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MILITARY SPECIFICATION

CRIMPING TOOLS, TERMINAL HAND OR POWER ACTUATED, WIRE TERMINATION, AND TOOL KITS 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 crimping tools, inspection gages, and crimping tool kits used for connecting removable contacts (e.g., power, coaxial, shielded, thermocouple, and filter pin contacts), coaxial connectors, ferrules, terminals, end caps, and splices to wire conductors for use in electric connectors, terminal junction systems, and other electric or electronic components (see 3.1 and 6.1).

1.2 Classification. Crimping tools covered by this specification shall be of the following classes and types:

1.2.1 Classes.

Class I - Class I tools shall be hand operated and shall be the only crimping tools to be qualified, procured, and issued for military maintenance use (see 3.2).

Class II - Class II tools are referenced herein for the purpose of noting their existence only (see 6.7).

1.2.2 Types.

Type 1 - Type 1 tools shall be those which produce an indent crimp (see 3.1).

Type 2 - Type 2 tools shall be those which produce a formed crimp (see 3.1).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

QQ-B-526 - Brass, Leaded and Nonleaded: Rod, Shapes, Forgings, and Flat Products With Finished Edges (Bar and Strip).
QQ-C-502 - Copper Rods and Shapes; and Flat Products With Finished Edges (Flat Wire, Strips and Bars).
QQ-W-343 - Wire, Electrical (Uninsulated).
PPP-P-40 - Packaging and Packing of Hand Tools.

MILITARY

MIL-W-5086	-	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy.
MIL-T-7928	-	Terminals, Lug: Splices, Conductor: Crimp Style, Copper, General Specification for.
MIL-A-8625	-	Anodic Coatings, For Aluminum and Aluminum Alloys.
MIL-W-16878	-	Wire, Electrical, Insulated, High Temperature.
MIL-P-19834	-	Plates, Identification or Instruction, Metal Foil, Adhesive Backed, General Specification for.
MIL-F-21608	-	Ferrule, Shield Terminating, Crimp Style.
MIL-W-22759	-	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy.
MIL-C-45662	-	Calibration System Requirements.
MIL-W-81044	-	Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-Imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy.
MIL-W-81381	-	Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy.

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-130	-	Identification Marking of U.S. Military Property.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	-	Standard General Requirements for Electronic Equipment.
MS3190	-	Contact Wire Barrel, Crimp Type.
MS24254	-	Contact-Electrical Connector, Male, Removable.
MS24255	-	Contact-Electrical Connector, Female, Removable.
MS25036	-	Terminal, Lug, Crimp Style, Copper Insulated, Ring Tongue, Bell-Mouthed, Type II, Class I.

See supplement for list of associated specification sheets.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring 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 issue in effect on date of invitation for bids or request for proposal shall apply.

COPPER DIVISION ASSOCIATION, INC. - Copper Alloy No. CA187.

(Application for copies should be addressed to the Copper Division Association, Inc., 405 Lexington Avenue, New York, NY 10017.)

SD-6 - Provisions Governing Qualification.

(Application for copies should be addressed to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.)

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets.

3.1.1 Precedence. In the event of conflict between requirements of this specification and the associated specification sheets, the latter shall govern. In the event of conflict between this specification and the applicable documents (2.), this specification shall govern. The associated specification sheets take precedence over all documents referenced thereon.

3.2 Qualification.

(a) 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 4.3 and 6.3).
(b) Tool kits and contents therein shall meet the requirements of the applicable specifications. Commercial equivalents where military specification items are not available may be substituted provided visual, mechanical, and dimensional requirements are complied with.

3.2.1 Use of military part numbers. Military part numbers shall not be applied to a product, except for qualification test samples (see 6.3), until notification has been received from the activity responsible for qualification that the product has been approved for listing on the qualified products list.

3.2.2 Provisions governing qualification. The provisions governing qualification are specified in SD-6.

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

3.3.1 Finish. Aluminum parts shall be anodized in accordance with MIL-A-8625 or suitable anodizing process to meet the performance requirements specified herein. All other metal parts shall be made of corrosion-resistant material or protected to meet the performance requirements of this specification. Color shall be as specified on the applicable specification sheet. Cadmium plating shall not be used.

3.3.2 Dissimilar metals. When dissimilar metals are employed in intimate contact with each other, suitable protection against electrolytic corrosion shall be provided as specified in requirement 16 of MIL-STD-454.

3.4 Design and construction. Class I tools, tool kits, and in-service inspection gages shall conform to the applicable specification sheet.

3.4.1 Crimping operation.

3.4.1.1 Type 1 tools. All indenters shall be designed to travel with equal and simultaneous movement. When the tool is in the fully opened position, contacts shall pass freely between the indenters, both before and after being crimped. The design of the tool shall also provide for positive closed positioning of the indenters. The indenter closure selector shall have a positive detent at each setting. The tools shall be designed such that a crimp joint conforming to the requirements of this specification can be obtained without positioners or turrets for the range of contacts and wire accepted by the tool (see 3.1 and 6.1.2).

3.4.1.1.1 Contact shift during crimping. The contacts shall not rotate or move axially within the tool as a result of the movement of the tool mechanism or indenters, or during the crimping operation. There shall be no displaced crimp indents on the contact when a second crimp is performed on the contact immediately after the first crimp, and without the operator moving the contact.

3.4.1.2 Type 2 tools. The crimping operation shall be accomplished by a set of dies with the specified configuration (see 3.1). The movement of the opposing crimp dies shall be perpendicular to the mating die face and the fully closed position shall be as specified on the applicable specification sheet.

3.4.1.2.1 Locater. When required (see 3.1), a locating device shall be incorporated on the crimping dies for positioning the item to be crimped in the proper location prior to the initiation of the crimp cycle.

3.4.2 Tool malfunction. The tool shall be provided with a handle and indenter or die return mechanism and a full cycling ratchet mechanism that shall not jam or malfunction if operated with or without a contact, connector, positioner, turret, or die, as applicable. Any tool operation within the scope of this specification shall neither create a jammed mechanism nor impair the function of the tool. Metal particles from operation of the tool or the crimping operation shall not accumulate within the tool where they would contribute to or cause any malfunction of the tool mechanism.

3.4.2.1 Ratchet. The full cycle ratcheting mechanism shall be tamper proof so that it cannot be disengaged prior to or during the crimp cycle.

3.4.3 Removal of crimped parts. The crimped assembly shall be easily removed from the tool upon completion of the crimping operation.

3.4.4 Calibration. Tool calibration adjustments shall be accessible only when the tool is disassembled. These adjustments shall be made only by the manufacturer, or by an approved calibration laboratory.

3.4.5 Gages.

3.4.5.1 Inspection gages. Suitable "GO" and "NO-GO" gages shall be made available by the tool manufacturer for performing the qualification and quality conformance inspection gaging tests specified herein. These gages shall conform to the gaging limits specified on the applicable tool specification sheet.

3.4.5.2 In-service gages. The gages to be supplied to the Government for maintenance use shall be in accordance with the gage specification sheet specified on the applicable tool specification sheet.

3.5 Performance. Tools shall satisfactorily comply with the applicable test requirements of this specification.

(a) Type 1 tools. Type 1 tools covered by this specification shall satisfactorily crimp MS3190, MS24254, and MS24255 wire barrels (made of copper, SAE specification CA187, 1/2 hard) and other electric connector contacts to wires as specified in the applicable specification for the contacts.

(b) Type 2 tools. Type 2 tools covered by this specification shall satisfactorily crimp Class I terminals (MS25036), splices, end caps, and ferrules conforming to MIL-T-7928 and MIL-F-21608, shielded and coaxial contacts, coaxial connectors, and other connecting devices to wires or cables as specified on the applicable specification sheet.

3.5.1 Gaging. Tools shall meet the gaging limits specified on the applicable specification sheet when tested in accordance with 4.7.1.

3.5.1.1 Production gaging. Tools submitted for acceptance shall be gaged to the same limits as tools submitted for qualification approval.

3.5.2 Humidity (steady state). There shall be no damage to basic tools, turrets, positioners, or dies sufficient to impair operation when tested in accordance with 4.7.2.

3.5.3 Handle, indenter, and die return operation (full cycling). The return mechanism shall compel the handles and indenters or dies to automatically return to the fully open position when tested in accordance with 4.7.3. This requirement shall apply regardless of the plane or position of the tool, with or without a wired assembly located in the turret, positioner, or die.

3.5.4 Ratcheting mechanism. The tool shall not bottom and shall not automatically return to the fully open position when tested in accordance with 4.7.4.

3.5.4.1 Type 1 tools. The travel of each indenter between the final ratchet release position and the fully closed position shall not exceed 0.002 inch.

3.5.4.2 Type 2 tools. When tested in accordance with 4.7.4.2, the opposing dies shall meet with no resulting die travel between the final ratchet release and the fully closed position. The force required to release the ratchet mechanism shall not be less than 10 pounds nor more than 50 pounds.

3.5.5 High compression force. The tool shall conform to the gaging requirement of 3.5.1, after being subjected to a 150-pound compression force in accordance with 4.7.5.

3.5.6 Compression force. The crimping force shall not exceed the value specified on the applicable specification sheet when tested in accordance with 4.7.6.

3.5.7 Deformation of crimped connection.

3.5.7.1 Type 1 tools. The out-of-roundness of the crimped wire barrel shall not exceed the specified maximum diameter of the barrel by more than 0.002 inch for sizes smaller than size 20 or by more than 0.006 inch for size 20 and larger wire barrels when measured as specified in 4.7.7.1.

3.5.7.2 Type 2 tools. The crimped connection shall exhibit sufficient symmetry to assure the item's intended function when examined as specified in 4.7.7.2.

3.5.8 Cracking of crimped connection. There shall be no evidence of cracks penetrating the plating (or insulation, if applicable) and exposing the basis metal as a result of crimping when inspected as specified in 4.7.8.

3.5.9 Axial concentricity (straightness).

3.5.9.1 Type 1 tools. The axial concentricity of crimped contacts shall not exceed 0.012 inch total indicator reading (TIR) for sizes 12 and 16 contacts, and 0.011 inch TIR for size 20 and smaller contacts, when measured as specified in 4.7.9.1. This includes the maximum 0.005 inch TIR permitted the contact during its manufacture (see 3.1).

3.5.9.2 Type 2 tools. The crimped wire assembly shall exhibit sufficient straightness to assure the item's intended function when examined as specified in 4.7.9.2.

3.5.10 Voltage drop. The voltage drop across the crimp joint shall not exceed the value specified in table I or the applicable specification for each wired assembly when tested as specified in 4.7.10.

3.5.11 Tensile strength. The wire shall not break at, or pull out of the crimped joint, and the connection shall not break or become distorted to the extent that it is unfit for further use before the minimum tensile strength is reached as specified in table I or the applicable specification when tested in accordance with 4.7.11.

TABLE IA. Voltage drop and tensile strength (type 1 tools).

Wire barrel size	Wire size range	Test current (amps)	Maximum voltage drop (milli-volts)	Minimum tensile strength (pounds)			
				Silver- or tin-plated copper wire		Nickel-plated copper wire	
				Initial	After low temp. crimp	Initial	After low temp. crimp
12	12	23.0	3.0	110.0	93.0	100.0	85.0
	14	17.0	3.5	70.0	61.0	60.0	53.0
16	16	13.0	3.5	50.0	45.0	37.0	33.0
	20	7.5	4.0	20.0	14.0	19.0	13.0
20	20	7.5	4.0	20.0	14.0	13.0	9.0
	24	3.0	4.0	8.0	5.0	6.0	4.0
22	22	5.0	4.0	12.0	7.0	8.0	5.0
	26	2.0	4.0	5.0	4.0	3.0	2.5
24	24	3.0	4.0	8.0	5.0	5.0	3.0
	28	1.5	5.0	3.0	1.5	2.0	1.0
26	26	2.0	4.0	4.5	2.3	2.8	1.4
	30	1.0	6.0	1.5	0.8	1.5	0.8
28	28	1.5	5.0	2.7	1.4	1.7	0.9
	32	0.5	8.0	1.0	0.5	1.0	0.5

TABLE IB. Voltage drop and tensile strength (type 2 tools).

Terminal and splice size	Wire size range	Test current (amps)	Maximum voltage drop -- millivolt drop of equivalent length of wire plus this value		Minimum tensile strength (pounds)
			Terminal	Splice	
12-10	10	55.0	1	2	150.0
	12	41.0	1	2	110.0
16-14	14	32.0	1	2	70.0
	16	22.0	1	2	50.0
22-18	18	16.0	1	2	38.0
	22	9.0	1	2	15.0
24-20	20	11.8	2	4	19.0
	24	4.5	2	4	10.0
26-24	24	4.5	2	4	10.0
	26	3.0	3	6	7.0

3.5.12 Dielectric strength (type 2 tools) (when applicable, see 3.1). The insulation on terminals, splices, and ferrules shall show no evidence of damage, arcing, or breakdown when tested in accordance with 4.7.12.

3.5.13 Low temperature crimp. There shall be no binding of the tool handles, indenters, dies, or crimped wired assemblies when tested as specified in 4.7.13. The wired assemblies shall then meet the requirements of 3.5.10 and 3.5.11.

3.5.14 Shock. Crimping tools, turrets, positioners, or dies shall not be damaged as a result of the shock test of 4.7.14.

3.5.15 Life.

3.5.15.1 Type 1 tools. The tool shall be subjected to 200,000 crimping cycles in accordance with 4.7.15.1. The wired contacts crimped during the life test shall meet the requirements of 3.5.10 and 3.5.11. The tool shall meet the in-service requirements of 3.5.1 and the requirements of 3.5.3 and 3.5.4.

3.5.15.2 Type 2 tools. The tool shall be subjected to 25,000 crimping cycles in accordance with 4.7.15.2. The wired assemblies crimped during the life test shall meet the requirements of 3.5.10 and 3.5.11. The tool shall meet the in-service requirements of 3.5.1 and the requirements of 3.5.3 and 3.5.4.

3.5.16 Salt spray (corrosion). There shall be no damage to basic tools, turrets, positioners, or dies sufficient to impair operation when tested in accordance with 4.7.16.

3.6 Marking. All marking shall be in accordance with MIL-STD-130 and shall be permanently legible.

3.6.1 Nameplates and data plates. Nameplates and data plates on tools and tool kits, shall be marked with information in accordance with the applicable specification sheets. The plates shall be 0.003 to 0.005 inch thick aluminum foil in accordance with MIL-P-19834 and shall be permanently mounted. Marking shall be black on a light background.

3.6.1.1 Type 1 tools. Nameplates and data plates shall be of such size that they cover no more than 350 degrees of the turret and shall be readable in the same direction as the selector knob without inverting the tool (see figure 1).

3.6.1.2 Type 2 tools. Nameplates and data plates shall be as specified on the applicable specification sheet.

3.6.2 Tool kits. Contents charts and instruction sheets shall be white vinyl or equivalent with black lettering. The lettering shall be protected with a transparent coating.

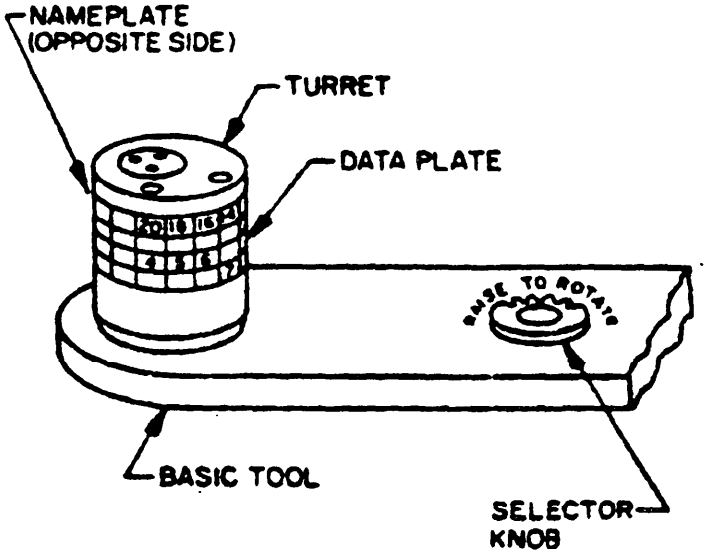


FIGURE 1. Orientation of nameplates and data plates on turrets.

3.6.3 Direct markings. Basic tools, turrets, positioners, dies, and gages shall be directly marked with information in accordance with the applicable specification sheet. Military part numbers shall be permanently engraved on the dies and gages.

3.7 Workmanship. Basic tools, turrets, positioners, dies, gages, and tool kits shall meet all design dimensions and requirements of this specification. The tools and tool cases shall contain no sharp edges, burrs, or other features which are potential personal hazards to the operator during normal usage.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, u less 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 equipment and inspection facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government. Calibration of the standards which control the accuracy of inspection equipment shall comply with MIL-C-45662.

4.2 Classification of inspection. The inspection of tools shall be classified as follows:

(a) Qualification inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall consist of subjecting the qualification test samples specified in 4.3.1 to the applicable examinations and tests of table II, in the sequence shown.

4.3.1 Qualification test samples. The test samples shall consist of the following:

4.3.1.1 Type 1 tools.

(a) Two of the same part numbered basic tools and turrets or positioners for which qualification is desired shall be tested except only one basic tool shall be subjected to the life test (see 4.7.15.1). This admits qualification approval of both the basic tool and the turret or positioner tested.
(b) After approval of items in (a), qualification approval of additional dash numbered turrets or positioners shall be obtained by testing two of each additional turret or positioner with two previously qualified basic tools.
(c) Qualification approval of turrets or positioners alone shall be obtained by testing two of each dash numbered turret or positioner with two previously qualified basic tools.

4.3.1.2 Type 2 tools.

(a) Two of the same part numbered basic tools and dies for which qualification is desired and two sets of dies specified on the applicable specification sheet shall be tested except only one basic tool shall be subjected to the life test (see 4.7.15.2). This admits qualification approval of both the basic tool and the dies tested.

TABLE II. Qualification inspection.

Examination or test	Requirement paragraph	Test paragraph	Type 1		Type 2	
			Basic tools (4.3.1.1(a))	Turrets or positioners (4.3.1.1(b) and (c))	Basic tools (4.3.1.2(a))	Dies (4.3.1.2(b) and (c))
Visual and mechanical examination	3.1, 3.3, 3.3.1, 3.3.2, 3.4, 3.6, 3.6.1, 3.6.2, 3.6.3, 3.7	4.5	X	X	X	X
Inspection gaging	3.5.1	4.7.1.1	X	X	X	X
Humidity (steady state)	3.5.2	4.7.2	X	--	X	--
In-service gaging	3.5.1	4.7.1.2	X	X	X	X
Handle, indenter, and die return operation (full cycling)	3.5.3	4.7.3	X	--	X	--
Ratcheting mechanism	3.5.4	4.7.4	X	--	X	--
High compression force	3.5.5	4.7.5	X	--	X	--
Compression force	3.5.6	4.7.6	X	--	X	--
Deformation of crimped connection	3.5.7	4.7.7	X	X	X	X
Cracking of crimped connection	3.5.8	4.7.8	X	X	X	X
Axial concentricity (straightness)	3.5.9	4.7.9	X	X	X	X
Voltage drop	3.5.10	4.7.10	X	X	X	X
Tensile strength	3.5.11	4.7.11	X	X	X	X
Dielectric strength	3.5.12	4.7.12	--	--	X 1/	X 1/
Low temperature crimp	3.5.13	4.7.13	X	--	X	--
Compression force	3.5.6	4.7.6	X	--	X	--
Voltage drop	3.5.10	4.7.10	X	--	X	--
Tensile strength	3.5.11	4.7.11	X	--	X	--
Shock	3.5.14	4.7.14	X	--	X	--
In-service gaging	3.5.1	4.7.1.2	X	--	X	--
Handle, indenter, and die return operation (full cycling)	3.5.3	4.7.3	X	--	X	--
Ratcheting mechanism	3.5.4	4.7.4	X	--	X	--
Life	3.5.15	4.7.15	X	--	X	--
Voltage drop	3.5.10	4.7.10	X	--	X	--
Tensile strength	3.5.11	4.7.11	X	--	X	--
Salt spray (corrosion)	3.5.16	4.7.16	X	--	X	--
In-service gaging	3.5.1	4.7.1.2	X	--	X	--
Handle, indenter, and die return operation (full cycling)	3.5.3	4.7.3	X	--	X	--
Ratcheting mechanism	3.5.4	4.7.4	X	--	X	--
Visual and mechanical examination	3.1, 3.3, 3.3.1, 3.3.2, 3.4, 3.6, 3.6.1, 3.6.2, 3.6.3, 3.7	4.5	X	X	X	X

1/ When applicable (see 3.1).

(b) After approval of items in (a), qualification approval of additional dash numbered dies shall be obtained by testing two of each additional die with two previously qualified basic tools.
(c) Qualification approval of dies alone shall be obtained by testing two of each dash numbered die with two previously qualified basic tools.

4.3.2 Qualification rejection. There shall be no failures during any examination or test of the basic tools, turrets, positioners, or dies submitted for qualification tests (see 3.2).

4.3.3 Retention of qualification. To retain qualification, the supplier shall forward to the qualifying activity at 18-month intervals a summary of group A. At 36-month intervals a group B report shall be submitted. The qualifying activity will establish the initial reporting date. The report shall consist of:

(a) A summary of the results of the tests performed for inspection of product for delivery, group A, indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests 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 qualifying activity 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. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 36-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during three consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product from each group, as defined by 4.3 to testing in accordance with the qualification inspection requirements.

4.4 Quality conformance inspection.

4.4.1 Groups A and B inspection. Quality conformance inspection shall consist of the following:

(a) Group A inspection (lot by lot) (see 4.4.2).
(b) Group B inspection (periodic) (see 4.4.3).

4.4.2 Group A inspection. Before acceptance, tools shall be selected in accordance with MIL-STD-105, inspection level S-4. The tools shall be subjected to the examinations and tests in the sequence specified in table III, and have an acceptable quality level of 1.0 percent defective. Delivery of products which have passed the group A inspection shall not be delayed pending the results of the group B inspection. Group A rejection and reinspection shall be in accordance with the procedures of MIL-STD-105.

4.4.2.1 Disposition of group A samples. Tools which have passed all the group A inspection may be delivered on the contract or purchase order if the lot is accepted and the sample units are still within specified tolerances.

TABLE III. Group A inspection.

Examination or test	Requirement paragraph	Test paragraph	Type 1		Type 2	
			Basic tools	Turrets or positioners	Basic tools	Dies
Visual and mechanical examination	3.1, 3.3, 3.3.1, 3.3.2, 3.4, 3.6, 3.6.1, 3.6.2, 3.6.3, 3.7	4.5	X	X	X	X
Inspection gaging	3.5.1	4.7.1.1	X	X	X	X
Handle, indenter, and die return operation (full cycling)	3.5.3	4.7.3	X	--	X	--
Ratcheting mechanism	3.5.4	4.7.4	X	--	X	--
High compression force	3.5.5	4.7.5	X	--	X	--
Deformation of crimped connection	3.5.7	4.7.7	X	X	X	X
Axial concentricity (straightness)	3.5.9	4.7.9	X	X	X	X
Tensile strength	3.5.11	4.7.11	X	X	X	X

4.4.3 Group B inspection. A periodic inspection shall be made at 36-month intervals from the date of the letter of notification of the tool's acceptability for qualification. Group B inspection shall consist of the examinations and tests performed in the sequence specified in table IV on one sample unit selected from inspection lots which have passed the group A inspection. Group B rejection and reinspection shall be in accordance with the procedures of MIL-STD-105.

4.4.3.1 Disposition of group B samples. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.

TABLE IV. Group B inspection.

Examination or test	Requirement paragraph	Test paragraph	Type 1		Type 2	
			Basic tools	Turrets or positioners	Basic tools	Dies
In-service gaging	3.5.1	4.7.1.2	X	X	X	X
Compression force	3.5.6	4.7.6	X	--	X	--
Deformation of crimped connection	3.5.7	4.7.7	X	X	X	X
Cracking of crimped connection	3.5.8	4.7.8	X	X	X	X
Axial concentricity (straightness)	3.5.9	4.7.9	X	X	X	X
Voltage drop	3.5.10	4.7.10	X	X	X	X
Tensile strength	3.5.11	4.7.11	X	--	X	--
Low temperature crimp	3.5.13	4.7.13	X	--	X	--
Compression force	3.5.6	4.7.6	X	--	X	--
Voltage drop	3.5.10	4.7.10	X	--	X	--
Tensile strength	3.5.11	4.7.11	X	--	X	--
Shock	3.5.14	4.7.14	X	--	X	--
In-service gaging	3.5.1	4.7.1.2	X	--	X	--
Handle, indenter, and die return operation (full cycling)	3.5.3	4.7.3	X	--	X	--
Ratcheting mechanism	3.5.4	4.7.4	X	--	X	--
Visual and mechanical examination	3.1, 3.3, 3.3.1, 3.3.2, 3.4, 3.6, 3.6.1, 3.6.2, 3.6.3, 3.7	4.5	X	X	X	X

4.4.4 Inspection of preparation for delivery. Packaging inspection shall be in accordance with PPP-P-40.

4.5 Visual and mechanical inspection. The tools, tool kits, accessories, piece parts, and tool gages shall be examined to ensure conformance with requirements of this specification and the applicable detail documents not covered by the performance requirements of 3.5. In-process controls of component parts, unrelated to lot sizes of finished tools, may be utilized in lieu of examination of these components in the finished tools to assure conformance of these component parts. Examination in a continuing manner shall be performed to assure compliance with the following requirements:

(a) Applicable specification sheet (see 3.1).
(b) Materials (see 3.3).
(c) Finish (see 3.3.1 and 3.3.2).
(d) Design and construction (including dimensions) (see 3.4).
(e) Marking (see 3.6, 3.6.1, 3.6.2, and .6.3).
(f) Workmanship (see 3.7).

4.6 Standard conditions for inspection. Unless otherwise specified herein, all inspections required by this specification shall be made under the following conditions:

Temperature: 15° to 35°C (59° to 95°F).
Relative humidity: 20 to 80 percent.
Barometric pressure: 550 to 800 millimeters of mercury.

4.6.1 Wired assemblies. Wired assemblies crimped during the tests specified in 4.7 shall be made with suitable lengths of silver-, tin-, or nickel-plated wire conforming to MIL-W-5086, MIL-W-16878, MIL-W-22759, MIL-W-81044, MIL-W-81381, or as specified on the associated specification sheet (see 3.1).

4.7 Test methods.

4.7.1 Gaging. Activate the tool to the fully closed position. The "GO" gage shall be freely inserted in the space between the opposing closed indenters or dies of the tool. With the "GO" pin in this position, the pressure on the tool handles shall be released, and the tool shall automatically return to its fully open position. Close the tool to the fully closed position. The "NO-GO" pin of the gage shall not be insertable between the opposing indenters or dies of the tool.

4.7.1.1 Inspection gaging. Indenter or die closures shall be tested with the inspection gages specified in 3.4.5.1 and shall meet the requirements of 3.5.1.

4.7.1.2 In-service gaging. Indenter or die closures shall be tested with the in-service gage specified in 3.4.5.2, or with the manufacturer's equivalent inspection gage, and shall meet the requirements of 3.5.1.

4.7.2 Humidity (steady state). The basic tool, with its turret, positioner, or die installed shall be exposed to steady state humidity in accordance with method 103, condition A of MIL-STD-202. The basic tool and turret, positioner, or die shall meet the requirements of 3.5.2.

4.7.3 Handle, indenter, and die return operation (full cycling). Activate the tool to the fully closed position without a wired assembly in the tool and then release hand pressure from the tool. Repeat several times.

4.7.3.1 Type I tools. Operate the tool again to make up 20 wired assemblies for each contact size and wire plating accommodated by the tool and turret or positioner under test. Ten of these shall be made with the largest size wire accommodated by the contact as specified in Table IA and 10 with the smallest size wire. The three wired assemblies made up as specified in 4.7.6.1 may be considered as being included in the total number specified above. Upon completion of each operation of the tool and release of the applied pressure, the tool shall meet the requirements of 3.5.3.

4.7.3.2 Type 2 tools. Operate the tool again to make up 20 wired assemblies each of the largest and smallest size shielded (or coaxial) contact, terminal, splice, or ferrule accommodated by each cavity of the die under test. The wire or cable used, and the method of assembly shall be as specified in the applicable specification or specification sheet. Ten assemblies each shall be made with the largest and smallest size wire or cable accommodated by the item to be crimped. When only 1 wire or cable is shown, make up 10 samples for each item. The wired terminal and splice assemblies made up as specified in 4.7.6.2 may be considered as being included in the total number specified above. Upon completion of each operation of the tool and release of the applied pressure, the tool shall meet the requirements of 3.5.3.

4.7.4 Ratcheting mechanism. Close the tool on the "NO-GO" pin of the inspection gage specified on the applicable specification sheet until a gentle positive force is exerted by the indenters on the gage pin. CAUTION: DO NOT CRIMP THE GAGE. When the operator's hand pressure is released, the tool shall meet the requirements of 3.5.4.

4.7.4.1 Type 1 tools. The travel of each indenter between final ratchet release position and the fully closed position shall meet the requirements of 3.5.4.1.

4.7.4.2 Type 2 tools. A measurable compression force shall be exerted on the handles of the tool, 1.25 ±0.125 inches from the extremities of the handles. Without crimping a wired assembly, the force required to release the ratcheting mechanism and the travel of the opposing crimp dies shall meet the requirements of 3.5.4.2.

4.7.5 High compression force. A compression force shall be exerted on the handles of the tool, 1.25 ±0.125 inches from the extremities of the handles at a rate of approximately 5 pounds per second until a force of 150 pounds is reached. The force shall be applied while crimping the largest size contact, terminal, splice, or ferrule accommodated by the basic tool, to the largest size wire or cable specified for it. The 150-pound force shall be continuously applied for a 30 second duration. The tool shall then be tested in accordance with 4.7.1.1 and shall meet the requirements of 3.5.5.

4.7.6 Compression force.

4.7.6.1 Type 1 tools. The tool shall be mounted such that a measurable compression force can be exerted on the handles, 1.25 ±0.125 inches from the extremities of the handles. Three contacts with the largest size wire barrel accommodated by the basic tool shall be crimped to the largest size wire specified for them. The force necessary to make the crimps shall meet the requirements of 3.5.6.

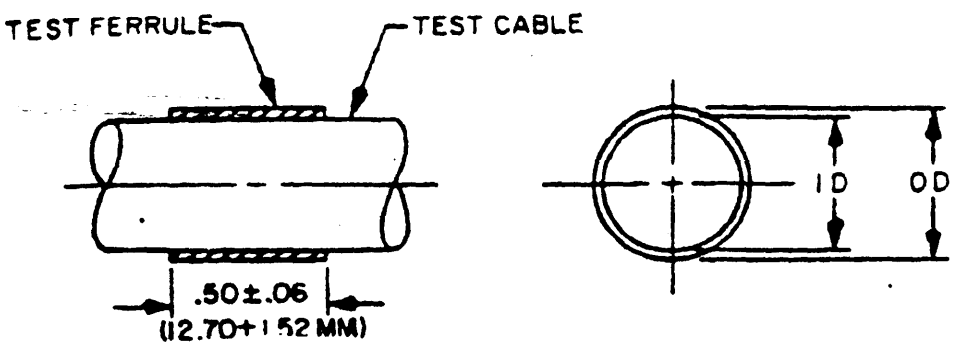
4.7.6.2 Type 2 tools. The tool shall be mounted as specified above. For terminal and splice dies, three of the largest size terminals and splices accommodated by the basic tool shall be crimped to the largest size wire specified for them. In addition, test ferrules and cables shall be selected and crimped in accordance with figure 2 and the applicable specification sheet. The opposing dies shall close to a maximum gap of 0.010 inch and the force necessary to make the crimps shall meet the requirements of 3.5.6.

4.7.7 Deformation of crimped connection.

4.7.7.1 Type 1 tools. The maximum diameter of the crimped wire barrels on all contact-wire assemblies made up for 4.7.3.1 and 4.7.6.1, if applicable, shall be measured and shall meet the requirements of 3.5.7.1.

4.7.7.2 Type 2 tools. The wired assemblies made up for 4.7.3.2 and 4.7.6.2, if applicable, shall be visually examined for symmetry of crimp, sharp edges or corners, or otherwise unsuitable characteristics and shall meet the requirements of 3.5.7.2.

4.7.8 Cracking of crimped connection. The crimped connection of all wired assemblies made up for 4.7.3 and 4.7.6, if applicable, shall be inspected with the aid of a magnifying device having a power magnification of 10. The crimped connection shall meet the requirements of 3.5.8.



Ferrule material shall be seamless copper tubing, alloy no. 122. Anneal to a Rockwell hardness of 55 maximum on the 15-T scale.

For ferrule I.D., O.D. and test cable, see applicable specification sheet (3.1).

FIGURE 2. Test ferrule and cable for compressive force test (type 2 tools).

4.7.9 Axial concentricity (straightness).

4.7.9.1 Type 1 tools. Six contact-wire assemblies are required for this test. Three of those made up for 4.7.3.1 with the smallest size wire barrel accommodated by the tool and crimped to the smallest size wire specified for that size contact shall be used. The other three shall be those made up for 4.7.6.1, if applicable, with the largest size wire specified for that size contact. The wired contacts shall be chucked in the retention area shown in figure 3 and rotated. Indicator readings shall be taken at the diameters specified in the figure. The test setup shall be as shown in figure 4. The TIR measurements shall conform to 3.5.9.1.

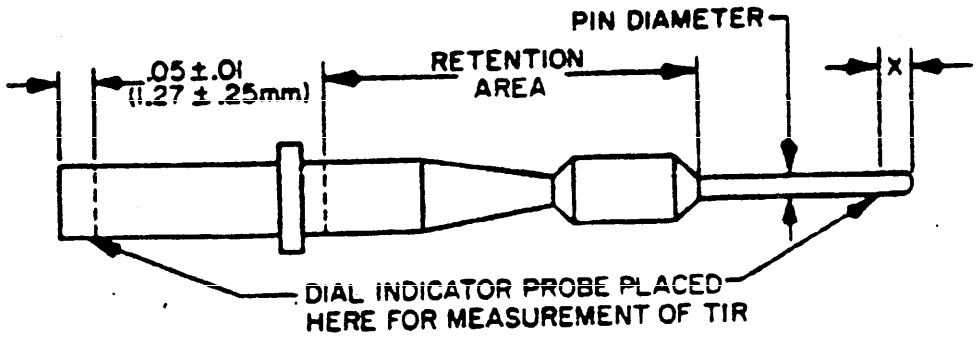
4.7.9.2 Type 2 tools. The wired assemblies prepared for 4.7.3.2 and 4.7.6.2, if applicable, shall be visually examined for bending of tongues on terminals and curvature of splice bodies, and shall meet the requirements of 3.5.9.2.

4.7.10 Voltage drop.

4.7.10.1 Type 1 tools. The entire length of the contact-wire assemblies made up for 4.7.3.1 and 4.7.6.1, if applicable, shall be made to carry the applicable test current specified in table IA. After the temperature stabilizes (approximately 1 minute), the voltage drop shall be measured from a point on the positioning shoulder of the contact to another point 1/2 inch distant on the attached wire and shall meet the requirements of 3.5.10.

4.7.10.2 Type 2 tools. The wired assemblies prepared for 4.7.3.2 and 4.7.6.2, if applicable, shall be tested in accordance with the voltage drop test of MIL-T-7928, MIL-F-21608, or the applicable specification and shall meet the requirements specified therein and 3.5.10.

4.7.11 Tensile strength. The wired assemblies prepared for 4.7.3 and 4.7.6, if applicable, shall be placed in a tensile testing device with appropriate fixtures and sufficient force shall be applied to pull the wire out of the assembly or break the wire or crimped item. The speed of head travel of the tensile device shall be 1.0 ±0.25 inch per minute. The holding surfaces of the tensile device clamp may be serrated to provide sufficient gripping or holding strength. The wired assemblies shall meet the requirements of 3.5.11.



For size 12 and larger pin contacts, X = 1 pin diameter
For pin contacts smaller than size 12, X = 2 pin diameters

FIGURE 3. Contact retention area for axial concentricity measurement (TIR).

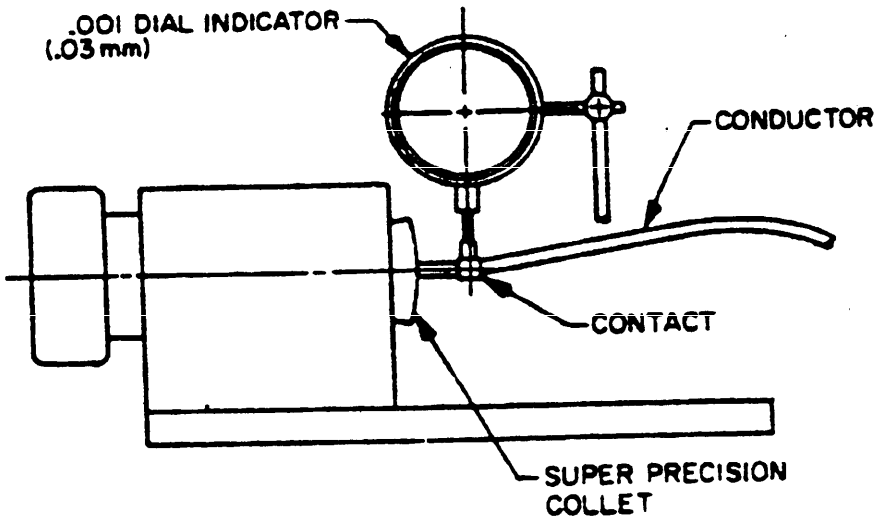


FIGURE 4. Test setup for axial concentricity measurement (TIR).

4.7.12 Dielectric strength (type 2 tools) (when applicable, see 3.1). Four wired assemblies of the largest size and type accommodated by the tool shall be prepared and tested in accordance with MIL-T-7928, MIL-F-21608, or the applicable specification and shall meet the requirements specified therein and 3.5.12.

4.7.13 Low temperature crimp. The basic tool, turret, positioner, or die, and the items to be crimped shall be exposed to a temperature of -15°C for 2 hours. Immediately after removing these from the test chamber, the tool shall be used to make its respective crimp.

4.7.13.1 Test samples.

4.7.13.1.1 Contacts, uninsulated terminals, splices, and ferrules. Four of each type and size connecting device accommodated by the tool and two suitable lengths each of the largest and smallest size wires or cables accommodated by them shall be subjected to the low temperature crimp test. The compression forces shall be measured as in 4.7.6 and the requirements of 3.5.13 shall be met.

4.7.13.1.2 Insulated terminals, splices, and ferrules. Eight of each type and size connecting device accommodated by the tool and four suitable lengths each of the largest and smallest size wires or cables accommodated by them shall be subjected to the low temperature crimp test. The compression forces shall be measured as in 4.7.6 on half of the respective samples. These samples shall then be subjected to 4.7.10 and 4.7.11. The remaining assemblies shall be subjected to 4.7.12.

4.7.14 Shock. The tool, with a turret, positioner, or die installed, shall be loosely placed in a 12 x 12 x 12 inch box made of 1/4 inch plywood which has been rigidly fastened to the carriage of a shock test device. The box may be open at the top to facilitate accessibility to the tool. The tool shall be subjected to a shock test in accordance with method 213, test condition I of MIL-STD-202. Two shocks shall be applied, one with the contact entrance of the tool facing the bottom of the box and the other with the contact entrance facing away from the bottom. The tool shall meet the requirements of 3.5.14.

4.7.15 Life.

4.7.15.1 Type 1 tools. Only one tool shall be tested. The tool shall be mounted such that it can be mechanically actuated at a rate of 15 to 20 cycles per minute, where a cycle consists of closing the tool to the positive stop position and allowing the handles to return to the fully open position. The tool selector setting shall be set as specified in table V. A compression force shall be applied to the extremities of the handles to crimp test rods of the diameters and materials shown in table V as applicable. For tools used to crimp size 12 contacts, the rod shall be advanced a minimum of 1/4 inch after each crimp to provide a new crimping surface. For tools used to crimp size 16 and smaller contacts, the rod shall be advanced a minimum of 1/8 inch. After every 50,000 cycles, the tool shall be manually operated to crimp six wire-contact assemblies using the largest wire barrel that the basic tool is designed to crimp. Three of the contacts shall be crimped to the largest size wire and three to the smallest size wire accommodated by the contact. The tool shall require no adjustments or repairs during the 200,000 cycles, but it shall be permissible to remove foreign matter and lubricate the tool every 50,000 cycles. All requirements of 3.5.15.1 shall be met.

4.7.15.2 Type 2 tools. Only one tool shall be tested. The tool shall be mounted such that it can be mechanically actuated at a rate of 15 to 20 cycles per minute, where a cycle consists of closing the tool to the positive stop position and allowing the handles to return to the fully open position. A set of dies used to crimp the largest ferrule, terminal, or splice that the tool is designed to crimp shall be

installed in the tool such that a 30 to 50 pound handle force is required to release the ratcheting mechanism at the end of the normal crimping cycle with no sample in the tool. After every 5,000 cycles, the tool shall be manually operated to crimp six wired assemblies using the largest terminal, splice, or ferrule accommodated by the tool. Three shall be crimped to the largest size wire or cable and three to the smallest size accommodated by the item. When only one size wire or cable is specified, only three samples need be prepared. The tool shall require no adjustments or repairs during the 25,000 cycles. All requirements of 3.5.15.2 shall be met.

TABLE V. Test rod for life test (type 1 tools).

Largest contact accommodated	Selector setting	Rod dia.-in. (±0.001)	Material specification	Physical properties
12	8	0.125	Coml. leaded bronze or QQ-C-502	Rockwell hardness B50 ±2 Min. tensile strength 48,000 psi
16	7	0.064	QQ-B-626, Comp. 2 or QQ-N-343	
20	8			

4.7.16 Salt spray (corrosion). The basic tool with a turret, positioner, or die installed shall be subjected to a salt spray (corrosion) test in accordance with method 101, condition B of MIL-STD-202. The salt solution shall be 5 percent concentration. Immediately after removal from the chamber, the basic tool and turret, positioner, or die shall be rinsed in running water not warmer than 38°C and subsequently dried in a circulating air oven for 12 hours at a temperature of 38 ±3°C. Upon removal from the oven, the basic tool and turret, positioner, or die shall meet the requirements of 3.5.16.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be in accordance with the requirements of PPP-P-40. Unit packages and shipping containers shall also be marked with the following information:

(a) Number (revision and amendment, if applicable) of this specification.
(b) Military part number and title.
(c) Manufacturer's name.
(d) Manufacturer's part number.
(e) Month and year inspected.

6. NOTES

6.1 Intended use. Tools and kits covered by this specification are intended for crimping MIL-C-23216, MIL-C-26636, and MIL-C-39029 removable contacts (e.g., power, coaxial, shielded, thermocouple and filter pin contacts); MIL-C-39012 coaxial connectors; MIL-T-7928 terminals; and MIL-F-21608 ferrules to wire conductors for use in electric connectors, terminal junction systems, and other electric or electronic components. These tools may be used to crimp other connecting devices of design or materials other than those specified herein provided the required performance is obtained.

6.1.1 Tool selection. MIL-STD-1646 specifies the proper tool selection for use with military electric connectors and connections.

6.1.2 Type 1 tools. Crimping contacts without positioners or turrets (as applicable) is not a recommended practice, but is an emergency procedure only.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification and applicable specification sheet.
(b) Military part number for basic tools, turrets, positioners, dies, inservice gages, and kits, as required.
(c) Quantity desired.

6.3 Qualification.

(a) 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 suppliers is called to this requirement, 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 may 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; however, information pertaining to qualification of products may be obtained from the Naval Ammunition Depot (NAD-70515), Crane, Indiana 47522.
(b) With respect to Air Force, tool kits requiring qualification, etc. The activity responsible for the qualified products list is Air Force Logistic Command, and information pertaining to qualification of products may be obtained from the Air Force Logistic Command (MMGE), Wright-Patterson Air Force Base, Ohio 45433.

6.4 International standardization agreement. Certain provisions of this specification are the subject of internation standardization agreement (NEPR No. 58). When amendment, revision, or cancellation of this specification is proposed which affects or violates the international agreement concerned, the preparing activity will take appropriate reconciliation action through internation standardization channels including departmental standardization offices, if required.

6.5 Marginal indicia. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

6.6 Patent notice. The Government has a royalty-free license under the listed patents and patent applications for the benefit of manufacturers of the items called for in this specification and related specification sheets either for the Government or for use in equipments to be delivered to the Government.

U.S. patent numbers	U.S. patent applications serial numbers
2,991,675	158,956
3,059,511	172,195
3,063,313	172,354
	302,170
	617,783

6.7 Performance of class II tools. Performance of crimp joints made with class II tools shall conform to the requirements of crimp joints made with class I tools.

Custodians:
Army - EL
Navy - AS
Air Force - 84

Review activities:
Army - MI, MU, AV, EL
Navy - SH, EC
Air Force - 12, 17, 80, 82, 85
DSA - ES

User activities:
Army - ME, AT, GL, WC
Navy - YD
Air Force - 70

Preparing activity:
Navy - AS

Agent:
DSA - ES

(Project 5120-0808)

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

5. PROBLEM AREAS

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b. Recommended Wording:

c. Reason/Rationale for Recommendation:

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7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
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