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MILITARY STANDARD

MANUFACTURING MANAGEMENT PROGRAM



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MIL-STD-1528A (USAF)

DEPARTMENT OF DEFENSE

Washington DC 20402

Manufacturing Management Program

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1. SCOPE

1.1 Purpose. The purpose of this standard is to prescribe the manufacturing management objectives and requirements which must be met by the contractor's manufacturing management system on any contract which incorporates this standard. The system shall assure effective application of manufacturing management principles and methods to assure efficient manufacture, or preparation for manufacture, of defense acquisition programs hardware. The system shall establish, and assure application through program phases, criteria for capability, capacity, producibility, productivity, manufacturing planning and risk reduction, strategic and critical materials conservation, and surge and mobilization to each aspect of hardware design, procurement, manufacture, and shipment.

1.2 Application. This standard is intended for use during all phases of the acquisition process.

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2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

STANDARDS

MIL-STD-1521 - Technical Reviews and Audits for Systems, Equipment, and Computer Programs.

2.1.2 Other Government documents, drawings and publications. The following other Government documents, drawings and publications form a part of this standard to the extent specified herein.

DOD 4245.7-M - Transition from Development to Production

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

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

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3. DEFINITIONS

The following definitions are in addition to those in the applicable documents listed in paragraph 2 above:

3.1 Critical forms and parts. Materials that represent high availability risks to peacetime production or surge and mobilization requirements. They include semi-processed and finished parts with potential risk to a program due to problems such as long leadtime, foreign source or diminishing domestic manufacturing source.

3.2 Industrial modernization incentives program (IMIP)/(formerly Tech Mod). A joint venture between the Government and industry to reduce weapon system, subsystem, or equipment acquisition costs; and to accelerate the implementation of modern equipment and management techniques in the industrial base. This joint venture is formalized through a contractual agreement providing Government incentives for contractor capital investment beyond that required to meet contractual commitments.

3.3 Limited production. The low rate, initial production of hardware in limited quantity which may be used in operational test and evaluation, for verification of manufacturing engineering adequacy and design maturity, or to establish a production base.

3.4 Manufacturing. The conversion of raw materials into products or components through a series of processes. It includes such major functions as manufacturing planning, tool design, scheduling, manufacturing engineering, material procurement, fabrication, assembly, test, packaging, installation and checkout, product assurance, and determination of resource requirements throughout systems acquisition.

3.5 Manufacturing engineering. That specialty of professional engineering which requires such education and experience as is necessary to understand and apply engineering procedures in manufacturing processes and methods of production of industrial commodities and products, and requires the ability to plan the practices of manufacturing, to research and develop the tools, processes, machines and equipment, and to integrate the facilities and systems for producing quality products with optimal expenditure.

3.6 Manufacturing feasibility and capability assessment. An assessment conducted to identify potential manufacturing constraints and risks and the capability of the contractor to execute the manufacturing efforts.

3.7 Manufacturing management. The techniques of planning, organizing, directing, coordinating, and controlling the use of people, money, materials, equipment, methods and processes, and facilities to manufacture systems.

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3.8 Manufacturing management/production capability review (MM/PCR). The investigation conducted by the Government at prospective contractor facilities during the source selection process. The reviews are conducted to evaluate each competing contractor's capability to meet all immediate and future production requirements of proposed systems by considering the contractor's current and projected business. The review includes an assessment of the potential impact on cost risk due to inadequate manufacturing facilities.

3.9 Manufacturing risk. The risk that a contractor will not be able to manufacture hardware that meet requirements within cost, performance and schedule parameters.

3.10 Manufacturing technology (MANTECH). A program through which contractors develop and carry out new or significantly improved manufacturing systems, processes, techniques, or equipment in support of DOD systems, subsystems, or equipment.

3.11 Industrial mobilization. The transformation of industry from its peacetime activity to the industrial program necessary to support the national military objectives. It includes the mobilization of materials, labor, capital, production facilities, and contributory items and services essential to the industrial program.

3.12 Producibility. Producibility is a design accomplishment that enables manufacturing to repeatably fabricate hardware which satisfies both functional and physical objectives at an optimum cost. Producibility results from a coordinated effort by systems/design engineering and manufacturing/industrial engineering to create functional hardware designs that optimize ease and economy of fabrication, assembly, inspection, test, and acceptance of hardware without sacrificing desired function, performance, or quality. A producible design includes complete design engineering and manufacturing planning consideration for the selection of material, tooling, facilities, capital equipment, test equipment, methods, processes, and personnel to be employed in the production of hardware to that design. Production quantities and rates are critical factors affecting producibility and must be taken into account whenever the producibility of design alternatives is assessed. Effective hardware producibility supports reliability and maintainability requirements and is fundamental to life cycle cost objectives.

3.13 Producibility analysis. The comparison of alternative design materials, processes, and manufacturing techniques to determine the most economical manufacturing processes and materials to produce a product while meeting performance specifications and required production rates.

3.14 Producibility engineering and planning. The engineering and production planning measures undertaken to ensure a timely transition from concept exploration to low risk, economical production.

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3.15 Production readiness. The degree to which a hardware program is ready to proceed into production. A hardware program is ready for production when a producible design is complete and the managerial and physical preparations necessary for initiating and sustaining a practical manufacturing effort allow a production commitment to be made without causing unacceptable risks of impact to schedule, performance, cost, quality, reliability, maintainability, or other established thresholds.

3.16 Production readiness review (PRR). A formal examination of a program to determine if the design is ready for manufacturing, if manufacturing engineering problems have been resolved, and if the contractor has adequately planned for the production phase. The review may be conducted incrementally.

3.17 Strategic and critical materials. Materials that would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and are not found or produced in the United States in sufficient quantities to meet such need. These materials are carried in the National Defense Stockpile. Strategic and critical materials include any raw material in short supply, limited domestic production or otherwise posing a risk to a production program.

3.18 Surge. The accelerated manufacturing of selected items with existing facilities and equipment in a peacetime environment (no declared national emergency).

3.19 Surge or mobilization rate. The number of systems over time that would be required to meet accelerated requirements under surge or mobilization conditions. This rate must be provided by the government to the contractor.

3.20 Work measurement. A system of collecting data on work hours and manufactured units to determine the relationship between standard hour content of work performed and actual work hours expended.

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4. GENERAL REQUIREMENTS

4.1 Manufacturing management program. The contractor shall establish and maintain an effective manufacturing management program which complies with the requirements of this standard. Application of these requirements shall continue through each hardware acquisition phase. The program shall provide for timely identification of process improvements, and for detailed planning and control of manufacturing functions and for timely and effective transition to rate production as outlined in DOD 4245.7-M. The program shall be subject to review by the government, and may be disapproved at any time if it does not meet the requirements of this standard. The contractor shall afford Government personnel access to his technical personnel, production data and documentation to support review efforts.

4.1.1 Manufacturing management policy. The contractor shall prescribe in a documented management system how, when, and by whom each requirement of this standard is to be accomplished. The management system shall clearly indicate the authority and responsibility for each element of the manufacturing management system. No single contractor organizational element is required to be responsible for fulfilling the requirements of this standard. However, organizational structure must provide independence of manufacturing management from direction by other functional elements. Coordination between organizational elements responsible for manufacturing management and other organizational elements (i.e., program management, system or design engineering, contracts, finance, etc.) shall be prescribed in the procedures directing those other elements as well as in manufacturing management procedures.

4.1.2 Manufacturing management policy objectives. The objectives of the manufacturing management program shall be to:

- a. Establish and maintain a manufacturing system which provides efficient and effective manufacture of quality hardware.
- b. Increase productivity and reduce production unit cost.
- c. Identify and reduce the impact of critical and strategic materials on the program.
- d. Identify and reduce manufacturing risk.
- e. Plan according to a consistent manufacturing strategy incorporating these principles.

4.1.3 Manufacturing management controls. The management system shall provide for contractor audit performed at least annually to verify compliance with each requirement of this standard in accordance with the contractor procedures defining the contractor's manufacturing management system.

4.1.4 Manufacturing management procedures and practices. The contractor's manufacturing management procedures and practices shall prescribe, define, and specify controls over all actions required by this standard.

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5. DETAILED REQUIREMENTS

5.1 Manufacturing program planning. The manufacturing management program shall assure thorough planning for manufacture of the hardware to be produced. The planning process shall be documented sufficiently to provide for review and traceability and shall be applied iteratively throughout the life of the program. The process shall incorporate development of a program manufacturing strategy to minimize risk. The result shall be effective management of all aspects of the manufacturing process. DID DI-MISC-80074, Manufacturing Plan, applies to these requirements. Deliverable data identified on the DD Form 1423 shall be prepared in accordance with instructions specified in that DID.

5.1.1 Manufacturing planning. Manufacturing planning shall be accomplished throughout all program phases. The process must be a logical, planned sequence of activities resulting in identifying and obtaining production resources needed for efficient production. The planning process shall consider all aspects of manufacturing engineering, manufacturing methods, production and material control, minimization of scrap, rework and repair, and the requirements for facilities, materials, tooling, test equipment, equipment, personnel, training, government furnished property, and software. Effects of other business on resources shall be assessed.

5.1.2 Manufacturing risk identification and resolution. Manufacturing planning during all program phases shall assure continuing identification and evaluation of manufacturing risk, provide for timely resolution of risks, and identify requirements which must be accomplished in later acquisition phases. Documented risk identification and resolution shall continue throughout all program phases and include: monthly manufacturing trends during development and production, process and test yield rates, touch labor hours, hours for scrap, rework, repair, and out-of-station work, as well as other risk areas contained in DOD 4245.7-M.

5.1.3 Capital commitment identification. The contractor shall document future capital commitments necessary to effectively transition from the development to the production phase.

5.1.4 Production tooling and test equipment. The contractor shall establish criteria and implement actions necessary for the timely selection, acquisition, and use of tooling and test equipment to minimize impacts on production. Tooling philosophy and concepts shall be thoroughly defined during program demonstration and validation phases with consideration given to minimization of life cycle costs.

5.1.5 Manufacturing system verification. The manufacturing engineering approach, processes, tooling, test equipment, manufacturing and test software, and manufacturing methods with which significant risk is associated or which have not been previously proved satisfactory by production experience, shall be verified by testing, proofing, or demonstration, not later than the full-scale development phase of the program.

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5.1.6 Integrated factory planning. The contractor shall accomplish integrated factory planning which considers specific factory manufacturing requirements against a comprehensive business base forecast. This planning will include an annual productivity improvement goal and manufacturing technologies which could be implemented to achieve that goal.

5.1.7 Make-or-buy. The contractor shall perform make-or-buy analysis in accordance with solicitation requirements. Manufacturing personnel shall participate in the reviews to make sure manufacturing issues are considered, and that economical, low-risk sources of production are chosen. Second sourcing shall be considered for product-critical items.

5.1.8 Industrial material management.

5.1.8.1 Critical forms and parts. The contractor shall identify all critical forms and parts used, or planned to be used, in the system, and shall document them in accordance with requirements specified in the contract. For foreign supplied parts and components, the contractor shall develop realistic and practical plans and procedures for securing adequate supplies for surge and mobilization needs under war and contingency conditions.

5.1.8.2 Strategic and critical materials. The contractor shall identify all strategic and critical materials used, or planned to be used, in the system. The contractor shall develop realistic and practical plans and procedures to conserve strategic and critical materials, apply manufacturing procedures to minimize waste and scrap, and employ reclamation procedures.

5.1.8.3 Diminishing manufacturing sources and material shortages (DMSMS). The contractor shall regularly check the Government-Industry Data Exchange Program (GIDEP) data base for DMSMS items, during design, development, and production phases, and shall determine if any of these items are used in, or planned for use in the system. The contractor shall seek to develop or qualify alternate sources for DMSMS items. As a last resort, contractors shall utilize engineering change procedures.

5.1.9 Facilities. The contractor shall determine the facilities and energy requirements to support manufacturing requirements and plan for the effective and economical use of both contractor and government provided facilities. The latest state-of-the-art manufacturing technology shall be considered. The plant layout should be such that efficient and effective use is made of the contractor's facilities to store, move, manufacture, and support production.

5.1.10 Peacetime capacity, surge and mobilization. The contractor, when identified as a planned producer, shall perform industrial planning that compares total production capacity with requirements for peacetime, surge, and mobilization conditions. Planning shall consider the priorities and production implications of programs at the facilities being used. In addition, the planning shall identify shortfalls and feasible corrective actions. In order to ascertain production capability to meet contractual obligations, the contractor shall utilize peacetime production rates, including options, on all in-house DOD programs. For surge and mobilization, the contractor shall plan to have sufficient capacity available to meet the Government provided requirements.

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5.2 Design analysis for manufacturing. The contractor's manufacturing management program shall provide for design analysis resulting in a design which will be manufactured efficiently. Design review shall assure consideration of the objectives of manufacturing management with other design tradeoffs as required by MIL-STD-1521. The following elements shall be incorporated in the review process.

5.2.1 Producibility analysis. The contractor shall develop a comprehensive, well-defined producibility analysis effort as a prerequisite to entering FSD. The contractor shall develop a producibility element of his manufacturing plans, which:

- a. delineates the responsibilities of all disciplines and functions involved in producibility analysis.
- b. provides procedures and criteria for selecting candidate items for producibility analysis.
- c. prescribes techniques for producibility analyses.
- d. identifies criteria used in producibility analysis.

Adequate producibility of the design shall be addressed at system requirements review, system design review, preliminary design review, critical design review and production readiness review. The full-scale development phase shall include provisions to attain producibility of the design using cost-effective manufacturing methods and processes. Resource requirements for producibility analysis, long lead procurements and limited production shall be identified and programmed. The contractor shall confirm the capability to meet production unit cost, schedule and surge goals through an industrial resource analysis at the prime major/critical subcontract locations. Included in this analysis shall be the impact of ongoing manufacturing technology, producibility and industrial modernization incentives programs. Producibility efforts shall continue through the production phase.

5.2.2 Producibility criteria. Producibility criteria based on all design characteristics shall be developed and documented during the earliest program phase, and shall be updated iteratively as the design is developed. Design conformance with the criteria shall be addressed in the manufacturing feasibility and capability assessments at each major design review.

5.2.3 Design analysis. Manufacturing, process and method analysis of each major element of the design shall be conducted during the design process. Analysis shall be documented and traceable. This analysis shall consider surge and mobilization support needs and shall address:

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- a. Material selection: critical and strategic material conservation, avoidance of dependence on foreign sources, constraints on surge and mobilization responsiveness, and standardization of materials and components, and material lead time.
- b. Production tooling, special tooling and test equipment concepts.
- c. New or unique processes.
- d. Sequencing of assembly events, ease of assembly.
- e. Test and inspection instrumentation concepts.
- f. Manufacturing and test software.
- g. Tooling and facility utilization.
- h. Work methods to be used in rate production.
- i. Production quantity and rate.
- j. Process yield and stability and the impact of process variability on product quality.

This analysis will be submitted as specified in the contract prior to each formal design review. Analysis shall identify the most economical ways to manufacture the product at the required rate, and shall indicate capability and capacity factors related to the design.

5.2.4 Manufacturing Integration in the Design Process. Manufacturing engineering shall be integrated into the contractor's system engineering (design management) system. Manufacturing engineering shall have a formal, traceable part in the engineering decisions-making process relating to hardware design, and shall act as the formal manufacturing management interface with the system engineering entity. System engineering practice shall assure application of producibility criteria developed as part of the manufacturing feasibility and capability estimate. Factors listed in paragraph 5.2.3 shall be applied iteratively during design development as an element of the manufacturing engineering contribution to the system engineering process.

5.2.5 State-of-the-Art Reviews. The contractor shall perform periodic analyses of the manufacturing methods, processes, techniques, equipment, and materials planned for use in production. This may be accomplished by reviewing state-of-the-art advances in manufacturing technology with the Manufacturing Technology Division of the Air Force Materials Laboratory, Wright-Patterson AFB OH 45433, to encourage the use of the latest and most efficient manufacturing technology. Information available from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria VA 22314, and commercial sources should be considered as well.

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5.3 Manufacturing Operations Management.

5.3.1 Production Scheduling and Control. The contractor shall establish a production scheduling and control system which:

- a. Schedules all planned production activities.
- b. Identifies key production milestones required to attain production goals.
- c. Assesses and determines production lead time requirements for both contractor and Government furnished materials.
- d. Conducts and applies analyses required for economical lot release and economical order quantities.
- e. Tracks components and assemblies throughout the production cycle to assure production schedules are attained.
- f. Provides inputs to engineering change management relative to effectiveness for production incorporation.
- g. Assures engineering change incorporation is accomplished.

5.3.2 Work Measurement System. The government shall have full access to the documentation, data and reports generated by any contractor work measurement system.

5.3.3 Manufacturing Surveillance. The contractor shall maintain an effective, timely, and responsive manufacturing surveillance operation which:

a. Identifies factors which may adversely impact product quality, delivery, performance, or cost. The manufacturing surveillance system shall collect and analyze data of the following types or from the following sources as minimum:

- (1) Yield rates for manufacturing processes.
- (2) Yield rates for test operations at all levels of fabrication and assembly.
- (3) Scrap data.
- (4) Rework data, including data on out-of-station work.

Additional indicators should be selected to reflect the health of the entire manufacturing management program. Data shall be collected and used to identify problem areas and be in sufficient detail to permit effective investigation and corrective action. The system shall provide for documented traceability from data through analysis to corrective action, and shall provide for verification of corrective action implementation and effectiveness.

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b. Notifies the Government Contract Administration Services representative of anticipated contract delivery schedule delinquencies, production difficulties or delays which may adversely impact the program.

5.3.4 Control of subcontractors and vendors. The contractor's procedures to provide continuous management visibility and control of subcontractors, vendors and suppliers shall assure that requirements paragraphs 5.1.8, 5.2, and 5.3 of this standard are flowed down and effectively implemented. These procedures shall specify contractor review of subcontractor manufacturing management plans, systems, and production facilities to assure visibility of producibility problems, identification and resolution of production risk, production program surveillance, and timely reporting of production difficulties which would impact the program. Routine use of contractor manufacturing organization specialized disciplines to assist in the selection and management of subcontractors, vendors, and suppliers is necessary to perform this requirement. Government representatives may attend these reviews as observers. Order status of long lead or critical items shall be reviewed on a recurring basis. The contractor shall assure that subcontractors and vendors initiate timely Requests for Special Priorities Assistance, as appropriate.

5.4 Government reviews.

5.4.1 Manufacturing management/production capability review (MM/PCR). MM/PCR may be conducted before contract award for the program phase during which the production design is finalized, and before any production commitment. Solicitation instructions will contain MM/PCR requirements if the review is to be conducted as a part of contract source selection. The contractor shall provide necessary facilities and cooperate with the government team in their review.

5.4.2 Production readiness review (PRR). The government has the option to perform PRR(s), prior to the production decision or as otherwise specified in the contract. PRRs may be conducted incrementally. The review is conducted to determine that significant manufacturing problems have been resolved, or that a plan for their resolution acceptable to the government has been developed. The contractor shall provide necessary resources to support the PRR. Contractors conducting PRRs at subcontractor facilities will afford government representatives the opportunity to attend as observers. Prime contractors are responsible for assuring government program management that subcontractors are satisfactorily preparing for production whether formal subcontractor PRRs are held or not.

5.5 Manufacturing feasibility and capability assessments. The contractor shall make and formally document a manufacturing feasibility and capability assessment(s) in the conceptual phase, concurrently with the overall program feasibility and risk analysis. Assessments shall be made for each competing design alternative under consideration at the time of the assessment. Manufacturing feasibility and capacity assessment(s) shall analyze manufacturing resources needed. The assessments shall meet MIL-STD-1521 requirements as applicable, and shall:

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- a. Identify required production processes and manufacturing techniques not currently available, and the risks associated with advance development, the probability of meeting the need date, and possible contingency actions.
- b. Identify potential impact of critical and long lead time material and production equipment, the probability of meeting the need date, and possible contingency action.
- c. Provide production feasibility, cost, and schedule impact analyses to support trade-offs among alternatives.
- d. Provide cost and production schedule estimates to support management reviews.
- e. Determine an efficient rate of production and rate acceleration curve (preliminary during the demonstration and validation phase; final during FSD).
- f. Make recommendations for anticipated production testing and demonstration efforts--including specific requirements for production run demonstration using production tooling, test equipment, and manufacturing equipment.
- g. Develop methods of conserving critical and strategic materials and of reducing reliance on foreign sources.
- h. Identify potential production bottlenecks and limiting factors to rate production.
- i. Be documented and reported in accordance with provisions of MIL-STD-1521. DID DI-A-7089, Conference Minutes, applies to these requirements. Deliverable data identified on the DD Form 1423 shall be prepared in accordance with instructions specified in that DID.

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6. NOTES

6.1 Intended Use. This document is written to facilitate a tailored application, dependent on the phase of the acquisition process and other program specific information. The procuring activity will place on contract only those tasks necessary to accomplish program objectives.

6.2 Data requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below, shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. Whenever provisions of the DOD FAR Supplement, Part 27, Sub-Part 27.410-6 are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard is cited in the following paragraphs.

Paragraph No.	Data Requirement Title	Applicable DID No.	Opti
5.1	Manufacturing Plan	DI-MISC-80074	---
5.5	Conference Minutes	DI-A-7089	---

6.3 Subject term (key work) listing.

Critical forms and parts
 Industrial mobilization
 Industrial modernization incentives program (IMIP)
 Manufacturing
 Manufacturing engineering
 Manufacturing feasibility and capability assessment
 Manufacturing management
 Manufacturing management/production capability review (MM/PCR)
 Manufacturing risk
 Manufacturing technology (MANTECH)
 Producibility
 Producibility analysis
 Producibility engineering and planning
 Production readiness
 Production readiness review (PRR)
 Strategic and critical materials
 Surge
 Surge or mobilization rate
 Work measurement

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Custodian:
Air Force - 10

Preparing Activity:
Air Force - 10

Review activities:

Air Force - 01, 11, 13, 14, 15, 18, 19, 20, 26, 71, 99

User activities:

Air Force - 01, 11, 12, 13, 14, 15, 18, 19, 20, 68, 70, 71, 79, 80, 82, 84

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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(See Instructions - Reverse Side)

1. DOCUMENT NUMBER
MIL-STD-1528A

2. DOCUMENT TITLE
Manufacturing Management Program

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

VENDOR

USER

MANUFACTURER

OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

8. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

9. DATE OF SUBMISSION (YYMMDD)

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