

MIL-D-23660A(WEP)

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MIL-D-23660

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CODE IDENT

10001

MILITARY SPECIFICATION

DATA, TECHNICAL FOR ROCKET MOTORS

This specification has been approved by
Bureau of Naval Weapons, Department of the Navy

1. SCOPE

1.1 This specification covers requirements for the technical data to be prepared during the development program of rocket motors.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Military

MIL-D-1000	Drawings, Engineering, and Associated Lists
MIL-M-005474	Technical Manuals, General Requirements for Preparation of
MIL-D-5480	Data, Engineering and Technical Reproduction Thereof
MIL-R-18136	Research and Engineering Reports: Format and General Requirements
MIL-R-23021	Rocket Motor, General Manufacturing Specification for Inert Parts
MIL-R-23139	Rocket Motors, Surface Launched, Development and Qualification Requirements for

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STANDARDS

Military

MIL-STD-292

Ballistic Nomenclature-Rocket
Static Tests

MIL-STD-414

Sampling Procedures and Tables
for Inspection by Variables for
Percent Defective

PUBLICATIONS

Military

MIL-HDBK-5

Strength of Metal Aircraft
ElementsBureau of Naval Weapons

WR-12

Engineering Drawings, Associ-
ated Lists and Documents Re-
ferenced Therein

WR-43

Preparation of Quality Assurance
ProvisionsNWSO Publications

STD 10

Editorial Standards for Ordnance
Publications

M200

Military Outline of Form and
Instructions for the Preparation
of Specifications

(When requesting any of the above documents, give the title and complete designation of the item as shown above. Copies of specifications, standards and publications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Naval Supply Depot (Code CDS) 5801 Tabor Avenue, Philadelphia 20, Pennsylvania. All other documents may be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General requirements. -All the technical data forwarded by the designer to the procuring activity shall be prepared in accordance with the best engineering and technical standards and in strict accordance with referenced documents as specified in the detail requirements. All master documentation required herein shall be forwarded to the Bureau of Naval Weapons for authentication and disposition.

3.1.1 Action. -Action by BuWeps on technical data is specified in Section 4 and Appendix 1.

3.1.2 Quantity. -Quantity of technical data required shall be as specified in Appendix 1.

3.1.3 Type. -Type of technical data shall be as specified in Appendix 1. Unless otherwise specified, data and drawings shall comply with the following:

(1) Typewritten data, non-reproducible copies, shall be in accordance with MIL-D-5480, Type I, Class 1.

(2) Typewritten data, reproducible copies, shall be in accordance with MIL-D-5480, Type I, Class 2.

(3) Drawings furnished under Phase I may be Form 2 or Form 3 drawings in accordance with MIL-D-1000.

(4) Drawings furnished under Phase II shall be Form 1 drawings in accordance with MIL-D-1000.

3.1.4 Distribution. -Distribution of data shall be as designated by the procuring activity.

3.1.5 Units of measurement. -All units of measurement used in the reports shall be the following United States standards:

(1) Dimensions - inches

(2) Weights - pounds

(3) Pressure - pounds per square inch absolute

(4) Time - seconds

(5) Temperature - degrees Fahrenheit

(6) Thermal energy - British Thermal Units (BTU)

(7) Electricity - volt, ampere, ohm

3.1.6 Performance definitions. -The rocket motor and igniter performance definitions in specifications, reports, tests, data, etc., shall be in accordance with MIL-STD-292.

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3.2 Phases. -Technical data requirements of this specification are divided into phases as defined in MIL-R-23139.

3.3 Technical data required during Phase I (Development).

3.3.1 General design drawing. -The design agency shall submit a general design drawing of the proposed rocket motor in accordance with MIL-D-1000, Category A, Form 2 or Form 3 at the beginning of Phase I. Information (actual or estimated) shall include, but not be limited to the following:

(1) Performance characteristics including:

- pressure-time curves at low, ambient, and high operating temperatures
- thrust-time curves at low, ambient, and high operating temperatures
- total impulse at low, ambient, and high operating temperatures
- specific impulse, delivered
- specific impulse, theoretical
- mass fraction
- volumetric efficiency
- flame temperature
- characteristics velocity
- ratio of specific heats
- temperature coefficient of pressure
- temperature coefficient of burning rate
- burning rate

(2) Propellant composition and the following physical properties:

- strain at maximum stress
- maximum stress
- modulus of elasticity

(3) Igniter design, firing circuit, and igniter charge formulation.

(4) Motor weight including weight breakdown on major components.

(5) Travel of center of gravity.

(6) Proposed principal materials.

(7) Wall thickness of combustion chamber.

(8) Main assembly dimensions.

(9) Correlation dimension requirements as available.

3.3.2 Design data. -Design data including calculations, component parts, grain geometry, and reason for selection of propellant ingredients shall be retained for examination by the procuring activity. As a minimum this data shall be retained until Phase II is completed.

3.3.3 Propellant data. -Propellant data shall be retained for examination by the procuring activity upon request. As a minimum, this data shall be retained until Phase II is completed. Data normally includes the following:

- (1) Formulation
- (2) Burning rate at ambient temperature
- (3) Temperature coefficient of burning rate
- (4) Temperature sensitivity
- (5) Pressure exponent
- (6) Decomposition temperature
- (7) Auto-ignition temperature
- (8) Impact sensitivity
- (9) Brittle point
- (10) Physical properties at temperature range from 0°F to 110°F
- (11) Temperature stability properties at range 0°F to 110°F
- (12) Theoretical specific impulse
- (13) Measured specific impulse
- (14) Explosive classification of propellant
- (15) Ratio of specific heats
- (16) Hygroscopicity
- (17) Radio frequency attenuation characteristics

3.3.4 Design approval drawings. -The designer shall prepare design approval drawings in accordance with MIL-D-1000, Category A, Form 1 as soon as the motor design intended to be used in qualification testing has been finalized. These drawings shall be submitted to the procuring activity for evaluation, identification by BuWeps sketch number, and authentication during the Phase I. The drawings shall define the rocket motor which will be used for qualification testing. The design approval drawings shall be kept up to date until the manufacturing drawings have been prepared and approved. All the changes on design approval drawings after the authentication shall be approved by the Bureau of Weapons. The drawings shall consist of, but not be limited to the following:

- (1) Assembly drawing
- (2) Mating surface drawings
- (3) Design loads drawing
- (4) Propellant grain and performance drawings
- (5) Igniter assembly drawing, including the safe/arm device

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3.3.5 Model Specification. -A Model Specification shall be prepared for the rocket motor and igniter. This document shall contain a description of the rocket motor and a detailed qualification test program which will be carried out to demonstrate that the motor will be ready to be released to production. The Model Specification shall be submitted to the procuring activity for approval with the design approval drawings. The document shall be prepared in accordance with Defense Standardization Manual M200, Chapter V. Tests specified in the model specification shall include, but not be limited to, the following:

- (1) Static test firings at low, ambient and high operating temperatures.
- (2) Temperature gradient and cycling tests (including simulated aerodynamic heating where applicable).
- (3) Acceleration, vibration, and shock load tests at low, ambient, and high operating temperatures. The sequence of tests shall be arranged to produce the best statistical results. The specification shall include detailed information about the support points of the rocket motor to be tested and information if the motor shall be assembled with the other (simulated) parts of the missile. The tests shall be arranged to simulate the following conditions:

- a. Transportation
 - vibration
 - handling shocks
- b. Handling
 - drop tests, crated and uncrated motor
- c. Shipboard stowage
 - vibration
 - near miss shock
- d. Launcher, shipboard
 - vibration
 - acceleration, linear and angular
 - near miss shock
- e. Launching
 - acceleration
- f. Flight
 - vibration superimposed with mechanical shocks
 - centrifuge tests

- (4) Storage tests to demonstrate the minimum type life of the propellant.
- (5) Environmental testing, including salt spray, rain, and sand or dust tests.

(6) Additional tests as follows:

- a. Altitude tests
- b. Exhaust pattern blast tests
- c. Structural tests including hydrotests of pressurized components
- d. Launching shoe and attachment fittings static loading tests
- e. Thrust alignment tests
- f. Ignition shock tests
- g. Jettisoning tests
- h. Igniter tests
- i. Propellant fragment ejection tests
- j. Study of firing effects on motor skin, temperatures and shape
- k. Reliability static firings
- l. Flight tests

3.3.6 Handling and safety manual. -A preliminary manual for rocket motor operation and handling shall be prepared by the contractor. This manual shall be completed and available for distribution prior to the delivery of the first experimental flight test motor.

3.3.7 Monthly progress report. -Cumulative monthly progress letter reports shall be submitted during Phase I (Development) describing the progress made in the development program of the rocket motor. This report shall include a description of all tests conducted during the report period including test methods. Other specific requirements and the distribution for the report will be specified by the procuring agency. Reports shall state the contract number and the development program title. The progress reports shall be submitted within fifteen (15) days of the end of the reporting period to the procuring activity.

3.3.8 Final report. -Within thirty (30) days of the termination of the Phase I, a final report prepared in accordance with MIL-R-18136 shall be submitted. It shall include but not be limited to the following:

- (1) Copies of the monthly reports
- (2) Major problems encountered and solutions to problems
- (3) Financial status of contract
- (4) Conclusions

3.3.9 Propulsion Unit Data Sheet. -A Propulsion Unit Data Sheet is required for each loaded motor shipped by contractor for flight or other testing. Distribution of the data sheet shall be as requested by the procuring activity. Typical information to be included on the Propulsion Unit Data Sheet is as follows:

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- (1) Motor identification
- (2) Contract number
- (3) Loaded assembly drawing number
- (4) Motor serial number
- (5) Igniter identification
- (6) Igniter circuit resistance
- (7) Propellant lot number
- (8) Firing temperature limits
- (9) Storage temperature limits
- (10) Total weight of motor
- (11) Date of loading
- (12) Total crated weight
- (13) Location of the center of gravity
- (14) Shipping order number
- (15) Deviations on the motor
- (16) Firing expiration dates of explosive components

3.4 Documentation required during Phase II - - Qualification.

3.4.1 Inert parts documentation. -The data listed in 3.4.1.1 through 3.4.1.5 shall be prepared by the contractor and submitted as a package to the procuring activity for evaluation and authentication at the date specified in the contract.

3.4.1.1 Inert parts drawings and lists. -Inert parts drawings and associated lists shall be end product drawings in accordance with MIL-D-1000, Category E or Category F, as applicable, Form 1. Inert parts drawings and associated lists shall be identified with Bureau of Naval Weapons drawing numbers and code identification.

3.4.1.1.1 Classification of characteristics. -The classification of characteristics shall be incorporated into the inert parts drawings in accordance with WR-43.

3.4.1.2 Microfilm of inert parts drawings and lists. Microfilm aperture cards of the authenticated inert parts drawings and associated lists required by 3.4.1.1, preceding, shall be prepared in accordance with WR-12.

3.4.1.3 Inert parts specification(s). -If required, a design specification for inert parts procurement shall be prepared per Standardization Manual M200, Chapter V. Specification MIL-R-23021, Rocket Motors, Inert Parts General Specification, shall be used where applicable as an inert parts procurement specification.

3.4.1.4 Material specification. -Design material specifications shall be prepared for materials used in the inert rocket motor design and not covered by existing Military, Weapons, or Federal specifications. These specifications shall be prepared in accordance with Standardization Manual M200, Chapter V.

3.4.1.5 Process data specifications. -When requested by the procuring activity, a processing data shall be prepared for nonmandatory, non-standard manufacturing processes in the form of Ordnance Data (OD) as specified in WR-12.

3.4.2 Loaded motor data. -The data listed in paragraphs 3.4.2.1 through 3.4.2.6 shall be prepared by the contractor prior to completion of Phase II and submitted to the procuring activity for evaluation and authentication.

3.4.2.1 Loaded motor drawings and lists. -Loaded motor drawings and associated lists shall be end product drawings in accordance with MIL-D-1000, Category E or Category F, as applicable, Form 1. Loaded motor drawings and associated lists shall be identified with Bureau of Naval Weapons drawing numbers and code identification.

3.4.2.1.1 Classification of characteristics. -The classification of characteristics shall be incorporated onto the loaded motor drawings in accordance with WR-43.

3.4.2.2 Microfilm of loaded motor drawings and lists. -Microfilm aperture cards of the authenticated loaded motor drawings and associated lists required by 3.4.2.1, preceding, shall be prepared in accordance with WR-12.

3.4.2.3 Loaded motor specification. -Loaded motor specification for rocket motor procurement shall be prepared in accordance with Standardization Manual M200, Chapter V, and shall include the necessary information for procurement of loaded units. Unless otherwise specified, performance requirements of the rocket motor shall be given on a separate performance data drawing prepared in accordance with MIL-D-1000, Category E, Form 1. When possible, the sampling and acceptance for test firings shall be specified in accordance with MIL-STD-414.

3.4.2.4 Other design specifications. -When required by the procuring activity, design specifications for procurement of major motor components which will be procured separately shall be prepared in accordance with Standardization Manual M200, Chapter V.

3.4.2.5 Material specification. -Design material specifications shall be prepared in accordance with Standardization Manual M200, Chapter V, for materials used in loaded motor parts and propellants not covered by existing Military, Weapons, or Federal specifications.

3.4.2.6 Process data. -When considered appropriate, processing data shall be prepared for non-standard, non-mandatory manufacturing processes in the form of Ordnance Data (OD) and as specified in WR-12.

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3.4.3 Other data.

3.4.3.1 Ordnance Pamphlet (OP). -Unless otherwise specified, an OP shall be prepared in accordance with MIL-M-005474 (WEP), NWSO Publications Standard 10, and other specific instructions from the procuring activity. It shall include complete instructions for ammunition depots and operating forces in receiving, processing, handling, assembly and disassembly, maintenance, storage, testing, and issuing of the rocket motor. A short description of the rocket motor, lists of special test equipment, and an illustrated parts breakdown shall be included.

3.4.3.1.1 First draft. -Three (3) copies of the first OP draft shall be forwarded to procuring activity for review. The draft shall include descriptions of the proposed illustrations.

3.4.3.1.2 Second draft. -Three (3) copies of the second OP draft with representative illustrations included shall be forwarded to the procuring activity for review.

3.4.3.1.3 Final OP. -One (1) reproducible copy, one (1) set of offset negatives, two (2) sets of blueprint or equivalent page proofs, and one (1) unscreened negative of each half-tone illustration, without nomenclature, shall be forwarded to the procuring activity.

3.4.3.2 Propellant process and procedure manual. -The contractor shall prepare a manual describing recommended methods, processes, and in-process testing for manufacturing the propellant. This manual shall include:

- (1) Detailed mixing and processing of propellant
- (2) Restricting of grain
- (3) Propellant in-process testing procedures
- (4) Specialized safety procedures

3.4.3.3 Stress analysis report. -This report shall be prepared by the contractor for the complete solid propellant rocket motor and all component parts including propellant grain. Factor of safety for all components based on calculated data shall be shown in tabulated chart form. Stress calculations shall be based on the maximum loads and the minimum material conditions. A preliminary stress report shall be provided at the beginning of development and shall be maintained current during the period of development and modified as necessary. The definitions and instructions of handbook MIL-HDBK-5 shall be used where applicable.

3.4.3.4 Photographs and motion picture film records. -Photographs of tests and failed parts and films of test firings in color shall be obtained by the contractor. Photographs and films shall be made available to the procuring activity upon request.

3.4.3.5 Monthly report. -The cumulative monthly progress report shall be submitted during Phase II (Qualification). The report shall meet the requirements of 3.3.7.

3.4.3.6 Final report. -The final report shall be submitted within 30 days of termination of the Phase II. The report shall meet the requirements of 3.3.8.

3.4.3.7 Qualification test report. -Qualification test report shall be furnished covering the qualification tests specified in the Model Specification. The report shall describe the test methods, results, and all other associated data. Each test report shall include, but not be limited to, the following:

- | | |
|-----------------------------|---------------------|
| (a) Title page | (d) Discussion |
| (b) Table of contents | (e) Conclusions |
| (c) Factual Data of Test(s) | (f) Recommendations |

The discussion shall contain an evaluation of the test results and the basis for the conclusions. Any failure or adverse incidents occurring during testing shall be reported giving all pertinent details, including the probable or determined cause. Photographs clearly showing failures of any components shall be submitted with the report. Appendices as required shall be included to provide rocket or component descriptions, a chronological record of testing, etc.

3.4.3.8 Rocket firing data. -Detailed data obtained or derived for each rocket motor static test fired during the qualification program shall include, but shall not be limited to, the following:

- (1) Propellant batch number
- (2) Propellant weight and density
- (3) Meteorological data (temperature, relative humidity, barometric pressure, etc.)
- (4) Rocket weight before firing
- (5) Rocket weight after firing
- (6) Nozzle throat diameter before and after firing
- (7) Area ratio (nozzle exit area to throat area)
- (8) Igniter type (weight of powder and composition, and percent by weight of composition)
- (9) Igniter resistance
- (10) Igniter firing current and voltage
- (11) Temperature conditioning data (conditioning temperature and time, and elapsed time between removal from conditioning and firing)
- (12) Thrust versus time curve (artist's concept)
- (13) Chamber pressure versus time curve (artist's concept)
- (14) Description of components after disassembly (after firing)
- (15) Total impulse
- (16) Specific impulse
- (17) Ignition delay
- (18) Percent regressivity

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- (19) Mass flow coefficient (C_W)
- (20) Impulse of weight ratio or propellant and of total weight
- (21) Effective gas velocity
- (22) Propellant burning rate

3.4.3.9 CPIA data sheets. -Chemical Propulsion Information Agency (CPIA) data sheets shall be prepared by the contractor for the Chemical Propulsion Information Agency Manuals.

3.4.3.10 Propulsion Unit Data Sheet. -Propulsion Unit Data Sheet is required with each loaded motor shipped outside of designer's facility.

3.5 Data requirements. -No data is required by this specification or by applicable documents referenced in Section 2, unless specified in the contract or order (see 6.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 The design activity shall establish and maintain an adequate procedure for checking, reviewing and maintaining documents prepared and furnished under this specification to insure satisfactory quality.

4.2 Review. -Design activity responsible for the preparation of the documentation shall review the documentation for completeness, technical and engineering accuracy, legibility, reproducibility, and for conformance to the requirements specified in the contract and referenced documents, prior to the submission of this data to the procuring activity.

4.3 Evaluation of documentation.

4.3.1 Phase I. -Documentation required in 3.3.4 shall be submitted to procuring activity for evaluation and authentication. Other documents required in 3.3 shall be amended if requested by procuring activity.

4.3.2 Phase II. -Documentation required in 3.4 shall be submitted to the procuring activity for evaluation. Documents required in 3.4.1 and 3.4.2 and in the subparagraphs thereof shall be authenticated by the procuring activity.

5. PREPARATION FOR DELIVERY

5.1 Drawings and associated lists. -Drawings and associated lists shall be packaged and packed as specified MIL-D-1000.

5.2 Other documentation. -When applicable other documents required by this specification shall be packaged and packed as specified in MIL-D-1000 and by the procuring activity.

6. NOTES

6.1 Intended use. -This specification is intended for the use of rocket propulsion research and development activities. This document will normally be used in conjunction with MIL-R-23139 (WEP).

6.2 Ordering data. -Procurement documents should specify, but not be limited to, the following:

- (a) Title, number and revision letter of this specification.
- (b) Request for data (Appendix I)
- (c) Distribution of data (3.1.4)

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APPENDIX I
DATA CHART

PARAGRAPH	TITLE <u>PHASE I</u>	KIND & AMOUNT OF COPIES	ACTION	SUBMITTAL DATE
3.3.1	General Design Drawing	3N	Information	30 days after receiving contract
3.3.2	Design Data		Information	As requested
3.3.3	Propellant Data		Information	As requested
3.3.4	Design Approval Drawings	1M + 3N	Signatures	End of Phase I
3.3.5	Model Specification	1M + 5N	Approval	Simult. with design approval drawings
3.3.6	Handling and Safety Manual	10N	Approval	Prior to flight testing
3.3.7	Monthly Progress Report	Distr. List	Information	Monthly 15 days after end of reporting period
3.3.8	Final Report	Distr. List	Information	30 days after end of Phase I
	<u>PHASE II</u>			
3.4.1.1	Inert Parts Drawings and Associated Lists	1M + 3N	Signatures	During first half of Phase II
3.4.1.2	Microfilm of Inert Parts Drawings and Associated Lists	2 Cards	Information	45 days after authentication of masters
3.4.1.3	Inert Motor Specification	1M + 3N	Signatures	Simult. with inert dwgs.

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APPENDIX I (Cont)

PARAGRAPH	TITLE	KIND & AMOUNT OF COPIES	ACTION	SUBMITTAL DATE
3.4.1.4	Material Specifications	1M + 3N	Signatures	During Phase II
3.4.1.5	Process Data	1M + 3N	Signatures	During Phase II
3.4.2.1	Loaded Motor Drawings and Associated Lists	1M + 3N	Signatures	End of Phase I
3.4.2.2	Microfilm of Loaded Motor Drawings and Associated Lists	2 Cards	Information	45 days after authentication of masters
3.4.2.3	Loaded Motor Specifications	1M + 3N	Signatures	End of Phase II
3.4.2.4	Design Specifications	1M + 3N	Signatures	End of Phase II
3.4.2.5	Material Specifications	1M + 3N	Signatures	End of Phase II
3.4.2.6	Process Data	1M + 3N	Signatures	End of Phase II
3.4.3.1	OP	1M + 1R + 2N	Approval	End of Phase II
3.4.3.2	Propellant Manual	5N	Approval	End of Phase II
3.4.3.3	Stress Analysis Report	5N	Approval	End of Phase II
3.4.3.4	Photographs, Motion Films		Information	As required
3.4.3.5	Monthly Report	Distr. List	Information	Monthly 15 days after end of reporting period
3.4.3.6	Final Report	Distr. List	Information	30 days after end of Phase II
3.4.3.7	Qualification Test Report	5N	Approval	30 days after testing

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APPENDIX I (Cont)

PARAGRAPH	TITLE	KIND & AMOUNT OF COPIES	ACTION	SUBMITTAL DATE
3.4.3.8	Rocket Firing Data	5N	Approval	30 days after firing
3.4.3.9	CPIA Data Sheet	As req'd	Approval	As required

N = non-reproducible

R = reproducible

M = Master

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

MIL-D-23660A(Wep) DATA, TECHNICAL FOR ROCKET MOTORS

ORGANIZATION (of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

 DIRECT GOVERNMENT CONTRACT SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

 YES NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE