program Plan required by MIL-Q-9858 which shows exactly how AAIE is being incorporated into a manufacturing system including as a minimum: flow and control of product, establishment of decision point, recall planning, AAIE design characteristics, type of verification, data collection and management, and hardware and software interfaces.

m. Recall. The return for reinspection due to an unsuccessful verification of all inspected product which has not reached the decision point.

n. Repair. The action of correcting a condition which causes AAIE not to perform proper inspections or not to make correct inspection decisions.

o. Tolerance limits. The acceptance limits established on the AAIE in order to account for the inaccuracies demonstrated during qualification testing of the equipment. These limits are set within the drawing specification limits to assure that only acceptable product is passed by the equipment.

p. UUT - unit under test.

q. Verification. The process of presenting a standard of known value or characteristics to the AAIE to determine if the result of the automatic inspection is within an acceptable range.

r. Verification standard. A device of known size and characteristics which closely resembles the UUT and is used periodically to perform verification. This device should be designed to be cycled through the AAIE and associated material handling systems. If system design requires self-verification, a different type of device, not necessarily resembling the UUT, may be attached to the machine. It shall perform verification every cycle because the decision point is the inspection point in this type of design and no recall is possible.

6.3 Documentation for use of AAIE. Although not required for formal design approval, the following documents may be submitted to support design approval.

Calibration Charts
Definition of Variable Parameters
Threshold Values
Control Repair and Requalification Plan
Configuration Management Plans

6.3.1 Calibration charts. Calibration charts shall define the exact ACC/REJ limits to which the AAIE is set for all features being inspected. The charts should also include the limits of acceptability for readings obtained when verification standards are cycled through. Typically, if the readings observed from the cycling of the verification standards are within the limits on this chart, the AAIE is considered to have passed verification.

6.3.2 Variable parameter definition. The definition of variable parameters shall state the current value which has been given to all variable parameters in the AAIE computer. The AAIE shall be so designed that these may be accessed and outputted on demand for comparison with the definition.

6.3.3 Values of test parameter. The values assigned to test parameter, other than those normally checked during calibration/verification shall be documented.

6.3.4 Control, repair and requalification. The contractor is responsible to maintain a system to control the integrity of the AAIE in accordance with the provisions of MIL-STD-120 and MIL-STD-45662 at all times when in use. This system shall include as a minimum, but shall not be limited to the following:

a. Procedures for responsibilities, preparation of control methods, record keeping and execution of those methods to include assurance of hardware/software integrity and hardware/software configuration management.

b. Repair procedures.

c. Requalification procedures.

d. Periodic surveillance test procedures.

The requirements for the planning and government review of this system shall be as specified in the contract and as required by the Contracting Officer or his designated representative.

6.4 Functional tests. In addition to the testing specified herein, additional testing may be required to satisfy the Contracting Officer or his Quality Assurance Representative prior to his acceptance of the inspection data. These tests would be a functional test prior to accepting product, periodic surveillance testing and testing after modification/rework/repair.

6.5 Approval for use. Approval of the data required under this specification constitutes a design acceptance by the Government. The acceptance of product inspected by the AAIE is the responsibility of the contracting officer or his designated representative. Documentation requirements for such acceptance include achieving, acquiring or preparing the following:

a. Written government approval of the Design Qualification Review. (See 3.2)

b. Calibration and Verification Standards in accordance with MIL-STD-45662 and the government approved designs.

c. Calibration charts or approved equivalent, definition of all variable parameters, "checksums" and thresholds as applicable.

d. Control, Repair and Requalification Plans including software security, identification and configuration control.

e. Methods for record-keeping to include run times, verification results, maintenance records, down times, and current set-up values.

6.6 Vendor testing. Although not required for Government approval of the design it is recommended that an initial test be performed at the vendors facility prior to shipment and installation of the equipment into the production facility. This test should be performed to provide sufficient confidence that the equipment meets all requirements.

6.7 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are involved and the DD Form 1423 is not used, the data specified below shall be delivered by the

contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs.

Paragraph	Data Requirements	Applicable DID
3.2	Acceptance Inspection Equipment Design Documentation	DI-R-10054
4.2.2		

6.8 Subject term (key word) listing.

Acceptance limits
Acceptance test plan
Accuracy
Automated acceptance inspection equipment
Automatic decision
Built-in test
Calibration
Calibration chart
Calibration standard
Computer software architecture
Control, repair and requalification plan
Data collection
Decision point
Design approval
Digital output
Documentation
Fail safe design
Foreign matter contamination
Functional test
Gage head design
Inspection performance
Integrity of AAIE
Non-destructive evaluation
Non-quantitative inspection
Operation
Processor sensitivity
Quantitative inspection
Recall
Reliability
Repair
Scan design
Test parameters
Tolerance limits
Unit under test
Variable parameters
Verification
Verification Standard

Custodian:
Army - AR

Preparing activity:
Army - AR

(Project 5220-A210)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-A-70625	AUTOMATED ACCEPTANCE INSPECTION EQUIPMENT FOR NON-ELECTRIC COMPONENTS, DESIGN, TESTING AND APPROVAL, OF

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.