DEPARTMENT OF THE ARMY
U.S. ARMY BELVOIR RESEARCH,
DEVELOPMENT AND ENGINEERING CENTER

PRODUCIBILITY ENGINEERING

STANDARD PRACTICE MANUAL

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Belvoir RD&E Center
U.S. ARMY
ATCOM

FORT BELVOIR, VIRGINIA

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FOREWORD

The U.S. Army Belvoir Research, Development and Engineering Center (BRDEC) Producibility Engineering Standard Practice Manual is for use in the preparation, acceptance, and maintenance of Technical Data Packages (TDPs) that are to be utilized for competitive procurement of military materiel. This manual is intended for use as guidance in the interpretation of the contract requirements for engineering drawings during the preparation of TDPs, by both Government and Industry. In itself, the manual is not intended to be cited as a contract requirements document.

This update includes major changes in Section V, Producibility Engineering and Planning (PEP), which now contains a suggested PEP Statement of Work (SOW) that may be tailored and incorporated into development contract requirements; and in Section II, Belvoir Technical Data Management, which now contains Engineering Release Record (ERR) requirements that have been changed to incorporate the TDP Certification into the ERR, which is used to identify and release engineering documentation to establish or change a configuration baseline.

Emphasis is placed upon the concurrent application and integration of the traditional specialty engineering disciplines during the design process to achieve producibility. You are encouraged to follow these practices, and in the spirit of Total Quality Management (TQM) improve them through your knowledge and experience, and refine them with your comments and suggestions. The soldier in the field deserves our best efforts in the development of this Center's most important product, which is the TDP that is used in competitive procurement to produce the materiel upon which the soldier depends.

Dennis C. Cochrane
Colonel, EN
Commanding
U.S. Army Belvoir Research, Development
and Engineering Center

Comments and recommendations for changes, additions, or deletions should be forwarded to the Commander, U.S. Army Belvoir Research, Development and Engineering Center, Attn: SATBE-TS, Fort Belvoir, Virginia 22060.

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Implementation Instructions 1, 7, 9, and 10 contain the mandatory requirements for contractors when they are made a part of the contract.

LIST OF REFERENCE DOCUMENTS

CODE OF FEDERAL REGULATIONS (CFR)

Title 21	Food and Drugs
Title 29	Labor
Title 40	Protection of Environment
Title 46	Shipping
Title 49	Transportation

FEDERAL ACQUISITION REGULATION (FAR)

FAR Part 9	Contractor Qualifications, Subpart 9.2, Qualification Requirements
FAR Part 10	Specifications, Standards, and Other Purchase Descriptions
FAR Part 10	Paragraph 10.004, Selecting Specifications or Descriptions for Use
FAR Part 27	Patents, Data, and Copyrights
FAR Part 48	Value Engineering

DEFENSE FEDERAL ACQUISITION REGULATION SUPPLEMENT (DFARS)

DFARS Appendix E	DOD Spare Parts Breakout Program

DEPARTMENT OF DEFENSE

DOD SD-6	Provisions Governing Qualifications (Qualified Products Lists)
DOD 4120.3M	Defense Standardization and Specification Program Policies, Procedures and Instructions
DOD 4121.3M	Qualified Products Lists (QPLs)
DOD 4140.26M - Vol I	Defense Integrated Material Management Manual for Consumable Item Vol I Commodity Oriented Item
DODI 4200.15	Manufacturing Technology Program
DOD 4245.7M	Transition From Development to Production
DODD 5000.1	Defense Acquisition

LIST OF REFERENCE DOCUMENTS (Continued)

DODI 5000.2	Defense Acquisition Management Policies and Procedures
Part 2	General Policies and Procedures
Part 3	Acquisition Process and Procedures
Part 5	Acquisition Planning and Risk Management Section A, Acquisition Strategy Section E, Industrial Base
Part 6	Engineering and Manufacturing Section A, Systems Engineering Section C, Reliability and Maintainability Section D, Computer Resources Section E, Transportability Section H, Human Factors Section I, System Safety, Health Hazards and Environmental Impact Section K, Design To Cost Section L, Nondevelopmental Items Section M, Use of the Metric System Section N, Computer Aided Acquisition and Logistics Support Section O, Design for Manufacturing and Production Section Q, DOD Standardization Program Section R, DOD Parts Control Program
Part 7	Logistics and Other Infrastructure
Part 9	Configuration and Data Management Section A, Configuration Management
DOD 5000.2-M	Defense Acquisition Management Documentation and Reports
DOD 5000.37M	Commercial and Nondevelopmental Item (NDI) Handbook
DOD 5010.12L	Acquisition Management System and Data Requirements Control List (AMSDL)

Defense Systems Management College, Ft. Belvoir, VA

Systems Engineering Management Guide

STANDARDS

Federal

FED-STD-66	Steel: Chemical Composition and Hardenability
FED-STD-151	Metals; Test Methods

LIST OF REFERENCE DOCUMENTS (Continued)

DOD and Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-171	Finishing of Metal and Wood Surfaces
MIL-STD-195	Marking of Connections for Electrical Assemblies
MIL-STD-210	Climatic Information To Determine Design and Test Requirements For Military Systems and Equipment
MIL-STD-337	Design To Cost
MIL-STD-410	Non-Destructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant, Magnetic Particle, Radiographic, and Ultrasonic)
MIL-STD-453	Inspection, Radiographic
MIL-STD-454	Standard General Requirement for Electronic Equipment
MIL-STD-470	Maintainability Program For Systems and Equipment
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-490	Specification Practices
MIL-STD-499	Engineering Management
MIL-STD-645	Dip Brazing of Aluminum Alloys
MIL-STD-681	Identification Coding and Application of Hookup and Lead Wire
MIL-STD-690	Failure Rate Sampling Plans and Procedures
MIL-STD-721	Definition of Terms for Reliability and Maintainability
MIL-STD-756	Reliability Modeling and Prediction
MIL-STD-781	Reliability Testing For Engineering Development, Qualification and Production
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production

LIST OF REFERENCE DOCUMENTS (Continued)

MIL-STD-790	Reliability Assurance Program for Electronic Parts Specifications
MIL-STD-882	System Safety Program Requirements
MIL-STD-889	Dissimilar Metals
MIL-STD-961	Preparation of Military Specifications and Associated Documents
MIL-STD-965	Parts Control Program
MIL-STD-970	Standards and Specifications, Order of Preference For the Selection of
MIL-STD-973	Configuration Management
MIL-STD-1261	Arc Welding Procedures for Constructional Steels
MIL-STD-1264	Radiographic Inspection for Soundness of Welds in Steel by Comparison to Graded ASTM E390 Reference Radiographs
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1388-1A	Logistic Support Analysis
MIL-STD-1388-2A	Logistics Support Analysis Record, DOD Requirements for a
MIL-STD-1467	Software Support Environment
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
MIL-STD-1474	Noise Limits for Military Materiel
MIL-STD-1521	Technical Reviews and Audits For Systems, Equipment, and Computer Software
MIL-STD-1528	Manufacturing Management Program
MIL-STD-1595	Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-STD-1771	Value Engineering Program Requirements
MIL-STD-1806	Marking Technical Data Prepared By or For The Department of Defense
DOD-STD-1866	Soldering Process, General (Non-Electrical)
MIL-STD-1875	Ultrasonic Inspection, Requirements for

LIST OF REFERENCE DOCUMENTS (Continued)

MIL-STD-1949	Inspection, Magnetic Particle
MIL-STD-2000	Standard Requirements For Soldered Electrical and Electronic Assemblies
MIL-STD-2101	Classification of Characteristics
MIL-STD-2167	Defense System Software Development
MIL-STD-2168	Defense Systems Software Quality Program
MIL-STD-6866	Inspection, Liquid Penetrant
MIL-STD-45662	Calibration System Requirements

SPECIFICATIONS

Federal

TT-L-26	Lacquer (Brushing, Clear and Pigmented for Exterior and Interior Use)
A-A-208	Ink, Marking, Stencil, Opaque (Porous and Non-porous Surfaces)
GG-P-455	Plates and Foils, Photographic (Photosensitive Anodized Aluminum)

DOD and Military

MIL-P-514	Plates, Identification, Instruction and Marking, Blank
MIL-T-704	Treatment and Painting of Materiel
DOD-D-1000	Drawings, Engineering and Associated Lists
MIL-E-2036	Enclosures for Electric and Electronic Equipment
MIL-D-5480	Data, Engineering and Technical, Reproduction Requirements for
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-H-6875	Heat Treatment of Steel, Process for
MIL-H-7199	Heat Treatment of Wrought Copper-Beryllium Alloys, Process for (Copper Alloys: Numbers 170, 172, 175)
MIL-Q-9858	Quality Program Requirements
MIL-P-11268	Parts, Materials, and Processes Used in Electronic Equipment

LIST OF REFERENCE DOCUMENTS (Continued)

MIL-R-11470	Radiographic Inspection, Qualifications of Equipment, Operators and Procedures
MIL-M-13231	Marking of Electronic Items
MIL-P-19834	Plates, Identification or Instruction, Metal Foil, Adhesive Backed, General Specification for
MIL-T-31000	Technical Data Packages, General Specification for
MIL-I-45208	Inspection System Requirements
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities

HANDBOOKS

Federal

FED HDBK H6	Federal Item Name Directory for Supply Cataloging

Military

MIL-HDBK-59	Computer-Aided Acquisition and Logistic Support (CALS) Program Implementation Guide
MIL-HDBK-H108	Sampling Procedures and Tables for Life and Reliability Testing (Based on Exponential Distribution)
MIL-HDBK-115	U.S. Army Reverse Engineering Handbook (Guidelines and Procedures)
MIL-HDBK-132	Protective Finishes for Metal and Wood Surfaces
MIL-HDBK-139	Plastic, Processing of
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-288	Review and Acceptance of Engineering Drawing Packages
MIL-HDBK-472	Maintainability Predictions
MIL-HDBK-691	Adhesive Bonding
MIL-HDBK-727	Design Guidance for Producibility
DOD-HDBK-763	Human Engineering Procedures Guide

LIST OF REFERENCE DOCUMENTS (Continued)

MIL-HDBK-780	Standardized Military Drawings
DOD-HDBK-4245.8H	Value Engineering

OTHER GOVERNMENT AGENCIES

U.S. Army

AR 40-5	Preventive Medicine
AR 40-46	Control of Health Hazards to Health from Laser and Other High Intensity Optical Sources
AR 40-583	Control of Potential Hazards to Health from Microwave and Radio Frequency Radiation
AR 70-1	Army Acquisition Policy
AR 385-9	Requirements for Military Lasers
AR 385-16	System Safety Engineering and Management
AR 385-64	Ammunition and Explosive Safety Standards
AR 700-127	Integrated Logistic Support (ILS)
AR 750-1	Army Materiel Maintenance Concepts and Policies
DA PAM 5-4-5	Value Engineering Handbook
DA PAM 70-XX	Materiel Acquisition Handbook
DA PAM 700-28	ILS Program Assessment Issues and Criteria
DA PAM 700-127	Integrated Logistic Support (ILS) Manager's Guide
DA PAM 738-750	The Army Maintenance Management System

U.S. Army Materiel Command

DARCOM HDBK 700-2.1	Logistic Support Analysis
AMC R 700-15	Integrated Logistic Support
AMCP 700-4	LSA Technique Guide
AMCP 700-11	LSA Review Team Guide
AMCP 700-22	LSA Primer

LIST OF REFERENCE DOCUMENTS (Continued)

AMCP 702-3	Quality Assurance Reliability Handbook
AMCP 706-133	Maintainability Engineering Theory and Practice
AMCP 706-134	Maintainability Guide for Design
AMCP 706-196	Design Guide for Reliability, Part Two
AMCP 706-197	Design Guide for Reliability, Part Three
AMCP 706-198	Design Guide for Reliability, Part Four
AMCP 706-200	Design Guide for Reliability, Part Six

U.S. Army Test and Evaluation Command

TOP 1-2-610	Human Factors Engineering Part I: Test Procedures
TOP 1-2-610	Human Factors Engineering Part II: Human Engineering Data Guide For Evaluation (HEDGE)

U.S. Army Belvoir RD&E Center

Standardization Document Preparation Guide (SDPG)

HDBK 70-1	Vol I, Planning and Structuring Programs
HDBK 70-1	Vol II, Contracting Strategies
HDBK 70-1	Vol III, Implementing MANPRINT
HDBK 70-3	Total Life Cycle Competition Strategy
HDBK Report 2431	Contracting for Computer Software Development
SOP 10-1	Organization Mission and Function Manual
SOP 70-8	Value Engineering Program
SOP 70-15	Producibility Engineering and Planning (PEP)/Production Engineering (PE)
SOP 70-18	Human Factors Engineering
SOP 70-37	Configuration Management
SOP 385-16	Safety for Systems

LIST OF REFERENCE DOCUMENTS (Continued)

SOP 700-2	Parts Control Program
SOP 700-3	Spare Parts Program
SOP 702-6	Product Assurance, Quality Assurance Program

U.S. Air Force, Rome Air Development Center

RADC-TR-75-22	Non-Electronic Reliability Notebook

U.S. Navy

NAVSO P-6071	Best Practices

National Institute of Standards and Technology
(formerly National Bureau of Standards)

Monograph 88	Heat Treatment and Properties of Iron and Steel

NON-GOVERNMENT ORGANIZATIONS

Aluminum Association (AA)

Aluminum Standards and Data

American National Standards Institute (ANSI)

ANSI B4.1	Preferred Limits and Fits for Cylindrical Parts for English Units
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B46.1	Surface Texture
ANSI Y14.1	Drawing Sheet Size and Format
ANSI Y14.5M	Dimensioning and Tolerancing
ANSI/ASME Y14.24M	Types and Applications of Engineering Drawings
ANSI Y14.31	Undimensioned Drawings
ANSI/ASME Y14.34M	Associated Lists
ANSI/AWS A2.4	Symbols for Welding and Nondestructive Testing

American Society for Metals (ASM)

ASM	Metals Handbook

LIST OF REFERENCE DOCUMENTS (Continued)

American Society of Mechanical Engineers (ASME)

ASME	Boiler and Pressure Vessel Code, Section IX, Welder Qualifications
ASME/ANSI Y14.24M	Types and Applications of Engineering Drawings
ASME/ANSI Y14.34M	Associated Lists

American Society For Testing and Materials (ASTM)

ASTM E94	Guide For Radiographic Testing
ASTM E142	Method For Controlling Quality of Radiographic Testing
ASTM E164	Practice For Ultrasonic Contact Examination of Weldments
ASTM E165	Practice For Liquid Penetrant Inspection Method
ASTM E273	Practice For Ultrasonic Examination of Longitudinal Welded Pipe and Tubing
ASTM E390	Reference Radiographs For Steel Fusion Welds
ASTM E709	Practice For Magnetic Particle Examination
ASTM E1032	Method For Radiographic Examination of Weldments

American Welding Society (AWS)

AWS/ANSI A2.4	Symbols for Welding and Nondestructive Testing
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.3	Structural Welding Code - Sheet Steel
AWS D14.3	Welding Earthmoving and Construction Equipment, Specification for

International Organization For Standardization (ISO)

ISO R468	Surface Roughness
ISO R1051	Rivet Shank Diameters
ISO R1938	System of Limits and Fits for Metric Units
ISO 8402	Quality - Vocabulary

LIST OF REFERENCE DOCUMENTS (Continued)

ISO 9000	Quality Management and Quality Assurance Standards - Guidelines for Selection and Use
ISO 9001	Quality Systems - Model for Quality Assurance in Design/ Development, Production, Installation and Servicing
ISO 9002	Quality Systems - Model for Quality Assurance in Production and Installation
ISO 9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test
ISO 9004	Quality Management and Quality System Elements - Guidelines

LIST OF ACRONYMS

A

AA	Aluminum Association
ADP	Automated Data Processing
ALDT	Administrative and Logistic Down Time
AMC	Army Materiel Command
AMCP	Army Materiel Command Pamphlet
AMCR	Army Materiel Command Regulation
AMSDL	Acquisition Management System and Data Requirements Control List
ANSI	American National Standards Institute
AR	Army Regulation
AS	Acquisition Strategy
ASM	American Society of Metals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATCOM	Aviation and Troop Command
AWS	American Welding Society

B

BRDEC	Belvoir Research, Development and Engineering Center

C

CAD	Computer Aided Design
CAGE	Commercial and Government Entity (formerly FSCM)
CALS	Computer Aided Acquisition and Logistic Support
CARC	Chemical Agent Resistant Coating
CCB	Configuration Control Board
CDRL	Contract Data Requirements List
CFR	Code of Federal Regulations
CI	Confidence Indicator and Configuration Item
CICS	Customer Information Control System
CIE	Commercial Inspection Equipment
CM	Configuration Management and Corrective Maintenance
COML	Commercial-Off-The-Shelf
CPP	Camouflage Pattern Painting
CRISD	Computer Resources Integrated Support Document
CSCI	Computer Software Configuration Items
CSDM	Computer System Diagnostic Manual
CSOM	Computer System Operator's Manual

D

DBDD	Data Base Design Document
DID	Data Item Description
DL	Data List
DOD	Department of Defense

LIST OF ACRONYMS (Continued)

D (Continued)

DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DSREDS	Digital Storage and Retrieval Engineering Data System
DT/OT	Development Testing/Operational Testing

E

ECP	Engineering Change Proposal
EDCARS	Engineering Data Computer Assisted Retrieval System
EDM	Engineering Data Management
EDMICS	Engineering Data Management Information Control System
EDMT	Engineering Data Management Team
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERR	Engineering Release Record

F

FAR	Federal Acquisition Regulations
FAST	Functional Analysis System Technique
FCA	Functional Configuration Audit
FSC	Federal Supply Classification
FSCM	Federal Supply Classification Manufacturer (see CAGE)
FSM	Firmware Support Manual

G

GFB	Government Furnished Baseline
GFP	Government Furnished Property
GIDEP	Government-Industry Data Exchange Program

H

HEDGE	Human Engineering Data Guide For Evaluation
HEL	Human Engineering Laboratory
HFE	Human Factors Engineering

I

IDD	Interface Design Document
IFB	Invitation For Bid
IL	Index List
ILS	Integrated Logistics Support
IMW	Image Management Workstation
IPR	In-Process Review

LIST OF ACRONYMS (Continued)

I (Continued)

IRS	Interface Requirements Specification
ISO	International Organization For Standardization

J

J-SIIDS	Joint-Services Interior Intrusion Detection System

K - None

L

LLCSC	Lower Level Computer Software Component
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Record
LRIP	Low Rate Initial Production

M

MAC	Maintenance Allocation Chart
MACI	Military Adaptation of a Commercial Item (see NDI)
MC	Materiel Change (formerly PIP)
MDT	Mean Down Time
MIG	Metal Inert Gas
MIRF	Major Item Requirement Forecast
MMT	Manufacturing Methods and Technology
MPCAG	Military Parts Control Advisory Group
MR	Maintenance Ratio
MSC	Major Subordinate Command
MTBF	Mean-Time-Between-Failures
MTBMA	Mean-Time-Between-Maintenance-Actions
MTD	Manufacturing Technology Development
MTTR	Mean-Time-To-Repair

N

NBS	National Bureau of Standards (see NIST)
NDI	Nondevelopmental Item
NIST	National Institute of Standards and Technology (formerly NBS)
NOR	Notice of Revision
NSN	National Stock Number

O

OCD	Operational Concept Document
ORD	Operational Requirements Document (formerly ROC)
OSHA	Occupational Safety and Health Administration
OT	Operating Time and Operational Testing

LIST OF ACRONYMS (Continued)

P

PCA	Physical Configuration Audit
PCP	Parts Control Program
PD	Purchase Description
PDP	Product Drawing Package
PE	Production Engineering
PEP	Producibility Engineering and Planning
PET	Producibility Engineering Team
PIP	Product Improvement Program (see MC)
PL	Parts List
PM	Preventive Maintenance
PMS	Program Management System
PMW	Program Managers Workstation
POC	Point of Contact
P3I	Preplanned Product Improvement
PPE	Preproduction Evaluation
PPSL	Program Part Selection List
PRR	Production Readiness Review
PWD	Procurement Work Directive

Q

QAP	Quality Assurance Provisions
QEB	Quality Engineering Branch
QEPL	Quality Engineering Planning List
QPL	Qualified Products List

R

RE	Reverse Engineering
RFD	Request For Deviation
RFP	Request For Proposal
RFW	Request For Waiver
ROC	Required Operational Capability (see ORD)

S

SCMP	Software Configuration Management Plan
SCN	Specification Change Notice
SDDD	Software Detail Design Document
SDP	Software Development Plan
SDPG	Standardization Document Preparation Guide
SEDT	Standardization and Engineering Data Team
SIE	Special Inspection Equipment
SIRF	Secondary Item Requirement Forecast
SMD	Standardized Military Drawing
SOW	Statement of Work

LIST OF ACRONYMS (Continued)

S (Continued)

SPM	Software Programmer's Manual
SPP	Spare Parts Program
SPRINT	Spare Parts Review Initiatives
SPS	Software Product Specification
SQEP	Software Quality Evaluation Plan
SRS	Software Requirements Specification
SSN	Standard Study Number
SSPM	Software Standards and Procedures Manual
SSS	System/Segment Specification
ST	Standby Time
STD	Software Test Description
STLDD	Software Top Legal Design Document
STP	Software Test Plan
STPR	Software Test Procedure
STR	Software Test Report
SUM	Software User's Manual

T

TACOM	Tank Automotive Command
TAMMS	The Army Maintenance Management System
TCM	Total Corrective Maintenance time
TD/CMS	Technical Data/Configuration Management System
TDP	Technical Data Package
TDPL	Technical Data Package List
TDPPS	Technical Data Package Planning Schedule
TECOM	Test and Evaluation Command
TIG	Tungsten Inert Gas
TLCCS	Total Life Cycle Competition Strategy
TLCSC	Top-Level Computer Software Component
TPM	Total Preventive Maintenance time
TQM	Total Quality Management
TROSCOM	Troop Support Command (see ATCOM)
TRUST	Total Reevaluation Under SPRINT Thrusts
TT/UT	Technical Test/User Test

U - None

V

VDD	Version Description Document
VE	Value Engineering
VECP	Value Engineering Change Proposal
VEP	Value Engineering Proposal

LIST OF ACRONYMS (Continued)

V (Continued)

VEPC	Value Engineering Points of Contact
VEPM	VE Program Manager
VES	Value Engineering Study

W-Z - None

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SECTION I

THE TECHNICAL DATA PACKAGE (TDP)

1.1 DEFINITION.

MIL-T-31000, Technical Data Packages, General Specification For, defines the Technical Data Package (TDP) as:

> "A technical description of an item adequate for supporting an acquisition strategy, production, engineering and logistics support. The description defines the required design configuration and procedures required to ensure adequacy of item performance. It consists of all applicable technical data such as drawings and associated lists, specifications, standards, performance requirements, quality assurance provisions, and packaging details."

1.2 TECHNICAL DATA PACKAGE USAGE.

The TDP is the key documentation in bidding and contracting for production of military materiel. The TDP is a document that can be tailored or supplemented as required to support the uses listed in Figure I-1A. The TDP's completeness, accuracy, clarity, and adequacy are major factors in determining:

a. Method of procurement

b. Degree of competition

c. Probability of procuring materiel of requisite quality and reliability within planned schedules

In order for a fixed-price competitive procurement to be successful, each qualified bidder must be able to interpret the technical requirements of the TDP in essentially the same way.

1.3 TECHNICAL DATA PACKAGE CONTENT.

The Federal Acquisition Regulation (FAR), Part 10, Specifications, Standards and other Purchase Descriptions, requires:

> "Plans, drawings, specifications, standards or purchase descriptions for acquisitions shall state only the Government's actual minimum needs and describe the supplies and/or services in a manner designed to promote full and open competition."

The TDP elements per MIL-T-31000 are identified in Figure I-1B.

1.4 SPECIFICATIONS (Implementation Instruction - contains mandatory requirements).

1.4.1 General.

Requirements for the Belvoir Research, Development and Engineering Center (Belvoir RD&E Center) specifications and purchase descriptions are described in the following documents:

Document	Notes on Content
DOD 4120.3M, Defense Standardization Specification Program, Policies, Procedures and Instructions	Policies and procedures
DODI 5000.2, Part 6, Section Q, DOD Standardization Program	Policies and procedures
MIL-STD-490, Specification Practices	Types of program peculiar specifications with examples
MIL-STD-961, Preparation of Military Specifications and Associated Documents	Style, format, revisions, specifications etc. for six sections
Belvoir Standardization Document Preparation Guide (SDPG)	Detailed guidance for preparing Belvoir RD&E Center specifications

Although there are five types of military specifications (system, development, product, process and material), Belvoir RD&E Center purchase descriptions and specifications are normally development and product types. Development specifications are often called performance specifications; product specifications may be either performance or design. Performance specifications are used mostly for commercially available or modified hardware, while design specifications are used with Government Product drawings. The content of a specification varies depending on the type.

MIL-STD-490 describes the requirements for the preparation of program peculiar specifications, and provides a definition for this type of document. For Army applications, this standard applies to specifications for those items and systems which are obviously only one-of-a-kind and therefore, little or no potential exists for any future application by other DOD developers. All other product type specifications are prepared as standardization documents in accordance with MIL-STD-961 and the SDPG.

1.4.2 Product (End Item) Specification.

The detailed requirements for Belvoir RD&E Center specifications are included in the Belvoir SDPG. The product (End item) specification is the basic document of a TDP.

1.4.3 Purchase Description (PD).

Purchase descriptions (PDs) have the same content and format requirements as military specifications, therefore, guidance for preparation can be found in the Belvoir SDPG. While PDs are not subject to coordination as described in DOD 4120.3M, they are subject to pertinent restrictions on repetitive use (FAR 10, Paragraph 10.004(b)).

1.5 CONTRACT DATA REQUIREMENTS.

When a development or engineering services contract specifies the delivery of a complete (or elements of a) TDP, then MIL-T-31000, Technical Data Packages, General Specification For, shall apply and the contract shall include:

- Contract Data Requirements List (CDRL) DD Form 1423

- Drawings and Associated Lists or elements in accordance with MIL-T-31000, with the appropriate DD Form 2554-1 thru -8, TDP Option Selection Worksheet

- Data Item Descriptions (DIDs) as appropriate (DD Form 1664)

1.6 QUALITY ASSURANCE PROVISIONS (QAPs).

Quality Assurance Provisions in the TDP are contained in the item specification and/or on the Product drawing in accordance with MIL-T-31000, Appendix B.

1.7 DATA RIGHTS.

Department of Defense (DOD) policy, implementing instructions, and contract clauses with respect to acquisition of rights in technical data are in the FAR, Part 27, Patents, Data, and Copyrights.

1.8 CONFIGURATION MANAGEMENT (CM).

Configuration Management (CM) is a discipline applying technical and administrative direction and surveillance to:

a. Identify and document the functional and physical characteristics of a configuration item,

b. Control changes to those characteristics, and

c. Record and report change processing and implementation status.

The end item configuration defined by the TDP is controlled by CM. CM establishes configuration baselines, provides traceability of engineering change proposals (ECPs), deviations and waivers, and provides uniform change control procedures. CM requirements are specified in:

- DODI 5000.2, Part 9, Configuration and Data Management

- MIL-STD-973, Configuration Management
- Belvoir RD&E Center SOP 70-37, Configuration Management

The Configuration Control Board must assure that proposed changes do not violate the basic design integrity of the product.

1.8.1 Engineering ECP Evaluation Sheet.

The ECP Evaluation Sheet addresses the need for the change, provides the technical evaluation of the change, makes a recommendation regarding the disposition of the change proposal, and discusses its impact on other factors of acquisition and fielding. Details for its preparation, and a Sample, is contained in Belvoir RD&E Center, SOP 70-37, Appendix A, dated November 7, 1990.

1.9 FUTURE PROCUREMENT READINESS FOR TECHNICAL DATA PACKAGES (TDPs) (Implementation Instruction - contains mandatory requirements).

1.9.1 Conditions Requiring TDP Updating.

TDPs will be maintained in a constant state of readiness for use in order to minimize production cost and claims against existing TDPs. All documentation will be updated to reflect design changes and made available concurrent with implementation of the change in accordance with DODI 5000.2, Part 9, Section A, Configuration Management, paragraph 3.e.(3). The TDPs will be updated when any of the following conditions exist:

a. When outstanding changes exist against previous contract(s).

b. When known design deficiencies exist.

c. When updating actions are required to reflect the state-of-the-art manufacturing advances by the industry.

d. When drawing inspection, as outlined in paragraph 8.6, indicates a need.

e. When an item appears on a Requirement Forecast.

1.9.2 Updating Procedure.

Based upon the above, the cognizant project engineer shall take the following action:

a. Request from the Standardization and Engineering Data Team an "as-is" printout of the Document Usage List.

b. Request from the Standardization and Engineering Data Team an Engineering Change List (Supplement).

c. Initiate a producibility analysis if necessary to bring the TDP up to the state-of-the-art manufacturing advances.

d. Incorporate the outstanding changes in accordance with Configuration Management Procedures including those resulting from Modification Work Order and Product Improvement Program actions.

1.10 SIGNATURE AUTHORITY FOR TECHNICAL DATA PACKAGES (TDPs) TO BE USED FOR COMPETITIVE PROCUREMENT OF PRODUCTION HARDWARE (Implementation Instruction - contains mandatory requirements).

1.10.1 To ensure the uniform management of TDP Signature Authority throughout the Center, the following standard practice is established:

a. Approval shall be indicated by the appropriate signature in the DESIGN APPROVAL, and APPROVED FOR PROCUREMENT blocks on the drawing. The appropriate signature levels are indicated in the following matrix, and cannot be further delegated:

APPROVAL SIGNATURE AUTHORITY	DRAWINGS PREPARED TO THE REQUIREMENTS OF:									
	MIL-T-31000 MIL-STD-100 BELVOIR SPM				MIL-T-31000 MIL-STD-100				SOURCE CONTROL DRAWING *	
	DSGN APPVL		PRCMT APPVL		DSGN APPVL		PRCMT APPVL		DSGN APPVL	PRCMT APPVL
	D	TA	D	TA	D	TA	D	TA	D	D
PROJECT ENGINEER	X									
BRANCH(TEAM) CHIEF		X	X		X					
DIVISION CHIEF				X		X	X			
DIRECTOR OF TD								X	X	
BELVOIR TECH DIRECTOR										X

LEGEND:	APPVL	APPROVAL	TA	TOP ASSEMBLY DRAWING
	D	DETAIL DRAWING	TD	TECHNICAL DIRECTORATE
	DSGN	DESIGN	SPM	STANDARD PRACTICE MANUAL
	PRCMT	PROCUREMENT		

* With only one approved source of supply. When a Source Control Drawing has 2 or more approved sources, the Approval Signature Authority is the Project Engineer and Branch (Team) Chief.

A drawing title block is shown below for reference:

<table>
<tr><td>DRAWN BY</td><td>DATE</td><td colspan="3" rowspan="2">U.S. ARMY
BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
FORT BELVOIR, VIRGINIA 22060-5606</td></tr>
<tr><td>CHECKED BY</td><td>ENGINEER</td></tr>
<tr><td colspan="2">CONTRACT NO.</td><td colspan="3" rowspan="2"></td></tr>
<tr><td colspan="2">DESIGN APPROVAL
DATE</td></tr>
<tr><td colspan="2" rowspan="2">APPROVED FOR PROCUREMENT
DATE</td><td>SIZE
A1</td><td>CAGE CODE
97403</td><td>DWG NO.</td></tr>
<tr><td colspan="2">SCALE</td><td>SHEET</td></tr>
</table>

b. Any official with signature authority may recommend DISAPPROVAL of a drawing or drawing package. However, disapproval shall be recorded in writing by a Memorandum signed by the Director of the Technical Directorate, to Chief, Engineering Data Management Division.

c. At the discretion and request of the Approval/Disapproval official, a review group composed of representatives from Producibility Engineering, Product Assurance, Configuration Management and other disciplines as required, will assist the official by providing guidance as to the suitability of the subject drawing package.

d. The Review Group shall be chaired by an engineer from the Producibility Engineering Team of the PA&E Directorate. Requests for assistance from a Review Team shall be made to the Chief, Producibility Engineering Team, who will assemble an appropriate team to support the drawing package review.

e. All supervisors are expected to cooperate when requested to provide personnel to serve on a Review Group.

f. Each new Technical Data Package (TDP) forwarded for release to the Engineering Data Bank must be accompanied by a certification signed by the appropriate Approval official. See paragraph 1.12, Technical Data Package (TDP) Certification.

1.11 TECHNICAL DATA PACKAGE (TDP) SCHEDULING (Implementation Instruction - contains mandatory requirements).

Technical Data Package (TDP) scheduling is designed to establish adequacy and availability of technical data packages to support planned procurement (by USAMC Major Subordinate Commands (MSCs) and other U.S. Government activities) based on the Major Item Requirement Forecast (MIRF) and the Secondary Item Requirement Forecast (SIRF) within those Federal Supply Classes (FSCs) for which Belvoir RD&E Center has engineering design responsibility. In addition unplanned requirements initiated by the Contracting Officer and supply activities, i.e., Procurement Work Directives and Request for Engineering Assistance, must be supported.

The efforts involved in this task are: solicitation of inputs from the Technical Directorate engineering personnel, preparation and maintenance, and distribution of the Belvoir RD&E Center TDP Program Schedule and Periodic Status Reports.

The Product Assurance & Engineering (PA&E) Directorate is assigned total responsibility for assuring schedule development, solicitation of data, preparation, and maintenance of TDP schedules. PA&E is the Belvoir RD&E Center TDP Control Point, and is the single office of Belvoir RD&E Center which receives requirements for TDPs and furnishes TDP availability dates. The Technical Directorate Division Chief is responsible for the coordination and completion of the Technical Data Package Planning Schedule (TDPPS) and establishing availability dates.

1.11.1 Planned TDP Requirements.

The TDPPS form is to be used to solicit coordinated inputs from the engineering personnel of Belvoir RD&E Center. The project engineer or other Division representative familiar with the TDP involved should personally coordinate the various inputs by hand-carrying the TDPPS to each Division/Activity and obtain their commitments to dates. Further, the responsible project engineers and producibility engineers should be aware of the TDPPS commitments; therefore, it is recommended that both sign the TDPPS signature block "Division Engineer(s)" (see Figures I-2, I-3, and I-4).

Figure I-5 graphically shows the relationship of the Belvoir RD&E Center TDPPS Program with outside and internal organizations.

Any TDP schedule slippage is to be handled and reported as outlined in Figures I-6, I-7, and I-8.

1.11.2 Unplanned TDP Requirements ("HOT PWDs").

The PA&ED, SATBE-TSC, Engineering Data Management Division receives requests for TDPs to support unplanned procurement as Procurement Work Directives ("HOT PWDs"), and as Requests for Engineering Assistance. These are defined as follows:

a. "HOT PWD": An <u>URGENT</u> unplanned requirement, initiated by the Contracting Officer, for additional technical documents and/or changes to previously furnished documents in support of a pending procurement work directive (PWD) (Figure I-9).

b. REQUEST FOR ENGINEERING ASSISTANCE: A request initiated primarily by the Contracting Officer but may come from the supply activities for Technical Assistance and/or changes to documents in support of planned or pending procurement (Figure I-10).

<u>NOTE</u>: Since "HOT PWDs" and Requests for Engineering Assistance are handled in the same manner, the term "HOT PWD" in these procedures apply to both.

1.11.2.1 Procedures for "HOT PWDs".

When Belvoir receives a request for support as defined above the following actions are taken:

a. Belvoir RD&E Center Point of Contact (POC), SATBE-TSC, receives "HOT PWD"; establishes suspense date for a reply back from the Directorate, and sends it by cover Memo, enclosed, within one (1) workday of its receipt to the Programs Office of the responsible Directorate for necessary action. "HOT PWD" (Figure I-11); "ENGR ASST" (Figure I-12).

<u>NOTE</u>: If a DRAWING CHANGE is required, an ECP must be processed and the change with the approved ECP forwarded to the Standardization and Engineering Data Team. If no Drawing Changes are required a response must be furnished to SATBE-TSC before or by Suspense date.

b. The Directorate takes the necessary action on the "HOT PWD" and responds back to the POC within the suspense time specified, as follows:

(1) <u>Interim Response</u>: (Action Not Yet Completed) Gives status of action, such as: Awaiting information/action from outside source; technical data completed and sent to Standardization and Engineering Data Team for processing and mailout, etc. (Figure I-13).

(2) <u>Final Response</u>: All Action Is Completed (Figure I-14).

c. POC sends Directorate's response and all other applicable documents/information to requestor; records interim action (Figure I-15) or completion of project (Figure I-16).

1.11.3 Contacts for TDP Scheduling:

Product Assurance & Engineering Directorate (PA&E)

- Belvoir RD&E Center TDP Control Point
- Standardization
- Quality & Reliability
- Standardization and Engineering Data Team
- Safety, Health, and Environmental Office
- Packaging

Logistics Equipment Directorate (LED)

- Engines

Engineering Materials & Coatings (AMSRL-MA-E)

- Materials

1.12 TECHNICAL DATA PACKAGE (TDP) CERTIFICATION PROCESS (Implementation Instruction - contains mandatory requirements).

It is the responsibility of the project engineer concerned with the certified TDP to follow up on any unresolved problems or questions with all affected parties, both inside and outside the Center.

1.12.1 Purpose. The purpose of the TDP certification process is to objectively assess the quality of Center TDPs and inform the procuring organization of potential shortfalls and limitations prior to use in a quantity procurement. The certification process concerns both newly developed TDPs and updated TDPs. The TDP certification shall be attached to the TDP Engineering Release Record (ERR). For certification requirements and format see paragraph 2.2.8.

1.13 PRODUCT DRAWING PACKAGE (PDP) CONFIDENCE INDICATOR (CI).

1.13.1 Background.

The Technical Data Package (TDP) is the most important product of the Belvoir RD&E Center, therefore, it is imperative that the Project Engineer have a method of indicating its adequacy for use in a competitive procurement contract.

Paragraph 8.5 requires a data review be conducted prior to final acceptance, and a TDP Certification, paragraphs 1.12 and 2.2.8, to accompany each ERR releasing the TDP for use in procurement. The PDP CI is a tool for use by the Project Engineer in making judgments for executing these two essential requirements.

The CI should be used as a tool to identify the systemic causes in the acquisition process that produces an inadequate PDP. Before proceeding with the selection of a representative sample from a given drawing package, the following questions should be answered regarding the PDP's development background:

CI DEVELOPMENT BACKGROUND CHECKLIST

YES	NO	QUESTION
____	____	1. Was an Acquisition Strategy (AS) document prepared for this development program?
____	____	2. Was a TDP acquisition plan developed as a companion to the AS?
____	____	3. Was the level of design disclosure justified by the planned usage for the TDP?
____	____	4. Were PEP efforts included in the TDP acquisition plan and the development contract to assure its producibility aspects?
____	____	5. Were the TDP development activities adequately funded and was the delivery schedule realistic?
____	____	6. Was the TDP used to fabricate a prototype, thus proving the drawings?
____	____	7. Was the prototype tested to provide data on the item's performance?
____	____	8. Was a FCA conducted to establish the configuration item's functional baseline?
____	____	9. Was a PCA conducted to establish the basis for the product baseline?
____	____	10. Was a Producibility Analysis performed on the TDP, using concurrent application of specialty engineering disciplines during the design process, to determine whether the item can be produced economically to the drawing and specification requirements?
____	____	11. Were the results of the Test, FCA, PCA, and Producibility Analysis that required corrective action incorporated into the TDP?
____	____	12. Was this TDP prepared in accordance with the requirements for Product Drawings in MIL-T-31000?

If any one of questions 6 through 12 is answered "NO", the PDP should be expected to have a CI in Zone C. If any one of questions 1 through 5 is answered "NO", care should be taken to ensure that efforts addressed in questions 6 through 12 were adequately performed even though the answer to all the questions 6 through 12 were "YES".

The CI is a measurement of the effectiveness of the entire TDP acquisition process, and should not be applied to measure the effectiveness of a single effort in the process, i.e., the Producibility Analysis effort alone. The Producibility Analysis should be conducted along with a FCA and PCA which was conducted on a prototype that was fabricated using the TDP, and that has successfully completed performance testing.

1.13.2 The Confidence Indicator (CI).

The CI provides the Project Engineer a rationale for making recommendations regarding the risk involved in using the PDP for competitive procurement. The CI is advisory only and shall not be used as a contractual requirement. However, the Project Engineer is encouraged to use it, and the results, both favorable and unfavorable regarding PDP adequacy, should be communicated to SATBE-TSX.

1.13.2.1 Definition:

The CI is based on the number of defectives found in a sampling of the PDP, a major element of the TDP. A defective is a drawing sheet containing one or more major errors. The numerical value of CI is determined by the following equation:

$$CI = 100 - 10(N)$$

where N = the number of defectives per hundred drawing sheets. Figure I-17 illustrates the linear relationship between the CI and the number of defectives.

1.13.2.2 Confidence Zones:

Enclosure 1-16 also indicates the three CI zones that are used to broadly categorize the adequacy of the PDP and to suggest the recommended course of action to be specified in the TDP Certification.

Zone A

CI 85 or above = The PDP is adequate for competitive procurement with acceptable risk of contractor claims against the Government.

Zone B

CI between 60 and 84 = The PDP is not adequate alone for competitive procurement but can be used with appropriate precaution. The contract must contain a Preproduction Evaluation (PPE) clause, and require a Physical Configuration Audit (PCA) of the First Article production hardware.

Zone C

CI less than 60 = The PDP is not adequate for competitive procurement. A Producibility Analysis must be performed on the PDP prior to competitive procurement, a PPE clause must be included in the First Production contract, and a PCA must be performed on the First Article production hardware.

Note: Careful judgment must be exercised for those CI values that are equal to or close to the border numbers 60 and 85. The size and estimated dollar value of the procurement and other factors should be considered.

A review of the sample drawing sheets by a competent team will require, on average, 2 hours per drawing sheet reviewed. The team members must also have a clear understanding of what is to be counted as an error.

1.13.2.3 Drawing Errors Counted for the CI:

a. A major drawing error that MUST be counted in determining the CI for a PDP is as follows:

   (1) Any error that affects form, fit, or function and would require correction by an ECP during a production contract.

   (2) Illegibility and nonreproducibility of the drawing.

b. Minor drawing errors are NOT counted in determining the CI for a PDP. This type error includes all drawing discrepancies not counted as major drawing errors above. For example:

   (1) Spelling errors, non-standard abbreviations, grammatic construction, and minor drafting errors that do not materially affect the usefulness of the drawing.

   (2) Deviations from the Belvoir Producibility Engineering Standard Practice Manual that does not materially affect the usefulness of the drawing.

   (3) Deviations from prescribed format that will not affect the interpretation of the technical requirements.

1.13.2.4 Sample Determination:

It is critically important that the drawing sheets selected for review be representative of the total PDP. The procedure for selecting the sample is described in paragraph 1.13.3.

1.13.2.5 CI Example:

- A PDP contains 200 drawing sheets.

- A sample of 32 drawing sheets selected in accordance with paragraph 1.13.3, Table 1, is reviewed and 1 defective drawing is found.

- N = Number of Defectives per hundred drawing sheets = (Number Defective x 100) ÷ Number of Units Inspected

  Numbers of Units Inspected = Sample Size

  N = (1 x 100) ÷ 32 = 3.125 Defectives per hundred drawing sheets

- CI = 100 - 10(N), See Figure I-17; CI = 100 - 10(3.125) = 68.75, use 69

With a CI value of 69 the Project Engineer would indicate in the TDP Certification that the PDP is not adequate for competitive procurement, but can be used with appropriate precaution. The production contract must contain a requirement for a PPE, and for a PCA to be performed on the First Article production hardware.

1.13.3 Product Drawing Package (PDP) Sampling.

1.13.3.1 General.

a. Purpose: To select a representative sample for a given drawing package that shall be used to determine the PDP Confidence Indicator.

b. Scope: These procedures apply to product drawings and associated lists prepared in accordance with MIL-T-31000.

1.13.3.2 Background.

In a given lot, sampling shall be applied to that group of drawings considered representative of all types of drawings containing the maximum number of producibility factors, such as, fit, tolerance stackup, standardization, material and other specification applications, plus drawing legibility and reproduction quality.

1.13.3.3 Sample Selection.

a. Sampling: Representative sampling shall be used for product drawings. The drawings will be broken down into types and categories identified by the criteria designated in paragraphs 1.13.3.4 and 1.13.3.5.

(1) Gage and instrument drawings are to be treated as an individual type, and when sampled they are to be listed on the matrix in paragraph 1.13.3.5 as "other".

(2) The number of sheets to be drawn for each drawing type and category of the PDP shall be as designated in paragraphs 1.13.3.3.c and 1.13.3.5.

b. Representative Sampling of Drawings: In order to assure that a representative sample is selected from the lot, each package of drawings shall be broken down into a type versus category matrix as shown in paragraph 1.13.3.5. After the number of sheets to be sampled has been determined, the total number is distributed proportionally, first to each type, and then to each category. At least one sheet is selected from each category, even though this may result in reducing the number of sheets to be selected from a larger category in the same type.

Once the actual sample has been selected the Project Engineer should ensure that all the characteristics in the sample that interface with other drawings in the PDP are checked for compatibility.

c. Number of Sheets in Sample.

(1) The sample size from the lot of product drawings shall be as designated in Table 1. The number of sheets to be selected from each type and category shall be proportional to the number of sheets in the total lot of product drawings.

(2) Gage and instrument drawings, when applicable, shall be treated as a separate type.

(3) Associated lists, (DL's, IL's and PL's) are reviewed 100% when originally prepared and shall not be sampled. When an assembly drawing is selected in the sample the separate PL shall be reviewed as part of the drawing, but the PL sheets shall NOT be counted as units of product.

(4) Each sheet of a multi sheet drawing shall be counted.

1.13.3.4 Definition of Terms.

a. Drawing Types: For sampling purposes, drawing types are defined as follows:

(1) Mechanical Drawing: A drawing depicting a part of or constituting an assembly or subassembly which transmits power through gears, linkages, cams or other mechanical means. (Example: gear reducer, mechanical transmission, gasoline engine, geared lathe, etc.)

(2) Electrical Drawing: A drawing depicting a device or assembly whose principle function is to transmit, convert or absorb electrical power. (Examples: power supply, motors, generators, electrical control devices, electrical heaters, lighting systems, electronic guidance systems, electrical power transmission, wired systems of communication, electric and electronic appliances, converters, printed or wired circuits, etc.)

(3) Hydraulic Drawing: A drawing depicting a device or an assembly whose principle function is to transmit power through suitable fluids or transmit, regulate or measure fluid flow. (Examples: oil pump, hydraulic press power linkage, hydraulic shock absorber, turbine, fluid drive transmission, etc.) For purposes of statistical sampling, pneumatic designs may be included in this group.

(4) Structural Drawing: The term Structural Drawing refers to drawings of steel, masonry, wood, concrete, etc., for buildings, bridges, towers, dams and other such structures ordinarily fastened by riveting, bolting, welding, nailing, or masonry fasteners. (Examples: roof truss, trailer frame, crane boom, radar tower, rocket launcher, bridge.)

(5) Source Control Drawing: A Source Control Drawing depicts an existing commercial item which exclusively provides the performance, installation and interchangeability characteristics required for a specific critical application.

(6) Vendor Item Drawing: A Vendor Item Drawing discloses configuration, performance, interchangeability and test requirements of an item to the extent necessary to enable a vendor or manufacturer to develop the details of design, and supply the item to meet Government requirements.

(7) Other: This classification allows for the establishment of additional types when it is desirable to do so for purposes of providing certain drawings with a greater degree of "chance of selection" than if they should be included in another lot. (Examples: a hydro-electric device, electro-mechanical device, gauges and instruments.)

b. Drawing Categories: For sampling purposes, categories are defined as follows:

(1) Assembly Drawing: An Assembly Drawing depicts the assembled relationship of two or more separable and/or inseparable parts, a combination of parts and subordinate assemblies, or a group of assemblies required to form an assembly of higher order.

(2) Subassembly Drawing: A Subassembly Drawing depicts an assembly which forms part of an assembly of a higher order. For purposes of drawing distribution by types and categories for sampling purposes (paragraph 1.13.3.3.b) a subassembly may be treated as an assembly within its type (Mechanical, Electrical, Hydraulic, Structural).

(3) Component or Part Drawing: A Component Drawing depicts a single piece-part or specification controlled unit of an assembly or subassembly.

(4) Diagram: A Diagram Drawing depicts the interconnection of components by piping, tubing or hose, electrical or electronic conductors or mechanical linkages depicted by single lines and graphic symbols representing sequential flow of power, liquids or gas within a system.

c. Unit of Product: The unit of product, or "unit" as used herein is a single drawing sheet.

d. Package: The term "package" applies to a collection of units from which types and categories are established for sampling purposes. Note: All the sheets in a PDP make up the "lot" for sampling purposes.

e. Lot: The term lot applies to the collection of total number of sheets in the PDP from which a sample is drawn.

f. Sample: A sample consists of one or more drawing sheets (units) drawn from a lot. The number of units drawn is the sample size and is based on the total drawing sheets in a lot as designated in Table 1.

g. Inspection: Inspection is the process of examining or otherwise comparing a unit of product with the contract requirements for preparation or revision of the document.

1.13.3.5 Example of Selecting a Representative Sample.

a. The PDP to be sampled is first broken down into the types and categories as defined in paragraph 1.13.3.4. The total number of drawing sheets in each type and category is counted and recorded in the matrix below, and totaled to indicate the Total Drawing Sheets in Package (Lot). The number of sheets to be selected is indicated in Table 1. This total sample is then proportioned first by type of drawing, then by category. This procedure is to assure that the sample is selected proportionally throughout the package (lot), and is representative of the lot. See paragraph 1.13.3.5.a.(1) for example.

(1) Following is an example of proportioning a total lot sample of 32 drawing sheets, as indicated in Table 1, from a lot of 200 drawing sheets. The distribution of the sample by type and category is shown in paragraph 1.13.3.5.a.(2). The proportion of the sample to be distributed is calculated below:

(a) Proportion by Type:	Total Sheets by Type	% of Lot	X	Lot Sample Size	=	Sample by Type Calculated	Use
Mechanical	27	(27 ÷ 200)	X	32	=	4.32	4
Electrical	22	(22 ÷ 200)	X	32	=	3.52	4
Hydraulic	2	(2 ÷ 200)	X	32	=	0.32	1
Structural	35	(35 ÷ 200)	X	32	=	5.60	5*
Source Control	4	(4 ÷ 200)	X	32	=	0.64	1
Vendor Item	74	(74 ÷ 200)	X	32	=	11.84	11*
Others	36	(36 ÷ 200)	X	32	=	5.76	6
Total Lot =	200			Total Lot Sample =			32

(b) Proportion by Category:	Total Sheets by Category	% of Category	X	Type Sample Size	=	Sample by Category Calculated	Use
Mechanical (27) (Sample 4)							
Assembly	2	(2 ÷ 27)	X	4	=	0.30	1
Subassembly	7	(7 ÷ 27)	X	4	=	1.04	1
Parts & Components	18	(18 ÷ 27)	X	4	=	2.67	2*
Total Type =	27			Total Type Sample =			4
Electrical (22) (Sample 4)							
Subassembly	1	(1 ÷ 22)	X	4	=	0.18	1
Parts & Components	19	(19 ÷ 22)	X	4	=	3.45	2*
Diagrams	2	(2 ÷ 22)	X	4	=	0.36	1
Total Type =	22			Total Type Sample =			4

	Total Sheets by Category	% of Category	X	Type Sample Size	=	Sample by Category Calculated	Use
Structural (35) (Sample 5)							
Assembly	2	(2 ÷ 35)	X	5	=	0.29	1
Subassembly	7	(7 ÷ 35)	X	5	=	1.00	1
Parts & Components	26	(26 ÷ 35)	X	5	=	3.71	3*
Total Type =	35			Total Type Sample =			5

* Reduce large type and category sample to allow a minimum of one (1) sheet sample to be selected from each type and category.

(2) The drawing and sample distribution by type and category is shown below:

LOT SAMPLE SIZE,
SAMPLE SIZE DISTRIBUTION BY DRAWING TYPE AND CATEGORY,
AND MAJOR ERRORS FOUND

Type of Drawing	CATEGORY				Total Sheets by type	Sample Size (Dwg Shts) by type	Number of Defectives by type
	Assembly	Subassy	Parts & Components	Diagrams			
Mechanical	1 2	1 7	2 18		27	4	0
Electrical		1 1	2 19	1 2	22	4	0
Hydraulic				1 2	2	1	0
Structural	1 2	1 7	3 26		35	5	1
Source Control			1 4		4	1	0
Vendor Item			11 74		74	11	0
Others			6 36		36	6	0
Total Drawing Sheets in Package (LOT)					200		
Table 1 - Total Sample Size (Drawing Sheets)						32	
Total Defectives							1

(3) Confidence Indicator (CI) calculated from above information is as follows:

N = Number of Defectives per hundred drawing sheets = (Number Defective x 100) ÷ Number of Units Inspected

N = (1 x 100) ÷ 32 = 3.125 Defectives per hundred drawing sheets

CI = 100 - 10(N), Reference Figure 1

CI = 100 - 10(3.125) = 68.75, use 69

With a CI value of 69 the Project Engineer would indicate in the TDP Certification that the PDP is not adequate for competitive procurement, but can be used with appropriate precaution. The production contract must contain a requirement for a PPE, and for a PCA to be performed on the First Article production hardware.

TABLE 1

Number of Drawing Sheets in Lot or Product Drawing Package	Sample Size* Number Drawing Sheets
1-25	100%
26-50	8
51-90	13
91-150	20
151-280	32
281-500	50
501-1200	80
1200-3200	125

* Based on MIL-STD-105, General Inspection Level II, Table I and Table II-A.

Note: It is assumed that the product drawings are prepared by an experienced organization to the requirements of MIL-T-31000, Product Drawings.

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SECTION II

BELVOIR TECHNICAL DATA MANAGEMENT

2.1 GENERAL.

The Belvoir RD&E Center Engineering Data Management function is assigned to the Product Assurance & Engineering Directorate, Engineering Data Management Division, SATBE-TS. When the Project Engineer needs to establish a product baseline, enter a new TDP into the system, request new drawing numbers, revise engineering documents, or update an existing TDP, the interaction with the Engineering Data Management Division will involve the following:

- Technical Documentation Management Controls
- Technical Data/Configuration Management System (TD/CMS)
- Digital Storage and Retrieval Engineering Data System (DSREDS)

2.2 TECHNICAL DOCUMENTATION MANAGEMENT CONTROLS (Implementation Instruction - contains mandatory requirements).

The Standardization and Engineering Data Team (SEDT), SATBE-TSE, located in Bldg. 315, 2nd Floor, VAULT Wing, is responsible for establishing and maintaining procedures required for processing engineering documentation and TDPs. Its activities include:

- Processing, microfilming, storage, and retrieval of all engineering documents in a TDP.

- Processing, microfilming, storage, and retrieval of all approved ECPs, VECPs, NORs, SCNs, RFDs, and RFWs.

- Providing initial Engineering Release documentation, and the latest revision of changed documentation, for loading into the TD/CMS, and DSREDS.

- Providing TDPs for procurement action.

- Providing prints of engineering documents not in DSREDS.

2.2.1 Requests for New Drawing Numbers.

Requests for new drawing numbers will not be accepted over the telephone. The forms needed for submitting these requests are available in the SEDT (see Figure II-1).

All paragraphs must be completed. If TDPL/SPEC is not applicable, then a reason(s) must be provided in the Remarks section of this form.

Failure to process completed drawings within one calendar year of receipt, or failure to request an extension will result in cancellation of the numbers assigned without further review.

Unused Drawing Numbers:

a. When the completed drawing package is delivered to the SEDT, a list of all unused drawing numbers must accompany the package.

b. A memorandum requesting an extension must be submitted to the SEDT, a list of all unused drawing numbers must accompany the package.

2.2.2 Document Reproduction.

Requests for reproduction shall be submitted through a DSREDS terminal. Request for reproduction of data not found in DSREDS shall be submitted on form number STRBE-FM 14-13 dated 15 Sep 93. These forms are available in the SEDT and the Publications Office. See Figures II-2 and II-3.

2.2.3 Request for Original Drawings.

All requests for charge-outs of original drawings must be accompanied by a copy of the approved ECP. A separate request is required for each ECP. Expected completion date will be given by SEDT personnel upon acceptance of the request. See Figure II-4.

2.2.4 Request for Processing.

Request for Processing and Distribution of TDPL Packages (SATBE Form 14-70 dated 1 Mar 93) must accompany new or revised original drawing that is delivered to the SEDT for microfilming (see Figure II-5). This Request for Processing is in addition to the TDP Certification required in paragraphs 1.12 and 2.2.8.

A Request for Processing is the formal request to process a completed document and is required by the SEDT to initiate incorporation into the appropriate repositories.

The information provided relative to the affected TDPL/SPEC, as well as contract information, distribution information and special instructions (when applicable) is used by the SEDT to ensure that distribution is made to the appropriate Procurement Organization.

2.2.5 Configuration Management (CM) Documentation.

All CM documents that are received by the SEDT are recorded upon receipt and then indexed. Indexing is the process of identifying and extracting essential data elements in preparation for data processing. Inherent in this procedure is the screening of submitted documents for completeness and accuracy. See MIL-STD-973, Configuration Management.

To ensure the timely processing of this documentation, samples of CM documents have been provided to be used as a guideline in the initial preparation or as a checking device after preparation is complete in Belvoir RD&E Center SOP 70-37, Research and Development Configuration Management, dated 7 November 1990.

2.2.5.1 Definitions.

a. Technical Data Package List (TDPL). A TDPL is a complete listing of all documents which comprise the TDP for a given item or system (see para 2.3). The TDPL is arranged in three sections:

Section 1 - Drawings
Section 2 - Specifications
Section 3 - Outstanding ECPs

b. Data List (DL). A tabulation of all engineering drawings, documents referenced thereon, associated parts lists and special lists, specifications and subordinate data lists pertaining to the item to which the data list applies (MIL-STD-100).

c. Engineering Change Proposal (ECP). A term which includes both a proposed engineering change and the documentation by which the change is described and suggested.

d. Engineering Release Record (ERR). The official document that releases all appropriate configuration identification documentation for systems or equipment to:

   (1) Establish the functional, allocated, and product baselines, or to;

   (2) Change an established baseline.

e. Notice of Revision (NOR). A form used to propose revisions to a drawing or list, and after approval, to notify users that the drawing or list has been, or will be, revised accordingly.

f. Specification Change Notice (SCN). A document used to propose, transmit and record changes to a specification. In proposed form, prior to approval, the SCN (P) supplies proposed changes in the text of each page affected.

2.2.6 Updating a Technical Data Package (TDP).

Once it is known that a TDP must be updated, then the engineer should order an As-Is computer listing from the SEDT. This listing will identify the deficiencies in the TDP. The "As-Is" TDPL will identify the deficiencies that exist in the TDP as of that run date, and will list all of the outstanding approved contractual ECPs against that TDP.

A new in-house ECP may be required at this point in order to correct deficiencies not previously identified.

After all of the corrections and additions have been made then the engineer can take the approved update ECP (which must include an update NOR) along with a Request for Processing to the Configuration Control Point to initiate final processing.

2.2.7 Checklists for Processing Engineering Documentation.

The following lists identify what should be included in engineering documentation packages when they are received by the SEDT for processing:

a. TDP-NOT UPDATED

Request for Processing
Approved ECP
Originals

NOTE: When new drawings are generated or deleted as a result of an ECP, the revision block of the new drawing will indicate (-) Rev See ECP (number), and the deleted drawing revision block will indicate the next higher revision and reference the ECP. An ERR is not required.

b. TDP-UPDATE

Request for Processing
ERR, with attached TDP Certification that is referenced in Block 10 of the ERR.
Update ECP
Update NORs
Originals

c. NEW DRAWING PACKAGE

Request for Processing
ERR, with attached TDP Certification that is referenced in Block 10 of the ERR. The ERR will satisfy the requirement for a Data List.
Originals

d. MULTI-SHEET DRAWINGS

When a multi-sheet drawing is initially accepted and submitted to the SEDT for processing, all sheets of the drawing shall have the same date of origin. This date will be the date of approval of the ECP or the ERR that is referenced for the (-) Rev of each sheet.

2.2.8 Engineering Release Record (ERR) Requirements.

Instructions for the preparation of an ERR utilizing DD Forms 2617 and 2617C are contained in MIL-STD-973, APPENDIX C. An Example ERR is provided in Figure II-6. ERRs are used to identify and release engineering documentation to establish or to change a configuration baseline. Most ERRs prepared by BRDEC will be to identify the engineering documentation that establishes the initial product baseline or to identify changes to the established or existing product baseline. The TDP Certification shall be an integral part of the ERR, and will be referenced in Block 10 of the ERR. See paragraph 2.2.8.1 below for TDP Certification requirements.

ERR requirements follow:

a. ERR NUMBER FORMAT: The ERR number will contain the item Top Assembly drawing number, and the TDPL (TL/TA) revision letter. For Example: For "TL-MIL-X-XXXXX/TA132XXEXXXX, Revision (-), the ERR number will be, "TA132XXEXXXX-". Other typical examples of ERR numbers are:

TA13217E2030B
MIL-T-10210C
SC 6730-97-CL-E02K
SC 6731-98-E01C
CPL-90120K
PD 81056A
PD 6115-0044H
13215E1718D
CID-A-A-10567E

b. ERR FOR NEW TDP: Block 10 of an ERR to establish the initial product baseline would contain the following statement:

THIS ERR IDENTIFIES THE ENGINEERING DOCUMENTATION FOR THIS ITEM'S INITIAL PRODUCT BASELINE.

SEE ATTACHED TDP CERTIFICATION.

Block 11 of the ERR will list the following:

- Product Specification on one line since all pages are maintained at the same revision level.
- TDPL and PLs on one line for each since all pages of each are maintained at the same revision level.
- Each drawing sheet, including each sheet of a multi-sheet drawing, will be listed on one line since each sheet has it's own revision level. Initially a multi-sheet drawing may be listed on one line since all sheets will be at (-) revision level; however, at the first revision each sheet will be listed on one line each.

c. ERR FOR UPDATED TDP: Block 10 of the ERR for an updated TDP will contain statements similar to the following:

THE INITIAL PRODUCT BASELINE WAS IDENTIFIED BY ERR TA132XXEXXX-.

SEE ATTACHED TDP CERTIFICATION.

or

THE PREVIOUS PRODUCT BASELINE WAS IDENTIFIED BY TL-MIL-X-XXXXX/TA132XXEXXXX, REVISION X.

SEE ATTACHED TDP CERTIFICATION.

Block 11 of the ERR for an updated TDP will list:

- All documents changed, added, or deleted since the previous release.

d. ERR OFFICIAL DATE: The official ERR date in Block 2 is the date of the ERR approval in Block 13, and will be the scheduled delivery date of the TDP as shown on the Belvoir Technical Data Package Planning Schedule (TDPPS). Note: The date in Block 7.b. is the approval date of the ECP shown in Block 7.a.

2.2.8.1 Technical Data Package (TDP) Certification.

The purpose of the TDP Certification is to objectively assess the TDP quality and inform the procuring organization of potential shortfalls and limitations prior to use in quantity procurement. A certification is required for both newly developed TDPs and updated TDPs, and will be attached to the ERR and referenced in Block 10 of the ERR.

a. The responsible project engineer shall prepare a TDP Certification not less than 30 days prior to "Final Cut Off" as scheduled in the Belvoir TDPPS. The TDP Certification must be coordinated with and receive the concurrence of the Producibility Engineering Team (PET), the Quality Engineering Branch (QEB), and the Configuration Management Team (CMT) of the Product Assurance and Engineering Directorate (PA&ED) prior to being attached to the ERR.

b. Format for Newly Developed TDP Certification. The following shall be used as a guide in preparing the Newly Developed TDP Certification:

TDP CERTIFICATION FOR ERR NO. TA132XXEXXX-.

I. Information/Data.

1. *Statement as to whether or not the item meets the objectives for cost, schedule, and performance parameters established at the programs new start milestone decision point as required in DODD 5000.1.*

2. *List of tests that have provided data on the item's performance:*

   - *Technical Test (TT)/User Test (UT).*

   - *Quality Assurance Provisions (QAPs) have been confirmed by test.*

   - *Summary of significant findings.*

3. *List of analyses, audits, and reviews that have provided data on TDP adequacy:*

   - *Producibility Analysis conducted and results integrated with the Design to Unit Production Cost (DTUPC) requirements.*

- *Functional Configuration Audit (FCA) conducted.*
- *Physical Configuration Audit (PCA) conducted.*
- *Production Readiness Review (PRR) conducted.*
- *Date of type classification.*
- *Summary of significant findings, and statement as to whether or not the TDP meets the requirements of the Belvoir Producibility Engineering Standard Practice Manual (PESPM).*

II. Deficiencies/Risk. Answer the following in sufficient detail to form an assessment:

1. Deficiencies in the item design and risk associated with each.

2. Deficiencies in the TDP and risk associated with each.

3. Unavailable data, not collected or not available, that leaves doubt as to the adequacy of the item or the TDP.

III. Suggested Actions to Minimize the Risk.

1. Estimate the time and resources needed to significantly decrease the risk as defined in II. above.

2. List the recommended actions to be taken by the procuring organization to decrease the risk to a successful production contract, i.e., Preproduction Evaluation (PPE) and Physical Configuration Audit (PCA).

Prepared By: ____________________, *Project Engineer, SATBE-XXX*

Concur: ____________________, *PET, PA&ED, SATBE-TSX*

____________________, *QEB, PA&ED, SATBE-TQE*

____________________, *CMT, PA&ED, SATBE-TSC*

Approved: ____________________, *Branch/Team/Division Chief, SATBE-XX*

Date: ____________________

c. Updated TDP Certification. The Updated TDP Certification will use the same format as the Newly Developed TDP Certification, but will be tailored to address only the changes and related deficiencies/risk since the prior certification.

2.3 TECHNICAL DATA/CONFIGURATION MANAGEMENT SYSTEM (TD/CMS).

The Technical Data/Configuration Management System (TD/CMS) provides the computerized identification, control, and status accounting during the acquisition, acceptance, storage, retrieval, reproduction, and dissemination phases of a TDP. The TD/CMS is a relational database designed to control, store, interrelate, and rapidly retrieve engineering data in support of engineering and procurement functions. The Belvoir SEDT maintains this database through a local technical services contractor. The database contains information on document identification and revision status for:

- Belvoir End Item Specifications
- Technical Data Package Lists (TDPLs)
- Parts Lists (PLs)
- Drawings
- Reference Standards and Specifications
- Status of outstanding Configuration Management actions against any document in the database.

Each user must have a personal log-in ID or Password before accessing the TD/CMS or DSREDS database, which can be obtained from the Information Management Office, Administrative Services Division, ASQNK-BVS, Bldg. 361, 704-1927. TD/CMS requires an additional personal access code, which can be obtained from SATBE-TSO, Bldg. 315, 704-3458.

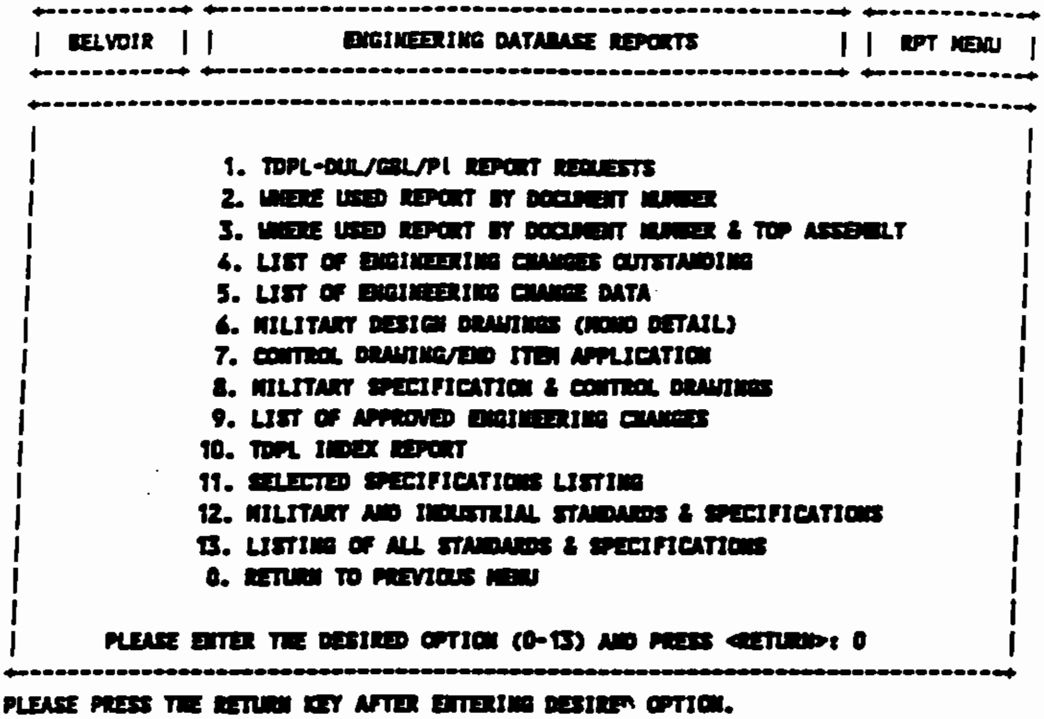
2.3.1 Objectives.

The objectives of the TD/CMS are to ensure adequacy and facilitate processing, handling, and management of technical data by:

a. Providing CM support and control
b. Maintaining TDP quality and data control
c. Minimizing administrative leadtime for data retrieval and preparation of management reports
d. Providing Army and DOD compatibility through use of standard data elements

2.3.2 Reports.

The TD/CMS generates Engineering Database Reports from information contained in TDP and CM documents as indicated on this Selection Menu:



```
+-----------+ +------------------------------------------------+ +-----------+
| BELVOIR  | |            ENGINEERING DATABASE REPORTS          | | RPT MENU  |
+-----------+ +------------------------------------------------+ +-----------+
+----------------------------------------------------------------------------+
|                                                                            |
|                1. TDPL-DUL/GBL/PL REPORT REQUESTS                          |
|                2. WHERE USED REPORT BY DOCUMENT NUMBER                     |
|                3. WHERE USED REPORT BY DOCUMENT NUMBER & TOP ASSEMBLT      |
|                4. LIST OF ENGINEERING CHANGES OUTSTANDING                  |
|                5. LIST OF ENGINEERING CHANGE DATA                          |
|                6. MILITARY DESIGN DRAWINGS (MONO DETAIL)                   |
|                7. CONTROL DRAWING/END ITEM APPLICATION                     |
|                8. MILITARY SPECIFICATION & CONTROL DRAWINGS                |
|                9. LIST OF APPROVED ENGINEERING CHANGES                     |
|               10. TDPL INDEX REPORT                                        |
|               11. SELECTED SPECIFICATIONS LISTING                          |
|               12. MILITARY AND INDUSTRIAL STANDARDS & SPECIFICATIONS       |
|               13. LISTING OF ALL STANDARDS & SPECIFICATIONS                |
|                0. RETURN TO PREVIOUS MENU                                  |
|                                                                            |
|       PLEASE ENTER THE DESIRED OPTION (0-13) AND PRESS <RETURN>: 0         |
+----------------------------------------------------------------------------+
PLEASE PRESS THE RETURN KEY AFTER ENTERING DESIRED OPTION.
```

2.4 DIGITAL STORAGE AND RETRIEVAL ENGINEERING DATA SYSTEM (DSREDS).

The DSREDS database contains Graphic Images of the latest revision for all the original source documents identified and maintained in the TD/CMS. Document images can be viewed through Program Managers Workstation (PMW) or an Image Management Workstation (IMW). Prints of documents in DSREDS may be obtained from:

- Local printer with PMW or IMW.

Each user must have a personal log-in ID or Password before accessing the DSREDS database, which can be obtained from the Information Management Office, Administrative Services Division, ASQNK-BVS, Bldg. 361, 704-1927.

DSREDS is a part of the DOD Computer-Aided Acquisition and Logistic Support (CALS) strategy to enable the integration of digital technical data in standard form for weapon system acquisition, design, manufacture, and support. For guidance in the acquisition of digital technical data, deliverable option, and physical media options see MIL-HDBK-59, Computer-Aided Acquisition and Logistic Support (CALS) Program Implementation Guide.

Other Services Databases included in the DOD CALS program are:

- Air Force;
  Engineering Data Computer Assisted Retrieval System (EDCARS)
- Navy;
  Engineering Data Management Information Control System (EDMICS)

SECTION III

ENGINEERING DRAWINGS

3.1 DEFINITION.

An engineering drawing discloses the physical and functional end-product requirements of an item. All drawings prepared for the Belvoir Research, Development and Engineering Center will adhere to this concept as required in MIL-STD-100.

3.2 REQUIREMENTS.

The first step in the acquisition of engineering drawings is to clearly define the drawing requirements in the contract. It is not enough to order drawings in accordance with MIL-T-31000 and MIL-STD-100. MIL-STD-100 allows many options in preparing engineering drawings, and one must select the options desired and communicate the requirements to the contractor in the Invitation For Bid (IFB) or Request For Proposal (RFP), and finally in the contract. Detail drawings prepared for the Belvoir RD&E Center shall be end-product monodetail type. The TDP Option Worksheet, DD Form 2554-1, shall be marked to specify Monodetail Drawings Mandatory. When conversion of existing multidetail drawings to monodetail drawings is required a Cross-Reference List (Figure III-5) shall be prepared. Before specifying the drawing requirements in a development contract the Project Engineer must review the item's Acquisition Strategy document and the TDP Acquisition Plan to be sure the drawings being acquired will support the intended use. This manual should be used by the cognizant Project Engineer as guidance while explaining the contract drawing requirements to the contractor. The manual may also be provided to the contractor for guidance in the interpretation of the contract drawing requirements. However, the manual itself is not intended to be cited in the contract as a requirements document.

3.2.1 Engineering Drawings and Associated Lists.

Drawing requirements are to be specified in accordance with MIL-T-31000. This specification contains the requirements for TDP elements, including drawings and associated lists as follows:

a. Conceptual design drawings. Defines design concepts in graphic form, and appropriate textual information. Cite DI-DRPR-81001 and reference DD Form 2554-2 in the CDRL (see Figure III-3).

b. Developmental design drawings. Provides sufficient data to support the analysis of a specific design approach and the fabrication of prototype hardware. Cite DI-DRPR-81002 and reference DD Form 2554-3 in the CDRL (see Figure III-4).

c. Product drawings. Provides the necessary design, engineering, manufacturing, and quality assurance requirements information to enable the procurement of an interchangeable item that duplicates the physical and performance characteristics of the original product, without additional design engineering effort or recourse to the original design activity. Cite DI-DRPR-81000 and reference DD Form 2554-1 in the CDRL (see Figures III-1 and III-2).

d. Commercial drawings. Provides the engineering and design information to support end items that are commercially developed, or not developed at Government expense, and are prepared in accordance with the design documentation practices of the contractor. Cite DI-DRPR-81003 and reference DD Form 2554-4 in the CDRL.

e. Special inspection equipment (SIE) drawings. Provides the data required to permit the limited production of SIE which duplicates the physical and performance characteristics of the original SIE. SIE is also known as special test equipment. Cite DI-QCIC-81004 and reference DD Form 2554-5 in the CDRL.

f. Special tooling drawings. Provides the data necessary to produce an item which duplicates the physical and performance characteristics identical to those of the original tooling. Cite DI-DRPR-81008 and reference DD Form 2554-6 in the CDRL.

Appendix A, of MIL-T-31000, provides guidance on completing the TDP option selection worksheets, DD Forms 2554-1 through 2554-8, associated with MIL-T-31000.

An engineering drawing tree identifies the interrelationships of engineering drawings and associated lists that are contained in the TDP for an end item. When a drawing tree is required by the contract statement of work (SOW), the CDRL DD Form 1423 shall list DI-DRPR-80558, Engineering Drawing Tree.

3.2.2 Units of Measurement.

To be determined in accordance with DODI 5000.2, Part 6, Section M, Use of the Metric System.

3.2.3 Drawing Sheet Size and Format.

Shall be in accordance with ANSI Y14.1. The following size drawings are preferred: A(A4), B(A3), C(A2), D(A1). Size E(A0), and F may be used when authorized by the responsible engineering drawing repository. The Belvoir Data Bank Technical Data/Configuration Management System (TD/CMS) is not equipped to process or store roll size drawings.

3.2.4 Distribution Statements.

Distribution statements shall be included on all drawings and associated lists. See MIL-STD-100, and MIL-STD-1806, Marking Technical Data Prepared by or for the Department of Defense.

3.2.5 Dating Drawings.

The method of specifying dates on drawings shall be in accordance with MIL-STD-100E, paragraph 101.24.

3.3 OTHER ACTIVITY DRAWINGS.

Before including a drawing prepared by other activities in the Technical Data Package (TDP), the drawing shall be reviewed for availability, legibility, active status, and for conformance to the requirements of MIL-T-31000 and MIL-STD-100. If it is determined that the drawing is inadequate or not readily available for competitive procurement, a new drawing shall be prepared in accordance with the requirements of this manual. When a redraw is necessary a note should be placed above the title block of the new drawing to call attention to the commonality with the original drawing.

3.4 DRAWING TITLES.

Drawing Titles, Chapter 300, MIL-STD-100, establishes procedures for creating titles for engineering drawings. The Federal Cataloging System establishes a uniform supply language. Each item must be identified by a single name and one National Stock Number, with drawing titles complying with MIL-STD-100 and Federal Item Name Directory for Supply Cataloging (Federal HDBK H6). Top assembly drawing titles shall be the same as the end item specification title. Drawing titles shall contain item names reflecting the appropriate commodity area. Use of approved item names for drawing titles will assist in cataloging, procuring, storing, and distributing of parts and will eliminate duplication while making substitution easier.

When selecting a drawing title, the item shall be placed in a basic grouping by name (Federal HDBK H6). The title shall be specific, using a descriptive noun and, generally, one or two modifiers. Modifiers are needed to restrict the item to a single specific concept. The title shall be "concept name," followed by a comma, followed by "modifier(s)."

Federal HDBK H6 lists all approved item names in the Federal Supply System and contains approved, colloquial, and part names in dictionary format with cross references.

3.5 TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS.

Engineering Drawing Practices, MIL-STD-100, prescribes general requirements for the preparation and revision of engineering drawings and associated lists. Types of Engineering Drawings, Chapter 200, and Associated Lists, Chapter 700, are now based on industry standards ANSI/ASME Y14.24M and ANSI/ASME Y14.34M, respectively. Therefore, a complete understanding of DOD Engineering Drawing Practices necessitates Project Engineer recognition of MIL-STD-100, ANSI/ASME Y14.24M, and ANSI/ASME Y14.34M as being a composite set. Figure III-6 of this manual provides a guide for selecting the type of drawing to be prepared for commercial items included in the TDP.

Types and Applications of Engineering Drawings, ANSI/ASME Y14.24M, defines the types, describes typical applications, and establishes minimum content requirements for:

- Ancillary Drawings
- Layout Drawing
- Detail Drawings: Monodetail and Multidetail
- Assembly Drawing
- Installation Drawing
- Modifying Drawings
- Arrangement Drawing
- Control Drawings
- Mechanical Schematic Diagram

- Electrical/Electronic Diagrams
- Special Application Drawings (i.e., wiring harness, Artwork Master, and Kit drawings)

Additional guidance is provided below for the preparation of Assembly Drawings, Modifying Drawings, and Control Drawings.

3.5.1 Assembly Drawings.

3.5.1.1 Top Assembly and Subassembly Drawings.

a. The Top Assembly Drawing shall reference the associated end item specification, installation drawings, assembly instructions, and wiring and schematic diagrams. Customarily the end item specification is referenced in Note 1 on the Top Assembly Drawing.

b. In a multi-sheet assembly drawing, the first sheet shall include notes and, as space allows, shall depict the item as an assembled unit. Find numbers shall increase as sheets progress and will have no bearing on the order of assembly.

c. For recurring parts in an assembly, the quantity required for each application shall be noted beside the find numbers on the drawing (Figure III-7); the parts list QTY REQD column shall show the total quantity required.

d. Parts lists for assemblies. When justified by planned limited procurement Commercial-Off-The-Shelf (COML) items, see example in Figure III-9, may be specified and identified on the PL by the Vendor CAGE CODE and part number without a supporting Vendor Item Drawing (see paragraph 3.5.3.1). The justification should be made on a case-by-case basis with an analysis of the savings that would be realized due to the increased competition provided by a Vendor Item Drawing vs. the cost of preparing the Vendor Item Drawing. The justification shall be approved by the Producibility Engineering Team Chief, SATBE-TSX. This method of specifying a COML item shall not be used solely to avoid preparing a Vendor Item Drawing.

    (1) Assembly Drawings (Separable) shall have a separate parts list with find numbers in the field of the drawing and a cross reference to the identifying numbers in the separate parts list. (See ANSI/ASME Y14.34M.) (Figure III-10)

    (2) Inseparable Assembly and Detailed Assembly Drawings shall have the materials and parts of the assembly identified in the field of the drawing by find numbers and a cross reference to the identifying numbers in an integral parts list. (See ANSI/ASME Y14.34M.) (Figure III-9)

    (3) Parts specified to non-Government standards, as required by MIL-STD-970, shall have a part number for identification entered in the part or identifying number column of the parts list. For example, see ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, Appendix VII added as a supplement August 3, 1990. Figure III-14 shows the Part Numbering System Covering Standard Items For Government Use from ANSI B18.2.1.

e. Tabulated Assembly Drawings may be prepared, when appropriate, for assemblies other than top assemblies. (See MIL-STD-100, paragraph 202.1, and ANSI/ASME Y14.24M, paragraphs 1.8 and 4.3.) (Figure III-8)

f. Assembly and limiting dimensions with necessary tolerances shall be shown for performance and interchangeability requirements. Overall, or other dimensions controlled by detail part requirements, or other lower order assemblies, may be added as "reference" dimensions for information. If dimensions require inspection at the top assembly, dimensions shall be shown with required tolerances. Use of "reference" dimensions shall be kept to a minimum to preclude revisions when detail parts are changed.

g. All materials that cannot be identified or designated as a part (such as solder or adhesive) shall be noted "As Required" (AR) in the QTY REQD column of the separate or integral Parts List (PL).

h. Below are examples of notes that may appear on assembly drawings:

ALL REQUIREMENTS OF SPECIFICATION
MIL-X-XXXXX SHALL APPLY.

GASKETS, FIND NO. XX AND XX, SHALL
BE SECURED IN PLACE WITH ADHESIVE
FIND NO. XX.

TREAT AND PAINT IN ACCORDANCE WITH
MIL-T-704, TYPE X.

3.5.1.2 Detail Assembly Drawings.

A detail assembly depicts an assembly on which one or more parts are detailed in the assembly view or on detail views. For PL requirements see paragraph 3.5.1.1 d. above. Examples for identifying stock materials and parts on the integral PL are shown in Figure III-9.

3.5.1.3 Inseparable Assembly Drawings.

An inseparable assembly drawing delineates items (pieces) which are separately fabricated and are permanently joined together (e.g., welded, brazed, riveted, sewed, glued, etc.) to form an integral unit (part) not capable of being disassembled for replacement or repair of the individual pieces (MIL-STD-100, paragraph 204.2.1). The inseparable assembly drawing shall fully define the end-product as assembled. Pieces of the inseparable assembly shall be detailed on the inseparable assembly drawing itself in the assembled condition. This precludes the risk of tolerance build-up from the detailed dimensions on the individual pieces and distortions due to the joining process (e.g., welding when they are permanently joined together as an inseparable assembly), and allows the end-product dimensions and tolerances of the inseparable assembly's features-of-size and position to be dominant.

In the event separate detail drawings of the inseparable assembly pieces are prepared, as permitted in MIL-STD-100, paragraph 406.12.3, and ANSI/ASME Y14.24M, paragraph 4.2, the details would be considered processing dimensions, as addressed in ANSI Y14.5M, paragraph 1.4 (f), and marked as NONMANDATORY (MFG DATA). These separate detail drawings are undesirable since their presence increases the cost of maintaining the TDP, and they do not preclude the requirement to fully dimension the inseparable assembly.

3.5.1.4 Dimensioning on Marine Product Drawings.

When preparing Belvoir Marine product drawings the customary practices and guidelines outlined below shall apply.

1. Dimensioning guidelines:

   a. Locating dimensions and size dimensions of components <u>which</u> <u>do</u> <u>not</u> <u>have</u> critical interface characteristics shall be in feet, inches, and fractions of an inch.

      - All dimensions up to and including 72 inches shall be shown in inches. Examples: 1", 1 1/2", 71"; Inch (") marks shall be used. In instances where it is deemed necessary for clarity, the work "inches" may be used in lieu of (").

      - All dimensions above 72 inches shall be shown in feet and inches. Example: 6'-1", 7'-0", 8'-1 1/2"; Feet (') and inch (") marks shall be used.

   b. Size dimensions of components <u>which</u> <u>do</u> <u>have</u> critical interface characteristics (such as machined shafts and bearing housings) shall be shown in decimal inches. Example: .50, 1.50; Inch (") marks shall not be used.

2. Parts List Callout of Stock Components guidelines:

   - Stock sizes of structural shapes and plate shall be assumed to be in inches. Inch (") marks shall not be used.

   Example: ANGLE, 2 X 2 X 1/4 STK
   BAR, FLAT, 1/2 X 3 STK
   PLATE, 1/2 STK

   - When supplemental dimensional data (such as the length of Angle, Bar or Channel and the length and width of Plate) is disclosed in the Parts List, feet (') and inch (") marks shall be used. Dimensions less than or equal to 72 inches shall be expressed in inches. Dimensions greater than 72 inches shall be expressed in feet and inches.

   Example: ANGLE, 2 X 2 X 1/4 STK, 7'-4" LONG
   BAR, FLAT, 1/2 X 3 STK, 18" LONG
   PLATE, 1/2 STK, 6" X 8"
   CHANNEL, C 12 X 30, 18'-6" LONG

- Inch (") marks shall not be used to disclose the stock size of Pipe, Fittings, Threads or Fasteners.

Example: PIPE, SEAMLESS, BLACK, SCHED 40, 1 1/2 NPS
ELBOW, 90°, SOCKET-WELDING, CLASS 3000, 1 1/2 NPS
SCREW, CAP, HEX HD, 1/4-20 UNC-2A X 1" LONG
WASHER, LOCK, HELICAL SPRING, REGULAR, 1/4 NOM
NUT, HEX, 1/4-20 UNC-2B

3.5.2 Modifying Drawings.

ANSI/ASME Y14.24M subdivides modifying drawings into the following types:

- Altered Item Drawing
- Selected Item Drawing
- Modification Drawing

Note: Drawings defining software resident in a firmware device shall be prepared as SOFTWARE CONTROL DRAWINGS for the master media, and ALTERED ITEM DRAWINGS for the firmware. See MIL-STD-100, paragraph 204.2.6 Software and firmware data.

3.5.2.1 Altered Item Drawing.

An altered item drawing delineates the physical alteration of an existing item under the control of another design activity or defined by a nationally recognized standard (see Figure III-11).

This drawing type includes:

- Information necessary to identify the existing item prior to alteration, including the original item identification.

- Complete details of the alteration.

- A unique identifier assigned to the altered item.

- Reidentification marking requirements.

- A parts list when the alteration necessitates any additional item(s) to produce the altered item.

- The notation ALTERED ITEM DRAWING adjacent to the drawing title block.

3.5.2.2 Selected Item Drawing.

A selected item drawing defines refined acceptance criteria for an existing item under the control of another design activity or defined by a nationally recognized standard. It requires further selection, restriction, or testing for such characteristics as fit, tolerance, material (in cases where alternate materials are used in the existing item), performance, reliability, etc., within the originally prescribed limits.

This drawing type includes:

- All information necessary to identify the item prior to selection including the original item identification.
- Full disclosure of the range of restricted characteristics (for example: fit, tolerance, performance, reliability, etc.).
- A unique identifier assigned to the selected item.
- Reidentification marking requirements.
- The notation SELECTED ITEM DRAWING adjacent to the drawing title block.

3.5.2.3 Modification Drawing.

A modification drawing delineates changes to items after they have been delivered. This drawing type includes:

- Instructions for the removal or installation of affected parts.
- Special notes.
- Item identification of affected items prior to modification.
- Effectivity (serial number, aircraft tail number, etc.) of items to be modified.
- Instructions for reidentification of modified items.
- Dimensions necessary to accomplish the modification. Dimensions shall be given from specific features which are readily identified and accessible, rather than from theoretical reference planes.
- A parts list identifying all items required for the modification.
- A list of special tools or equipment required or supplied.
- The notation MODIFICATION DRAWING adjacent to the drawing title block.

3.5.3 Control Drawings.

ANSI/ASME Y14.24M subdivides control drawings into the following types:

- Procurement Control Drawing (does not satisfy DOD requirements)
- Vendor Item Drawing (see Note 1 below)
- Source Control Drawing
- Design Control Drawing (formerly Envelope Drawing)
- Interface Control Drawing
- Identification Cross Reference Drawing

Note 1: When the planned procurement is for limited quantities, i.e., Marine items, Topographic Support System, etc., VENDOR or SOURCE CONTROL DRAWINGS will not be prepared. The item shall be identified on the PL by the manufacturer's CAGE CODE and part number, and COML shall be entered in the specification column. (Figure III-9)

Note 2: Drawings defining software resident in a firmware device shall be prepared as SOFTWARE CONTROL DRAWINGS for the master media, and ALTERED ITEM DRAWINGS for the firmware. See MIL-STD-100, paragraph 204.2.6 Software and firmware data.

3.5.3.1 Vendor Item Drawing.

Formerly called a Specification Control Drawing. A vendor item drawing discloses sufficient information to ensure identification and reprocurement of interchangeable items (see Figure III-12). It includes a list of SUGGESTED SOURCES OF SUPPLY, and the item does not require qualification testing in advance of procurement action. Text may be in either drawing note form or specification format.

This drawing type includes, as applicable:

- Configuration, defined pictorially or by description.
- Dimensions of item envelope and their limits.
- Mounting and mating dimensions and their limits.
- Interface characteristics and their limits.
- Acceptance criteria.
- Performance, maintainability, reliability, environmental, and other functional characteristics.

- Schematic, interconnection or other appropriate diagram to define item function or provide interconnection information.

- The notation VENDOR ITEM DRAWING placed adjacent to the drawing title block.

In preparing the Vendor Item drawing, it is important that interface and space envelope dimensions be defined and that performance criteria be properly selected. If testing in advance of procurement is essential, the part is normally a candidate for SC drawing. Performance criteria provided by the part manufacturer may be insufficient for defining the essential criteria for the part to operate in the end item, in which case the required information must be developed, or it may be excessively detailed to limit the sources for procurement of the part, in which case the unneeded requirements must be eliminated. Features and requirements not normally provided by vendors shall not be added to the drawing.

Requirements for marking of vendors identification numbers on parts and Quality Assurance Provisions (QAPs), when required, shall be included on the Vendor Item drawing. If additional Government identification numbers are required, the requirement should be prepared on an Altered Item Drawing. Performance and feature changes, including painting, shall be documented on an Altered Item Drawing.

If possible, two or more vendors shall be listed on Vendor Item drawings for commonly available parts.

3.5.3.2 Source Control Drawing.

A source control drawing discloses sufficient information to ensure identification and reprocurement of <u>acceptable items</u> (see Figure III-13). It establishes engineering requirements for the selection, and <u>qualification testing in advance of procurement action</u>, and includes APPROVED SOURCES OF SUPPLY.

This drawing type includes, as applicable:

- Configuration, defined pictorially or by description.

- Dimensions of item envelope and their limits.

- Mounting and mating dimensions and their limits.

- Interface characteristics and their limits.

- Acceptance criteria.

- <u>Qualification test requirements</u>.

- Performance, maintainability, reliability, environmental, and other functional characteristics.

- Schematic, interconnection or other appropriate diagram to define item function or provide interconnection information.

- The notation SOURCE CONTROL DRAWING placed adjacent to the drawing title block.

DI-DRPR-81010, Source Control Drawing Approval Request, shall be cited on the Contract Data Requirements List (CDRL), and the Approving Activity shall be identified.

3.5.3.3 Design Control Drawing.

Formerly, in DOD applications, this drawing type was called an Envelope Drawing that evolved into complete design disclosure. A design control drawing discloses the basic technical information and performance requirements necessary for a contractor/subcontractor to complete the detailed design required to develop and produce an item.

3.5.3.4 Interface Control Drawing.

An interface control drawing depicts physical and functional interfaces of related or cofunctioning items.

3.5.3.5 Identification Cross Reference Drawing.

An identification cross reference drawing is an administrative type drawing which assigns unique identifiers that are compatible with automated data processing (ADP) systems, item identification specifications, and provides a cross reference to the original incompatible identifier. For more guidance, see ANSI/ASME Y14.24M.

3.5.4 Diagrammatic Drawings.

Diagrammatic drawings including mechanical, electrical, and electronic schematic diagrams, are special purpose drawings other than end-product drawings used to supplement end-product requirements. Special purpose drawings do not establish item identification.

A diagrammatic drawing delineates features and relationships of items forming an assembly or system by means of symbols and lines (see MIL-STD-100, paragraph 204.1).

In addition to the standards referenced in MIL-STD-100 and ANSI/ASME Y14.24M, the following standard provides guidance for preparation of diagrammatic drawings:

MIL-STD-195 Marking of Connections for Electrical Assemblies

3.5.5 Undimensioned Drawings.

An undimensioned master drawing is a special applications drawing which depicts, to a precise scale, on environmental stable material, information for which dimensioned drawings would be impractical (see ANSI/ASME Y14.24M, paragraph 11.5, and ANSI Y14.31, Undimensioned Drawings).

The following note shall be added to undimensioned drawings (e.g., Printed Circuit (PC) art work, lines and offsets, name plates, and any other undimensioned drawings):

THIS STABLE BASE MATERIAL DRAWING IS NOT
FURNISHED FOR BIDDING PURPOSES, BUT IS LOANED
TO SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT.

3.5.6 Symmetrically Opposite Parts.

Symmetrically opposite parts shall be described in accordance with MIL-STD-100, paragraph 406.12.2.b.

3.5.7 Standardized Military Drawings (SMD).

A SMD is a control drawing for microcircuits in a military application (MIL-STD-100, paragraph 204.2.3). Guidance concerning SMDs is contained in MIL-HDBK-780.

3.5.8 Camouflage Pattern Drawing.

For camouflage pattern drawing requirements see MIL-STD-100, paragraph 204.2.8.

3.5.9 Kit Drawing.

Kit drawings are considered Special Application Drawings in accordance with MIL-STD-100, paragraph 204.1, and will be prepared to meet the requirements of ASME Y14.24M, paragraph 11.6. Also see Package Content Drawing in MIL-STD-100, paragraph 204.2.5, for that packaging which constitutes a synthetic grouping or combination of items, which in themselves do not constitute a functioning, engineering, or product assembly.

3.5.10 Set Listing.

Set Listings shall comply with the requirements of MIL-STD-100, paragraph 204.2.4, Combination of adopted items drawing.

3.6 INTERPRETATION NOTES.

Government drawings shall be prepared and interpreted in accordance with MIL-STD-100. When terms and symbols not contained in MIL-STD-100 are used, applicable reference documents shall be listed in note form on the drawing, such as:

FOR INTERPRETATION OF:

MARKING OF ELECTRICAL AND
ELECTRONIC ITEMS, SEE
MIL-STD-1285.

IDENTIFICATION CODING AND
APPLICATION OF HOOKUP AND
LEAD WIRE, SEE MIL-STD-681.

3.7 IDENTIFICATION NOTES.

Belvoir RD&E Center assembly, subassembly, inseparable assembly, and detail parts drawings shall contain a note specifying the required markings in accordance with MIL-STD-130. This item identification is essential to the configuration description that provides the means to identify and distinguish the item from every other item of supply. Drawings of assemblies having name plates do not require additional markings. Some conditions and examples of identification markings are illustrated below.

a. The following are examples of general notes specifying markings:

STEEL STAMP IN .125 HIGH CHARACTERS:
"97403 ASSY132XXEXXXX"

MARK IN 2.5 mm HIGH OR .094 INCH CHARACTERS:
"97403-132XXEXXXX" USING BLACK STENCIL INK
IN ACCORDANCE WITH A-A-208, AND COVER WITH
CLEAR LACQUER IN ACCORDANCE WITH TT-L-26.

MARK IN ACCORDANCE WITH MIL-STD-130, METHOD
OPTIONAL.

MARK MANUFACTURERS CAGE CODE AND PART NO.
IN ACCORDANCE WITH MIL-STD-130, METHOD
OPTIONAL.

MANUFACTURER'S IDENTIFICATION MARKING SHALL
BE IN ACCORDANCE WITH MIL-STD-130, METHOD
OPTIONAL.

b. When marking details are shown in the field of the drawing accompanied by a leader, the following type of note shall be used:

STEEL STAMP AS SHOWN IN ACCORDANCE WITH
MIL-STD-130.

3.8 GOVERNMENT-FURNISHED PROPERTY (GFP).

Government-Furnished Property (GFP) shall be designated by the notation "GFP" in drawing notes or in the GFP column of the PL (Figure III-10). Full description and nomenclature shall be given for each GFP item. The order of preference for selecting identification number of GFP is listed below:

a. Specification (type, class, model, etc., in description column)
b. Assembly drawing number of GFP item
c. National Stock Number (NSN)

NOTE: The NSN is not an identification number, therefore, when the NSN is used it shall appear in the PL description column and not in the part or identifying number column.

3.9 LOCATION OF NOTES.

The preferred location for general notes is on the right side of drawings as shown in Figures III-7, III-8, etc. The following minimum space shall be left below the revision block before starting notes on the drawing:

A size drawing - 1 inch

B " " - 3 inches

C " " - 3 "

D " " - 5 "

E " " - 6 "

3.10 COMPUTER AIDED DESIGN (CAD) DRAWING REQUIREMENTS (Implementation Instruction - contains mandatory requirements).

3.10.1 Purpose.

To establish and implement the procedure for receiving and maintaining Computer Aided Design drawings within the Belvoir RD&E Center. This is limited to the use of AutoCAD®, version 12 or earlier.

3.10.2 Scope.

These procedures are applicable to all organizational elements for whom the Belvoir RD&E Center receives new drawings and maintains design responsibility for new and existing drawings.

3.10.3 Responsibility.

a. Engineering Data Management Division, Product Assurance and Engineering Directorate, will:

(1) Maintain and publish the CAD Interface Procedures for the Belvoir RD&E Center.

(2) Establish a CAD (vector) database and maintain a filing system of CAD drawings received from contractors. This file will be maintained until DSREDS is capable of handling CAD drawings.

(3) Establish and publish methods and procedures for configuration management of the CAD drawings and associated lists. (Paragraph 3.10.5)

(4) Prepare and coordinate the contract clause(s) (Paragraph 3.10.5.1) that will be required to assure that the contractor delivers CAD generated data/files in addition to the traditional 2-dimensional drawing in a format and on a media that will be acceptable within the CAD database.

(5) Establish a program for converting the active drawings currently in the Belvoir RD&E Center data repository into CAD drawings.

(6) Provide a punched and printed aperture card of the received CAD drawing file with a stamped signature block on the reverse side of the aperture card per MIL-STD-100, Appendix A, Figure A-2, to the appropriate authority for approval signature. The signature block on the CAD drawing itself will initially bear the typed name of the project engineer (or other signing official) that will sign the original aperture card.

(7) Provide a copy of the signed aperture card to the Engineering Support Division (St. Louis), SATBE-SE, who will forward to the Engineering Data Technical Branch, Engineering Data Section, ASQNC-STL-DDFA for scanning into the DSREDS database.

b. Belvoir RD&E Center Division Chiefs, will:

(1) Comply with the CAD requirements and procedures as outlined in this manual.

(2) Assure that contracts in which CAD generated drawings are to be delivered contain the clause(s) exhibited in paragraph 3.10.5.1.

3.10.4 Procedures.

All CAD generated drawings submitted to the Government for processing shall be prepared as specified in paragraph 3.10.5.1 Contract Clause.

3.10.5 Standardization and Engineering Data Team (SEDT) Acceptance Procedures.

a. New Drawings. When new CAD drawings are presented to the SEDT they will be in accordance with paragraph 3.10.5.1. That is, in the required CAD format (AutoCAD®), on the appropriate media, bearing the required file structure and having the required batch file. The drawings shall have been previously previewed by the project engineer and shall be considered to be in appropriate condition for final acceptance. Accompanying the CAD drawings when they are presented to the SEDT, will be a listing of the directory of the files being presented which shall be signed by the contractor presenting the drawings to the Government. The SEDT will then compare the file directory with the listing being presented. The SEDT will then sign the listing as verification of the files received.

Depending upon the contract either SEDT or the contractor will then produce an aperture card corresponding to each file. The back of the aperture card will be stamped with a signature block and a C-size print will be made of each aperture card. Both the print and the aperture card will be forwarded to the project engineer for review and signature on the reverse side of the aperture card. At this point any discrepancy in the drawing which requires alteration of the existing drawing file will be returned to the contractor for correction.

Upon receipt of the signed aperture cards by the SEDT, a diazo will be made from the signed aperture card and forwarded to the Engineering Support Division (St. Louis), SATBE-SE, who will in turn forward to the Engineering Data Technical Branch, Engineering Data Section, ASQNC-STL-DDFA for scanning into the DSREDS database.

b. Subsequent changes to existing CAD drawings. When it is required to change existing drawings which are on file in the data repository the project engineer will request the original drawings as he has in the past. CAD drawings will be provided to the project engineer on the requested media commensurate with the number of drawings required and the facilities of the agent making the actual change.

The project engineer will make arrangements to have the CAD drawing file changed to incorporate the approved ECP and return the altered drawing file and its corresponding aperture card to the SEDT. After confirming that the changes were in accordance with the ECP, the SEDT will obtain the appropriate signature on the stamped back of the "NEW" aperture card.

When the aperture for a changed drawing has been signed, a diazo copy will be furnished to the Engineering Support Division (St. Louis), SATBE-SE, for processing as in paragraph a. above.

The altered CAD files will be stored in the data repository on an optical disk and be available to the project engineer upon request.

Note: When drawings are being changed, project engineers are encouraged to convert them to CAD format (AutoCAD® drawing format).

c. Drawings which are tracings and are changed to CAD drawings. Drawings which are in hard copy format, i.e., tracings, pencil on mylar, pencil on cloth, ink drawings, etc., will be furnished to the project engineer in accordance with the existing SEDT procedures. If the drawing is changed to a CAD format during the course of processing, the procedure of paragraph b. shall apply to the CAD drawing.

3.10.5.1 Contract Clause.

When the contractor shall be required to deliver CAD drawings in response to a contract requirement, the following is a suggested format for a contract clause to comply with the procedures in this manual:

The contractor shall generate, store, modify and retrieve product drawings and associated lists using CAD techniques in accordance with the following:

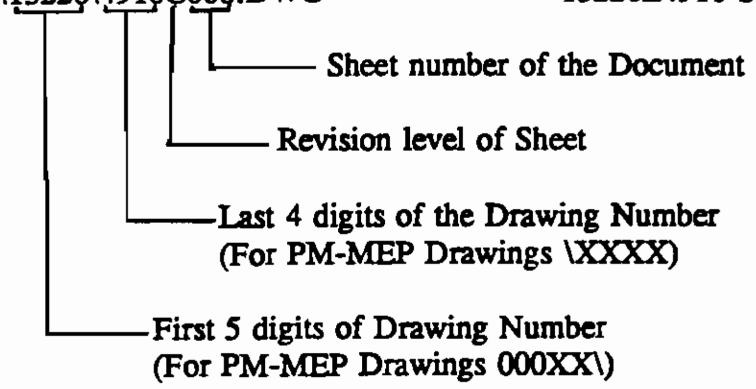
a. All CAD generated product drawings and associated lists submitted to the Government for processing shall:

(1) Be formatted in AutoCAD® and in a drawing file (filename.DWG) format.

(2) Have a unique file name structured as follows and using subdirectories as allowed by MS/DOS:

A:\(First 5 digits of Doc#)\(last 4 digits of Doc + Rev Ltr + 3 digit page#).DWG

Filename	Drawing Number
A:\13226\4513A001.DWG	13226E4513 Sheet No. 1
A:\13226\4910C008.DWG	13226E4910 Sheet No. 8



(3) Shall include an attribute file, i.e., NEWAPCD.DWG, that is physically located outside the periphery of the drawing border and consists of the following attribute tags:

	Attribute Tag	File Size (Characters)	Sample Entry
(a)	DOC-TYPE	2	DW

Use the following sample document types:

DW	Drawings and NORs
DL	Data List
EL	Inspection Equipment List
GL	Gage List
IL	Index List
ML	List of Material
PL	Parts List
LD	List of Drawings
LL	List of Parts
PP	Procurement Package
IN	Revision Notices or Engineering Orders to Drawings/Documents
SQ	Source Qualification Procedure

(b)	DOC-NUMBER	10	13226E4610

Government assigned drawing number, ECP number, Approval Sheet number, Spec number, TA number, etc.

	Attribute Tag	File Size (Characters)	Sample Entry
(c)	CODE-IDENT-NUM	5	97403
	Appropriate CAGE no.; "97403" for BRDEC.		
(d)	SHEET-NUMBER	3	003
	Sheet number of the drawing or document.		
(e)	REVISION-LETTER	1	A
	Revision letter of the drawing or sheet.		
(f)	NUMBER-OF-SHEETS	3	012
	Number of drawing or document sheets.		
(g)	MICROFILM-FRAME-NUMBER	2	01
	This will always be 01.		
(h)	NUMBER-OF-FRAMES	2	01
	This will always be 01.		
(i)	RIGHTS	1	U
	This will normally be "U" for unlimited rights.		
(j)	CONTROL-ACTIVITY	2	DA
	This will normally be "DA" for Department of Army.		
(k)	CARD-CODE	1	T
	Should be "T" for drawings and NORs, "H" for other documents.		
(l)	SECURITY-CLASS	1	N
	Should be: "N" for Unclassified. "C" for Confidential. "S" for Secret.		

	Attribute Tag	File Size (Characters)	Sample Entry
(m)	DWG-SIZE(LETTER)	1	D

Should be "A", "B", "C", "D", or "E"

Note: For metric sizes A4, A3, A2 and A1 substitute the following: A for A4, B for A3, C for A2, D for A1.

(n)	DWG-SIZE(NUMBER)	1	5

Should be:

"1" for drawing size "A", 8.5" x 11"
"2" for drawing size "A", 11" x 8.5"
"3" for drawing size "B", 11" x 17"
"4" for drawing size "C", 22" x 17"
"5" for drawing size "D", 34" x 22"
"6" for drawing size "E", 44" x 34", and "F", 28" x 40".

Note: After the attribute file is added, the drawing must be zoomed up to fill the display area on the monitor before storing the drawing file.

(4) Use AutoCAD® standard Roman font for all lettering.

(5) Lettering shall be a minimum height of .165 inches.

(6) Drawing sizes shall be A thru E. Larger sizes shall be accepted on an exception basis.

(7) Have layer names and use in the following sequence:

Layer Name	Use
0	Do not use. For use by administrator.
FORM	Shall contain the complete drawing form.
TITLE	Shall include all title block entries.
OBJECT	Shall contain the physical drawing of the item excluding hidden lines. This shall always be the fourth layer and shall always be the color blue and yellow to facilitate automated production of the aperture card.
HIDDEN	Shall contain only the hidden lines of the physical drawing.

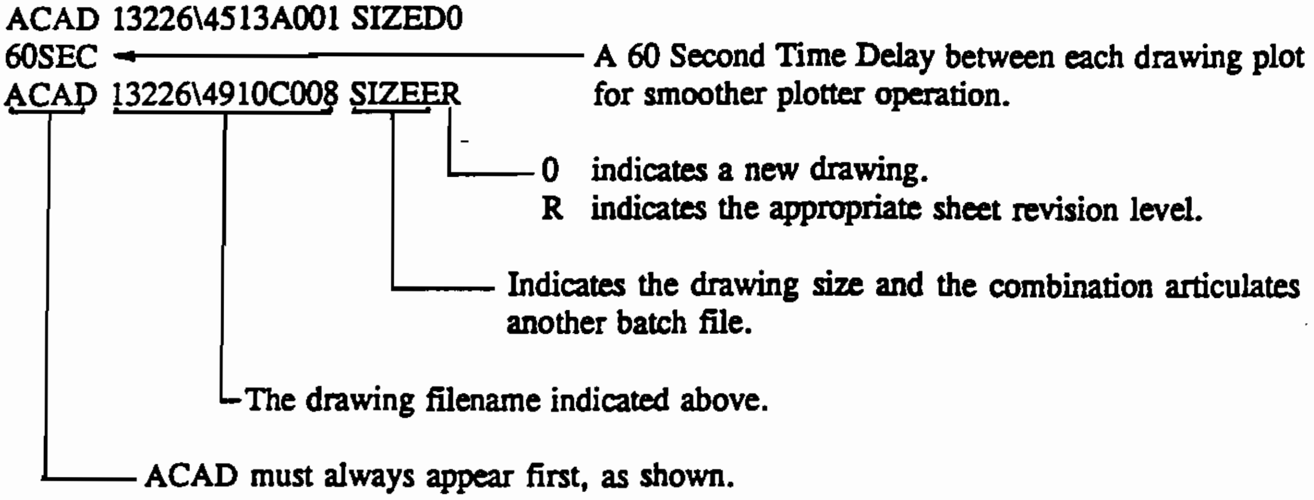
Layer Name	Use
DIMENSION	Shall contain all dimensioning information including true position dimensioning.
CALLOUTS	Shall contain all assembly callouts and their extension lines and the associated table(s).
CTRLINES	Shall contain all center lines.
PHANTOMLN	Shall contain all phantom lines.
NOTES	Shall contain all notes appearing within the borderlines of the drawing.
VIEWS	Shall contain all section and view identifying information.
WELDING	Shall contain all welding symbols and their extension lines any other welding information appearing on the body of the drawing exclusive of the drawing notes.
HYDRAULIC	Shall contain all hydraulic, pneumatic and/or plumbing symbols and associated information appearing on the body of the drawing exclusive of the drawing notes.
ELECTRICAL	Shall contain all electrical information pertaining to wiring such as wiring symbols used for building layouts or wiring harnesses for equipment.
PLUMBING	Shall contain all information pertaining to the physical piping and/or tubing as applied to water, fuel, air and/or waste lines.
HVAC	Shall be used for ducting and other information directly related to heating and air conditioning information within a structure.
COMM	Shall be used to show all information directly related to telephone lines and/or communication equipment.
LIGHTING	Shall be used for information pertaining to lighting primarily for structural applications.
SCENIC	Shall be used for background or other associated information such as existing survey locations for architectural applications or mating parts of an assembly that are used for reference information only.

Layer Name	Use
MATERIAL	Shall contain the crosshatching for material.
DWGDATA	Shall contain all necessary information pertaining to the drawing but not normally displayed on the drawing.
PUPRDATA	This layer is reserved for the attribute file described above and will be used to capture the punch and print data to be used in processing the aperture card.
PHOTO	Shall contain all markings excluding those appearing on the drawing form that may be used to aid the photographer to align the drawing and provide cutting and trimming information. This layer shall be frozen when delivered to the Government.

b. Drawings are currently accepted in the following media formatted in MS/DOS:

- 360 Kilobyte 5-1/4" diskettes
- 1.2 Megabyte 5-1/4" diskettes
- 40 Megabyte Passport Plus removable hard drive
- 1.44 Megabyte 3-1/2" diskettes
- 650 Megabyte 5-1/2" SONY erasable magneto optical disc

c. Each disk or tape presented shall have a file named APP.BAT that will contain information in the following format:



```
ACAD 13226\4513A001 SIZED0
60SEC
ACAD 13226\4910C008 SIZEER
```

A 60 Second Time Delay between each drawing plot for smoother plotter operation.

0 indicates a new drawing.
R indicates the appropriate sheet revision level.

Indicates the drawing size and the combination articulates another batch file.

The drawing filename indicated above.

ACAD must always appear first, as shown.

NOTE: A line must be generated for each drawing included and APP.BAT must appear in the same directory/subdirectory as the drawing file.

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SECTION IV

REVISION OF ENGINEERING DRAWINGS

4.1 GENERAL.

Drawing revisions shall be made in compliance with the requirements of MIL-STD-100, and this manual. Requirements for Engineering Change Proposals (ECPs), Request For Deviations (RFDs), Request For Waivers (RFWs), and Notices of Revision (NORs) are provided in MIL-STD-973, and Belvoir RD&E Center SOP 70-37. Examples of completed NORs, including "cloud" NORs, are shown in Belvoir RD&E Center SOP 70-37, 7 NOV 1990. Cloud NORs are marked drawings prepared for the more complex changes and shall be of quality suitable for microfilming.

Drawing changes may be Government initiated or contractor requested, both via an approved ECP. A contractor may submit RFDs or RFWs that do not require a drawing change. RFDs may be allowed for all parts to be fabricated under a contract and RFWs for specified parts (identified by serial numbers) that do not meet drawing requirements but are usable with or without rework. The RFD/RFW is submitted on DD Form 1694.

Unless otherwise specified, when revising an existing engineering drawing or referenced document the most recently approved graphic symbols, designations, letter symbols, abbreviations and drawing practices shall be used for any changes or revisions. Superseded symbology, etc., already appearing in the engineering drawing and in accordance with formerly approved standards should remain unchanged, provided the interpretation is clear and unambiguous (MIL-STD-100, paragraph 601.3). This is particularly applicable to changes, such as, ANSI Y14.5 to ANSI Y14.5M, and CAGE numbers vs FSCM and Code Identification.

4.2 REVISION PROCEDURES.

4.2.1 Change Forms.

Engineering Change Proposal (ECP) DD Form 1692, with supporting Notice of Revision (NOR) DD Form 1695, or Specification Change Notice (SCN) DD Form 1696, as applicable, is used for describing, as well as obtaining approval for the changes. The above change data may be prepared by the Government or by contractors. After recommendation of changes by the Belvoir RD&E Center project engineer, final acceptance will be made by the Configuration Control Board based on input from all concerned Government offices.

When a revision or change to an ECP is necessary the procedures outlined in MIL-STD-973, paragraph 5.4.2.2.3.2, will be followed.

NOTE: When processing a drawing changed by one or more ECPs, each ECP will occupy a single line on the revision block with a separate revision letter associated with each ECP. The Rev date will be the approval date of the applicable ECP.

4.2.1.1 Revision Approval. The NOR will be signed and dated in the "Activity Authorized to Approve Change for Government" blank at the time the NOR is prepared/approved. The initials of the signee will be transferred to the "APPROVED" column of the revision block of the revised drawing at the time the revision is accomplished.

4.2.1.2 Revision Date. The "DATE" column of the revision block of the drawing documents final acceptance of proposed changes. This date (on all CAD or manually revised drawings) is to be the date the ECP is approved and signed by the Configuration Manager or Belvoir Division Chief as applicable. This is the latest date which appears in the approval block at the bottom of the ECP.

4.2.1.3 Revision Signature. The revised drawings will be initialed by the engineer responsible for the final review (that person who signs the NOR in the "Activity Accomplishing Revision") as follows:

a. Manually Revised Drawings. The engineer will initial in or beside the "APPROVED" column of the revision block on the drawing. The original drawing will be microfilmed and both the aperture card and original drawing stored.

b. CAD Revised Drawings. The engineer or authorized representative will initial the back of the aperture card after the original drawing has been microfilmed. CAD drawings themselves will be destroyed at this time and the aperture card will then represent the original drawing. Original signatures or initials are not permitted on CAD drawings due to storage space limitations.

4.2.2 Change Justification.

Belvoir RD&E Center requires justification codes on all ECPs including Class II. Codes for Class II normally will be "A" for record change, spec, and TL updates, or "D" for deficiency corrections. Other applicable codes are listed in MIL-STD-973, paragraph 5.4.2.3.2, Class I ECP justification codes.

4.2.3 CAD Reproductions.

Reproduction of drawings maintained and controlled by a CAD system shall not be considered redraws. Hard copy drawings that are derived from and maintained as digitally stored product definition data shall include the following note beneath the last entry of the revision block area:

CAD MAINTAINED. CHANGES
SHALL BE INCORPORATED BY
THE DESIGN ACTIVITY.

See MIL-STD-100, paragraphs 510 and 511.

4.2.4 Revision Accomplishment. After the drawing has been revised, the drawing and the NOR will be reviewed to certify that the revision has been accomplished as designated in the NOR. The NOR will be signed and dated in the "Activity Accomplishing Revision" blank at the time of the review. This date will no longer be in agreement with the "DATE" column of the revision block of the revised drawing as specified in SOP 70-37 (Rev. 1990).

4.3 REDRAWN OR REPLACED DRAWINGS.

Additional procedures are defined in paragraphs 4.3.1 thru 4.3.9 for variations not covered in MIL-STD-100.

4.3.1 Damaged or Lost Originals.

Drawings which are controlled and stored in the data repository shall be replaced if damaged or lost. For replacement, a photocopy from the microfilm can be used instead of redrawing. For computer generated drawings, a new plot print may be provided. The replacement shall be handled as follows:

a. The duplicate original shall be of quality suitable for microfilming and reproduction. Touch up is permissible.

b. The duplicate original shall be updated in the revision block one revision higher than original drawing. The entry in the revision block shall read (as applicable):

"NEW ORIGINAL WITHOUT CHANGE,
OR "NEW ORIGINAL WITH CHANGE,
SEE ECP NO. XX-XXXX".

c. Redrawn drawings shall contain printed names in place of signatures appearing on original drawing, and the dates in the title block shall be the original date. For redrawn drawings where design responsibility has been transferred from another activity, see MIL-STD-100, paragraph 406.9.

d. The original drawing if available, will be destroyed by the Standardization and Engineering Data Team.

4.3.2 Revised and Redrawn Original or Copied and Revised Original.

When extensive changes are necessary but new identification is not required, preparing a new original by using photocopy or other methods may be more expedient than revising the current original. The ECP and NOR shall describe the revision.

The following procedures shall be used for revised and redrawn originals:

a. Prepare the new original in accordance with practices set forth in this manual.

b. The new original shall be updated one revision higher than original drawing. Data to be entered in new original blocks shall be as illustrated below:

REVISIONS		
ZONE	LTR	DESCRIPTION
	X	REDRAWN WITH CHANGE. SEE ECP NO. XX-XXXX

c. The old original shall contain the following revision block data without a revision letter:

		REPLACED WITH CHANGE BY REVISION X, SEE ECP NO. XX-XXXX

Also, "SUPERSEDED" shall appear above title block in .25 inch high characters.

4.3.3 Deleted/Superseded Sheets of Multi-Sheet Drawing(s).

Single sheets of multi-sheet drawings no longer required will be DELETED or SUPERSEDED. Do not OBSOLETE a sheet until entire drawing is OBSOLETE.

When single or multiple sheets of a multi-sheet drawing are no longer required for service, procedures shall be as follows:

a. When adding or deleting sheets of a multi-sheet drawing use the procedures outlined in MIL-STD-100, paragraphs 604.2.1a., and 604.2.2a. If any, but not all, interior sheets of a multi-sheet drawing are no longer required, follow procedures as illustrated by example (in which sheets 3 and 4 of a 5-sheet drawing are deleted/superseded):

(1) ECP shall describe changes.

(2) Entries to sheet 1, Status of Revisions Block, shall reflect changes to respective sheets in drawing as follows:

SHEETS					STATUS OF REVISIONS			
5	4	3	2	ZONE	LTR	DESCRIPTION	DATE	APPROVED
A	-	-	-		A	SEE ECP NO. 81HE0000	22 Jul 81	LEC
		B	-		B	SEE ECP NO. XX-XXXX		

(3) In title block, "SH 1 of 5" would be changed to "SH 1 of 3".

(4) Since sheet 3 will be replaced by a renumbered sheet, data to be entered in sheet 3 revision block shall be as illustrated below (without a revision letter):

	REPLACED WITH CHANGE BY REVISION B, SEE ECP NO. XX-XXXX

Add "SUPERSEDED" above title block in .25 inch high characters.

(5) Since sheet 4 will not be replaced with a renumbered sheet, data to be entered in sheet 4 revision block shall be as illustrated below (without reference to revision letter):

		DELETED, SEE ECP NO. XX-XXXX

Add "DELETED" above the title block in 0.25 inch high characters.

(6) Prepare photocopy or other acceptable copy of sheet 5.

(7) Original sheet 5 shall have following entry:

	B	REPLACES SHEET 3 REVISION - WITH CHANGE, SEE ECP NO. XX-XXXX

In title block "SH 5" would be changed to "SH 3".

(8) Copied sheet 5 shall have following data entered in its revision block (with a revision letter):

		THIS SHEET BECAME SHEET 3 WITH CHANGE, WAS SHEET 5, SEE ECP NO. XX-XXXX

Add "COPY" and "SUPERSEDED" above title block in .25 inch high characters as applicable.

b. If any consecutive, last sheets of a multi-sheet drawing are no longer required, follow procedures as illustrated by example (in which sheets 4 and 5 of a 5-sheet drawing are deleted):

(1) ECP and NOR shall describe changes.

(2) Entries to sheet 1, Status of Revisions Block, shall reflect changes to respective sheets in drawings as follows:

SHEETS					STATUS OF REVISIONS			
5	4	3	2	ZONE	LTR	DESCRIPTION	DATE	APPROVED
A	-	-	-		A	SEE ECP NO. 81HE0000	22 Jul 81	LEE
		-	-		B	SEE ECP NO. XX-XXXX		

"SH 1 of 5" would be changed to "SH 1 of 3" in title block.

(3) Data to be entered in both sheets 4 and 5 revision blocks shall be as illustrated below (without reference to a revision letter):

		DELETED, SEE ECP NO. XX-XXXX

Add "DELETED" above title block in .25 inch high characters.

4.3.4 Completely Filled Revision Block Area.

If the revision block area on a drawing has been completely filled and another revision needs to be incorporated, procedures shall be as follows:

a. Prepare photocopy (mylar), or other acceptable copy, of the original of quality suitable for microfilming and reproduction.

b. Replace all existing revisions on the photocopy with the next higher revision letter and the following change description:

"REPLACED WITH CHANGE, SEE ECP NO. XXXXXXXX."

c. Incorporate NOR changes to photocopy, and add NOR entry to "DELETE REVISIONS ___ thru ___", with reason "INADEQUATE SPACE EXISTS FOR ADDITIONAL REVISIONS."

d. Place "REPLACED BY REV X." in .25 inch high characters above the title block of the original.

4.3.5 Changes Requiring New Identification.

When an item must be changed and distinguished from the original item by a new identification number (as specified in MIL-STD-100, paragraph 402.14), generate the new drawing by one of the following methods:

a. Prepare a new original in accordance with practices set forth in this manual.

b. Obtain photocopy or other acceptable copy from original item drawing. Make necessary changes on copy to create new item, enter new identification number, and clear revision block of all previous information.

4.3.6 Monodetail Drawings From Multidetail Drawings.

When a set of monodetail drawings is made from one or more multidetail drawings, the monodetail drawings shall conform to all requirements of this manual.

A cross-reference listing of the multidetail and monodetail items shall be prepared for use in updating the automated records and in procurement of spare parts. The standard Cross-Reference List form shall be completed as illustrated in Figure III-5 and as follows:

a. Each sheet of Cross-Reference List shall be numbered and the total number of sheets shown on Sheet 1.

b. Part or item entries shall be in numerical order by multidetail drawing number, sheet, dash, and find number.

c. In column headed "SYM", each item shall be assigned an applicable symbol from interchangeability code contained in DOD 4140.26M - VOL 1. Interchangeability code symbols are:

OW - One way interchangeability means that the new item may be used to replace the original item.

TW - Two way interchangeability means that the new item and the original item can replace each other.

NI - Not interchangeable means that the new item and the original item cannot replace each other.

4.3.7 Returning Drawings to File.

Revised, new, and obsolete originals with authorizing ECP (as applicable) shall be separated from unchanged originals when delivered to the data repository. All unrevised sheets/originals shall be submitted to the Standardization and Engineering Data Team at the same time revised sheets, new sheets or obsolete originals are submitted.

This procedure is necessary to expedite recording, microfilming, reproduction, and distribution as required. When a multi-sheet original is revised, the revised Sheet 1 and other revised sheets (along with authorizing ECP) shall be delivered together, whereas unrevised sheets shall be delivered with unchanged originals. All sheets shall be grouped by size and placed in numerical order within size groups.

4.3.8 Updating of Associated Lists.

The TL, PL, and other associated lists are generated by the TD/CMS as outlined in Section II. Revised lists are made available after updating data from returned original drawings and supporting documents, including ECP, NOR, SCN, Configuration Control Board (CCB) action and Cross-Reference List.

4.3.9 Distribution of Drawings.

Distribution of copies of revised drawings and associated lists shall be made only after original revised drawings and supporting documents have been recorded, microfilmed, and the original drawings placed in the data repository.

4.3.10 Revision Letters and Drawing Numbers.

The letters "I", "O", "Q", "S", "X", and "Z" shall not be used for drawing revision letters or when developing new drawing numbers that contain letters (see MIL-STD-100).

4.3.11 Obsolete or Superseded Items.

Drawings will not be permitted to "float" within the data system. Drawings and parts lists with single applications, when deleted from the TDP and/or applicable drawings, shall be provided dispositions based on expected future use of the parts as either OBSOLETE or SUPERSEDED (LIMITED ACTIVE). The ECP Engineering Evaluation shall specify the disposition of the documents and appropriate NORs shall be included in the ECP package.

The ECP Engineering Evaluation Form Section 7 (Effect on Logistics) must address interchangeability of the deleted part and any existing or new design that supersedes or replaces it. If the item deleted is a stocked item, appropriate disposition of the inventory must be specified.

When the entire TDP is superseded or made obsolete, all drawings and associated parts lists in the TDP must be examined to determine proper disposition based on single- or multiple-use applications.

4.3.11.1 Obsolete Items.

When a drawing and associated parts list are no longer required for service, they shall be designated OBSOLETE. The procedure to obsolete documents is as follows:

a. ECP shall describe action being taken.

b. Data to be entered in revision block on sheet or sheets shall be as illustrated below, with the next revision letter:

	X	OBSOLETE, SEE ECP NO. XX-XE-XXXX

c. Items shall have the following notes added above the title block in .25 inch high characters on sheet or sheets as applicable:

   (1) Items replaced by another existing or new item, which is physically and functionally interchangeable and intended for stocking as a fielded replacement, shall have "OBSOLETE, USE INTERCHANGEABLE PART NO. 132...." added.

   (2) Items with no field application and/or items previously used in the field with no replacement necessary upon failure shall have "OBSOLETE - NO REPLACEMENT" added.

NOTE: When the entire TDP is made obsolete, the note must also be applied to the TL, Top Assembly PL, and above the Title Block of the Top Assembly on all sheets.

4.3.11.2 Superseded Items.

Items replaced by another existing or new item which provide a design improvement but are not interchangeable shall be designated SUPERSEDED (LIMITED ACTIVE). These items will remain active to support procurement of repair parts.

a. ECP shall describe action being taken.

b. Data to be entered in revision block on sheet or sheets shall be as illustrated below, with the next revision letter:

	X	SUPERSEDED, SEE ECP NO. XX-XE-XXXX

c. Items shall have "SUPERSEDED - ACTIVE FOR PROCUREMENT OF REPAIR PARTS ONLY - SEE NONINTERCHANGEABLE PART NO. 132..." added above the title block in .25 inch high characters on sheet or sheets.

NOTE: When the entire TDP is superseded, the following note must be applied to the TL, Top Assembly PL, and above the Title Block of the Top Assembly on all sheets:

> "SUPERSEDED - ACTIVE FOR PROCUREMENT OF REPAIR
> PARTS ONLY - FOR NEW PROCUREMENT OF END ITEM
> SEE TL-XXX-X-XXXXX/TAXXXXXXXXX."

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SECTION V

PRODUCIBILITY ENGINEERING AND PLANNING (PEP)

5.1 GENERAL.

Concern for producibility must be exercised at the start of the conceptual phase and will influence the entire design effort from that point on in every part of the life cycle. The purpose of PEP measures is to insure that materiel designs reflect good producibility prior to release for production. See MIL-HDBK-727, Design Guidance For Producibility.

5.2 APPLICABILITY.

PEP applies to all program levels and is funded with research, development, test, and evaluation (RDT&E) funds.

5.3 DEFINITIONS.

For the purpose of this manual, the following definitions apply:

Acquisition Strategy (AS). A conceptual framework for conducting materiel acquisition, encompassing broad concepts and objectives that direct and control overall development, production, and deployment of a materiel system.

Concurrent Engineering. A philosophy which calls for a multi-disciplinary team formed early in the concept exploration phase to assure all necessary considerations are taken in planning and implementing the most efficient and effective acquisition life cycle for a program/project. The team members will be headed by the responsible project engineer and include representatives from reliability, producibility, human factors, safety, and all other Center disciplines that have input.

Design To Cost (DTC). A discipline used to establish cost as a parameter equal in importance with technical requirements and schedules throughout the design, development, production, and operation of weapon systems, subsystems, and components.

Functional Configuration Audit (FCA). The formal examination of functional characteristics of a configuration item, prior to acceptance, to verify that the item has achieved the requirements specified in its functional and allocated configuration documentation (MIL-STD-973).

Life Cycle Cost (LCC). The total cost to the Government of a system over its entire useful life. It includes the cost of development, production, support, and where applicable, disposal.

Physical Configuration Audit (PCA). The formal examination of the "as-built" configuration of a configuration item against its technical documentation to establish or verify the configuration item's product baseline (MIL-STD-973).

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 (MIL-STD-1528).

Producibility Engineering and Planning (PEP). The engineering and production planning measures undertaken to ensure a timely transition from concept exploration to low risk, economical production (MIL-STD-1528).

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 (MIL-STD-1528).

Production. Converting raw materials into products or components through a series of manufacturing processes. The term applies to all phases of manufacturing from the conceptual through the production phases. It includes:

Production engineering
Production control
Quality assurance
The determination of resources required.

Production Engineering. Production technical support given to the manufacture of an equipment item. It involves both Production Process Engineering and Engineering Data Management (EDM). Production Process Engineering includes the review, selection and validation of manufacturing processes and production equipment; production planning; technical review and approval of Technical Data Packages (TDPs); and the conduct of pre-award surveys. EDM includes the review and approval of Engineering Change Proposals (ECPs) and updating the TDP to incorporate the approved ECPs; review and granting of waivers and deviations; providing Engineering in Support of Production (EISP); and conducting Physical Configuration Audits (PCAs). Also see MIL-HDBK-727, paragraph 1-4.2.1 Production/Manufacturing Engineering.

Technical Data Package (TDP). See paragraph 1.1, this manual.

Technical Data Package Acquisition Plan (TDP AP). The TDP AP may be a stand alone document or it may be incorporated into the Configuration Management Plan (CMP). This document will specify, but is not limited to, the following: types and design disclosure levels of drawings, type of configuration management, PEP measures to be accomplished, types of specifications, estimated costs and other resource requirements associated with TDP acquisition, and a schedule for developing and delivering the TDP to the acquiring activity.

5.4 PEP OBJECTIVES.

The objectives of the PEP effort (MIL-HDBK-727) includes, but is not necessarily limited to, the following:

1. Develop technical data packages.
2. Design and prove out special purpose production equipment and tooling.
3. Computer modeling simulation.
4. Engineering drawings.
5. Engineering, manufacturing, and quality support information.
6. Details of unique processes.
7. Details of performance ratings, and dimensional and tolerance data.
8. Manufacturing assembly sequence method sheet schematics.
9. Mechanical and electrical connections wiring diagram.
10. Material and finishing information.
11. Inspection, test, and evaluation requirements.
12. Calibration information.
13. Quality control data.

5.5 PEP MEASURES.

PEP measures (MIL-HDBK-727) are mostly software oriented and in general include, but not limited to, the following:

1. Examining the total technical and procurement data packages for:

    a. All dimensions and associated tolerances, parallelism, perpendicularity, etc.
    b. Appropriateness and availability of material selected
    c. Unique or peculiar processes and process specifications
    d. Special handling
    e. Special tooling
    f. Packaging and packing information
    g. Quality control data and procedures
    h. Adequacy of surface and protective finishes
    i. Inspection, test, and evaluation requirements
    j. Maintenance engineering/integrated logistics support
    k. Requirements for in-line production test equipment and end item test equipment
    l. Manufacturing assembly sequences
    m. Suitability for second source identification
    n. Cost-effectiveness analysis
    o. Calibration equipment and information
    p. Adequacy of mechanical and electrical connections.

2. Exploitation of foreign manufacturing technologies for enhanced producibility.

3. Performing risk analysis of new manufacturing processes.

4. Computer modeling or simulation of manufacturing processes to assess producibility.

5. Planning for plant layouts.

6. Applying value engineering principles and methodology throughout development.

7. Examining processes (as created by the combination of equipment and operation) to determine hazards to man or environment; preparing environmental impact assessments (EIA) and environmental impact statements (EIS) as appropriate.

8. Determining the need for a manufacturing technology development (MTD) or manufacturing methods and technology (MMT) effort (see DODI 5000.2, Part 5, Section E, Industrial Base).

9. Computer-aided manufacturing planning.

10. Producibility plan supportive of initial production facilities requirements.

The PEP measures actually addressed on Belvoir RD&E Center programs varies depending upon whether the development and production contractor are the same, or if they are two different contractors.

5.6 TECHNICAL DATA PACKAGE (TDP) DEVELOPMENT.

The TDP is the most important product of the Belvoir RD&E Center. The first PEP objective and first PEP measure is the development of TDPs, and the examination of the total technical and procurement data packages to insure that the designs reflect good producibility prior to release for production. The TDP requirements must be established and justified in the Acquisition Strategy (AS) document.

5.6.1 **Acquisition Strategy.** The AS document is the master plan for program execution from program initiation through post-production support. The AS plan will provide the justification for Product drawings in accordance with MIL-T-31000. For complete details on the AS requirements, see DODI 5000.2, Part 5, Section A. The Acquisition Strategy Report describes in greater detail the proposed AS and the rationale and justification for its selection as outlined in DOD 5000.2-M, Defense Acquisition Management Documentation and Reports.

5.6.2 **TDP Acquisition Plan.** Each program or project must have a TDP acquisition plan developed as a companion document to the AS document. The TDP acquisition plan may be a stand alone document or it may be incorporated into the Configuration Management Plan (CMP). The TDP acquisition plan must provide:

1. Documentation of the TDP requirement within the framework of the planned acquisition strategy for the materiel.

2. Identification of and justification for the level of design disclosure required in the drawings, and types of specifications required in the TDP.

3. A statement of the extent to which the data to be acquired will support future competition or other TDP uses, and a justification supporting any plan which does not provide for the acquisition of data suitable to support competitive reprocurement.

4. Schedules for data delivery, a drawing breakdown list, a schedule of incremental submission of drawings and preparation of prototype inspection reports.

5. A plan for Government reviews and procedures to be used for data approval during the development of the TDP.

6. Resources required and a financial plan that delineates sources and availability of funds to support both TDP acquisition and subsequent TDP maintenance.

7. A plan to assure that interface control documentation is accessible and properly distributed.

8. Plans for PEP efforts that will be accomplished to assure the producibility aspects of the TDP. PEP is required for new development, NDI (MACI), P3I, or any Acquisition Strategy that requires development.

9. Operations Security (OPSEC) and security classification guidance for TDPs, to include security requirements for handling, storage, transmission, marking, destruction, and sale or release to foreign governments and representatives.

5.6.3 **PEP Statement of Work (SOW).** The PEP SOW specifies the tasks that the contractor must perform. It does not discuss, describe, or order any data deliverable to the Government. However, the development of data such as plans or internal management reports are a necessary part of the contractor efforts and may be discussed in the SOW. The requirement for deliverable products as a result of performing the work identified in the SOW would be identified on the contract data requirements list (CDRL), DD Form 1423. Following is a suggested PEP SOW only and, if used, must be tailored to the specific needs and requirements of each individual program:

X. PRODUCIBILITY ENGINEERING AND PLANNING.

X.1 GENERAL. The contractor shall perform Producibility Engineering and Planning (PEP): those producibility engineering and production planning tasks undertaken during development to insure a smooth, timely, and cost-effective transition of the system from development to economical production. Producibility engineering and planning must be an integral part of the engineering development efforts to allow early identification of potential producibility and production problems. Producibility engineering and planning efforts also result in recommendations of design, specification, production, schedule, or trade studies which will improve and enhance future production of the system. Producibility engineering and planning tasks also include those actions required to try-out and prove that the specified manufacturing resources will perform as expected during production.

X.1.1 PURPOSE. Producibility engineering and planning ensures the design, development, and planning efforts during development result in adequate, accurate, clear, concise, and current technical data package. A TDP from which an economical cost-effective, reliable, and repeatable product at rated production is attainable. Producibility engineering and planning activities also develop and prove out the manufacturing resources required for the production phase. With the facilities, equipment, and tooling capacity in place, it would be possible to increase the output for industrial preparedness for surge and mobilization. The PEP program's design insures orderly transition to production and precludes repeated and time-consuming documentation reviews before a part can be produced.

X.1.2 OBJECTIVES. The objectives of the PEP program shall be to:

a. Design for a production rate of __________ units per month on a normal work schedule of a single 8-hour shift per day, five days per week for a total quantity of _________ at a design to unit production cost (DTUPC) not to exceed $________.

b. Define the most cost-effective product design, manufacturing methods, technologies, and production equipment.

c. Conduct producibility analyses on the system, subsystem, and components to identify and resolve anticipated production problems. Incorporate changes before design release of the documentation.

d. Perform trade-off analyses between manufacturing techniques, materials, weights, and cost to facilitate the management decision-making process. Ensure that the most economical processes are selected, consistent with system performance requirements.

e. Prepare and maintain a Manufacturing Plan and a Quality Program Plan compatible with the current design configuration.

f. Design, develop, and subsequently check out special purpose manufacturing, production, and inspection equipment for a timely production rate that supports production schedules.

g. Preclude the employment of proprietary and sole source items, process, and materials/documentation/technology.

h. Establish production tooling, test, and inspection equipment requirements (to include special tooling and special test equipment).

i. Implement a make-or-buy program early in the development effort.

j. Plan and fully document all manufacturing processes, procedures, techniques, reject/rework rates, standard hours, and performance indices for fabrication, assembly and testing. Identify and characterize each critical process to the extent necessary for control.

k. *Ensure all design changes resulting from PEP tasks are accomplished on a timely basis and incorporated in the items being produced on the pilot production line.*

l. *Develop measures to increase production, selecting surge capability levels through analysis of system/item design, production process, and facilitization plans. Develop a mobilization version of the TDP, ensuring maximum production capability consistent with minimum operational requirements under mobilization conditions.*

X.1.3 APPLICATION. Apply the PEP effort to all newly designed items, components, parts, material, and those existing high value items with a history of production problems. Producibility engineering and planning effort shall be extended to subcontractors and vendors. The contractor shall follow the guidance contained in DOD 4245.7-M, "Transition from Development to Production...Solving the Risk Equation", and NAVSO P-6071, "Best Practices. How to Avoid Surprises in the World's Most Complicated Process", as they relate to planning and preparation for successful transition from development into production.

X.2 PEP PLANNING. The contractor shall develop detailed PEP planning to assure that PEP effort for the end item uses a logical and planned sequence of activities that leads to a favorable balance between development and production cost. Planning starts with those producibility engineering activities associated with the exploratory design concepts of each technological approach and ends with the concluding activities at the end of Engineering and Manufacturing Development. The contractor shall integrate all PEP efforts on new system components, parts, and materials from any subcontractors and material suppliers into a single planning approach. This planning establishes quantifiable goals (where possible), assigns responsibility, and prescribes procedures for implementation of the PEP program. The planning should agree with (1) the system design; (2) the manufacturing technology; (3) the program milestones; (4) optimum utilization of resources; and (5) the contract requirements.

X.2.1 PEP PLANNING ACCOMPLISHMENT. The contractor shall provide the organization, management, and administrative efforts to satisfactorily complete the tasks required by the PEP planning. Individual assignments within the organization facilitate single points of contact for interface with the materiel developer (government managers) for each major area of this program. At each scheduled PEP review the contractor shall identify and report accomplishments toward achieving goals.

X.3 PEP STATUS. The contractor shall keep track of all activities, schedules, milestones, and other functions related to the PEP requirement.

X.4 PRODUCIBILITY ANALYSIS. The contractor shall perform producibility analyses to ensure design characteristics and material selections are compatible with economic production methods. The results of these analyses shall be integrated with the Design to Unit Production Cost (DTUPC) requirements. Individual trade-off studies shall consider impact on program life cycle cost, reproducibility, schedules, resource constraints, reliability, maintainability, surge capability, and other factors that impact overall program objectives. The producibility trade-off decisions should fully consider specific design *parameters and contractual requirements. The following analyses/documentation substantiate producibility trade-off decisions: (1) detailed cost; (2) testing requirements; (3) structural analysis; (4) weight impact; (5) performance; (6) human factors; (7) materials and processes; (8) reliability and maintainability; and (9) survivability/vulnerability.*

X.4.1 PRODUCIBILITY ANALYSIS LIST. Early in the development effort the contractor shall rank the contract work breakdown structure (CWBS) element components in the order of production cost (with the costliest component ranked first). This ranking shall identify the component nomenclature, part number, CWBS element number, estimated production cost, and production cost goal. Producibility analysis shall then be conducted on those items with the top 80 percent of the dollar value of the total components which are new designs and those existing designs which offer significant potential for producibility improvement. This ranking and analysis shall maintain references to engineering documentation and the applicable CWBS element to permit traceability and ensure that the total system has been reviewed.

X.4.2 COMPONENT REDESIGN. When a high risk or high production cost item is identified and trade-off analysis justifies the cost-effectiveness of redesign, the component or details thereof shall be redesigned within the existing state-of-the-production-art and established cost parameters.

X.5 PRODUCIBILITY REVIEW. The contractor shall conduct a producibility review as an integral part of each integral engineering design review. Likewise, the contractor shall support the Government conduct of formal design reviews (System Requirements Review, System Design Review, Preliminary Design Review, and Critical Design Review, in accordance with MIL-STD-1521), which will include integrated producibility reviews. These design and producibility reviews address the producibility aspects of the design and the manufacturing technology needed for production of the product. The design and producibility reviews follow the design review procedure determined during PEP planning (paragraph X.2). Items to be discussed include, but will not be limited to: simplicity of functional design, use of economical materials and manufacturing technology, standardization of materials and components, confirmation of design adequacy, unit cost, process repeatability and yields, product inspectability, special manufacturing test, critical process or special handling or safety inspection, and proprietary processes or data. The producibility review will be conducted allowing adequate, available time for changing the design data as a result of the review. In the case of Government conducted design reviews, the contractor will be formally furnished the findings and recommendations and corrective actions for comment and action. A schedule will be jointly developed, between the contractor and the Government, to re-examine those areas for acceptability. The re-examination will be accomplished during follow-on design and producibility reviews or production readiness reviews. Additional producibility reviews, will be conducted to evaluate production preparedness efforts.

X.6 TOOLING AND TEST EQUIPMENT. *The contractor shall identify, design, and provide rationale for tooling and test equipment. The rationale presented, when developing the tooling and test requirement, should demonstrate how the tooling design or redesign efforts required are needed over and above those being devised during the development phase. The contractor shall develop a master tooling list and define the maximum production rate that can be sustained with the combination of new and all available carryover tooling and test equipment.*

X.6.1 TOOLING LIST. *The tooling list, which shall define the complete production tooling, should be traceable to the lowest levels of the CWBS matrix by work center, assembly or final assembly station as developed during manufacturing planning. The tooling list is finalized during the Engineering and Manufacturing Development phase. The tooling list identifies equipment unique to this item under development and generic to the technology.*

X.6.2 NUMERICAL CONTROL (N/C) TAPES. *All activities, which include programming and computer proofing of N/C part programming and output tapes or other software required for the production effort, shall be identified by individual part numbers. This total tape requirement shall then be further identified by the applicable carryover tapes or software from the Engineering and Manufacturing Development phase, and the software that will be newly developed for the production effort. The final tape catalog will be completed during the Engineering and Manufacturing Development phase.*

X.6.3 PRODUCTION EQUIPMENT/TOOLING PROVE-OUT. *In order to prove-out all required production equipment and tooling, a pilot production line shall be established by the contractor during the Engineering and Manufacturing Development phase. The pilot production line shall consist of representative tooling and equipment of the same type and kind planned for use in full-rate production. The pilot line shall use the same processes, sequences, manufacturing personnel skills, equipment operating instructions, and the same safety and environmental considerations as the full-rate production line will. The pilot production line shall be used to construct preproduction prototype models which will later be evaluated during the Functional Configuration Audit (FCA) and the Physical Configuration Audit (PCA). The results of the prototype builds will be fed back into the PEP process and any necessary changes or modifications to the manufacturing plan, Technical Data Package, or Tooling List shall be made. These results shall be made available to the Government during Production Readiness Reviews (PRRs).*

X.7 MANUFACTURING PLANNING. *The contractor shall accomplish production planning, describing the methods to be employed for producing and delivering acceptable hardware and software on schedule and within cost limits. The start of the manufacturing planning shall be during the Demonstration and Validation phase, and completed during the Engineering and Manufacturing Development phase prior to the final Production Readiness Review.*

X.8 TECHNICAL DATA PACKAGE. *The contractor shall design, develop, produce, and validate a complete Technical Data Package for the manufacture of the system/item (for planned production and for mobilization production). The TDP contains all the data used* *by the contractor and associated subcontractors, vendors, and material suppliers to produce the item under competitive procurement. The TDP shall consist of the technical hardware and manufacturing and auxiliary equipment technical data. The TDP shall contain sufficient information to establish an alternate manufacturing source in fabricating, testing, qualifying, and accepting the item. The TDP shall not contain proprietary information without the prior written agreement of the Government, or as otherwise stipulated in the Pre-notification of Rights in Technical Data section of the contract. Validation of the TDP shall be accomplished through a Physical Configuration Audit, Pilot Production Line Prove-out, as well as successful use of the TDP during low rate initial production.*

X.8.1 SPECIFICATION. The contractor shall prepare specifications for all items undergoing development down to level ___ of the contract work breakdown structure. Specifications for the TDP shall be product specifications in accordance with MIL-S-83490 (or MIL-T-31000) and MIL-STD-490 (or military specifications in accordance with MIL-STD-961). The specifications shall include all necessary quantitative requirements and inspection.

X.8.2 DRAWINGS. The contractor shall prepare product drawings in accordance with MIL-T-31000 for each product part, component, or assembly of the tactical hardware and auxiliary equipment down to level ____ of the CWBS. Special test equipment, and special tooling drawings in accordance with MIL-T-31000 shall be prepared for the special purpose tooling, testing, acceptance, and inspection equipment in the manufacturing technical data portion of the TDP.

X.8.3 EQUIPMENT OPERATING INSTRUCTIONS (EOI). The contractor shall prepare detailed instructions for setting up and operating special purpose manufacturing, testing, acceptance and inspection equipment that are to be delivered to the Government. The EOI shall be in conformance with the detail manufacturing procedures for manufacturing tooling, and the detail quality procedure for the testing and inspection equipment. The EOI shall be numbered the same as the component under manufacturing or testing except prefixed by letters cross-referenced to the Manufacturing Instruction Sheets (MIS), Quality Assurance Provisions (QAP), or drawing requirement under inspection. Accept/reject criteria in the EOI shall be consistent with the allowable tolerance in the MIS, QAP, or drawing requirements. Programs for computerized special purpose inspection and acceptance equipment are part of the EOI.

X.9 PRODUCTION READINESS REVIEW (PRR). The contractor shall support and participate in the initial, intermediate, and final Production Readiness Reviews at each contractor facility involved and each subcontractor and vendor of the newly developed items. The purpose of the PRRs is to determine whether the production hardware and software are ready for efficient and economical quantity production. The PRRs provide adequate opportunity for the contractor to demonstrate that all important production engineering problems encountered have been resolved and adequate planning and demonstration of producibility has been accomplished for the production phase. Periodic evaluations will be performed after award of this contract in conjunction with the program progress review. The PRRs will be in sufficient depth and detail to determine the status of production readiness. Also, to determine that known or anticipated manufacturing *problems and high-risk areas have been identified and an impact assessment provided. Production Readiness Reviews will be conducted using the guidance in DOD 4245.7-M and NAVSO P-6071 for risk assessment. The contractor and selected subcontractors shall provide personnel to support the scheduled review. Contractor personnel who are knowledgeable of the management and details of the production functions and tasks shall be made available to work with Government personnel throughout the period of each review. The initial PRR will be conducted ___ months after entry into Engineering and Manufacturing Development. The intermediate PRR will be conducted ___ months prior to the Milestone III production decision, and the final PRR will be conducted ___ months prior to Milestone III. Each PRR will last approximately ___ days and in each case, the Government team will consist of approximately _____ personnel. The Government will provide the contractor with a detailed PRR plan prior to the initial PRR and specific PRR plans to the intermediate PRRs (if any) and before the final PRR.*

X.9.1 PRR ACTIVITIES. Specific activities to be contained in the PRR are:

a. The Government team reviews the status of tasks identified in the PEP Plan and their documentation.

b. The contractor demonstrates the operation of the production management systems and makes available internal production planning documentation required for an in-depth analysis for adequacy in relation to the work under contract.

c. Within ___ days after conclusion of the PRR, the Contracting Officer will provide the contractor a report of the production readiness status and identify any inadequacies in detail.

This ends the suggested PEP SOW.

For most Belvoir programs the above PEP SOW will be tailored by reducing or deleting the requirements in paragraphs X.6 TOOLING AND TEST EQUIPMENT and X.7 MANUFACTURING PLANNING, especially when the development contractor will not be the production contractor.

5.6.4 **<u>PEP Data Item Descriptions</u>**. Only approved DIDs may be used to procure data. All DIDs which have been cleared for use in defense contracts are listed in DOD 5010.12-L, Acquisition Management System and Data Requirements Control List (AMSDL). The AMSDL contains a numerical listing, and a key word index of all approved DIDs. Examples of PEP related DIDs are:

DI-DRPR-81000, Product Drawings and Associated Lists

DI-MISC-80074, Manufacturing Plan

DI-MGMT-80797, Producibility Analysis Report

DI-MISC-80006, Producibility Program Plan

DI-QCIC-80369, Quality Program Plan

DI-QCIC-81013, TDP Validation Report

5.6.5 PEP In The Acquisition Cycle. Starting early in the acquisition cycle, PEP must be conducted as an integrated, continuous part of the design process. This approach has recently been incorporated into the systems engineering concept known as Concurrent Engineering. It is essential that manufacturing and production engineers are members of the design team. Besides design and manufacturing technologies risks, programs face funding risks. Despite the best intentions of all concerned, inadequate funding can sink a program. Funding risks fall into the following three areas:

1. The first area involves the type programs started on short notice with the idea of compressing schedule to save money. This jeopardizes the early investigation of design and manufacturing technologies research.

2. A second area of funding risk surfaces when inadequate funds are committed for prove-out of the technical data package (TDP) or planned production processes, or both. To save time and money, "soft-tooled" prototypes are built instead of "hard-tooled" or production prototypes. Since the item tested is not built according to the TDP or by using actual production processes, the TDP and the producibility of the design are not validated. The time and money savings turn out to be illusions.

3. The third area of funding risk exists in those programs where funding needed to actually administer the PEP program is not made available in sufficient amounts or in a timely manner or both. The result is a program that will suffer problems, probably serious ones, in making the transition from development to production.

A tool for ensuring a smooth transition from development to production is Willoughby's templates contained in DOD 4245.7-M, Transition from Development to Production. Each template describes an area of risk and then specifies technical methods for reducing that risk. The very first template is Funding, followed by Design, Test, Production, Facilities, Logistics, and Management. Belvoir engineers are encouraged to use them. See DODI 5000.2, Part 3, Acquisition Process and Procedures, for the key features and characteristics of the acquisition process. Figure V-1, Belvoir PEP/PE Activities, shows the required or recommended PEP/PE activities in each phase of the acquisition cycle.

5.6.5.1 PEP in Concept Exploration and Definition (CE/D). Milestone 0. PEP commences in CE/D, Phase O, with formulation of a draft acquisition strategy. In applying the principles of concurrent engineering, producibility, as well as reliability, quality, supportability, and performance all must be considered throughout design development. Therefore, the design team must include specialty representatives for each specialty area to be considered. This design team must:

1. Review each design concept and alternative technical approach being considered for critical materials, manufacturing processes related to the specific design, design constraints, and the overall producibility of the various design approaches.

2. Identify manufacturing risk areas, and analyze each to develop alternative solutions. Determine the probability of success, and determine the time needed to resolve each identified risk.

3. Consider the full scope of current manufacturing and production technologies to determine industry's capability and capacity to produce the design.

4. Plan for the development of the production Technical Data Package (TDP).

5. Develop the PEP portion of the Statement of Work (SOW) for the Request for Proposal (RFP) for D/V, Phase I, and for the remainder of the program's development.

6. Document the results of the PEP efforts in the CE/D phase.

The Market Analysis activities are also conducted during this phase. The market analysis is comprised of two elements: market surveillance and market investigation.

The main objective of the market surveillance is to accumulate sufficient data to identify what technical capabilities exist which could meet potential user identified requirements. This surveillance is conducted prior to the O&O plan, and will initially identify the potential for a NDI solution.

The main objective of the market investigation is to combine all the data and information gathered from the market surveillance with the user's need to develop the Acquisition Strategy for a specific requirement. This is conducted in response to the O&O plan.

When a significant portion of the system functional requirements have been established a System Requirements Review (SRR) will be conducted to ascertain the adequacy in defining system requirements (see MIL-STD-1521, Appendix A). The SRR will include a review of Producibility Analysis Plans.

5.6.5.2 PEP in Demonstration and Validation (D/V). Milestone I. D/V, Phase I, must resolve the issue of what program is needed to do the job required by the user. The key activities during this phase include:

1. Demonstrating and validating candidate concepts.

2. Performing trade-off analysis, and risk analyses.

3. Laying the groundwork for production and support.

4. Update program thresholds - cost, schedules, performance, and supportability.

5. Begin design engineering.

6. Establish firm design to cost (DTC) goals.

7. Develop plans for long lead time (LLT), low-rate initial production (LRIP), and type classification actions.

8. Develop PEP Statement of Work for Engineering and Manufacturing Development (E/MD), Phase II.

A System Design Review (SDR) shall be conducted as the final review prior to the submittal of the D/V, Phase I, products. See MIL-STD-1521, Appendix B, for a complete list of items to be reviewed during the SDR. A review of the Producibility Analysis, and Producibility Analysis Plans are included on this list.

5.6.5.3 PEP in Engineering and Manufacturing Development (E/MD). Milestone II. The purpose of E/MD, Phase II, is to complete the system design and development, achieve readiness for production, reduce risks to production, and complete the plan for support of the selected system. The E/MD, Phase II, in an item's acquisition life cycle is the time when the final design and testing is documented for the critical transition from development to production. For a major system the development contractor is usually preselected as the production contractor. Therefore, production and manufacturing planning can occur without a physical development/production gap between phases in the acquisition cycle. However, with nonmajor systems, like most of Belvoir RD&E Center programs, the development contractor normally terminates activities at the end of E/MD, Phase II. A new contract is awarded to a different contractor for Production and Deployment, Phase III. The key activities during E/MD, Phase II, include:

1. Complete the development and validation of a TDP that is ready to support production.

2. Apply DOD 4245.7-M guidelines to assure a smooth transition from development to production.

3. Complete a Producibility Analysis.

4. Complete testing to assure that the system will perform satisfactorily in the operational environment, and is supportable.

5. Complete a Functional Configuration Audit (FCA) to verify satisfactory system performance, and establish the basis for the configuration item's functional baseline.

6. Complete a Physical Configuration Audit (PCA) to verify that the "as-built" configuration of the E/MD prototype used in testing and the FCA conforms to the technical documentation. The updated technical documentation will establish the Product Configuration Identification (PCI), and establish the basis for the configuration item's product baseline. The PCA may be repeated with each subsequent contractor or break in production, as the case will be when the developing contractor is not the production contractor. With Belvoir programs it is normal to have a gap between development and production.

7. Perform Value Engineering (VE) studies in conjunction with the Producibility Analysis.

8. Achieve Type Classification-Standard (TC-STD) prior to entry into production.

9. Initial Production Facilities (IPF) requirements, and verification of strategy to acquire the necessary manufacturing facilities, is accomplished when the development and production contractor are the same. However, with Belvoir programs where the development and production contractors are different the specific production facilities cannot be identified during E/MD.

A Production Readiness Review (PRR) will be accomplished during E/MD, Phase II, as a technical review of the completeness and producibility of the product design and the planning and preparation necessary for a viable production effort. DODI 5000.2, Part 6, Section O, Attachment 1, Production Readiness Review Considerations, provides a representative listing of potential areas to be evaluated.

5.6.5.4 Production Engineering (PE) in Production and Deployment (P/D). Milestone III. During P/D, Phase III, there is no RD&E funded PEP. However, the start of this phase does not conclude the need of the producibility effort in the acquisition life cycle. Producibility must be considered during production, although the impact will be less dramatic than during the previous phases. Several approaches exist to resolve producibility or production malfunctions after an item has been type classified-standard and approved for production. Procurement Appropriation Army (PAA) and Operation and Maintenance Army (OMA) funds can be programmed to investigate and correct malfunctions occurring in production items, and to provide Engineering Support to Items in Production (ESIP). The P/D phase is characterized by accomplishment of the following (those to be accomplished by the contractor must be addressed and outlined in the proposal and contract):

1. Complete a Preproduction Evaluation (PPE) to identify and purpose corrections of any discrepancy, error, omission, or deficiency which could preclude practical manufacture or assembly, or attainment of the required performance as set forth in the TDP.

2. Complete production planning including the preparation of a manufacturing plan, identify alternate materials, tool design, design of inspection equipment, preparing process sheets and required sequence of operations, identifying resource and skill requirements, make or buy decisions, CM procedures, and development of inspection plans and procedures.

3. Complete IPF requirements and verification of the strategy to acquire the necessary manufacturing facilities.

4. Complete fabrication of first article and First Article Test (FAT).

5. Conduct a Physical Configuration Audit (PCA) to assure the first article tested is in compliance with the TDP.

6. Conduct Production Readiness Review (PRR) equivalent to the final PRR in E/MD phase when the developer and producer are the same, and correct any identified deficiencies.

7. Achieve rate production, initial fielding of the materiel system and First Unit Equipped (FUE), together with its full complement of support equipment, publications, and services.

During the P/D phase the Government production engineers must also review and recommend action on all waivers and deviations proposed by the contractor. A deviation is a specific written authorization, to depart from a particular performance or design requirement of a specification or drawing, or other TDP document, for a specific number of units, or a specific period of time. A waiver is written authorization to accept a production item after inspection finds that it does not meet specified requirements, but is considered suitable for use "as is", or after the rework by an approved method. A change is any alteration to the existing configuration item for which a baseline has been established. The change must be defined by an Engineering Change Proposal (ECP). The configuration control board (CCB) will act on all ECPs. These changes are controlled and incorporated into the TDPs in accordance with the requirements of MIL-STD-973, Configuration Management.

5.6.5.5 Production Engineering (PE) in Operations and Support (O/S). Milestone IV. For deployed materiel in O/S, Phase IV, Post Production Engineering funding and Operation and Maintenance Army (OMA) funds will be used to investigate and correct malfunctions.

5.6.6 PEP for Nondevelopmental Items (NDI) (Implementation Instruction - contains mandatory requirements). Until recently, it was DOD policy that PEP did not apply to NDI since most people believed all NDI materiel was something already produced by a contractor and available for use without further refinement or development. This is an erroneous view since there are really three different categories of NDI:

1. Basic NDI. Off-the-shelf items (U.S. commercial, foreign, or other services) to be used in the same environment for which the items were designed. No development or modification of hardware or operational software is required.

2. NDI Adaptation. Off-the-shelf items (U.S. commercial, foreign, or other services) adapted for use in an environment different than that for which it was originally designed. These items will require some modification (e.g., militarization or ruggedization) and therefore, will require one or more forms of testing/verification.

3. NDI Integration. Maximum use of NDI items as subsystems, modules, or components which contribute to a materiel solution that entails low-risk systems integration. This requires substantial R&D effort for systems engineering, software modification, and testing to ensure the total system meets user requirements and is producible as a system.

Each succeeding NDI category entails an increasing amount of R&D and likewise, increased PEP requirements. DOD policies and procedures for NDI are contained in DODI 5000.2, Part 6, Section L, Nondevelopmental Items.

It is of great importance to ensure that unified and proper PEP procedures are applied throughout the Center for NDI acquisition. The following Standard Practices are established:

(1) A member of the Center Producibility Engineering Team (PET) shall participate in all Belvoir RD&E Center market analyses, and shall be a member of the project team in the NDI selection process.

(2) For proposed non-developmental item projects, supervisors/project team shall seek PEP guidance, and instruction from the PET. PET's producibility/production engineering expertise is required to determine the adequacy of current manufacturing capabilities and capacities for the candidate NDI producers.

(3) PET shall also review and comment on the Operational Requirements Document (ORD) and acquisition strategies (AS) resulting from market analyses.

5.6.7 **TDP Validation.** The development contractor shall be required to validate that the TDP and elements thereof conform to the contractual requirements, and that they accurately depict the materiel developed and produced under the contract. Use of the TDP in producing, inspecting and testing satisfactory hardware is considered acceptable evidence that the validation requirement has been met. The successful technical and user test of the materiel item must be followed by a Functional and a Physical Configuration Audit. The contract should specify drawing requirements in accordance with MIL-T-31000. When specified in the contract the contractor's validation shall be documented in a TDP Validation Report, and the CDRL DD Form 1423 will cite DI-QCIC-81013, TDP Validation Report.

5.6.8 **TDP Certification.** The purpose of the TDP Certification process is to objectively assess the quality of BRDEC's TDPs, and inform the procuring organization of potential shortfalls and limitations prior to use in a quantity procurement. For details see paragraph, 1.12 TDP Certification Process, and paragraph, 2.2.8 Engineering Release Record Requirements, of this manual.

5.7 PEP REGULATORY REQUIREMENTS.

References:

1. Department of Defense

a.	DODI 4200.15		Manufacturing Technology Program
b.	DOD 4245.7-M		Transition from Development to Production
c.	DODD 5000.1		Defense Acquisition
d.	DODI 5000.2		Defense Acquisition Management Policies and Procedures
		Part 2,	General Policies and Procedures
		Part 3,	Acquisition Process and Procedure
		Part 5,	Acquisition Planning and Risk Management
			Section A, Acquisition Strategy
			Section E, Industrial Base
		Part 6,	Engineering and Manufacturing
			Section A, Systems Engineering
			Section K, Design to Cost
			Section L, Nondevelopmental Items (NDI)
			Section O, Design for Manufacturing and Production
			Attachment 1, Production Readiness Review (PRR)
e.	DOD 5000.2-M		Defense Acquisition Management Documentation and Reports
f.	DOD 5000.37M		Commercial and Nondevelopmental Item (NDI) Handbook
g.	NAVSO P-6071		Best Practices
h.	MIL-STD-337		Design To Cost
i.	MIL-STD-499		Engineering Management
j.	MIL-STD-1521		Technical Reviews and Audits for Systems, Equipment and Computer Software
k.	MIL-STD-1528		Manufacturing Management Program

l.	MIL-T-31000	Technical Data Packages, General Specification For
m.	AR 70-1	Army Acquisition Policy
n.	DA PAM 70-XX	Materiel Acquisition Handbook

Note. A Materiel Acquisition Handbook is being developed as a companion document to AR 70-1. The handbook format is aligned with DODI 5000.2 for easy cross reference. The handbook contains sections such as type classification, modifications, and market analysis which deal with unique Army requirements.

2. Belvoir

a.	HDBK 70-1	Project Engineers Guide
	Volume I	Planning and Structuring Programs
	Volume II	Contracting Strategies
	Volume III	Implementing MANPRINT
b.	SOP 70-15	Producibility Engineering and Planning (PEP)/Production Engineering (PE)

SECTION VI

PRODUCIBILITY ANALYSIS AND PRODUCTION PLANNING

6.1 PRODUCIBILITY ENGINEERING.

Producibility engineering is the concurrent application of engineering disciplines during the design process. The objective is to achieve ease of manufacture of a desired item, in the required quantity, at optimum least cost and the minimum time, while still meeting the necessary quality and performance requirements. This is achieved by a series of trade-offs involving the various engineering disciplines taking into consideration manufacturing processes and methods, inspection and test requirements, reliability, maintainability, environment, transportability, human engineering, value engineering, and safety (DODI 5000.2, Part 6, Section A, Systems Engineering, and Section O, Design For Manufacturing and Production).

The integration of these engineering disciplines is conceptualized in Figure VI-1. The Product Engineer is responsible for assuring that these supporting functions do not violate the basic design integrity of the product.

As requirements information is taken in by the traditional engineering disciplines emphasis is placed on those traditional design techniques (such as stress analysis of structures) required at a given stage of design (conceptual, preliminary, or detailed design). The traditional design engineers draw heavily on the state-of-the-art technology of their area. Concurrently design documentation is being developed and/or modified by specialty engineering disciplines in such areas as reliability, maintainability, etc. The "specialists" are establishing some requirements independently of the emerging traditional discipline design, but they are also reviewing and modifying the traditional discipline output. Finally, all requirements are integrated into the unique demands of the system by the Product Engineer. The requirements are then described by specification and drawings which set out in clear language the "design-for" requirement. The design of any product element will usually require several iterations through each process step. See MIL-STD-499, Engineering Management. (For more details on this concept, see SYSTEMS ENGINEERING MANAGEMENT GUIDE, Defense Systems Management College, Fort Belvoir, Virginia.)

6.1.1 Designing for Producibility.

Concern for producibility must be exercised at the start of the concept exploration phase. This will influence the entire design effort from that point on into the development cycle. Inherent producibility limitations must be recognized and addressed at each stage of the development process. Broad producibility considerations might include the selection of materials and manufacturing processes. The iterative design process mapped in Figure VI-2 is filled with decision points, each of which permits a potential trade-off against some other requirement. However, all demands upon the system such as reliability, availability, maintainability, safety, or producibility heavily interact with each other throughout the design process creating the need for trade-offs.

Producibility Objectives in Design

Considerations should include but not be limited to these areas:

a. To maximize:

- simplicity of design
- use of economical materials
- use of material choices and process alternatives
- use of economical manufacturing technology
- standardization of materials and components
- confirmation of design adequacy prior to the production phase
- process repeatability
- product inspectability

b. To minimize:

- procurement lead time
- generation of scrap, chips, or waste
- use of critical (strategic) materials
- energy consumption
- special manufacturing tests
- special test systems
- use of critical processes
- pollution
- skill levels of manufacturing personnel
- unit costs
- design changes during manufacture
- use of limited availability items and processes
- use of proprietary items without "production right" release

Too often, it is assumed that designing for the use of existing tooling is the most economical approach without giving due consideration to new more economical materials and processes. Further, designers also tend to design around their existing processes without due consideration to on-going manufacturing technology developments. This can have detrimental effects on producibility and future purchases which may result in excessive engineering change orders. The producibility plan should identify the contractor's system of review of engineering design to assure that the composite of characteristics which, when applied to the equipment design and manufacturing planning, leads to the most effective and economic manufacturing approach.

6.1.2 Producibility Analysis.

Producibility is defined as the combined effect of those elements or characteristics of a design, and the production planning for it, that enables the item, described by the design, to be produced and inspected in the quantity required and that permits a series of trade-offs to achieve the optimum of the least possible cost and the minimum time, while still meeting the necessary quality and performance requirements (MIL-HDBK-727). Checklists for Producibility Analysis are contained in MIL-HDBK-727.

The primary end product of the producibility analysis is a TDP that is clear, accurate, and adequate to support the competitive procurement of the desired end item.

6.1.2.1 Elements or Characteristics of a Design.

This part of the definition describes form, fit, function, useful life, and the elements or characteristics that affect producibility. These producibility elements are as follows:

a. Specified Materials. The material properties may facilitate or limit the selection of a manufacturing process because of their interrelationship with formability, machinability, joining, and heat or surface treatment. A design specifying only one material is constrained to the manufacturing process compatible with that material. The design should specify as many alternate materials as possible.

b. Simplicity of Design. A complex approach to satisfying the design objectives can increase cost, and delivery time. A design that exceeds the functional requirements can increase weight, complexity, and manufacturing cost.

c. Flexibility of Production Alternatives. Most of the time any one of several materials or processes will result in an acceptable product. Therefore, specifying alternate materials is encouraged, along with the maximum allowable tolerance that will satisfy the functional requirement, in order to provide potential producers more flexibility in selecting a manufacturing process. This enhances producibility and competition.

d. Tolerance Requirements. Unnecessarily tight tolerance and surface roughness require more expensive and specialized manufacturing processes. Specify to the minimum quality level essential to satisfy the design objective.

e. Clarity and Simplicity of the TDP. Reliable, accurate, and complete information in the TDP is of vital importance to achieving producibility and the competitive procurement of an end item.

6.1.2.2 Elements or Characteristics of Production Planning.

This phase in the definition of producibility implies the assessment of all available resources to accomplish the production requirements of a design. Typically the factors to be considered are as follows:

a. Production Rate and Quantity. The production rate and quantity is required to establish the sizing of the facilities required to manufacture and assemble the end item. Errors in judgment here can result in high losses in time and money.

b. Special Tooling Requirements. Special purpose tools are those tools required to adapt a general purpose machine to a special purpose requirement. Both high-rate and low-rate production may require special tooling, but generally the quality and cost of the tooling are in direct proportion to the production rate. Failure to plan for tooling can have disastrous effects on producibility.

c. Manpower. Skilled production labor, i.e., machine operators, inspectors, etc., is vital to the producibility of any end item.

d. Facilities. The availability of unique facilities, and production equipment is vital to the producibility of any end item.

e. Availability of Materials. Good producibility planning will assure that the required material is not critical or geographically sensitive without specification of an appropriate alternate material.

6.1.2.3 Production or Inspection in Quantity Required.

Both production and inspection share the common relationships among the design elements of form, fit, function, material selection, and manufacturing processes. During production planning, consideration of production rate compatible with inspection processes is vital to producibility. For example, when considering manufacturing processes that will give a higher production rate to improve delivery time will provide no appreciable gain unless corresponding improvements can be made in the inspection processes.

6.1.2.4 Optimal Cost and Time Through Trade-offs.

The definition objective is to achieve the optimum of the least possible cost and the minimum time. Trade-offs are necessary to achieve this and still satisfy the performance requirements of the product. For producibility we strive for simplicity and standardization to reduce cost and time, however, a number of demands and requirements, for example, reliability, maintainability, and safety tend to increase the cost and time, and create the need for trade-offs throughout the acquisition process. A design that satisfies all the performance characteristics, and can be produced for the least possible cost, but cannot be available in the required time is not producible, therefore trade-offs must be made. These are all aspects of designing for producibility.

6.1.2.5 Necessary Quality and Performance Requirements.

In the process of achieving all the previously discussed elements of producibility, it is essential that the performance objectives of the design not be compromised or adversely affected by factors introduced to maximize producibility. The objective of producibility is a design that meets the performance objectives and yet can be produced in the simplest and most economical manner.

6.1.2.6 Process Capability.

The Producibility Engineer must have an understanding of Statistical Process Control (SPC) and manufacturing process capabilities. This is essential when analyzing or specifying dimensions, tolerances, and process limits. Specified tolerances and limits should be established for manufacturing processes having a Process Capability Index (Cp) of at least 1.33, which demonstrates that the process is capable of producing a product within the required limits. This means the Process Capability Ratio (Cr) is not greater than 0.75. The equation for Cr is:

$$Cr = \frac{6 \text{ X Standard Deviation}}{\text{Tolerance Spread}}$$

$$Cp = \frac{1}{Cr}$$

Example: $Cr = 0.75$

$$Cp = \frac{1}{0.75} = 1.33$$

This indicates that the normal process variation, when in control, will use 75% of the specified tolerance spread or limits.

The manufacturer must ensure that the process selected to produce the item has a Process Performance Index (Cpk) of at least 1.33, which demonstrates that the process fits and is centered within the required tolerance limits. The Cpk equation is as follows:

$$Cpk = \frac{\overline{X} - LS}{3 \text{ X Standard Deviation}} \text{ or } \frac{US - \overline{X}}{3 \text{ X Standard Deviation}}$$

where, $\overline{X}$ = the process average
LS = the lower specification (tolerance) limit
US = the upper specification (tolerance) limit

When examining a manufacturer's Cpk chart for continuous improvement, the Cpk should increase, the averages should be stable, and the amount of variation should decrease.

6.1.2.7 Producibility Analysis Guide.

Any contract requiring a Producibility Analysis should list DI-MGMT-80797, Producibility Analysis Report on the Contract Data Requirements List (CDRL) Form 1423. The following list of topics serves as a guide for a Producibility Analysis:

Topic	Paragraph
Dimensioning, Tolerancing, and Surface Texture	6.2
Materials Selection	6.3
Fabrication Process Suitability	6.4
Heat Treatments	6.5
Cleaning	6.6
Joining Methods	6.7
Coatings	6.8
Parts Control Program	6.9
Acceptance Criteria	6.10
Identification and Marking	6.11
Reliability	6.12
Maintainability	6.13
Environment	6.14

6.2 DIMENSIONING, TOLERANCING, AND SURFACE TEXTURE.

Items shall be dimensioned and toleranced in accordance with the fundamental rules of ANSI Y14.5M, Dimensioning and Tolerancing. Application of dimensioning and tolerancing requires a systematic approach to obtain optimum results. The first consideration in establishing a tolerance must be the functional requirement of the part. Then consideration is given to the availability of economical processes that have the capability to produce within the required limits. See paragraph 6.1.2.6, Process Capability.

6.2.1 Configuration Definition.

All manufactured items **require 100% interchangeability** of parts and that the parts can be produced by standard tooling if possible. All dimensions are reviewed to assure that size, shape and location of all features can be determined and that functional datums, suitable for standard manufacturing and inspection practices, are used. Any feature shall be defined only once.

6.2.2 Manufacturing Options.

The end product concept demands that drawings permit all practical fabrication processes. For example, an end product drawing would allow fabrication by welding and machining and by casting or forging and machining. A particular process is not dictated unless no other method of fabrication is feasible. This requires that tolerances be suitable for more than one production process and simultaneously provide functional size requirements. For example, if the manufacturing process drawing specifies "DRILL .0.650+.003", the corresponding end product drawing would specify only the hole size with larger tolerance (if functionally feasible) to permit punching of the hole. Tolerances shall be assigned to each dimension based on function, and "blanket" tolerances shall be avoided. This does not preclude the use of a general tolerance to cover the majority of like tolerances after individual dimensional analysis has been performed. Unnecessarily restrictive tolerances and surface texture requirements shall be changed to reflect functional requirements.

The surface texture of an item results from method of fabrication and is, to a large extent, directly proportional to size tolerance. International Organization for Standardization ISO R468, Surface Roughness, or Appendix D of ANSI B46.1, Surface Texture, may be used as a guide to surface texture specification. Cylindrical fits shall be reviewed using ANSI B4.1, Preferred Limits and Fits for Cylindrical Parts for English Units or ISO R1938, System of Limits and Fits for Metric Units.

6.2.3 Assembly Dimensions.

The sequence or method of assembly to toleranced dimensions shall be specified, if required, to assure proper alignment and function of assembled parts. When spacers or shims are used or required (for adjusting for specific dimensions), excess material for grinding or extra lamination for peeling may be provided. Requirements for shaft end-play shall be indicated when applicable. Assembly notes are typically required for clearances, bolt torques, drive alignment, belt tension and keyways.

6.2.4 Old Drawings.

When new editions of ANSI Y14.5 are published, design intent shown on old drawings may be lost or obscured. Therefore, drawings made to the obsolete ANSI Y14.5 should be reviewed before using them in procurement to assure that tolerancing will be properly understood by bidders and manufacturers.

6.3 MATERIALS SELECTION.

MIL-HDBK-727 provides guidelines for selection of materials. ASTM and other industry specifications and standards shall be used as a first choice when defining the material requirements. It is not necessary to define material by two equivalent specifications. Listing of optional materials is desirable. Electrolytic action between dissimilar metals shall be minimized. Table I of MIL-STD-171, Finishing of Metal and Wood Surfaces, and MIL-STD-889, Dissimilar Metals, serve as guides for material compatibility.

6.4 FABRICATION PROCESS SUITABILITY.

MIL-HDBK-727 includes a survey of fabrication processes and defines related producibility factors. The primary fabrication process dimensions (castings, forgings, etc.) often present problems when manufacturing drawings are converted to end product drawings. The secondary fabrication processes survey provides a guide to potential fabrication processes to obtain dimensions shown on the end product drawing.

6.4.1 Primary Fabrication Processes.

6.4.1.1 Cast And Forged Parts.

In accordance with the end product concept, these drawings shall delineate the completed item after machining or other secondary fabrication processes. Allowable material, draft angles, fillets, corner radii, etc., shall be specified. Proper datum selection and definition are especially important for these drawings. Datum targets as defined in ANSI Y14.5 shall be used when appropriate. Casting acceptance criteria, allowable repair procedures, and special requirements shall be noted. Grain flow in forged parts shall be defined as applicable.

6.4.1.2 Extruded Parts.

An end product extrusion drawing shall define all cross-sectional dimensions and tolerances, permissible form variations (e.g., straightness, twist, flatness, contour, angularity), and required length and tolerance. Whenever possible, extrusions shall conform to applicable commercial tolerances. It is often practical to contact a commercial mill for determining proper tolerances for the drawing.

6.4.1.3 Formed Parts.

These parts are produced by sheet metal forming operations such as stamping, blanking, punching, piercing, drawing, or rolling. In addition, parts produced by the bending of tubing and other standard shapes are considered formed parts. Dimensioning and tolerancing of parts suitable for fabrication by these methods must include consideration of process and material limitations. These end product drawings depict only the finished part and shall not include flat patterns or other process information. The bend radii and bend reliefs specified shall be consistent with standard fabrication methods. For severely formed parts, subsequent treatments, such as annealing, stress relief, etc., should be specified to eliminate the adverse effects of cold working.

6.4.1.4 Molding, Thermoforming, and Miscellaneous Plastics Processing.

MIL-HDBK-139 (Plastics, Processing of) may be utilized as a guide in determining suitability of dimensions and tolerances for plastic components.

6.4.2 Secondary Fabrication Processes.

MIL-HDBK-727 provides a survey of secondary fabrication processes with expected size tolerances and surface textures. Potential secondary fabrication processes shall be considered during review of dimensions and tolerances. When tooling centers or other tooling features can be allowed on end product, the drawing shall define these features as non-mandatory and note their function. This will prevent subsequent omission of permissible features that do not affect end item functions.

6.5 HEAT TREATMENTS.

MIL-HDBK-727 provides a brief survey of heat treatments, annealing, and stress relieving suitable for steel products. Additional information concerning steel is in the ASM Metals Handbook, NBS Monograph 88, Heat Treatment and Properties of Iron and Steel, and FED-STD-66, Steel: Chemical Composition and Hardenability Properties. Heat treatments for aluminum alloys are discussed in the Aluminum Association (AA) publication Aluminum Standards and Data. When applicable, the following specifications shall be referenced:

Specification	Title
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-H-6875	Heat Treatment of Steel, Process for
MIL-H-7199	Heat Treatment of Wrought Copper-Beryllium Alloys, Process for (Copper Alloys: Numbers 170, 172, 175)

Depending upon part-function and stress level, hardness range or mechanical properties shall be specified. When severe fabrication processes are expected to result in undesirable stresses, stress relieving shall be specified. Temperature, time, and cooling rate shall be specified when appropriate.

6.6 CLEANING.

MIL-HDBK-727, MIL-HDBK-132, and MIL-STD-171, provide a survey of cleaning methods. Specific cleaning methods are seldom specified on end product drawings. Generally, the cleaning requirements are included in a protective finishing specification noted on the drawing. Some drawings may include a general note such as "PART TO BE FREE OF GREASE, DIRT, DUST OR ANY OTHER FOREIGN MATTER" without reference to a specific cleaning method. Occasionally, it is necessary to specify cleaning methods to remove contaminants with chemicals compatible with adjacent materials or for components which cannot be cleaned by conventional production cleaning methods. Preparation of mating metallic and nonmetallic parts to be joined by bonding might require specification of a particular cleaning method.

6.7 JOINING METHODS.

MIL-HDBK-727 provides a survey of joining methods. The suitability of a particular joining method depends upon functional factors.

6.7.1 Mechanical Fasteners.

Fastener hardware shall be selected and applied in accordance with MIL-STD-454, Requirement 12. When suitable military standard fasteners are not available, industry standard hardware shall be utilized in lieu of preparation of an end product drawing for a specially designed fastener. For riveted assemblies, BRDEC drawing D13217E1061, Rivet Requirements, may be referenced. This drawing specifies acceptable quality and workmanship. Metric sizes for rivets can be found in ISO R1051, Rivet Shank Diameters.

6.7.2 Metallurgical Joining.

These joining methods must be considered in conjunction with materials. The efficient use of these processes requires a careful analysis of joint design including configuration, fit, and accessibility to processing equipment. Three major types of metallurgical joining are welding, brazing, and soldering.

6.7.2.1 Weldments.

Weldment drawings depict an item in its final or completed state, however, this is one of those instances where process information and controls shall be specified on the drawing. This is necessary in order to completely define the engineering requirements and to assure that the end product requirements will be achieved. For example, the type of weld joint is controlled by symbols, intermittent welding may be specified in order to minimize the effects of weld distortion, qualification of the welding process may be required, and a requirement to qualify the welder may be necessary. The characteristics of welding and types of welding processes normally used are discussed in the following paragraphs:

a. Characteristics of Welding. Welded constructions are widely used for speed of manufacture, economy, and efficient use of materials. Furthermore, welding offers great mobility since it can be done in a shop, in the field, at the building site, or even under water. Modern welding techniques and equipment allows relatively easy welding of a variety of steels, aluminum, and other metals. Welding, when properly done, will produce joints that are in many cases equal or greater in strength than the parent material.

b. Types of Welding Processes. Commonly used welding types are gas and arc welding. More exotic types include laser, electronic beam, and friction welding. In gas welding, hydrogen or acetylene and oxygen are mixed in the welding torch to generate a hot flame capable of melting metals. The most common welding is arc welding where electricity is used to generate the heat. The following varieties of arc welding are commonly used:

   (1) Shielded and submerged metal arc welding use coated welding rods. The coating generates inert gas around the molten metal to prevent oxidation. Both processes may be used for medium and heavy steel welding. Shielded metal arc is used also for medium and heavy aluminum welding.

   (2) MIG (metal inert gas) welding uses consumable wire and inert gas, normally helium, argon, carbon dioxide or a mixture thereof, to surround the molten metal to prevent oxidation. MIG welding is used for light steel, aluminum, magnesium, copper, nickel, etc.

   (3) TIG (tungsten inert gas) welding uses a nonconsumable tungsten tip to conduct electricity to the work place, and uses a hand fed consumable wire. Inert gas is used to prevent oxidation as in MIG welding. The uses of TIG welding is similar to those of MIG welding.

   (4) Resistance welding is either spot welding, projection welding or seam welding. It is performed by pressing the work pieces together and passing a current through them to melt a limited area between the metals. Spot welding and seam welding are done on sheet metal and do not require electrodes or gas shielding. Projection welding is used to weld studs and similar items to sheet metal and it also does not require use of electrodes or inert gas. Resistance welding may be used on variety of metals and thicknesses.

   (5) The exotic types such as laser, electron beam, etc., are seldom used on Belvoir drawings and will require special considerations. They are normally used when the work piece cannot tolerate heat.

6.7.2.1.1 Welding Controls.

The end-product weldment may appear to be acceptable when inspected visually but still contain internal defects, therefore, process controls and finally inspection and acceptance methods must be specified to assure that the end-product meets all the engineering requirements. The design engineer must define the following welding controls:

a. Welding Joint Type and Size. Welding joint types (butt, bevel, fillet, etc.) and sizes are normally shown on the weldment drawing. The joint type symbols are in accordance with ANSI/AWS A2.4, Symbols for Welding and Nondestructive Testing, and the sizes are expressed in numbers in the welding symbols. The size of a weld is normally dictated by the thickness of materials to be joined if full strength of the joint is required. If less than full penetration is sufficient, the designer engineer may specify partial penetration in accordance with ANSI/AWS A2.4. The tolerance applied to the length and spacing of intermittent welds, weld sizes and any joint preparation required shall be governed by all applicable AWS workmanship standards and ANSI/AWS A2.4.

b. Qualification Requirements. Qualification of welders and welding procedures are important means in the control of welding quality.

(1) Welding Qualification. Welders doing the actual welding of parts may be qualified or unqualified. Qualified welders have welded samples that have been examined and tested officially. The welder has been certified to indicate qualification. A certification (qualification) covers only those metals, thicknesses and types of joints that have been tested. If a welder has not welded the type of joint and materials for which he was certified, for an extended period of time, he must requalify. An unqualified welder may be a skilled welder; he merely has not recently demonstrated his welding capabilities. The design engineer should specify the requirement for qualified welders for critical and highly stressed joints. This may be accomplished by requesting welder qualification per AWS or ASME welding codes, per MIL-STD-1595; or by calling out Class 2 or 3 of MIL-STD-1261.

(2) Welding Procedures Qualification. Welding procedures are prepared for each different type of joint and they specify required voltage and amperage ranges, inert gas type and flow, welding rod type or filler wire, wire feed speed, preheat and post heat requirements, etc., as applicable to a specific joint. When sample parts have been welded in accordance with the procedures and then officially examined, tested, and found acceptable, the procedure may be certified. Qualification of a procedure will provide greater assurance that the production weld joints will be acceptable when welded in accordance with the procedure. However, the contractor is not required to record his procedures or to qualify them unless specifically requested by the drawing, specification, or contract. When welding thin sheet metal (.18" and under) for light load applications, written procedures or qualification of procedures may not be required. However, at the option of the design engineer, preparation of the welding procedures may be requested, as well as a requirement to be submitted to the Government for acceptance. The AWS welding codes provide examples of well prepared procedures. The procedures may also be requested to be qualified in accordance with the acceptable AWS or ASME codes. MIL-STD-1261 provides for written welding procedures for all classes of welding. These procedures are requested to be forwarded to Government engineer for acceptance.

(3) Additional Qualifications. Welding inspectors and welding equipment may be requested to be qualified in accordance with AWS or ASME codes when required.

Normally, inspectors for other than visual inspection will be required to be qualified by their applicable process specifications. Welding equipment is not usually requested to be qualified for Belvoir welding.

c. Inspection and Acceptance. The quality of any weld depends on the type, size, number and distribution of flaws. By selecting the inspection type and acceptance criteria, the design engineer can control the quality of acceptable welds. Naturally, with tighter acceptance criteria and by using more effective inspection methods, the cost of the welding will increase with the quality. It is important for the design engineer to realize that <u>no</u> inspection method will be able to detect all weld defects all the time. The worst enemy of weld strength is a crack. <u>In specifying other than visual inspection, the applicable inspection symbol shall be included with the welding symbol on the weldment drawing, as specified in ANSI/AWS A2.4</u>. All the following inspection methods are able to detect surface cracks (assuming a good inspector). The ultrasonic and radiographic methods also detect cracks that are deep in the weld. The following inspection methods may be specified:

(1) Visual Inspection. Visual inspection, the simplest inspection method, is performed on all welding in addition to other possible inspections. It is normally accomplished with a 5X magnifying glass and will indicate surface defects such as undersize, undercutting, overlap, porosity, and cracks. Maximum acceptable sizes and grouping limitations of defects may be defined by referring to AWS or ASME codes, or MIL-STD-1261, Arc Welding Procedures for Constructional Steels. No cracks are acceptable. Visual inspection is normally performed on 100% of the welding.

(2) Magnetic Particle Inspection. Magnetic particle inspection will augment visual inspection and will detect subsurface defects up to about 0.1 inch in depth. The cost of a magnetic particle inspection is moderate. The process control specification normally used on Government drawings is MIL-STD-1949, Inspection, Magnetic Particle. Acceptance criteria for MT is specified similar to the visual inspection acceptance discussed above.

(3) Liquid Penetrant Inspection. Penetrant inspection will indicate surface defects and thru holes. Penetrant inspection may be used on ferrous and non-ferrous materials at a moderate cost. The acceptance criteria for penetrant inspections are similar to visual and magnetic particle inspections. Process requirements for penetrant inspection are normally specified to be in accordance with MIL-STD-6866, Inspection, Liquid Penetrant.

(4) Ultrasonic Inspection. The basic principle of ultrasonic inspections is to direct a high frequency sound beam into the welded material on a predictable path. When this beam is echoed back from discontinuities in the weld, it will be indicated on a scope as deviations from the predicted path. In this way, the ultrasonic method is able to detect subsurface discontinuities and cracks, and is often used in connection with the radiographic inspection that will shows the defects on film. MIL-STD-1875, Requirements For Ultrasonic Inspection, ASTM E 164, or AWS Welding Codes may be used for controlling the process and for defining acceptance for various defects detected by the ultrasonic inspection.

(5) Radiographic Inspection. Ideally, radiographic inspection is able to penetrate the weld and indicate all defects. This inspection method is most effective on flat butt welds but is less effective on other types of weld joints. Other than butt welds will normally require more than one shot of a single area to indicate the complete weld. Radiographic inspection is relatively expensive and will require a certified inspector to interpret the results.

Radiographic inspection process may be controlled through MIL-STD-453, Inspection, Radiographic, MIL-R-11470, Radiographic Inspection; Qualification of Equipment, Operators and Procedures, ASTM E 142, or other suitable specifications. For acceptance criteria, standards such as MIL-STD-1264, Radiographic Inspection For Soundness of Welds in Steel By Comparison to Graded ASTM E 390 Reference Photographs, AWS and ASME welding codes may be used.

(6) Load Testing. The most reliable method to determine the strength of a completed weld is to test it. This may be accomplished for example, by pressure testing tanks or by applying a suitable load (tension, compression, bending, etc.) on the weldment. The load used in testing should always be more than the expected working load. Properly performed load testing will ensure that the weldment will be strong enough to withstand the working loads initially. It will not, however, discover minor cracks that may propagate during continuous use and cause a later failure.

6.7.2.1.2 Welding Documentation.

The project engineer must prepare documentation for welding requirements, to be included in a contract package, at two different points in the development of an item. These two points and some of the welding codes and specifications to be cited are as follows:

a. Design Contract Requirements. In this instance, the contractor is being tasked to design the welding joints, specify the processes to be controlled, determine if certification of the welder and procedures are required, test the design, and to deliver detailed documentation to support the preparation of MIL-T-31000, Product drawings for use in the next phase. The contractor has complete freedom of design in order to meet the performance requirements.

b. Manufacturing Contract Data Requirements. At this point, the project engineer must prepare a Technical Data Package (TDP) for use in competitive procurement of an end item. The weldment design is specified in detail, the end item design and drawings have been proven by test and physical configurations audit (PCA), processes necessary to meet the engineering requirements of the design are identified, certification of procedures and welders are included where necessary, and finally the method of inspection and quality assurance provisions (QAPs) are identified. The contractor has no freedom of design since all requirements are provided on detailed engineering drawings.

c. Welding Codes and Specifications. The American Society of Mechanical Engineers (ASME) and the American Welding Society (AWS) have prepared nationally recognized codes and specifications. The most general codes are as follows:

   (1) AWS D1.1, Structural Welding Code-Steel

   (2) AWS D1.2, Structural Welding Code-Aluminum

   (3) AWS D1.3, Structural Welding Code-Sheet-Steel

   (4) AWS D14.3, Welding Earthmoving and Construction Equipment, Specification for

   (5) ASME Boiler and Pressure Vessel Code, Section IX, Welder Qualifications

   (6) Specialized specifications and codes are available at the technical library and from:

The American Society of Mechanical Engineers
United Engineering Center
345 East 47th Street
New York, NY 10017

American Welding Society
550 NW LeJeune Road
P. O. Box 351040
Miami, FL 33126

The design engineer may select parts of these codes to control the welding quality, however, he cannot refer to the entire code without taking deviations and selecting options for testing and acceptance. There are many other specifications and standards available for controlling welding quality. Each has its own limitations. Therefore, before using any of them as a requirement, the design engineer has to study the appropriate specification and then specify the particular deviations and options that are applicable to his particular needs.

When determined to be necessary each welder, welding operator, and tack welder shall be qualified in accordance with one of the applicable codes. Optional tests are available for welder qualifications and should be included in the TDP if desired. Additionally, it is recommended that the TDP require welder qualification tests to be administered at the beginning of the specific contract being awarded rather than accepted previous qualification. A standard statement has been written to be included in a military specification or TDP to allow the Government to require retesting of a welder (operator, tacker) if there is reason to believe he is not producing welds of the quality required by the code or specification. The statement is as follows: "In the event of evidence of poor welds, the Government reserves the right to require retesting of any welder, welding operator, or tack welder. The test results shall be made available for review by the contracting officer's representative."

Welding procedures shall be qualified in accordance with the applicable code or specification, and may include options which would further limit the welding procedures. An example is AWS D1.1 that has such options: Section 10--Tubular Structures. These options should be invoked when they are applicable. Note that AWS allows prequalification of welding procedures under certain conditions. The project engineer may or may not wish to allow this prequalification and should so stipulate in the TDP. In addition to the above, repair procedures also need qualification.

Welding shall be done in accordance with the ASME or AWS code or specification which was used for welding procedure qualification, or otherwise specified. The project engineer may wish to require Government approval prior to each repair weld or to limit repair welds to one time only, particularly in aluminum.

There are military standards and specifications which may be used instead of the ASME and AWS documents; however, prior to invoking any code or specification it must be reviewed for applicability and currency of status. Particular attention must be paid to the need for calling out weld classes, grades and/or other options; if no class, grade, or other option is called out, the minimum will be used by the contractor whether the project engineer intended it or not.

Care should be taken in determining the type and level of inspection required for a given weld. This should be based on the design safety factor and criticality of the weld to the function of the end product, and to potential safety hazards to personnel and liability of the engineer. Several types of inspection, as previously discussed, are possible: visual, dye penetrant, magnetic particle, ultrasonics, and radiography. It should be noted that no single inspection method will find all types of discontinuities (cracks, porosity, lack of fusion, etc.) in a weld. Visual inspection should be made to 100% of all welds, augmented with 5X magnification. A comparison of the inspection methods follow:

METHOD	AREA OF DETECTABLE DISCONTINUITIES	ADVANTAGES	LIMITATIONS	PROCEDURE SPECIFICATION	ACCEPT SPEC
Visual	Surface	Simple, inexpensive	No below surface inspection		ASME AWS
Liquid Penetrant	Surface openings due to cracks, porosity, overlaps.	Inexpensive, easy to use, portable, sensitive to small surface flaws	Discontinuity must be opened to the surface	ASTM E 165	ASME AWS
Magnetic Particle	Surface or near surface	Inexpensive	Limited to ferromagnetic material. May require demagnetization	ASTM E 709	ASME AWS

METHOD	AREA OF DETECTABLE DISCONTINUITIES	ADVANTAGES	LIMITATIONS	PROCEDURE SPECIFICATION	ACCEPT SPEC
Ultrasonic	Below surface for cracks, delamination, lack of fusion, inclusions, or interfaces	Can penetrate thick materials, portable	Requires coupling with component by contact to surface or immersion in a fluid	ASTM E 164 ASTM E 273	ASME AWS
Radiography	Below surface for porosity, inclusions, lack of fusion, incomplete penetration.	Film provides permanent record. Can inspect a wide range of materials and thicknesses.	Radiation safety requires precautions. Detection of cracks can be difficult.	ASTM E 1032 ASTM E 94	ASTM E 390

For each of these inspection methods, acceptance levels must be set forth in the TDP either in specific terms or by invoking an acceptance document and specifying the level (grade, class, etc.) within the acceptance document.

6.7.2.1.3 Example Welding Notes.

DOD guidance provided in MIL-STD-970 and DODI 5000.2 directs the preferential use of industry standards and specification in DOD acquisition documents.

The examples below are not intended to be used verbatim, but sound engineering judgement must be applied to determine the applicable specification, the type of inspection required, and the degree of inspection necessary to ensure quality welding for each specific application. The following examples will provide guidance for the application of AWS Welding Standards on Belvoir engineering drawings:

a. AWS D1.1 - Structural Welding Code - Steel

Example Note:

WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.1. INSPECTION SHALL BE VISUAL. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL EXAMINATION.

Typical Application: Boom Outrigger and Tongue Assemblies - AVL Bridge

Example Note:

> WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.1. INSPECTION SHALL BE VISUAL AND ULTRASONIC. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL EXAMINATION. ULTRASONIC INSPECTION SHALL BE 100% LENGTH OF WELDS INDICATED.

Typical Application: Ramp Bay Strongback - Ribbon Bridge

b. <u>AWS D1.2 - Structural Welding Code - Aluminum</u>

Example Note:

> WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.2. INSPECTION SHALL BE VISUAL. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL EXAMINATION.

Typical Application: Housing - 36,000 BTUH Vertical MPI Air Conditioner

Example Note:

> WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.2. INSPECTION SHALL BE VISUAL AND DYE PENETRANT. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL EXAMINATION. INDICATED WELDS BELOW WATER LINE SHALL BE 100% DYE PENETRANT TESTED.

Typical Application: Hull - Combat Support Boat

c. <u>AWS D1.3 - Structural Welding Code - Sheet Steel</u>

Example Note:

> WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D1.3. INSPECTION SHALL BE VISUAL. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL INSPECTION.

Typical Application: Control Unit Enclosure - Joint Services Interior Intrusion Detection System (JSIIDS)

NOTE: Although inspection other than visual (i.e., nondestructive testing) is provided for by each of these referenced codes and would be governed by the end item specification requirements, sound engineering judgement must be utilized when determining the type of inspection to be required. Further, the degree of inspection must also be considered when reaching a decision on inspection type. All three AWS codes referenced allow 100% inspection of all welds for their full length, spot inspections of welds, and sample type inspections as per MIL-STD-105.

d. AWS D14.3 - Welding Earthmoving and Construction Equipment, Specification for

Example Note:

> WELDING AND INSPECTION SHALL BE IN ACCORDANCE WITH AWS D14.3. BASE METAL CLASSIFICATION CLASS ____ (SEE SPECIFICATION FOR BASE METAL CLASSES TO BE JOINED). INSPECTION SHALL BE VISUAL. 5 X MAGNIFICATION SHALL BE USED TO EVALUATE ANY AREAS QUESTIONED BY INITIAL VISUAL INSPECTION.

Typical Application: M1 Mine Clearing Rake

In addition to the use of commercial codes, specifications, and standards for welding and inspection, consumables such as electrodes should also be specified by AWS specification and classification.

AWS makes recommendations within each commercial code as to applicable electrodes for general application. However, sound engineering judgement must be used in filler metal selection to ensure quality welds.

Other commercial organizations provide regulation of welding procedures, qualification of welders, inspection and testing of welded joints, i.e., the American Bureau of Shipping (ABS) have recognized codes which may be tailored for specific requirements.

6.7.2.2 Brazed Assemblies.

End product drawings depicting brazed assemblies normally define only the relationship of joined parts. Detail joint design parameters, such as fit, are defined by referenced specifications and are not included on the drawing. Brazing shall be in accordance with MIL-STD-454, Requirement 59. MIL-STD-645, Dip Brazing of Aluminum Alloys, shall be specified for dip brazed aluminum assemblies.

6.7.2.3 Parts Joined By Solder.

End product drawings that specify mechanical or electrical soldering shall define the solder to be utilized in the parts list of materials for the assembly. For mechanical soldering, DOD-STD-1866, Solder Process, General Specification for, shall be specified. Electrical and electronic soldering shall be in accordance with MIL-STD-2000.

6.7.3 Chemical Joining.

End product drawings specifying chemical bonds are of two types, those that require detailed joint definition and those for which process specifications or standards control joint preparation and design. MIL-HDBK-691, Adhesives, provides guidance to application and selection of adhesives, including joint fabrication and preparation. The end product drawing shall specify joint design, preparation, application, and curing processes as necessary to ensure a functional bond. When applicable, adhesives shall conform to MIL-STD-454, Requirement 23.

6.8 COATINGS.

Coatings specified on end product drawings serve many purposes including corrosion protection, conductivity, lubrication, and coloring. Before deciding the level at which treatment and painting should be specified on end product drawings, consider spare parts procurement, production methods suitable for treatment and painting (many such processes have size limitations), and quality of protection achieved if parts are treated after assembly. For example, certain thermoplastic materials must be masked during overall treatment of equipment to avoid degrading their electrical and physical properties. Table X of MIL-P-11268 Parts, Materials, and Processes Used in Electronic Equipment, provides a listing of thermosetting materials which should be masked to prevent degradation. MIL-HDBK-132 serves as a guide to protective finishes. The applicable detail specification for a required finish shall be specified on the end product drawing. Finishes not further identified by specification may be referenced by finish number in accordance with MIL-STD-171.

Lubricants must be compatible with function of the part and its expected environment. Military and Federal standards and specifications shall be specified whenever possible to define necessary lubricants. Where required for proper lubrication, suitable fittings shall be provided. Lubricants shall be designated by the notation "AR" in QTY REQD column of the PL.

Antiseize compounds, pipe sealing compounds, etc., shall be specified as applicable. These compounds shall also be designated by the notation "AR" in the PL.

6.9 PARTS CONTROL PROGRAM (PCP).

6.9.1 General.

The DOD Parts Control Program (PCP), as described by Department of Defense Instruction (DODI) 5000.2, Part 6, Section R, is intended to provide a pragmatic approach for keeping acquisition and support costs for spare parts at a manageable level. Each time a new weapon enters the inventory, it brings with it thousands of new items for spares and support equipment. Through the application of parts control, reduced documentation, testing and provisioning costs along with increased reliability and maintenance are achieved for those new parts entering the DOD inventory.

6.9.2 Objectives.

The objectives of the PCP are three-fold.

(1) To reduce cost by controlling item proliferation of military materiel.

(2) To prevent new and unneeded, or inferior, parts from entering the logistics system and minimize the variety of parts used in new designs by maximum use of standard parts.

(3) To ensure the use of high-quality, high-reliability parts and materials during design, production, and modification.

6.9.3 Standard Parts.

Standard parts are defined as parts described by a General Equipment Specification, Military-Federal Specification or Standard, or an Industry Standard formally adopted by DOD for general application. See MIL-STD-970, Order of Preference For the Selection of Standards and Specifications.

6.9.4 Application.

In accordance with DODI 5000.2 a DOD PCP is required by each Army element responsible for development and acquisition of military materiel. The PCP is accomplished through the use of MIL-STD-965A and by using the Military Parts Control Advisory Groups (MPCAG's), who review contractor-submitted parts lists and make part substitution recommendations. The MPCAG contact points are listed in MIL-STD-965, paragraph 6.4.1. The contractual application of PCP and MIL-STD-965A is normally applied during the following acquisition phases:

- Phase I, Demonstration and Validation, if this can be expected to yield appreciable cost savings.
- Phase II, Engineering and Manufacturing Development. PCP should always be applied to contracts for design and fabrication of a system or equipment to meet the performance requirements of a specification.
- Production. PCP should be applied for production quantities where a baseline is already established or in the case where Engineering Change Proposals (ECPs) are likely to be submitted.

6.9.5 Program Part Selection List (PPSL).

MIL-STD-965 requires that all parts for new design be selected from a current, approved and maintained PPSL. Two procedures covering the submission, review, and approval of the PPSL and changes thereto are described in MIL-STD-965. Procedure I is usually applied on contracts involving only one contractor, while Procedure II should be considered when there is an aggregation of contractor/subcontractors. The PPSL is used with either procedure.

6.9.5.1 Government Furnished Baseline (GFB).

Government furnished baseline are developed and supplied by the MPCAG's. GFB's are normally called out in the contract and serve as a baseline PPSL from which the contractor can freely select parts for his design control PPSL.

6.9.5.2 PPSL Approval.

Once the contractor has submitted his PPSL and recommendations from the MPCAG's have been received, it is the responsibility of the Technical Directorate project engineer to accept the MPCAG recommendations for implementation. The Technical Directorate project engineer must provide written notification to the Belvoir PCP point of contact concerning their implementation decisions. Inclusion of brief explanations regarding nonconcurrence decisions will enhance subsequent MPCAG recommendations.

6.9.6 Parts Control Program Documentation.

Documents available for PCP principles and practices include:

DODI 5000.2	Part 6, Section R, DOD Parts Control Program
MIL-STD-965	Parts Control Program
MIL-STD-970	Order of Preference For the Selection of Standards and Specifications
MIL-P-11268L	Parts, Materials and Processes Used in Electronic Equipment
DI-MISC-80072A	Program Parts Selection List (PPSL)
DI-MISC-80071A	Part Approval Requests
DI-E-7030	Test Data for Nonstandard Parts
BELVOIR SOP 700-2	Parts Control Program (PCP)

6.10 ACCEPTANCE CRITERIA.

6.10.1 General.

Depending on design considerations, Belvoir drawings may include tests to assure that hardware is properly fabricated or assembled. This is especially true in cases when quality cannot be measured directly, for example, swaging strength of cables, welding quality, etc. Also, easily performed testing may be listed on drawings, for example, verification of continuity on wiring harnesses. If less than 100 percent inspection is considered acceptable, the drawing should specify the sampling. If other than visual welding inspection is specified, testing symbols of ANSI/AWS A2.4 must be used in connection with welding symbols.

6.10.2 Flexible Parts.

If drawings depict parts or assemblies that flex or deform, specify conditions for which given dimensions and tolerances apply (e.g., free-standing, supported a specific way, etc.). See ANSI Y14.5M, par. 6.8, Free State Variations.

6.10.3 Typical Tests.

a. Proof Pressure - Hydrostatic pressure tests shall include pressure, time, media, and allowable leakage.

b. Magnetic Particle Inspection - Inspection shall be in accordance with MIL-STD-1949, Inspection, Magnetic Particle. Personnel certification shall be in accordance with MIL-STD-410, Non-Destructive Testing Personnel Qualification and Certification. Allowable defects shall be defined.

c. Liquid Penetrant Inspection - Inspection shall be in accordance with MIL-STD-6866, Inspection, Liquid Penetrant, and personnel certification in accordance with MIL-STD-410. Definition of allowable defects shall be noted.

d. Radiographic Inspection - Inspection shall be in accordance with MIL-STD-1264, Radiographic Inspection For Soundness of Welds in Steel By Comparison to Graded ASTM E 390 Reference Photographs, MIL-R-11470, Radiographic Inspection: Qualifications of Equipment, Operators and Procedures, MIL-STD-453 Inspection, Radiographic, as applicable. Acceptance standard shall be noted and allowable defects shall be defined.

e. Enclosure Requirements - Pressure, time, and leakage allowances shall be noted. See MIL-E-2036, Enclosures for Electrical and Electronic Equipment, Naval Shipboard.

f. Electrical - Electrical parameters and characteristics shall be noted. Continuity checks, dielectric data, and durability shall be specified.

g. Dynamic Tests - Pertinent cycling, torsional deflection, capacities, gear backlash, and similar data shall be noted as required.

h. Mechanical Properties Tests - All tests relating to the verification of metal properties shall be conducted in accordance with Federal Standard No. 151, Metals; Test Methods, or the applicable ASTM specification.

i. Workmanship - When workmanship requirements must be defined, MIL-STD-454, Requirement 9, may be specified.

6.11 IDENTIFICATION AND MARKING.

General Marking requirements on drawings are discussed in paragraph 3.7. For marking requirements for electrical or electronic items, see MIL-M-13231, Marking of Electronic Items. When appropriate, identification, instruction, warning, and designation data may be applied by use of the plates. Three types of plates frequently used on military equipment are discussed below.

6.11.1 Standard Plates.

The standard plate format as covered in MIL-P-514, Plates, Identification, Instruction and Marking, Blank, specified by type, style, and composition shall be used, (MS numbers referenced in MIL-P-514 are design standards only and not part or identifying numbers. Therefore, these MS numbers shall not be entered on the PL). Nomenclature and other legend data to be filled in on standard plate format shall be specified in detail on the assembly drawing, specifying or depicting the plate. Other ordering data requirements shall be as specified in Section 6 of MIL-P-514.

6.11.2 Special Plates.

Special plates shall be designed in accordance with MIL-P-514 and requirements herein when no suitable standard plate exists. Plate materials are selected to conform with equipment requirements and MIL-P-514.

a. If photosensitive aluminum (MIL-P-514, Composition C) is desired, the type, grade, and class of material shall be specified in accordance with GG-P-455. A plate thickness of .020 ± .002 inches is the most economical and shall be used whenever practical. Plate thicknesses of .012, .032, .063, .125, and foil thicknesses of .003, .005, and .008 inches may also be specified. The maximum standard plate stock available is 24 x 40 inches.

b. A name plate is said to be anodized when made from flat anodized aluminum stock. Therefore, any embossing, relief stamping, punching, or trimming done to anodized plates after processing will break the anodized coating. If this is undesirable, the following note is required on the drawing:

> **ALL LEGEND SHALL BE FORMED BY PHOTOGRAPHIC PROCESSING. NO EMBOSSING, RELIEF STAMPING, OR PUNCHING SHALL BE USED FOR FORMING SERIAL NUMBERS OR OTHER CHARACTERS WHICH VARY ON EACH PLATE.**

Plate content requirements shall specify in detail plate size, information content, and lettering size. For example, when photographic anodized aluminum plates are desired, the material block shall contain the words:

"SEE NOTE (number)"

and the note referenced shall read:

> **THIS PLATE SHALL CONFORM TO MIL-P-514, TYPE III, COMPOSITION C, (GG-P-455, TYPE I OR II, GRADE A, CLASS I).**

The above note shall be modified accordingly for other materials.

6.11.3 Adhesive Backed Plates.

In cases where attachment of regular plates presents a problem, adhesive backed aluminum foil plates may be used. The following note shall be added on the drawing:

> **THIS PLATE SHALL CONFORM TO MIL-P-19834, TYPE I (OR TYPE II, AS APPLICABLE).**

MIL-P-19834, Plates, Identification, Metal Foil, Adhesive Backed, covers adhesive backed foil .003-inch thick. If adhesive backed plate is used, an appropriate surface preparation shall be required prior to attachment of plate.

6.12 RELIABILITY.

Section XII presents an introduction to the principles of Reliability Engineering.

6.13 MAINTAINABILITY.

Working space and access to areas requiring maintenance shall be considered with respect to echelon of accomplishment of maintenance. Clothing, such as heavy gloves worn by field personnel, is a factor. Maintenance skills and special tool requirements shall be minimized. Lubrication, servicing, and repair part replacement are important factors. Shelf life of individual replacement items shall be reviewed. See Section XI for a discussion of Maintainability Engineering.

6.14 ENVIRONMENT.

Environmental conditions specified for the equipment shall be a factor in the producibility analysis. MIL-STD-210 specifies climatic conditions for military equipment. In addition a Materiel Developer's Guide for Pollution Prevention, 28 August 1992, is available by written request to:

Commander
Army Materiel Command
ATTN: AMCRD-E
5001 Eisenhower Avenue
Alexandria, VA 22333

This guide is intended to raise individual awareness of their responsibilities for compliance with Federal, State, and Local Laws and Ordinances regarding pollution prevention, and reducing their exposure to individual criminal liability.

6.15 TRANSPORTABILITY.

Consideration shall be given to highway, railroad, ocean, and airborne transportability parameters in accordance with DODI 5000.2, Part 6, Section E, Transportability.

6.16 HUMAN ENGINEERING.

Section XIV describes Human Factors Engineering (HFE) Goals and Requirements.

6.17 VALUE ENGINEERING.

A functional cost analysis shall be considered in accordance with Section X of this manual.

6.18 SAFETY.

Section XIII presents the principles and procedures of Safety Engineering.

6.19 MANUFACTURING SIMPLIFICATION.

Elimination of unnecessary parts and processes shall be a factor in the Producibility Analysis. Nonstandard processes and special tooling shall be minimized, and normal shop tooling and processes shall be considered in the review but not listed on drawings. Special gaging requirements shall be kept to the minimum necessary to ensure design functions. Standard components and parts shall be used. Similar items (fasteners, covers, or gears) used on any equipment under study shall be standardized. Consideration shall be given to standard patterns, dies, gages, etc.

6.20 PRODUCIBILITY ANALYSIS REPORT (Implementation Instruction - contains mandatory requirements).

A report is required at completion of a Producibility Analysis. This report shall include a detailed listing of findings, recommended changes, and reasons for the changes. Any contract requiring a Producibility Analysis should list DI-MGMT-80797, Producibility Analysis Report, on the Contract Data Requirements List (CDRL), Form 1423. All changes resulting from a Producibility Analysis shall be made in accordance with Section IV of this manual.

6.20.1 Format of the Report.

The report contents are addressed on data item DID-MGMT-80797. The foreword of the report should tell the purpose and background for the Producibility Analysis. Problems that are repeated on many drawings may be reported as general problems with references to drawings where they occur. Other problems should be reported by brief descriptions with proposed changes to eliminate them. The problems should be classified as Major or Minor, to indicate their relative importance. Tolerance stack-ups are normally shown on drawings and not in the report. Calculations for verifying problems and corrections should be included in reports, or in appendix, as applicable. Recommended changes may be categorized to correspond with the types of errors, as defined below:

a. Major Error - A major error is one that, if not corrected, could result in a hardware defect or in a production cost increase or schedule delay. Major errors are further categorized as:

Category	Example
Manufacturing Process	Critical assembly sequences are necessary for assembly but have not been specified.
Performance Ratings	Drawings for critical components specify incomplete performance requirements.
Dimensions	Parts inadequately defined, missing dimensions.

Category	Example
Tolerances	Tolerances have been assigned without regard to function of features; block tolerance range is unnecessarily restrictive for most features.
Materials	Material inadequately defined.
Inspection and Test Data	Test data specified without toleranced input and parameters.
Packaging	Requirements have been erroneously omitted from specification.
MIL-D-5480 Data, Engineering and Technical, Reproduction Requirements For	Drawing quality not adequate for producing quality microfilm.
MIL-T-31000	Drawing does not meet the requirements of the design disclosure specified.
MIL-STD-100	Control drawings do not meet the requirements of MIL-STD-100, and ANSI/ASME Y14.24M.

b. Minor Error - A minor error is any error other than a major error that is in violation of standards or specifications that regulate the drawing requirements. Minor errors are further categorized as:

Category	Example
Drafting	Misspelled words or minor drafting errors.
Other	Any other defect of a minor nature.

6.21 CONFIGURATION AUDITS (Implementation Instruction - contains mandatory requirements).

Physical Configuration Audit (PCA) and the Functional Configuration Audit (FCA) are used by the Government to compare hardware with its technical documentation. As applicable, the procedures specified in MIL-STD-973 may be used for these audits.

6.21.1 Physical Configuration Audit (PCA).

The PCA is a formal examination of the as-built hardware (that has demonstrated the ability to meet the functional requirements and has successfully passed the DT/OT Testing) against its technical documentation to establish the configuration item (CI) product baseline. Whenever possible, the PCA should be conducted on hardware that has been subjected to an FCA. The PCA compares all the technical data, drawings, specifications, and manuals to the hardware. PCA is not manufacturing acceptance inspection but a verification to assure that the drawings and other data describe the hardware. The audit findings may be used to change the drawings and data to match the successfully tested hardware where determined necessary.

For most Belvoir items the development contractor will not be the production contractor. When the development contractor will not be the production contractor the production contract should require a preproduction evaluation (PPE), and a PCA to assure that the technical documentation allows alternate manufacturing processes and accurately reflects the as-built first article production hardware.

6.21.1.1 Procedure for the PCA.

a. Upon receipt, hardware shall be inspected to determine any physical damage. As required, hardware shall be operated to determine if it is functional and meets dynamic or functional characteristics noted on drawings.

b. As appropriate, continuity of electrical, pneumatic, and hydraulic systems shall be verified.

c. To preclude material damage or danger to personnel, precautionary measures for disassembly shall be determined, e.g., relieving of pressurized or springloaded systems.

d. During disassembly, assembly drawing requirements shall be checked for dimensions, torques, and special procedures.

e. Each detail part shall be audited to the drawing requirements. This would consist of determining drawing dimensions and could include other items, such as:

   (1) Material verification through spectrographic analysis

   (2) Plating analysis

   (3) Hardness testing

   (4) Grain flow on critical forging through microphotography

   (5) Verification of casting soundness

   The part drawing may be used for recording findings. Each characteristic that falls within drawing tolerance range may be verified by a check mark placed beside the drawing dimension, by a suitable note using a color code, or by some other suitable means. For characteristics outside drawing tolerance, the actual measurement shall be recorded. As far as practical, all records shall be maintained on the audit drawings.

f. Audit data shall be analyzed, and resolution of all discrepancies will be determined before reassembly. Where appropriate, ECPs will be prepared to bring drawings on level with hardware. Successful completion of a PCA will provide a configuration management baseline. It also will provide assurance that the TDP is complete, matches the hardware, is suitable for use in full scale production, and that it is appropriate for operational, maintenance, and logistic purposes.

6.21.2 Functional Configuration Audit (FCA).

The objective of the Functional Configuration Audit (FCA) is to verify that actual performance of the configuration item complies with applicable specification requirements. The FCA for a complex configuration item may be conducted on a progressive basis when so specified by the contracting agency.

6.21.2.1 Required Information.

The following information shall be available for the FCA team:

a. Test plans, specifications, and applicable reports for the configuration item

b. Preproduction test results

c. Applicable ECP actions

6.21.2.2 Audit.

Testing accomplished with the approved test procedures and validated (witnessed) data shall be sufficient to ensure configuration item performance as set forth in Section 3 of the specification, and shall meet the quality assurance provisions/qualification requirements contained in Section 4 of the specification. Deficiencies shall be documented and made a part of the FCA minutes. Completion dates for the resolution of all discrepancies shall be established and documented.

6.21.2.2.1 Simulation.

For performance parameters which cannot be completely verified during testing, adequate analysis or simulations shall be made. The results of the analysis or simulation will be sufficient to insure configuration item performance as defined in the specification.

SECTION VII

QUALITY ASSURANCE PROVISIONS (QAPs)

7.1 GENERAL.

Quality Assurance Provisions are inspections, including examinations and tests, performed to ensure that technical requirements of all end items and spares are met. QAPs delineate the contractor's minimum inspection responsibilities to substantiate product conformance to drawings and specifications prior to submitting the product to the Government for acceptance. The inspection required to verify QAP characteristics shall not be interpreted as eliminating the necessity to inspect any drawing characteristics not already classified. These QAP characteristics should be included in establishing the quality control (QC) inspection program in accordance with MIL-Q-9858, Quality Program Requirements, or MIL-I-45208, Inspection System Requirements. QAPs shall meet the requirements of MIL-T-31000, Appendix B, Quality Assurance Provisions.

7.2 TYPES OF QUALITY ASSURANCE PROVISIONS.

QAPs for end items should appear as inspections and tests in Section 4 of specifications and purchase descriptions. QAPs for spare parts should appear as notes on the spare part drawing and if QAP is extensive, it should be continued on an additional drawing sheet. However, some Major Subordinate Commands (e.g., TACOM) require separate sheets for drawing QAPs.

7.2.1 QAPs in Specifications/Purchase Descriptions.

These QAPs should comply with MIL-STD-961 and the Belvoir Standardization Document Preparation Guide (SDPG). Critical characteristics shall be inspected 100%. Sampling for examination and test shall be in accordance with MIL-STD-105. Sample size shall be determined by using MIL-STD-105, Table I and Table IIa. A lot shall be accepted when 0 defects are found, and rejected when 1 or more defects are found.

7.2.2 QAPs on Spare/Repair Part Drawings.

QAP preparation requirements are prescribed in MIL-T-31000, Appendix B, Quality Assurance Provisions.

7.2.2.1 Criteria for Preparation.

QAPs on drawings will normally be prepared for component, subassembly and assembly drawings. QAPs will not be prepared for:

a. Components, subassemblies, or assemblies that are not required for installation in the maintenance or repair of an end item, subassembly, or component (except those destined for use in modifications, reconditioning, or retrofit programs).

b. Simple items such as nuts, bolts, washers, locks, hinges, etc., unless they are employed for critical usage or high accuracy is required.

c. Items not supported by detail drawings with requirements contained in a detail specification.

d. Components covered by a specification (e.g., springs, gears) having like characteristics and being applicable to a category of related items. In such cases, QAPs should be included in the specification for those items.

7.2.2.2 Drawing Analysis for QAPs.

QAPs are developed from an analysis of item design. Each characteristic on the drawing shall be analyzed to determine effect, if discrepant, on end item, and shall be classified Critical or Major as applicable. Definitions for these defect classifications are presented in MIL-STD-2101, Classification of Characteristics. The QAP drawing analysis procedure identifies characteristics whose conformance will verify design objectives. Considerations for assigning classification are:

a. Classification shall be determined by considering the condition that could result if a characteristic was not within specified limits.

b. Classification shall be based on class of defect definition and shall not be used as an arbitrary means of increasing amount of inspection for a particular characteristic.

c. Classification shall not be based on magnitude of tolerance.

d. Classification should not be based on the effect of omitting a feature.

7.2.2.3 Format and Samples.

7.2.2.3.1 Characteristic Identification.

Each classified characteristic should be identified where it appears on the drawing by means of code letters. The code should fall in the following series:

Critical - C1-C99

Major - M101-M199

All others

Minor characteristics are not normally identified and tabulated on the drawing. All characteristics not classified and identified on the drawing will be considered minor.

7.2.2.3.2 QAP Note.

Each drawing requiring QAP(s) should contain a note summarizing the inspections and containing the following information:

EXAMPLE NOTE:

X. QUALITY ASSURANCE PROVISIONS:

THESE REQUIREMENTS APPLY WHEN THE ITEM IS PROCURED AS A REPAIR PART:

A. INSPECTION FOR CRITICAL CHARACTERISTICS SHALL BE 100 PERCENT OF THE LOT QUANTITY. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE IIA. A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE.

B. CLASSIFICATION OF CHARACTERISTICS:

CRITICAL - NONE
MAJOR - M101-M102

C. ALL OTHER CHARACTERISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY OR INSPECTION SYSTEM.

Figures III-12, III-13, VII-1, VII-2, and VII-3 are examples of drawings with QAPs.

7.3 SPECIAL INSPECTION EQUIPMENT (SIE).

Standard Commercial Inspection Equipment (CIE) should be used whenever possible. When CIE is unavailable or inadequate to perform required inspections, Special Inspection Equipment (SIE) will be used. SIE documentation shall be submitted as a part of the Technical Data Package, see paragraph 3.2.1.e.

7.4 QUALITY ENGINEERING PLANNING LIST (QEPL).

The QEPL is used to indicate status of quality engineering documentation and to plan work. When a complete TDP is procured for the first time or there are a significant number of drawing changes in an existing package, the contractor will be required to submit a QEPL. When a QEPL is required in the contract it will be prepared in accordance with MIL-T-31000, and data item description DI-CMAN-80788 will be listed on the Contract Data Requirements List (CDRL), DD Form 1423.

7.5 CALIBRATION.

All inspection equipment must be calibrated in accordance with MIL-STD-45662. When this requirement is not covered by other specifications in a contract, this calibration requirement should be added.

7.6 TOTAL QUALITY MANAGEMENT (TQM).

There is a world-wide trend towards more stringent customer expectations with regard to quality. Accompanying this trend has been a growing realization that continual improvements in quality are often necessary to achieve and sustain good economic performance. The DOD Total Quality Management Master Plan, August 1988, states that "DOD's TQM implementation strategy aims at achieving one broad, unending objective: continuous improvement of products and services."

The International Organization for Standardization (ISO) has issued a series of standards on Quality Assurance in the interest of harmonizing national and international standards in this field. The following ISO standards were adopted on 6 June 1991 and are approved for use by DOD:

ISO 8402	Quality - Vocabulary
ISO 9000	Quality Management and Quality Assurance Standards - Guidelines for Selection and Use
ISO 9001	Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing
ISO 9002	Quality Systems - Model for Quality Assurance in Production and Installation
ISO 9003	Quality Systems - Model for Quality Assurance in Final Inspection and Test
ISO 9004	Quality Management and Quality System Elements - Guidelines

SECTION VIII

TECHNICAL DATA ACCEPTANCE

8.1 ACCEPTANCE.

Belvoir RD&E Center drawings and associated lists shall be prepared to the requirements of MIL-T-31000, MIL-STD-100, ANSI/ASME Y14.24M, ANSI/ASME Y14.34M, and this manual.

8.2 GOVERNMENT ASSISTANCE.

The Government will provide engineering assistance in the explanation, interpretation, presentation, and acceptance of data in accordance with the specified contractual documents.

8.3 QUALITY ASSURANCE.

The contractor shall establish a TDP quality control system in accordance with MIL-T-31000 for the review, analysis, correction, and inspection of all data prior to submission for acceptance by the Government. The Government reserves the right to perform any inspections during data preparation to assure conformance to the prescribed requirements. When specified in the contract the contractor's TDP quality control system shall be documented in a TDP Quality Control Program Plan, and data item description DI-QCIC-81009 shall be listed on the Contract Data Requirements List (CDRL), DD Form 1423.

8.4 ACCEPTANCE CRITERIA.

Data preparation and data acceptance criteria set forth in MIL-T-31000, MIL-STD-100, ANSI/ASME Y14.24M, ANSI/ASME Y14.34M, and this manual shall form the basis for Government acceptance.

8.4.1 General.

To meet Government requirements, data shall be sufficiently complete and adequate to provide nonrestrictive, competitive data suitable for use by any competent manufacturer for bidding, estimating, processing, fabricating, assembling, testing, gaging, procuring of commercially available components, inspecting, and for other associated uses. In addition, data shall provide complete item identification, performance and operation characteristics, maintenance and provisioning information, and reprocurement information.

Nonrestrictive data includes unlimited data rights and precludes the need for specific manufacturing processes, machinery and tooling. Nonrestrictive data is accomplished by depicting alternate materials and fabrication methods, using end product concepts, specifying alternate sources of supply for commercial components, and disclosing complete inspection criteria and performance and operating characteristics. Nonrestrictive data can be used for competitive bids.

8.4.2 Proved Data.

A TDP is "proven" by using it in producing, inspecting, and testing acceptable hardware. The contractor shall maintain, and make available to the Government representative, records of inspection and test results that will shown actual measurements and performance of hardware in comparison with drawing requirements. The Government "verifies" the TDP by monitoring during drawing preparation, reviewing the completed drawings, and by configuration audits.

8.5 DATA REVIEW AND ACCEPTANCE.

Data review shall be conducted prior to final acceptance. MIL-HDBK-288, Review and Acceptance of Engineering Drawing Packages, details procedures to be followed in monitoring and reviewing drawing packages being prepared, and provides guidance to the drawing reviewer concerning what to look for when reviewing a TDP.

8.6 DRAWING INSPECTION.

TDPs containing 100 drawing sheets or less shall be reviewed 100% prior to final acceptance. For larger TDPs the drawings may be inspected by a Government representative using the Limiting Quality Method of MIL-STD-105. Limiting Quality is set at ten percent defective for major defects, and probability of acceptance (PA) of a ten percent defective lot is also set at ten percent. The complete drawing package will be considered a single lot.

A major defect is defined as an error in the drawing that, if not corrected, could cause a hardware defect affecting form, fit, function, or production contract cost or scheduled delivery. Illegibility and nonreproducibility are classified as major defects. A minor defect is defined as an error in the drawing, other than a major error, violating standards or specifications for drawing requirements.

8.7 DRAWING SUBMITTAL.

After assuring that the TDP meets the contractual requirements, see Section II, paragraph 2.2, Technical Documentation Management Controls, for guidance and checklist to be used prior to submitting a TDP to the Standardization and Engineering Data Team for placement into the data repository.

SECTION IX

COMPUTER SOFTWARE

9.1 GENERAL.

This section covers the general requirements for development and acquisition of computer software as part of military systems. It is intended to be used as general guidance for the project engineer; the more detailed requirements are provided in the referenced documents. DODI 5000.2, Part 6, Section D, Computer Resources, and MIL-STD-2167 serves as key documents.

9.2 PLANNING.

When computer software is required to enable the military end item to function, the project engineer needs to determine the type of software to be used and if support functions will be by the contractor or by the Government during the life cycle. The acquisition plan is then tailored to specific requirements. Belvoir RD&E Center Handbook "Contracting for Computer Software Development" provides extensive guidance for determining appropriate statement of work and complexity of software in a system. After acceptance, software should be maintained and controlled in accordance with MIL-STD-973.

9.3 ACQUISITION AND DEVELOPMENT.

9.3.1 Procurement.

In procurement of software the RFP and the contract shall include the following references as applicable:

a. MIL-STD-2167 for software development requirements

b. MIL-STD-1521 for technical reviews

c. MIL-STD-490 for specification practices

d. MIL-STD-973 for configuration management practices and audits

e. DIDs as required to control management, design, test, and operational support of software

Additional information for the background for computer software management and acquisition may be obtained from the Joint Regulation - Management of Computer Resources in Defense Systems.

9.3.2 Development Requirements.

MIL-STD-2167 provides background requirements and should be consulted for detailed information.

The software development cycle normally includes the following phases (which can occur one or more times during the software life cycle):

a. Software requirements analysis
b. Preliminary design
c. Detailed design
d. Coding and unit testing
e. Computer software component integration and testing
f. Testing

Computer software shall be organized as one or more Computer Software Configuration Items (CSCI) consisting of Top-Level Computer Software Components (TLCSCs), Lower Level Computer Software Components (LLCSCs), and units, in accordance with MIL-STD-2167 and MIL-STD-973. Software Quality Assurance shall be included in planning and shall be an integral part of the development effort. The software quality evaluation/assurance (SQE/SQA) program and plan should include:

a. SQE/SQA procedures, tools, method, facilities, and activities in accordance with DI-MCCR-800W

b. Establishing and maintaining a complete set of software requirements to be used as standards during the development

c. Description of organization responsible for performing SQE/SQA and its relationship to operating organization

d. Required skill levels of personnel who shall be performing SQE/SQA

e. Establishing and implementing controlled processes for developing software and documentation

f. Specific resources necessary to perform SQE/SQA

g. Establishing and maintaining a process to evaluate software, software documentation, and development process

h. Providing a schedule of each SQE/SQA activity, demonstration, key meeting, review, audit, etc.

9.3.3 Commercial Software.

Development of software should include use of off-the-shelf commercial software as feasible. The developer shall clarify and establish the Government's data rights on commercial software and provide certification for the commercial software.

9.3.4 Configuration Management.

Developmental software may be put under configuration control in accordance with MIL-STD-973. Timing, however, is a consideration: if developed data is placed under formal configuration management too early, formal handling of ECPs, deviations and waivers will increase development costs. Therefore, formal configuration control should be applied when developmental software configuration has stabilized and no significant changes are anticipated in the judgment of the project engineer.

9.3.5 Data Items.

Data items required to be delivered are tailored to specific system development. Typical data items prepared and procured during a computer software development cycle include:

DID TITLE	TYPICALLY REQUIRED	DID TITLE	TYPICALLY REQUIRED
SDP	X	STP	X
SCMP		STD	X
SSPM		STPR	X
SQEP		STR	X
SSS	X	OCD	X
SRS	X	CSOM	
IRS		SUM	
STLDD	X	CSDM	
SDDD		SPM	
IDD		FSM	
DBDD		CRISD	X
SPS	X		
VDD	X		
ECP	X		
SCN	X		

The following data items are in the management category:

Software Development Plan (SDP)
Software Configuration Management Plan (SCMP)
Software Standards and Procedures Manual (SSPM)
Software Quality Evaluation Plan (SQEP)

The following data items are in the engineering category:

System/Segment Specification (SSS)
Software Requirements Specification (SRS)
Interface Requirements Specification (IRS)
Software Top Legal Design Document (STLDD)
Software Detailed Design Document (SDDD)
Interface Design Document (IDD)
Data Base Design Document (DBDD)
Software Product Specification (SPS)
Version Description Document (VDD)
Engineering Change Proposal (ECP)
Specification Change Notice (SCN)

The following data items are in the test category:

Software Test Plan (STP)
Software Test Description (STD)
Software Test Procedure (STPR)
Software Test Report (STR)

The following data items are in the operational and support category:

Operational Concept Document (OCD)
Computer System Operator's Manual (CSOM)
Software User's Manual (SUM)
Computer System Diagnostic Manual (CSDM)
Software Programmer's Manual (SPM)
Firmware Support Manual (FSM)
Computer Resources Integrated Support Document (CRISD)

9.3.6 ADP Approval.

Specific ADP approvals must be obtained for any ADP hardware and/or software acquired or developed and should be obtained as early in the acquisition cycle as possible. This approval is separate from any acquisition approvals obtained; the local Commander has up to $500K approval authority. See the Information Management Office's Assistant Data Processing Officer for further guidance.

9.4 SOFTWARE ACCEPTANCE.

Software acceptance should occur after the Functional Configuration Audit (FCA), as delineated in MIL-STD-2167. Software acceptance criteria should be specified in the end item specification or in the contract.

9.5 SOFTWARE STORAGE.

Computer specifications and manuals will be microfilmed and stored in the Vault, similar to other Belvoir RD&E Center data. Computer program (code) media (punched cards, magnetic material, optical media, or electronic memory) will be stored at the Belvoir Computer Operation Division Vaults.

9.6 CONFIGURATION CONTROL.

The baseline for computer software will be established after testing and acceptance. Any changes to non-magnetic and magnetic software shall be done in accordance with MIL-STD-973. ECPs, DD Form 1692 shall be used for all change proposals. Change proposals shall include justifications and estimated cost for change. Reporting for accomplishment of updating or retrofit changes shall be made in accordance with MIL-STD-973. When program media is revised, prior revisions shall be maintained until at least two subsequent revisions are in use.

9.7 SUPPORT DOCUMENTATION.

Documents available to support management of computer software are:

Document	Title
DODI 5000.2	Part 6, Section D, Computer Resources, Attachment 1, Software Engineering Practices
BELVOIR Report 2431 Hdbk	Contracting for Computer Software Development
MIL-STD-1467	Software Support Environment
MIL-STD-2167	Defense System Software Development
MIL-STD-2168	Defense System Software Quality Program
MIL-STD-973	Configuration Management

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SECTION X

VALUE ENGINEERING (VE)

10.1 GENERAL.

The purpose of Value Engineering (VE) is to achieve savings through use of an organized effort (team or individual) that analyzes function of system, equipment, facilities and supplies so as to achieve the required function at the lowest overall cost consistent with requirements for performance, including reliability, maintainability, and delivery. The history, methodology and benefits of VE are presented in DA Pamphlet 5-4-5, Value Engineering Handbook. VE policies and procedures for using and administering value engineering techniques in contracts are prescribed in Federal Acquisition Regulations (FAR), Part 48, Value Engineering, and DODI 5000.2, Part 6, Section O, Design For Manufacturing and Production.

10.2 VALUE ENGINEERING PROGRAM.

A VE program is established to support and apply VE discipline to all major elements of an organization. A VE Program Manager (VEPM) is assigned to implement the program. Duties include direction of program effort and administration of Belvoir Research, Development and Engineering Center resources. Value Engineering Points of Contact (VEPC) serve as the focal point for all VE activities in accordance with Belvoir RD&E Center Standard Operating Procedure (SOP) 70-8, Value Engineering Program. An effective and sustained VE program will have:

a. Periodic top management attention to assure implementation and continuing attention by middle management

b. A master plan to ensure that actions which may effectively contribute to a successful VE program are considered and acted upon

c. Value engineering objectives, policies, responsibilities, and reporting requirements firmly established and implemented

The three types of VE Recommendations are:

10.2.1 Value Engineering Proposal (VEP).

A specific proposal developed internally by Army/Government personnel for total value improvement. A VEP can also be submitted by a contractor that is providing services and acts as an arm of the agency holding the contract.

10.2.2 Value Engineering Change Proposal (VECP).

A specific cost reduction proposal, developed and submitted by a contractor (in most cases a production contractor), under VE contract provisions (incentive clauses or program requirement clauses) which require a change to contract specifications, purchase description or statement of work.

10.2.3 Preliminary VEP and VECP.

A value engineering change proposal which is submitted for review prior to availability of information necessary to support a formal VEP or VECP. A preliminary VEP is in order to permit a preliminary evaluation relative to merits of proposed change. (See 10.2.1 and 10.2.2.)

10.3 VALUE ENGINEERING STUDY (VES).

For VE to be effective, the approach must be systematic and organized. Before the study can begin, two preliminary steps must be accomplished. First, items with high potential for value improvement must be identified. Then a data package for the items (product, service, or process) must be assembled.

a. To identify items with high potential, consider the following:

   (1) Older items often reflect outdated technology

   (2) Complex items are generally candidates for simplification

   (3) Procurement problems usually indicate a need for value improvement

   (4) Excessive procurement or support costs usually indicate potential for value improvement

   (5) Overdesign in the form of tight tolerances, fine surface textures, unnecessary features, etc., indicate a need for value improvement

   (6) Non-interchangeable items indicate a need for value improvement

b. A data package for a product or manufactured item should include:

   (1) A complete set of drawings, sketches, layouts, and associated lists

   (2) A specification or purchase description

   (3) A model, an assembly, or parts

   (4) A production quantity forecast

   (5) Cost data

The performance of a VES is centered around the concepts and evaluations of function, cost, and worth, and the answers to six fundamental questions. The functions are identified for the item or service, the costs are established for each of the alternatives considered for accomplishing the required functions, and the worth of the functions is that alternative having the lowest overall total cost. This is the essence of the VES: evaluation of function, cost, and worth. Before one can evaluate the function, cost, and worth of an item or service, valid and complete answers must be obtained to the following questions:

What is the item or service?
What does it do?
What does it cost?
What else would do the job?
What would be the alternative cost?
What is it worth?

The first step in performing a VES is to select the systems or parts of systems that have the highest potential for cost reduction.

The next step in the performance of a VES is the definition of the function. This is accomplished by the use of either a Function Analysis or Functional Analysis System Technique (FAST). Functional Analysis is a multi-discipline method for enhancing product value by improving the relationship of worth to cost through the study of function. Function is defined simply by active verb and a measurable noun. FAST is a diagramming technique that graphically shows the logical relationships of the functions of an item, system, or procedure. Function identification is the critical element in the VES. Performance of a cost analysis without first defining function remains only a cost analysis: It is not a Value Engineering Study.

I. Information Phase

a. Investigate the project:

1. What is the project?
2. What is the problem?
3. What is the cost?
4. What must be accomplished?
5. What is now accomplished?

b. Analyze function and cost:

1. What is the basic function worth?
2. What are the secondary functions worth?
3. What are the high cost areas?
4. Can any function be eliminated?

II. Speculation Phase

Speculate on alternatives:

1. What else will perform the function?
2. Where else can the function be performed?
3. How else can the function be performed?

III. Evaluation Phase

Evaluate alternatives:

1. How might each idea work?
2. What will be the cost?
3. Will each idea perform the basic function?
4. What is the best alternative?

IV. Development Phase

Develop alternative:

1. How will the new idea work?
2. How can disadvantages be overcome?
3. What will be the total cost?
4. Why is the new way better?
5. Will it meet all the requirements?
6. What are the Life Cycle Costs?

V. Presentation Phase

Present alternatives:

1. Who must be convinced?
2. How should this idea be presented?
3. What was the problem?
4. What is the new way?
5. What are the benefits?
6. What are the savings?
7. What is needed to implement the proposal?

These are the five basic phases in the VE job plan employed in conducting a VE Study. The results of a VES will usually be a fully documented VEP or Contractor VECP that reduces overall costs in development, engineering, test and evaluation, production, procurement, supply, and maintenance programs.

10.4 PRODUCTION ENGINEERING RESPONSIBILITIES.

Production engineering personnel are in a favorable position to identify potential cost reduction items. Their responsibilities include the following VE-related efforts:

10.4.1 Waivers and Deviations.

Report to VEPC all waivers and deviations to contracts relative to specifications, testing, or tooling which will result in lower procurement costs.

10.4.2 ECPs.

Review all approved ECPs to TDP on current or anticipated buys and refer those with cost reduction potential to the VEPC for further study.

10.4.3 Value Engineering and Cost Reduction ECPs.

Technically evaluate Code V, Value Engineering, VECPs, and Code R, Cost Reduction ECPs.

10.5 VALUE ENGINEERING DOCUMENTATION.

Additional documents available for VE principles and practices include:

Document	Title
FAR	Part 48, Value Engineering
DODI 5000.2	Part 6, Section O, Design For Manufacturing and Production
MIL-STD-1771	Value Engineering Program Requirements
DOD HDBK 4245.8H	Value Engineering
BELVOIR SOP 70-8	Belvoir Research, Development and Engineering Center VE Program

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SECTION XI

MAINTAINABILITY ENGINEERING

11.1 PURPOSE.

This section provides an introduction to the principles of maintainability engineering.

11.2 DEFINITION.

Maintenance includes the actions necessary to retain materiel in or restore it to service condition. Total maintenance is composed of preventive maintenance (PM) and corrective maintenance (CM). Maintainability is the probability that an item will conform to specified conditions within a given period of time, when maintenance is performed in accordance with prescribed procedures and resources.

11.2.1 Quantitative Maintainability Indices.

Indices used to support maintainability analysis must be composed of measurable quantities, provide effectiveness-oriented data, and be readily obtainable from operational and applicable development testing. The following paragraphs describe some of these indices.

Mean-Time-to-Repair (MTTR): MTTR is total corrective maintenance down time accumulated during a specific period divided by total number of corrective maintenance actions completed during same period. Because frequency of corrective maintenance actions and number of man-hours are not considered, this index does not provide a good measure of maintenance burden.

Maximum-Time-to-Repair (MaxTTR): The maximum corrective maintenance down time within which either 90 or 95 percent of all corrective maintenance actions can be accomplished. It is useful in cases where there is a tolerable down time for the system.

Maintenance Ratio (MR): The cumulative number of man-hours of maintenance expended in direct labor during a given period of time, divided by cumulative number of end item operating hours during same time. The MR is a useful measure of relative maintenance burden associated with a system. It provides a means of comparing systems and is useful in determining compatibility of a system with the size of the maintenance organization.

Mean-Time-Between-Maintenance-Actions (MTBMA): The mean of the distribution of time intervals between corrective maintenance actions, preventive maintenance actions or all maintenance actions. This index is frequently used in availability calculations.

11.3 MAINTAINABILITY.

Maintainability has three broad factors: design, personnel and support.

11.3.1 Design.

The design factor covers physical aspects of the equipment itself: requirement for test equipment, spare parts, maintenance tools, training and personnel skill levels required to perform maintenance as directed by design, use and other factors applicable to equipment.

11.3.2 Personnel.

The personnel factor includes the skill level of maintenance personnel, their attitudes, experience, technical proficiency, and other human factors usually associated with equipment maintenance.

11.3.3 Support.

The support factor covers logistics and the maintenance organization involved in maintaining equipment. Support includes tools, test equipment, spare parts on hand at a particular location, availability of manuals and technical data associated with equipment, the particular supply problems which exist at a site and the general maintenance organization.

11.4 DESIGN OBJECTIVES.

Maintainability should be designed into the equipment and is, therefore, under control of the designer, during development and under control of production engineers during the producibility analysis. Maintainability engineering objectives are:

a. Simplification of overly complex maintenance tasks

b. Provision for rapid and positive recognition of equipment malfunction or marginal performance

c. Provision for optimum accessibility for all components requiring maintenance, inspection, removal, or replacement

d. Provision of maximum safety features for both personnel and equipment in the performance of maintenance

e. Reduction to a minimum of mean time to repair (MTTR) for scheduled and unscheduled maintenance

f. Provision of organizational and field maintenance requirements compatible with facilities normally available

g. Provision for interchangeability (If possible, a substitute for a failed component should be replaceable without recalibration.)

h. Provision for optimum visibility (If possible, the maintained part should be visible for removal, replacement and/or repair.)

11.5 AVAILABILITY.

The all-important goal in equipment design is equipment availability. Availability is the parameter that translates system reliability and maintainability characteristics into an index of effectiveness.

11.5.1 Definition.

Availability is defined as the probability that, at an arbitrary point in time, equipment is available for operations.

The basic mathematical definition of availability is:

Availability = Up time / Total time

The breakdown of the total time in the different time-based elements is as follows:

Total Time = Up time + Down time

where

Up Time = Operating time (OT) + Standby time (ST)

and

Down Time = Total corrective maint. time (TCM) +
Total preventive maint. time (TPM) +
Administrative and logistic down time (ALDT)

Different combinations of elements combine to formulate different definitions of availability.

a. Inherent Availability (Ai)

When system availability is defined with respect only to both operating time and corrective maintenance, it is called inherent availability.

Ai = MTBF/(MTBF + MTTR)

This definition is useful in determining the basic system operational characteristic under controlled test conditions. For most systems, however, it provides a very poor estimate of true combat potential.

b. Achieved Availability (Aa)

When system availability excludes standby, supply administrative waiting periods and operator before-and-after maintenance checks, it is called Achieved Availability.

Aa = OT/(OT + TCM + TPM)

Another expression for Achieved Availability is:

Aa = MTBMA/(MTBMA + MMT)

MMT is the mean maintenance time used during DT and initial production testing when the system is not operating in its intended support environment.

c. Operational Availability (Ao)

This availability covers all segments of time that the equipment is intended to be operational.

Ao = (OT + ST)/(OT + ST + TPM + TCM + ALDT)

One other frequently encountered expression for operational availability is:

Ao = MTBMA/(MTBMA + MDT)

where

MDT = mean down time

The MDT interval includes corrective and preventive maintenance and administrative and logistic down time, assuming that standby time is zero.

11.6 MAINTAINABILITY REVIEW.

Maintainability of equipment shall be reviewed upon receipt of Operational Requirements Document (ORD) and, thereafter, during various in-process reviews (IPRs). A maintainability review is conducted to assure that an item meets maintainability requirements. It consists of three phases: design review, test review and data feedback review.

11.6.1 Design Review.

A design review shall be conducted by maintainability, reliability, quality assurance, producibility, testing and other appropriate personnel prior to release of the design and prior to each significant design change in order to ensure that goal of maximum availability of equipment is reached. This review shall not duplicate the task of the designer, but shall be considered an essential supplementary activity. The review shall determine the merits of parts, components, and assemblies and their relation to each other based on function, reliability, maintainability, dimensions, weight, cost, and interchangeability. Characteristics considered shall include service life, MTBF, MTTR allowable time between PM actions, reaction time, storage life, combat ready rate, and amenability to later modification. The following checklist indicates the type of information to be obtained during a maintainability review:

a. Are the parts Military Standards, commercial off-the-shelf, or made-to-order?

b. Are the parts accessible for adjustments, tests, preventive maintenance, corrective maintenance, removal and replacement without removal of other parts?

c. Are special tools or fixtures necessary for adjustments, tests or repairs?

d. What are the techniques and locations for adjustments, tests or repair? (On site, in depot or in factory?)

e. Are histories of reliability and maintainability of parts acceptable?

f. Does design (arrangement and installation) allow adequate work space?

g. Are any special (hard to obtain) components, parts, or supplies needed in maintenance?

h. Are spare parts and replacement items adequately available?

i. Are required skilled personnel available?

j. Is maintenance allocation satisfactory?

11.6.2 Test Review.

A test review shall determine whether the test program will thoroughly measure ability of an item to perform as required in the specified environment with acceptable maintainability. The test program must provide data on component failures, repairs, and replacements to establish initial replacement parts lists. Tests shall be planned on an individual basis to demonstrate the required operation.

During test, records must be kept of modes and causes of failure, repairs, improvements, alterations, and replacements made to correct the failures. These shall be complete historical records to serve in understanding similar conditions in the future.

The test results shall be used to firm-up or revise the maintenance allocation chart (MAC), the requirements of the procurement specifications, and the list of repair parts and special tools.

11.6.3 Data Feedback Review.

Maintenance data is available from field reports after equipment has been issued. This information shall be periodically reviewed to determine the modes and causes of failures, adequacy of maintenance manuals, tools, procedures, and test and diagnostic equipment. Field experience data will indicate when maintenance is no longer economical and when equipment should be removed from supply system. This maintainability information is obtained from The Army Maintenance Management System (TAMMS) at the Maintenance Data Processing Center.

11.7 COORDINATION.

All projects need to be coordinated with the Product Assurance Division, SATBE-TQ, to ensure that proper Maintainability aspects have been considered. Early coordination will save much time later in the project's life cycle. To be most effective the specialty discipline of Maintainability Engineering must be applied concurrently during the design process.

11.8 MAINTAINABILITY DOCUMENTATION.

Additional documents available to aid in maintainability determination are:

Document	Title
DODI 5000.2	Part 6, Section C, Reliability and Maintainability
MIL-STD-470	Maintainability Program Requirements
MIL-STD-471	Maintainability/Verification/Demonstration/Evaluation
MIL-STD-721	Definition of Terms for Reliability and Maintainability
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-472	Maintainability Prediction
AMCP 706-133	Maintainability Engineering Theory and Practice
AMCP 706-134	Maintainability Guide for Design

SECTION XII

RELIABILITY ENGINEERING

12.1 PURPOSE.

This section provides an introduction to principles of reliability engineering.

12.2 DEFINITION.

Reliability is the probability that an item or system will perform its intended function for a specified time interval under specified environmental conditions.

12.3 RELIABILITY.

Reliability has three basic factors: function, time and environment.

12.3.1 Function.

This factor concerns functional intent of the item or system.

12.3.2 Time.

This factor concerns time interval during which the item must function without failure in order to successfully complete its mission. Ordinarily, there is time available between missions for maintenance.

12.3.3 Environment.

This factor concerns the circumstances under which the item is expected to function. For example, is the item to function in a high temperature, high humidity atmosphere? Will it be subjected to vibrations and shock during logistic handling? Are skilled operators needed to operate the item?

12.4 DESIGN OBJECTIVES.

12.4.1 Reliability Systems.

There are two very different system reliability design objectives:

a. Enhance system effectiveness (addressed by means of Mission Reliability).

b. Minimize the burden of owning and operating a system (addressed by means of Logistics-Related Reliability).

Mission Reliability is the probability that a system will perform mission essential functions for a period of time under conditions stated in mission profile. Measures of mission reliability address only those incidents that affect mission accomplishment.

Logistic-Related Reliability measures must be selected to account for or address all incidents that require response from the logistic system.

12.4.2 Reliability Aims.

To establish reliability, the principal aims of the designer are as follows:

a. Keep design simple. Use an approach which achieves specification requirements with fewest number of parts.

b. Know functional environment.

c. Know environmental, functional, and reliability capabilities of parts based upon actual data. Do not rely on hearsay.

d. Keep operational stresses to a minimum, consistent with cost, weight, and performance factors.

e. Know effect of failures on total system operation. Design system so that a mode of failure will have the minimum effect on overall system performance.

f. Schedule preventive maintenance procedures for checking system parts.

g. Evaluate tolerance accumulation, results of environmental changes, and adequacy of design for long term system performance.

12.5 RELIABILITY MEASUREMENT.

Reliability is measured in terms of probability of survival, mean time between failure (MTBF), and failure rate. If item has a constant failure rate, the exponential distribution applies as follows:

$$R = e^{-t/m}$$

where

R = reliability
e = 2.71828
t = mission time
m = MTBF

Values of R are as follows for values of -t/m:

R	-t/m
0.990	-.01
0.980	-.02
0.951	-.05
0.923	-.08
0.905	-.10

12.5.1 Survival.

Survival is defined as the satisfactory performance of an intended function for a specified time interval under specified environmental conditions.

12.5.2 Mean Time Between Failures (MTBF).

MTBF is the ratio of total operation hours to total number of failures. Most equipment is time-oriented, and MTBF is expressed in hours. However, some equipment is cycle-oriented (explosive ordnance) and time is expressed as mean firings between failures.

12.5.3 Failure Rate.

Failure rate is the measure of failures that occur per unit of time, and is usually expressed in terms of failures per hour, per 1,000 hours, per 1,000 miles, or per 100 firings.

12.6 RELIABILITY REVIEW.

The reliability review consists of three phases: design review, test, and data feedback. The reliability review assures the item has the required reliability.

12.6.1 Design Review.

During initial stages of conception of a component or system after specification of Operational Requirements Document (ORD), the proposed product configuration shall be reviewed with respect to reliability of its subassemblies and components. This review consists of determining merits of assemblies or components on the basis of weight, cost, function, and interchangeability. For example, pressure-fed systems may be compared to pump-fed systems, gasoline engines to diesel engines, steel construction to aluminum construction. Characteristics considered include service life, Mean Time to Repair (MTTR), allowable time between preventive maintenance (PM) actions, reaction time, storage life, combat-ready, is-rate, and MTTR amenability to later modification. Mean time to repair is the sum of maintenance time divided by number of maintenance actions. This type of review is an essential activity and shall be conducted prior to release of design and prior to each significant design change. The review shall be the combined effort of reliability, maintainability, quality, producibility, and testing personnel, and it shall be conducted independently of design function. The following checklist indicates the type of information to be obtained during a reliability review:

a. Is item an off-the-shelf device, or is it specifically designed for a particular function?

b. Is item to perform more than one function?

c. Can an existing off-the-shelf item be used?

d. Is item to function at its maximum performance limits?

e. Is data available on similar items performing similar functions?

f. Does item have an existing failure history?

g. Can redundancy concepts be used to back up item?

h. Is item physically and functionally compatible with other system components?

i. Is design sufficiently stressed for all environmental conditions that an item may be exposed to during its service life?

j. Are any unusual manufacturing problems anticipated?

12.6.2 Testing.

The test program must assure the provision of data to verify product operation in terms of its function, the environment in which it functions, and the required time it must function. The test program must provide data that can be used to establish the initial replacement parts list. This list is based upon component failures and replacements during end product life tests.

The type of tests required to demonstrate required reliability should be planned for each item on an individual basis. If test is destructive, sampling may be applied in accordance with MIL-HDBK-H108, MIL-STD-781, Exponential Distribution, and MIL-STD-690, as applicable to test requirements. These tests can be designed to terminate after certain number of failures or specified maximum time period, or they can be designed as sequential tests where length of test depends on test results. During test, modes and causes of failure must be recorded. Records must be made of repairs, improvements, or alterations made to the equipment and of any deviations or waivers granted. These records shall be complete historical records to serve for later use in understanding similar conditions.

Test results are used as the basis for requirements included within the procurement specification and/or establishing the components that will be replacement parts.

12.6.3 Data Feedback.

After equipment is issued to the field, valuable information pertinent to equipment reliability is obtained from field reports. This information shall be periodically reviewed to determine equipment reliability under battlefield conditions. Causes and modes of failures and types of failure distributions are essential if deficient equipment is to be improved. Such field data will indicate when reliability deteriorates to the point that lower echelon maintenance is uneconomical, and when equipment is to be removed from the supply system. This type of reliability information is obtained from published sources of reliability data such as MIL-HDBK-217, Reliability Prediction of Electronic Equipment; RADC-TR-75-22, Rome Air Development Center Non-Electronic Reliability Notebook; the Government-Industry Data Exchange Program (GIDEP); and the Army Sample Data Collection Program at the Maintenance Management Center, Lexington, Kentucky.

12.7 COORDINATION.

All projects need to be coordinated with the Product Assurance Division, STRBE-TQ, to ensure that proper Reliability aspects have been considered. Early coordination will save much time later in the project's life cycle. To be most effective the specialty discipline of Reliability Engineering must be applied concurrently during the design process.

12.8 RELIABILITY DOCUMENTATION.

Additional documents available to aid in reliability determination are:

Document	Title
DODI 5000.2	Part 6, Section C, Reliability and Maintainability
MIL-STD-721	Definition of Terms for Reliability and Maintainability
MIL-STD-756	Reliability Modeling and Prediction
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-790	Reliability Assurance Program for Electronic Parts Specifications
AMCP 702-3	Quality Assurance Reliability Handbook
AMCP 706-196, 197, 198 and 200	Design Guide for Reliability, Parts Two, Three, Four and Six
BELVOIR SOP 10-1	Organization Mission and Functions Manual
BELVOIR SOP 702-6	Product Assurance, Quality Assurance Program
DA PAM 738-750	The Army Maintenance Management System (TAMMS)

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SECTION XIII

SYSTEM SAFETY ENGINEERING

13.1 PURPOSE.

This section defines the essential safety engineering requirements for Belvoir RD&E Center's systems, associated subsystems and equipment, and to ensure safety is integrated into the system throughout its life cycle.

13.2 OBJECTIVES.

The primary objectives of the Center System Safety Engineering are to:

a. Assure that maximum safety consistent with mission requirements is designed or incorporated into systems in a timely and cost effective manner.

b. Identify and evaluate hazards throughout the life cycle of the system.

c. Initiate engineering efforts to either eliminate or control the identified hazards to an acceptable level.

d. Use historical data generated by similar systems to improve safety of new system.

e. Minimize the need for retrofit actions to improve safety by timely inclusion of safety considerations during development and acquisition of systems.

f. Assure that system modifications do not degrade inherent system safety.

g. Consider ease of demilitarization and disposal of the system early in the life cycle.

13.3 SYSTEM SAFETY ENGINEERING REQUIREMENTS.

A MIL-STD-882, System Safety Program Requirements will be tailored to every program at the Center and will be in effect from the beginning of each project. Hazard analyses will be performed at the earliest feasible time to allow accomplishment of the objectives stated in paragraph 13.2. Historical data will be used to facilitate analyses.

Primary efforts to reduce or eliminate hazards will be through design. If elimination by design is impractical, safety device will be used. Procedures and training will be used only where it is impossible to control a hazard through design.

Safety criteria and requirements will be included in Request for Proposals, Invitation for Bids, Request for Quote, System and Military Specification, Purchase Descriptions, Statements of Work, and other contractual documents.

Occupational Safety and Health Administration standards, other Federal safety and health standards, military standards and national consensus standards will be met unless meeting them is demonstrated to be beyond the state-of-the-art or not within the constraints of mission effectiveness.

13.4 GENERAL SAFETY DESIGN CRITERIA.

The following is a partial list of safety criteria to evaluate the equipment during design, procurement, production, operation and disposal:

a. Equipment shall be designed so that a potential failure will not jeopardize safety of operating personnel.

b. Reduction of equipment sound levels to acceptable levels shall be one of the major concerns through system life cycle.

c. Personnel safety shall not be considered as a candidate for trade-off.

d. The predominant means of controlling hazards will be hazard elimination through engineering control.

e. Where hazards cannot be eliminated, they will be effectively controlled to an acceptable level.

f. Warning devices and procedures will not be the sole means of controlling catastrophic and critical hazards.

g. Sharp edges, bare electric contacts and unguarded moving parts are safety hazards to be avoided.

h. Warning and instruction plates shall be highly visible and permanent.

13.5 SAFETY DOCUMENTATION.

Documents available to aid in safety determination are:

<u>Document</u>	<u>Title</u>
DODI 5000.2	Part 6, Section I, System Safety, Health Hazards, and Environmental Impact
MIL-STD-454	Standard General Requirement for Electronic Equipment
MIL-STD-882	System Safety Program Requirements
MIL-STD-1474	Noise Limits for Military Materiel

Document	Title
AR 40-5	Preventive Medicine
AR 40-46	Control of Health Hazards to Health from Laser and Other High Intensity Optical Sources
AR 40-583	Control of Potential Hazards to Health from Microwave and Radio Frequency Radiation
AR 385-9	Requirements for Military Lasers
AR 385-16	System Safety Engineering and Management
AR 385-64	Ammunition and Explosive Safety Standards
BELVOIR SOP 385-16	Safety for Systems, March 25, 1991
Code of Federal Regulations (CFR)	
Title 21	Food and Drugs
Title 29	Labor
Title 40	Protection of Environment
Title 46	Shipping
Title 49	Transportation
National Electrical Code	
National Fire Codes	
American National Standards	

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SECTION XIV

HUMAN FACTORS ENGINEERING

14.1 PURPOSE.

This section defines Human Factors Engineering (HFE) performed by the U.S. Army Human Engineering Laboratory (HEL) Detachment at Fort Belvoir and describes its objectives, Army requirements for HFE, and required documentation. It also describes how to address mandatory requirements of DODI 5000.2, Part 6, Section H, Human Factors, and the Belvoir RD&E Center SOP 70-18, Human Factors Engineering to include HFE in all relevant Army materiel acquisitions.

14.2 DEFINITION.

Briefly, HFE is applied to the design of systems, equipment, and facilities to:

a. Achieve required performance by personnel.

b. Minimize skill, personnel and training requirements.

c. Achieve required operational reliability of personnel - equipment combinations.

d. Foster design standardization of the user and maintainer interfaces within a system or across systems.

To achieve these goals, HFE influences design in ways that reduce task complexity, operator fatigue, or training requirements. HFE causes an increase in system safety, operational efficiency, and simplicity of operation and maintenance. In other words, HFE influences design of machines, work environments and tasks in ways that lead to integration of human capacities and system/task demands.

14.3 HUMAN FACTORS ENGINEERING CONDITIONS.

HFE addresses three primary conditions: User conditions, environmental conditions and operational conditions.

14.3.1 User Conditions.

User conditions relate to mental and physical capacities of the user: skill levels, body sizes, clothing or other encumbrances, and noise or stressors that can degrade performance.

14.3.2 Environmental Conditions.

Environmental conditions such as weather, illumination, vibration, terrain, and climate also impact on design.

14.3.3 Operational Conditions.

Operational conditions influence performance. Time-critical operations such as emergency egress, quick deployment, rapid fire, or combat combinations must be considered.

14.4 DESIGN OBJECTIVES.

To increase operational reliability, HFE must:

a. Consider skill level, aptitude, abilities, and range of physical characteristics of user population.

b. Simplify operation/maintenance tasks as much as possible.

c. Aid equipment designers by providing data on the physical limits of the users and maintainers and by providing Human Factors Engineering design criteria.

d. Consider environment of use and how design fits into that environment.

e. Reduce need for specialized/extensive training, operator judgment, excessive vigilance, or unusual physical strength.

14.5 HUMAN FACTORS ENGINEERING REVIEW.

14.5.1 Life Cycle Review.

HFE review begins during the very earliest phase of development, including mission need statements, and continues throughout the life cycle. All draft or final form requirements or acquisition documents are reviewed by a Human Factors Engineer as are test plans, test data, and ECPs.

14.5.2 Review Guidance.

BELVOIR SOP 70-18, para 6.a. states: "...Directors will: (1) Insure that their personnel are instructed in importance and urgency of the HFE program. (2) Insure that project engineers contact HEL Detachment during Conceptual Phase of System Life Cycle of all development items to obtain assistance in identifying human factors problem areas. (3) Insure that preliminary drafts and final copies of the Operational Requirements Document (ORD) contain technical requirements for human factors. Forward a copy of all draft and final form ORDs to the HEL Detachment for review and comment on technical requirements for human factors. (4) Insure that project engineers give appropriate consideration to human factors, and, development, and test of equipment. (5) Insure that the Development Plans and Contracts contain an appropriate human factors clause for items involving man as an element in operation and maintenance. Coordinate technical requirements for the human factors clause with the HEL Detachment. (6) Insure that the HEL Detachment is notified of all progress report and in-process review meetings and is provided opportunity for participation in these meetings. (7) Insure that the HEL Detachment reviews and approves all safety and all development test plans which involve the participation of humans in operation, checkout, maintenance or system controls."

14.5.3 Documentation.

To aid accomplishment of these purposes, the HEL representative at Belvoir will be provided with notifications, data, and documentation.

14.6 HUMAN FACTORS ENGINEERING IN DEVELOPMENT AND ACQUISITION.

14.6.1 Human Engineering Requirements.

MIL-H-46855, Human Engineering Requirements for Military System, Equipment and Facilities, should be imposed as a clause in acquisition documents whenever the user or maintainer interface is complex and the contractor will have responsibility for developing the interface. In such cases, contractors should be required to submit a Human Engineering Program Plan and other data as stated in MIL-H-46855.

14.6.2 Design Criteria.

The design of all materiel shall conform to MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities. MIL-STD-1474 shall be imposed whenever limitation of equipment produced noise is required.

14.6.3 Operational Criteria.

Equipment design shall allow for operation by 5th to 95th percentile soldiers who are suitably dressed for environment of interest. Design for HFE shall be such that soldiers who are trained on the item conduct all tasks in the times allotted, conduct all tasks with the accuracy needed, and do not make more than 5% repeated errors of omission or comission in conduct of tasks.

14.7 HUMAN FACTORS ENGINEERING DOCUMENTATION.

Additional documents available to aid HFE determination are:

Document	Title
DODI 5000.2	Part 6, Section H, Human Factors
DOD-HDBK-763	Human Engineering Procedures Guide
BELVOIR SOP 70-18	Human Factors Engineering
TECOM TOP 1-2-610	Human Factors Engineering, Part I: Test Procedures
TECOM TOP 1-2-610	Human Factors Engineering, Part II: Human Engineering Data Guide For Evaluation (HEDGE)

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SECTION XV

LOGISTICS ENGINEERING (LE)

15.1 PURPOSE.

This section provides an introduction to the principles of LE. It also describes the analytical tool, Logistic Support Analysis (LSA), which is used to determine support and supportability related requirements, design objectives and resource requirements. The need to address system support and supportability is critical as these are major factors in the overall life cycle cost of the system and are greatly influenced by decisions made during system development.

15.2 DEFINITION.

a. Logistics engineering encompasses those activities that deal with (1) designing the system hardware for supportability and (2) designing the overall support capability for the system. It is the technical engineering application of logistics considerations to the design process.

b. Integrated Logistic Support (ILS) is primarily a management function that provides for the planning, funding and management needed to insure that the ultimate user of the system will receive a system that can be economically and efficiently supported. Through this management process, the Materiel Developer insures the proper staffing and coordination of supportability requirements, design opportunities and support resources within the Readiness Command, the Combat Developer and, ultimately, the user community. ILS is defined as having 12 elements (or logistic support resource areas). These are:

- design influence;
- maintenance planning;
- manpower and personnel;
- supply support;
- support equipment and Test, Measurement and Diagnostic Equipment (TMDE);
- training and training devices;
- technical data;
- computer resources support;
- packaging, handling and storage;
- transportation and transportability;
- facilities; and
- standardization and interoperability.

c. Logistic Support Analysis (LSA) is the analytical process undertaken, during the acquisition process, to: (1) influence system performance parameters and system configuration from a supportability standpoint, and (2) determine and assist in the logical development of the logistic support resources required for the system. The data derived from the LSA process is documented in the LSA documentation, LSAD. LSA Record, LSAR, a subset of the LSAD. LSAR is a data base formatted in accordance with MIL-STD-1388-2 requirements.

15.3 OBJECTIVE.

15.3.1 Design Influence. Logistics engineering influences system design (hardware, software and support) by defining logistics requirements and integrating them with the design of the system. Historically, logistics has been considered "after the fact" with system development. Logistics is often interpreted to mean manuals, training and provisioning efforts. Logistics is more diverse than that and includes all 12 elements of ILS and their integration with the system and environment in which it will be used. The goal of logistics engineering is to take lessons learned, operational and maintenance experience and ownership considerations related to these elements and make them a factor in the development of the system.

15.3.2 Support Resource Identification and Development. As the system develops, logistics engineering works to identify all the resources which will be required to support the system over its life. These resources need to be developed and acquired to support the system in the field. The LSA process is used to determine what operational and maintenance functions and tasks, test and support equipment, spare/repair parts, personnel and training, transportation and handling equipment, technical data and facilities are required to support the system. This information can then be formatted into the ILS products commonly thought of as logistic resources.

15.3.3 Application of LE. A comprehensive, tailored LSA program is required for all major and non-major materiel system acquisitions, major modification program and applicable research projects. Logistics engineering is the concurrent engineering activity through which this LSA requirement is integrated with the other engineering disciplines and the requirements for an ILS program. Management of the ILS requirements is accomplished by the ILS Management office, but the technical work of integrating the supportability performance characteristics is the responsibility of LE. LE requirements are tailored to each individual program to meet the users requirements and acquisition strategy.

15.4 LE IN DESIGN.

a. Identification of Constraints. Specific information about the mission requirements is needed in order to determine the performance characteristics of the system. Many of these same requirements must be known in order to determine the supportability requirements. The operational requirements and the maintenance concept are the basics. During concept formulation, LE expands the definition of HOW and WHERE the system will be used to include the support structure requirements. By analyzing similar systems and existing capabilities, qualitative and quantitative system parameters can be established to insure supportability. These parameters can include RAM requirements, standardization of test and support equipment, parts programs, life cycle cost and other requirements related to the 12 ILS elements. Much of this effort is done in coordination with other activities already taking place to determine the functional and physical characteristics of the system.

b. Designing Supportable Systems. Once the qualitative and quantitative support characteristics have been identified they can be included in system specifications, purchase descriptions and design tradeoffs to influence the actual design of the system. Alternative prime mission equipment and support configurations can be evaluated to select an approach which will result in greater cost/system effectiveness. LE participates in the development of contract requirements, design reviews, tradeoff analyses and configuration selection to insure that supportability is considered. A number of LSA tasks are used to provide an assessment of the design for supportability.

15.5 LE AND SUPPORT RESOURCES.

a. Identification of Support Resources. As the system configuration becomes more defined, the design can be assessed to determine what specific support resources will be required to sustain it in the field. LSA tasks are used to evaluate different support scenarios and their associated requirements to determine which provides the best balance of system availability and cost effectiveness. The identified support elements are evaluated to determine if the existing support structure, including manpower and personnel, training, supply support, facilities, test and support equipment and technical data, can be utilized. When existing resources can support new systems, the costs associated with acquiring new resources are reduced.

b. Development of Support Resources. When the design of a new system necessitates the development of new support resources, or the modification of existing resources, care must be taken to ensure that these resources are developed and acquired in a systematic method to insure continuity and compatibility with existing resources. The analytical process used to determine the requirements (LSA tasks) is continued in greater detail to determine specific operation and maintenance functions and tasks. These further analyses develop the associated ILS products and other technical data. (The primary purpose of much of the "ILS Functional Community" is in defining and approving the format that this technical data is acquired in. The acceptance of the technical data itself is a function of several specific functional offices including, but not limited to, logistics engineering, maintenance engineering, provisioning, training and the specific TRADOC schools involved in the development program.)

15.6 LOGISTICS SUPPORT ANALYSIS (LSA).

15.6.1 LSA Tasks.

Analysis is the primary tool used in performing logistics engineering. Any analysis, however simple, that results in a decision on the scope and level of logistic support is LSA. LSA can be defined as follows:

> The LSA PROCESS is a PLANNED SERIES OF TASKS performed to EXAMINE all elements of a proposed SYSTEM to DETERMINE the LOGISTIC SUPPORT required to KEEP that system USEABLE for its intended purpose; and to INFLUENCE the DESIGN so that BOTH the SYSTEM and SUPPORT can be PROVIDED at an AFFORDABLE COST. (AMC PAM 700-22, LSA)

MIL-STD-1388-1 defines the uniform analyses prescribed by regulation as LSA. The LSA tasks are divided into three basic categories: manage; analyze and synthesize; and test and correct. Each of these categories works to meet the overall objective of developing a supportable system.

a. MANAGE. These tasks are performed from the pre-concept phase through deployment. The management tasks address the planning and control of the LSA program to insure that it meets the system acquisition objectives in an effective and efficient manner. These tasks include: planning what analyses are required for the program; tailoring those analyses to the supportability objectives (design influence and resource requirements) and/or hardware development level; and managing the actual performance of those analyses.

b. ANALYZE AND SYNTHESIZE. These tasks can be further divided into three subsets: system definition (hardware, software and support); evaluation and tradeoff alternatives; and identification of resource requirements. During the early phases, LSA is used to estimate gross logistics requirements for alternative concepts. These are refined to develop constraints in terms of the design, operation and support characteristics. These constraints are used to influence the design and operational concepts.

As the system is further defined, the emphasis shifts toward optimizing the support system within established parameters. The LSA tasks are iteratively performed for progressively lower system indenture levels. Support resources can then be identified in more detail. Support resources are optimized by: (a) the identification of repair and discard tasks; (b) the application of Reliability Centered Maintenance (RCM); (c) the allocation of tasks to specific maintenance levels; and (d) the formulation of design recommendation to achieve improvements. Ultimately, this process results in the detailed definition of the requirements in the form of ILS products.

c. TEST AND CORRECT. The Test, Evaluate and Fix approach is firmly established within the LSA tasks. Verifying the accuracy and adequacy of the logistic support identified begins early in the process. Testing, evaluating and correcting deficiencies in both the design and the support system continue throughout the life cycle. The validity of the analysis results and attendant data products must be successfully demonstrated within stated confidence levels. Results of formal test and evaluation programs and post deployment assessments are analyzed and corrective actions implemented as necessary. Most of this effort appears transparent as it is incorporated in the Test and Evaluation program for the system.

d. APPLICATION. As stated above, LSA is a requirement for all programs. This has been done to insure that supportability becomes an integral part of the design process. The specific requirement for each LSA program is tailored to meet the system's specific needs. LSA tasks are tailored in terms of: the specific MIL-STD analyses applied; the design indenture level (from system level to piece part); life-cycle phase; and whether they are performed in-house or under contract.

15.6.2 LSA Record (LSAR).

a. LSA Record (LSAR) is a subset of the total logistics documentation process. It is a standardized data base structure designed for the documentation of logistics constraints and supportability resources identification/development. It is an efficient and effective means of capturing engineering and supportability information and manipulating it to obtain information related to specific subtopics.

The major application of LSAR is in the development and capture of provisioning related parts information. Use of LSAR to capture provisioning is a mandatory requirement for all DOD systems. This, however, is not the only use of the LSAR. LSAR can capture engineering information related to supportability. This information includes, but is not limited to: mission operational requirements; reliability and maintainability data (FMECA, R&M predictions); MANPRINT requirements; Reliability Centered Maintenance data; redesign information; and support equipment performance parameters.

b. APPLICATION. The application LSAR requirements is determined based on program information needs, life-cycle phase, cost effectiveness and acquisition strategy. LSAR data can encompass a large volume of data and is specifically tailored to the needs of each program. LSA/LSAR is one of the Resource Critical Information (RCI) areas for Computer-Aided Acquisition and Logistic Support (CALS).

15.7 RELATIONSHIP TO TDP.

The TDP is used to produce (manufacture) a total end item. It is also used in the procurement of spare parts for that end item once it has been fielded. LE works to influence the system design to make it more readily supportable. This includes efforts to improve component access, to enhance producibility, and to design cost effective subsystems and assemblies. The structure and content of the TDP have a significant impact in the procurement of spare parts. Through the use of LE analyses and techniques, the TDP will identify all spare parts with adequate information (alternative sources and QAPs) to support their later procurement. Inadequate development of the TDP to support parts procurement can result in expensive Reverse Engineering of some spare parts at a later date.

In addition, the TDP structure (breakdown of assemblies and components) influences the layout of the maintenance tasks in the Technical Manuals (TMs) and Maintenance Allocation Chart (MAC). It also provides source data to the development of the Repair Parts and Special Tools manual (RPSTL) and is a major component of the Provisioning technical support documentation.

15.8 DOCUMENTATION.

Additional documents available to aid logistics support determination are:

Document	Title
DODD 5000.2	Defense Acquisition Management Policies and Procedures
MIL-STD-1388-1	Logistic Support Analysis (LSA)
MIL-STD-1388-2	DOD Requirements for a LSA Record
AR 70-1	Army Acquisition Policy
AR 700-127	Integrated Logistic Support (ILS)
AR 750-1	Army Materiel Maintenance Concepts and Policies

Document	Title
DA PAM 700-28	ILS Program Assessment Issues and Criteria
DA PAM 700-127	Integrated Logistic Support (ILS) Manager's Guide
AMC R 700-15	Integrated Logistic Support
AMC PAM 700-4	LSA Techniques Guide
AMC PAM 700-11	LSA Review Team Guide
AMC PAM 700-22	LSA Primer

SECTION XVI

REVERSE ENGINEERING

16.1 GENERAL.

If competitive procurement cannot be made because of lack of detailed drawings, Belvoir RD&E Center may rely on Reverse Engineering (RE) to obtain the necessary data. Reverse Engineering supports the SPRINT and TRUST programs outlined in Section XVIII. RE is a controlled process to analyze, measure and test existing parts to obtain drawings and other data with unlimited rights.

16.2 RE PROCESS.

RE Process includes:

a. functional/economical analysis (based on data analysis)

b. material analysis

c. dimensional analysis

d. preparation of drawings and test plans

e. fabrication to drawings

f. testing of parts

g. finalizing the Technical Data Package (TDP)

16.2.1 Data Analysis.

Data analysis includes a rights analysis and an economic analysis. Rights analysis will determine if the Government has rights to use developed drawings in competitive procurement. Economical analysis will determine if cost involved in developing the necessary TDP is justified by anticipated procurement cost savings.

16.2.2 Material Analysis.

Part material may be determined by analyzing part function and use. If this is not possible, material composition may be determined by spectro analysis. Material surface finishes may be determined by various gaging means. Material surface hardness may be determined by testing with a suitable hardness tester. To find depth of hardening, the part may be sectioned and macro analyzed. All findings shall be recorded for use in final report.

16.2.3 Dimensional Analysis.

Part dimensions may be measured by use of standard measuring equipment, coordinating machines, optical or laser measuring equipment, digitizers, and other suitable means. Manufacturing and interface tolerances shall be determined by analysis. Measured dimensions shall be recorded in final report.

16.2.4 Drawings and Test Plans.

Based on findings of material and dimensional analysis, Product drawings, complete and suitable for competitive procurement, shall be prepared as described in Section III of this manual. Test plans shall also be prepared in accordance with applicable sections of this manual.

16.2.5 Fabrication and Testing.

When necessary to verify that the reverse engineered part conforms to form, fit and function of the original part, the new part shall be fabricated to reverse engineering drawings and tested in accordance with the test plan. Testing may include assembling the part into an old assembly and testing the assembly in normal or accelerated conditions, or the part may be subjected to special testing.

16.2.6 Finalized TDP.

Drawings and specifications will be changed and finalized as required by the test results. A report shall be prepared to include data and material analysis considerations and results, and test plans and testing results.

16.3 REVERSE ENGINEERING DOCUMENTATION.

Additional documents available to aid reverse engineering determination are:

Document	Title
MIL-HDBK-115	U.S. Army Reverse Engineering Handbook (Guidelines and Procedures)
DFARS Appendix E	DOD Spare Parts Breakout Program

SECTION XVII

QUALIFIED PRODUCTS LIST (QPL)

17.1 GENERAL.

In accordance with Federal Acquisition Regulations, the purpose of the Qualified Products List (QPL) is to allow procurement from prequalified sources, thereby reducing time and effort for inspection and testing. The QPL is normally used when acceptance testing of the product would require more than 30 days, special testing set-up is required, or hardware is for life survival or emergency. QPL identifies qualified product by specification, Government designation, manufacturer's designation, part or model number, trade name, test or qualification reference, manufacturer's name and address, and Commercial and Government Entity (CAGE) code. QPL should be used with caution due to continuous new applicants and funding requirements to support tests.

17.2 QPL PROCEDURES.

Belvoir responsibilities in preparing and maintaining QPLs are as follows:

a. Arranging publicity for the qualification requirements including:

   (1) Intent to establish a QPL for product

   (2) The specification number and name of product

   (3) Notification that upon establishment of a QPL for product, consideration in all future awards for product will be given only to products accepted for inclusion in applicable QPLs

b. Qualifying products that meet specification requirements. The following should be included:

   (1) Listing manufacturers and suppliers whose products qualify

   (2) Maintaining qualification data

   (3) Clarifying, as necessary, qualification requirements

   (4) In appropriate cases (when requested by contracting officer), providing and publicizing written waivers of qualification requirements

   (5) Withdrawing or omitting qualification of a listed product, as necessary

c. Advising suppliers whose products are on a QPL, that:

   (1) QPL does not constitute endorsement of product by the Government

(2) Products listed have been qualified under latest applicable specification

(3) QPL may be amended without notice

(4) Listing of a product does not release supplier from compliance with specification

(5) Use of QPL information for advertising or publicity is permitted. However, supplier must not state or imply that product is only product of that type qualified, or that the Government in any way recommends or endorses product.

d. Re-examining a qualified product when:

(1) Manufacturer has modified product or changed material or processing sufficiently so that validity of previous qualification is questionable

(2) Requirements in specification have been amended or revised sufficiently to affect the character of product

(3) It is necessary to determine that quality of product is maintained in conformance with specification

17.3 QPL SUPPORT DOCUMENTATION.

Additional documents available to aid QPL determination are:

Document	Title
DOD SD-6	Provisions Governing Qualifications (Qualified Products List)
FAR - Part 9	Qualifications Requirements
DOD 4121.3M	Qualified Products Lists (QPLs)

SECTION XVIII

SPARE PARTS REVIEW INITIATIVES (SPRINT)

18.1 GENERAL.

The Spare Parts Review Initiatives (SPRINT) program is for enhancing procurement of repair parts. It includes all activities required to reduce cost of repair parts and to increase their availability. SPRINT is part of the Total Reevaluation Under SPRINT Thrusts (TRUST) program that analyzes all aspects of reasonable pricing for repair parts.

18.2 SPRINT ACTIVITIES.

The following typical activities may be performed under SPRINT:

a. When developing hardware, assure maximum use of standard items of supply

b. Identify all repair parts. Assure that technical disclosure is complete including QAPs

c. Improve data on VENDOR ITEM and SC drawings to increase competition by disclosing complete envelope, interface and performance data and assuring that quality conformance inspection and approval procedures are included either on the drawing or in a document referenced on the drawing

d. Conduct vendor searches to identify additional sources for commercial parts

e. Search for standard items of supply to replace fabricated parts

f. Use reverse engineering techniques to create competitive drawings

g. Use value engineering techniques on fabricated parts to simplify the design and lower cost

h. Update vendor drawings periodically to maintain preparedness for procurement

i. Assure that all TDPs for spare parts stand alone for competitive procurement

18.3 SPRINT SUPPORT DOCUMENTATION.

Documents available to aid SPRINT work are:

Document	Title
DFARS Appendix E	DOD Spare Parts Breakout Program
MIL-STD-970	Standards and Specifications, Order of Preference For the Selection of
BELVOIR SOP 700-3	Spare Parts Program (SPP)
BELVOIR HDBK 70-3	Total Life Cycle Competition Strategy Handbook

SECTION XIX

TOTAL LIFE CYCLE COMPETITION STRATEGY (TLCCS)

19.1 GENERAL.

DOD policy requires the use of competition in the acquisition of materiel to control cost and quality. The TLCCS is a key part of the overall Acquisition Strategy that addresses in detail life cycle competition for an entire system to include end items, components, spare parts, services and maintenance and overhaul. Belvoir project engineers must therefore include a strategy for competition in plans for development, procurement, and support of hardware. The methods selected to achieve competition may vary with individual development program.

19.2 PLANNING FOR COMPETITION.

Competition should be planned early in acquisition program cycle. During concept evaluation for developing the Operational Requirements Document (ORD), competition strategy should be considered. Once the ORD has been defined, competition strategy has to be implemented in each procurement. Strategy and planning documentation will contain a separate paragraph under the contracting section entitled "TLCCS." This requirement will be a specific item of review at key acquisition panels, committees and boards, and, similar to ILS concepts, will be applied to developmental, non-developmental and product-improved systems and equipment. The TLCCS must be clear and specific as to how competition will be pursued. Backup, supporting, and implementing data will be contained in other documentation supporting planned acquisition, such as the Configuration Management Plan, the ILSP and the Acquisition Plan. Specific consideration for life cycle competition strategy are outlined below.

19.2.1 Development.

Plans for obtaining bids for end item development should address competitive aspects of each part of the bidding process:

a. Bid requirements. Does Request for Proposals (RFP) require bidders to submit an expensive and extensive proposal? If design drawings and calculations are required with bid, response will be reduced. Also, the time available to prepare bid should be increased as bid requirements become more extensive. Would encouragement of joint bids enhance competition?

b. Program requirements. Both a reasonable development schedule and well defined deliverables encourages competition. Conversely, a requirement for submission of reports in excess of commercial practice will deter bidders.

c. Contract conditions. Where the developer can be assured a limited production, the program is generally more attractive to the bidder. Incentive fees can also be considered to make the program attractive. Defining responsibility for risk during development can be an important aspect of bid competition.

d. Notices and advertisement. Competition can be promoted by contacting and encouraging potential bidders and by making program information easy to obtain. During the development step of the life cycle, data needed for competitive bidding in subsequent steps must be produced. Hence, bidding and contract documents should include requirements for this type of data.

19.2.2 Production.

In obtaining bids for production of end items, emphasis is placed on the Technical Data Package (TDP) to promote competition and to assure interchangeability. In addition to above considerations for the development part of the life cycle, the following should be considered for production:

a. Has the Technical Data Package been verified and is it adequate for competitive bids?

b. Can the requirements be simplified or made less restrictive?

c. Is it feasible to split the production quantity between two bidders?

d. Can the production quantity be increased by including multiyear repair parts requirements?

e. Are bidders' qualifications included in the RFP to restrict unqualified bidding and thereby encourage qualified sources to compete?

19.2.3 Support.

The support phase of life cycle includes procurement of repair parts, updating of technical manuals, and maintaining ILS. The principles for planning discussed in earlier paragraphs are also applicable to the support phase.

19.2.4 Repair parts.

Though repair parts may be initially procured from the developer and the first production contractor, it is important to assure that the TDP includes appropriate drawings and other data necessary to procure repair parts in a competitive environment. Reverse Engineering techniques may be used to create competitive data for spare parts whenever competitive drawings are not available. SPRINT program principles may also be used. Continuous search for standard items of supply to replace manufactured parts should be planned in the program.

19.3 SUPPORT DOCUMENTATION.

Additional documents available to aid Total Life Cycle Competition Strategy determination are:

Document	Title
DODD 5000.1	Defense Acquisition
DODI 5000.2	Defense Acquisition Management Policies and Procedures, Part 5, Section A, Acquisition Strategy
BELVOIR HDBK 70-3	Total Life Cycle Competition Strategy Handbook

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TECHNICAL DATA PACKAGE (TDP)

USAGE

CONFIGURATION MANAGEMENT

DEVELOPMENT

PROCUREMENT

PRODUCTION

PROVISIONING

TRANSPORTATION

INSTALLATION

MAINTENANCE

MOBILIZATION

FIGURE I-1A. Technical Data Package Usage.

TECHNICAL DATA PACKAGE (TDP) ELEMENTS
PER MIL-T-31000

- SPECIFICATIONS
- DRAWINGS AND ASSOCIATED LISTS (CONCEPTUAL, DEVELOPMENTAL, PRODUCT, COMMERCIAL)
- SPECIAL INSPECTION EQUIPMENT (SIE) DWGS AND ASSOC LISTS
- SIE OPERATING INSTRUCTIONS
- SIE DESCRIPTION DOCUMENTATION
- SIE CALIBRATION PROCEDURES
- SPECIAL TOOLING DRAWINGS AND ASSOCIATED LISTS
- PRESERVATION, PACKAGING, PACKING, AND MARKING DATA
- SOFTWARE AND SOFTWARE DOCUMENTATION
- TEST REQUIREMENTS DOCUMENTS

FIGURE I-1B. TDP Elements.

SATBE-TS (70) S:

DATE:

MEMORANDUM FOR:

SUBJECT: FY__ Technical Data Package (TDP) Program Scheduling

1. The item(s) identified on the enclosed TDP Planning Schedule(s) (TDPPS) are required for procurement. The adequacy/availability of the TDP(s) must be established by your Division and reported to the requesting Command/activity by this office.

2. Request that you complete and coordinate the enclosed TDPPS(s) to include the following requirements:

a. IF THE TDP IS ADEQUATE, no update is required, list the complete TDP identification (Spec/TA/Dwg/PD/CID/SC/other, its latest Rev/Amend, and its date). If you recommend procurement of a specific make/model, list the make, model, type, size, part number or other identification. If you recommend an option/add-on to an existing contract, list the contractor and contract number. For these last two cases it is not necessary to identify the TDP.

b. IF THE TDP IS NOT ADEQUATE, list the TDP (Spec/TA/Dwg/PD/CID/SC/other) and schedule all appropriate actions. If an Item, Set, Kit, Outfit, Assembly or System requires more than one TDP for procurement, prepare a TDPPS for each TDP required.

c. In accordance with Belvoir Producibility Engineering Standard Practice Manual, paragraphs 1.12.1 and 2.2.8.1, Pre-Certification data must accompany the completed TDPPS(s) delivered to this office for updated TDPs, and a TDP Certification must be a part of the ERR and accompany all completed TDPs delivered to the Standardization and Engineering Data Team.

d. All action elements must include an estimate of the type and amount of funds required to complete their scheduled action. (This is not a request for funds.)

e. The Program Management System (PMS) number for the item must be provided.

f. Purchase Descriptions on ATCOM managed items require a coordination with HQ ATCOM and this circulation time must be scheduled on the TDPPS.

g. Camouflage Pattern Painting (CPP), Chemical Agent Resistant Coating (CARC), and Army Secure Lighting Program (ASLP) requirements must be included in the TDP, as applicable.

h. Any outstanding Specification Change Notices (SCNs) should be incorporated into the specification by revision or amendment before the TDP is used for a new procurement.

i. The completed TDPPS reflects the official Center status of the TDP, and approval signature of the Directorate Division Chief.

3. Request the completed, coordinated and approved TDPPS be furnished this Office NLT ___________ to meet reporting requirements of TROSCOM Reg 700-29. Point of contact for this action is SATBE-TSC, Extension 42123. --The Soldiers' Command.

Encl

Chief, Engineering Data Management
Division
Product Assurance & Engrg Directorate

FIGURE I-2. Memorandum, Subj: FY__ Item(s) Added to Belvoir RD&E Center Technical Data Package (TDP) Program (SATBE-TS).

For use of this form, see
BRDEC Standard Practice Manual

TECHNICAL DATA PACKAGE PLANNING SCHEDULE (TDPPS)
FOR
PREPARATION, REVIEW, REVISION, AND UPDATING TECHNICAL DATA PACKAGE

$: ____________
(Due back to SATBE-TS)

DATE ____________
(Sent to Division)

FY _____ PROGRAM
SSN ____________
ITEM NOMENCLATURE ____________ LIN: ____________
NSN ____________
Source and Date of Requirement ____________
QTY ________ / $ ________

APPLICABLE DOCUMENTS:

		PREPARE	REVISE	AMEND	UPDATE
Specification/PD/Set List/Other ____________	Action Reqd →				
Drawings (Top Assembly) TA ____________	Action Reqd →				
TDPL (Identification) ____________	Action Reqd →				

STANDARDIZATION PROJECT NO: ____________ PMS No. ____________ REMARKS ____________

SATBE- ____________ -- DO NOT SCHEDULE ANY STARTS OR COMPLETIONS ON A SATURDAY, SUNDAY, OR HOLIDAY --

DESCRIPTION OF TDP ACTION		Mo												ACTION ELEMENT
(Start with Mo & Yr of First Action) →		Yr												
PRODUCT SPECIFICATION/PD/SET LIST/OTHER														
Starting & Completion Date														Div
Packaging														PA&E
Material														AMSRL-MA-E
Safety														PA&E
Engine (When Used)														LED
Quality & Reliability														PA&E
Initial Document Draft to Stdzn	Includes PDs for Circulation to HQ ATCOM													Div
Type & Print (30 Days)														Stdzn
Circulation of Document (60 Days)														Stdzn
Resolve Comments & Prepare Final Draft														Div
Final Draft to Standardization														Div
Type, Approve, Number, Date (30 Days)														Stdzn
PRODUCT DRAWINGS & ASSOCIATED LIST														
Starting & Completion Date														Div
SUBMIT & APPROVE ECP FOR TDPL UPDATE (0-45 Days) *														Div
START & COMPLETE CCB APPROVED SPEC/DWG CHANGES														Div
FINAL CUTOFF: ALL DOC'S TO DATA BANK f/PREP OF TDPL														Div
COMPUTERIZE, MICROFILM, AND FORWARD TDP/TDPL/OTHER														Data Bank

APPROVAL

TEAM CHIEF: __________ (Initial)
TARGET DATE: __________
DIVISION ENGINEER(S): PROJECT __________ PROD __________ TEL ____ / ____ DATE ____ / ____
LOGISTICS EQUIPMENT DIR: (Items Requiring Engines) __________ TEL __________ DATE __________
PA&E DIR: PACKAGING __________ AMSRL-MA-E: MATERIAL __________ TEL ____ / ____ DATE ____ / ____
PA&E DIR: SAFETY __________ QUALITY __________ TEL ____ / ____ DATE ____ / ____
STANDARDIZATION (Spec/Set/Other) __________ PRODUCIBILITY __________ TEL ____ / ____ DATE ____ / ____
ENGINEERING DATA BANK (TDP/TDPL/Other) __________ TEL __________ DATE __________
DIRECTORATE DIVISION CHIEF __________ TEL __________ DATE __________

* When sending the ECP to the St. Louis CCB, state that the TDP is for a planned procurement and ask that the CCB Record of Action be returned to this Center by the date you schedule on this line.

SATBE FM 13-9 (Rev)
1 Jun 93

Edition of 1 Jun 92 is obsolete.

ACTION ELEMENTS
LIST AMOUNT ($) AND TYPE FUNDS REQUIRED

FUNDS	DIV	PACK	MTL	SH&E	ENGINE	Q&R	STDZN	DATA BANK
F7S								
F7M								
.16								
R&D								
TOTAL								

ENCL. ________

FIGURE I-3. Technical Data Package Planning Schedule (TDPPS) Form.

DATE:

GENERAL INSTRUCTIONS FOR PREPARATION OF TDPPS

1. Heading: FY, SSN, Date, Item Nomenclature, Source and Data of Requirement, and Qty/$ (if known) is to be filled in by the Belvoir RD&E Center TDP control point prior to sending TDPPS to the Division for preparation of a schedule except in the following cases, when it should be filled in by the appropriate Division:

a. When a TDP action is started by the Division. (Example - when a TDP, previously reported as adequate or has been completed, is found to need more work).

b. When an item is added to the program by the Division.

c. When the dates of an ongoing TDP action are rescheduled to an earlier or a later date by the Division, which would result in the preparation of a "Revised" TDPPS.

2. Applicable Documents and all succeeding spaces requiring entries are to be filled in by the Division and/or other activities with which the TDPPS is coordinated. The Division Chief should sign the TDPPS to acknowledge approval of the completed form.

SPECIAL NOTE: Applicable documents (Spec, PD, Dwgs, Set Listing) should not be entered on the TDPPS if the Division: *

a. Recommends procurement of a specific make and model. In this case, list the mfr, make, type, size, model, model number, part number, or other description for sufficient identification, in the Remarks Section and state that make and model procurement is recommended.

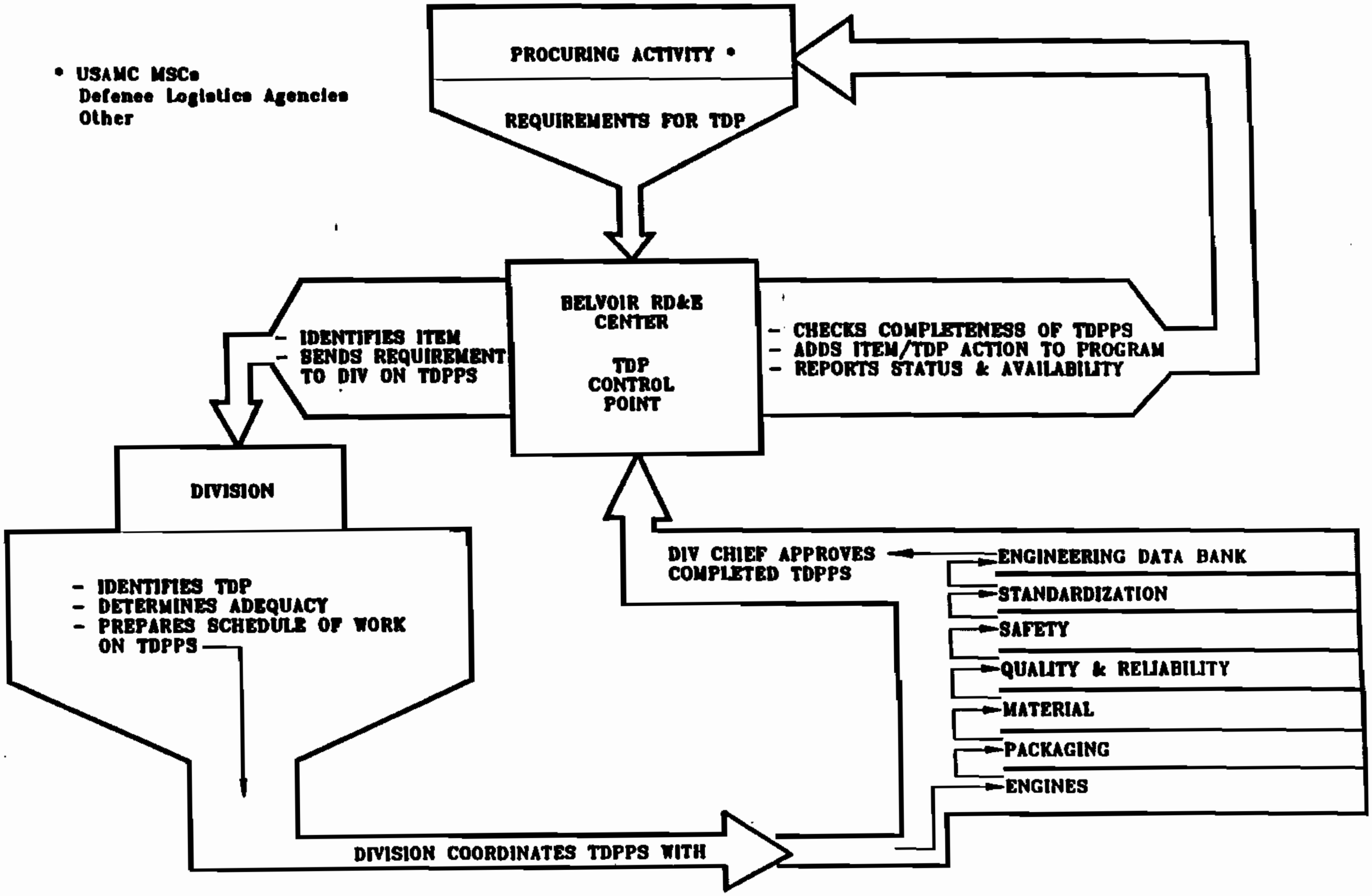
b. Recommends add-on/exercise option to existing contract. In this case, list name of mfr and contract number in Remarks Section after ascertaining that this recommendation can be carried out by the procuring activity.

* If applicable document is not listed (due to recommending a or b above), the TDPPS need be signed only by the Division Chief - no other signatures are necessary.

FIGURE I-4. General Instructions for Preparation of TDPPS.

FLOW CHART FOR PROCESSING TDPPS

TDPs--RECEIPT OF REQUIREMENTS, SCHEDULING, REPORTING STATUS/AVAILABILITY



* USAMC MSCs
Defense Logistics Agencies
Other

FIGURE I-5. Flow Chart For Processing TDPPS.

SATBE-TS (70)

MEMORANDUM FOR:

SUBJECT: Notice of Overdue Technical Data Package (TDP) Action

1. Reference:

a. Technical Data Package Planning Schedule (TDPPS) on subject item.

b. Belvoir RD&E Center Production Engineering Standard Practice Manual.

2. This TDP action is overdue at the milestone indicated below and requires immediate action:

MILESTONE AND DATE DUE......................:
PGM FY & TDP ACTION TYPE.....................:
ITEM..:
SCHEDULED TDP TARGET DELIVERY DATE:

3. Unless the time lost to the missed milestone can be regained prior to the next milestone, the attached TDPPS must be revised, coordinated, and submitted to STRBE-TSC no later than __________________.

4. If the revised TDPPS reflects a slippage of the target date, and the TDP is required for planned procurement by a USAMC Major Subordinate Command (MSC), the MSC must be informed in writing of the reason for the slippage and the new target date. This slippage memo must be processed thru the Hardware Director and Director of PA&E and signed by the Technical Director. Enclosed is the suggested format for preparation of the memorandum. It contains all necessary information in reporting the slippage.

5. For other agencies (other than MSCs) and Belvoir procurements, the revised TDPPS with the reason for the slippage indicated in the "Remarks" section, is sufficient. No slippage memo is required.

6. SATBE-TSC, 42123, is point of contact for additional information. --The Soldiers' Command.

Encl

Chief, Engineering Data Management
 Division
Product Assurance & Engrg Directorate

FIGURE I-6. Notice of Overdue TDP Action.

SATBE-TS (70)

MEMORANDUM FOR: See Distribution

SUBJECT: Reporting Slippages of Technical Data Package (TDP) Target Dates

1. This Memorandum supersedes DF, SATBE-TC, 21 Oct 87, subject as above with 1 Encl.

2. Memorandums of Agreement (MOAs) with USAMC Major Subordinate Commands (MSCS) require that the slippage of a scheduled target date of a TDP required for planned procurement use be reported in writing to the MSC requiring it as soon as the slippage is identified.

3. Belvoir RD&E Center policy requires the reporting of target date slippages of TDPs required by all other outside agencies (other than USAMC MSCs) and for Belvoir procurements by the method indicated below in paragraph 4.b.

4. In accordance with the above, the Hardware Division responsible for the TDP must:

a. For TDPs for USAMC MSCs:

(1) Report the slippage to the MSC concerned, giving the reason and the revised scheduled target date. This report is to be processed thru the Hardware Director and the Director for Product Assurance & Engineering and signed by the Technical Director.

(2) Furnish a signed copy of the Report and a "Revised" Technical Data Package Planned Schedule (TDPPS) to SATBE-TSC, for TDP program purposes.

NOTE: Enclosed is a suggested format for preparation of the Report (Encl). It covers all information considered necessary in reporting the slippage. Parts of the format are clarified, as follows:

- "FY" and "Target Date" are those shown on the TDPPS for the TDP involved.
- If the "Revised To" date cannot be established due to problems, it should be shown as "Not Determined" and the reason explained in the Report. In this case, a "Revised" TDPPS is not required. A new TDPPS however, must be prepared by the Hardware Division as soon as the target date can be determined.

b. For TDPs for Outside Agencies (other than MSCs) and for Belvoir RD&E Center Procurement: Furnish a "Revised" TDPPS, with the reason for the slippage indicated in the remarks section, to SATBE-TSC.

Encl

Chief, Engineering Data Management
Division
Product Assurance & Engrg Directorate

DISTRIBUTION:

SATBE-ZTE
SATBE-F
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SATBE-JC

SATBE-JD
SATBE-JI
SATBE-JN
SATBE-JP

SATBE-T
SATBE-TS
SATBE-TSO
SATBE-TSE

FIGURE I-7. Reporting Slippages of TDP Target Dates.

------------------------ SUGGESTED FORMAT FOR SLIPPAGE MEMORANDUM ------------------------

SATBE-(Symbol)

MEMORANDUM FOR:

SUBJECT: Slippage of Technical Data Package (TDP) Target Date(s)

CDR, ATCOM ATTN: AMSTR-ME	or	CDR, TACOM ATTN: AMSTA-G	or	CDR, Other MSCs as applicable

1. Reference(s) (If applicable or necessary).

2. The purpose of the memorandum is to report the slippage of the scheduled target date(s) for the following TDP(s): Give the following pertinent data in narrative form, if one item, or in chart form, if more than one item:

SSN / NOMENCLATURE / - FY / SCHEDULED TDP TARGET DATE(S)
CURRENT REVISED TO

3. Give reason(s) for slippage. Provide relevant circumstances surrounding the slippage, such as: background, prior coordination meetings, person involved/affected (names, dates); situations over which this Center had/has no control, and any other information explaining why slippage could not be prevented. Attach copies of supporting documents, as applicable. Indicate any advance action taken to make the MSC aware of the problem(s) causing the slippage, and with whom the action was discussed.

4. Give an assessment of the impact the slippage has on the planned procurement action and with whom the impact was discussed.

5. Give assurance of effort to minimize the impact of slippage.

Signed by the Technical Director

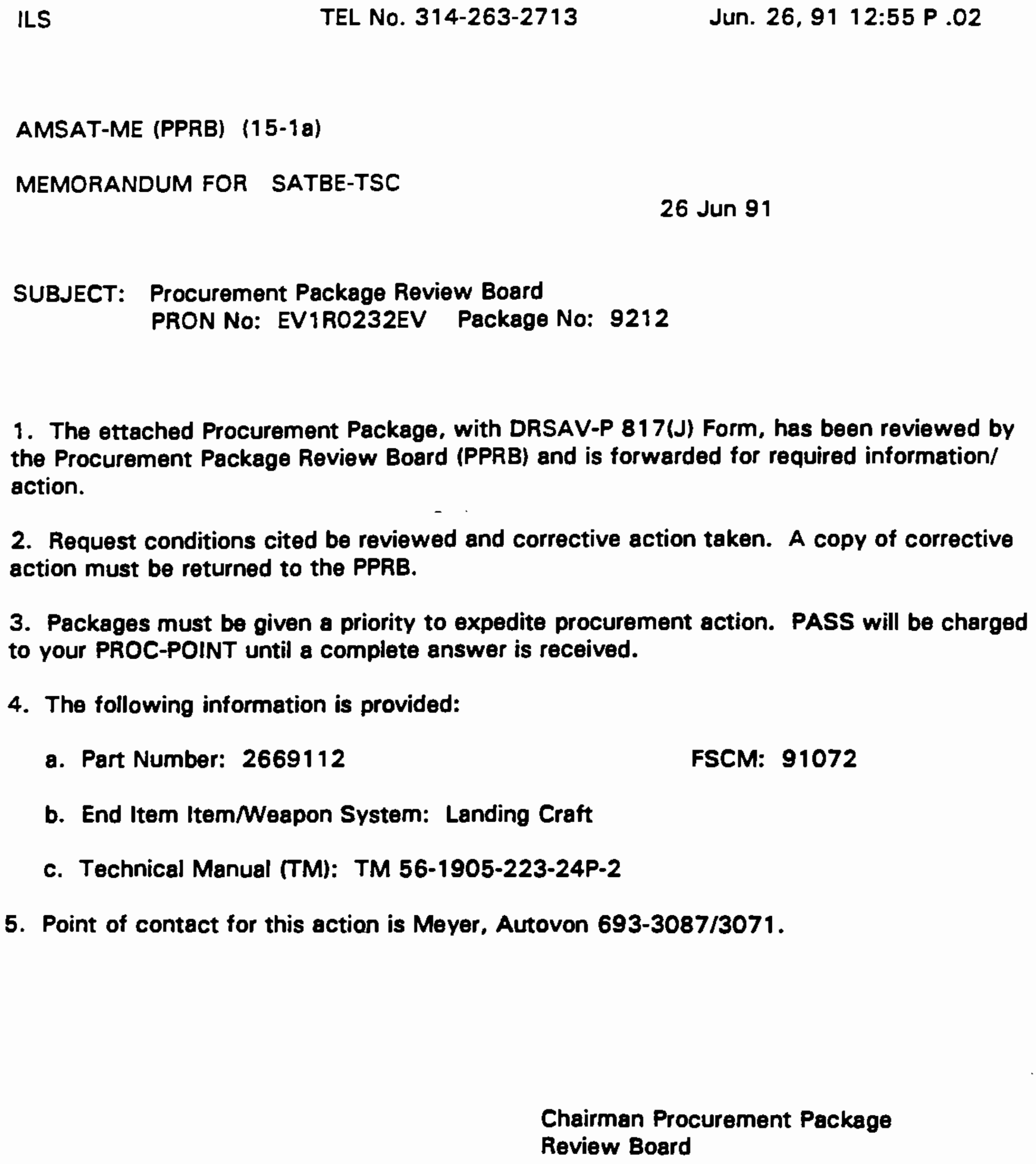
************** NOTE TO THE PREPARER OF THIS MEMORANDUM **************

(1) If the "REVISED TO" date cannot be established, it should be shown as "Not Determined" and the reason fully explained.

(2) Furnish a signed copy of the memorandum to: SATBE-T
SATBE-TSC

(3) Furnish tha "Revised" TDPPS to: SATBE-TSC. Do Not send the "Revised" TDPPS outside the Center.

FIGURE I-8. Suggested Format For Slippage Memorandum.



ILS TEL No. 314-263-2713 Jun. 26, 91 12:55 P .02

AMSAT-ME (PPRB) (15-1a)

MEMORANDUM FOR SATBE-TSC

26 Jun 91

SUBJECT: Procurement Package Review Board
PRON No: EV1R0232EV Package No: 9212

1. The attached Procurement Package, with DRSAV-P 817(J) Form, has been reviewed by the Procurement Package Review Board (PPRB) and is forwarded for required information/action.

2. Request conditions cited be reviewed and corrective action taken. A copy of corrective action must be returned to the PPRB.

3. Packages must be given a priority to expedite procurement action. PASS will be charged to your PROC-POINT until a complete answer is received.

4. The following information is provided:

a. Part Number: 2669112 FSCM: 91072

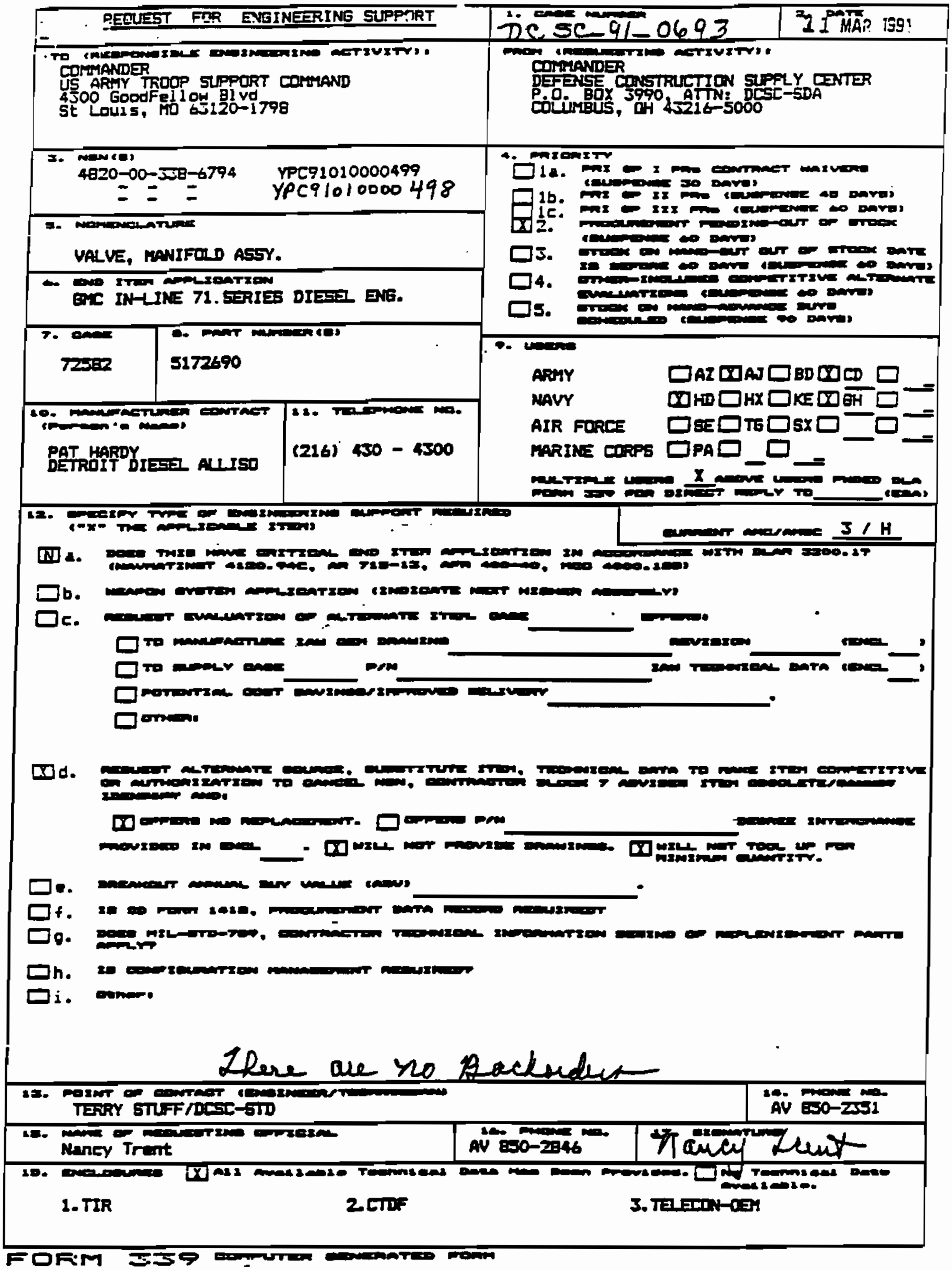
b. End Item Item/Weapon System: Landing Craft

c. Technical Manual (TM): TM 56-1905-223-24P-2

5. Point of contact for this action is Meyer, Autovon 693-3087/3071.

Chairman Procurement Package
Review Board

FIGURE I-9. Example, Procurement Work Directive (PWD).



REQUEST FOR ENGINEERING SUPPORT

1. CASE NUMBER: DC SC-91-0693

2. DATE: 21 MAR 1991

TO (RESPONSIBLE ENGINEERING ACTIVITY):
COMMANDER
US ARMY TROOP SUPPORT COMMAND
4300 GoodFellow Blvd
St Louis, MO 63120-1798

FROM (REQUESTING ACTIVITY):
COMMANDER
DEFENSE CONSTRUCTION SUPPLY CENTER
P.O. BOX 3990, ATTN: DCSC-SDA
COLUMBUS, OH 43216-5000

3. NSN(S)
4820-00-338-6794 YPC91010000499
YPC91010000498

4. PRIORITY
- ☐ 1a. PRI OF I PRs CONTRACT WAIVERS (SUSPENSE 30 DAYS)
- ☐ 1b. PRI OF II PRs (SUSPENSE 45 DAYS)
- ☐ 1c. PRI OF III PRs (SUSPENSE 60 DAYS)
- ☒ 2. PROCUREMENT PENDING-OUT OF STOCK (SUSPENSE 60 DAYS)
- ☐ 3. STOCK ON HAND-BUT OUT OF STOCK DATE IS BEFORE 60 DAYS (SUSPENSE 60 DAYS)
- ☐ 4. OTHER-INCLUDES COMPETITIVE ALTERNATE EVALUATIONS (SUSPENSE 60 DAYS)
- ☐ 5. STOCK ON HAND-ADVANCE BUYS SCHEDULED (SUSPENSE 90 DAYS)

5. NOMENCLATURE
VALVE, MANIFOLD ASSY.

6. END ITEM APPLICATION
GMC IN-LINE 71.SERIES DIESEL ENG.

7. CAGE: 72582

8. PART NUMBER(S): 5172690

9. USERS
ARMY ☐ AZ ☒ AJ ☐ BD ☒ CD ☐ __
NAVY ☒ HD ☐ HX ☐ KE ☒ GH ☐ __
AIR FORCE ☐ SE ☐ TG ☐ SX ☐ __ ☐ __
MARINE CORPS ☐ PA ☐ __ ☐ __
MULTIPLE USERS X ABOVE USERS FAXED DLA FORM 339 FOR DIRECT REPLY TO ________ (ESA)

10. MANUFACTURER CONTACT (Person's Name)
PAT HARDY
DETROIT DIESEL ALLISO

11. TELEPHONE NO.
(216) 430 - 4300

12. SPECIFY TYPE OF ENGINEERING SUPPORT REQUIRED ("X" THE APPLICABLE ITEM)

CURRENT AMC/AMSC 3 / H

N a. DOES THIS HAVE CRITICAL END ITEM APPLICATION IN ACCORDANCE WITH DLAR 3200.17 (NAVMATINST 4120.94C, AR 715-13, AFR 400-40, MCO 4000.18B)

☐ b. WEAPON SYSTEM APPLICATION (INDICATE NEXT HIGHER ASSEMBLY)

☐ c. REQUEST EVALUATION OF ALTERNATE ITEM. CAGE ________ OFFERS:
- ☐ TO MANUFACTURE IAW OEM DRAWING ________ REVISION ________ (ENCL __)
- ☐ TO SUPPLY CAGE ________ P/N ________ IAW TECHNICAL DATA (ENCL __)
- ☐ POTENTIAL COST SAVINGS/IMPROVED DELIVERY ________.
- ☐ OTHER:

☒ d. REQUEST ALTERNATE SOURCE, SUBSTITUTE ITEM, TECHNICAL DATA TO MAKE ITEM COMPETITIVE OR AUTHORIZATION TO CANCEL NSN, CONTRACTOR BLOCK 7 ADVISES ITEM OBSOLETE/CANNOT IDENTIFY AND:
☒ OFFERS NO REPLACEMENT. ☐ OFFERS P/N ________ DEGREE INTERCHANGE PROVIDED IN ENCL ____. ☒ WILL NOT PROVIDE DRAWINGS. ☒ WILL NOT TOOL UP FOR MINIMUM QUANTITY.

☐ e. BREAKOUT ANNUAL BUY VALUE (ABV) ________.

☐ f. IS DD FORM 1418, PROCUREMENT DATA RECORD REQUIRED

☐ g. DOES MIL-STD-789, CONTRACTOR TECHNICAL INFORMATION CODING OF REPLENISHMENT PARTS APPLY?

☐ h. IS CONFIGURATION MANAGEMENT REQUIRED?

☐ i. Other:

There are no Backorders

13. POINT OF CONTACT (ENGINEER/TECHNICIAN)
TERRY STUFF/DCSC-STD

14. PHONE NO.
AV 850-2351

15. NAME OF REQUESTING OFFICIAL
Nancy Trent

16. PHONE NO.
AV 850-2846

17. SIGNATURE
Nancy Trent

18. ENCLOSURES ☒ All Available Technical Data Has Been Provided. ☐ No Technical Data Available.

1. TIR
2. CTDF
3. TELECON-OEM

FORM 339 COMPUTER GENERATED FORM

FIGURE I-10. Example, Request For Engineering Assistance.

S: 24 July 1991

10 July 1991

SATBE-TSC (715-11a)

MEMORANDUM FOR: SATBE-FMD (Mr. Gordon)

SUBJECT: HOT PWD; CTRL# PWD230 PRON: EV147005EV/ PKG: 9406
EV147008EV

1. Reference: AMSAT-ME (PPRB) memorandum, 08 July 1991, subject as above.

2. Please provide SATBE-TSC with your written response no later than 24 July 1991. **Also provide the Program Management System (PMS) number for the item on receipt of this request to POC.**

3. The following information is provided to aid you in your response:

   a. Nomenclature: CONE

   b. Part Number: 4-100110-2

   c. NSN: 2305-01-149-9249 / 2305-01-160-5610

   d. End Item: LACV-30

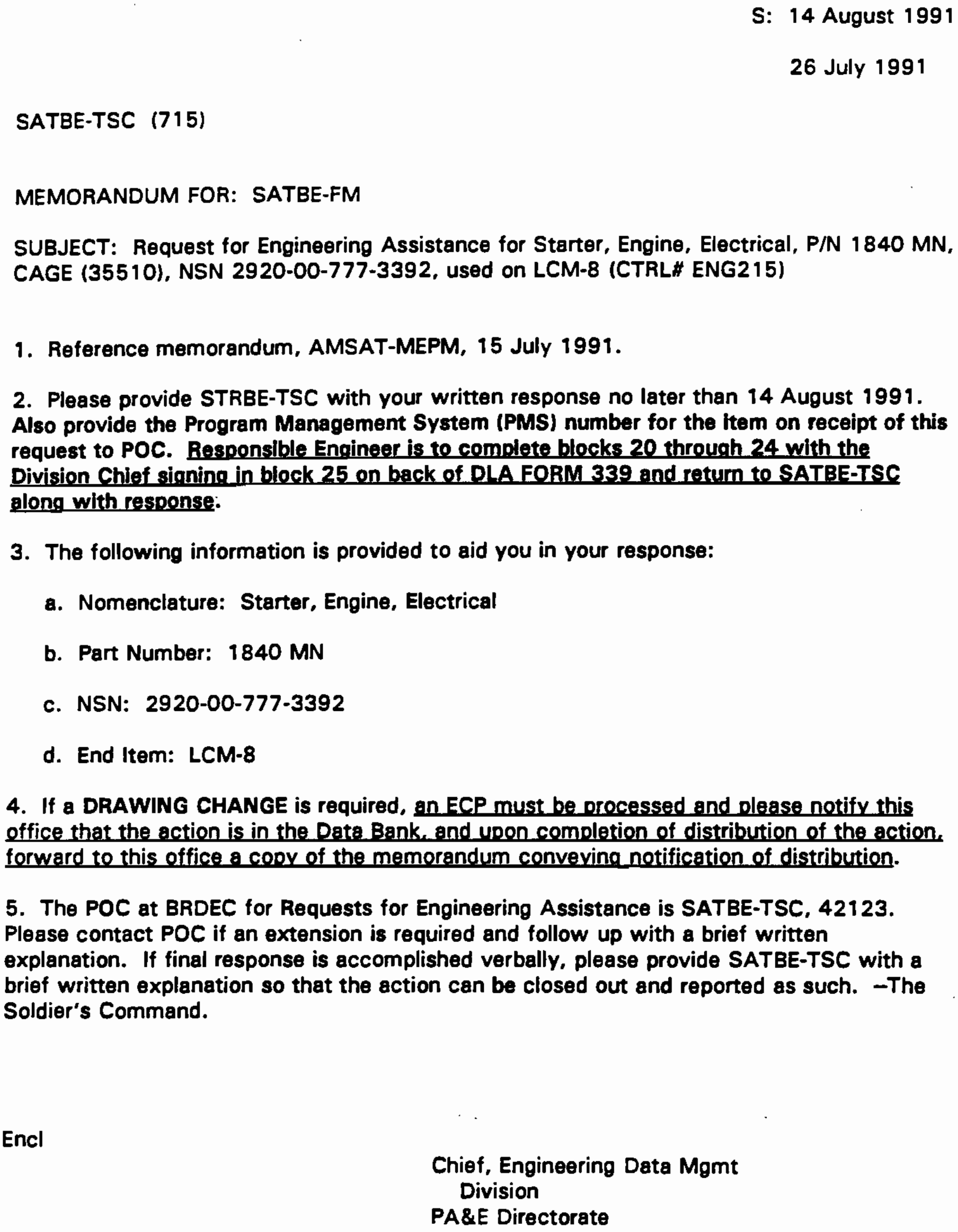
4. If a **DRAWING CHANGE** is required, an ECP must be processed and please include the HOT PWD number in the memorandum forwarding the change with the approved ECP to the Data Bank. This will increase the priority given to the action. In addition, the inclusion of the HOT PWD number will facilitate the closing of the HOT PWD as the Data Bank will notify SATBE-TSC when distribution of the change is complete.

5. The point of contact at BRDEC for HOT PWDS is SATBE-TSC, 42123. Please contact POC if an extension is required and follow up with a brief written explanation. If final response is accomplished verbally, please provide SATBE-TSC with a brief written explanation so that the action can be closed out and reported as such. –The Soldier's Command.

Encl

Chief, Engineering Data Mgmt
Division
PA&E Directorate

FIGURE I-11. Example, "HOT PWD" Memorandum.



S: 14 August 1991

26 July 1991

SATBE-TSC (715)

MEMORANDUM FOR: SATBE-FM

SUBJECT: Request for Engineering Assistance for Starter, Engine, Electrical, P/N 1840 MN, CAGE (35510), NSN 2920-00-777-3392, used on LCM-8 (CTRL# ENG215)

1. Reference memorandum, AMSAT-MEPM, 15 July 1991.

2. Please provide STRBE-TSC with your written response no later than 14 August 1991. Also provide the Program Management System (PMS) number for the item on receipt of this request to POC. **Responsible Engineer is to complete blocks 20 through 24 with the Division Chief signing in block 25 on back of DLA FORM 339 and return to SATBE-TSC along with response**.

3. The following information is provided to aid you in your response:

a. Nomenclature: Starter, Engine, Electrical

b. Part Number: 1840 MN

c. NSN: 2920-00-777-3392

d. End Item: LCM-8

4. If a **DRAWING CHANGE** is required, an ECP must be processed and please notify this office that the action is in the Data Bank, and upon completion of distribution of the action, forward to this office a copy of the memorandum conveying notification of distribution.

5. The POC at BRDEC for Requests for Engineering Assistance is SATBE-TSC, 42123. Please contact POC if an extension is required and follow up with a brief written explanation. If final response is accomplished verbally, please provide SATBE-TSC with a brief written explanation so that the action can be closed out and reported as such. –The Soldier's Command.

Encl

Chief, Engineering Data Mgmt
Division
PA&E Directorate

FIGURE I-12. Example, Request For Engineering Assistance Memorandum.

SATBE-JBS (SATBE-O/1 Feb 91) 1st End Mr. Short/kb/x42565
SUBJECT: HOT PWD; CTRL # PWD193, PRON: EV1BO348: PKG: 8859

Commander, US Army Belvoir Research, Development and Engineering Center,
ATTN: SATBE-JBS, Fort Belvoir, VA 22060-5606

12 FEB 1991

FOR Competition Management, ATTN: SATBE-TSC

1. Drawing 13226E0491 titled "Gridcooler" was prepared back in November 1984 when the only available heat exchanger of this type was manufactured by R.W. Fernstrum & Co. of Menomiee, Michigan. The term Gridcooler is in fact a registered trademark name belonging to R.W. Fernstrum and as such should not be used to donate similar items made by other companies.

2. An attempt to update and change the drawing name was started about 2 years ago but was dropped when the Chief of Procurement at HQ TROSCOM ruled the PPE effort in the ADCOR contract for boats was at an end and further, Engineering Change Proposals (ECPs) would not be processed. Currently, a task order is being processed to up-date the Technical Data Package (TDP) for the MK-2 boat and a part of that effort will include the correction of the drawing title.

3. Point of contact for this information is Mr. John Short, AUTOVON 654-2565. -- The Soldiers' Command.

Encl
wd

Chief, Bridge Division
Dir for Cmbt Engrg

FIGURE I-13. Example, Interim Response Letter.

SATBE-FSH (715) 27 Jun 91

MEMORANDUM FOR SATBE-TSC

SUBJECT: Request for Engineering Support, Case No. 91-1266 (CTRL# ENG210)

1. Defense Construction Supply Center, Columbus, requests on DLA Form 339, paragraph 12, that the user specify which style of Oiler is required: atomizer tip with pistol grip or oil stream tip with thumb latch. DCSC also refers to Navy action for revision of CID A-A-50477.

2. SATBE-FSH has reviewed the subject Request for Engineering Support and procurement of Oilers, Hand. We have not been able to determine what style of Oiler is required by the user in the field for this procurement action. Perhaps the item manager, supply system, or user in the field can be solicited directly for this information.

3. A copy of this subject request for engineering support was also forwarded to the Navy (Naval Construction Battalion Center, Port Hueneme) which has responsibility for CID A-A-50477.

4. POC is Ed Hellwig at 42825.

Chief, Fuel and Water Supply Division

FIGURE I-14. Example, Final Response Memorandum.

26 July 1991

SATBE-TSC (715)

MEMORANDUM FOR: Chairman Procurement Package Review Board,
ATCOM, ATTN: AMSAT-MEAD (PPRB),
St. Louis, MO 63120-1798

SUBJECT: Procurement Package Review Board, PRON No. EV147171EV, Package No. 9308, CTRL# PWD217

1. The enclosed response from SATBE-F, 24 July 1991, subject as above, provides a interim response to the subject request (Encl).

2. We have reviewed the response and find it administratively adequate. The estimated completion date is "date".

3. The point of contact at the Belvoir Research, Development and Engineering Center for HOT PWDS is SATBE-TSC, DSN 654-2123. –The Soldiers' Command.

Encl

Chief, Engineering Data Mgmt
Division
PA&E Directorate

FIGURE I-15. Example, Record of Interim Action Memorandum.

16 July 1991

SATBE-TSC (715)

MEMORANDUM FOR: Commander, Defense Construction Supply Center,
P.O. Box 3990, ATTN: DCSC-SDA,
Columbus, OH 43216-5000

SUBJECT: Request for Engineering Assistance, Electric Space Heater, Case No. 91-1360

1. The enclosed memorandum from SATBE-FES, 09 July 1991, provides a final response to the subject request (Encl).

2. We have reviewed the response and find it administratively adequate. We consider this a closing action.

3. The point of contact at the Belvoir Research, Development and Engineering Center for Requests for Engineering Assistance is SATBE-TSC, DSN 654-2146. --The Soldiers' Command.

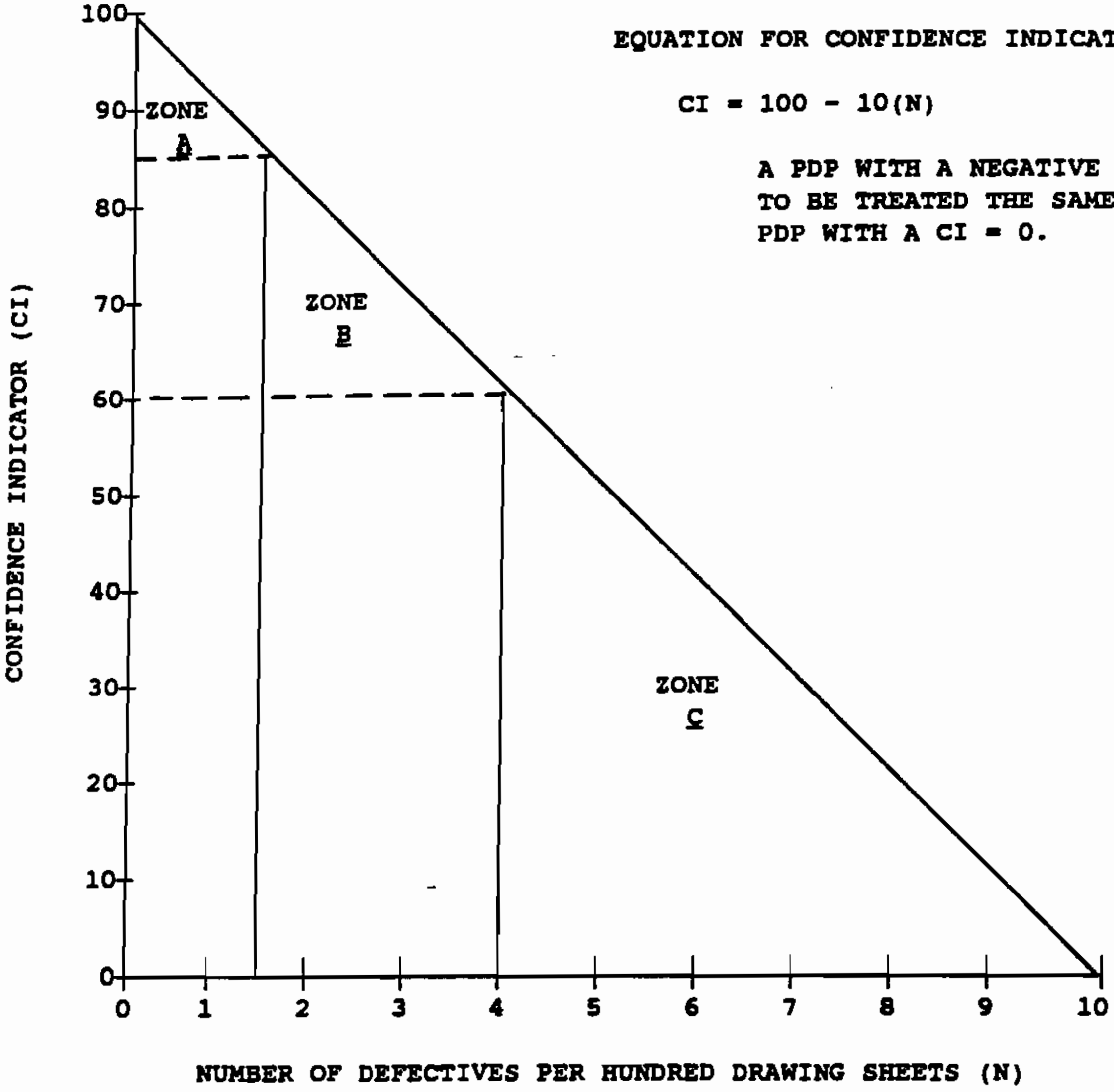
Encl

Chief, Engineering Data Mgmt
Division
PA&E Directorate

CF (w/encl):
SATBE-FP
SATBE-FES

FIGURE I-16. Example, Completion of Project Memorandum.

PRODUCT DRAWING PACKAGE (PDP) CONFIDENCE INDICATOR (CI)



EQUATION FOR CONFIDENCE INDICATOR:

CI = 100 - 10(N)

A PDP WITH A NEGATIVE CI IS TO BE TREATED THE SAME AS A PDP WITH A CI = 0.

FIGURE I-17. Product Drawing Package (PDP) Confidence Indicator (CI).

SATBE- ______________
(date)

MEMORANDUM FOR: SATBE-TSE, Standardization and Engineering Data Team

SUBJECT: Request for New Drawing Numbers

1. Request assignment of _____ new drawing number which will be used for:

( ) New Item
( ) Floating Drawing
( ) Spare Parts
( ) Reverse Engineering
( ) Product Improvement Program (PIP)

2. The affected TDPL/Spec is:

( ) TA Number:______________________, FSC :__
( ) Specification:____
( ) Not Applicable. See Remarks.

3. These drawing numbers are applicable to:

Contract Number:____
Contractor Name:____
End Product Nomenclature______________________________________
____

4. Remarks:

Signature:______________________________
Title:__________________________________

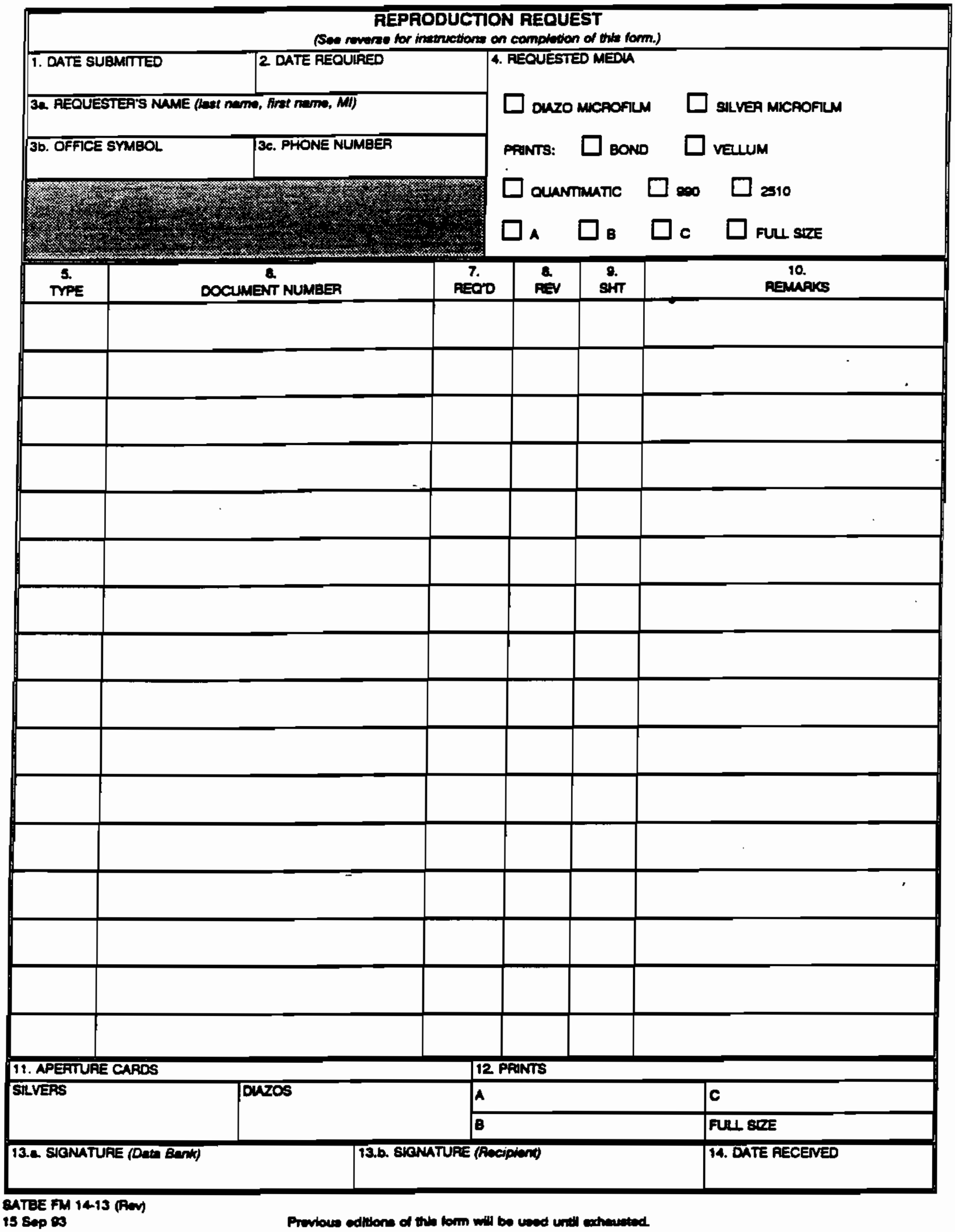
SATBE-TSE
TO: SATBE- FROM: Chief, SEDT DATE:

1. The following drawing number(s) have been assigned as requested:

2. Failure to process completed drawings within one (1) calendar year of receipt, or failure to request an extension will result in cancellation of the above numbers without further review.

Chief, Standardization and Engineering Data Team

FIGURE II-1. Request for New Drawing Numbers.



REPRODUCTION REQUEST

(See reverse for instructions on completion of this form.)

1. DATE SUBMITTED

2. DATE REQUIRED

3a. REQUESTER'S NAME *(last name, first name, MI)*

3b. OFFICE SYMBOL

3c. PHONE NUMBER

4. REQUESTED MEDIA

☐ DIAZO MICROFILM ☐ SILVER MICROFILM

PRINTS: ☐ BOND ☐ VELLUM

☐ QUANTIMATIC ☐ 990 ☐ 2510

☐ A ☐ B ☐ C ☐ FULL SIZE

5. TYPE	6. DOCUMENT NUMBER	7. REQ'D	8. REV	9. SHT	10. REMARKS

11. APERTURE CARDS

SILVERS

DIAZOS

12. PRINTS

A

B

C

FULL SIZE

13.a. SIGNATURE *(Data Bank)*

13.b. SIGNATURE *(Recipient)*

14. DATE RECEIVED

SATBE FM 14-13 (Rev)
15 Sep 93

Previous editions of this form will be used until exhausted.

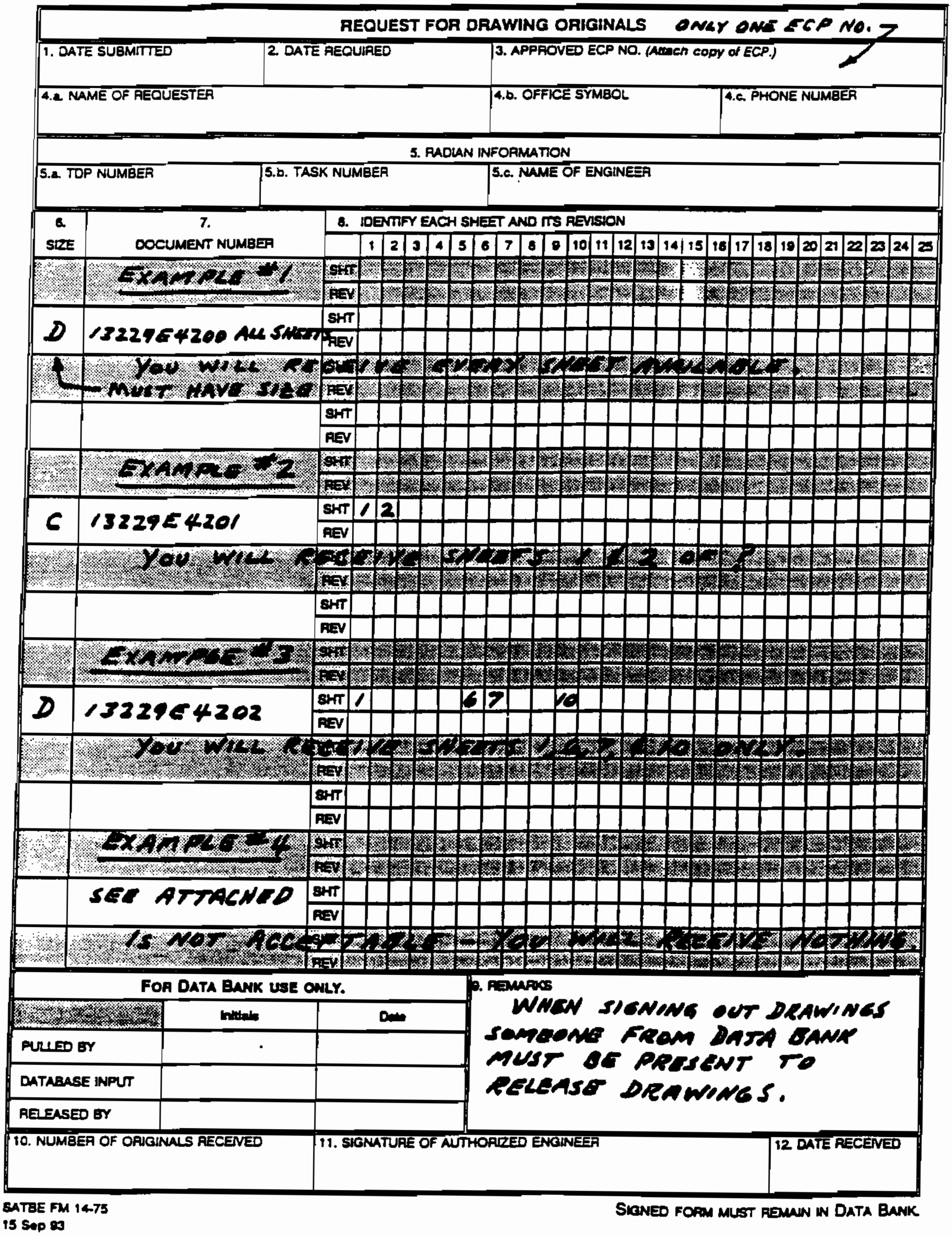
FIGURE II-2. Reproduction Request.

INSTRUCTIONS FOR PREPARING SATBE FM 14-13

BLOCK	
1, 2, 3	Self explanatory.
4	Check media in which requested work should be provided. Check size of print desired.
5	Enter type of document; e.g., TDPL, PL, DW.
6	Enter document number and size; e.g. B75-003, D13200E4900, etc.
7	Enter total number of copies required.
8	Enter revision letter of document requested: e.g., A, B, C, etc.
9	Enter sheet number.
10	Use this column for miscellaneous information.
11, 12	Enter production totals.
13	Enter Data Bank and recipient signatures.
14	Enter date copies were received by requester.

SATBE FM 14-13 *(reverse)*
15 Sep 93

FIGURE II-3. Instructions For Preparing Reproduction Requests.



REQUEST FOR DRAWING ORIGINALS ONLY ONE ECP NO.

1. DATE SUBMITTED
2. DATE REQUIRED
3. APPROVED ECP NO. *(Attach copy of ECP.)*
4.a. NAME OF REQUESTER
4.b. OFFICE SYMBOL
4.c. PHONE NUMBER

5. RADIAN INFORMATION

5.a. TDP NUMBER
5.b. TASK NUMBER
5.c. NAME OF ENGINEER

6. SIZE	7. DOCUMENT NUMBER	8. IDENTIFY EACH SHEET AND ITS REVISION																								
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	EXAMPLE #1	SHT																									
		REV																									
D	13229E4200 ALL SHEETS	SHT																									
		REV																									
	YOU WILL RECEIVE EVERY SHEET AVAILABLE.	SHT																									
	MUST HAVE SIZE	REV																									
		SHT																									
		REV																									
	EXAMPLE #2	SHT																									
		REV																									
C	13229E4201	SHT	1	2																							
		REV																									
	YOU WILL RECEIVE SHEETS 1 & 2 OF 2	SHT																									
		REV																									
		SHT																									
		REV																									
	EXAMPLE #3	SHT																									
		REV																									
D	13229E4202	SHT	1					6	7			10															
		REV																									
	YOU WILL RECEIVE SHEETS 1, 6, 7, & 10 ONLY.	SHT																									
		REV																									
		SHT																									
		REV																									
	EXAMPLE #4	SHT																									
		REV																									
	SEE ATTACHED	SHT																									
		REV																									
	IS NOT ACCEPTABLE - YOU WILL RECEIVE NOTHING.	SHT																									
		REV																									

FOR DATA BANK USE ONLY.

	Initials	Date
PULLED BY		
DATABASE INPUT		
RELEASED BY		

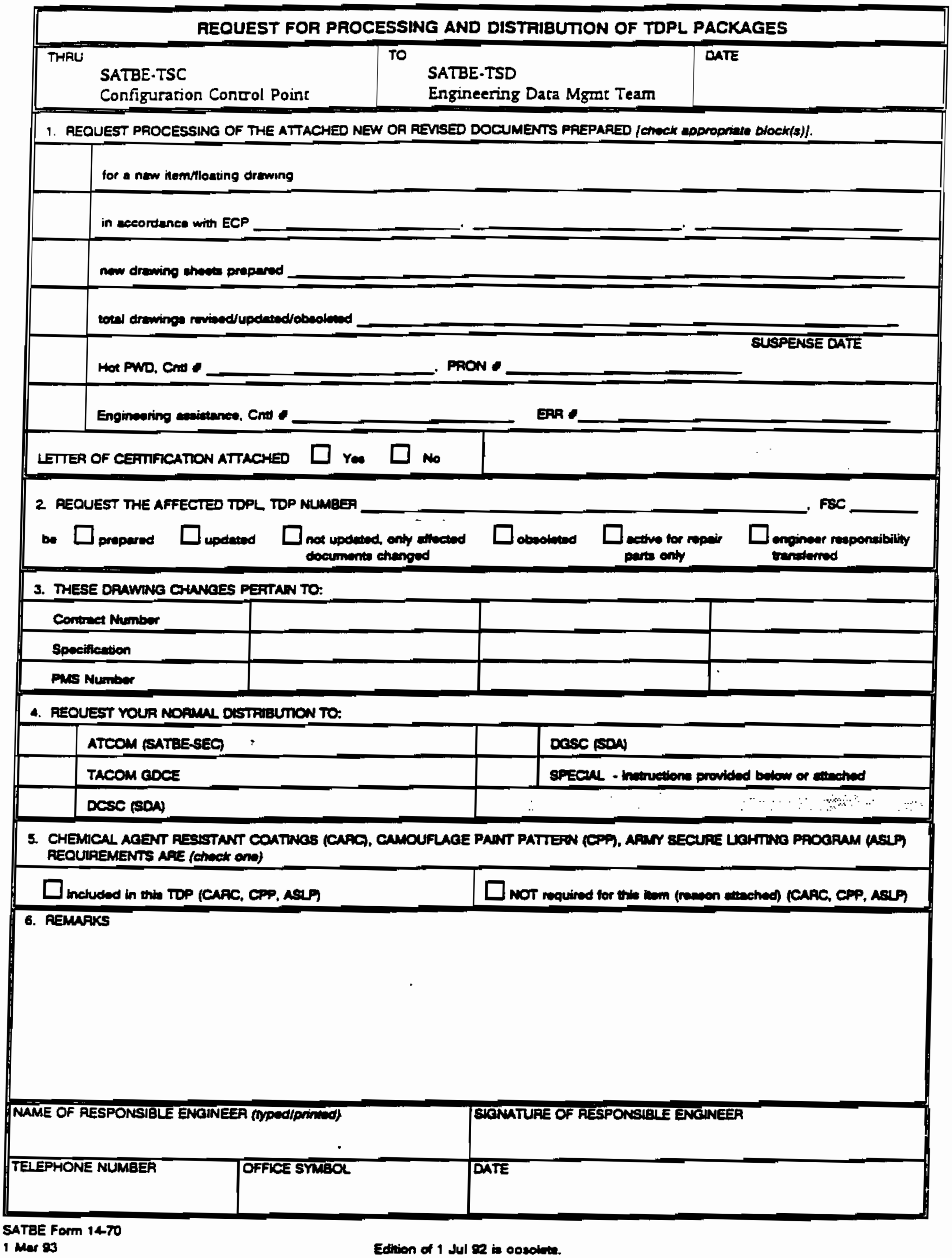
9. REMARKS
WHEN SIGNING OUT DRAWINGS SOMEONE FROM DATA BANK MUST BE PRESENT TO RELEASE DRAWINGS.

10. NUMBER OF ORIGINALS RECEIVED
11. SIGNATURE OF AUTHORIZED ENGINEER
12. DATE RECEIVED

SATBE FM 14-75
15 Sep 93

SIGNED FORM MUST REMAIN IN DATA BANK.

FIGURE II-4. Request For Drawing Originals.



REQUEST FOR PROCESSING AND DISTRIBUTION OF TDPL PACKAGES

THRU	TO	DATE
SATBE-TSC Configuration Control Point	SATBE-TSD Engineering Data Mgmt Team	

1\. REQUEST PROCESSING OF THE ATTACHED NEW OR REVISED DOCUMENTS PREPARED *(check appropriate block(s))*.

☐ for a new item/floating drawing

☐ in accordance with ECP ____________, ____________, ____________

☐ new drawing sheets prepared ____________

☐ total drawings revised/updated/obsoleted ____________

☐ Hot PWD, Cntl # ____________, PRON # ____________ SUSPENSE DATE

☐ Engineering assistance, Cntl # ____________ ERR # ____________

LETTER OF CERTIFICATION ATTACHED ☐ Yes ☐ No

2\. REQUEST THE AFFECTED TDPL, TDP NUMBER ____________, FSC ____________

be ☐ prepared ☐ updated ☐ not updated, only affected documents changed ☐ obsoleted ☐ active for repair parts only ☐ engineer responsibility transferred

3\. THESE DRAWING CHANGES PERTAIN TO:

Contract Number			
Specification			
PMS Number			

4\. REQUEST YOUR NORMAL DISTRIBUTION TO:

☐	ATCOM (SATBE-SEC)	☐	DGSC (SDA)
☐	TACOM GDCE	☐	SPECIAL - instructions provided below or attached
☐	DCSC (SDA)		

5\. CHEMICAL AGENT RESISTANT COATINGS (CARC), CAMOUFLAGE PAINT PATTERN (CPP), ARMY SECURE LIGHTING PROGRAM (ASLP) REQUIREMENTS ARE *(check one)*

☐ Included in this TDP (CARC, CPP, ASLP) ☐ NOT required for this item (reason attached) (CARC, CPP, ASLP)

6\. REMARKS

NAME OF RESPONSIBLE ENGINEER *(typed/printed)*		SIGNATURE OF RESPONSIBLE ENGINEER
TELEPHONE NUMBER	OFFICE SYMBOL	DATE

SATBE Form 14-70
1 Mar 93

Edition of 1 Jul 92 is obsolete.

FIGURE II-5. Request For Processing and Distribution of TDPL Packages.

ENGINEERING RELEASE RECORD (ERR)

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO EITHER OF THESE ADDRESSES. RETURN COMPLETED FORM TO THE GOVERNMENT ISSUING CONTRACTING OFFICER FOR THE CONTRACT/PROCURING ACTIVITY NUMBER LISTED IN ITEM 3 OF THIS FORM.

1. ERR NO. TA132XXE05XXF
2. DATE (YYMMDD) 93-03-31
3. PROCURING ACTIVITY NUMBER SEE BLK 7.a.
4. DODAAC

5. BASELINE ESTABLISHED OR CHANGED (X one)
☐ FUNCTIONAL ☐ ALLOCATED
☒ PRODUCT

6. TYPE OF RELEASE (X one)
☐ INITIAL
☒ CHANGE

7.a. ECP NUMBER 93HEXXXX
b. EFFECTIVE DATE (YYMMDD) 93-02-26

8. FUNCTIONAL ASSEMBLY NOMENCLATURE
FORWARD AREA REFUELING EQUIPMENT (FARE), TA132XXE05XX

9. SYSTEM/CONFIGURATION ITEM
a. NOMENCLATURE SEE BLK 8
b. PART NUMBER SEE BLK 8

10. REMARKS/MISCELLANEOUS

THE PREVIOUS PRODUCT BASELINE WAS IDENTIFIED BY ERR NO. TA132XXE05XXE (OR IDENTIFED BY TL-MIL-F-52XXX/TA132XXE05XX, REVISION E).

SEE ATTACHED TDP CERTIFICATION.

11. DATA RELEASED OR REVISED

CAGE CODE	DOCUMENT				REVISION		RELEASE		CHANGE		OTHER
	TYPE	NUMBER	PAGE of PAGES		LETTER	DATE/YYMMDD	h.		i.		
a.	b.	c.	d.	e.	f.	g.	IR	MAR	CH	CAN	j.
81349	C-5	MIL-F-52XXX		22	A	XX-04-02			X		
97403	SCN	001A		3		93-02-26			X		MIL-F-52XXXA
97403	TD	TL-MIL-F-52XXX/TA 132XXE05XX		*	F	93-03-31			X		
97403	PL	132XXE52XX		2	K	XX-04-15		X			ADDED
97403	PL	132XXE53XX		*	N	93-02-26			X		
97403		B132XXE36XX			J	93-02-26			X		
97403		B132XXE37XX			F	XX-08-12				X	DELETED
97403		C132XXE38XX	1-3	3	-	93-03-31	X				ADDED
97403		C132XXE39XX	1	3	B	92-09-15		X			ADDED
97403		C132XXE39XX	2	3	-	91-01-31		X			ADDED
97403		C132XXE39XX	3	3	A	92-06-15		X			ADDED
97403		C132XXE40XX			C	93-02-26			X		
97403		D132XXE41XX			E	93-02-26			X		
97403		D132XXE52XX			L	XX-04-15		X			ADDED

(USE CONTINUATION SHEET DD FORM 2617C IF NECESSARY)

*TD AND PL WILL BE COMPUTER GENERATED, PAGES NOT KNOWN.

12. SUBMITTED BY (Signature)
SATBE-XXX
(SIGNED PROJECT ENGINEER)

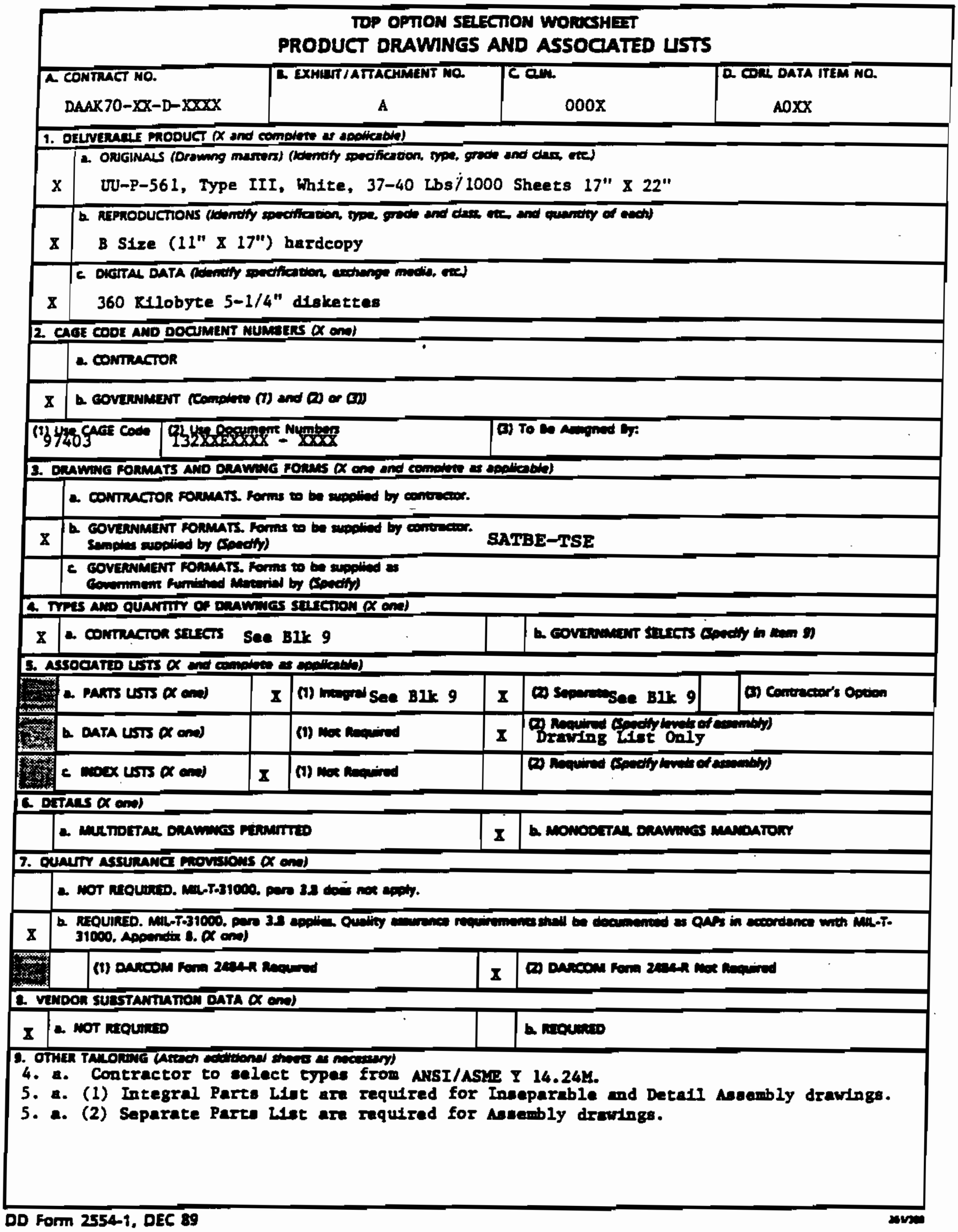
13. APPROVED BY (Signature)
SATBE-XX
(SIGNED DIVISION CHIEF) 93-03-31

DD Form 2617, APR 92

Together with DD Form 2617, replaces DARCOM Form 1724-R, which is obsolete.

Page 1 of 1 Pages

FIGURE II-6. Example, Engineering Release Record (ERR).



TDP OPTION SELECTION WORKSHEET

PRODUCT DRAWINGS AND ASSOCIATED LISTS

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN.	D. CDRL DATA ITEM NO.
DAAK70-XX-D-XXXX	A	000X	A0XX

1. DELIVERABLE PRODUCT *(X and complete as applicable)*

X a. ORIGINALS *(Drawing masters) (Identify specification, type, grade and class, etc.)*
UU-P-561, Type III, White, 37-40 Lbs/1000 Sheets 17" X 22"

X b. REPRODUCTIONS *(Identify specification, type, grade and class, etc., and quantity of each)*
B Size (11" X 17") hardcopy

X c. DIGITAL DATA *(Identify specification, exchange media, etc.)*
360 Kilobyte 5-1/4" diskettes

2. CAGE CODE AND DOCUMENT NUMBERS *(X one)*

☐ a. CONTRACTOR

X b. GOVERNMENT *(Complete (1) and (2) or (3))*

(1) Use CAGE Code	(2) Use Document Numbers	(3) To Be Assigned By:
97403	132XXEXXXX - XXXX	

3. DRAWING FORMATS AND DRAWING FORMS *(X one and complete as applicable)*

☐ a. CONTRACTOR FORMATS. Forms to be supplied by contractor.

X b. GOVERNMENT FORMATS. Forms to be supplied by contractor. Samples supplied by *(Specify)* SATBE-TSE

☐ c. GOVERNMENT FORMATS. Forms to be supplied as Government Furnished Material by *(Specify)*

4. TYPES AND QUANTITY OF DRAWINGS SELECTION *(X one)*

X a. CONTRACTOR SELECTS See Blk 9 ☐ b. GOVERNMENT SELECTS *(Specify in item 9)*

5. ASSOCIATED LISTS *(X and complete as applicable)*

a. PARTS LISTS *(X one)*	X	(1) Integral See Blk 9	X	(2) Separate See Blk 9		(3) Contractor's Option
b. DATA LISTS *(X one)*		(1) Not Required	X	(2) Required *(Specify levels of assembly)* Drawing List Only		
c. INDEX LISTS *(X one)*	X	(1) Not Required		(2) Required *(Specify levels of assembly)*		

6. DETAILS *(X one)*

☐ a. MULTIDETAIL DRAWINGS PERMITTED X b. MONODETAIL DRAWINGS MANDATORY

7. QUALITY ASSURANCE PROVISIONS *(X one)*

☐ a. NOT REQUIRED. MIL-T-31000, para 3.8 does not apply.

X b. REQUIRED. MIL-T-31000, para 3.8 applies. Quality assurance requirements shall be documented as QAPs in accordance with MIL-T-31000, Appendix B. *(X one)*

☐ (1) DARCOM Form 2484-R Required X (2) DARCOM Form 2484-R Not Required

8. VENDOR SUBSTANTIATION DATA *(X one)*

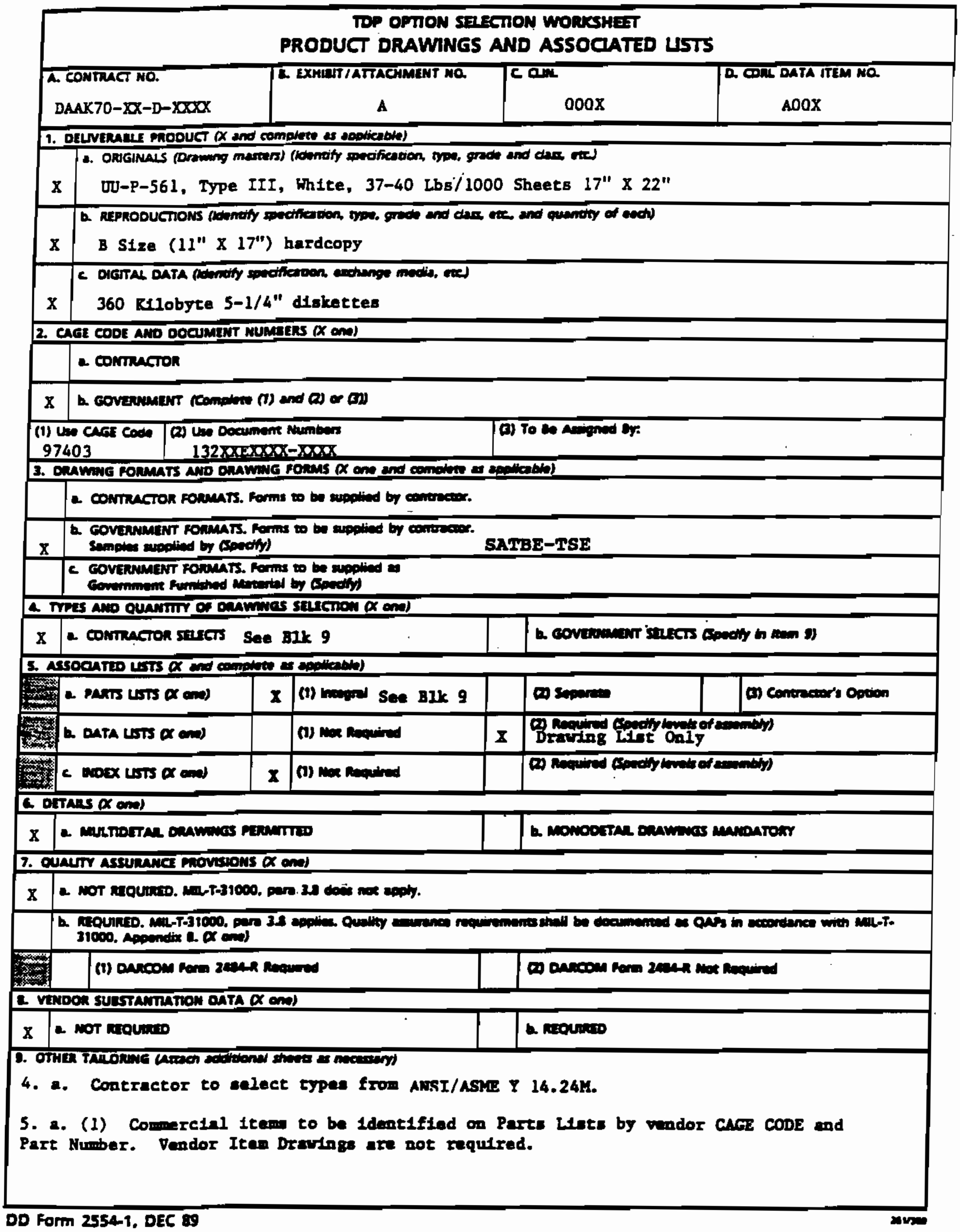
X a. NOT REQUIRED ☐ b. REQUIRED

9. OTHER TAILORING *(Attach additional sheets as necessary)*

4. a. Contractor to select types from ANSI/ASME Y 14.24M.
5. a. (1) Integral Parts List are required for Inseparable and Detail Assembly drawings.
5. a. (2) Separate Parts List are required for Assembly drawings.

DD Form 2554-1, DEC 89

FIGURE III-1. TDP Option Selection Worksheet; Example, Drawings for Competitive Procurement.



TDP OPTION SELECTION WORKSHEET

PRODUCT DRAWINGS AND ASSOCIATED LISTS

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN.	D. CDRL DATA ITEM NO.
DAAK70-XX-D-XXXX	A	000X	A00X

1. DELIVERABLE PRODUCT *(X and complete as applicable)*

X	a. ORIGINALS *(Drawing masters) (Identify specification, type, grade and class, etc.)* UU-P-561, Type III, White, 37-40 Lbs/1000 Sheets 17" X 22"
X	b. REPRODUCTIONS *(Identify specification, type, grade and class, etc., and quantity of each)* B Size (11" X 17") hardcopy
X	c. DIGITAL DATA *(Identify specification, exchange media, etc.)* 360 Kilobyte 5-1/4" diskettes

2. CAGE CODE AND DOCUMENT NUMBERS *(X one)*

	a. CONTRACTOR
X	b. GOVERNMENT *(Complete (1) and (2) or (3))*

(1) Use CAGE Code	(2) Use Document Numbers	(3) To Be Assigned By:
97403	132XXEXXXX-XXXX	

3. DRAWING FORMATS AND DRAWING FORMS *(X one and complete as applicable)*

	a. CONTRACTOR FORMATS. Forms to be supplied by contractor.
X	b. GOVERNMENT FORMATS. Forms to be supplied by contractor. Samples supplied by *(Specify)* SATBE-TSE
	c. GOVERNMENT FORMATS. Forms to be supplied as Government Furnished Material by *(Specify)*

4. TYPES AND QUANTITY OF DRAWINGS SELECTION *(X one)*

X	a. CONTRACTOR SELECTS See Blk 9		b. GOVERNMENT SELECTS *(Specify in item 9)*

5. ASSOCIATED LISTS *(X and complete as applicable)*

a. PARTS LISTS *(X one)*	X	(1) Integral See Blk 9		(2) Separate		(3) Contractor's Option
b. DATA LISTS *(X one)*		(1) Not Required	X	(2) Required *(Specify levels of assembly)* Drawing List Only		
c. INDEX LISTS *(X one)*	X	(1) Not Required		(2) Required *(Specify levels of assembly)*		

6. DETAILS *(X one)*

X	a. MULTIDETAIL DRAWINGS PERMITTED		b. MONODETAIL DRAWINGS MANDATORY

7. QUALITY ASSURANCE PROVISIONS *(X one)*

X	a. NOT REQUIRED. MIL-T-31000, para 3.8 does not apply.
	b. REQUIRED. MIL-T-31000, para 3.8 applies. Quality assurance requirements shall be documented as QAPs in accordance with MIL-T-31000, Appendix B. *(X one)*

	(1) DARCOM Form 2484-R Required	
	(2) DARCOM Form 2484-R Not Required	

8. VENDOR SUBSTANTIATION DATA *(X one)*

X	a. NOT REQUIRED		b. REQUIRED

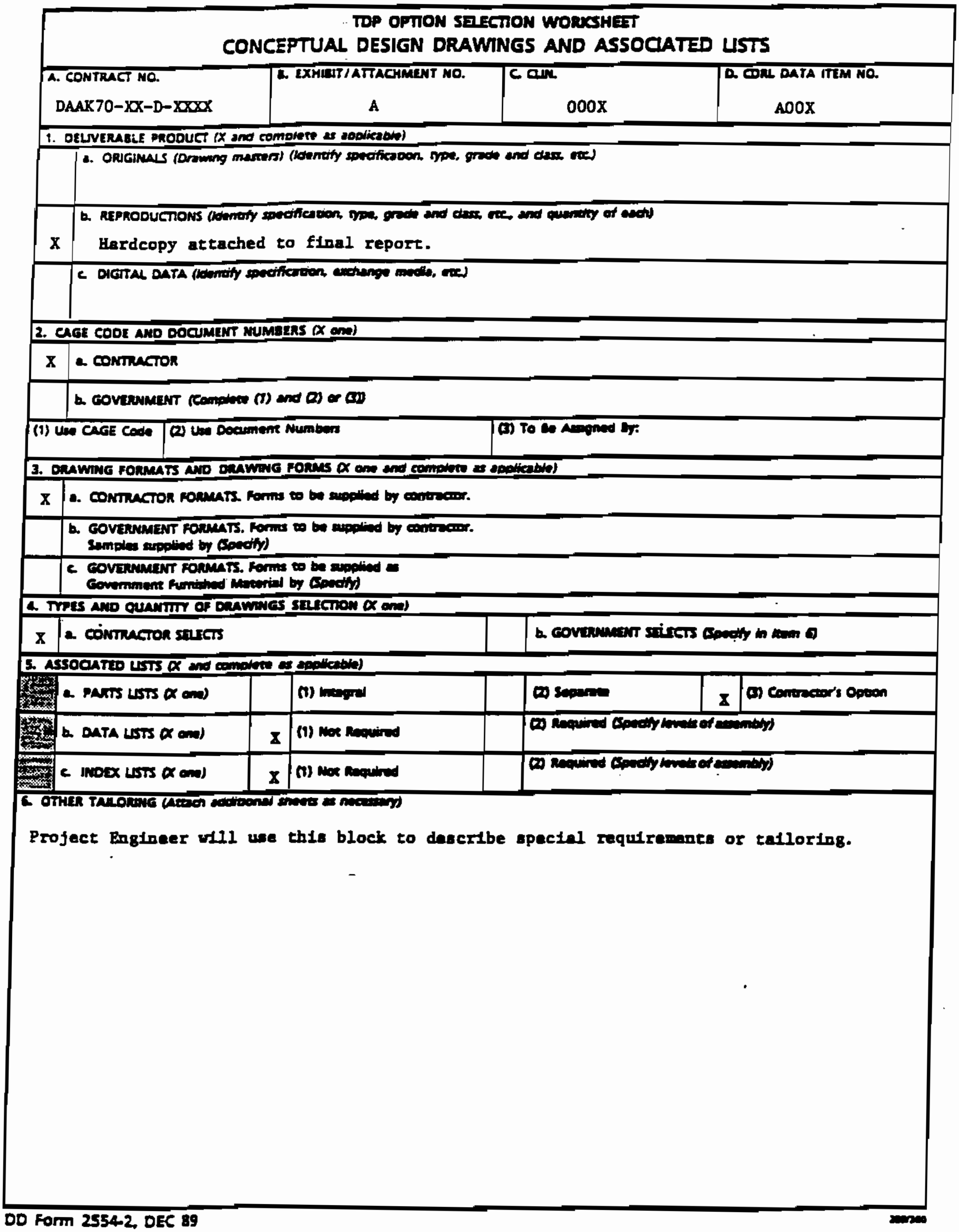
9. OTHER TAILORING *(Attach additional sheets as necessary)*

4. a. Contractor to select types from ANSI/ASME Y 14.24M.

5. a. (1) Commercial items to be identified on Parts Lists by vendor CAGE CODE and Part Number. Vendor Item Drawings are not required.

DD Form 2554-1, DEC 89

FIGURE III-2. TDP Option Selection Worksheet; Example, Marine Drawings for Limited Competitive Procurement.



TDP OPTION SELECTION WORKSHEET

CONCEPTUAL DESIGN DRAWINGS AND ASSOCIATED LISTS

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN.	D. CDRL DATA ITEM NO.
DAAK70-XX-D-XXXX	A	000X	A00X

1. DELIVERABLE PRODUCT *(X and complete as applicable)*

	a. ORIGINALS *(Drawing masters) (Identify specification, type, grade and class, etc.)*
X	b. REPRODUCTIONS *(Identify specification, type, grade and class, etc., and quantity of each)* Hardcopy attached to final report.
	c. DIGITAL DATA *(Identify specification, exchange media, etc.)*

2. CAGE CODE AND DOCUMENT NUMBERS *(X one)*

X	a. CONTRACTOR
	b. GOVERNMENT *(Complete (1) and (2) or (3))*

(1) Use CAGE Code	(2) Use Document Numbers	(3) To Be Assigned By:

3. DRAWING FORMATS AND DRAWING FORMS *(X one and complete as applicable)*

X	a. CONTRACTOR FORMATS. Forms to be supplied by contractor.
	b. GOVERNMENT FORMATS. Forms to be supplied by contractor. Samples supplied by *(Specify)*
	c. GOVERNMENT FORMATS. Forms to be supplied as Government Furnished Material by *(Specify)*

4. TYPES AND QUANTITY OF DRAWINGS SELECTION *(X one)*

X	a. CONTRACTOR SELECTS		b. GOVERNMENT SELECTS *(Specify in item 6)*

5. ASSOCIATED LISTS *(X and complete as applicable)*

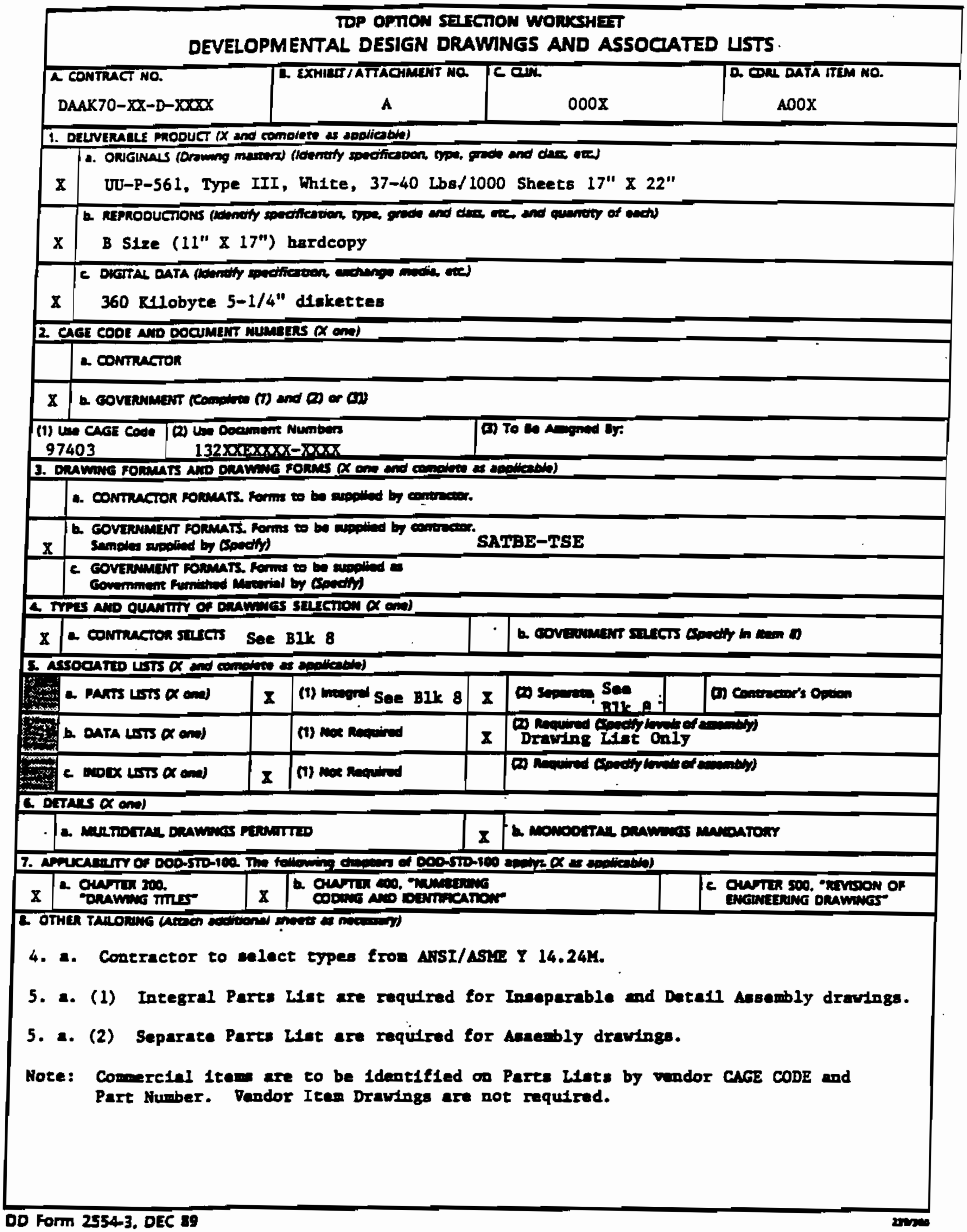
a. PARTS LISTS *(X one)*		(1) Integral		(2) Separate	X	(3) Contractor's Option
b. DATA LISTS *(X one)*	X	(1) Not Required		(2) Required *(Specify levels of assembly)*		
c. INDEX LISTS *(X one)*	X	(1) Not Required		(2) Required *(Specify levels of assembly)*		

6. OTHER TAILORING *(Attach additional sheets as necessary)*

Project Engineer will use this block to describe special requirements or tailoring.

DD Form 2554-2, DEC 89

FIGURE III-3. TDP Option Selection Worksheet; Example, Conceptual Design Drawings.



TDP OPTION SELECTION WORKSHEET

DEVELOPMENTAL DESIGN DRAWINGS AND ASSOCIATED LISTS

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN.	D. CDRL DATA ITEM NO.
DAAK70-XX-D-XXXX	A	000X	A00X

1. DELIVERABLE PRODUCT *(X and complete as applicable)*

X	a. ORIGINALS *(Drawing masters) (Identify specification, type, grade and class, etc.)* UU-P-561, Type III, White, 37-40 Lbs/1000 Sheets 17" X 22"
X	b. REPRODUCTIONS *(Identify specification, type, grade and class, etc., and quantity of each)* B Size (11" X 17") hardcopy
X	c. DIGITAL DATA *(Identify specification, exchange media, etc.)* 360 Kilobyte 5-1/4" diskettes

2. CAGE CODE AND DOCUMENT NUMBERS *(X one)*

	a. CONTRACTOR
X	b. GOVERNMENT *(Complete (1) and (2) or (3))*

(1) Use CAGE Code	(2) Use Document Numbers	(3) To Be Assigned By:
97403	132XXEXXXX-XXXX	

3. DRAWING FORMATS AND DRAWING FORMS *(X one and complete as applicable)*

	a. CONTRACTOR FORMATS. Forms to be supplied by contractor.
X	b. GOVERNMENT FORMATS. Forms to be supplied by contractor. Samples supplied by *(Specify)* SATBE-TSE
	c. GOVERNMENT FORMATS. Forms to be supplied as Government Furnished Material by *(Specify)*

4. TYPES AND QUANTITY OF DRAWINGS SELECTION *(X one)*

X	a. CONTRACTOR SELECTS See Blk 8		b. GOVERNMENT SELECTS *(Specify in Item 8)*

5. ASSOCIATED LISTS *(X and complete as applicable)*

a. PARTS LISTS *(X one)*	X	(1) Integral See Blk 8	X	(2) Separate See Blk 8		(3) Contractor's Option
b. DATA LISTS *(X one)*		(1) Not Required	X	(2) Required *(Specify levels of assembly)* Drawing List Only		
c. INDEX LISTS *(X one)*	X	(1) Not Required		(2) Required *(Specify levels of assembly)*		

6. DETAILS *(X one)*

	a. MULTIDETAIL DRAWINGS PERMITTED	X	b. MONODETAIL DRAWINGS MANDATORY

7. APPLICABILITY OF DOD-STD-100. The following chapters of DOD-STD-100 apply: *(X as applicable)*

X	a. CHAPTER 300. "DRAWING TITLES"	X	b. CHAPTER 400. "NUMBERING CODING AND IDENTIFICATION"		c. CHAPTER 500. "REVISION OF ENGINEERING DRAWINGS"

8. OTHER TAILORING *(Attach additional sheets as necessary)*

4. a. Contractor to select types from ANSI/ASME Y 14.24M.

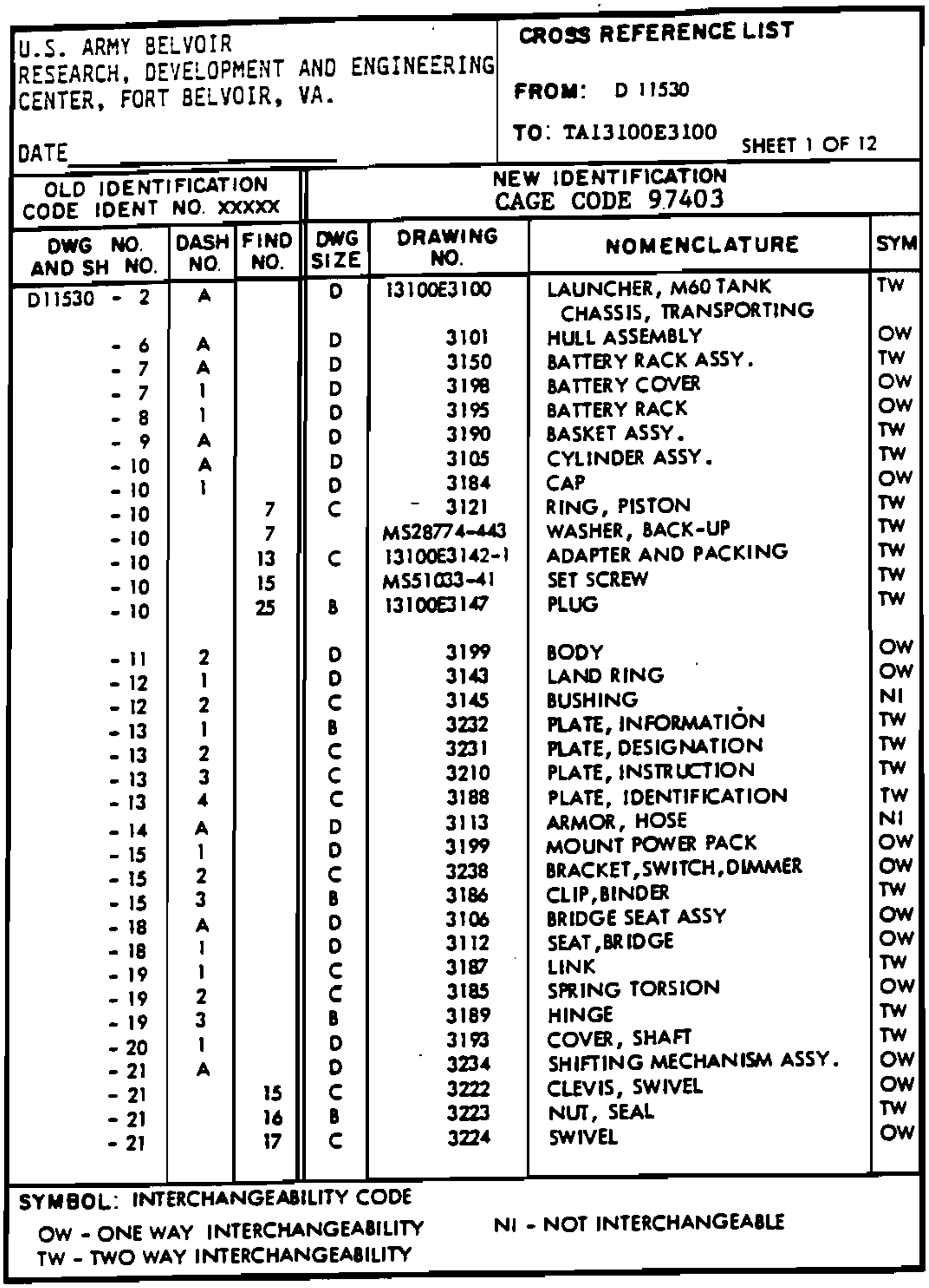
5. a. (1) Integral Parts List are required for Inseparable and Detail Assembly drawings.

5. a. (2) Separate Parts List are required for Assembly drawings.

Note: Commercial items are to be identified on Parts Lists by vendor CAGE CODE and Part Number. Vendor Item Drawings are not required.

DD Form 2554-3, DEC 89

FIGURE III-4. TDP Option Selection Worksheet; Example, Developmental Design Drawings.



U.S. ARMY BELVOIR
RESEARCH, DEVELOPMENT AND ENGINEERING
CENTER, FORT BELVOIR, VA.

DATE ____________

CROSS REFERENCE LIST

FROM: D 11530

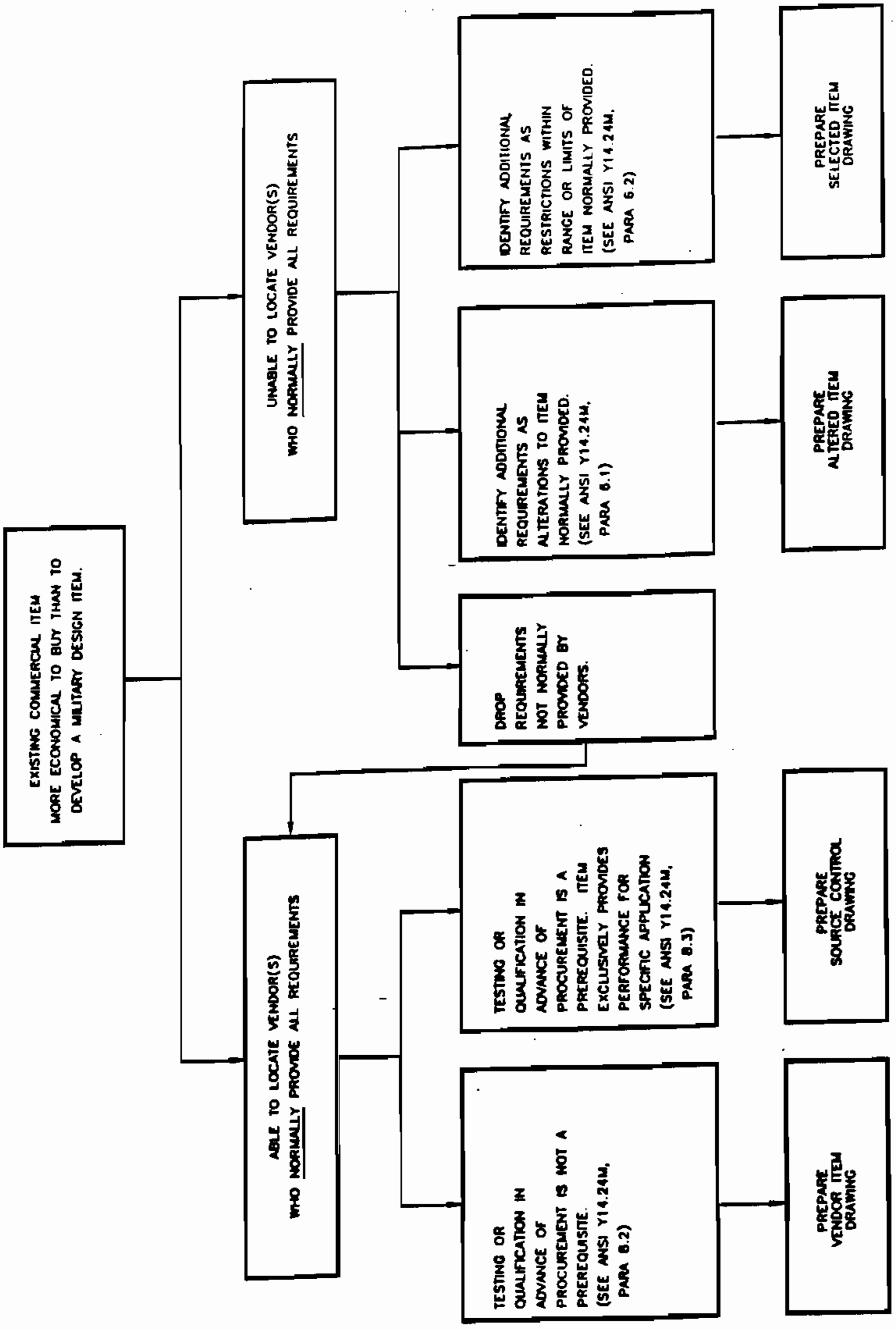
TO: TA13100E3100 SHEET 1 OF 12

OLD IDENTIFICATION CODE IDENT NO. XXXXX			NEW IDENTIFICATION CAGE CODE 97403			
DWG NO. AND SH NO.	**DASH NO.**	**FIND NO.**	**DWG SIZE**	**DRAWING NO.**	**NOMENCLATURE**	**SYM**
D11530 - 2	A		D	13100E3100	LAUNCHER, M60 TANK CHASSIS, TRANSPORTING	TW
- 6	A		D	3101	HULL ASSEMBLY	OW
- 7	A		D	3150	BATTERY RACK ASSY.	TW
- 7	1		D	3198	BATTERY COVER	OW
- 8	1		D	3195	BATTERY RACK	OW
- 9	A		D	3190	BASKET ASSY.	TW
- 10	A		D	3105	CYLINDER ASSY.	TW
- 10	1		D	3184	CAP	OW
- 10		7	C	- 3121	RING, PISTON	TW
- 10		7		MS28774-443	WASHER, BACK-UP	TW
- 10		13	C	13100E3142-1	ADAPTER AND PACKING	TW
- 10		15		MS51033-41	SET SCREW	TW
- 10		25	B	13100E3147	PLUG	TW
- 11	2		D	3199	BODY	OW
- 12	1		D	3143	LAND RING	OW
- 12	2		C	3145	BUSHING	NI
- 13	1		B	3232	PLATE, INFORMATION	TW
- 13	2		C	3231	PLATE, DESIGNATION	TW
- 13	3		C	3210	PLATE, INSTRUCTION	TW
- 13	4		C	3188	PLATE, IDENTIFICATION	TW
- 14	A		D	3113	ARMOR, HOSE	NI
- 15	1		D	3199	MOUNT POWER PACK	OW
- 15	2		C	3238	BRACKET, SWITCH, DIMMER	OW
- 15	3		B	3186	CLIP, BINDER	TW
- 18	A		D	3106	BRIDGE SEAT ASSY	OW
- 18	1		D	3112	SEAT, BRIDGE	OW
- 19	1		C	3187	LINK	TW
- 19	2		C	3185	SPRING TORSION	OW
- 19	3		B	3189	HINGE	TW
- 20	1		D	3193	COVER, SHAFT	TW
- 21	A		D	3234	SHIFTING MECHANISM ASSY.	OW
- 21		15	C	3222	CLEVIS, SWIVEL	OW
- 21		16	B	3223	NUT, SEAL	TW
- 21		17	C	3224	SWIVEL	OW

SYMBOL: INTERCHANGEABILITY CODE

OW - ONE WAY INTERCHANGEABILITY
TW - TWO WAY INTERCHANGEABILITY
NI - NOT INTERCHANGEABLE

FIGURE III-5. Cross-Reference List.



NOTE: For additional guidance for determining drawing type see ANSI/ASME Y14.24M, Appendix B, Figure B-1.

FIGURE III-6. Decision Diagram for Determining Drawing Type for Commercial Item.

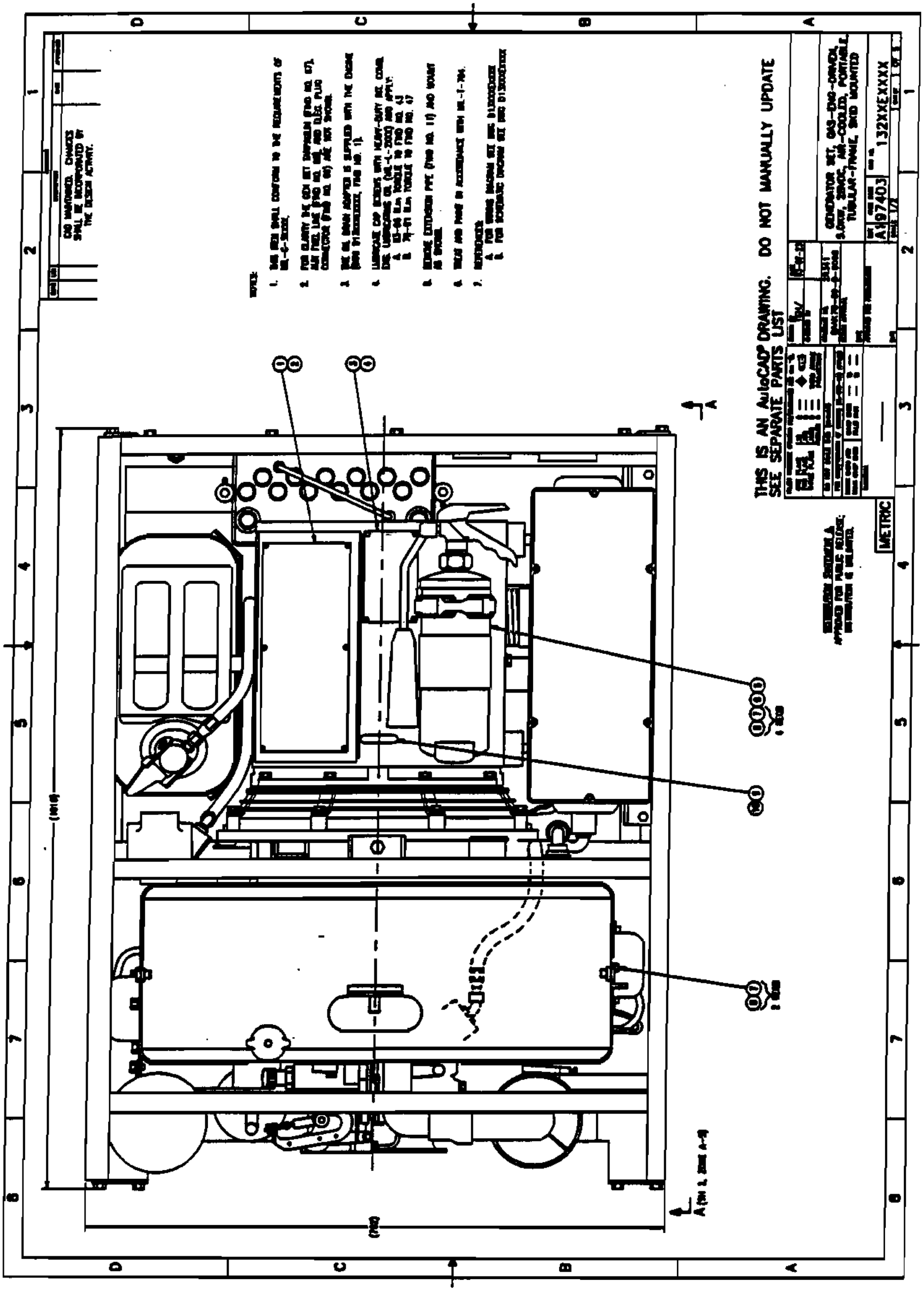


FIGURE III-7. Assembly Drawing.

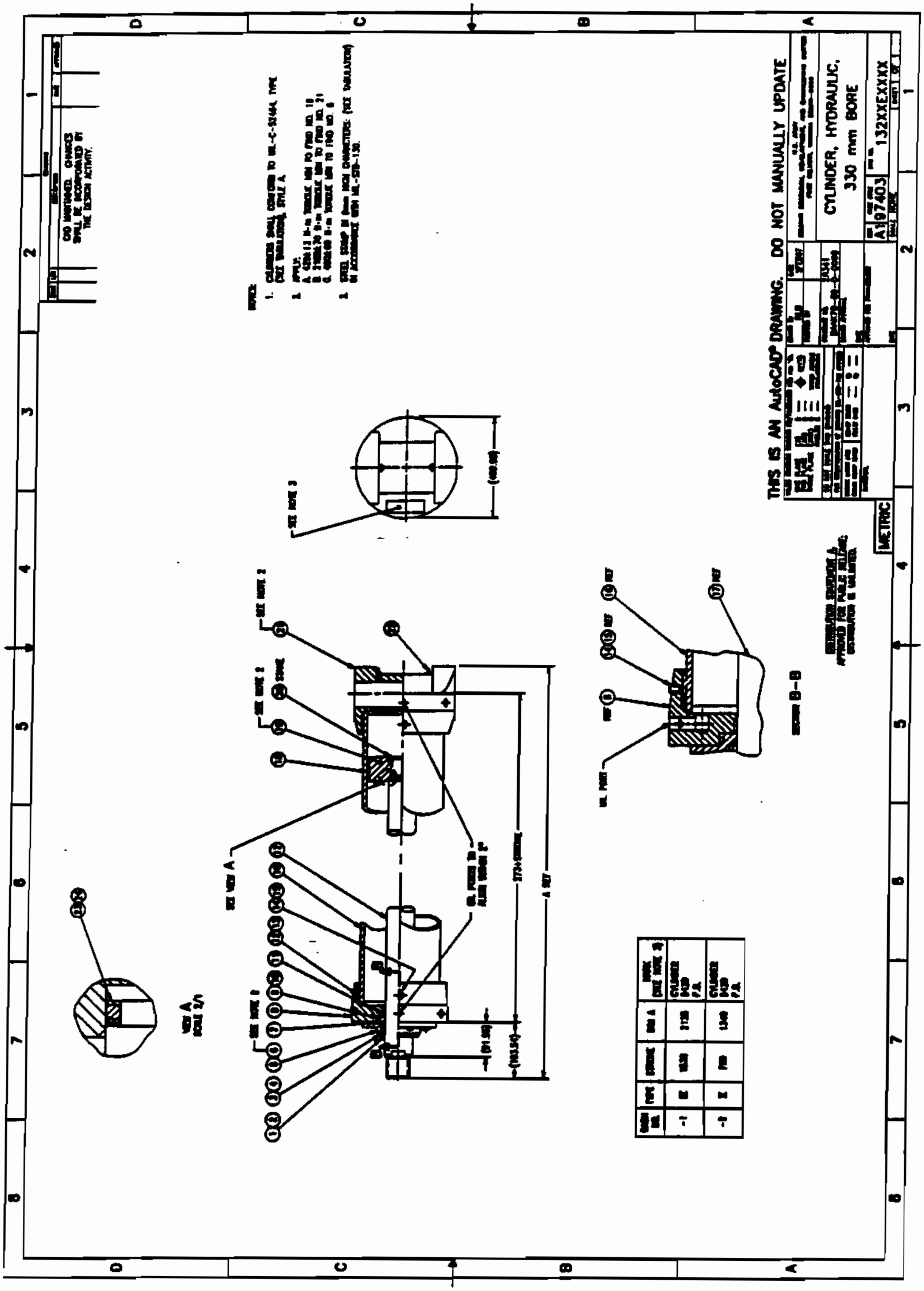
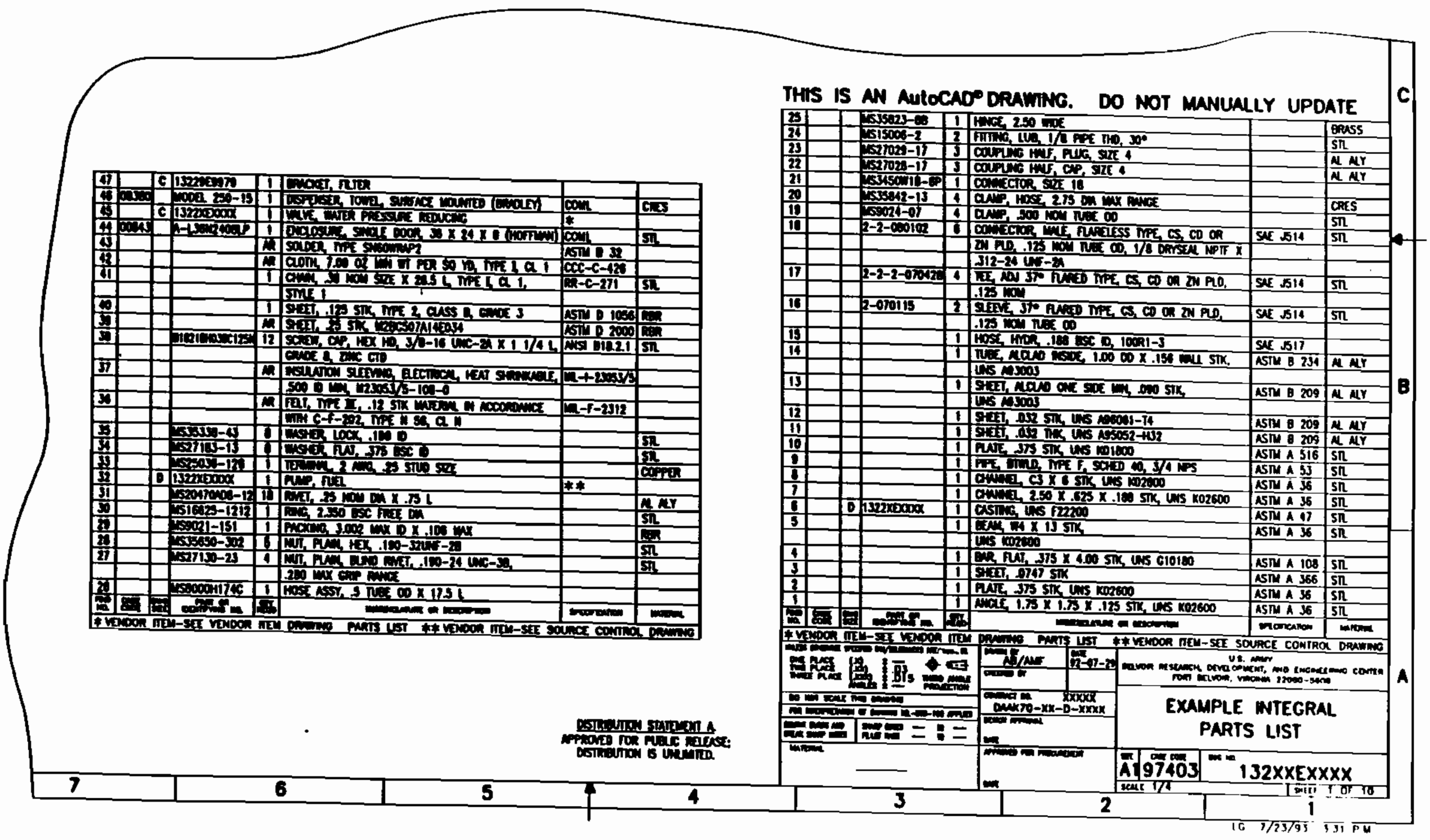


FIGURE III-8. Tabulated Assembly Drawings.



THIS IS AN AutoCAD® DRAWING. DO NOT MANUALLY UPDATE

FIND NO.	CAGE CODE	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
47		C	13229E9979	1	BRACKET, FILTER		
46	08380		MODEL 250-15	1	DISPENSER, TOWEL, SURFACE MOUNTED (BRADLEY)	COML	CRES
45		C	1322XEXXXX	1	VALVE, WATER PRESSURE REDUCING	*	
44	00843		A-L36N2406LP	1	ENCLOSURE, SINGLE DOOR, 36 X 24 X 8 (HOFFMAN)	COML	STL
43				AR	SOLDER, TYPE SN60WRAP2	ASTM B 32	
42				AR	CLOTH, 7.00 OZ MIN WT PER SQ YD, TYPE I, CL 1	CCC-C-426	
41				1	CHAIN, .38 NOM SIZE X 28.5 L, TYPE I, CL 1, STYLE 1	RR-C-271	STL
40				1	SHEET, .125 STK, TYPE 2, CLASS B, GRADE 3	ASTM D 1056	RBR
39				AR	SHEET, .25 STK, M2BC507A14E034	ASTM D 2000	RBR
38			B18210H038C125N	12	SCREW, CAP, HEX HD, 3/8-16 UNC-2A X 1 1/4 L, GRADE 8, ZINC CTD	ANSI B18.2.1	STL
37				AR	INSULATION SLEEVING, ELECTRICAL, HEAT SHRINKABLE, .500 ID MIN, M23053/5-108-0	MIL-I-23053/5	
36				AR	FELT, TYPE III, .12 STK MATERIAL IN ACCORDANCE WITH C-F-202, TYPE II 56, CL II	MIL-F-2312	
35			MS35338-43	8	WASHER, LOCK, .190 ID		STL
34			MS27183-13	8	WASHER, FLAT, .375 BSC ID		STL
33			MS25036-126	1	TERMINAL, 2 AWG, .25 STUD SIZE		COPPER
32		D	1322XEXXXX	1	PUMP, FUEL	**	
31			MS20470AD8-12	18	RIVET, .25 NOM DIA X .75 L		AL ALY
30			MS16625-1212	1	RING, 2.350 BSC FREE DIA		STL
29			MS9021-151	1	PACKING, 3.002 MAX ID X .108 MAX		RBR
28			MS35650-302	6	NUT, PLAIN, HEX, .190-32UNF-2B		STL
27			MS27130-23	4	NUT, PLAIN, BLIND RIVET, .190-24 UNC-3B, .280 MAX GRIP RANGE		STL
26			MS8000H174C	1	HOSE ASSY, .5 TUBE OD X 17.5 L		

* VENDOR ITEM-SEE VENDOR ITEM DRAWING PARTS LIST ** VENDOR ITEM-SEE SOURCE CONTROL DRAWING

FIND NO.	CAGE CODE	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
25			MS35823-08	1	HINGE, 2.50 WIDE		BRASS
24			MS15006-2	2	FITTING, LUB, 1/8 PIPE THD, 30°		STL
23			MS27029-17	3	COUPLING HALF, PLUG, SIZE 4		AL ALY
22			MS27028-17	3	COUPLING HALF, CAP, SIZE 4		AL ALY
21			MS3450W18-8P	1	CONNECTOR, SIZE 18		
20			MS35842-13	4	CLAMP, HOSE, 2.75 DIA MAX RANGE		CRES
19			MS9024-07	4	CLAMP, .500 NOM TUBE OD		STL
18			2-2-080102	6	CONNECTOR, MALE, FLARELESS TYPE, CS, CD OR ZN PLD, .125 NOM TUBE OD, 1/8 DRYSEAL NPTF X .312-24 UNF-2A	SAE J514	STL
17			2-2-2-070428	4	TEE, ADJ 37° FLARED TYPE, CS, CD OR ZN PLD, .125 NOM	SAE J514	STL
16			2-070115	2	SLEEVE, 37° FLARED TYPE, CS, CD OR ZN PLD, .125 NOM TUBE OD	SAE J514	STL
15				1	HOSE, HYDR, .188 BSC ID, 100R1-3	SAE J517	
14				1	TUBE, ALCLAD INSIDE, 1.00 OD X .156 WALL STK, UNS A83003	ASTM B 234	AL ALY
13				1	SHEET, ALCLAD ONE SIDE MIN, .090 STK, UNS A83003	ASTM B 209	AL ALY
12				1	SHEET, .032 STK, UNS A96061-T4	ASTM B 209	AL ALY
11				1	SHEET, .032 THK, UNS A95052-H32	ASTM B 209	AL ALY
10				1	PLATE, .375 STK, UNS K01800	ASTM A 516	STL
9				1	PIPE, BTWLD, TYPE F, SCHED 40, 3/4 NPS	ASTM A 53	STL
8				1	CHANNEL, C3 X 6 STK, UNS K02600	ASTM A 36	STL
7				1	CHANNEL, 2.50 X .625 X .188 STK, UNS K02600	ASTM A 36	STL
6		D	1322XEXXXX	1	CASTING, UNS F22200	ASTM A 47	STL
5				1	BEAM, W4 X 13 STK, UNS K02600	ASTM A 36	STL
4				1	BAR, FLAT, .375 X 4.00 STK, UNS G10180	ASTM A 108	STL
3				1	SHEET, .0747 STK	ASTM A 366	STL
2				1	PLATE, .375 STK, UNS K02600	ASTM A 36	STL
1				1	ANGLE, 1.75 X 1.75 X .125 STK, UNS K02600	ASTM A 36	STL

* VENDOR ITEM-SEE VENDOR ITEM DRAWING PARTS LIST ** VENDOR ITEM-SEE SOURCE CONTROL DRAWING

ONE PLACE
TWO PLACE
THREE PLACE
ANGLES
THIRD ANGLE PROJECTION
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN BY AB/AMF
DATE 92-07-29
CHECKED BY
CONTRACT NO. XXXXX
DAAK70-XX-D-XXXX
DESIGN APPROVAL
DATE
APPROVED FOR PROCUREMENT
DATE

U.S. ARMY
BELVOIR RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER
FORT BELVOIR, VIRGINIA 22060-5606

EXAMPLE INTEGRAL
PARTS LIST

SIZE A1
CAGE CODE 97403
DWG NO. 132XXEXXXX
SCALE 1/4
SHEET 1 OF 10

LG 7/23/93 3:31 PM

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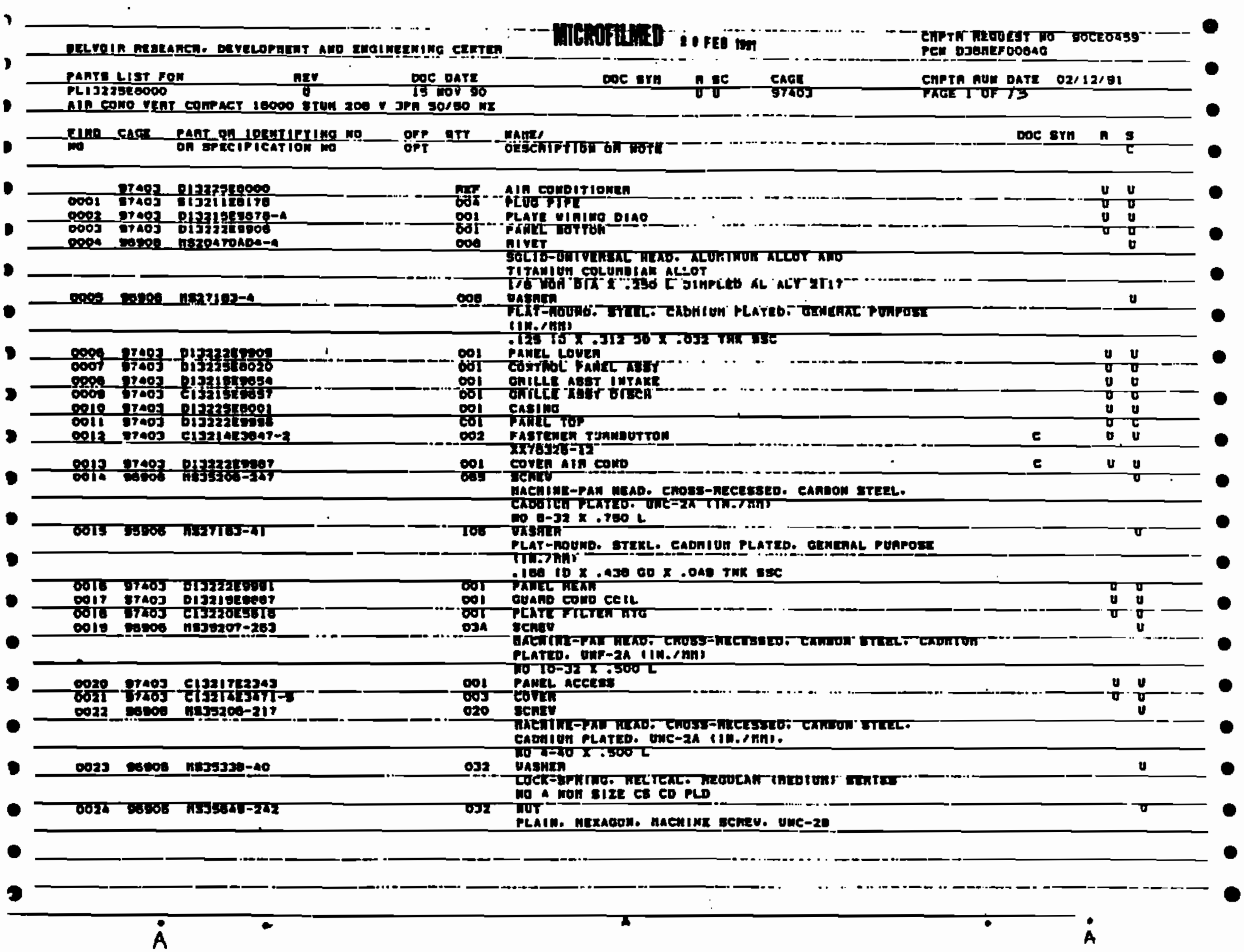
FIGURE III-9. Integral Parts List (PL).



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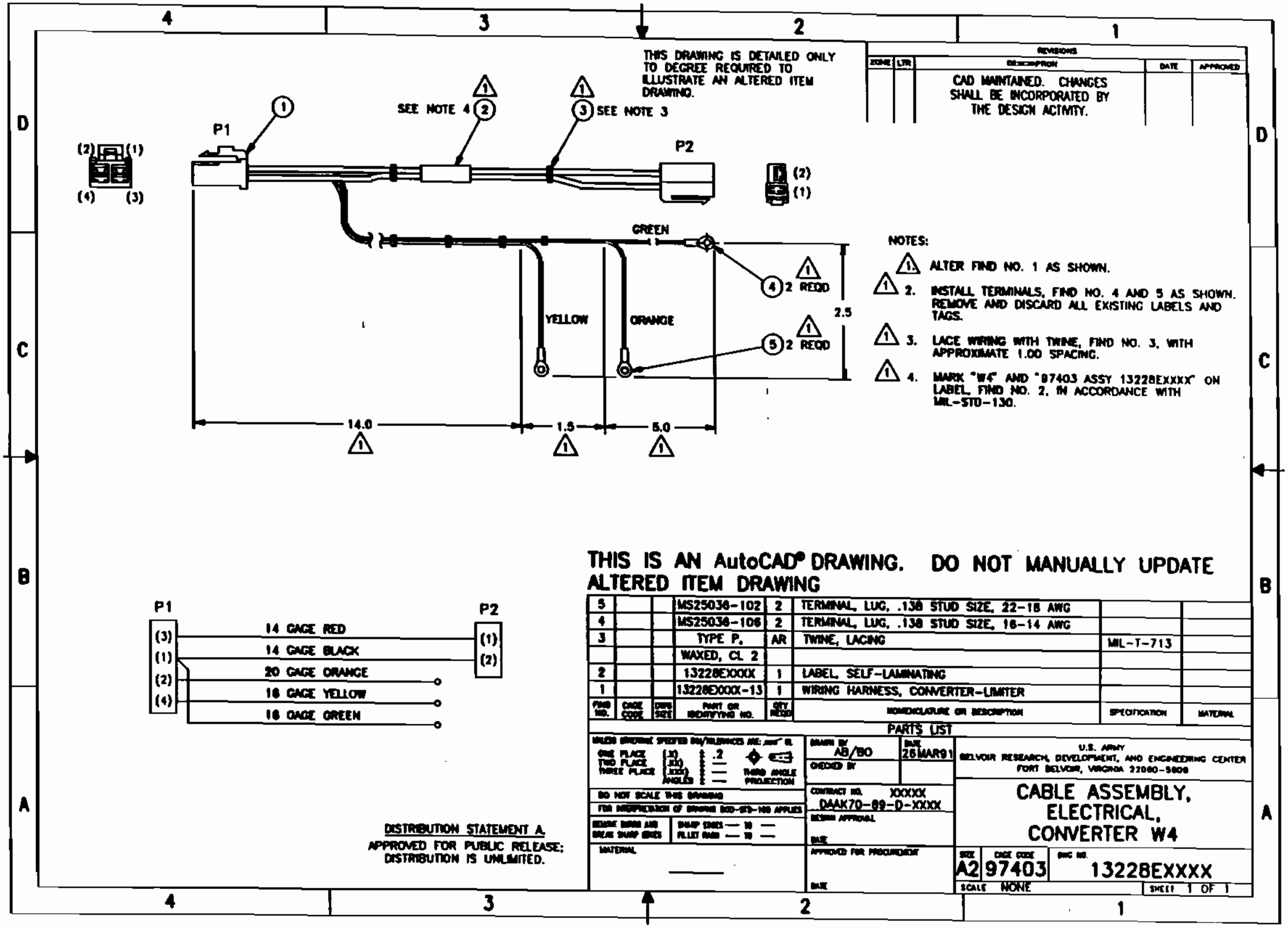
                                                          MICROFILMED  2 0 FEB 1991     CMPTR REQUEST NO  90CE0459
BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER                                    PCN D38REF0064G

PARTS LIST FOR            REV          DOC DATE         DOC SYM    R SC    CAGE         CMPTR RUN DATE  02/12/91
PL13225E8000              0            15 NOV 90                   U U     97403        PAGE 1 OF 73
AIR COND VERT COMPACT 18000 BTUH 208 V 3PH 50/60 HZ

FIND  CAGE   PART OR IDENTIFYING NO    OFF  QTY   NAME/                                              DOC SYM   R  S
NO           OR SPECIFICATION NO       OPT        DESCRIPTION OR NOTE                                              C

      97403  D13225E8000                     REF  AIR CONDITIONER                                                  U  U
0001  97403  B13211E8178                     004  PLUG PIPE                                                        U  U
0002  97403  D13219E9878-A                   001  PLATE WIRING DIAG                                                U  U
0003  97403  D13222E9906                     001  PANEL BOTTOM                                                     U  U
0004  96906  MS20470AD4-4                    008  RIVET                                                               U
                                                  SOLID-UNIVERSAL HEAD, ALUMINUM ALLOY AND
                                                  TITANIUM COLUMBIAN ALLOY
                                                  1/8 NOM DIA X .250 L DIMPLED AL ALY 2117
0005  96906  MS27183-4                       008  WASHER                                                              U
                                                  FLAT-ROUND, STEEL, CADMIUM PLATED, GENERAL PURPOSE
                                                  (IN./MM)
                                                  .125 ID X .312 OD X .032 THK SSC
0006  97403  D13222E9909                     001  PANEL LOWER                                                      U  U
0007  97403  D13225E8020                     001  CONTROL PANEL ASSY                                               U  U
0008  97403  D13219E9654                     001  GRILLE ASSY INTAKE                                               U  U
0009  97403  C13215E9857                     001  GRILLE ASSY DISCH                                                U  U
0010  97403  D13225E8001                     001  CASING                                                           U  U
0011  97403  D13222E9998                     001  PANEL TOP                                                        U  C
0012  97403  C13214E3047-2                   002  FASTENER TURNBUTTON                                  C           U  U
                                                  XX78326-12
0013  97403  D13222E9907                     001  COVER AIR COND                                       C           U  U
0014  96906  MS35206-247                     085  SCREW                                                               U
                                                  MACHINE-PAN HEAD, CROSS-RECESSED, CARBON STEEL,
                                                  CADMIUM PLATED, UNC-2A (IN./MM)
                                                  NO 8-32 X .750 L
0015  96906  MS27183-41                      108  WASHER                                                              U
                                                  FLAT-ROUND, STEEL, CADMIUM PLATED, GENERAL PURPOSE
                                                  (IN./MM)
                                                  .188 ID X .438 OD X .049 THK SSC
0016  97403  D13222E9991                     001  PANEL REAR                                                       U  U
0017  97403  D13219E9907                     001  GUARD COND COIL                                                  U  U
0018  97403  C13220E5816                     001  PLATE FILTER MTG                                                 U  U
0019  96906  MS35207-263                     034  SCREW                                                               U
                                                  MACHINE-PAN HEAD, CROSS-RECESSED, CARBON STEEL, CADMIUM
                                                  PLATED, UNF-2A (IN./MM)
                                                  NO 10-32 X .500 L
0020  97403  C13217E2343                     001  PANEL ACCESS                                                     U  U
0021  97403  C13214E3471-5                   003  COVER                                                            U  U
0022  96906  MS35206-217                     020  SCREW                                                               U
                                                  MACHINE-PAN HEAD, CROSS-RECESSED, CARBON STEEL,
                                                  CADMIUM PLATED, UNC-2A (IN./MM).
                                                  NO 4-40 X .500 L
0023  96906  MS35338-40                      032  WASHER                                                              U
                                                  LOCK-SPRING, HELICAL, REGULAR (MEDIUM) SERIES
                                                  NO 4 NOM SIZE CS CD PLD
0024  96906  MS35649-242                     032  NUT                                                                 U
                                                  PLAIN, HEXAGON, MACHINE SCREW, UNC-2B
```

FIGURE III-10. Separate Parts List (PL), Computer Generated.



NOTES:

⚠1. ALTER FIND NO. 1 AS SHOWN.

⚠2. INSTALL TERMINALS, FIND NO. 4 AND 5 AS SHOWN. REMOVE AND DISCARD ALL EXISTING LABELS AND TAGS.

⚠3. LACE WIRING WITH TWINE, FIND NO. 3, WITH APPROXIMATE 1.00 SPACING.

⚠4. MARK "W4" AND "97403 ASSY 13228EXXXX" ON LABEL, FIND NO. 2, IN ACCORDANCE WITH MIL-STD-130.

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ALTERED ITEM DRAWING

FIND NO.	CAGE CODE	DWG SIZE	PART OR IDENTIFYING NO.	QTY REQD	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL
5			MS25036-102	2	TERMINAL, LUG, .138 STUD SIZE, 22-18 AWG		
4			MS25036-106	2	TERMINAL, LUG, .138 STUD SIZE, 16-14 AWG		
3			TYPE P, WAXED, CL 2	AR	TWINE, LACING	MIL-T-713	
2			13228EXXXX	1	LABEL, SELF-LAMINATING		
1			13228EXXXX-13	1	WIRING HARNESS, CONVERTER-LIMITER		

PARTS LIST

CABLE ASSEMBLY,
ELECTRICAL,
CONVERTER W4

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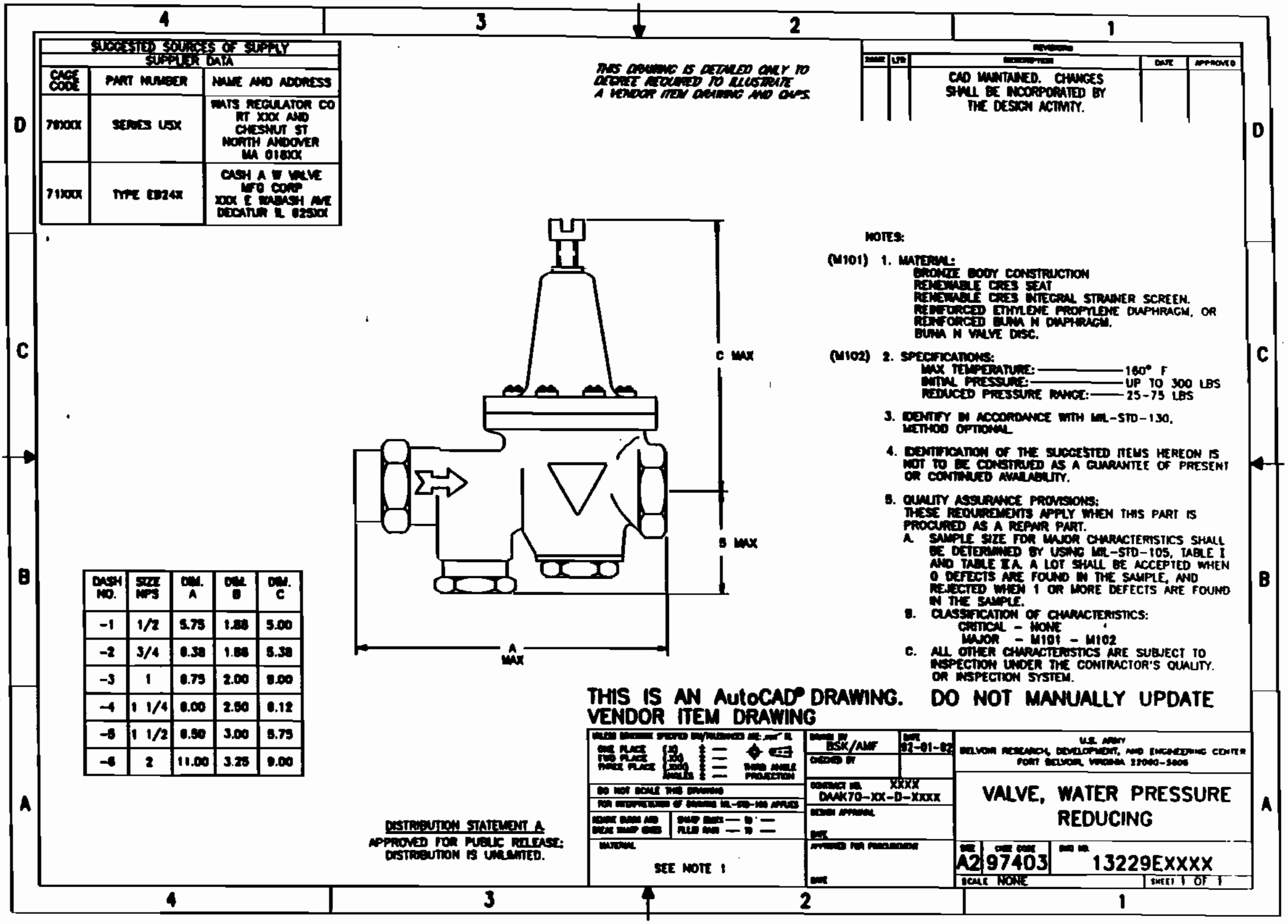
FIGURE III-11. Altered Item Drawing.



SUGGESTED SOURCES OF SUPPLY

SUPPLIER DATA

CAGE CODE	PART NUMBER	NAME AND ADDRESS
79XXX	SERIES U5X	WATS REGULATOR CO RT XXX AND CHESNUT ST NORTH ANDOVER MA 018XX
71XXX	TYPE E824X	CASH A W VALVE MFG CORP XXX E WABASH AVE DECATUR IL 625XX

DASH NO.	SIZE NPS	DIM. A	DIM. B	DIM. C
-1	1/2	5.75	1.88	5.00
-2	3/4	6.38	1.88	5.38
-3	1	6.75	2.00	6.00
-4	1 1/4	8.00	2.50	6.12
-5	1 1/2	8.50	3.00	6.75
-6	2	11.00	3.25	9.00

NOTES:

(M101) 1. MATERIAL:
BRONZE BODY CONSTRUCTION
RENEWABLE CRES SEAT
RENEWABLE CRES INTEGRAL STRAINER SCREEN.
REINFORCED ETHYLENE PROPYLENE DIAPHRAGM, OR
REINFORCED BUNA N DIAPHRAGM.
BUNA N VALVE DISC.

(M102) 2. SPECIFICATIONS:
MAX TEMPERATURE: —————— 160° F
INITIAL PRESSURE: —————— UP TO 300 LBS
REDUCED PRESSURE RANGE: —— 25-75 LBS

3. IDENTIFY IN ACCORDANCE WITH MIL-STD-130, METHOD OPTIONAL.

4. IDENTIFICATION OF THE SUGGESTED ITEMS HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY.

5. QUALITY ASSURANCE PROVISIONS:
THESE REQUIREMENTS APPLY WHEN THIS PART IS PROCURED AS A REPAIR PART.
A. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE IIA. A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE.
B. CLASSIFICATION OF CHARACTERISTICS:
CRITICAL - NONE
MAJOR - M101 - M102
C. ALL OTHER CHARACTERISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY. OR INSPECTION SYSTEM.

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VENDOR ITEM DRAWING

VALVE, WATER PRESSURE REDUCING

DISTRIBUTION STATEMENT A

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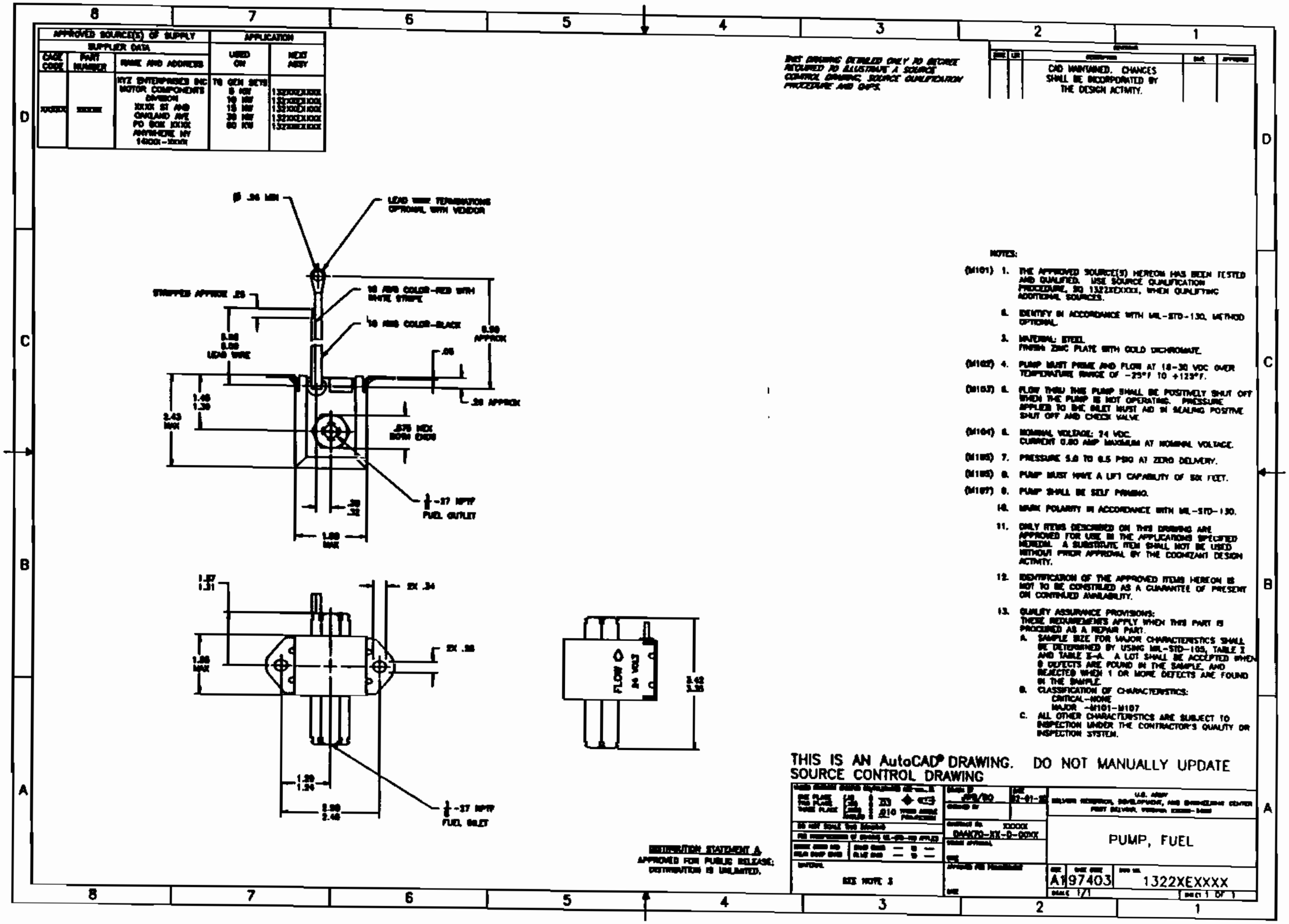
FIGURE III-12. Vendor Item Drawing with QAP Note.



APPROVED SOURCE(S) OF SUPPLY			APPLICATION	
SUPPLIER DATA				
CAGE CODE	PART NUMBER	NAME AND ADDRESS	USED ON	NEXT ASSY
XXXXX	XXXXX	XYZ ENTERPRISES INC MOTOR COMPONENTS DIVISION XXXX ST AND OAKLAND AVE PO BOX XXXX ANYWHERE NY 14XXX-XXXX	TO GEN SETS 5 KW 10 KW 15 KW 30 KW 60 KW	 1322XXXXXXX 1322XXXXXXX 1322XXXXXXX 1322XXXXXXX 1322XXXXXXX

NOTES:

(M101) 1. THE APPROVED SOURCE(S) HEREON HAS BEEN TESTED AND QUALIFIED. USE SOURCE QUALIFICATION PROCEDURE, SQ 1322XEXXXX, WHEN QUALIFYING ADDITIONAL SOURCES.

2. IDENTIFY IN ACCORDANCE WITH MIL-STD-130, METHOD OPTIONAL.

3. MATERIAL: STEEL
FINISH: ZINC PLATE WITH GOLD DICHROMATE.

(M102) 4. PUMP MUST PRIME AND FLOW AT 18-30 VDC OVER TEMPERATURE RANGE OF -25°F TO +125°F.

(M103) 5. FLOW THRU THIS PUMP SHALL BE POSITIVELY SHUT OFF WHEN THE PUMP IS NOT OPERATING. PRESSURE APPLIED TO THE INLET MUST AID IN SEALING POSITIVE SHUT OFF AND CHECK VALVE.

(M104) 6. NOMINAL VOLTAGE: 24 VDC.
CURRENT 0.80 AMP MAXIMUM AT NOMINAL VOLTAGE.

(M105) 7. PRESSURE 5.0 TO 6.5 PSIG AT ZERO DELIVERY.

(M106) 8. PUMP MUST HAVE A LIFT CAPABILITY OF SIX FEET.

(M107) 9. PUMP SHALL BE SELF PRIMING.

10. MARK POLARITY IN ACCORDANCE WITH MIL-STD-130.

11. ONLY ITEMS DESCRIBED ON THIS DRAWING ARE APPROVED FOR USE IN THE APPLICATIONS SPECIFIED HEREON. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR APPROVAL BY THE COGNIZANT DESIGN ACTIVITY.

12. IDENTIFICATION OF THE APPROVED ITEMS HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY.

13. QUALITY ASSURANCE PROVISIONS:
THESE REQUIREMENTS APPLY WHEN THIS PART IS PROCURED AS A REPAIR PART.
A. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE II-A. A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE.
B. CLASSIFICATION OF CHARACTERISTICS:
CRITICAL—NONE
MAJOR —M101-M107
C. ALL OTHER CHARACTERISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY OR INSPECTION SYSTEM.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

SQ 1322XEXXXX
DATE ____________

SAMPLE

SOURCE QUALIFICATION PROCEDURE FOR SOURCE CONTROL DRAWING 1322XEXXXX PUMP, FUEL, ELECTRIC, 24 VOLT

This procedure is approved for use within the US Army Belvoir Research, Development and Engineering Center, Fort Belvoir, VA 22060-5606 (CAGE Code 97403).

1. SCOPE AND PURPOSE

1.1 Scope. This procedure covers qualification of electrically operated in-line fuel pumps for use with 24 Volt (V), direct current (dc) electrical systems on Tactical Quiet (TQ) 5 KW through 60 KW Generator Sets. The guidance contained herein is to be followed prior to and during the process of approving sources of supply for inclusion on source control drawing number 1322XEXXXX (see 6.2).

1.2 Purpose. It is the intent of qualification to provide the Government products of requisite quality, reliability and safety through testing prior to and independent of award of a production contract. Such pretesting is in recognition of the complexity of performance requirements and sensitivity of design or end item application that render it impractical to rely on first article and acceptance testing. Qualifications is intended for use in support of multiple acquisition and repetitive procurement by the Government and associated contractors.

2. APPLICABLE DOCUMENTS

2.1 Specification and Standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, in effect on the date of application for qualification.

SPECIFICATIONS

FEDERAL

TT-S-735	- Standard Test Fluids, Hydrocarbon.
VV-F-800	- Fuel Oil, Diesel.

1

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

SPECIFICATION (cont.)

MILITARY

MIL-T-5624	- Turbine Fuels, Aviation, Grades JP-4 and JP-5.
MIL-T-83133	- Turbine Fuel, Aviation, Kerosene Type, Grade JP-8.

STANDARDS

MILITARY

MIL-STD-100E	- Engineering Drawing Practices.
MIL-STD-462	- Electromagnetic Interference, Measurement of.
MIL-STD-810	- Environmental Test Methods.

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Government drawings. The following Government drawings form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those in effect on the date of application for qualification.

DRAWINGS

1322XEXXXX	- Pump, Fuel.

(Copies of drawings required by contractors in connection with qualification should be obtained from the USA Belvoir Research, Development and Engineering Center, ATTN: STRBE-___), Fort Belvoir, VA 22060-5606.)

3. REQUIREMENTS

3.1 Application for qualification. See MIL-STD-100E, Appendix D, para 50.3.

3.2 Facilities surveys. See MIL-STD-100E, Appendix D, para 50.6.

3.3 Retention of approved source of supply status. See 4.1.3.

3.4 Description. Pumps shall operate on nominal 24 Vdc, negative ground, be self-priming with minimum lift capability of six feet, operate at temperatures between -25 °F to 120 °F, operate on all specified fuels, produce flow rate and pressure as specified and operate without a durability failure for a minimum of 5,040 hours.

3.5 Design and construction. Pumps shall conform to drawing 1322XEXXXX.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

3.6 Performance.

3.6.1 Output. Pump shall output minimum delivery as specified in table I under the following conditions:

a. Minimum 18 VDC to maximum 30 VDC; load current not to exceed 0.8 amperes.
b. Temperature range between -25 °F and 120 °F.
c. While inclined up to 15 degrees from horizontal in any direction.
d. While using diesel fuel conforming to VV-F-800, grades DF-1, DF-2, or DF-A; JP-5 conforming to MIL-T-5624; JP-8 conforming to MIL-T-83133.

TABLE I

GENERATOR SET	MINIMUM DELIVERY (GAL/HR)
5 KW, 60 Hz	.65
5 KW, 400 Hz	.70
10 KW, 60 Hz	1.25
10 KW, 400 Hz	1.35
15 KW, 50/60 Hz	1.35
15 KW, 400 Hz	1.50
30 KW, 50/60 Hz	2.70
30 KW, 400 Hz	3.00
60 KW,-50/60 Hz	5.40
60 KW, 400 Hz	6.00

3.6.2 Storage. The pumps shall not be damaged by exposure to humidity or salt fog without packing.

3.6.3 Endurance. The pumps shall operate a minimum of 5,040 hours without a durability failure (see 6.2.1).

3.6.4 Vibration/shock. The pumps shall not be damaged by exposure to shock and vibration when tested in accordance with 4.5.7 and 4.5.8.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified, the __________ ________ is responsible for the performance of all inspection requirements as specified herein.

4.1.1 Responsibility for compliance. All items must meet all requirements of section 3. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all specified requirements.

4.1.2 Inspection equipment. Unless otherwise specified, the ____________________ is responsible for the provision and maintenance of all inspection equipment. Inspection equipment will be capable of repetitive measurements to an accuracy of 10% of the measurement tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

4.1.3 Retention of qualification. To retain qualification, the contractor shall requalify the product at _______ year intervals. Requalification shall be as specified in 4.4 and 4.5.

4.2 Classification of inspections.

a. Qualification examination (see 4.4.2).
b. Qualification tests (see 4.5).

4.3 Inspection conditions. Unless otherwise specified inspections shall be conducted under the following conditions:

a. Air temperature: 75 ± 18 °F.
b. Barometric pressure: 28.5 + 2 inches mercury.
c. Relative humidity: 50 ± 30%.

4.4 Qualification inspection. Qualification inspection shall be conducted at facilities designated or approved by the Government on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample. For the purpose of qualification, unless otherwise specified, the prospective supplier shall submit seven pump assemblies. The sample units shall be taken at random from a production run and shall be produced with equipment and procedures normally used in production. The sample units shall have been subjected to and passed the requirement of examination (see 4.4.2). Each pump assembly shall be qualified separately.

4.4.2 Examination. All pumps shall be examined to determine conformance to drawing 1322XEXXXX.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

4.4.2.1 Classification of defects. For examination purposes, defects shall be classified as listed in table II.

TABLE II. Classification of defects.

Category	Defect	Method of examination
Critical	None	
Major		
101	Assembly, incomplete	Visual
102	Dimensions affecting interchangeability, out of tolerance	SIE 1/
103	Faulty workmanship affecting performance	Visual
Minor		
201	Dimensions not affecting interchangeability out of tolerance	SIE
202	Identification marking, improper	Visual

1/ SIE = Standard Inspection Equipment.

4.4.3 Tests. Pumps shall be subjected to the test specified in table III, in the order shown:

TABLE III. Qualification Tests.

Sample No.	Test	Paragraph No.
1	Output	4.5.1
	Endurance	4.5.2
	Output	4.5.1
2	Output	4.5.1
	Fuels	4.5.3
	Output	4.5.1
3	Output	4.5.1
	Electromagnetic interference	4.5.4

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

TABLE III. Qualification Tests. - continued

Sample No.	Test	Paragraph No.
4	Output	4.5.1
	Extreme temperature resistance	4.5.5
	Output	4.5.1
5	Output	4.5.1
	Fuel resistance	4.5.6
	Output	4.5.1
6	Output	4.5.1
	Vibration resistance	4.5.7
	Output	4.5.1
	Fungus resistance	4.5.7.1
	Output	4.5.1
7	Output	4.5.1
	Shock resistance	4.5.8
	Output	4.5.1
	Corrosion resistance	4.5.8.1
	Output	4.5.1

4.4.4 Failure. Failure of any pump assembly to pass any of the specified inspections shall be cause for refusal to grant qualification of the item represented.

4.5 Methods of inspection.

4.5.1 Output. The pump shall be tested for output at the minimum voltage of 18 volts (dc) and the maximum voltage of 30 volts (dc). The test fuel shall be diesel fuel, grade DF-2, conforming to VV-F-800. The pump inlet and the test fuel level shall be maintained at the same height within plus or minus two inches. A minimum of five values each of discharge pressure, volume, and current consumption shall be obtained at each voltage setting at fifteen minute intervals. The readings shall be taken at points approximately equidistant between pressure at zero delivery and delivery at zero pressure. All pressure readings shall be taken at the pump outlet. Failure to maintain the minimum delivery volume shall constitute failure of this test.

4.5.2 Endurance. The pump shall be operated as specified in table IV. The test fuel shall be diesel fuel, grade DF-2, conforming to VV-F-800 unless otherwise specified. The pump shall be operated continuously for the total hours indicated for each voltage setting

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

except as necessary to perform required scheduled maintenance or daily PMCS as recommended in the operation manual. Failure of any component or failure of the pump to maintain minimum delivery volume specified in table I shall constitute failure of this test.

TABLE IV. Endurance schedule.

Voltage	Delivery per hour		Time-hours
	Gallons	Liters	
18	0	0	120
	6	22.7	1200
	15	57	1200
30	0	0	120
	6	22.7	1200
	18	68.4	1200

4.5.3 Fuels. The pump shall be operated on each of the fuels specified in 3.6.1 for not less than 8 hours. Verify that the pump operates continuously when the test fuel level is 6 feet below the level of the pump. Verify that the pump operates when inclined at an angle of 15 degrees from horizontal; this test will be repeated for four 15-degree tilts at 90 degree increments, radially. Failure of the pump to continuously operate or deliver the minimum delivery volume specified in table I shall constitute failure of this test.

4.5.4 Electromagnetic interference. The pump shall be tested in accordance with methods CE04 and RE02 of MIL-STD-462. Failure to meet the requirements of UM04 limits for Class 2 equipment as specified in MIL-STD-461 shall constitute failure of this test.

4.5.5 Extreme temperature resistance. The pump shall be mounted on the generator set and operated as specified in 4.5.1, except that the values shall be recorded at -25 °F and 120 °F and the pump shall not be reoperated at 18 VDC at the higher temperature. The test fuels used shall be diesel fuel, grade DF-1 or DF-A, conforming to VV-F-800 for the low temperature test and diesel fuel, grade DF-2 for the high temperature test. Failure of the pump to operate or deliver the minimum volume specified in table I shall constitute failure of this test.

4.5.6 Fuel resistance. The pump shall be subjected to the fuel resistance test specified in table V. Except for the first 48 hours of phase I and phase III testing, the pump shall be operated at rated flow for 2 hours per day.

After being tested, the pump shall evidence no damage or leakage, and shall subsequently continue to deliver the minimum volume specified in table I.

TABLE V. Fuel resistance schedule.

Phase	Period	Medium	Temperature °F + 5°
Phase I soak	168 hours	TT-S-735, type III	75
Phase II dry	4 hours	Air	120
Phase III soak	168 hours	TT-S-735, type III	75
Phase IV dry	4 hours	Air	120

4.5.7 Vibration resistance. The pump shall be mounted on the generator set and assure that mounting is free from resonances over the test frequency range. The generator sets shall be subjected to a simple harmonic motion having an amplitude of ___ inch (___ inch maximum total excursion), the frequency being varied uniformly between the approximate limits of __ and __ Hz. The entire frequency range, from __ to __ Hz and return to __ Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours). After completion of the vibration test, the pump shall be operated as specified in 4.5.1. Failure of the pump to operate as specified in 4.5.1 shall constitute failure of this test.

4.5.7.1 Fungus resistance. The pump shall be subjected to a fungus test in accordance with MIL-STD-810, method 508.4; exposure shall be for 28 days.

4.5.8 Shock resistance. The pump shall be mounted on the generator set and shall be subjected to three sawtooth shock pulses of 25 g at 18 ms duration in each direction along 3 mutually perpendicular axes of the pump (total of 9 shocks). The shock pulse shape shall be in accordance with figure 1 of amplitude and time duration as specified. After completion of the shock test, the pump shall be operated as specified in 4.5.1. Failure of the pump to operate as specified in 4.5.1 shall constitute failure of this test.

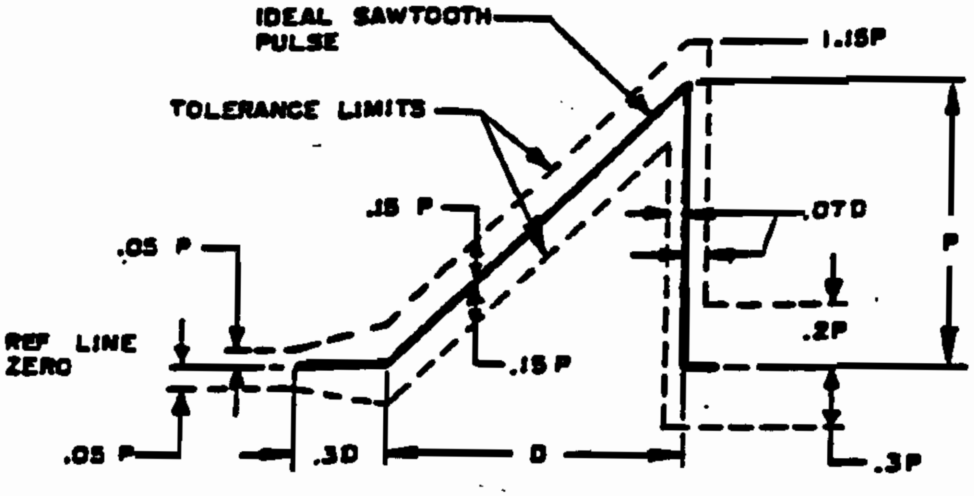


Figure 1. Terminal-peak sawtooth pulse configuration

8

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

4.5.8.1 Corrosion resistance. The pump shall be subjected to salt fog in accordance with MIL-STD-810, method 509.3. The pump shall be subject to two cycles as follows:

24 hours - salt fog exposure
24 hours - standard ambient (drying)

Salt concentration shall be 5 ± 1 percent solution. Any corrosion will be analyzed for both immediate and potential long term effects on proper functioning of the pump.

5. PACKING

Not applicable.

6. NOTES

6.1 Intended use. The pumps are intended for use on TQ-5 KW thru 60 KW generator sets.

6.2 Definitions. The following definitions apply to the text of this document:

6.2.1 Endurance failure. An endurance failure is defined as any malfunction that precludes further operation of the pump.

6.2.2 Qualification. The process by which items to be purchased are tested, prior to any actual procurement action, to ensure the item satisfies the specified requirements.

6.2.3 Source control drawing. A source control drawing provides an engineering description and acceptance criteria for purchased items that require design activity imposed qualification testing and exclusively provides performance, installation and interchangeability specific characteristics required for critical applications. It includes a list of approved manufacturers, the manufacturers' item identifications, and acceptance criteria for items which are interchangeable in specific applications. The source control drawing establishes item identification for the controlled item(s). The approved items and sources listed on a source control drawing are the only acceptable items and sources (ASME Y14.24M).

6.2.4 Sources of supply. For the purposes of this procedure, a manufacturer approved for listing on a source control drawing.

6.2.5 Testing laboratory. A laboratory having facilities to perform the qualification examination and testing. This laboratory may be one of the following:

(1) Government operated or contract laboratory. A laboratory operated by, or under contract to, the Government.

(2) Laboratory not operated or contracted by the Government. A laboratory operated by or having contract with a manufacturer or distributor.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

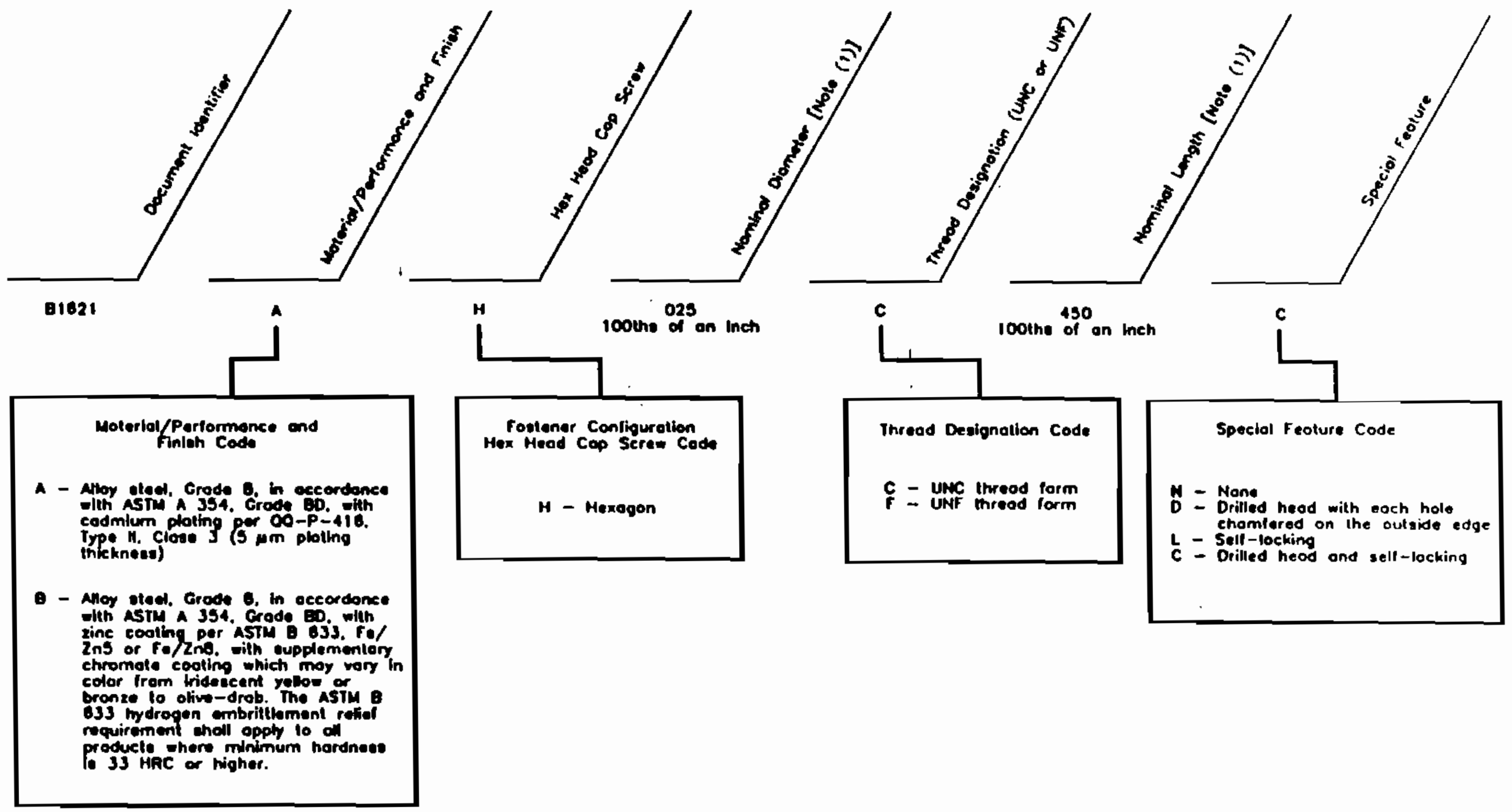
6.3 Qualification and award of contracts. With respect to manufacturers requiring qualification, award of contract will be made only for manufacturing sources which are, prior to the award of contract, approved for inclusion on the applicable drawing whether or not such sources have actually been listed by that date. The attention of potential suppliers is called to this requirement, and manufacturers are urged to arrange qualification per this procedure for those products, they propose to offer the Government, sufficiently in advance in order that they may be eligible to be awarded contracts or orders for the products covered by the applicable drawing.

Information pertaining to approval of manufacturers for inclusion on source control drawings should be obtained from the Belvoir Research, Development and Engineering Center, ATTN: STRBE-___, Fort Belvoir, VA 22060-5606.

FIGURE III-13. Source Control Drawing and Source Qualification Procedure.

PART NUMBERING SYSTEM COVERING STANDARD ITEMS FOR GOVERNMENT USE

NOTE: THE GOVERNMENT ENCOURAGES THE GENERAL USE OF THIS SYSTEM TO ACHIEVE MAXIMUM PARTS STANDARDIZATION.



Material/Performance and Finish Code

A – Alloy steel, Grade 8, in accordance with ASTM A 354, Grade BD, with cadmium plating per QQ-P-416, Type II, Class 3 (5 μm plating thickness)

B – Alloy steel, Grade 8, in accordance with ASTM A 354, Grade BD, with zinc coating per ASTM B 633, Fe/Zn5 or Fe/Zn8, with supplementary chromate coating which may vary in color from iridescent yellow or bronze to olive-drab. The ASTM B 633 hydrogen embrittlement relief requirement shall apply to all products where minimum hardness is 33 HRC or higher.

Fastener Configuration Hex Head Cap Screw Code

H – Hexagon

Thread Designation Code

C – UNC thread form
F – UNF thread form

Special Feature Code

N – None
D – Drilled head with each hole chamfered on the outside edge
L – Self-locking
C – Drilled head and self-locking

EXAMPLE: B1821AH025C450C indicates a screw, cap, hexagon head, made of alloy steel, Grade 8, cadmium plated, 0.250-20 UNC-2A (diameter/threads per inch) UNC Class 2A threads, 4.50 in. in length, with drilled head and self-locking feature.

NOTE:
(1) Round off third number to next higher number if fourth number is five (5) or greater.

FIGURE III-14. Example, Commercial Specification Part Numbering System (ANSI B 18.2.1).

BELVOIR PRODUCIBILITY ENGINEERING AND PLANNING (PEP)/PRODUCTION ENGINEERING (PE)

ACQUISITION MILESTONES AND PHASES (DODI 5000.2)

PHASE 0	PHASE I	PHASE II	PHASE III	PHASE IV
CONCEPT EXPLORATION AND DEFINITION	DEMONSTRATION AND VALIDATION	ENGINEERING AND MANUFACTURING DEVELOPMENT	PRODUCTION AND DEPLOYMENT	OPERATIONS AND SUPPORT
- Acquisition Strategy - Market Surveys - Bread Board Model - Risk Alternative Assessment - Concept Selection	- Preliminary Design - Engineering Verification - Risk Reduction - Brass Board Model - Initial Prototype - Technical Test/User Test I (TT/UT I) - Initial Technical Data Package (TDP)	- Engineering Development Prototype - Technical Test/User test II (TT/ UT II) - Resolve Tradeoffs/Interoperability - Validate TDP for Competitive Procurement - Type Classification (TC)	- Production Proveout - Full Rate Production - Field Support - Follow On Test and Evaluation (FOT&E)	- System provides required capabilities - Identify deficiencies that must be corrected to improve performance
0.1 BEGINNING PEP BY • Appointing production team • Addressing production feasibility and production risks • Identifying manufacturing technology required to reduce production risks • Formulating overall production strategy to achieve a state of production readiness • Design to cost considerations • Begin considering Long Lead Time Items (LLTIs) 0.2 SYSTEM REQUIREMENTS REVIEW (SRR) MIL-STD-1521 • Responsiveness to SOW and system requirements • Producibility Analysis Plans • Producibility and manufacturing considerations: Proprietary processes; critical/scarce and proprietary materials; corrosion prevention and control program implementation • Specialty Discipline Studies • Risk identification and reduction • Significant trade-offs	1.1 CONTINUE PEP BY • Risk addressed at SRR updated • Performing Producibility Analysis • Reducing production risks and assessing production feasibility • Reviewing TDP and updating production requirements to: - Accomplish design producibility - Address manufacturing technology deficiencies - Develop PEP Statement of Work for contract • Evaluate test data vs. PEP • Design to cost considerations 1.2 SYSTEM DESIGN REVIEW (SDR) MIL-STD-1521 • Encompasses total system requirements • Standardization, manufacturing methods and controls, proprietary processes, corrosion prevention and control program processes • TDP producibility problems/solutions • Logistics planning • Adequacy of supporting manufacturing base • Test results	2.1 COMPLETE PEP • Priority is producibility of product design • Perform producibility analysis • Perform Physical Configuration Audit (PCA) • Perform Functional Configuration Audit (FCA) • Define specific PEP contractor tasks • Establish configuration item baseline • Evaluate test data vs. PEP • Design to cost considerations 2.2 PRODUCTION READINESS REVIEW (PRR) DODI 5000.2, PART 6, SECTION O, ATTACHMENT 1 • Readiness of system design for production • Standardization • Make or buy plans • Production planning documentation • Quality Engineering/Quality Assurance Provisions • Logistic planning • Value Engineering (VE) • Government Furnished Property (GFP) • Software organization and compliance • TDP adequacy for producibility • Type Classification-Standard (TC-STD) • Testing • Formal PRR report required 2.3 LOW RATE INITIAL PRODUCTION MAY OCCUR PROVIDED DEVELOPER AND PRODUCER ARE THE SAME	3.1 PRODUCTION ENGINEERING (PE) • Support to Procurement Activity concerning production processes, production equipment-Engineering in Support of Items in Production (ESIP) • Review ECPs • Update TDP to incorporate approved ECPs • Review/grant waivers and deviations • Design to cost considerations • Production Assessment Review (PAR) 3.2 FOR NEW PROCESSES/PRODUCERS • Perform Physical Configuration Audit (PCA) • Pre Production Evaluation (PPE) • First Article Test (FAT)	4.1 PRODUCTION ENGINEERING (PE) • Update TDP

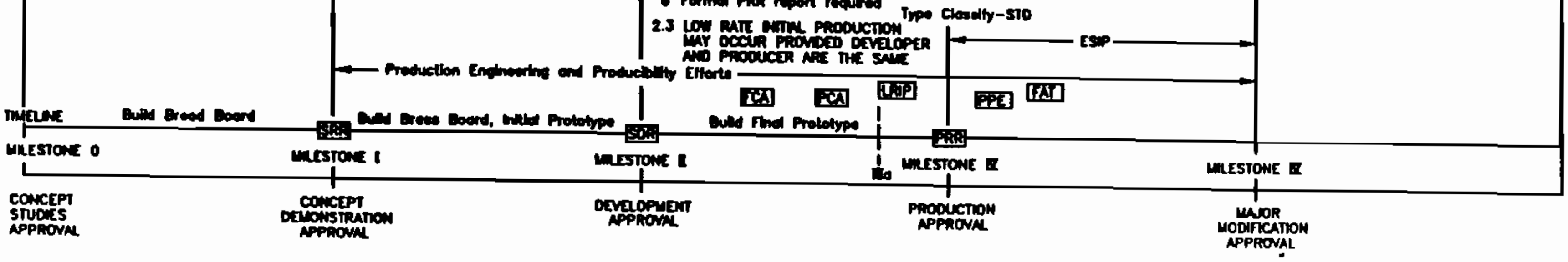


FIGURE V-1. Belvoir PEP/PE Activities.

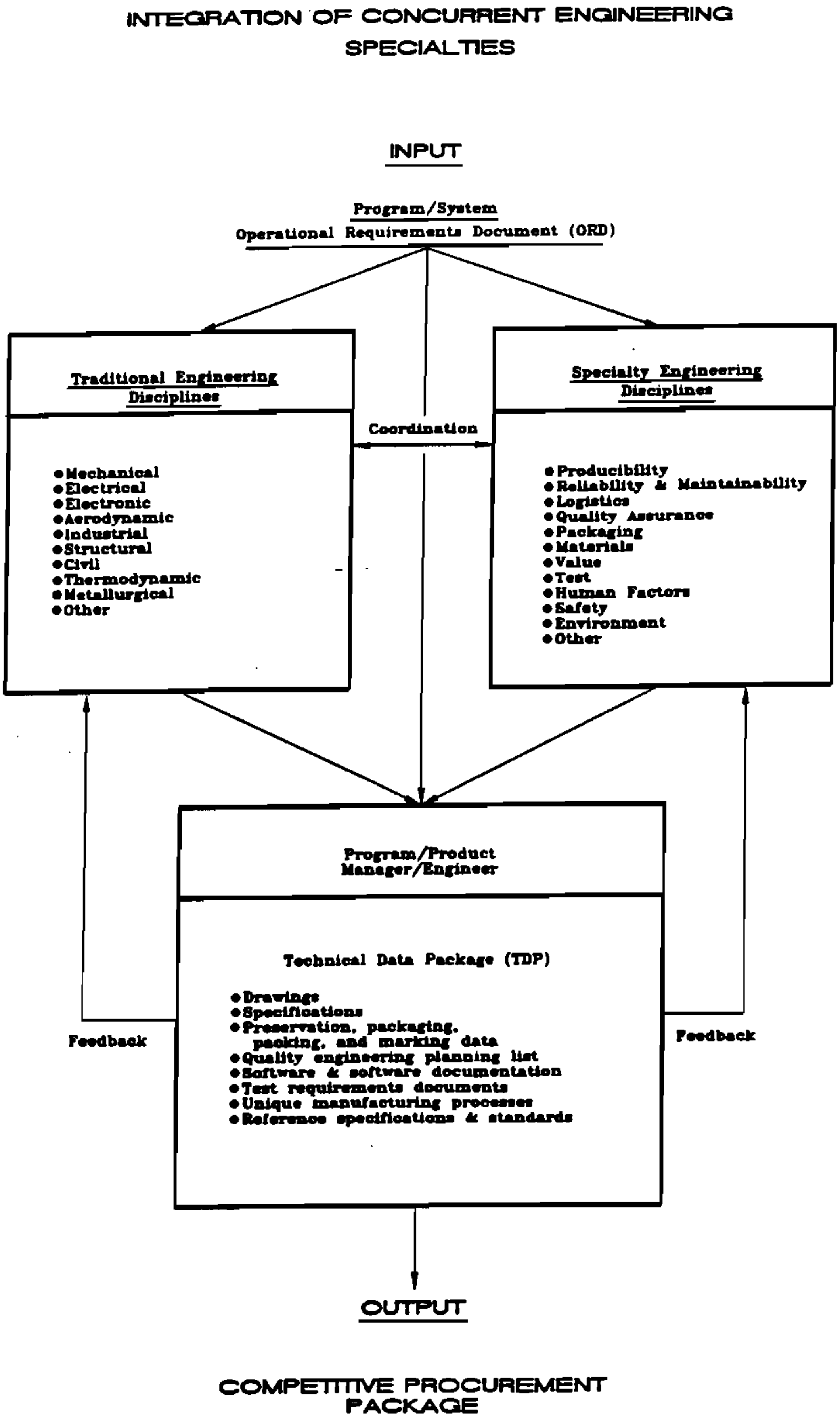


FIGURE VI-1. Integration of Concurrent Engineering Specialties.

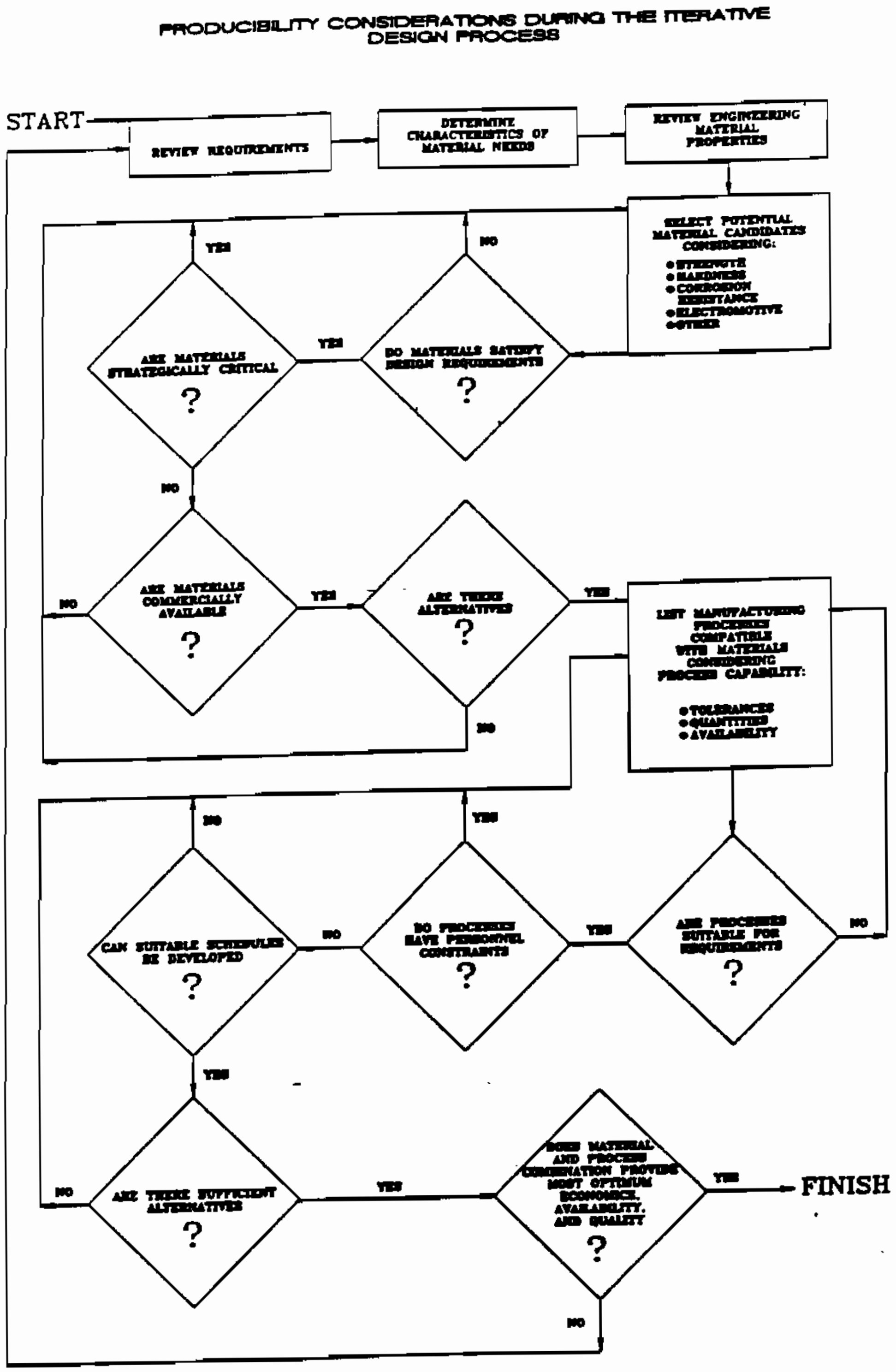
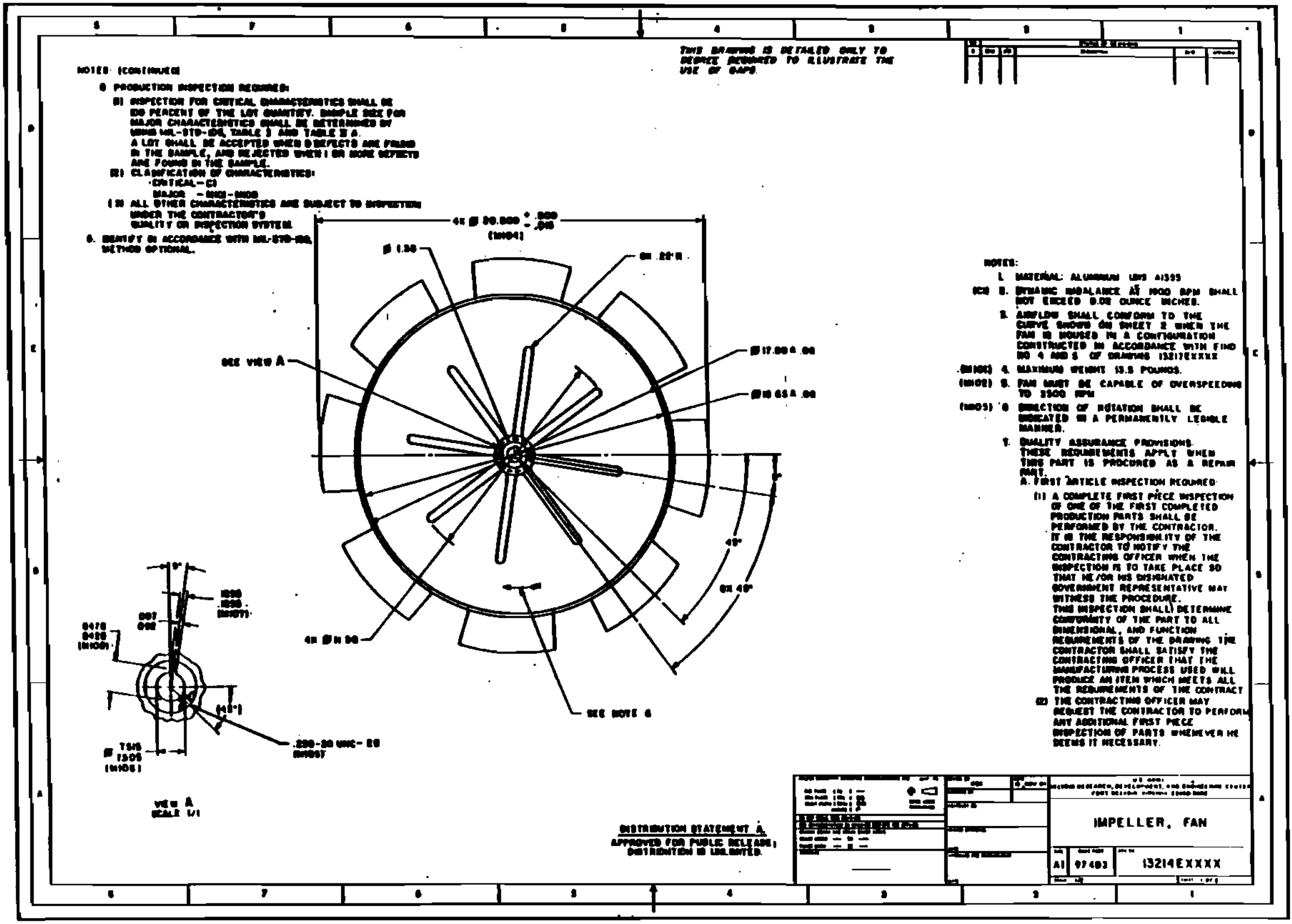


FIGURE VI-2. Producibility Considerations during the Iterative Design Process.



NOTES:

1. MATERIAL: ALUMINUM UNS A1395

(C1) 2. DYNAMIC IMBALANCE AT 1000 RPM SHALL NOT EXCEED 0.02 OUNCE INCHES.

3. AIRFLOW SHALL CONFORM TO THE CURVE SHOWN ON SHEET 2 WHEN THE FAN IS HOUSED IN A CONFIGURATION CONSTRUCTED IN ACCORDANCE WITH FIND NO 4 AND 5 OF DRAWING 13217EXXXX

(M101) 4. MAXIMUM WEIGHT 13.5 POUNDS.

(M102) 5. FAN MUST BE CAPABLE OF OVERSPEEDING TO 3500 RPM

(M103) 6 DIRECTION OF ROTATION SHALL BE INDICATED IN A PERMANENTLY LEGIBLE MANNER.

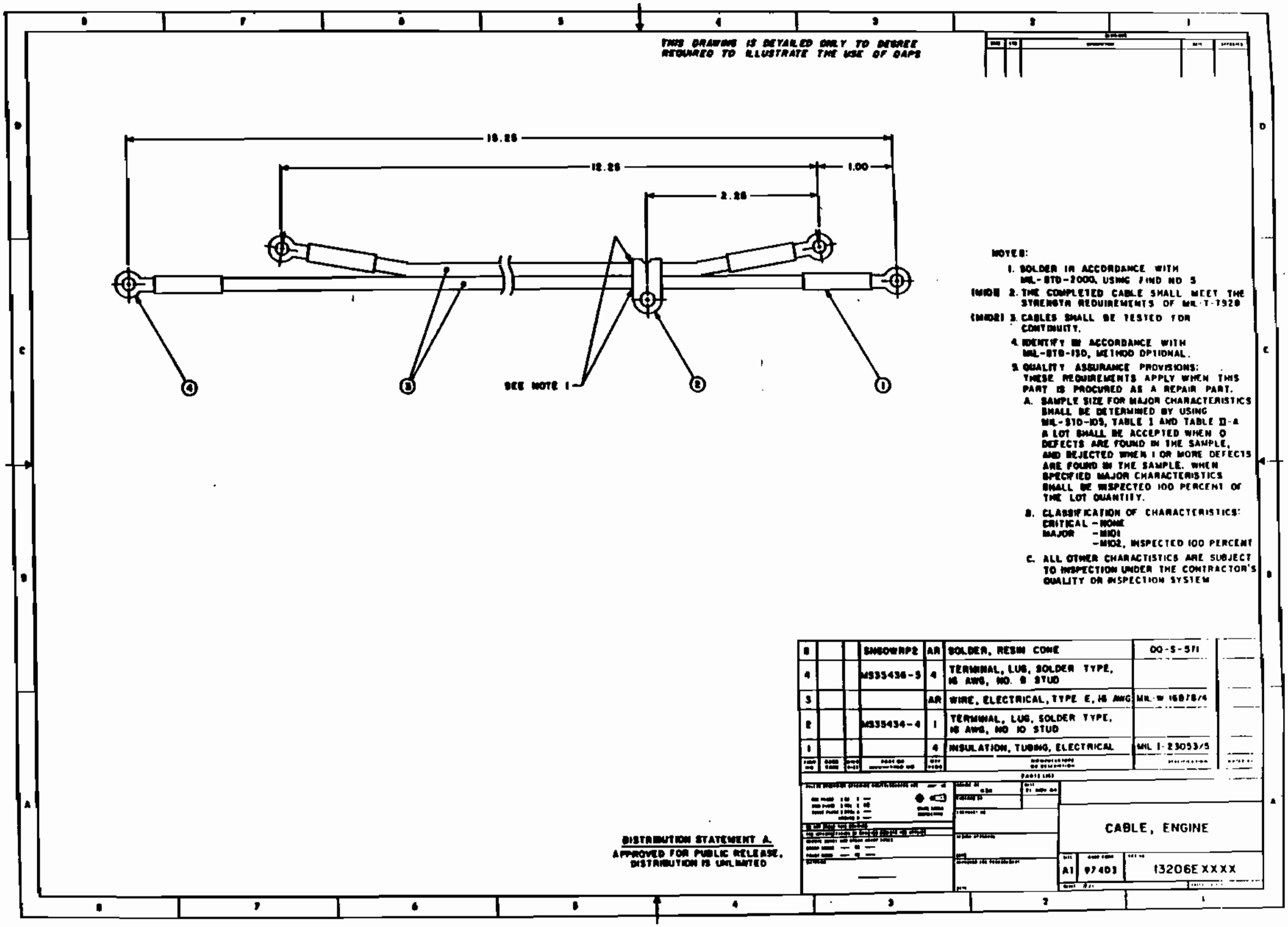
7. QUALITY ASSURANCE PROVISIONS. THESE REQUIREMENTS APPLY WHEN THIS PART IS PROCURED AS A REPAIR PART.
A. FIRST ARTICLE INSPECTION REQUIRED
(1) A COMPLETE FIRST PIECE INSPECTION OF ONE OF THE FIRST COMPLETED PRODUCTION PARTS SHALL BE PERFORMED BY THE CONTRACTOR. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE CONTRACTING OFFICER WHEN THE INSPECTION IS TO TAKE PLACE SO THAT HE/OR HIS DESIGNATED GOVERNMENT REPRESENTATIVE MAY WITNESS THE PROCEDURE. THIS INSPECTION SHALL DETERMINE CONFORMITY OF THE PART TO ALL DIMENSIONAL, AND FUNCTION REQUIREMENTS OF THE DRAWING. THE CONTRACTOR SHALL SATISFY THE CONTRACTING OFFICER THAT THE MANUFACTURING PROCESS USED WILL PRODUCE AN ITEM WHICH MEETS ALL THE REQUIREMENTS OF THE CONTRACT
(2) THE CONTRACTING OFFICER MAY REQUEST THE CONTRACTOR TO PERFORM ANY ADDITIONAL FIRST PIECE INSPECTION OF PARTS WHENEVER HE DEEMS IT NECESSARY.

NOTES (CONTINUED)

8 PRODUCTION INSPECTION REQUIRED:
(1) INSPECTION FOR CRITICAL CHARACTERISTICS SHALL BE 100 PERCENT OF THE LOT QUANTITY. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE II A. A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE.
(2) CLASSIFICATION OF CHARACTERISTICS:
CRITICAL - C1
MAJOR - M101 - M106
(3) ALL OTHER CHARACTERISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY OR INSPECTION SYSTEM.

9. IDENTIFY IN ACCORDANCE WITH MIL-STD-130, METHOD OPTIONAL.

FIGURE VII-1. Example, Impeller with QAP Note.



NOTES:

1. SOLDER IN ACCORDANCE WITH MIL-STD-2000, USING FIND NO 5

(M101) 2. THE COMPLETED CABLE SHALL MEET THE STRENGTH REQUIREMENTS OF MIL-T-7928

(M102) 3. CABLES SHALL BE TESTED FOR CONTINUITY.

4. IDENTIFY IN ACCORDANCE WITH MIL-STD-130, METHOD OPTIONAL.

5. QUALITY ASSURANCE PROVISIONS: THESE REQUIREMENTS APPLY WHEN THIS PART IS PROCURED AS A REPAIR PART.

A. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE II-A A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE. WHEN SPECIFIED MAJOR CHARACTERISTICS SHALL BE INSPECTED 100 PERCENT OF THE LOT QUANTITY.

B. CLASSIFICATION OF CHARACTERISTICS:
CRITICAL - NONE
MAJOR - M101
- M102, INSPECTED 100 PERCENT

C. ALL OTHER CHARACTISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY OR INSPECTION SYSTEM

5			SN60WRP2	AR	SOLDER, RESIN CORE	QQ-S-571
4			MS35436-5	4	TERMINAL, LUG, SOLDER TYPE, 16 AWG, NO. 8 STUD	
3				AR	WIRE, ELECTRICAL, TYPE E, 16 AWG	MIL-W-16878/4
2			MS35434-4	1	TERMINAL, LUG, SOLDER TYPE, 16 AWG, NO 10 STUD	
1				4	INSULATION, TUBING, ELECTRICAL	MIL-I-23053/5

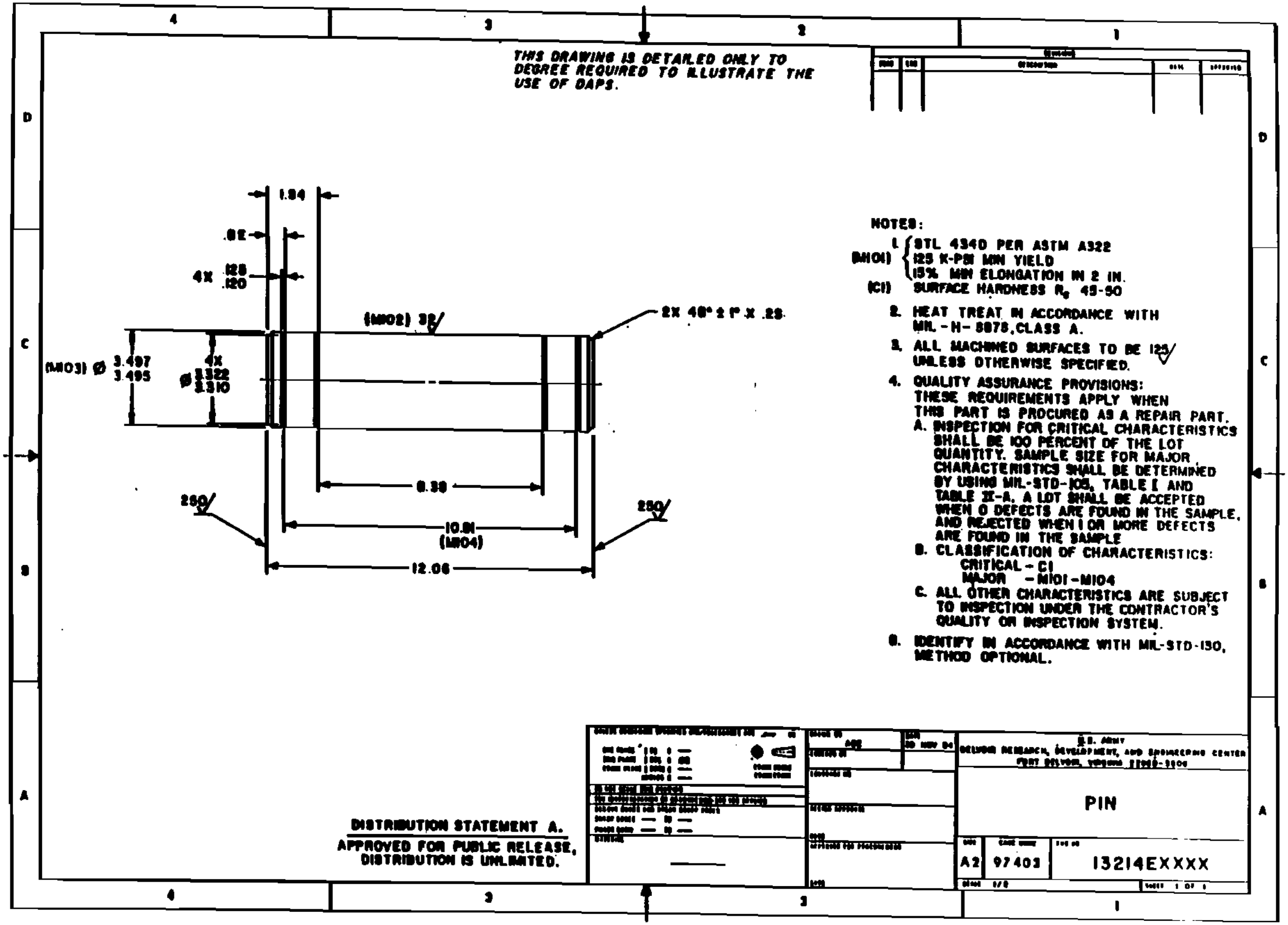
PARTS LIST

CABLE, ENGINE

A1 97403 13206EXXXX

DISTRIBUTION STATEMENT A.
APPROVED FOR PUBLIC RELEASE,
DISTRIBUTION IS UNLIMITED

FIGURE VII-2. Example, Cable with QAP Note.



NOTES:

1. (MI01) STL 4340 PER ASTM A322
125 K-PSI MIN YIELD
15% MIN ELONGATION IN 2 IN.
(C1) SURFACE HARDNESS R_c 45-50

2. HEAT TREAT IN ACCORDANCE WITH MIL-H-6875, CLASS A.

3. ALL MACHINED SURFACES TO BE 125 UNLESS OTHERWISE SPECIFIED.

4. QUALITY ASSURANCE PROVISIONS:
THESE REQUIREMENTS APPLY WHEN THIS PART IS PROCURED AS A REPAIR PART.
   - A. INSPECTION FOR CRITICAL CHARACTERISTICS SHALL BE 100 PERCENT OF THE LOT QUANTITY. SAMPLE SIZE FOR MAJOR CHARACTERISTICS SHALL BE DETERMINED BY USING MIL-STD-105, TABLE I AND TABLE II-A. A LOT SHALL BE ACCEPTED WHEN 0 DEFECTS ARE FOUND IN THE SAMPLE, AND REJECTED WHEN 1 OR MORE DEFECTS ARE FOUND IN THE SAMPLE
   - B. CLASSIFICATION OF CHARACTERISTICS:
     CRITICAL - C1
     MAJOR - MI01 - MI04
   - C. ALL OTHER CHARACTERISTICS ARE SUBJECT TO INSPECTION UNDER THE CONTRACTOR'S QUALITY OR INSPECTION SYSTEM.

5. IDENTIFY IN ACCORDANCE WITH MIL-STD-130, METHOD OPTIONAL.

DISTRIBUTION STATEMENT A.
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FIGURE VII-3. Example, Pin with QAP Note.

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