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SUPERSEDING
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MILITARY SPECIFICATION

INSTALLING AND REMOVAL TOOLS, CONNECTOR ELECTRICAL CONTACT, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for installing and removal tools for use in installing and removing electrical contacts used in connectors and other electrical and electronic components (see 6.1).

1.2 Classification. Installing and removal tools covered by this specification shall be of the following types, classes, and compositions, as specified (see 3.1 and 6.2):

TYPE

- I - Installing tool.
- II - Removal tool.
- III - Combination installing and removal tool.

CLASS

- 1 - Front release of contacts.
- 2 - Rear release of contacts.
- 3 - Side release of contacts.

COMPOSITION

- A - Metal.
- B - Plastic.
- C - Combination metal and plastic.

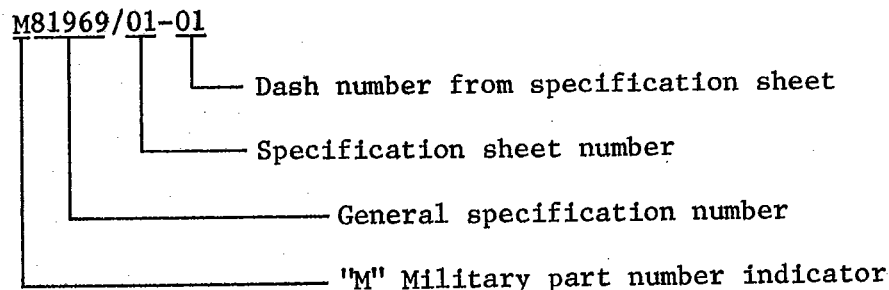
Beneficial comments (additions, deletions, recommendations) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (ESSD) (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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* 1.3 Military part number. The military part number shall consist of the letter "M," the basic number of the specification sheet, and an assigned dash number (see 3.1) as shown in the following:



2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

L-P-392	Plastic Molding Material, Acetal, Injection and Extrusion
L-P-393	Plastic Molding Material, Polycarbonate, Injection and Extrusion
L-P-410	Plastic, Polyamide (Nylon), Rigid: Rods, Tubes, Flats Molded and Cast Parts
L-P-1183	Plastic Molding Material, Acrylonitrile-Butadiene-Styrene (ABS), Rigid
QQ-S-763	Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resisting
PPP-P-40	Packaging and Packing of Hand Tools

Military

MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting.
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys

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SPECIFICATIONS (Continued)

Military (Continued)

MIL-C-22520 Crimping Tools, Terminal, Hand or Power
 Actuated, Wire Terminal, and Tool Kits

See Supplement 1 for list of associated specification sheets.

STANDARDS

Federal

FED-STD-406 Plastics: Method of Testing

Military

MIL-STD-105 Sampling Procedures and Tables for Inspection
 by Attributes

MIL-STD-202 Test Methods for Electronic and Electrical
 Component Parts

MIL-STD-1344 Test Methods for Electrical Connectors

MIL-STD-1646 Servicing Tools for Electric Contacts and
 Connections, Selection and Use of

MIL-STD-45662 Calibration System Requirements

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

* 2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM E18-79 Methods of Test for Rockwell Hardness and
 Rockwell Superficial Hardness of Metallic
 Materials.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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Electronic Industries Association

EIA RS-359 Standard Colors for Color Identification and Coding.

(Application for copies should be addressed to Electronic Industries Associations, 2001 Eye Street, N.W., Washington D.C. 20006.)

* Society of Automotive Engineers

AIR 1351 Manufacturers' Identification of Electrical Connector Contacts, Terminals and Splices.

(Application for copies should be addressed to Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Tools furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.4 and 6.3).

3.3 Materials. Materials shall be as specified herein. However, when a definite material is not specified (see 3.3.1), a material shall be used which will enable the tools to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

* 3.3.1 Metal (aluminum and steel). All aluminum parts shall be anodized in accordance with MIL-A-8625 or equivalent to meet the requirements as specified herein. All steel parts shall be in accordance with QQ-S-763 or equivalent, unless otherwise specified. Aluminum and steel parts shall be corrosion resistant to meet the requirements specified herein. Cadmium plating shall not be used (see 3.1).

* 3.3.2 Plastic. Plastic parts shall be in accordance with L-P-392, L-P-393, L-P-410, L-P-1183, or MIL-M-14 unless otherwise specified.

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3.4 Design and construction. Tools shall be of the design, construction, and physical dimensions specified (see 3.1).

3.4.1 Handles. Metal or plastic handles shall be designed as specified (see 3.1).

3.4.2 Tool tips. All tool tips shall have a smooth finish and round edges. Metal tool tips shall be polished and free from nicks and burrs. Unless otherwise specified (see 3.1), break all sharp edges 0.005 +.0005 radius on metal tool tips.
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3.5 Performance.

3.5.1 Rotation. When tools are tested as specified in 4.6.2.3 or 4.6.2.5, there shall be no cuts or tears on the grommet sealing member, scratching of the contact surface exposing the base metal, and there shall be no evidence of breakage, cracking, chipping or any other damage to the tool that would impair the service function of the tool.

3.5.2 Thrust. When tools are tested as specified in 4.6.2.4 or 4.6.2.5, there shall be no cuts or tears on the grommet sealing member, scratching of the surface exposing the base metal, and there shall be no evidence of breakage, cracking, chipping or any other damage to the tool that would impair the service function of the tool.

3.5.3 Impact strength (tools with plastic probes). When tools are tested as specified in 4.6.3, the minimum impact strength shall be 1-1/2 foot-pounds per inch.

3.5.4 Hardness (tools with metal probes). When tools are tested as specified in 4.6.5, the hardness shall be as specified (see 3.1).

* 3.5.5 Salt spray (corrosion) (compositions A and C only). When tools are tested as specified in 4.6.5, there shall be no evidence of extensive corrosion, or corrosion that could effect the operation of the tool.

* 3.5.6 Durability. When tested as specified in 4.6.2.6, there shall be no evidence of breakage, cracking, chipping, or any other damage to the tool that would impair the service function of the tool. There shall be no overlap or collapse or misalignment of the tool tip.

3.5.7 Plunger force (tools with plunger tips only). When tools are tested as specified in 4.6.6, the operation force shall not exceed the value specified (see 3.1).

* 3.6 Marking. All tools will be color coded as indicated on the individual specification sheet, with the exception of Type III, which will be color coded as indicated below, and the removal tool end of the Type III shall be white.

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Color (per EIA RS-359)	Contact Size
Yellow	23
Green	22 or 23/22
Red	20
Blue	16
Yellow	12
Red	8
Blue	4
Yellow	0
Red	00
Blue	0000

3.6.1 Part number. Tools shall be marked to include the military part number and other marking as specified (see 3.1). Marking shall remain legible after each test.

* 3.6.2 Manufacturer identification. The manufacturer's name or symbol shall be permanently attached to each tool. Location of the identification is optional unless otherwise specified (see 3.1). The symbol must be specified in AIR 1351.

3.7 Workmanship. Tools shall be fabricated, constructed in accordance with the best practice to produce an item free from all defects which would effect proper functioning in service. Particular attention shall be given to freedom from chips, dirt, grit, and other foreign material; also to freedom from defects, burrs, sharp edges, corners, and points.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.1.1 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

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4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202 or MIL-STD-1344 as specified (see 3.1).

* 4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Qualification inspection consists of all applicable tests of this specification.

* 4.4.1 Sample size. Four tools of each size shall be subjected to qualification inspection to assure that all sizes of tools work in applicable military qualified connectors without damaging the connectors, contacts, or tools. The tools shall be divided evenly between test groups 1 and 2.

* 4.4.1.1 Optional sample size. At the discretion of the qualification agent, a modified sampling plan may be approved in lieu of sample sizes specified in 4.4.1.

4.4.2 Inspection routine. The sample shall be subjected to the inspections specified in Table I, in the order shown.

* TABLE I. Qualification inspection.

Inspection	Requirement Paragraph	Method Paragraph	Test Group 1	Test Group 2
Visual and mechanical inspection	3.1, 3.3, 3.4 3.6 and 3.7	4.6.1	X	X
Plunger force (tools with plunger tips only)	3.5.7	4.6.6	X	---
Rotation	3.5.1	4.6.2.3 or 4.6.2.5	X	---
Thrust	3.5.2	4.6.2.4 or 4.6.2.5	X	---
Impact strength (tools with plastic probes)	3.5.3	4.6.3	X	---
Durability	3.5.6	4.6.2.6	---	X
Salt Spray (corrosion) (compositions A and C only)	3.5.5	4.6.5	---	X
Hardness (tools with metal probes)	3.5.4	4.6.4	X	---

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* 4.4.3 Failures. Any failure may be cause for refusal to grant qualification approval.

* 4.4.4 Retention of qualification. To retain qualification, the contractor shall forward to the qualification agent at 36-month intervals a summary of group A results and a group B report. The qualification agent will establish the initial reporting date. The report shall consist of:

a. A summary of the tests performed for inspection of product for delivery, group A, indicating the number of lots that have passed and the number that have failed. The summary shall include the total of tools manufactured in each lot, the total number of tools examined in each lot and the total number of tools rejected in each lot. The results of all reworked lots shall be identified and accounted for.

b. The complete results of tests performed for qualification verification inspection, group B, including the number and mode of failures. The test report shall include results of all qualification verification inspection tests performed and completed during the 36-month period. If the test results indicate nonconformance with specification requirements, and corrective action acceptable to the qualification agent has not been taken, action may be taken to remove the failing product from the Qualified Products List.

Failure to submit the report within 60 days after the end of each 36-month period may result in loss of qualification for the product. The contractor shall immediately notify the qualification agent at any time during the 36-month period that the inspection data (group A or B) indicates failure of the qualified product to meet the requirements of this specification.

4.5 Qualify conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Inspection lot. An inspection lot shall consist of all tools of the same specification sheet produced under essentially the same conditions, and offered for inspections specified in Table II, in the order shown.

4.5.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in Table II, in the order shown.

4.5.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The Acceptable Quality Level (AQL) shall be as specified in Table II. Major and minor defects shall be as defined in MIL-STD-105.

4.5.1.2.2 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

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TABLE II. Group A inspection.

Inspection 1/	Requirement paragraph	Method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination:	3.4	4.6.1	---	---
Material	3.1, 3.3	4.6.1	0.65	---
Finish	3.1, 3.3.1.3	4.6.1	1.5	---
Marking	3.6	4.6.1	---	2.5
Workmanship	3.7	4.6.1	1.0	---

1/ The contractor may use in-process controls for these requirements unrelated to the lot size of finished parts.

4.5.2 Qualification verification inspection. Qualification verification inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 6.3.1), delivery of products which have passed group A shall not be delayed pending the results of these qualification verification inspections.

4.5.2.1 Group B inspection. Group B inspection shall consist of the inspections and tests specified in Table I, in the order shown. Group B inspection shall be made on sample tools which have passed group A inspection.

4.5.2.1.1 Sampling plan. Two tools shall be selected at random from items produced, 36-months after the date of notification of qualification, and each subsequent 36-month period.

4.5.2.1.2 Failures. If any sample fails to pass group B inspection, the entire sample shall be considered to have failed.

4.5.2.1.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract.

4.5.2.1.4 Noncompliance. If a sample fails to pass group B inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has

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been taken, group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group B inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 Packaging inspection. The sampling and inspection of the preservation-packaging, packing and container marking shall be in accordance with the requirements of PPP-P-40.

4.6 Methods of inspection.

4.6.1 Visual and mechanical inspection. Tools shall be examined to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with applicable requirements (see 3.1, 3.3, 3.4, 3.6 and 3.7).

* 4.6.2 Mechanical tests (see 3.5).

4.6.2.1 Connector selection and preparation. Select one military qualified connector with pin contacts. Half of the contacts shall be wired with maximum diameter (O.D.) (see 6.4) wire and half with minimum diameter (O.D.) wire specified in the applicable military connector specification (see 6.4). The contacts shall be crimped on the wire with the applicable MIL-C-22520 crimp tool. For tools used with size 22 contacts, the connector insert shall have the closest contact spacing qualified and the connector shall be divided into four quadrants: Two diagonally opposite quadrants shall be wired with minimum diameter wire and the other two shall be wired with maximum diameter wire. Prior to installing the contacts, the connector and contacts shall be examined per paragraph 4.6.2.2. Install all contacts prior to performing mechanical tests.

* 4.6.2.2 Connector, contact and tool visual examination. The entry way surrounding a connector contact cavity, the surface of the wired contact and the tool shall be examined under three power magnification for damage. The location of any damage shall be noted and described in detail. Untested cavities are recommended but not required.

* 4.6.2.3 Rotation (removal tool) (see 3.5.1). A three pound axial load shall be applied to the tool while in the full removal position. With load applied, the tool shall be rotated 90 degrees clockwise followed by 180 degrees counterclockwise. This test shall be performed 20 times on a contact wired with the maximum diameter (O.D.) wire and 20 times on a contact wired with the minimum diameter (O.D.) wire (see 6.4). A new contact and connector contact cavity for each applicable wire size shall be used on the first and twentieth installing/removal cycles. Visual examination per paragraph 4.6.2.2 shall be performed after the first and twentieth removals.

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- * 4.6.2.4 Thrust (see 3.5.2). For tools designated to insert or remove 22 gage contacts, a three pound axial load shall be applied with the tool in the fully inserted and/or removal position. For all other tool sizes a ten pound axial load shall be applied. The load shall be applied at a rate of one inch/min. This test shall be performed 20 times on a contact wired with the maximum diameter (O.D.) wire and 20 times on a contact wired with the minimum diameter (O.D.) wire (see 6.4). A new contact and connector contact cavity for each applicable wire size shall be used on the first and twentieth installing/removal cycles. Visual examination per paragraph 4.6.2.2 shall be performed after the first and twentieth removals.
- * 4.6.2.5 Combined rotation and thrust (option). The tests per paragraph 4.6.2.3 (Rotation) and 4.6.2.4 (Thrust) may be combined and accomplished at the same time provided that all requirements of both paragraphs are met. The sequence of combined tests shall be:
- a. Insert contact with the insertion tool and apply an axial load of 3 pounds for size 22 and 10 pounds for larger sizes. Remove insertion tool.
 - * b. Insert removal tool and apply an axial load of 3 pounds for size 22 and rotate per paragraph 4.6.2.3. For larger sizes apply an axial load of 10 pounds to the removal tool, back off to 3 pounds and rotate per paragraph 4.6.2.3.
 - * c. Visual examination per paragraph 4.6.2.2 shall be performed after the first and twentieth removals per paragraph 4.6.2.6 and 4.6.2.4.
- * 4.6.2.6 Durability (see 3.5.6). Unless otherwise specified, the installing and/or removal tool shall perform their respective service function 40 cycles for tools with plastic tips and 500 cycles for tools with metal tips. One tool shall be used with contacts wired with maximum diameter (O.D.) wire and the other tool shall be used with contacts wired with minimum diameter (O.D.) wire (see 6.4). For tools with plastic tips, the fortieth cycle shall be performed in an untested cavity. During insertion on the first, tenth, twentieth and fortieth cycle, the plastic tip shall be examined for tip overlap. The metal tools shall be examined after every hundred cycles.
- 4.6.3 Impact strength (tools with plastic probes) (See 3.5.3). Tests shall be performed in accordance with Federal Test Method Standard No. 406, method 1071. Plastic samples shall be prepared from plastic representative of the lot used to fabricate plastic probes.
- * 4.6.4 Hardness (tools with metal probes) (see 3.5.4). Hardness test shall be performed in accordance with ASTM Test Method E18-79. The hardness shall be obtained at each end of probes.
- 4.6.5 Salt spray (corrosion) (composition A and C only) (see 3.5.5). Tools shall be tested in accordance with method 101 of MIL-STD-202. The following detail and exception shall apply:

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a. Test-condition letter - B.

b. Examination after test - Tools shall be examined for evidence of corrosion, pitting, and ease of operation.

4.6.6 Plunger force (tools with plunger tips only) (see 3.5.7).
The operation force shall be measured, using an appropriate gage.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with PPP-P-40. (Until these tools are specifically listed in PPP-P-40, the packaging requirements shown for "crimping tool, terminal" shall be used.)

6. NOTES

6.1 Intended use. The installing and removal tools covered by this specification are intended to install and remove removable electric contacts used in electric connectors and other electric and electronic equipment as specified in MIL-STD-1646.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Title, number and date of the applicable specification sheet, type and size required, and the complete part number (see 1.2 and 3.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the Naval Air Systems Command, Washington, D.C. 20361; however, information pertaining to qualification of products may be obtained from the Naval Avionics Center, Code 714, 6000 East 21st Street, Indianapolis, IN 46218.

* 6.4 Maximum and minimum wire sizes. The maximum and minimum wire sizes shall be the military wires in the applicable military connector specification.

6.5 Repairability. All tools covered by this specification are non-repairable. In plunger type removal tools, the probe and plunger shall be permanently attached to the body of the tool.

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6.6

Cross reference. See Table III.

* 6.7 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

* TABLE III. Cross reference of superseded documents.

Superseded Documents	Superseded By	Superseded Documents	Superseded By
MS3156	MIL-I-81969/1	MS24256A	MIL-I-81969/17
MS3159	MIL-I-81969/30	MS24256R	MIL-I-81969/19
MS3160	MIL-I-81969/16	MS24256RH	MIL-I-81969/19
MS3165	MIL-I-81969/29	MS27495	MIL-I-81969/8
MS3166	MIL-I-81969/14	MS27509	MIL-I-81969/14
MS3167	MIL-I-81969/14	MS27534	MIL-I-81969/14
MS3178	MIL-I-81969/28	MS90455	MIL-I-81969/17
MS3323	MIL-I-81969/2	MS90456	MIL-I-81969/19
MS3342	MIL-I-81969/3	MS90458	MIL-I-81969/3
MS3344	MIL-I-81969/3	MS90459	MIL-I-81969/2
MS3447	MIL-I-81969/14	MS90562	MIL-I-81969/27
MS3448	MIL-I-81969/30	MIL-C-21097/12	MIL-I-81969/7
MS3483	MIL-I-81969/15	MIL-C-21097/18	MIL-I-81969/6
MS14035	MIL-I-81969/31	MIL-C-24308/18	MIL-I-81969/1
MS14036	MIL-I-81969/31	MIL-C-28731/21	MIL-I-81969/13
MS17805	MIL-I-81969/18	MIL-C-28731/22	MIL-I-81969/11
MS17806	MIL-I-81969/20	MIL-C-55302/28	MIL-I-81969/9
MS18137	MIL-I-81969/31	MIL-C-55302/65	MIL-I-81969/12
MS18278	MIL-I-81969/39	MIL-C-55302/66	MIL-I-81868/12
		MIL-C-55302/79	MIL-I-81869/8
		MIL-C-55302/105	MIL-I-81969/5
		MIL-C-55302/106	MIL-I-81969/4
		MIL-C-55302/86	MIL-I-81969/10
		MIL-C-83723/31	MIL-I-81969/14
		MIL-C-83723/32	MIL-I-81969/29
		NAS 1664 Rev 1	MIL-I-81969/14

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Custodians:

Army - CR
Navy - AS
Air Force - 85

Preparing Activity:

Navy - AS
(Project No. 5120-0989)

Review activities:

Army - MI, AR, AT, GL
Navy - EC, SH, OS
Air Force - 11, 17, 99
DLA - ES, ST

User activities:

Army - ME, AV
Navy - MC, YD
Air Force - 19

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