

# Applicable Documents

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**Abstract.** It is a common practice to refer to applicable documents in both programmatic and product-specification documents in contracted development. The practice permits inclusion of a vast amount of lessons-learned and Government and commercial standards and best practices that can be referenced without the need to include the information directly in the document, or to maintain the referenced information. Product requirements documents often specify interfaces and interoperability characteristics by reference to interface control documents included in the list of applicable documents. Benefits accruing to the product from the use of applicable documents are reduced overall cost, better products and better interoperability. Costs accruing to the product development effort are the cost of maintaining visibility on changes to applicable documents outside the control of the Program and the cost of verification of all included requirements.

Experience on many Programs and with several customers has shown that there is a wide variation in the manner in which applicable documents are incorporated in product specifications. The observed differences fall into several broad categories, such as: the method of citation of applicable documents; the difference between compliance and reference documents; the methods of referencing the documents in the requirements statements; and the approach to sub-tiering of the applicable documents.

This paper will discuss the different approaches to utilizing applicable documents within product documents and the issues and risks that arise, illustrated with examples. Using lessons learned across the program and customer experience, a robust, standardized approach is recommended that should increase the benefit of using applicable documents while reducing the cost.

## Scope

This paper addresses the use of applicable documents in the contracted development of systems in which requirements are included as part of the contract. Examples are based on the author's experience in US Government contracted development. However, the principles discussed in this paper can be applied to any contracted development environment, be it Government contracting or commercial.

The principles can also be applied successfully in any system development environment subject to regulation, whether requirements are formally stated or not. Every system being developed is subject to environmental, health and safety and other regulations, and recognition and inclusion of the regulatory-imposed requirements should be handled following the principles in this paper.

Additionally, every system being developed interoperates with other systems through documented interfaces. The bodies that have developed and maintain those interface standards (de facto or de jure) update the standards from time to time, and the system developer can use the principles in this paper for assuring that the product is compliant with the most current standards.

## Introduction

Typical specification formats utilized in US Department of Defense contracting provide for the citation of applicable documents. Specification formats recommended in commercial practice also include a references section. The author has found little written about the proper method for citing and referencing applicable documents in specifications and this paper has been written to begin to fill that void.

MIL-STD-961E states, in Section 4.19:

“Judicious referencing of other documents in specifications is a valuable tool that eliminates the repetition of requirements and [eliminates the repetition of] tests adequately set forth elsewhere. However, unnecessary or untailored referencing of other documents can lead to increased costs, excessive tiering, ambiguities, and compliance with unneeded requirements.” (emphasis added by author)

The “judicious referencing” of other documents is a mechanism for incorporating lessons learned within the product domain. Also, it supports the inclusion of commercial standards and practices, thereby promoting design reuse and benefiting from enormous amounts of product research and development across multiple domains.

The applicable documents are of two types:

- Compliance – the cited document contains requirements included in the citing document by reference
- Reference – the cited document provides data or information useful in enhancing the understanding of the citing document

Documents can be referenced in product specifications and in programmatic documents (e.g., Statement of Work). This paper will address citation in product specifications only.

MIL-STD-961E, section 4.19, restricts citation of documents by document type within specifications, as follows:

e. References to policy-type documents, such as directives, instructions, and regulations should be avoided. Many Government regulatory agencies, such as the Environmental Protection Agency or the Occupational Safety and Health Administration, issue directives and regulations that serve as technical standards. It is acceptable to reference these types of directives and regulations.

g. Documents that define management and manufacturing practices and processes shall not be cited in performance specifications, and should be avoided in all specifications.

MIL-STD-961E also recommends that cited documents be “current” documents, those “approved” for use and that the documents be “readily available” (section 4.19(b)). It is generally inappropriate to cite cancelled documents, or earlier, superseded, versions of a document. However, there may be contractual reasons to do so, such as continuing to use a superseded document until a major transition in the contract, at which time all applicable documents will be reviewed and citations updated. It might be appropriate to cite a “non-current” document if the “non-current” document contains information that is appropriate to the development effort, as outlined in section 4.19(c), which states that

“[non-current] documents may only be referenced for guidance or for specific item types, grades, or classes, which the specification designates as inactive and will be eventually replaced.”

Lastly, MIL-STD-961 (section 4.19(h)) recommends that

“Specifications, standards, drawings, or other documents that contain proprietary or unique design solutions that would restrict competition or not be readily available should not be referenced.”

This is specific direction to the contracting agency in order to promote open competition.

However, when specifying at a detailed level, the contractor may choose to specify “proprietary or unique design solutions” if such a choice yields the best design solution.

## Impact of Applicable Documents Use

Several benefits accrue to a Program from the use of applicable documents. First, use of other, established, requirements documents as compliance documents avoids having to rediscover or redefine them. Such reuse reduces cost and reduces risk, as the cited requirements have already been subjected to review, and verification, on other Programs. Second, citation of requirements from other, established, reference documents avoids having to insert the requirement in each document in which it is needed. This reduces cost during the requirements definition phase and reduces the configuration-management costs during maintenance. Additionally, citation of non-requirement reference material, e.g., environmental data, provides the same cost reduction benefits. Lastly, use of requirements included by citation contributes to completeness and understanding, and reduces the risk of missing requirements.

Misapplication of applicable documents, as will be discussed in this paper, however, can lead to increased cost and increased risks.

## Applicable Document Utilization

Various standard specification formats exist (MIL-STD-490A, MIL-STD-961E, JSSG-2000A, various DIDs). A typical format is shown in Figure 1. Compliance documents are cited in functional/performance, interface, environmental and design and construction requirements throughout Sections 3, 4 and 5 and the Appendices containing requirements. Reference documents can be cited anywhere in the specification.

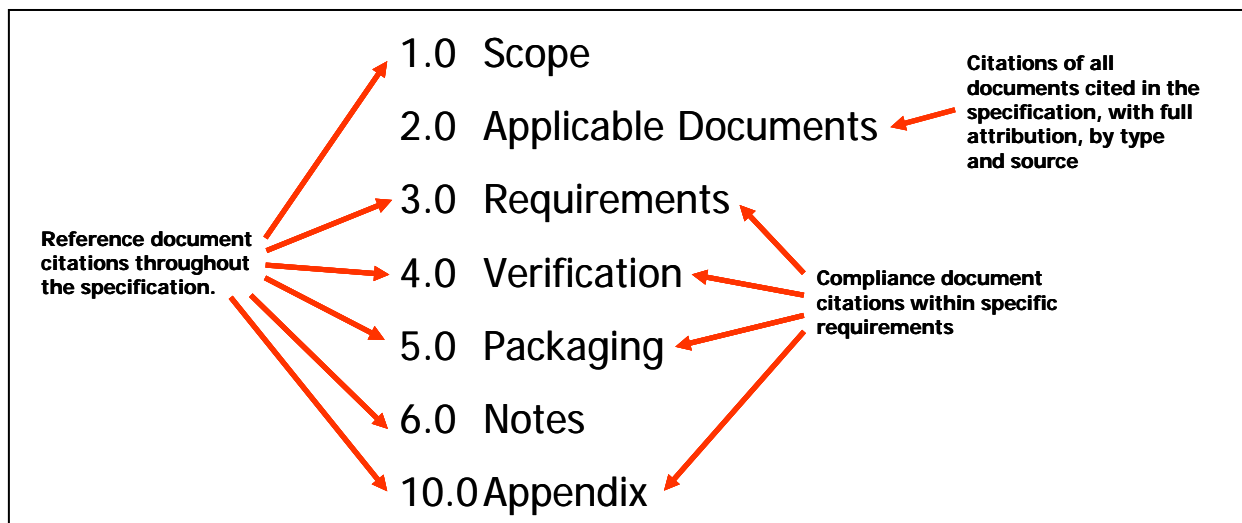


Figure 1. Typical Specification Outline.

## **Areas of Confusion**

Many different approaches to the use of applicable documents have been observed in the absence of a recognized, accepted standard for the citation of applicable documents. Many specifications show confusion in the use of applicable documents in the following areas:

- Citation instead of inclusion
- Citation of a reference document as a compliance document
- Citation of an entire document in requirements
- Citation of an incorrect document in an incorrect location
- Citations in Section 2
- Full citation of the document in the requirement
- Precedence
- Document tiering
- Flowdown to subcontractors

Each area is discussed below.

## **Disclaimer**

Some examples of requirements citing applicable documents are given in this paper. There is no intent to criticize the original author, as little has been written with regard to a standard way to handle applicable documents (c.f., MIL-STD-490A, MIL-STD-961E and JSSG-2000A).

## **Citation Instead of Inclusion**

The specification developer should first determine if it is better to include the compliance requirements from compliance document directly in the specification under development, or to cite the applicable section of the compliance document. MIL-STD-961E provides the following guidance in section 4.19.a:

“If the information is less than a page and if it is not a violation of copyright provisions ..., it should be included directly into the specification without referencing another document.”

Inclusion of a requirement, or a few requirements, or some reference information rather than citation, will ease the work of the specification user, as he or she will not have to go searching for the cited document. However, should the “parent” source be updated or changed, there will be no direct link back to that “parent” source, and the change may not be known to the specification users.

## **Citation of a Reference Document as a Compliance Document**

There is often confusion between citation of compliance documents (containing requirements) and reference documents (containing supporting information). The following requirement provides an example:

**The <item> shall limit orbital debris generation in compliance with NSS1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris.**

NASA document NSS1740.14 does NOT impose requirements on a spacecraft design to ensure that it limits orbital debris generation. It does define methods and measurands for assessing the spacecraft design to determine if it will generate orbital debris. It is process-oriented, not product oriented. Therefore, it cannot be a compliance document. However, it provides useful reference material, and an engineer can derive between 15 and 20 product requirements which, when satisfied, will lower the probability that operation of the spacecraft will produce orbital debris. A better requirement statement would be:

**The <item> shall limit orbital debris generation using NSS1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris for guidance.**

NSS1740.14 would then be listed in the “Reference Documents” section.

The effect of incorrect citation is that the specification user will not be sure of the intent of the specification writer, with some confusion introduced.

## Citation of an Entire Document in Requirements

There is a tendency to cite an entire document in a requirement, as shown in the following examples:

**The <item> shall meet MIL-STD-1472 for all 1-g human-machine interfaces.**

~~The <item> shall meet NASA-STD-3000 for all micro-g and 0-g human-machine interfaces.~~

Both requirements are valid product requirements. However, both MIL-STD-1472 and NASA-STD-3000 contain some explicit requirements (“shalls”) and numerous implicit requirements in the form of design guidance. It has been estimated that each of the documents may contain approximately 3000 requirements.

MIL-STD-961E recommends (section 4.19(d)):

“Unless the entire referenced document applies, it shall not be cited in total, but shall be tailored by citing the appropriate sections of the document, such as specific types, grades, or classes; test methods; or definitive descriptions (for example, “the painting requirements of MIL-STD-000”). Do not reference specific paragraph, table, or figure numbers from another document since these may change when the document is revised. “

The product requirements should only cite one specific section per requirement, as shown below.

**The <item> electrical connectors shall be in accordance with section 5.9.14 of MIL-STD-1472.**

As MIL-STD-961E recommends that the citation refer to the topic in the cited document, not the actual section number, as a revision of the cited document might result in renumbering of the sections in the cited document, an alternative statement is:

**The <item> electrical connectors shall be in accordance with the “connectors” section of MIL-STD-1472.**

The effect of inclusion of the entire document, if only some of the content is needed, is increased design and development activity. Additionally, all the cited requirements will have to be verified.

## Citation of Incorrect Document in an Incorrect Location

**The <item> shall operate during and after exposure to rain at a rate of 100 millimeters (mm) per hour for a 1 hour duration at +24 degrees Celsius (C) and with a 64-knot wind as defined in MIL-HDBK-310.**

The first requirement is a good example. However, in the second requirements, MIL-STD-810F is not a product requirements document – it addresses methods for environmental testing. The requirement should be rewritten as a product requirement for Section 3 and a verification requirement Section 4:

**The <item> shall be sealed to prevent water incursion (Water Tightness).**

**Verification that the <item> is sealed to prevent water incursion shall be conducted using**

Both MIL-STD-810F and MIL-HDBK-310 should then be referenced in the “Reference Documents” section. MIL-STD-810F is a reference because it provides procedural information, rather than requirements. MIL-HDBK-310 is a reference because it provides reference information rather than requirements.



Again, the effect of this misapplication of applicable documents is potential confusion upon the part of the specification user. The stated requirement is unclear and not correct.

## Citation in Section 2

Many specifications reviewed by the author have section 2 titles and introductory text similar to:

<p><b>2.0 APPLICABLE DOCUMENTS</b></p> <p><b>2.1 APPLICABLE DOCUMENTS</b></p> <p>The following documents are applicable to the &lt;Item&gt; requirements:</p>
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The first problem is the use of the same title for sections 2.0 and 2.1. Section 2.1 should be called “COMPLIANCE DOCUMENTS”. The introductory text in Section 2.1 places no restrictions on the cited documents – if a document is updated at some point during the product life cycle, then the product must be updated to agree with the compliance documents. This introduces a significant risk, especially if a cited document is updated late in the development cycle. It also introduces risk as it is incumbent upon the contractor to be aware of impending updates to cited documents. This could entail the contractor establishing a surveillance program to ensure that the development team is aware of all impending and released changes to all cited documents.

The following text is recommended to reduce risk:

<p><b>2.0 APPLICABLE DOCUMENTS</b></p> <p>The documents listed in this section are cited in this specification.</p> <p><b>2.1 COMPLIANCE DOCUMENTS</b></p> <p>The following documents of the exact revision and date listed below form a part of this specification to the extent specified herein.</p> <p>This section lists documents cited in Sections 3, 4, 5 or Appendices including requirements. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples.</p> <p>While every effort has been made to ensure the completeness of this list, specification users are cautioned that they must meet all specified requirements of documents cited in this specification, whether or not they are listed here. Failure to include a cited document in this section does not mean that it is not included in this specification. Inclusion of</p>
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The introductory statements force exact attribution of the applicable documents and ensure that any update to an applicable document will force a formal explicit review and possible change to the specification.

The format for Sections 2.0, 2.1 and 2.2 shown on the previous chart are the “short” form. MIL-STD-490 and MIL-STD-961 recommend listing the documents within Sections 2.1 and 2.2 by source. See Section 5.7.2 – 5.7.3 of MIL-STD-961E for an example of the “long” form. Note that MIL-STD-961E makes no distinction between compliance and reference documents.

The effect of this recommended change will be to make the specification more understandable to the designers and developers by clearly separating the two types of document.

## Sample Section 2 Citations

A standard format is to reference the documents (compliance and reference) in a tabular format, as follows:

Table 1: Summary of style usage

<b>MIL-DTL-15090D</b>	<b>Detail Specification, <i>Enamel, Equipment, Light Gray, (Navy Formula No. 111)</i>, Department of Defense</b>
<b>6 November 1996</b>	

**MIL-STD-1399-300A**      **Military Standard, Interface Standard for Shipboard Systems, Section 300A, Electric Power, Alternating Current, Department of Defense**  
**Notice 1**

**11 March 1992**

**MIL-STD-1472F**      **Department of Defense Design Criteria Standard, Human Engineering, Department of Defense**  
**Notice 1**

**5 December, 2003**

Specification developers should decide if the citation in the requirement statement should have the full attribution, or just the base number (i.e., MIL-STD-130M or MIL-STD-130). The full attribution must be provided in Section 2. It is recommended that the base document number be used when cited in a requirement. This will simplify change management of the specification, as the version information need only be changed in Section 2.

## Precedence

There can be conflicts between the cited documents and requirements in the citing specification.

Add a subsection to Section 2 with the following text:

### 2.X Order of precedence

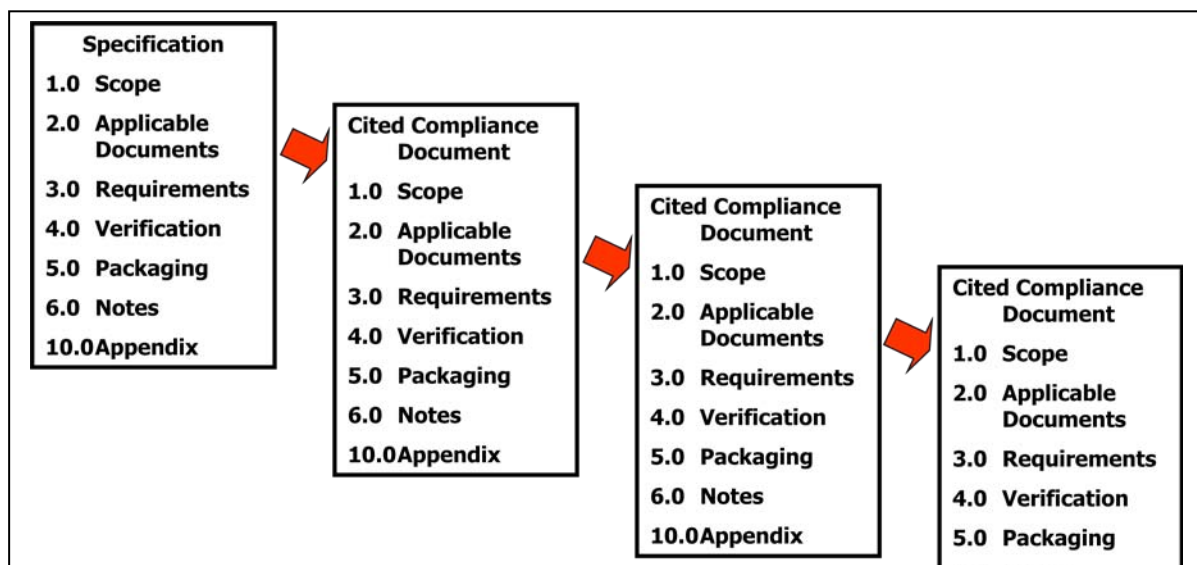
In the event of a conflict between the text of this specification and the references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Quoted from JSSG-2000A, paragraph 2.5.

Inclusion of this text in every specification will promote understanding of the specification, and ensure that the correct requirements are applied.

## Document Tiering

A given specification may include cite compliance documents which themselves cite compliance documents, forming a “waterfall” of tiered citations. Without instructions to the contrary, the requirements included by citation in all sub-tier documents would be included in the top-level document, and would require verification of their satisfaction. See Figure 2.



## Figure 2. Specification Tiering Example.

The “Department of Defense Joint Service Specification Guide Air System”, JSSG-2000A provides the following guidance to specification developers in section 2.4:

Control of document tiering has become a primary way of controlling contractual applicability of cited documents. Care must be taken to ensure that each cited document is appropriate to the first-tier references or compliance documents (including those references or compliance documents cited in the contract, which themselves would become first-tier references or compliance documents and, thus, their second tier would become contractually applicable as well).

Exceptions to tiering applicability are generally defined by DoD policy. For example, in the Perry memo previously cited, the direction on tiering of specifications and standards includes, “Approval of exceptions may only be made

by the Head of the Departmental or Agency Standards Improvement Office and the Director, Naval Nuclear Propulsion for specifications and drawings used in nuclear propulsion plants in accordance with Pub. L. 98-525 (42 U.S.C. fl7158 Note).”

Section 2.4 of the JSSG-2000A documents then suggests the following solution:

When the <item> specification is directly referenced in the contract, it is a first-tier specification and is applicable. Documents referenced in the first-tier specification are applicable as follows:

- a. Second Tier - All documents directly referenced in the first-tier specification are only applicable to the extent specified.
- b. Lower Tier - All documents directly referenced in second- or lower-tier documents are for guidance only unless otherwise directed by the contract.

An additional section should be included in Section 2 of the specification including this text. Inclusion of this text provides explicit guidance to the specification user and will help to reduce or eliminate misunderstandings. Further, it will eliminate time wasted on tracking down lower-tier documents, and verifying requirements from lower-tier specifications.

## **Flowdown to Subcontractors**

The specifications provided to the subcontractors for the items that they are to provide should also contain a Section 2, and the flowed-down requirements should cite that portion of the applicable document in the parent document that corresponds to the flowed-down requirement.

This practice will ensure a clear understanding between the buyer and the subcontractor as to what is under contract.

## **Summary**

The importance of applicable documents can not be understated. Appropriate use provides for inclusion of lessons-learned and standards. The use of applicable documents is not well documented in the literature, and recommendations have been made for good methods to be used in inclusion of applicable documents in specifications.

Rigor and clarity in the use of applicable documents will reduce costs by eliminating confusion and reducing the number of requirements to be verified, as well as reducing the costs associated with the maintenance of the specifications over the life of the Program. And, by improving the mutual understanding of the requirements between the buyer and the seller, developmental risk will be reduced.

## **References**

National Aeronautics and Space Administration, NASA Standard 3000, Man-Systems

Integration Standards, Revision B, July 1995.

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## **Biography**

Jim van Gaasbeek has 35 years experience analyzing and developing rotary-wing and fixed-wing aircraft, launch vehicles and spacecraft, both in the United States and European defense environments. Beginning as a rotor aeroservoelastician, his career has progressed with experience in constructive and virtual simulation, accident investigation, vehicle-management system design and systems engineering, concentrating in risk management and requirements development, management and verification.