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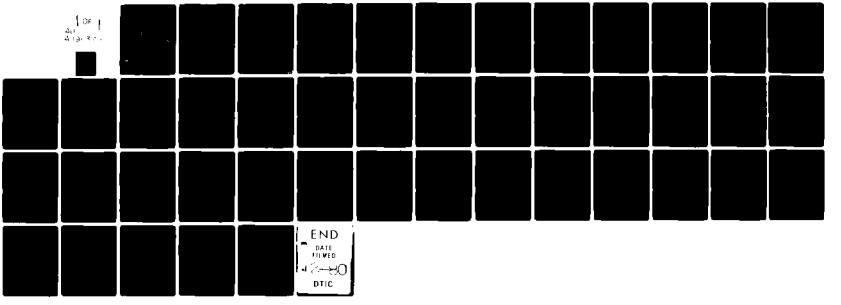

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This guidance document is to aid USAF R&D managers, contracting officers, and acquisition managers who are involved in the procurement of defense material by providing information that will help assure that the products being acquired will satisfy the requirements of those who will use the equipment. This quality guide is intended to be an adjunct to other existing policies and procedures and will provide a conceptual framework and basis for understanding the quality role in relation to specific contractual language. It is also designed to illustrate that product quality is an all encompassing →

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USAF
ACQUISITION MANAGERS
QUALITY GUIDE

Prepared By

International Technology Corporation

Contract No. F33615-79-C-5067

June 1980

USAF ACQUSITION MANAGERS QUALITY GUIDE

The purpose of this guidance document is to aid those USAF R&D managers, contracting officers, and acquisition managers who are involved in the procurement of defense material by providing information that will help assure that the products being acquired will satisfy the requirements of those who will use the equipment.

It is intended to be an adjunct to other existing policies and procedures and will provide a conceptual framework and basis for understanding the quality role in relation to specific contractual language. It is also designed to illustrate that product quality is an all encompassing concern and numerous organizational elements contribute to overall product quality. Quality is, in fact, everyone's business.

USAF ACQUISITION MANAGERS QUALITY GUIDE

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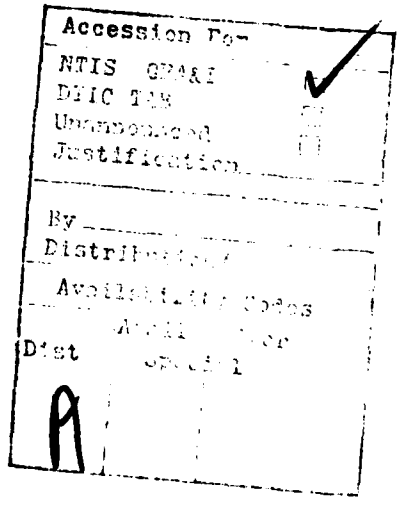


I. OVERVIEW

Acqusition managers, as well as R&D managers and contracting officers, must consider quality in terms of all of the product's attributes as related to the needs of the user. Their view of product quality must not be inhibited by any arbitrary organizational division or "special" product features. The manager must consciously recognize product quality as a primary responsibility; equipment delivered on schedule at the agreed cost will be of little benefit if it does not meet the users needs. The manager must acquire a product of specified excellence at the least possible cost in the public market place. These responsibilities are the managers alone and it necessitates specific responsibilities assigned to specific individuals who must be competent in whatever technological and administrative disciplines apply.

Product quality is of interest at the highest levels of government and it is essential to the national interest. It is a real, not an abstract, consideration for those personnel whose lives may depend on the successful operation of a weapon or other type of system. Product quality must begin with those individuals who will use the product; it is their responsibility to define in exacting detail what characteristics are essential to their mission. If no such definition is provided, it will be a matter of chance if their requirements are met. Furthermore, failure of the product to perform other missions than described by the user reflect not on the producer or the product, but on the using organization who did not convey all of the necessary requirements or characteristics needed.

The Office of Management and Budget issued the OMB Circular A-109, which is concerned with the system acquisition process in all of the governmental departments. The circular essentially results in the establishment of national priorities for major systems of all kinds. It is very limited in terms of specific performance concepts, dealing instead with broad system mission purpose and concepts. Product quality at this stage is described only in the broadest general terms.

At the Department of Defense (DoD) level, quality begins to appear from two different perspectives. The first is in the 5000 series of DoD Directives; principally 5000.2 where specific performance requirements must be defined in Annex A. The first quality milestone, that identifies the user's needs in broad operational/performance terms, is established at this point. The product quality characteristics are normally stated in dynamic terms, i.e., performance. They may include static characteristics as well, e.g., overall weight or dimensions.

Product quality characteristics that are dynamic are concerned with operating parameters or functions. Examples of these operating or dynamic functions may include speed, horsepower, RF power, bandwidth, etc. These dynamic characteristics may be evaluated for conformance in instant tests such as maximum power thrust or they may also be evaluated in time related, i.e., reliability tests which require continuing performance without failure under some prescribed conditions for some period of time. Static or physical characteristics are measured on an instant basis for conformance. All such measurements, tests, analysis, demonstrations, etc. are measures of product quality and conformance to them may require specialized technical discipline capabilities such as gamma rays, ultrasonics, liquid crystal inspection, etc.

After the requirements have been described, the responsibility issues becomes that of (1) who must assure the equipment will be capable of attaining the necessary quality and (2) who will measure the equipment to assure conformance to those quality requirements. In organizational terms, the activity responsible for technical requirements or technical activity, must define the technical characteristics of the equipment and prepare necessary product descriptions in terms of drawings, specifications and other forms of documentation. This technical activity must not only define the product's technical characteristics but must also be responsible for prescribing "inspection testing or other contract quality requirements that are essential to assure the integrity of products and services," (DAR 14-201). The technical activity then has a dual quality role: assuring quality of design conformance to user need; and establishment of methodology for determing compliance to design.

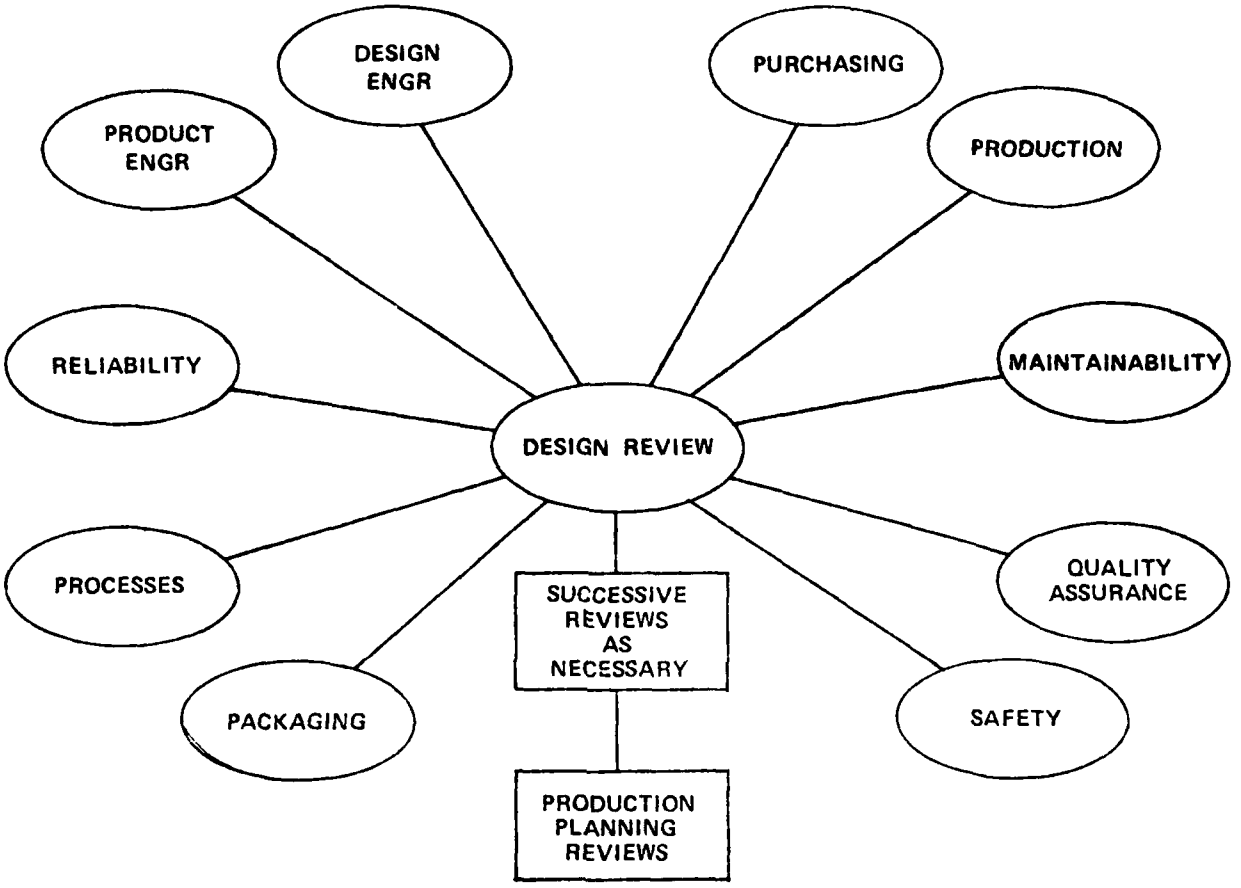
Definition of requirements in a contractual sense may begin in the conceptual phase of the life cycle and will usually be limited to minimal technical objectives that are anticipated to be achievable within the contract time constraints. Operational environments, safety factors and interface considerations with other systems may be involved. By the conclusion of this phase, elements of design requirements and methods necessary to assure they have been achieved will have been performed. At the validation phase, the design quality of performance requirements and the quality methodology for assuring they have been achieved are subject to better definition and configuration perspectives. Management controls in some form are necessary.

By the full-scale engineering development phase, the quality of design in terms of equipment characteristics should have been established. Measures for assuring that design requirements have been accomplished should also have been developed. The quality of design in terms of its own excellence then becomes an issue. It is not enough that required peformance can be achieved, but design reviews must be performed which relate to such matters as: tolerances, safety factors, part deratings, part selection criteria, ageing considerations, worst case stress analysis, transients expected, redundancy, sneak circuit analysis, etc. Excellence of quality of design is a vital quality function which the acquisition manager must assure is confirmed by engineering elements of the organization. Appendix 1 provides a typical design review procedure which will assist in providing assurance that the quality of design has been considered. Figure I-1 depicts typical organizations that participate in the design review process.

Also, by the full-scale engineering development phase, the methods of assuring that the equipment conforms to the established design requirements must be accomplished. This begins with assuring that a system definition, usually in the form of a specification or series of specifications, is prepared which describes all characteristics including physical and performance characteristics. If reliability requirements are established, they must be stated numerically with appropriate performance levels in terms of mean time before failure (MTBF), or probability of mission success.

Figure I-1

Participation in the Design Review Process



In addition, demonstration methodology must be identified which will assure the requirements have been accomplished (MIL-STD 781). For spot or instant performance demonstrations, procedures must be established to preclude disagreements as to whether or not the requirement has been demonstrated. Physical requirements must also be described. If maintainability is a requirement, it should be stated in terms of mean time to repair (MTTR) or maintenance man hour per operational hour. Demonstration methodology must also be defined (MIL-STD 471). Quality of design may also become a maintainability issue as in requirements for accessability or test points or other ease of maintenance considerations which may be specified.

In addition to the standardization and otherwise specified procedures for testing which commonly appear in specifications, specialists should examine tests, inspections and measurements to be performed and consider the need for, and, if necessary, develop other structured inspection/test approaches. Consideration must be given to the need for: pre-production samples, periodic production samples, pilot tests, methods for lot formation or sample selection, testing outlines including sequence, characteristics data, etc. Ultimately, the specification must assure the product conforms to the requirements by providing physical characteristics, including workmanship by a measurement or examination, and dynamic characteristics by either instant or time related, e.g., reliability tests with defined test and inspection methodology. MIL-STD 490 provides a standard DoD method for specifying practices for preparing specifications.

It can be seen that quality is a very broad subject which interfaces with many organizations, and that quality considerations transcend traditional organizational boundaries. Aside from all of the specific technical requirements, the management systems, the contractor performance evaluation and the other myriad problems the project manager faces, motivation is also a crucial issue.

Profit is important and essential to the continuing existence of any firm and, in theory, profit will equate to quality. In the arena of military systems procurement, however, it is not as clear cut an issue as, for example, when the commercial air carrier purchases major systems. Although it is not necessarily logical, the inoperative commercial aircraft seems to be more important to the producer than inoperative military systems. In the commercial market, the feedback is faster and producer and purchaser work together in concert to solve the problem.

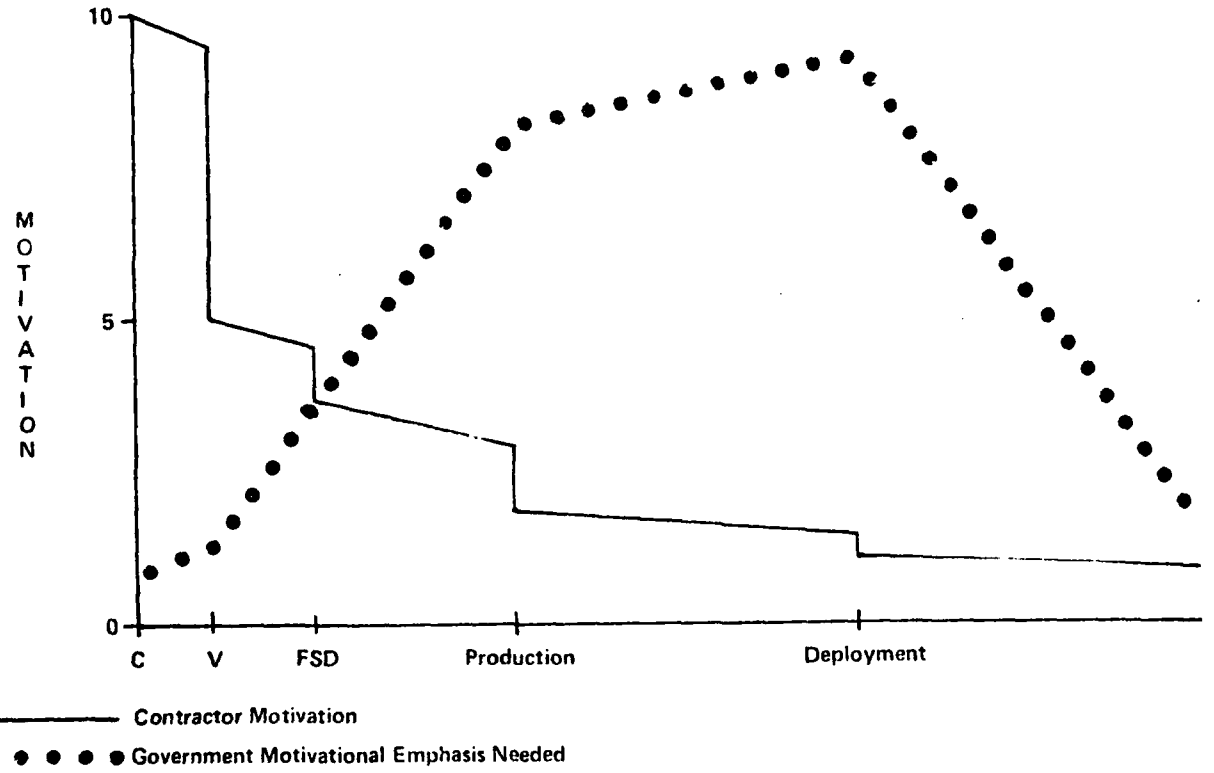
Based on interviews and existing policy reviews, there appears to be an increasing dysfunctional phenomenon in the firm's motivational inspiration as the system moves through the life cycle. Motivation is high through the full-scale development phase and into early production. Through the later life cycle phases, the project manager must somehow provide government motivation that the firm will respond to. No ready solution can be presented due to the different conditions that exist on each system. The project manager must devote attention to producer quality

measurements on a continuing basis and must develop solutions for each case. Solutions range from modifying contracts to include incentives, to encouraging the development of contractor motivational programs, to creating psychological rewards such as developing a continuing dialogue with contractor personnel at the junior executive and operator levels. Early NASA motivational programs which included introducing astronauts to employees at all levels is an example of an imaginative, innovational, essentially no cost, program which produced substantial quality benefits.

Figure I-2 graphically illustrates areas where it is necessary to encourage further contractor motivation over the system life cycle.

Figure I-2

Life Cycle Motivational Dysfunction



II. QUALITY FUNCTIONS IN THE LIFE CYCLE

The preceding section of the guide was designed as a broad oversight of quality considerations involved in the system acquisition process. This section will more closely relate to duties and responsibilities normally assigned to the Quality Assurance and Reliability Organizations in the various life cycle phases.

A. CONCEPTUAL PHASE

Consideration must be given to the user needs as stated in the Mission Element Needs Statement (MENS) in relation to what appears in the system technical description. The MENS may relate to deficiencies in existing capability in system quality terms such as inadequacies in system readiness, mission performance or logistic support requirements. Quality planning at this stage is essentially limited to establishment of broad performance objectives. Consideration may also be given to the state-of-the-art questions and very preliminary life cycle cost studies.

B. DEMONSTRATION AND VALIDATION (D&V) PHASE

Development of a specific quality strategy must begin as soon as possible after milestone 0 as a part of the overall system strategy. The quality strategy is to a large degree, dependent upon the overall acquisition strategy. Consideration can be given to product quality, i.e., principally physical and dynamic requirements. Bands of uncertainty regarding expected performance should be developed predicated on similar systems and design estimates. Subsystem performance achievements can be documented in addition to the principal technical objectives in the DCP Annex A. Some limited configuration controls must be in effect so that test results can be correlated with changing designs or test method. General types of testing that must be performed can be identified and test procedures standardized per existing test procedures, e.g., vibration tests, performed per method 201A, MIL-STD 202.

A system specification should be developed by the end of the D&V phase with accompanying performance requirements. While these requirements

are subject to tradeoff against cost schedule and supportability, their establishment will provide a measurable and definable performance baseline. The system specification need only reflect primary subsystem goals and does not necessarily include individual configuration items. However, prime item or system specifications should be prepared. The system specification should include testing and inspection requirements for: verification of performance requirements, verification of physical characteristics, R&M requirements demonstrations, and such other tests/inspections that are required to confirm that all established requirements have been accomplished. To the extent subsystem specifications are prepared, the same general guidelines prevail. In these specifications, however, in addition to definition of functional and physical requirements, there must be adequate definitions of interface parameters and complete test and inspection requirements necessary to demonstrate each specified functional characteristic. Contingency plans should also be developed for tailoring in-plant management systems such as MIL-Q-9858 quality program or MIL-STD-785, Reliability Program. Contractor preparation of equipment specifications must be consistent with the instructions in MIL-STD 490 or MIL-STD 483, Configuration Management Practices. At the conclusion of the D&V phase, it will be necessary to perform an independent quality assessment in accordance with AFR 74-1.

C. FULL-SCALE ENGINEERING DEVELOPMENT

During this segment of the System Development Cycle, a second DoD level review of the system will be performed. At milestone 2, the Annex A goals should be verified as being achievable and threshold values specified should be the minimum values acceptable. Adequate investigation must be performed to confirm that Government Funished Equipment (GFE) which is to be incorporated will also meet performance requirements. Necessary liaison must be established with the government activity furnishing the GFE, e.g., appropriate Air Logistic Activity, to obtain and provide necessary product information.

In support of DCP Annex A, a continuing summary of major assembly performed test results should be maintained. An ongoing analysis and periodic (monthly) review of this data will give advance indication of quality problems

that are predictable in required reliability demonstrations. Repeated failures indicate that corrective action is ineffective and even if statistics permit reliability demonstration success, field performance problems are likely. Any such data should be prepared so that trends are apparent. It may be desirable to establish a routine meeting of the government and contracting, engineering, quality assurance, manufacturing and R&M personnel to review the data. Any such review, formal or informal, should also include Initial Operative Test and Evaluation (IOT&E) using command representatives. In the event these informal exchanges of information are formalized, it may be desirable to combine them with existing technical reviews, or if none are established, to organize a formal joint reliability, maintainability and system quality review team.

During this phase, engineering reviews should be conducted on an organized and scheduled basis. As mentioned earlier, Figure I-1 illustrates typical technical disciplines that participate in design reviews and Appendix 1 contains a typical approach to design review. This appendix provides an identification of the supporting material which should be available and a list of typical design issues.

At the same time, the quality assurance elements should be devoting particular attention to specified requirements and recording achievements in an organized manner. There are existing requirements for recording and monitoring specified goals for reliability and maintainability requirements. This does not obviate the need for a logical organized approach to collecting and recording specific product performance as it relates to requirements which do not have associated reliability requirements established, or the need for a comprehensive performance summary. The development and maintenance of product performance history as experienced in the development progress will enable the acquisition manager to have an overall perspective of the quality of the system as it is developing. This data will, as well, supplement contractually required performance data such as reliability. This data will also be applicable to the independent product assessment required at the end of the full-scale engineering development phase. Appendix 2 illustrates one method of assembling system quality data to supplement other information.

D. PRODUCTION

Prior to a decision to enter the production phase, the third milestone review will be held. The DCP will still be the primary documentation for use by the Defense Systems Acquisition Review Council (DSARC). It will summarize the program achievements in relation to the requirements and overall acquisition strategy. A primary consideration will be the Annex A data with current system performance data. Back-up performance data as outlined in Appendix 2 and the Independent Product Assessment will provide supplementary or back-up data for Annex A and the Milestone Reference File.

After award of the production contract, the quality role will be limited essentially to assuring conformance to established requirements. While there are numerous associated activities, product conformance to requirements is the primary concern. The USAF quality assurance organization performs or participates in a variety of non-quality functions due to their presence in the manufacturing facility in substantial numbers. These functions, while not directly concerned with inspection and test, also influence the ultimate success or failure of contract objectives. Despite the numerous functions assigned and areas of involvement, the quality function essentially remains as that of assuring that the product conforms to contract requirements. This determination is in consonance with the basic DoD quality assurance philosophy contained in Section 14 of the DAR and is essentially performed by controlling the overall production process and supplemented by such product inspection as is required. This divides, for all practical purposes, the USAF in-plant quality assurance approach into two areas: (1) control of production processes, and (2) direct product inspection. The central quality assurance responsibility still remains that of confirming that the system conforms with specified requirements and taking title to it for the government by signifying on the Material Inspection and Receiving Report, that it does meet requirements.

III. QUALITY INTERFACES IN THE DEFENSE ACQUISITION REGULATION

The preceding paragraphs of the guide have dealt with the quality role in post contractual terms. Section 14, of the DAR (Procurement Quality Assurance) is concerned with all phases of the life cycle and deals with the post contractual situation as well. There are several areas in other sections of the DAR where product quality/performance is a consideration. The purpose of this section of the guide is to identify those DAR interfaces where product quality should be a consideration.

DAR 1-319 which is concerned with renegotiation practices requires the review of profit of defense contractors performing renegotiable contracts and subcontracts. The first item of the report concerning performance is "the product exceeded met or fell below the contract requirements." This is a clear requirement for product quality data. To be responsive to the requirements requires a rational, consistent analysis of product quality. It would be an error to discount this opportunity on the grounds that, if accepted, the product met requirements. This is a direct opportunity to relate product quality to profit, consistent with the general DAR guidance.

Component Breakout (DAR 1-326) is an activity that may cause product performance deficiencies. The two elements of DoD policy on whether or not to breakout a component are: (1) cost savings, and (2) quality, reliability, performance or delivery. There is an obvious need for quality considerations in the component breakout decision process.

Determination of the responsibility of prospective contractors (DAR 1-900) has traditionally been a part of the quality role. The primary determination is made by the contracting officer with the assistance of numerous functional areas including quality assurance. It strengthens these proceedings when contract administration elements routinely prepare assessments of contractor performance on previous contracts. This is not normally an additional manpower requirement since most defense contractors receive successive contracts and pre-award surveys are frequent occurences. Such data collected as depicted in Appendix 2 would be of material assistance. It would also provide a rational data base for post-award orientation (DAR 1-1800).

Procurement planning 1-2100 is an area where the quality role is essential as a part of realistic judgments. The sample procurement plan format in DAR 1-2102 has several areas where quality considerations have merit. Examples are Integrated Logistics Support Planning Concept, Application of Life Cycle Cost, R&M and Government Furnished Material. The quality assurance element should either expand the above paragraph with a quality section or prepare a separate paragraph.

Profit, DAR 3-401(b), is identified here as a basic industrial objective. It is to be directly related to stimulating contractor performance by rewarding effective performance with high profits, mediocre performance with mediocre profits and poor performance with poor profits. The principal contract objective is to obtain a quality product delivered on schedule at a reasonable price. It follows then that performance in terms of product quality should always be considered when profit related determinations are made. This, in turn, requires that some standard method of measuring quality be developed and applied uniformly to assure that product quality is integrated into an overall motivational approach.

The Cost Plus Award Fee (CPAF) concept discussed in DAR 3-405.5 allows profit to be related to areas of performance where measures of progress or success are less susceptible to finite measurements. In this case, "quality" is specifically mentioned. Fees that are available in either case are subject to limitations as described in DAR 3-405.6(c)(2). In addition, it is likely that quality will be only one of the incentive areas and the interrelationship of the fee areas must be evaluated carefully.

Contracts with performance incentives, DAR 3-407.2, can be considered as a profit motivational contract that has the potential for improving product quality through the quality management system. Performance as used in this paragraph is not limited to technical performance of the product but relates to the performance of the contractor as well. As an example, a plan could be designed which would relate to end item inspection/test findings. A clever, innovative product quality program interfacing with a profit relationship could be designed which would utilize the

profit motive to improve production techniques. Such a program would aid in reducing the undiscovered defects which are frequently present due to the normally acceptable defect risk levels. R&M requirements are an obvious application of this contracting mode. One significant difference between Performance Incentives and CPAF Contracts is that a target fee is established about which the fee can vary up or down as opposed to only positive fee earnings on the CPAF contract. If a quality oriented performance incentive were to be utilized, it would be necessary to specify exactly what the target objective is in measurable terms, e.g., no discrepancies on 50 percent of the products at final acceptance inspection.

The "Make or Buy" program described in DAR 3-900 and Clause 7-204.20(a) provides an opportunity to influence product quality. Make or buy reviews should evaluate price, delivery, quality and performance. The contractor has the responsibility for make or buy decisions. These decisions are accepted unless they are adverse to the government's interests. Government evaluation may be simply that of assuring proper categorization. Cost is a primary consideration. However, quality considerations should not be overlooked.

DAR 3-800 is concerned with price negotiation policies and techniques applicable to prime and selected subcontracts. There is a quality responsibility role in the contracting office and in the Contract Administration Office to support the contracting officer. While this paragraph of the DAR is primarily concerned with pricing opportunities, it provides a forum for introducing product quality information. The weighted guidelines profit factors analysis is silent on product quality but its consideration is consistent with DAR 3-401(b) which associates profit with performance, including reliability, quality and performance.

The Leader Company method of procurement described in DAR 4-701 requires special effort on the part of quality and production personnel. The principal element of this procedure is that the leader company furnishes manufacturing assistance to a second follower company that is expected to become another supplier for the item/system. Government personnel in the leader and in the company plants should maintain a close liaison under this type of contracting.

Management systems described in DAR 1-331 are those documented methods for defining or stating policy, objectives or requirements. Examples are MIL-Q-9858 Quality Program, MIL-STD 785 Reliability Program, MIL-STD 470 Maintainability Program Requirements and MIL-STD 483 Configuration Management Practices. The foregoing management systems are particularly relative to product quality. They all require the contracting firm to perform some management services in some prescribed fashion. All contribute to product quality and they are, in effect, service contracts within the overall contract framework to be performed. They are all of interest to the acquisition manager and should be reviewed by the manager periodically.

Much of this document has dealt with specifics which the acquisition manager may not have to be concerned with personally. This guide, though, was designed to provide, in addition, an overall perspective that quality is everyone's business and quality functions are performed by practically everyone involved in contract administration. The quality assurance organization can, due to its unique involvement in many of the firm's activities, provide an effective overview for assimilating and providing the contract manager with product quality information.

IV. CONTRACT LANGUAGE AND PRODUCT QUALITY

This part of the guide is to provide insight and information relative to significant clauses that are frequently included in contracts and which can have an impact on product quality. A listing of such clauses is contained in Appendix 3.

The principal contract objective is to obtain a quality product delivered on schedule and at a reasonable price. In view of the magnitude and complexity of the overall contracting endeavor, standardization, as far as possible, is achieved by standard contract language contained in the DAR. While these contractual terms and conditions are highly structured and stylized, they, nevertheless, are closely related to successful performance of the quality function. The DAR is clear as to when these clauses must be included in contracts and when they are optional. Some clauses such as the Quality Program, are well known and therefore, will not be discussed. Those that follow are considered to be worthy of inclusion in the guidance document. The selection and application of inspection/quality clauses are described in detail in DAR 14-101 and are summarily treated here.

A. STANDARD QUALITY CLAUSES

Quality Program, DAR 7-104.28

This clause may be used in all supply and R&D contracts. It incorporates MIL-Q-8958A in the contract.

Inspection System, DAR 7-104.33

This clause may be used in all supply contracts. It incorporates MIL-I-45208 in the contract.

Inspection, DAR 7-103.5

This clause is required in all fixed price supply and R&D contracts with a value of over $10,000. This clause requires that the contractor maintain an inspection system responsive to the products being procured and that it be acceptable to the government and also that inspection records be kept at least for the duration of the contract. This is a powerful contract

requirement despite its deceptive simplicity. It further requires that the contractor provide "all reasonable facilities and assistance" for the safety and convenience of government inspectors in the performance of their duties. In the event the contractor requests government inspection and the supplies are not ready for inspection, or in the event they are rejected and subsequent government inspections are required, the contractor may be charged for the extra government efforts. DAR 14-403(e) and AFCMDR 74-1 elaborates on government actions in this regard. This portion of the clause is, in effect, a penalty-based motivational device and it should not be construed as an end in itself but simply as one form of motivation available to the quality function.

Responsibility for Inspection, DAR 7-103.24

This clause may be used as the only contractor quality management requirement required in Small Purchase Fixed Price Supply contracts with a value of $10,000 or less. It is discussed in DAR 14-101.1 and its effect is to make the contractor responsible for the performance of inspections and tests which are identified in the contract specifications and drawings. It also incorporates a requirement for verifying techical requirements as described in commercial items described by a manufacturer's part number.

B. CLAUSES DIRECTLY RELATED TO PRODUCT QUALITY

First Article Tests, DAR 7-104.55

First Article Tests are intended to be a demonstration that a firm can provide a product meeting all requirements. The test is particularly desirable when:

- the contractor has not furnished the item previously;
- substantial changes have been made or production has been discontinued for an extensive period;
- the article is described only by a performance standard; or
- the first article will become a manufacturing standard.

First Article Tests are not normally employed:

- o in an R&D contract;
- o if the item is on the Qualified Products List (QPL);
- o for commercial products; or
- o products with complete technical specifications unless the requirements are so novel that a first article examination is essential to assurance of conforming material.

There are two principal cases of First Article Testing: (1) when the contractor will perform the tests, and (2) when the government will perform the tests. Combination testing may be desirable also with each party performing some of the tests. There is a standard provision available (DAR 7-104.55(i) that, when used, makes it mandatory that the production items and the First Article be manufactured in the same facility. If it is necessary for personnel from the purchasing and/or technical organizations to evaluate the First Article item, care should be taken to assure the item does, in fact, conform before the demonstration. There are major quality considerations in the First Article process to be examined, both covering the requirements and the conformance to the requirements as well. First Article Testing require a significant degree of planning and other pre-testing activities, particularly when major systems are involved. DAR 1-1900 should be reviewed for contracting criteria and a major technical review is required to assure that the test will, in fact, demonstrate that the requirements have been achieved.

Clauses for Preservation, Packaging and Packing Requirements, DAR 7-104.67

These requirements are an essential part of a supply contract and products can be rendered unusuable as a consequence of inattention to them. It is essential that quality personnel in purchasing and technical activities determine what protection will be required and that contract administration personnel assure that the requirements are achieved. Instructions in these matters for personnel in contracting offices are included in DAR 1-1204.

Warranty Clauses, DAR 7-105.7

A warranty is a promise given by a seller to a buyer regarding the nature, usefulness or condition of a product or service to be furnished. The actual warranty is used in the contract to establish the rights and obligations of the buyer and the seller. The warranty usually provides that for some period after acceptance, the product/service will perform as originally stated. During this period, the government may require corrective action by the contractor in the event defects/non-conformance are encountered. If there was a government design, correction action would be limited insofar as requiring the contractor to take action. However, workmanship and material and conformance are the responsibility of the contractor. DAR 1-324 provides extensive guidance for personnel establishing warranty requirements in contracts. Contract administration personnel must be alert for the inclusion of such clauses and must plan their actions so that proper investigations are possible in the event warranty claims are processed.

Standards of Work, DAR 7-302.3

This clause simply states that the performance of work and services shall conform to high professional standards. When the clause appears in a contract, Government quality personnel should attempt to relate work to any known and existing defined standard. Some definitions should be established and should be agreed upon by the firm and the Government. Work should be examined for adherence to the standard.

New Material, DAR 7-104.48

It is generally expected that supplies provided under contract will be new. However, there may be circumstances as described in DAR 1-1208 when it is desirable to accept items/materials which are not new. Surplus material may also be a matter of concern and its utilization is described in DAR 7-104.49. Since contracts will normally include these clauses, quality personnel should be aware of them, and, in the event that other than new material is proposed, should review the materials/items in light of user needs and contract terms and conditions.

Make or Buy Program, DAR 7-204.20

Make or Buy issues may have an impact on the product quality. When the clause is invoked in a contract the preliminary review of the program should consider the primary concerns of price, delivery and quality and performance of the products involved. Proposed "make" items need a specific review of the make quality as opposed to what the quality would be if the product were purchased elsewhere. There are other considerations, of course, such as tooling, availability of personnel, costs, etc. Product quality aspects of the two situations should be a major consideration. DAR 3-900 provides further guidance.

Rights in Data and Computer Software, DAR 7-104.9

Technical data encompasses a broad field of documentation in a wide variety of forms. For example: drawings, photographs, written texts, computer printouts, manuals, computer programs, etc. and the contract clause may take several forms. One major issue is the question of who has rights to use the data and what limitations are involved. There is considerable guidance existing in such documents as AFCMDR 74-1, AFSCR 310-1 and the AFCMD supplement and AFSCM 310-2. In view of the involvement of quality personnel in configuration control, inspection of data, etc., the specific clauses in the contract should be reviewed closely. Definitions, rights, subcontractor relationships, possible deferred delivery, and warranty of data are examples of matters that are, or should be, contractually defined. DAR Section 9 provides further guidance on Patents Data and Copyrights in connection with the procurement of supplies and services.

Material Inspection and Receiving Report, DAR 7-104.62

In most instances, this clause will be included in contracts where it is anticipated that a distinct object or entity will be delivered. The clause will be included whether items are priced separately or not. The contractor must prepare a Material Inspection and Receiving Report (MIRR) in accordance with instructions in DAR Appendix 1. The form will usually be the DD 250 and this documents the official procurement quality assurance act of acceptance of supplies, services and shipments. They

also have other uses for various organizations in the logistics support activities. The contractor is most concerned with its use as part of the documentation which is used by fiscal authorities as justification for payment. The requirements for government approval of the MIRR (DD 250) is an effective motivator available to quality assurance personnel.

Government Property, DAR 7-104.24

The controls and administration required for government property are lengthy and complex, e.g., DAR Sections XIII, XXIV, DAR Appendices B and C and other documents as well. There are numerous categories of government property and associated instructions. The quality role will vary from contractor to contractor and any unique requirements placed for the quality assurance activities should be clearly described. Of all of the categories of government property, the one which normally relates closely to the quality role is Military Property (DAR 13-101.7) which is designed for military operations and includes end items, integral components of systems and related support equipment. In the event MIL-Q-9858 is in the contract and Military Property is a part of the contract, the quality assurance role is at least in part defined. Government material (DAR 13-101.4) is a quality consideration as is special tooling (DAR 13-101.5), and special test equipment (DAR 13-101.6). This brief discussion is intended only to highlight quality considerations when government property is involved in a contract and QA personnel must evaluate each contract requirement.

Engineering Change Proposals, DAR 7-104.89

Engineering Change Proposals (ECPs) are discussed in DAR 26-200 as a part of the general subject of contract modifications. They relate to other procedural documents such as the Configuration Management System. The essence of the quality assurance role is to assure that there is no diminution of performance characteristics that are essential to the user. It is essential that documentation of approvals be confirmed before modified equipments are accepted and that there be a clear equipment oriented audit trail that identifies the items in which the changes appear as opposed to those manufactured prior to the change.

Inspection of Supplies and Correction of Defects, DAR 7-203.5

This clause must be incorporated into all cost reimbursement type supply contracts. It does not incorporate minimum quality systems as does the inspection clause DAR 7-103.5. If a system is required, MIL-I-45208 or MIL-Q-9858 or some specifically tailored or designed system may be included in the contract. This is a penalty-oriented motivational clause in that if defective supplies are delivered and not replaced with acceptable material, there are monetary penalties. These penalties may result in a reduction of any fixed fee or even return of fee paid. It also may result in the government contracting elsewhere for the supplies and charging to the firm increased costs that occur. This clause is more complex than described above. However, it can have a serious impact on a firm. Government and contractor personnel involved in the contract's execution and administration should recognize its presence and assure that there is no cause for assessing possible penalties.

C. CLAUSES INDIRECTLY RELATED TO THE QUALITY ASSURANCE FUNCTION

Title and Risk of Loss, DAR 7-103.6

The importance of this clause resides in the fact that upon formal acceptance, title of material is transferred to the government regardless of when or where possession is taken. The acceptance, delivery times and locations stated in the contract provisions must be thoroughly reviewed to determine when the responsibility for risk of loss or damage passes to the government. It is not necessarily synonymous with acceptance.

Liquidated Damages, DAR 7-105.5

The appearance of this clause is an indication that the delivery schedule is of such importance that if delays are encountered the government will suffer damages. If delivery is delayed, a certain amount of charges will be assessed each day until delivery occurs. This clause is a signal that delivery is of unusual importance and quality planning will have a greater than normal urgency or importance. Quality personnel may not be aware of the reason for this clause in the contract or be involved in the

consequences. However, non-conformances, i.e., quality defects, may lead to assessment of the charges. Therefore, a continuing review of progress and difficulties, particularly as they relate to product quality and performance is advisable. DAR 1-310 provides general policies and procedures relating to this clause.

Management Systems, DAR 7-104.50

Management Systems are not a product in the hardware sense. They are, in fact, a service which has been contracted for as part of a complete contract. A system is described in DAR 1-331 as a documented method for assisting managers in achieving a management objective. MIL-Q-9858, Quality Program, is an example of a management system as is MIL-STD 785, Reliability Program. Normally, the organizational elements that established the management system requirement will evaluate accomplishments. The systems should be itemized on the form DD 1660 and there should be some assignment of responsibility for each, thus assuring conformance with the system requirements.

Value Engineering, DAR 7-104.4

Value Engineering (VE) is an incentive technique to reward firms that can reduce the cost of items or services without negatively impacting "needed performance, quality, maintainability, reliability, or interchangeability" (DAR 1-1701). VE is not limited to production contracts but may be applied to any of the life cycle phases. There may also be a requirement for a VE program or management system. VE is included here due to occasional misgivings that VE changes "reduce" the "quality" of the product. Quality assurance personnel who often are concerned with VECP changes must consider the proposal in terms of user's needs as opposed to arbitrary concerns about what "quality" may be affected. VECPs may properly originate in quality areas such as those where an outdated, inefficient test or inspection method has been specified. The quality assurance organization at the technical activity which originated the requirement should participate in the review of VECP recommendations from contracting organizations.

Progress Payments, DAR 7-104.35

Progress payments are authorized by the inclusion of this clause and payments are generally based on requests from contractors which relate to work progress. They are not normally directly related to the quality function other than as a part of the acceptance process. Among the conditions under which progress payments are reduced or suspended may be the situation in which the contractor is not progressing satisfactorily in the agreed upon work. The quality assurance routine observation of conditions may provide the contracting officer with necessary information which, when made known, will result in consideration of changes to progress payment schedules.

Payments, DAR 7-103.7

This clause establishes in contractual language the fact that the contractor shall be paid upon the submission of invoices or vouchers for supplies delivered and "accepted." The title transfer, inspection and delivery of material predominates the quality role in contract proceedings. The DD 250 normally is submitted as part of the documentation for the paying office. It is required in fixed price supply and R&D contracts.

Aircraft, Missile and Space Vehicle Accident Reporting and Investigation, DAR 7-104.81

This clause is included at the discretion of the contracting officer. It is included due to the fact that accidents may be the result of defective parts, workmanship or design. Quality of material will likely be an issue unless the cause is clearly operator error.

Order of Precedence, DAR 7-204.40

This clause is used at the discretion of contracting officials when preparing solicitations. It is intended to preclude conflicting provisions. If it is incorporated into the contract, it can become a referee document when questions of precedence within contract documentation occurs. It is a standard clause and should be included. Quality personnel should assure its inclusion in complex contracts and recognize it in the Contract Administration function.

Production Progress Report, DAR 7-204.47

Production progress reporting is included here only because quality personnel may be requested to aid in determining production status. Quality personnel are also in a position where they may observe situations that can have a negative effect on anticipated production rates. DAR 25-200 provides comprehensive information on the production reporting procedures.

Safety Precautions for Ammunition and Explosives, DAR 7-104.79

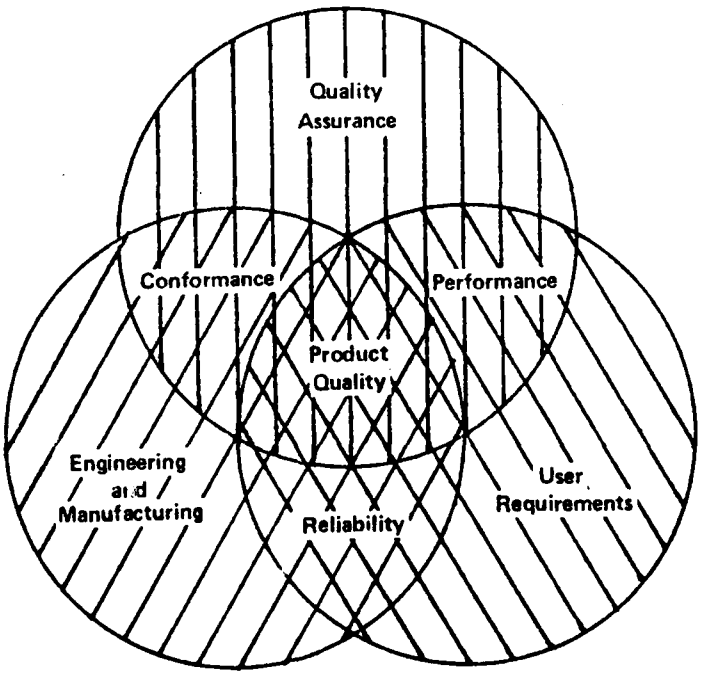
Safety is included here due to the frequent involvement of quality personnel in such functions as inspection of explosive material storage sites, explosive material transportation vehicles, equipment tests, etc. DoD Handbook 4125.26M is used as a contractor's manual for such material. DAR 1-323 provides contracting guidance regarding the utilization of the clause.

This guidebook has provided a broad overview of the project management process. It has provided a view of the contract language that may appear in USAF contracts and provides some specific suggestions for monitoring system quality status and progress.

Throughout the life cycle there are many and diverse technical and administrative requirements that impinge on the quality assurance role of assuring product conformance with requirements. It is essential that the organizational interfaces mesh smoothly and ultimately result in the production of which is commonly called a "quality product." It is not the quality assurance responsibility to assume this management role but rather the project manager that must recognize the role of all of the organizational elements and their contribution to overall product quality. Figure I-3 is a visual illustration of the technical disciplines and organizations that must recognize each other's responsibilities and roles in assuring the production of a system meeting all requirements.

Figure I-3

Organizational Elements Contributing to Overall Procurement Quality



APPENDICES

APPENDIX 1

PRODUCT QUALITY DESIGN REVIEW PROCEDURES

The purpose of this Appendix is to provide a procedure by which the adequacy and quality of designs may be evaluated. In the absence of other instructions, it will provide a common baseline for preparing for, and participating in, a design review and will assure the performance of an objective review. In order to effectively participate in the review, the participant should obtain material similar to that in Part A of each section in time to assure understanding of the system issues. It is assumed that there will be a review board chairman who will provide a list of attendees, completed actions and open items for further study.

This appendix is organized as follows:

I. SYSTEM/SUBSYSTEM DESIGN REVIEW

A. REQUIRED INFORMATION

1. A block diagram in which delineation is carried down to the subsystem and/or functional component level.
2. Design specifications.
3. A description of the intended function.
4. Identification of risk areas and design margin.
5. Alternate approaches to the design which were considered.
6. Why the selected approach was chosen.
7. Supplemental information that, in the designer's opinion, will facilitate understanding of requirements and/or approach.
8. Reliability and maintainability allocations.
9. Unusual design requirements, e.g, tight electrical or physical requirement, demonstration testing, combatibility with other systems, etc.
10. Maintenance concept.
11. System partitioning and mechanical packaging.
12. Subsystem/system test results.
13. Performance and interface requirements upon which design is based.

B. CHECKLIST FOR SYSTEM/SUBSYSTEM DESIGN REVIEW

1. Does the design meet the mission requirements and specifications?

2. What alternate approaches were considered?

3. What are the limits of satisfactory performance?

4. Has a system/subsystem test plan been identified?

5. What problems areas and failure modes can be anticipated based on previous experience and/or analysis, and should they receive further study?

6. Have reasonable performance/reliability/maintainability tradeoffs been made? Define them.

7. Will redundancy be required to meet reliability goals, and if so, how can it be done?

8. Are interfaces properly identified and specified?

9. Have all environmental factors been considered?

10. Can environment be limited to a smaller range?

11. What special test equipment or facilities will be required to checkout system, subsystem or components?

12. Is the design cost effective?

13. Have operating life, storage life, and shelf life been considered?

14. Has a tolerance study been completed and an optimum error budget developed? Is it optimum and realistic for subsequent detailed design?

15. Have necessary safety considerations been implemented in design?

16. Has a maintainability concept been identified?

17. Have risk areas been identified? What are they?

18. What physical limitations exist?

19. Have all "purchased items" used in system/subsystem been defined?

20. Have all documentation requirements been defined?

21. Have human factors been considered?

II. CIRCUIT/HARDWARE DESIGN REVIEW

A. REQUIRED INFORMATION

1. Performance requirements for the circuit/hardware item to be reviewed.

2. Any assumptions made in identifying design baseline.

3. Functional block diagram showing relation of item(s) to be reviewed.

4. Schematics and parts list of each item. Parts list should show part stress level that exists in design.

5. Is there any part or material for which a waiver will be required.

6. Summary of reliability estimate and allocation, resulting MTBF and failure rate base.

7. Identification of risk areas.

8. Breadboard test results (when available).

9. Supplemental information which will facilitate understanding of requirements, approach or results.

10. Circuit failure mode analysis (as applicable).

B. CHECKLIST FOR CIRCUIT/HARDWARE DESIGN REVIEW

1. Does the design meet all performance requirements?

2. What key performance requirements have created the greatest design complexity?

3. If any of the previous factors were relaxed or if redistribution of tolerances were possible, what savings would result?

4. What alternate approaches were considered?

5. Is the analysis of the design sufficiently complete and accurate?

6. Have off-the-shelf or standard items been used where practical?

7. What problem areas and failure modes can be anticipated based on previous experience and analysis? Should they receive further study?

8. What parts are critical to: (1) circuit/hardware performance; (2) system/subsystem performance?

9. Is the design cost effective?

10. Does the item require special handling? Is it designed for ease of fabrication, test, assembly and maintenance?

11. Has use of adjustments been minimized?

12. Has a complete statistical or worst case analysis been performed?

13. Is the design physically and electrically compatible with other parameters? (Dimensions, input and output characteristics, noise generation and/or susceptibility.)

14. Do breadboard test results agree with analysis?

15. Has minimum use of tight tolerance, precision parts or parameters been made?

16. Are any special test equipment or techniques required?

17. Are there any parts requiring waivers or qualification?

18. Are power supplies properly decoupled?

19. Have critical layout and path length restrictions been identified?

8. CHECKLIST FOR CIRCUIT/HARDWARE DESIGN REVIEW (Cont'd)

20. Has sneak circuit analysis been performed?

21. Have risk areas been defined? What are they?

22. Has a fail-safe design philosophy been used?

23. Is protection against secondary failures incorporated where possible?

24. Have human factors been considered? (Man-machine interface, human safety factors)

25. Are multiple sources available for each part type?

26. Is the interaction between adjustments and other circuit parameters minimized?

27. Have all parts been applied within company/military standard derating limits?

28. Are special QC or vendor problems anticipated?

III. TEST PROCEDURE REVIEW

A. REQUIRED INFORMATION

1. Proposal, performance requirements, interface requirements, and test requirements upon which the test procedure is based.
2. Test flow diagram.
3. Description of tests to be performed.
4. Identification of risk areas.
5. Alternate test methods considered.
6. Supplemental information which the test engineer feels will facilitate understanding the requirements and/or approach.
7. Test philosophy.
8. Reason for test requirement change.
9. Test equipment selection and tradeoff criteria.
10. Identification of measurement tolerances and acceptance criteria.

B. CHECKLIST FOR TEST PROCEDURE REVIEW

1. Does the test plan encompass an integrated test cycle from system level down to the lowest test level?

2. Has a requirement been identified for each test?

3. Is the test feasible?

4. Has all test equipment, both special purpose and commercial been identified to perform the tests?

5. For tests which use commercial test equipment, are the test requirements within the capability of the equipment?

6. Are tests performed in a logical sequence?

7. Do design changes need to be made to facilitate or improve testing?

8. Do the test procedures verify interface compatibility?

9. Are error tolerances and compatibility verified at the lowest test level?

10. Are all self-test loops exercised for both GO and NO GO paths?

11. Are there any areas of over or under testing?

12. Are in-plant test facilities adequate to perform all testing?

13. Is the test equipment available?

14. Has a measurement error analysis been performed?

15. Has consideration been given to verification of requirements by analysis and inspection as well as testing?

16. Have all supporting (both equipment and personnel) resources been identified?

17. Have the responsibilities of the test participants been identified?

18. Are any operational tests required to verify requirements?

19. Are the tests organized to maximize use of early test results in later test phases?

20. Has the criteria for success, for failure been identified?

21. Has sufficient consideration been given for data storage and/or reduction?

B. CHECKLIST FOR TEST PROCEDURE REVIEW (Cont'd)

22. Are any GFE equipment or facilities required?

23. Has adequate test tolerance degradation been provided for test equipment, cabling, connector interfaces, etc.?

24. Is the test schedule compatible with the design cycle?

25. Has consideration been given to the test data being used for reliability, maintainability and safety analysis?

26. Have risk areas been defined? What are they?

IV. COMPUTER SOFTWARE DESIGN REVIEW

A. REQUIRED INFORMATION

1. Specification and interface requirements upon which program design is based.

2. Structured flow in which the program delineation is carried down to the subprogram and/or routine/subroutine level.

3. A description of the intended function, with benchmark definitions for comparative analysis.

4. Identification of risk areas.

5. Alternate approaches to the design which were considered.

6. Why the selected approach is best.

7. Supplemental information that in the programmer's opinion will facilitate understanding of requirements and/or approach.

8. Input/output data formats.

9. Program user manual (if applicable).

10. Tradeoff indicating machine more effective for program utilization.

11. Test results.

B. CHECKLIST FOR COMPUTER SOFTWARE REVIEW

1. Does the program meet requirements or specifications?

2. Is the program organization logical?

3. Were alternate approaches considered?

4. Are there any other approaches which should be considered?

5. Is analysis of the program sufficiently complete? Do any areas require additional study?

6. What are the limits of satisfactory performance?

7. Are intercommunications requirements between sub-programs, routines and sub-routines properly identified and specified?

8. Is program/sub-program partitioning considered optimum?

9. What limitations exist?

    a. Memory size
    b. Cycle time for iterative programs.

10. Is an error budget required? If so, has the error analysis been completed? Is is optimum and realistic for subsequent detailed development?

11. Have reasonable performance/memory size tradeoffs been made?

12. Have reasonable performance/loop cycle time tradeoffs been made?

13. Can existing programs, sub-programs or routines be modified for use in any functional program requirements?

14. Has a debugging plan been identified?

15. What special test programs will be required to check out system?

16. Has a suitable set of check solutions or simulations been made?

17. Is the program user manual complete? Does it adequately specify operating limitations, interpretation of output data, and input data required?

18. Are input/output formats defined?

19. Have diagnostic statements been included to detect input errors?

20. What computer is recommended for running the program? What is it?

APPENDIX 2

MAJOR CHARACTERISTIC PERFORMANCE DATA STATUS SUMMARY[1]

SYSTEM/SUBSYSTEM	CHARACTERISTIC[2]		MONTH 1[3]	MONTH 2	MONTH 3	MONTH ....
Major Item #1	Reliability	REQUIRED				
		ACHIEVED				
	Maximum Power	REQUIRED				
		ACHIEVED				
	Sensitivity	REQUIRED				
		ACHIEVED				
	Rotation Speed	REQUIRED				
		ACHIEVED				
	Clutter Level	REQUIRED				
		ACHIEVED				
	Response Time	REQUIRED				
		ACHIEVED				
	Insertion Loss	REQUIRED				
		ACHIEVED				
	Scan Rate	REQUIRED				
		ACHIEVED				

1. A narrative should be prepared with each report that will provide a general status summary of product in terms of conformance to requirements.
2. Characteristics are examples for illustrative purposes only.
3. Periods are monthly but should be established as appropriate.

APPENDIX 3

PRODUCT QUALITY RELATED CLAUSES

Clause	Supply Contract		R&D Contract	
	Fixed Price	Cost Reimburs.	Fixed Price	Cost Reimburs.
Inspection	7-103.5		7-302.4	
Title and Risk of Loss	7-103.6	7.205.3	7-302.28	7-404.7
Payments	7-103.7		7-302.2	
Responsibility for Inspection	7-103.24			
Rights in Data and Computer Software	7-104.9	7-204.9	7-303.54	7-403.49
Government Property	7-104.24	7-203.21	7-303.7	7-402.25
Quality Program	7-104.28	7-204.10	7-303.15	7-403.15
Inspection System	7-104.33			
Progress Payment	7-104.35		7-303.23	
Value Engineering	7-104.44	7-204.32	7-303.31	7-403.27
New Material	7-104.48			7-403.30
Production Progress Report	7-104.51	7-204.47		
First Article Approval	7-104.55	7-204.39	7-303.39	7-403.34

APPENDIX 3

PRODUCT QUALITY RELATED CLAUSES (Cont'd)

Clause	Supply Contract		R&D Contract	
	Fixed Price	Cost Reimburs.	Fixed Price	Cost Reimburs.
Material Inspection and Receiving Report	7-104.62	7-204.44	7-303.13	7-403.41
Preservation Packing and Packing Requirements	7-104.67			
Marking of Shipments	7-104.68			
Safety Precautions for Ammunition and Explosives	7-104.79	7-204.49	7-303.20	7-403.24
Aircraft, Missile and Space Vehicle Accident Reporting and Investigation	7-104.81	7-204.36	7-303.48	7-403.45
Engineering Change Proposals	7-104.89	7-204.56	7-303.58	7-403.53
Liquidated Damages	7-105.5		7-304.7	
Warranties	7-105.7		7-304.10	
Inspection of Supplies and Correction of Defects		7-203.5		7-402.5
Order of Precedence		7-204.40	7-303.40	7-403.35
Standards of Work			7-302.3	7-402.4
Make or Buy Program		7-204.20		7-403.14