NOTE: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

METRIC

DOD-STD-2101(OS)
10 MAY 1979
SUPERSEDING
(SEE PAGE 11 PARAGRAPH 2)

DEPARTMENT OF DEFENSE
STANDARD PRACTICE

CLASSIFICATION OF CHARACTERISTICS

AMSC N/A

AREA QCIC

DEPARTMENT OF DEFENSE
Washington, DC 20301

Classification of Characteristics

DOD-STD-2101 (OS)

1. This Military Standard is approved by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

2. This standard supersedes Naval Weapons Requirements WR 43A dated 14 June 1965, for the Naval Sea Systems Command.

3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Commanding Officer
Naval Ordnance Station
Standardization/Documentation Division (501)
Indian Head, MD 20640

by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FORWARD

This Military Standard sets forth practices for the selection, classification and identification of the essential design characteristics of products developed under the cognizance of the Naval Sea Systems Command. (NOTE: This standard should be selectively applied and tailored for use in contracts. Its use may significantly increase the cost for preparing engineering drawings and specifications; therefore, it may not be cost effective in all instances).

This Military Standard was prepared to establish a uniform methodology for the process of classifying and annotating those characteristics deemed essential to the government acceptance of products. The broadened scope of annotation clarifiers was necessary to accomodate several conflicting methods.

The "Classification of Characteristics" terminology of MIL-STD-490 was selected over the "Classification of Defects" terminology of MIL-STD-961 as being more descriptive of the process defined herein. In this context characteristics are classified for a variety of reasons, including preassignment of inspection priorities, while defects are classified primarily for determination of approval authority on waivers and deviations. While the terms are used interchangeably and recognized DOD and industry wide as being the same, the term "Classification of Characteristics" is considered to be more suitable for that process performed during the development of specifications and drawings.

An additional difference between this Military Standard and both MIL-STD-490 and MIL-STD-961 is the location of classification annotations in specifications. Both MIL-STD-490 and MIL-STD-961 require the classification annotations to be placed in Section 4, Quality Assurance Provisions, while this Military Standard requires the annotation to be placed with the requirements in Sections 3 and 5. In many cases this reduces the duplication of requirements simply for indicating classification.

CONTENTS

APPENDIX B
USE OF NOTES

APPENDIX C
EXAMPLES OF CLASSIFICATION CODES

APPENDIX D
SELECTION OF SAMPLING REQUIREMENTS

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1. SCOPE

1.1 Purpose. The purpose of this document is to establish requirements and procedures for selecting, identifying and classifying essential design characteristics required for government acceptance of products. C of C (Classification of Characteristics) is established for use by producing activities in the development of test and inspection plans, and also for use by government quality assurance personnel who are required to review those plans and monitor producing activities quality programs. By providing information necessary to evaluate product quality, C of Cs assist decision-making and reduce judgement demands on government inspectors, indicate essential inspection requirements, facilitate effective allocation of inspection effort, guide the use of sampling, provide information useful for dispositioning nonconforming material and facilitate delegation of waiver and dispositioning responsibilities. C of Cs also encourage more complete design disclosure, promote concern for quality and production requirements by designers, and serve as a means of identifying and transmitting design information from the design activity for use in the production activity as essential inspection characteristics.

1.2 Scope. This document establishes requirements and defines responsibilities, procedures and methods for classifying characteristics appearing in drawings and specifications of equipments.

1.3 Application. The provisions of this document are applicable to procurements of shipboard systems, equipments, and components (e.g., expendable and nonexpendable weapons, ships machinery, sonar, radar, command and control) when imposed by the applicable work authorization document or contract. It is for use by the organization having design responsibility for the item procured; that is, the organization responsible for preparing drawings, specifications and standards. The appendices to this document are presented for purposes of technical guidance.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

DOD-D-1000	- Drawings, Engineering and Associated Lists
MIL-S-83490	- Specifications, Types and Forms

STANDARDS

MILITARY

MIL-STD-100	- Engineering Drawing Practices
MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-109	- Quality Assurance Terms and Definitions
MIL-STD-414	- Sampling Procedures and Tables for Inspection by Variables for Percent Defective
MIL-STD-490	- Specification Practices
MIL-STD-961	- Outline of Forms and Instructions for the Preparation of Specifications and Associated Documents
MIL-STD-1235	- Single and Multi-Level Continuous Sampling Procedures and Tables for Inspection by Attributes

HANDBOOKS

MILITARY

MIL-HDBK-53	- Guide for Sampling Inspection
MIL-HDBK-106	- Multi-Level Continuous Sampling Procedures and Tables for Inspection by Attributes
MIL-HDBK-107	- Single-Level Continuous Sampling Procedures and Tables for Inspection by Attributes

(Copies of specifications, standards and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 General. For the purpose of this document, the following definitions are applicable. Other terms related to quality assurance are defined in MIL-STD-109.

3.1.1 Characteristics, critical. A critical characteristic is one that analysis indicates is likely, if defective, to create or increase a hazard to human safety, or to result in failure of a weapon system or major system to perform a required mission.

3.1.2 Characteristic, major. A major characteristic is one that analysis indicates is not critical but is likely, if defective, to result in failure of an end item to perform a required mission.

3.1.3 Characteristic, minor. A minor characteristic is one that analysis indicates is significant to product quality but is not likely, if defective, to impair the mission performance of the item.

3.1.4 Classification of characteristics. C of C is the process of assigning classification codes (Critical, Major, Minor) to design characteristics of an item.

3.1.5 Classification code. CCs (Classification Codes) are those codes assigned in the process of classification of characteristics.

3.1.6 Classification criteria. The criteria of coordination, life, interchangeability, function and safety, collectively designated by the acronyms CLIFS and individually defined below.

3.1.6.1 Coordination. Refers to features that affect or are affected by mating, assembly or integration of an end item with adjoining end items.

NOTE: The term coordination is the same as interface/interface control but is used here for the simplicity of the use of the acronym "CLIFS" which is used throughout the text.

3.1.6.2 Life. Refers to features that affect the item's service life, storage or shelf life, fatigue life, durability, reliability, failure frequency, wear resistance, corrosion resistance, or resistance to environmental stresses.

3.1.6.3 Interchangeability. Refers to features that affect form, fit or function of an item in such a way as to enable common use or replacement with like items without selective assembly or modification.

3.1.6.4 Function. Refers to features that affect the ability of an item to perform its intended purpose. Functional performance may be discrete or continuous in time, active or passive, or measurable by attributes or variables.

3.1.6.5 Safety. Refers to features that affect the probability of accident or potential risk to the safety of humans who further asemble, handle, maintain, use, or repair an item or whose safety depends in any way upon the integrity or proper functioning of the item.

3.1.7 Design analysis. Engineering analysis of the means by which an item is able to respond to the demands of its mission; the basis for classification of characteristics.

3.1.8 Design activity. The activity(ies) or organization(s) within the activity responsible for the establishment of technical requirements (e.g., drawings, specifications, standards, etc.) and for prescribing inspection, testing or other quality requirements.

3.1.9 Inspection by characteristics. Application of specified inspection sampling parameters (e.g., AQL) to each classified characteristic individually.

3.1.10 Inspection by class. Application of a specified sampling plan index (e.g., AQL, AOQL) to a classified category (Critical, Major or Minor) or to a selected set of characteristics within one of those categories rather than to each characteristic individually.

3.1.11 Item. Any part, subassembly, assembly, system or other device identified by a drawing or specification.

3.1.12 Item, commercial. An item designed for an available for purchase on the commercial market and is included in item, privately developed.

3.1.13 Item, end. An item in the assembled or completed state at which government procurement takes place.

3.1.14 Item, minor hardware. An item susceptible to simple correction or open stock replacement, or an item on which all inspection characteristics are unclassified or minor.

3.1.15 Item, privately developed. An item completely developed at private expense and offered to the Government as a production article, with Government control of the article's configuration normally limited to its form, fit and function (includes commerical items).

3.1.16 Item, standard stock. An off-the-shelf item identified as an Industry Standard Item (SAE, AISI, etc.) or Government Standard Item (MS, FS, AN, etc.).

3.1.17 Repair item. Any individual part, subassembly or assembly required for the maintenance or repair of an end item.

3.1.18 Requirements analysis. Engineering analysis of the requirements, stated and implied, imposed upon a device by its design mission; a prerequisite for classification of characteristics.

3.1.19 Sampling plan, standard. A sampling plan described in MIL-STD-105, MIL-STD-414, MIL-STD-1235 or other applicable military standard, military specification, government directive or government instruction. A standard sampling plan can be specified by reference or citation of a sanctioned government source document.

3.1.20 Sampling plan, special. Any sampling plan other than a standard sampling plan. A special sampling plan cannot be specified by reference and must be fully described.

4. GENERAL REQUIREMENTS

4.1 Design activity responsibility. When classification of characteristics is required, the design activity responsible for preparing drawings and specifications shall ensure that CCs, inspection sampling and other special acceptance requirements are prepared, as provided herein, and included in drawings and specifications for the equipment to which CCs apply. Specification of CCs on drawings and specifications, rather than in separate documents, is required in order to increase participation by design engineers in the C of C process and to simplify the correction, revision and cancellation of CCs.

4.2 Analysis procedure and administration. Classification of characteristics shall be accomplished by performing requirements analysis, design analysis and selection of units for inspection. Appendix A is intended to guide the analysts in this effort. Requirements analysis shall consider mission functions of hardware elements, duration of required performance, environmental limits of the mission, availability of maintenance and effects of failures on the mission. Design analysis shall consider the design features of hardware elements relative to the requirements of coordination, life, interchangeability, function and safety. Design analysis shall encompass, as appropriate, study of material properties, fabrication, assembly and testing processes, tolerances, design life, failure modes, effects of failure on performance and safety, and the effects of normal use, handling, shipping and storage on safety. Units of inspection shall be selected using information developed in design analysis. Because of the multiple interfaces and activities affected by C of C, the classification procedure must receive inputs from the design engineering and quality assurance activities of the design organization. Inputs from reliability, manufacturing planning and other special technologies shall also be obtained as necessary. A conference procedure or equivalent organizational technique shall be used to administer the preparation and promulgation of CCs and to resolve differences of opinion or interpretation.

5. DETAILED REQUIREMENTS

5.1 Requirements of CCs. CCs shall be prepared for each item which is expected to be an item of separate procurement, or procurement as a spare or repair item.

5.2 Format for product described by specifications. For items described by specifications (MIL-STD-961 or MIL-STD-490), the CCs shall be included in Section 3, Requirements and Section 5, Packaging/Preparation for Delivery. Examples of notes which may be used as applicable to specifications are given in Appendix B herein.

5.3 Format for product described by drawings. For items described by drawings (MIL-STD-100), CCs shall be included directly on the documents at the level of assembly at which the characteristic first appears. Appendix B provides examples of notes which may be used as applicable to drawings.

5.4 Annotation. On drawings (MIL-STD-100), CCs shall appear immediately beside the characteristic call-out. In specifications, CC annotation shall appear in Sections 3 and 5. Examples of CC annotation are given in Appendix C herein.

5.5 Classification codes. Classification shall be indicated by means of a category code letter, as follows.

Critical - C
Major - M
Minor - no letter

5.6 Numbering. The characteristics classified shall be numbered serially on each drawing (regardless of number of sheets), specification or separate CC document with arabic numerals, as follows.

Critical - C1 through C99
Major - M101 through M199, M1101, M1102, etc.
Minor - 201, 202, etc.

Annotation of minor characteristics on drawings and specifications is not a requirement. The provisions for annotation of minor characteristics are included for those cases where special attention (special inspection or test methods or equipments, etc.) is necessary. While these designated minor characteristics cannot directly affect major or critical criteria, they are to be of such a nature that noncompliance could impact or allow impact on other acceptance criteria. Examples of these characteristics are age control dates, lot identification, shipping container labeling, etc. Drawing notes should be used to the maximum extent possible to identify those exceptional minor characteristics, in lieu of annotation.

5.7 Supplementary symbols. The following symbols shall be used to designate the requirements indicated. When used, the appropriate symbol shall appear within the parentheses, as a suffix to the CC annotation.

Examples: (C2E), (M104P), (-M110V)

D - Certified test or process data acceptable as verification.

E - Requires exceptional testing or inspection, not covered by a standard sampling plan.

P - To be verified prior to assembly.

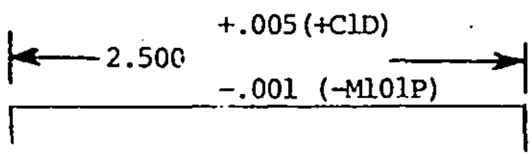
V - Critical or major, as classified, when part is procured as a separate item; minor when covered by higher assembly level inspection or test.

F - Designates a critical characteristic that is classified only because of effect on mission performance, and therefore has no effect on safety.

L - Designates a critical characteristic that has potentially hazardous or unsafe conditions for individuals during the processing of items, but would not present a safety hazard in Fleet usage.

5.8 Bilateral tolerances. When the minimum and maximum limits of a characteristic have different classifications, the classification code shall be preceded by a plus (+) or minus (-) sign, as appropriate.

Example:



5.9 Requirement for inspection provisions. Unless otherwise specified in the contract or work authorization, inspection requirements shall be specified for all critical, major and designated minor characteristics. Appendix D is intended to guide the classification of characteristics analysts in this determination. In specifying inspection requirements in Form 1 specifications (reference MIL-S-83490), care should be exercised not to reference contractor documents which define performance, processes, test requirements, procedures, etc., and which can be altered or revised outside the purview of the contract. In such cases the entire requirement should be stated in the form of a note. Because an objective of C of C is to allocate inspection effort in proportion to the significance of each characteristic, specification of inspection requirements for unclassified characteristics should be avoided wherever possible.

5.10 Relation to procurement cycle. C of C shall be accomplished prior to the release of the associated drawings or specifications for production.

5.11 Revisions. Changes, revisions, cancellations, and corrections, to CCs included in specifications and drawings shall be made by the same manner, methods and procedures used to accomplish other drawing and specification changes.

Preparing Activity:
NAVY - OS

Project QCIC-N006

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APPENDIX A
IDENTIFICATION, SELECTION AND CLASSIFICATION OF QUALITY CHARACTERISTICS

10. GENERAL

10.1 Scope. This appendix provides information for performing requirements analysis, design analysis, and selection of units for inspection to be used for accomplishing classification of characteristics.

10.2 Application. This appendix is presented for purposes of technical guidance to the organization having design responsibility for the item.

20. REFERENCED DOCUMENTS

See Section 2 of the basic standard.

30. DEFINITIONS

See Section 3 of the basic standard.

40. GENERAL GUIDANCE INFORMATION

40.1 Purpose. This appendix provides guidance information for use by the responsible design activity in accomplishing classification of characteristics.

50. DETAILED GUIDANCE INFORMATION

50.1 Identification and selection of characteristics.

50.1.1 Requirements analysis.

50.1.1.1 Requirements analysis information. Requirements analysis is a systematic procedure for determining the demands made on an item by its intended mission. Five types of information should be developed.

a. All functions the item must perform during its mission.

b. The duration of performance required of each function. When the performance times are random variables, their maximum values should normally be used. For unbounded random variables, percentile values that will be exceeded infrequently or with low probability should be used.

c. Environmental extremes applicable to the mission. Environments may include shock, high temperature, low temperature, vibration, acceleration, acoustic noise, vacuum, pressure, humidity, salt spray, fungus, ionizing radiation and others. The limits of environmental variables that may be experienced by the item should be listed. Interactions due to two or more environmental extremes occurring simultaneously and contributions due to self-induced heating structural resonances, interfacing systems, enemy actions, etc., should be not overlooked.

d. Maintenance available to the item in service. Answer the questions, "Can the item be maintained in use?" If so, "What maintenance can be performed under worst-case conditions?"

e. Effect of failures. Answer the questions, "Can partial or complete failure of the item be tolerated?" "What would be the effects of failure on the mission?"

For a simple item, most of the necessary information may be readily accessible in the product documentation. But for a complex device, the defining documents are likely to be numerous and the statements of requirements somewhat diffused. For complex devices where the analysis must be performed at several assembly levels, it is nearly always necessary to synthesize some of this information for lower level assemblies. Thus it is desirable that both the design engineer and quality assurance engineer participate actively in the analysis activity.

50.1.2 <u>Design analysis</u>.

50.1.2.1 <u>Design analysis for new designs</u>. Design analysis is a procedure for identifying and understanding in detail the means by which an item is able to respond to the requirements of its mission, and for determining the quality features upon which successful response depends. All available technical data relating to the item should be reviewed in support of the design analysis. Relevant data may include development test results and reports of design review, reliability analysis, failure modes and effects analysis and maintenance engineering analysis, as applicable and available. The analysts begin by listing the functions performed by the device and comparing them with the functions identified by the requirements analysis. Does the device perform all functions required of it? If it does not, the design problem thus uncovered must be resolved. Next, the principles of operation of the device must be understood. The analysts must answer completely the question, how does it work? At this point, analysis of device features relevant to the criteria of CLIFS (Coordination, Life, Interchangeability, Function and Safety) may be undertaken. Questions that may be answered include:

a. What material properties or attributes of the item are significant in determining the quality, i.e., product conformance of design intent? Material properties include hardness, ductility, strength, mass, density, resistivity, capacitance, specific heat, magnetic susceptibility, chemical inertness, reflectivity, surface tension, viscosity, color, vulnerability to radiation-induced changes, and may others. Attributes are characteristics describable as present or absent; they are distinct from variables which are characteristics measured on a scale. Attributes and material properties may influence quality with respect to any or all of the CLIFS criteria. The design engineer should indicate how material selection and design attributes were chosen to respond to the mission requirements.

b. How must the item be processed, fabricated, assembled and tested? In addition to observable properties, the processing history of a device can influence its quality to any or all of the CLIFS criteria. This can occur in several ways. Manufacturing processes can affect material properties in ways not readily observable - hydrogen embrittlement of heat treated metals is an example. Fabrication activities such as machining are equally influential. Stress applied during testing may induce cumulative irreversible damage impossible to detect by nondestructive means. The quality assurance engineer's knowledge of shop practices and capabilities is essential at this step of hardware analysis.

c. What tolerances are important to an acceptable fit of the device with mating items in higher assembly? Definition of interface requirements is a system engineering task. These requirements are usually passed down from above to lower level devices, but may require synthesis or verification by analysis. Att his point, the analysts are looking "outward" from the device under study examining requirements imposed on it by the larger system. Often the true or actual tolerances imposed on a device by the higher level assembly will be difficult or impossible to determine by analysis. It may be necessary to wait for test data to resolve such questions or it may be necessary to specify a "safe" tolerance known to be conservative. Interface requirements are often characterized in terms of "form, fit and function," they may include dimensions, weight, power requirements (voltage, frequency, phase), specification of required inputs, and unilateral, bilateral or statistical tolerances on all of these.

d. What tolerances must constitute elements meet for proper functioning of the device and for interchangeability of replaceable parts within it? The analyst must also look "inward" to evaluate requirements imposed by functions of the item under study on its lower level elements. Tolerances may apply to dimensions, electrical or mechanical parameters or other parameters such as time to perform certain functions. Tolerances may be unilateral (+.001 - .000), bilateral (±.001) or statistical. Statistical tolerances can be stated in terms of variance, standard error, mean absolute error, circular, spherical or eliptical probable error, RMS error, or a variety of other forms. Surface finish expressed in micro-inches RMS is an example of a statistical tolerance.

e. What is the item's design life and what characteristics determine the life? Wear, corrosion, fatigue, peak stresses, parameter drift, contamination, response to ionizing radiation and age effects such as depolymerization are among the many factors that may influence service life. The presence of so many contending processes, coupled with the difficulty of identifying which process limits the life of a given device, may indicate the need for partipation by materials specialists

APPENDIX A (Cont'd)

in the analysis process. If the item is not maintainable, end of life occurs upon functional failure. Thus, reliable life (time from deployment to an arbitrary unsatisfactory reliability) is the design life parameter. Reliable life may be much shorter than mean life. It is estimated by reliability analysis.

f. How can the item fail? Partially? Completely? If FMECA (Failure Modes, Effects and Criticality Analysis) or Fault Tree Analysis had been performed on the item, the analysis should be reviewed to determine the failure modes to which the item is subject, whether each mode results in partial or complete functional failure, and the causes that can generate each mode. If no such analysis is available, the analyst should perform a simplified analysis. The process is straightforwarded and qualitative. Each part in the device is considered in succession. All conceivable failure modes of each part are listed, both degradative and catastrophic. It is important to list not only what is expected to happen, but rather every failure mode that can happen. This usually requires some consolidation of simple failure events, particularly when considering higher levels of assembly. For example, all of the numerous failures that can affect an amplifier in continuous use can be summarized in three failure modes - no output, gain out of tolerance, noise or distortion of the amplified signal. Similarly, for many switches, all failure possibilities can be summarized by considering that such a switch may fall open when it should remain closed, may close (short) when it should be open, or may have excessively high circuit resistance. In reviewing the ways an item can fail, it is important to assess possible effects of environmental stresses as well as operating stresses. For this reason, it is important that the best available environmental envelope be prepared during the preceding requirements analysis. Beside each failure mode should be listed all causes believed capable of giving rise to the failure. Partial or complete compensation provisions in the design should be considered. While lengthy, this process is the essence of FMECA as applied to C of C activity, since these causes are precisely the quality defects classifications are intended to prevent.

g. Can failure of the item pose a safety hazard to humans and, if so, how? Anything that can cause a failure mode that may generate or increase a safety hazard to persons involved in the assembly, handling, maintenance use or repair of the device should be identified as relating to the safety criterion.

h. Can normal use, handling, shipping or storage of the device pose a safety hazard to humans, an if so, how? Some devices are inherently dangerous. This is true of weapons and some components of weapons and of energy sources generally. For any device that stores energy in transferable form - mechanical, electrical, chemical, thermal or radioactive - the analysts should identify those quality features which, if defective, may increase the safety risks normally associated with the device.

APPENDIX A (Cont'd)

50.1.2.2 Analysis for reprocurement of existing designs. Existing designs are reprocured by the government for a variety of reasons - as repair items, to replenish stock piles, or in connectiion with system alterations, modifications and overhauls. Frequently, reprocurements involve new suppliers. Therefore, C of C may be required under conditions that preclude access by analysts to the designers or to design data. In these cases, the analysts should obtain and evaluate data relating to the operating history of similar items. Failure and rejection data are particularly useful for design analysis. When CCs must be assigned under these conditions, or when CCs exist but the rationale for them is in doubt, more emphasis should be placed on verification at low assembly levels.

50.1.2.3 Design analysis for standard stock items, privately developed items, and minor items. Design analysis should be performed on standard stock items, privately developed items, and minor items in the same manner as for more complex devices. Normally, all characteristics should be unclassified. If design analysis indicated that any characteristic must be classified, the item should be described by a Level 2 or Level 3 drawing (DOD-D-1000) or Form 1 or Form 2 specification (MIL-S-83490), with CC data added as supplemental military requirements.

50.1.3 Levels of inspection.

50.1.3.1 Selection of units of inspection. Quality control effort is minimized when inspections are performed at the highest assembly levels consistent with the required information content and sensitivity of the inspections; that is, the highest levels at which defective units can be detected and classified unambiguously. But emphasis must be placed on the need for unambiguous classification. Typically a very small fraction of the parts in a complex device are found to contribute most of the quality and reliability problems. It is much more efficient to detect and eliminate these parts by inspection at low assembly levels than to detect them in higher level tests. Based on procurement information and the technical information developed in design analysis, a device should generally be selected as a unit of inspection if it meets one or more of the following criteria:

a. It is to be procured as an end item under contract.
b. It is to be procured as a repair item.
c. It is required to be interchangeable for use or safety.
d. Its performance can be determined only under actual service conditions (e.g., it must be tested destructively).
e. It is inaccessible or costly to inspect, repair or replace after installation in a higher assembly.

No device meeting any of the foregoing criteria should be excluded from inspection or from C of C because it is designated as a standard stock item, privately developed item or minor hardware item.

APPENDIX A (Cont'd)

50.2 Classification of characteristics.

50.2.1 Judgement factors. At this point, the analysts will have identified units of inspection comprising the item under analysis, together with quality characteristics of each unit of inspection relevant to the CLIFS and other acceptance criteria. The final step is to assess the seriousness of the relevant defects to the item's contribution to the mission. Three classification categories are available. They are: Critical, Major and Minor as previously defined herein.

50.2.1.1 Basis of classification. Assignment of a characteristic to classification category demands careful exercise of engineering judgement. The anticipated effect of a defect on the mission, as revealed by the analysis, and the conditions under which the unit of inspection may be procured, are the only valid basis for classification. Care must be exercised not to over-classify or under-classify. Classifications should reflect the seriousness of the defects. C of C should not be used as a means of creating additional requirements. Classification should not be used as an arbitrary means of increasing the amount of inspection for a particular characteristic, nor should classification be based solely on the magnitude of the specified tolerance.

50.2.1.2 Rationale of classification. A characteristic should not be classified unless the analysts are agreed that they would require rework or scrapping of subsequent items exhibiting the defect. Although minor characteristics can have no direct impact on CLIFS criteria, those annotated must have significant impact on other acceptance criteria (i.e., mandatory test/inspection, safety labeling, etc.). Classification covering "all other" characterisitcs, loose terminology such as "affecting serviceability, " and similar catch-all wording, should be avoided. It should be remembered that the assigned classifications will also guide quality assurance personnel in dispositioning discrepant material and making decisions on waiver and deviation requests. Some of those decisions will have to be made many years after the C of C analysis, during reprocurements, repair item procurements, and procurements from alternate sources. Thus it is important to maintain a consistent rationale giving rise to the classification decisions.

50.2.1.3 Multiple CLIFS criteria. If a characteristic is judged classifiable with respect to two or more of the CLIFS criteria, the most stringent of the applicable classification categories should be assigned to it. Duplicate classifications of the same characteristic should be avoided.

APPENDIX A (Cont'd)

50.2.1.4 Classification suffixes. Six suffixes which amplify the range of guidance options available to the classifier are provided below.

D - Certified test or process data acceptable as verification.

E - Requires exceptional testing or inspection, not covered by a standard sampling plan.

P - To be verified prior to assembly.

V - Critical or major, as classified, when part is procured as a separate item; minor when covered by higher assembly level inspection or test. The V suffix should be used to cover the many situations where dimensional characteristics are vital at part level because interchangeability is required, but are of minor significance after assembly has been completed.

F - Designates a critical characteristic that is classified only because of effect on mission performance, and therefore has no effect on safety.

L - Designates a critical characteristic that has potentially hazardous or unsafe conditions for individuals during the processing of items, but would not present a safety hazard in Fleet usage.

APPENDIX B
USE OF NOTES

10. GENERAL

10.1 Scope. This appendix provides information on standard and nonstandard notes which may be used on drawings and specifications.

10.2 Application. This appendix is presented for the purpose of technical guidance in using notes as applicable in drawings and specifications which specify classified characteristics.

20. REFERENCED DOCUMENTS

Not applicable.

30. DEFINITIONS

See section 3 of the basic standard.

40. GENERAL GUIDANCE INFORMATION

40.1 Purpose. This appendix presents examples of standard notes and describes nonstandard notes which may be used during classification of characteristics.

50. DETAILED GUIDANCE INFORMATION

50.1 Standard notes. The following standard notes may be used as applicable in drawings and specifications which specify classified characteristics.

a. Classification of characteristics. This C of C covers quality requirements which affect coordination, life, interchangeability, function, and safety.

b. Sampling standard. Sampling procedures shall be in accordance with MIL-STD-___ unless otherwise specified.

c. Inspection by class. AQL, AOQL or LQ values, when specified for a group of identically classified characteristics, shall apply to the group as a whole.

d. Classification suffixes. Classified characteristics followed by one of the suffixes listed below shall be inspected to the requirements indicated.

D - Certified test or inspection data acceptable as verification.

APPENDIX B (Cont'd)

E - Requires exceptional testing or inspection, not covered by a standard sampling plan.

P - To be verified prior to assembly.

V - Critical or major, as classified, when part is procured as a separate end item; minor when covered by higher level inspection or test.

F - Designates a critical characteristic that is classified only because of effect on mission performance, and therefore has no effect on safety.

L - Designates a critical characteristic that has potentially hazardous or unsafe conditions for individuals during the processing of items, but would not present a safety hazard in Fleet usage.

50.2 Nonstandard notes. A variety of nonstandard notes may be necessary to explain C of C requirements or convey C of C information. They should be used liberally. In general, a note is needed whenever the suffix E is appended to one or more CCs. In addition, notes may be used to describe required inspection methods, inspection conditions, special tools or gages, lot formation requirements and other inspection or test requirements.

APPENDIX C
EXAMPLES OF CLASSIFICATION CODES

10. GENERAL

10.1 Scope. This appendix provides examples of the classification codes as applied to various types of characteristics on specifications and drawings.

10.2 Application. This appendix is presented for the purpose of technical guidance in illustrating the use and application of the classification codes. The examples are not intended to indicate the level of classification of a particular characteristic.

20. REFERENCED DOCUMENTS

Not applicable.

30. DEFINITIONS

See section 3 of the basic standard.

40. GENERAL GUIDANCE INFORMATION

40.1 Purpose. This appendix presents examples of the application of classification codes to dimensional characteristics, notes, and to specification characteristics.

50. DETAILED GUIDANCE INFORMATION

50.1 Dimensional characteristics. The following examples illustrate the application of classification codes to dimensional characteristics.

$$\begin{matrix}.752\\.748\end{matrix}\ \text{(CIP)} \quad \text{or } .750 \pm .002 \text{ (CIP) or } .752^{+.000}_{-.004}\ \text{(CIP)}$$

a. Maximum and minimum classified critical. Requires verification prior to assembly.

$$\begin{matrix}.752\\.748\end{matrix}\ \text{(M101)} \quad \text{or } .750 \pm .002 \text{ (M101) or } .752^{+.000}_{-.004}\ \text{(M101)}$$

APPENDIX C (Cont'd)

b. Maximum and minimum classified major.

$\begin{matrix}.752\\.748\end{matrix}$ (+C1) or $.750 \pm .002$ (+C1) or $.752^{+.000}_{-.004}$ (+C1)

c. Maximum classified critical.

$\begin{matrix}.752\\.748\end{matrix}$ (-M101V) or $.750 \pm .002$ (-M101V) or $.752^{+.000}_{-.004}$ (-M101V)

d. Minimum classified major when part is procured as separate end item; minor when procured as part of higher assembly.

$\begin{matrix}.752\ (+C1)\\.748\ (-M101)\end{matrix}$ or $.750 \pm .002$ $\begin{matrix}(+C1)\\(-M101)\end{matrix}$ or $.752$ $\begin{matrix}+.000\ (+C1)\\-.004\ (-M101)\end{matrix}$

e. Maximum classified critical - Minimum classified major.

50.2 Notes. The application of classification codes to notes are demonstrated in the following examples.

(M101P) Both sides of the window, item q , shall be free from primer, paint, or foreign materials and from scratches, cracks, or chips that would reduce visual observation.

a. All characteristics in note classified major. To be verified prior to assembly.

(201D) Material: Steel, AISI 1040 to 1060 inclusive, (+Heat treated to a Hardness of Rc 36-40).

APPENDIX C (Cont'd)

b. Portion of note in parentheses classified minor. Certified test data acceptable as verification. Remainder of note classified.

(M101D) Material: Steel, corrosion resistant (AISI 201 annealed at 1,900°F minimum) (12 guage) sheet or strip cold formed to give a hardness of (Rc 32 minimum) in area indicated by dot dash (.-) lines.

c. Material and annealing temperature classified major. Certified test data acceptable as verification. Thickness (gauge) classified as major. Hardness classified critical; to be verified prior to assembly.

50.3 Specification characteristics. Classification codes as applied to specification characteristics are illustrated as follows.

a. Arming and nonarming (C1) The Safety and Arming Module shall not be armed when subjected to a spin of 1,000 ± 50 rpm for 3.0 seconds minimum. The module shall not be fully armed within 1.3 seconds and shall be fully armed in 3.0 seconds when subjected to a spin of $2{,}000 \begin{smallmatrix} + 200 \\ - 000 \end{smallmatrix}$ rpm.

b. Sum beam width (M102) The sum antenna half-power beam width shall be 8.0 ± 0.5 degrees.

c. Marking (M106) In addition to any special marking required by contract or order, all marking shall be in accordance with MIL-STD-129 and Code of Federal Regulations 49 CFR 171-190.

APPENDIX D
SELECTION OF SAMPLING REQUIREMENTS

10. GENERAL

10.1 Scope. This appendix establishes guidance for selection of sampling inspection requirements to be used for verifying quality characteristics.

10.2 Application. This appendix is presented for the purpose of technical guidance. The inspection requirements as described herein should be specified for all critical, major and designated minor characteristics.

20. REFERENCED DOCUMENTS

See section 2 of the basic standard.

30. DEFINITIONS

See section 3 of the basic standard.

40. GENERAL GUIDANCE INFORMATION

40.1 Purpose. This appendix describes sampling inspection requirements to be used by classification of characteristics analysts for verifying quality characteristics.

50. DETAILED GUIDANCE INFORMATION

50.1 General.

50.1.1 One hundred percent inspection. Unless otherwise indicated (see 5.9) the C of C analysts should specify the sampling inspection requirements to be used for verifying quality characteristics. One hundred percent inspection may be required but should be avoided to the maximum extent possible. One hundred percent inspection cannot guarantee perfect outgoing quality, because inspection processes are subject to human errors growing out of fatigue, monotony and similar factors. In same instances, the cost of 100 percent inspection is prohibitive. Also, 100 percent inspection is not feasible when the test or inspection process is destructive.

50.1.2 Sampling risks. Sampling inspection is based on an assumption of statical regularity. The sample is assumed to represent the lot, batch or group from which it was chosen. Inferences about the quality of the larger group, made by examination of the sample, are evaluated

APPENDIX D (Cont'd)

by means of a statistical decision rule and a decision to accept or reject the larger group is made. Because sampling is based on statistical principles, risks are inherent in its use. Two types of risks are associated with sampling: 1) a good lot may be rejected, 2) a bad lot may be accepted. A good sampling plan balances these risks. It protects consumer and producer by providing information about the lot and it minimizes inspection and rework. The analysts should study the documents referenced below, so as to thoroughly understand their use before specifying sampling requirements.

50.2 Sampling plans.

50.2.1 Standard sampling plans. Sampling requirements may be stated in terms of lot size, sample size and acceptance number or in terms of AQL (Acceptable Quality Level), AOQL (Average Outgoing Quality Limit), or LQ (Limiting Quality). Standard sampling plans and additional guidance are prescribed in MIL-STD-105, MIL-STD-414, MIL-STD-1235, MIL-HDBK-53, MIL-HDBK-106, and MIL-HDBK-107.

50.2.2 Special sampling plans. Special sampling plans may be specified when desirable or when no standard plan is acceptable. When a special sampling plan is specified, the suffix E should be appended to the classification notation of the characteristic affected and the plan should be fully described in a note.

50.3 Lot formation.

50.3.1 Lot size and development. The size of inspection lots and the manner of their formation are matters requiring judgement by the analysts. For a given unit of inspection, limits on lot size are generally imposed by the production process - a lower limit by quantity of material produced, an upper limit by available handling or storage capacity. Within those limits the primary characteristic to be preserved in forming lots is homogeneity of items within a lot with respect to the quality characteristics to be inspected. Thus, it is often desirable to define lots in terms of the output or average output of a shift, production day, production week or other time unit during which essentially uniform quality controls may be expected to operate.

50.4 Sampling plan indices.

50.4.1 Acceptable quality level. AQL is a percent defective which a sampling plan will accept with high probability. Specification of an AQL does not mean that the government will willingly accept known defective units of product, but that the government is willing to limit the contractor's risk of having acceptable lots rejected by sampling. In MIL-STD-105, MIL-STD-1235, and MIL-STD-414, sampling plans are indexed by AQL. Lower AQLs imply more exacting and extensive sampling, higher AQLs imply less exacting, less extensive sampling.

50.4.2 Average outgoing quality limit. The AOQL is the maximum average outgoing quality for a given sampling inspection plan. Sampling plans which are selected to assure a desired AOQL are based on the assumption that rejected lots can and will be subjected to screening inspection. Plans of this type cannot be used where destructive type testing is the only means of determining conformance to specified quality requirements. In MIL-STD-105, the AOQL can be calculated by multiplying the appropriate factor, found in Table V-A or V-B, times the quantity (1-sample size/lot size). In MIL-STD-1235, the AOQLs appear at the bottom of the corresponding AQL columns in the tables. IN MIL-STD-414, the AOQL can be determined for a specified sampling plan by finding the maximum value of P(A) x p x (1-sample size/lot size). P(A), the probability of acceptance, is the ordinate value and p, the process average, is the corresponding abscissa value of the OC curves given in Tables A-3 (MIL-STD-414).

50.4.3 Limiting quality. LQ, or LTPD (Lot Tolerance Percent Defective) as it is sometimes termed, is the maximum percent defective (poorest product quality) the consumer is willing to risk accepting with a specified (low) probability. Specification of LQ does not mean the government will willingly accept known defective units of product. In MIL-STD-105, LQs with associated consumer risks of ten percent and five percent are given in Tables VI and VII respectively, or may be obtained from the corresponding OC curves. In MIL-STD-1235 and MIL-STD-414, LQs with associated consumer risks must be determined from the corresponding OC curves. Handbook H53 contains further details on OC curves and sampling plan indices such as AQL, AOQ, and LQ.

50.5 Variables inspection.

50.5.1 Conditions for use. Inspection by variable may be specified when the quality characteristic to be inspected is measurable on a continuous scale, and where it is known (or may be assumed) that successive measurements are independent, identically distributed, normal random variables. The condition of independence is satisfied when no measurement is affected by preceding measurements. The condition of identical normal distribution is satisfied when successive measurements are described by the well known bell-shaped Gaussian curve and when the mean and standard deviation of the distribution do not vary in time.

50.5.2 Advantages and disadvantages. Variables inspection has the advantages over attributes inspection of inherently greater information content, permitting reduced sample sizes in many applications. However, variables inspection typically demands greater time, attention and instrumentation. MIL-STD-414 provides procedures for estimating the mean and standard deviation of samples variables, for computing percent defective and determining lot acceptance or rejection.

50.6 Continuous inspection.

50.6.1 Description. Continuous inspection is a continuous sampling procedure in which decisions are made unit by unit regarding the fraction of following units to be inspected. Usually, 100 percent inspection is required of units initially produced, followed by alternating periods of sampling and screening. MIL-STD-1235 provides a number of continuous sampling plans for inspection by attributes with instructions for their use.

50.7 Inspection by characteristic and class.

50.7.1 General. Inspection by characteristic means that the specified sampling requirements apply to each indicated characteristic individually. Inspection by class means that the specified sampling requirements apply collectively rather than individually to all characteristics of the device within the same CC category (critical, major, minor). When inspecting by class, the acceptance number (maximum number of defects that will allow a lot be accepted) applies to all characteristics within the class (defects are cumulative). Additionally, clearance or screening requirements apply to all characteristics within a class and not to just those defects which caused the rejection. When inspection by class is specified, analytical procedures are available for the case where the class must be divided into two or more subclasses. An example is the situation in which some characteristics of a class have the P suffix appended; that is, they must be inspected prior to assembly, while the remaining characteristics of the class are to be inspected after assembly. Apportionment of sampling requirements to subclasses should be made so as to assure a quality level consistent with the requirements specified for the class as a whole. A procedure is given in the following paragraphs for various cases.

50.7.2 Apportionment using AOQL. The AOQL is utilized to assign sampling plans to subclasses. This assures that the maximum percent defective which is accepted under a subclass inspection system will not exceed that of the original class inspection system. To apportion a class AOQL ($AOQL_c$) among m subclasses, you may assign the equivalent subclass AOQLs ($AOQL_e$) any value as long as the sum of all the subclass AOQLs does not exceed the $AOQL_c$.

$$\sum_{e=1}^{m} AOQL_e \leq AOQL_c$$

The above formula is valid where $AOQL_c \leq 10.1$.

For example, if class AOQL of 4.0 is assigned, then equivalent AOQLs could be assigned to three subclasses as follows:

$$AOQL_1 = 0.5$$
$$AOQL_2 = 2.0$$
$$AOQL_3 = 1.5$$

$$\sum_{e=1}^{3} AOQL_e = 4.0 = AOQL_c$$

When assigning the $AOQL_e$s, consideration should be given to subclasses which have a quality problem, the relative sizes of the subclasses, which AOQLs are available in standard inspection tables, and the costs of sampling to a specified $AOQL_e$.

Another method is to divide the $AOQL_c$ equally among the subclasses:

$$AOQL_e = \frac{AOQL_c}{m} \text{ for } e = 1, 2, \ldots, m$$

This formula is valid where $AOQL_c < 10.0$.

If the $AOQL_c \geq 10.0$, then a more exact formula must be used:

$$AOQL_e = 1-(1-AOQL_c)^{1/m} \text{ for } e = 1, 2, \ldots, m.$$

A disadvantage to dividing the assigned $AOQL_c$ equally among the m subclasses is that the calculated $AOQL_e$ is usually not available in standard inspection tables and the next tighter AOQL available must be assigned to all the subclasses, resulting in increased inspection costs.

50.7.3 Apportionment using AQL. Apportionment of a class AQL among subclasses varies according to the Military standard being used as follows.

a. When using MIL-STD-105, a class AQL is often assigned. To apportion a class AQL (AQL_c) among subclasses is considerably more

APPENDIX D (Cont'd)

complicated mathematically and not reducible to a simple formula. When a class AQL is assigned, it is necessary to refer to Table V-A or V-B of MIL-STD-105 and find a corresponding AOQL. Since there are several possible AQLs given in MIL-STD-105 for each assigned AQL, it is necessary for the cognizant agency to decide what overall $AOQL_c$ is desired for the class of characteristics under consideration. This $AOQL_c$ can then be apportioned among the subclasses and corresponding $AOQL_e$s calculated as discussed in paragraph 50.7.2. From the $AOQL_e$s calculated, new sampling plans with corresponding new lot sizes, sample sizes, and AQLs can be found in Table V-A or V-B of MIL-STD-105.

b. When using MIL-STD-1235, a class AQL specified can be directly assigned a corresponding class AOQL from the tables. Then subclass AOQLs may be calculated as discussed in paragrpah 50.7.2.

c. Since the sampling plans designated in MIL-STD-414 are applicable to the inspection of a single quality characteristic of a unit of product and not to a class of characteristics, the above procedures are not applicable to MIL-STD-414.

50.8 Inspection of interface characteristics.

50.8.1 Inspection criteria. Interfaces of repair parts, equipments, subsystems and components, which are procured separately, shall be identified on design disclosure documents. These interfaces in most cases are defined by a composite group (subclass) of characteristics which should be inspected and analyzed as an entity to insure proper physical, functional and environmental interface, i.e., this subclass should be inspected by class.

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

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

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)*

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