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MILITARY SPECIFICATION

AUTOMATED ACCEPTANCE INSPECTION EQUIPMENT 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 all Automated Acceptance Inspection Equipment (AAIE) systems. This specification is applicable to both government and contractor owned equipment which is used to assure that supplies offered for Government acceptance conform to the Government design requirements (see 6.1).

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

a. Dimensional inspection/functional test: variable and nonvariable.

b. Electronic, electric and electromechanical components, subsystems and systems inspection/functional test: variable and nonvariable (see 6.1).

c. Nondestructive evaluation (NDE).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

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, Picatinny Arsenal, New Jersey 07806-5000 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS

MILITARY

DOD-D-1000 - Drawing, Engineering and Associated Lists
MIL-I-45607 - Inspection Equipment, Design, Acquisition, Maintenance and Disposition of

STANDARDS

MILITARY

DOD-STD-100	-	Engineering Drawing Practices
MIL-STD-109	-	Quality Assurance Terms and Definitions
MIL-STD-120	-	Gage Inspection
MIL-STD-129	-	Marking for Shipment and Storage
MIL-STD-454	-	Standard General Requirements for Electronic Equipment
MIL-STD-480	-	Configuration Control - Engineering Changes, Waivers and Deviations
DOD-STD-1686	-	Electrostatic Discharge Program
MIL-STD-2077	-	Test Programs, General Requirements for
DOD-STD-2167	-	Defense Systems Software Development
MIL-STD-45662	-	Calibration System Requirements

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government. - Other documents applicable to a specific armaments item are listed in the item detail specification.

2.3 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 the design of all AAIE systems utilized for assuring that supplies offered for Government acceptance conform to contract requirements (See 6.5). This approval shall consist of a design qualification review as noted below. It is the intent

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of this document to provide design criteria for all manner of AAIE submitted to the Government for approval; however, it is conceivable that all of the design requirements herein may not be applicable to certain types of AAIE. It is the responsibility of the contractor to submit all design information which is applicable to the AAIE. The final decision regarding applicability of the requirements of this specification shall be made by the Government. The AAIE design approval shall be made by the Government. The AAIE design approval requirements apply on a contract basis for each design and the related approval requirements apply to each piece of AAIE being delivered. If a new contract is issued, and the contractor determines that previously approved AAIE can be used, new Government approval must be obtained; but this may be waived dependent on the discretion of 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 design submitted and approved prior to fabrication.

c. A final design which contains the final as-built configuration of the AAIE and the results of all tests.

d. Designs shall be submitted in accordance with 6.7.

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

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

b. Theory of equipment operation including measurement techniques, rate of operation, flow of UUTs, equipment configuration, fail-safe features, built-in-test features, sketches of inspecting elements and control functions.

c. Theory of software operation including rate of processing, fail-safe and built-in-test features. DOD-STD-2167 with Software Requirement Specifications, System/Segment Specification, Software Development Plan and Operational Concept document Data Item Descriptions (DIDS) shall be used as a guide in preparing the documentation. The computer hardware designation and its operating system and the associated software programming language shall be submitted as required.

d. Description of calibration and verification systems (when applicable).

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e. A draft plan for performing the AAIE acceptance tests.

f. Apportionment of system reliability, considering required reliability, decision-making reliability, handling and inspection accuracy, calibration/verification cycles, AAIE systems configuration control methods and recall procedures. The system shall include the AAIE and its decision-making apparatus, its handling apparatus, any operator intervention techniques considered, UUT fixturing and interconnection, and the contractor's total quality control system.

g. For AAIE used for electronic component acceptance testing list all known and expected contractor and commercial calibration procedure requirements including and AAIE system calibration concept.

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

(1) Data bus/Address bus.
(2) Input/Output (I/0) ports and communication interfaces.
(3) American Standard Code for Information Interchange (ASCII) character set for data.
(4) Storage media (type, compatibility, integrity/capacity).
(5) Read Only Memory (ROM), Programmable Read Only Memory (PROM) and Random Access Memory (RAM) characteristics.
(6) Environmental limitations, if any.
(7) Accessibility of data channels for statistical analysis (not required but recommended).
(8) Data output formats of printout equipment,etc.
(9) Diagnostic capabilities for AAIE and UUT(s)
(10) Operator panel/controls layout.
(11) Software security concept.
(12) Capability of providing variable test stimuli parameters and measurement instrumentation with wide range, and access to all possible test points.
(13) Computer and associated programming language to be used.
(14) Proposals for personnel training.

i. Engineering drawings. Concept drawings shall conform to DOD-D-1000, Level 1 and DOD-STD-100 (multi-detail option). Government or contractor format shall be used as specified by the contract.

3.2.2 Detailed designs. The detailed design shall include but not be limited to the following:

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a. Equipment layout.

b. Engineering drawings in accordance with DOD-D-1000, Level 2 and DOD-STD-100. (Multi-detail option). Government or contractor format as specified in the contract.

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

d. Description and operation of built-in test features.

e. Draft plans for setup, calibration, verification, operation and recall. When an item of test equipment is to be commercially purchased the manufacturer's calibration cycle for the item of equipment is to be submitted with the plans. Regardless of the method for calibration of commercial equipment, calibration of the AAIE system, as a system shall be performed at the AAIE/UUT interface.

f. Details of adapters, cables, connectors, wiring diagrams, wire color coding, holding fixtures, etc., that may be required.

g. System and subsystem schematics, wiring diagrams and block diagrams.

h. Description of data collection, management and analysis.

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

j. Detailed software design documents and software listings (or commercial equivalent) including cross-reference to all inspection requirements as specified on DD Form 1423 and in accordance with the contract. Also to be included is a description of hardware and software interfaces. DOD-STD-2167 with Software Design Document and Interface Requirements Specification DIDS shall be used as a guide in preparing the documentation. Provision shall be made by the submitter so that knowledgable personnel and appropriate facilities are available so that a software "walkthrough", if necessary, for Government personnel charged with the responsibility of evaluating the AAIE may be facilitated.

k. Detailed acceptance test plan for all software testing. DOD-STD-2167 with Software Test Plan, Software Test Description and Software Test Procedure DIDS shall be used as a guide in preparing the documentation.

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

m. Detailed designs of the following shall be required:

(1) Data bus/address 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, capacity).
(5) Read Only Memory (ROM), Programmable Read Only Memory (PROM), and Random Access Memory (RAM).
(6) Self-test features.
(7) Programming language.
(8) Environmental limitations.
(9) Accessibility of data channels for statistical analysis.
(10) Proposals for personnel training.

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

a. Acceptance test report including date of test, test specimen identification including revision, results of test, data generated, sample data outputs (printouts, diskettes, or other mediums as applicable), definition of setup, variable parameters, acceptance limits, verification results, demonstrated reliability and accuracy and a determination of acceptability. DOD-STD-2167 with Software Test Report DIDs as applicable shall be used as a guide in preparing the documentation.

b. Final software design documents and listings including cross-reference to all inspection requirements. DOD-STD-2167 with Computer System Operator Manual, Software Users Manual and Software Product Specification DIDs shall be used as a guide in preparing the documentation. Provision shall be made by the submitter for personnel and facilities to be available to conduct a software "walk-through" for Government personnel charged with the responsibility of evaluating the AAIE.

c. Engineering drawings that represent the government accepted version of the AAIE to the extent specified in the contract. These drawings shall be per DOD-D-1000, Level 2. DOD-STD-100 also applies.

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d. Final setup and operation, verification, calibration, and recall (OVCR) procedures.

e. Final designs of calibration and verification standards, fixtures, and aids.

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 prior to and during any test. A series of signals indicative of proper test results 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. Parts present in the equipment during startup must be rejected since the entire testing cycle is not seen by these parts. For equipment, including material handling, there shall be a confirmatory signal such that any rejected UUT has in fact been cycled out of 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. All equipment shall be designed to incorporate easily performed periodic calibration so as to readily allow assurance that the equipment will be accepting only good product and rejecting all bad product for the duration of the approved calibration period. This assurance will be further amplified by use of the verification techniques as specified in 3.3.3 of this document. The period of calibration shall be determined by the contractor and agreed to by the Government. The calibration system shall be in accordance with MIL-STD-45662.

3.3.2.1 Calibration system-quantitative dimensional inspection. Where the inspection equipment is making a quantitative measurement, calibration standards shall be employed to assure adequate calibration. Calibration standards used to calibrate the system need not represent all features of the UUT but only those being inspected or tested by the AAIE. For quantitative gaging and testing, calibration standards shall be certifiable to at least two significant digits more than the part tolerance. All calibration standards for quantitative dimensional inspection AAIE are to be maintained in accordance with MIL-STD-45662.

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3.3.2.2 Calibration system-nondestructive evaluation. For nondestructive evaluation (NDE) AAIE the calibration standards shall have their design based on critical flaw size as determined by Fracture Mechanics Analysis. These designs are to have a margin of safety so that 100% of all critical flaws are rejected. These designs shall normally be developed by the Government and provided to the contractor 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 subsequently obtain government approval. All calibration standards for NDE are to be maintained in accordance with MIL-STD-45662.

3.3.2.3 Calibration system-electronic AAIE. For AAIE that is used to accept electronic or electromechanical product, calibration is to be performed in the following manner. Those components of test stimuli that have as an output a readily measurable value shall be calibrated by equipment that has measurement standards that are traceable to the National Institute of Standards and Technology (NIST) or if this is not possible, to industry standards approved by the Government. Test measurement components must also be calibrated with sources whose accuracy is traceable to NIST. All components of AAIE shall be calibrated with calibration equipment that is at least four times more accurate than the required accuracy of its associated testing component within the AAIE (i.e., for a calibration voltage measurement of 1v +/- 0.1v the voltmeter used for this purpose shall be calibrated with equipment that is accurate to +/-0.025v). All test stimuli, loading requirements and measurement capabilities should be calibrated at the AAIE/UUT interface. All equipment used to calibrate electronic AAIE is to be maintained in accordance with MIL-STD-45662.

3.3.3 Verification - All equipment shall be designed to incorporate easily performed periodic verification so as to allow assurance that the equipment will continue to accept and reject product with the same consistency as it did at the time of its previous calibration.

3.3.3.1 Verification system-mechanical/NDE - All Mechanical/NDE AAIE as a minimum shall use a system of verification, such as verification standards, on a periodic basis during any production run of product. This period will be determined by the contractor and approved by the Government. This equipment shall be maintained in accordance with MIL-STD-45662. Calibration standards may also serve as verification standards when economically feasible and when they will in no way cause nonconforming product to be accepted by the AAIE. However, when calibration standards are elected to be used for this purpose, their stricter tolerances must be used. All verification standards shall be sufficiently durable so as to

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withstand repeated cycling in the normal automatic mode through the AAIE as well as in the production material handling system from point of entry to the point of exit of the standard. The design features of the standards (e.g., hardness, material, automatic or manual handling, wear rates, frequency of replacement, etc.) shall be chosen to provide the lowest overall life cycle cost while not compromising inspection accuracy. Standards 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 designed so that they represent the UUT in all features which affect the AAIE inspection. 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.

3.3.3.2 Verification systems-electronic UUT. For AAIE used to perform inspection and test of electronic UUTs, verification may be performed in either of two ways. The first is by the use of verification standards. These standards must be of known electrical parameters such that the adequacy of the AAIE is ascertained by observing its responses to these standards during tests. The second method of verification that is acceptable is to ascertain that a minimum of testing faults are checked by determining that each testing stimuli source as well as each measurement function that is contained by the AAIE performs its function within the tolerances required. This minimum amount shall be determined by the contractor and approved by the Government. As an example, a self-test routine using a "wrap-around" method designed to do all system measurement and stimuli exercising and to find the acceptable amount of all possible faults would be acceptable as a simulated verification standard.

3.3.3.3 Verification standards certification. For quantitative inspection, verification standards shall be certifiable to at least one significant digit more than parts tolerance.

3.3.4 Decision-making. The AAIE may use either a variable or nonvariable 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 not to be cost-effective. A variable output is defined as an output value (voltage, pressure, etc.) from a sensor which is proportional to the stimulation of that sensor. A nonvariable output is defined as an event signal which indicates the AAIE has passed or rejected the UUT.

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3.3.4.1 Variable-quantitative inspection. For variable output quantitative inspection, all setup, 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 (see 6.2). When a computer, as part of the AAIE, is used to make a decision based on an attribute, the computer software architecture shall be designed so that the variable outputs are externally accessible for verification, calibration, setup, 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 setup, 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 resolution during inspection. The number of significant digits used by the processor for decision-making during automatic inspection shall be at least 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 resolution during calibration. During calibration, the processor for decision making shall use no more than one significant digit more than that of the calibration standard. Digits beyond this maximum are not significant.

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, calculation for this purpose may be conducted with as many significant digits that the internal processor will allow.

3.3.4.2 Nondestructive evaluation. 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.

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3.3.4.3 Nonvariable inspection. For nonvariables 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 design 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 designed so that no inputs, commands, or combinations of instructions other than those necessary for test, maintenance, trouble shooting 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. Security should be provided so that the production test operator will normally not have access to the maintenance, trouble shooting, or repair modes of the AAIE; this, by design, should be left to the AAIE technician or engineer.

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 setup, shall be locked and access denied at all times except during calibration, maintenance, or repair by authorized personnel.

3.3.7 Built-in test. The AAIE shall contain a built-in-test (BIT) unless specified otherwise in the contract. BIT may be used by the contractor to provide the means for monitoring system performance and the detection of hardware failures which affect decision-making as well as to help to ensure the integrity of the AAIE.

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.

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3.3.9 Scan design. For AAIE used for NDE applications where sensors are scanning, a minimum of 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 methods.

3.3.11.1 Nonelectronic component measurements. For given types of dimensional measurements, certain methods are preferred as follows:

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

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

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

3.3.11.2 Electronic component measurements. For acceptance measurements of electronic components, a complete functional type of measurement is preferred. Other types of measurements may be acceptable if Government approval is first obtained. Those other types of measurement are test pattern sets (TPS) and as such may be considered to be acceptable providing it can be shown that an acceptable amount of all possible rejects can be detected so that the overall quality of any component or assembly that is considered acceptable by the decision making process of the equipment will meet the intent of 3.4 of this specification. TPSs are to be developed in accordance with MIL-STD-2077, when required by the contract.

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 and verification intervals.

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3.3.12.3 Calibration procedures. Calibration procedures shall provide all information needed for calibration including record keeping, calibration interval, calibration standards, calibration data sheets, adjustment procedures and maintenance procedures.

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 shall require prior written Government approval.

3.3.14 Electrostatic Sensitivity. All AAIE being developed to test UUTs that are or contain parts that are considered to be electrostatically sensitive shall be designed in accordance with DOD-STD-1686.

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, based upon the accuracy and decision making reliability determined. For critical inspections the acceptance limits are set based on system reliability apportionment. All calculations made to arrive at these limits shall be documented and reported in the Final Design package. For noncritical inspections, the following rules shall apply.

3.4.1 Variables inspection of quantitative characteristics. For variables inspection of quantitative characteristics, the accuracy of the AAIE shall be determined by calculating its 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 3.2.2.1 and 3.2.3.a). The acceptance limits shall be established using the precision and bias which make up the accuracy of measurement as defined in 6.2.a. Normally the acceptance limits shall be set:

a. Inside the tolerance limits by two times the precision (two standard deviations-see 6.2.a).

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

3.4.2 Variables inspection for nondestructive examination. For variable inspection in nondestructive examination (NDE), the accuracy shall be defined as the variation of the signal magnitude when testing the reject standard. It is a design goal that this shall not exceed 10% of the threshold value. Regardless of the actual variation, the smallest defect signal in the standard shall always be at least 10% greater than the reject 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 25% of the smallest defect signal.

3.4.3 Nonvariable inspection reliability. For nonvariable inspection the accuracy of the AAIE shall be certified through the calibration process defined 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 best 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 or assembly shall contain dirt, grease, chips, rust, corrosion, or other foreign matter which might interfere with the function of the AAIE.

3.5.4 Testing security. In those cases where the contract requires, and when performing classified testing, appropriate measures shall be employed to ensure that the AAIE does not, in anyway, violate security integrity.

3.6 Design guidance. MIL-STD-454 may be used as a guide in the design and construction of all non-deliverable 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

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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 that the submitted AAIE and supporting items and documentation and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet the requirements of sections 3 and 5. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all AAIE 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 resulting from errors or omissions in AAIE designs.

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 design 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. If this is the case; however, the details of each must be submitted. 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 para(s) 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 section 3.2.3, all AAIE must pass an acceptance test to be certified as acceptable by the Government for use in the inspection of Government supplies requiring an acceptance test. The testing shall be performed at the contractor's facility with the AAIE fully integrated into the manufacturing system and calibrated in a manner approved by the Government as outlined in 3.3.2 of this document. 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

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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 marginal by the Government (see 6.2) shall be removed from the test and any data generated with these parts shall be ignored as though no test had been performed. The acceptance test, in general, will be composed of the following two parts:

a. A determination of the compatibility between the accepted design and the physical hardware.

b. The determination that the physical hardware does, in fact, perform the designed testing function.

4.2.2.1 Acceptance test-physical conformance. The first part of the acceptance test will be an inspection of the AAIE physical configuration in relation to all associated documentation for the purpose of proving to the satisfaction of the Government that the AAIE was built in accordance with all documentation previously submitted to and approved by the Government. (This is a Physical Configuration Audit as defined in MIL-STD-480.) Responsibility for the PCA may be delegated by the contract procuring activity to the contract administration activity.

4.2.2.2 Acceptance test-functional conformance. The second part of the acceptance test for the AAIE will be a functional test to prove to the satisfaction of the procuring agency that the AAIE does, in fact, perform all tests required by the governing procurement or the fabrication specification. The test assures the equipment inspects in a complete and accurate manner, and the decision-making capability of the testing system properly designates each unit under test in accordance with its accept or reject status. (This is a Functional Configuration Audit as defined in MIL-STD-480. It may also be used interchangeably with the term "qualification test").

4.2.2.2.1 Accuracy testing (nonelectronic and electronic AAIE). All equipment shall be tested to define the accuracy of the inspection system. During the performance of each accuracy test, the AAIE and the test parts shall be kept as clean as possible. These tests are to be performed after the AAIE has been calibrated in accordance with MIL-STD-45662.

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4.2.2.2.1.1 Accuracy test (non-electronic components-variable). The accuracy test shall be performed dynamically, (i.e., the full automatic run mode) using verification standards or production parts. The verification standards shall be cycled through the AAIE in the automatic mode so that at least 30 data points are established for each characteristic being inspected. Mean and standard deviations are to be 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 providing that 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 between 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.

4.2.2.2.1.2 Accuracy test (electronic components-variable). In lieu of an accuracy test for electronic component AAIE the decision-making reliability test of 4.2.2.2.2 is to be performed. This is to be performed only after completion of a total AAIE system calibration.

4.2.2.2.1.3 Accuracy test (nonelectronic components-nonvariable). The accuracy test shall consist of measurement of the fixed inspection devices 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.

4.2.2.2.1.4 Accuracy test (electronic components-nonvariable). The accuracy test for electronic components within this section is only applicable to digital components or the portion of a component that is composed only of digital circuits. The portion of the component that is analog electronic components must be tested in accordance with 4.2.2.2.1.2. The accuracy test as allowed by this paragraph shall consist of measurements using a software program of a Digital Static Pattern Test (DSPT) which must be submitted to the Government for approval. Approval of this DSPT will be based, in part, on an analytical demonstration that will prove to the satisfaction of

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the Government that the test generated by the DSPT is capable of detecting at least 95% of all faults that can possibly occur.

4.2.2.2.2 Decision-making reliability (AAIE-General). All equipment shall be tested to define the decision-making reliability of the inspection system. During these tests, only the cleanliness procedures intended during normal production shall be employed. Inert components may be substituted for explosive components.

4.2.2.2.2.1 Decision-making reliability (nonelectronic AAIE) The decision-making reliability portion of the test shall be performed using acceptable production parts, verification standards and reject production parts which are properly identified as known rejects. If normal production parts have been chosen to be used are not available at time of the acceptance test, parts specially made to represent normal production may be used for purposes of testing, if practical. It is desirable that every inspected characteristic be represented by a high and low reject test part, if possible. The test shall be run by continuously cycling the production parts, both acceptable and rejectable, at normal production design rates, and observing that the rejectable parts are properly identified. For equipment with automatic segregation this requirement includes assuring that those parts that are rejectable are ejected out the ejection device and those parts identified as acceptable are ejected out to the acceptance device. The duration of the test and the number of times the parts are cycled shall be determined by the contractor, so as to demonstrate the system requirements of 3.4.1 at a 90% confidence level, and submitted for Government approval. This submission should be via the acceptance test plan. Records shall be kept of the sequence of introduction of the parts and standards and the respective accept/reject results. Additionally, when the standards or production parts are being tested, the actual variables data being obtained from these tests shall be recorded. Requirements for rejection of acceptable parts shall be included in the acceptance test plan. Data from the standards/production parts shall be compared to the limits on the calibration charts to determine any drift that may be occurring. 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.

4.2.2.2.2.2 Decision-making reliability (electronic AAIE). Electronic accept and reject production parts may be used as UUTs for this test. If necessary they may be modified so that known defectives are selectively seeded within. (A known defective is one that is intended to cause the UUT to fail the AAIE test under known input functional conditions). The total number of defectives injected (or "seeded") should be such so that 10% of the normal testing for acceptability of the UUT is accomplished.

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Whenever possible, one of the defects injected into the UUT shall be representative of the most complex test performed on the item and designed to exercise the maximum number of programmed subroutines within the software configuration. The duration of the test and the number of times the parts are to be cycled shall be determined by the contractor, so as to demonstrate the system requirements of 3.4.1 at a mutually satisfactory confidence level and submitted to the Government for approval. This submission should be via the acceptance test plan. Upon performance of the test, the results should show that the spread of the quantitative values of each pass and each failure should be within 5% of itself. When no production part is available for this test a UUT simulator may be used. This need not have the physical attributes of electronic component but must be capable of demonstrating that all of the tests required of the AAIE for the actual UUT testing are properly performed. The design of this simulator must be submitted to the Government for approval and must contain all documentation to completely and appropriately describe, calibrate and maintain it. Further, a plan to demonstrate its performance must also accompany its submission.

4.2.2.2.3 Functional test (NDE-variables). The functional test for all NDE AAIE utilizing variables output in performing nondimensional inspection shall cover two basic areas, repeatability and decision-making reliability.

4.2.2.2.3.1 Repeatability test. The repeatability test shall be performed dynamically. The approved reject standards shall be cycled through the equipment at least 100 consecutive times, if practical. (If the amount is impractical due to time constraints, etc., a practical amount shall be agreed upon.) 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.

4.2.2.2.3.2 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 10% of the parts cycled through the equipment shall be known rejects from previous testing which are serialized. The test shall be run by continuously cycling the production parts, at the design rate, under normal production conditions with the reject parts and the reject standards randomly included. 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

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times the reject standards are cycled shall be determined so as to demonstrate the requirements of 3.4.2 to a 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.

4.2.3 AAIE configuration control. In order to assure the quality of present and future products being accepted by Government approved AAIE, it is required that the contractor has a system to control configuration changes. Upon original Government certification of AAIE designs, all changes to hardware, software and related documentation are to be submitted to the original Government agency for approval, with the new revision levels affixed, and upon subsequent approval by the Government, these revision levels become the level being worked on the production floor. No changes to any hardware, software or documentation is to be implemented by the contractor until new Government approval is obtained. Furthermore, to allow an audit of the revision of software in use within the AAIE at any point in time (so as to validate whether this usage is authorized or not), a method of easily determining the exact configuration of all software in use by the AAIE during product acceptance testing shall be implemented by the contractor. Methods such as:

a. The use of a "check sum" as an integral part of the software or,

b. Having a Master Disk in the Contractor's Quality Assurance department's library with the facility to easily run a comparison for differences between the production version and the Master Disk version are known workable examples; other methods may be used.

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 ensure safe arrival and to withstand the environment of the installation. Where necessary for packaging and handling, electrostatic devices shall be provided.

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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. It is intended to be used in conjunction with existing quality assurance documentation and in conjunction with equipment technical specifications or purchase descriptions for procurement. It is further intended to be used for approval of AAIE designs that will be employed in the final acceptance of product and not for in-process inspection unless the in-process acceptance is also to be considered as final acceptance data.

6.2 Definitions.

a. Acceptance test. In the context of this document this is a demonstration of the AAIE to show that all aspects of the testing requirements of the product are present in order to be accepted by this equipment. These aspects include completeness of test with accuracies of measurement dictated by part tolerances, AAIE related inaccuracies and good practice.

b. Accuracy. A term which describes the closeness of test measurements to the true calibration/metrology laboratory measurement. For quantitative data, accuracy is normally defined as 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 calibration/metrology laboratory 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.

c. Attribute. A characteristic or property which is comprised in terms of whether it does or does not exist, (e.g., go or not-go) with respect to a given requirement.

d. Automatic acceptance inspection equipment (AAIE). Automatic and semiautomatic equipment in which the inspection and acceptance determination of the product is performed, in whole or in part, in an automatic manner.

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

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handling devices and provide information to a printer device so that a fail/pass condition and related numerical values are subsequently available as "hard copy" as required.

f. Calibration. The process of comparing an NIST traceable standard's value with the AAIE measured value and adjusting the AAIE as needed to achieve the required accuracy.

g. 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.

h. Calibration standard. A device of known characteristics, traceable to NIST, used to calibrate the AAIE. Calibration standards need not represent all the characteristics of the UUT, but those of interest.

i. 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.

j. 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 an verification intervals.

k. Integrity of AAIE. The condition of the AAIE within which it is functioning as intended and making the correct decisions.

l. Marginal part. A production part which has been selected for test purposes but which has demonstrated features so that the AAIE may accept or reject the part on a subsequent test.

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This uncertainty of test results may be due to causes such as irregular surface finish, minor damage, taper, ovality, or other part irregularities of a marginal nature. This uncertainty may also be due to the lack of repeatability within the inspection equipment. Such parts shall not be used for acceptance test purposes because of the difficulties in determining whether or not a proper decision has been made.

m. Master disk. A computer or computer controlled AAIE storage device used to contain the last Government accepted version of the test software from which production floor AAIE software is copied and may be compared to at any time. This disk is kept secured by the contractor's QA department and is made immediately available upon the request of the appropriate Government representative.

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

o. Recall. The return of inspected product for reinspection due to an unsuccessful verification of the AAIE.

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

q. 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 UUT drawing specification limits to assure that only acceptable product is passed by the equipment.

r. UUT. - Unit under test.

s. 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.

t. 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.

u. Walk-through, software. A technique of proving a software program functional operation by which each succeeding line of code of the program listing is explained in detail to an

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interested and knowledgeable party. This explanation is provided by an individual completely familiar with all aspects of the program and is generally the program writer.

v. Wrap-around. This is a method by which a self test of an item of AAIE can be performed through the use of cables which connect all AAIE electrical output stimuli to the UUT input connector points and by using a special pre-determined routine (integral to the AAIE) causes all these devices to perform and this performance is in turn checked for correctness of results.

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 the actual current value of the variable parameter may be accessed and provided as an output, 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, MIL-STD-45662, and MIL-I-45607 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.

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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 test. 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. Functional testing would generally require stimulus, power, loads and required measurement devices to validate proper performance of a UUT in accordance with an expected sequence of operations.

6.5 Approval for use. Approval of the data required and supplied in accordance with this specification and the contract 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 of 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 setup 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.

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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 are cited in the following paragraphs.

Paragraph(s)	Data requirements	Applicable DID
3.2.d	Acceptance Inspection Equipment Engineering Documentation	DI-R-1714

6.8 Subject term (key word) listing.

Acceptance limits
Accuracy
Automated acceptance inspection equipment
Built-in test
Calibration chart
Calibration standard
Computer software architecture
Control, repair and requalification plan
Design approval
Fail safe design
Functional test
Integrity of AAIE
Nondestructive evaluation
Nonquantitative inspection
Processor sensitivity
Quantitative inspection
Recall
Repair
Tolerance limits
Unit under test
Verification
Verification Standard

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6.9 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - AR

Preparing activity:
Army - AR

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-A-70625A (AR)	

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.)

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