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## **Plum Brook Station Reference**

# **Guide for Preparation of Technical Specifications**

*Approved by Plum Brook Management Office/7030:*

**NASA - Glenn Research Center  
Cleveland, OH 44135**

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Page 1 of 16

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title: Guide for Preparation of Technical Specifications</b>	

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<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

## GUIDE FOR PREPARATION OF TECHNICAL SPECIFICATIONS

A detailed technical specification for hardware must be prepared for each subcontract end item to set forth specific performance, design, fabrication, and quality requirements. The specification will be used by the subcontractor to assist him in understanding completely NASA’s procurement requirement. The Technical Specification is a companion document to the Statement of Work, but its purpose and composition are significantly different.

The Statement of Work is a detailed description of subcontractor and buyer responsibilities under a contractual arrangement. The Technical Specification, on the other hand, is a description of the parameters (size, shape, tolerance, testing) of the end result of the contract. Specifications may take the form of, or include, pictures, blueprints, descriptive literature, text, formulas, or other matter which assist in the description of the procurement requirement.

The requesting department/section assisted by Quality Assurance/Safety is responsible for writing the technical specification.

### Types of Specifications and Characteristics

Specifications generally fall into three categories: fabrication, performance, or purchase descriptions. Often a specification may be a combination (e.g., fabrication/performance). All specifications are written in the same format. Following are definitions and descriptions of these types of specifications, one or more of which will play a part in delineating any procurement requirement.

Fabrication Specifications set forth precise measurements, tolerances, materials, in-process and finished product tests, quality assurance, inspection requirements and other specific information. Under this type of specification; the prepare is responsible if there are design or related omissions, errors, and deficiencies in the specifications and drawings.

Performance Specifications set forth operational characteristics desired for the item. In such specifications the design, measurement, and other details are not stated nor considered important so long as the performance requirement is met. Where an item is purchased by a performance specification, the subcontractor accepts general responsibility for design, engineering, quality assurance, and achievement of the stated performance requirements. The subcontractor has general discretion and election as to detail, but the work is subject to NASA's reserved right of final inspection and approval or rejection.

Purchase Descriptions are specifications which designate a particular manufacturer's model, part number, or product. The description may be modified by the phrase “or equal.”

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<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

Under this specification, if the subcontractor furnishes, or uses in fabrication, the specified brand name or an acceptable and approved “equal,” the responsibility for proper performance generally falls upon NASA. It is the subcontractor's responsibility to assure that the product is, in fact, equal to the specified brand named product. Purchase descriptions need not be rewritten in NASA’s format but may be used in their original form to indicate NASA’s requirement.

Many specifications, particularly those for existing hardware, packing, and delivery, may already exist. It is often necessary, however, in development, to generate specifications to describe fully the end result required of subcontractors. Where specifications are developed, the following points should be considered:

<u>ITEM</u>	<u>POINTS TO BE CONSIDERED</u>
Description	<ul style="list-style-type: none"> <li>A. Accurate reflection of what is required.</li> <li>B. Sufficient detail for the subcontractor to make a determination of price.</li> <li>C. Other specifications, if applicable (in whole or part).</li> <li>D. Clear, comprehensive, and brief.</li> <li>E. Brand names or equivalent (with salient features).</li> <li>F. Descriptive literature, if applicable.</li> <li>G. Engineering drawings, if applicable.</li> <li>H. Critical features.</li> <li>I. Minimum and maximum parameters.</li> <li>J. Date and title of specifications.</li> </ul>
Principles of Operation	<ul style="list-style-type: none"> <li>A. Essential operating conditions.</li> <li>B. Restrictive or significant environmental conditions.</li> <li>C. Reliability.</li> <li>D. Serviceability (warranties and guarantees).</li> <li>E. Intended uses.</li> <li>F. Interface equipment.</li> </ul>
Packaging	<ul style="list-style-type: none"> <li>A. Minimum and maximum measurements.</li> <li>B. Ease of Maintenance.</li> <li>C. Other specifications, if available.</li> </ul>
Utilities (Electrical, water, air, etc.)	<ul style="list-style-type: none"> <li>A. Voltage, frequency, number of phases.</li> <li>B. Tolerances.</li> <li>C. Availability of utility and connections.</li> <li>D. Responsibility of interface and installation.</li> </ul>

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

Quality Assurance

- A. Detailed test and record requirements.
- B. Inspection planning requirements.
- C. Special processes.
- D. Sample control; inspection and test.
- E. Personnel qualifications.
- F. Nondestructive tests.

Special Features, If Any

- A. Environment tests.
- B. Acceptance test criteria.
- C. Spare parts option list breakdown by component.
- D. Restrictions.
- E. Qualifications (input and output characteristics).

**RULES OF INTERPRETATION**

When writing a technical specification, the writer must keep in mind the following rules of interpretation used in government contracting to avoid costly errors.

In interpreting contract language, the most widely followed rules used are those found in the Restatement of the Law of Contracts, Paragraphs 235 and 236. These rules are frequently used by the Boards of Contract Appeals and have been cited in numerous cases, e.g., Randolph Engineering Co., ASBCA 4872, 58-2 BCA Para. 2053. They are summarized as follows:

Standards for Interpretation of Provisions

The standard of interpretation of an integrated written contract is the meaning that would be attached to the writing by a reasonably intelligent person acquainted with all operative usage and knowing all the facts and circumstances prior to and contemporaneously with the making of the contract.

Primary Rules of Interpretation

(1) Technical words and words of art are given their technical meaning unless the context or a usage which is applicable indicates a different meaning,

(2) A writing is interpreted as a whole and all writings forming part of the same contract are interpreted together. It is improper to interpret a single word, phrase or sentence out of context with the rest of the contract.

(3) All circumstances accompanying the transaction may be taken into consideration, with the exception of oral statements made by the parties of what they intended a writing to mean.

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

The circumstances under which the contract was made may always be shown, as the objective is to determine the meaning of the writing at the time and place when the contract was made, and all the surrounding circumstances at that time necessarily throw light on the meaning of the contract.

#### Secondary Rules of Interpretation

- (1) An interpretation which gives a reasonable and effective meaning to all the language is preferred to one that leaves part of the language unreasonable or of no effect.
- (2) The principal apparent purpose of the contract is given weight in determining the meaning to be given to the contract or any part thereof.
- (3) Where there is an inconsistency between general provisions and specific provisions, the specific provisions ordinarily qualify -the meaning of the general provisions.
- (4) Where words bear more than one reasonable meaning, an interpretation is preferred which operates more strongly against the party which drafted the language.

In interpreting specifications, the most frequently used rule is the one interpreting the language against the party that drafted the contract. Another way of stating this rule is that when there are two reasonable interpretations of a specification, the interpretation of the subcontractor will be accepted.

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Glenn Research Center Plum Brook Station Guide	Title: Guide for Preparation of Technical Specifications

Specification for the Preparation of Technical Specifications

This specification shall govern the preparation of all NASA Plum Brook Station Specifications. The Technical Specification and supporting documentation is defined as a concise statement of the parameters of the end item or service to be provided by the subcontractor. The Statement of Work contains the requirements placed on the subcontractor, the definition and extend of responsibilities, and the scope and restrictions of expected effort in executing the subcontract.

Each technical specification shall consist of the following pages and sections:

- Title Page and Approvals
- Index of Page Revisions
- Table of Contents
- 1.0 Scope
- 2.0 Applicable Documents
- 3.0 Technical Requirements
- 4.0 Quality Control, Quality Assurance and Safety
- 5.0 Preparation for Delivery
- 6.0 Notes and Supplemental Information

1.0 Scope

1.1 The scope section shall be a concise statement of the product or service which the Technical Specification covers in such a way that the subcontractor can gain a clear insight into the end result.

1.2 Where appropriate, scope should indicate the use of the fabricated equipment to which the specification applies, or the general nature of the service being contracted. Any descriptive information contained in this section should be brief.

2.0 Applicable Documents

2.1 This section is a listing of each document utilized in the body of the specification. Specifications, standards, codes, and handbooks shall be listed in this section. References to these documents in the body of the specification must be specific, designating all applicable portions by document, section, and paragraph.

2.2 All drawings that apply directly to the work shall be listed in this section. Drawings for information only shall be listed in Section 6 and be clearly marked "for information only."

2.3 All specification requirements which reference the applicable portions of the documents and drawings shall be screened for applicability and possible conflict with other specifications and drawings. This is the responsibility of the specification writer.

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

2.4 Documents which are referenced without citation of section or paragraph shall apply in their entirety. Where there is a citation of section or paragraph, only the cited portion is applicable.

2.5 NASA's subcontractors are not obligated to adhere to subtier references contained within primary reference documents. If subtier reference documents are important, they must be specifically set forth as required documents.

### 3.0. Technical Requirements

#### 3.1 Design Requirements

3.1.1 This section shall describe all requirements which determine the design of the items being procured. Space requirements, systems requirements, requirements imposed by other equipment, aesthetic requirements, and major functional characteristics shall be described in detail.

3.1.2 In a design and fabrication contract, the design requirements shall be a principal section of the specification.

#### 3.2 Material Requirements

3.2.1 Where applicable, standard material specifications shall be used. American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME) and the like are commercially approved documents that contractors readily accept.

3.2.2 Original material specifications shall be written where commercial standards, or NASA's customers' specifications do not exist.

3.2.3 Materials that are radioactive, toxic, hazardous, or flammable shall be so identified.

3.2.4 Material finish shall be specified where the material stock finishes become functional surfaces of the fabricated items.

#### 3.3 Fabrication Requirements

3.3.1 Fabrication requirements shall be those for converting stock materials into finished items that will be furnished by pieces or assembled into a fabricated item.

3.3.2 Fabrication includes such operations as forging, forming, machining, heat treating, welding surface treating, plating, painting, coating, demagnetizing, and cleaning. Whenever possible, the specification shall be written to govern the effects of the processes rather than the process or process parameters, themselves.

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<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

However, where recognized process abuses may cause damage, certain limitations may be placed on process parameters such as heat-treatment temperatures, heating or quenching rates, and amounts of deformation in forming or straightening. Marking, stamping, and other identification techniques shall be limited to those which preclude contamination, damage, or interference with end use or function.

### 3.4 Assembly and Workmanship

3.4.1 This subsection shall define all characteristics that are critical to the assembly of the machine, instrument, or structure from component parts fabricated.

3.4.2 The assembly requirements vital to function, such as fit, alignment, balance, and adjustment shall be fully specified.

3.4.3 Assembly workmanship requirements shall clearly convey to the subcontractor the area and degree of skill required of the tradesmen in assembly and mechanical adjustment.

3.4.4 Where alignment marks, keying, or pinning after assembly are required for reassembly, this shall be specified.

3.4.5 If as-assembled dimensions are necessary, these shall be required by the specification. Alignment surfaces and marks shall be identified on the assembly drawings and prints included with the shipment.

### 4.0 Quality Assurance & Safety and Test Requirements

4.1 The requirements and responsibilities of the subcontractor relating to a Quality Assurance/Safety Program shall be defined by reference to existing national standards or by detailing them in this Section of the Technical Specifications.

4.2 This subsection shall contain the specific quality assurance/safety and test requirements which the item or service must meet and satisfy.

4.3 Tests shall be identified by type, and required procedures and techniques specified.

4.4 Facilities and equipment required to perform the tests shall be identified

4.5 Required Safety inspections and test criteria shall be identified and specified.

4.6 When a required test is potentially hazardous, the procedures for conducting the test shall be reviewed and approved for safe operation, and shall comply with applicable safety codes and standards.

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

4.7 When detailed operational and qualification tests are required after installation, the extent of the required subcontractor participation and responsibility shall be defined in the Statement of Work.

4.8 Acceptance criteria for a performance or reliability test shall be specified in detail.

4.9 Units and precision of measurements shall be defined (are ounces avoirdupois or troy, are tons long, short, or metric). Measurement methods shall be specified where applicable by reference to commercial standards. When practical, the subcontractor shall be required to develop process and inspection techniques (subject to NASA review), and final product acceptance shall be in conformance to the original specification.

4.10 Functional and Performance Tests

4.10.1 This paragraph shall describe in detail the responsibilities and requirements for all functional and performance testing activities. In contrast to product specifications, which specification shall define precise test methods? Standard methods and code tests shall be used where applicable or required. The specification writer is responsible for this determination.

4.10.2 Detailed operational tests may be required for complex mechanical or electrical equipment. In this case, the subcontractor's and NASA's responsibilities fully defined, including the type and competence of personnel supplied by the subcontractor and the electrical and mechanical services, foundations, etc, supplied by NASA.

4.10.3 Where equipment is procured on a performance specification, the acceptance levels of performance shall be precisely specified. This type of equipment is generally subcontractor designed and built, often proprietary item, and the specification is based completely on performance characteristics.

5.0 Preparation for Delivery

5.1 This section shall govern disassembly, draining or cleaning, preservation and protection, packaging, packing, shipment marking, and shipping documents. The applicability of existing standards shall be considered where appropriate.

5.2 Vibration acceleration loads in shipment often exceed the design stress limit of equipment. In such cases, equipment shall be disassembled and the delicate and heavy parts packed separately.

5.3 Unless otherwise required, tanks and fluid lines shall be drained and blown out, and all openings sealed by caps, plugs, or flange covers. These shall be of a design that will not be easily overlooked in reassembly of the equipment.

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

5.4 Finished surfaces shall be protected from damage and preserved from corrosion. Protective coatings shall be required to be easily removable.

5.5 Loose items shall be packed in secondary packages with suitable packing materials.

5.6 The packaging shall be specified on the basis of shipping method, handling facilities, and storage after receipt. Packaging will be different for air, rail, truck, and sea shipments, as will the requirements for lugs, slings, or prefabricated returnable containers.

5.7 Compliance with appropriate federal statutes and regulations for shipment of hazardous or radioactive material is mandatory.

5.8 An optional consideration is to direct the subcontractor to provide a shipping and packaging plan when the item(s) being shipped would benefit by such planning.

## 6.0 Notes and Supplemental Information

6.1 This section shall contain only information of an explanatory or general nature. No specification requirements shall appear herein, the information shall be marked "for information only." The section should contain information that may be useful for the prospective contractor's understanding of the specification.

6.2 Examples and illustrations of ancillary requirements may be included here for guidance and information.

## Preparation Instructions - Format, Style, Assistance and Checklist

### 7.0 Format

7.1 All specifications shall follow a standard format as follows:

Title Page and Approvals  
Index of Page Revisions  
Table of Contents

In addition, each specification shall consist of the following six sections:

1.0 Scope  
2.0 Applicable Documents  
3.0 Technical Requirements  
4.0 Quality Assurance and Test Requirements  
5.0 Preparation for Delivery  
6.0 Notes and Supplemental Information

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

7.2 There will be varying subsections under each of these sections consistent with the procurement requirement. The subsections will of necessity differ from one Technical Specification to another.

7.3 In some instances an entire section may not be required. When this occurs, the section title should be included in the specification followed by the words “not applicable.”

7.4 The information in each of the six sections must be unique to the item specified, and the first five sections (Scope through Preparation for Delivery) together must contain all of the requirements of the item or service specified. Section 6, as the heading indicates, contains no requirements, but may be used to present information which may assist the contractor to a better understanding of the procurement requirement. This section is not limited to the examples described in the paragraphs. Any and all information such as the description of use, which may contribute to understanding the job, may be included.

7.5 The writers of technical specifications should be sure that all required information for performance for both the subcontractor and his suppliers is included. Particularly, all drawings must completely define the product or component, including all references to specifications and/or procedures involved. Lack of complete information can produce unacceptable end products and subsequent program delays.

7.6 In general, process information, which may be construed by the subcontractor as telling how to fabricate an item or perform a service, should not be included. Such information may ultimately relieve the subcontractor of responsibility for the end result. If it is necessary to direct processes or methods, the NASA Buyer should be made aware prior to the solicitation of prospective subcontractors.

7.7 All subcontractor requests for deviation from NASA Specifications or any documents listed in the “Applicable Documents” section must be submitted to the NASA Buyer in writing.

8.0 Page Format

8.1 The cover page shall carry the legend centered at the top:

Specification Document No.  
Plum Brook Station  
Sandusky, Ohio

In the center of the cover page, the document shall be identified as follows:

TECHNICAL SPECIFICATION  
FOR

\_\_\_\_\_

Date

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications	

The lower section shall contain approval information as follows:

Prepared by \_\_\_\_\_ Date \_\_\_\_\_  
Originator

Approved by \_\_\_\_\_ Date \_\_\_\_\_  
Task Manager

Approved by \_\_\_\_\_ Date \_\_\_\_\_  
BS/TSS Manager

Reviewed by \_\_\_\_\_ Date \_\_\_\_\_  
Manager, Safety/Quality & Environmental

Concurred by \_\_\_\_\_ Date \_\_\_\_\_  
NASA Manager

Approved by \_\_\_\_\_ Date \_\_\_\_\_  
Purchasing Manager

Filed by \_\_\_\_\_ Date \_\_\_\_\_  
Records Office

8.2 Intentionally left blank.

8.3 Each section of the Technical Specification shall be numbered with an Arabic number. Each subsection and paragraph thereunder shall be identified as follows:

1.0 SECTION TITLE  
1.1 Subsection  
1.1.1 Paragraph  
1.1.1.1 Subparagraph

8.4 Section headings shall be totally capitalized and underlined. Subsections shall be capitalized and underlined; paragraph and subparagraph headings shall be capitalized

8.5 All specifications shall be approved by the Task Manager, BS/TSS Manager, NASA Manager and the Quality Assurance and Safety Office representative prior to submission to Procurement for solicitation and procurement. Subsequent revisions shall be approved in a similar manner.

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<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

9.0 Assistance

During the formative stages of drafting the Technical Specification, assistance and information can be obtained from the following:

9.1 NASA Buyer for general guidance, overall procurement questions, and format.

9.2 Quality Assurance/Safety for information on quality assurance standards, specifications, requirements, and safety considerations.

10.0 Language Style

10.1 The paramount consideration in a specification is its technical essence, and this should be presented in language free of vague and ambiguous terms and using the simplest words and phrases that will convey the intended meaning. Inclusion of essential information shall be complete, whether by direct statements or reference to other documents. Consistency in terminology and organization of material will contribute to the specification's clarity and usefulness. Sentences shall be as short and concise as possible. Punctuation should aid in reading and prevent misreading. Well-planned word order requires a minimum of punctuation. When extensive punctuation is necessary for clarity, the sentence(s) shall be rewritten. Sentences with compound clauses shall be converted into short and concise separate sentences.

10.2 The only abbreviations employed shall be those in common usage and not subject to misinterpretation. The first time an abbreviation is used in text, it shall be placed in parentheses and shall be preceded by the word or term spelled out in full; eg., pounds per square inch (psi).

10.3 The only symbols that shall be used in the text to express ranges or tolerances are the "+", "-", and "±". Other symbols may be used in equations and tables. Graphic symbols, when used in figures, shall be in accordance with industrial standards. (Any symbol formed by a single character should be avoided if practicable, since an error destroys the intended meaning.)

10.4 Trade names, copyrighted names, or other proprietary names applying exclusively to the product of one company shall not be used unless the item(s) cannot be adequately described because of the technicality involved, construction, or composition. In such instances, one, and if possible, several commercial products may be included, followed by the words "or equal" to assure wider competition and that bidding will not be limited to a particular make specified. The same applies to manufacturers' part numbers or drawing numbers for minor parts when it is impracticable to specify the exact requirements in the specification. The particular characteristics (salient features) required shall be included to define "or equal."

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

10.5 Certain words and phrases are frequently used in a specification. The following rules shall be followed:

10.5.1 Referenced documents shall be cited thus:

“conforming to . . .”  
“as specified in . . .”  
“in accordance with”

10.5.2 “Unless otherwise specified” shall be used to indicate an alternative course of action. The phrase shall always come at the beginning of the sentence, and, if possible, at the beginning of the paragraph. This phrase shall be used only when it is possible to clarify its meaning by providing a reference.

10.5.3 When making reference to a requirement in the specification and the requirement referenced is rather obvious or not difficult to locate, the simple phrase “as specified herein” is sufficient and should be used.

10.5.4 The phrase “. . . to determine compliance with . . .”, or “. . . to determine conformance to . . .” should be used in place of “. . . to determine compliance to . . .” In any case, use the same wording throughout

10.5.5 In stating positive limitations, the phrase shall be stated thus: “The diameter shall be not greater than . . .”

10.5.6 The emphatic form of a verb shall be used throughout the specification; that is, state in the requirements section that “the indicator shall be designed to indicate . . .” and in the section containing test provisions “The indicator shall be turned to zero and 220 volts alternating current applied.” For specific test procedures, the imperative form may be used providing the entire method is preceded by “the following tests shall be performed,” or related wording. Thus, “Turn the indicator to zero and apply 220 volts alternating current.”

10.6 Use “shall” whenever a specification expresses a provision that is binding. Use “should” and “may” whenever it is necessary to express nonmandatory provisions. “Will” may be used to express a declaration of purpose on the part of NASA. It may be necessary to use “will” in cases where simple futurity is required (i.e., power for the motor will be supplied by electricity).

## 11.0 Technical Specification Checklist

11.1 The following checklist for Technical Specifications provides some of the considerations the writer must bear in mind:

Does the technical specification completely define the job to be done?

<b>Glenn Research Center Plum Brook Station Guide</b>	<b>Title:</b> Guide for Preparation of Technical Specifications

Are sentences structured so that there is no. question of the contractor's obligations?

Are the proper reference documents cited? Are the internal references specific and complete?

Have all elements of quality control and testing been considered and included in the specification?

Does the specification indicate all design, material, fabrication, and assembly characteristics?

Does the specification properly reflect its relationship to, the Statement of Work? Are they compatible?

Have all loose ends been considered, so that the prospective subcontractor is not left hanging?

Has all extraneous material been removed?

Have all inconsistencies and ambiguities been eliminated?

Is the specification internally consistent and adequate for procurement?

Is the procurement requirement over-specified? Under-specified?

11.2 This checklist is not complete, but should be used by the writer as a guide to review the quality of work.