DANIELS MANUFACTURING CORPORATION

SLIDES ONLY

NO SCRIPT PROVIDED

Component & Tooling

Identification Training

Agenda

- History
- Introduction to Connectors
- Introduction to Contacts
- Tool Selection
- 4/8 Indent Tooling
- Crimping
- Terminals, Splices, & Stamped & Formed Contacts
- Form Crimp Tooling
- Insertion/Removal Tools
- Wire Stripping
- Tips

History

Tooling Support

Our mission is to be your trusted partner in tooling and technology for mission-critical electrical systems. DMC provides a full catalog of tooling to support EWIS including:

- Crimp Tools & Accessories (qualified to AS22520)
- Insertion/Removal Tools (qualified to AS81969 & AS5259)
- Connector Assembly Tools
- Tensile Test Equipment
- Safe-T-Cable®
- Twist-Strip®
- Lacelok®

History

Tool Kits

DMC researches, designs, and develops tool kits to support specific platforms and wiring systems.

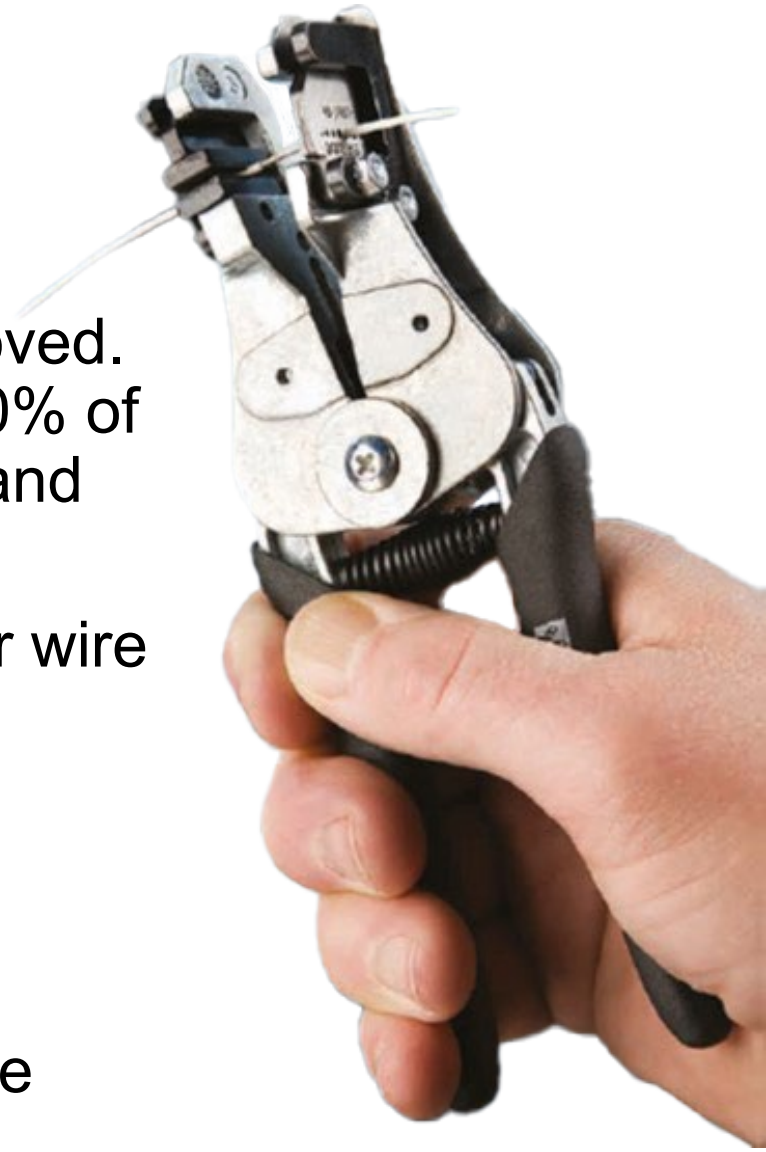
Our comprehensive kits include all the items needed to strip, crimp, insert, remove, torque, and test. Kits also come with cross-reference charts for the connectors, contacts, and terminals which eliminates time-consuming research.

Introduction to Wire Stripping

Wire Preparation

The Proper Technique

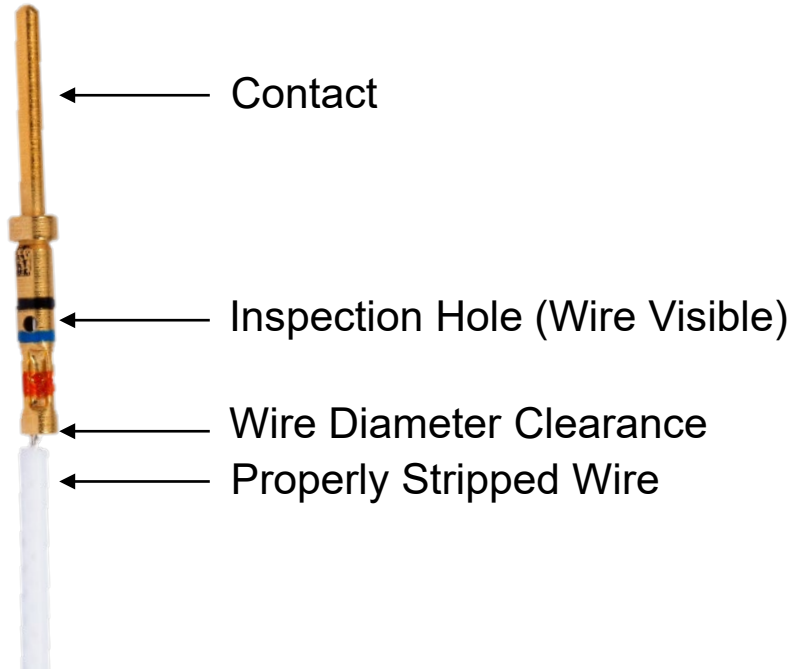
1. Determine the proper length of insulation to be removed. Wire must be visible in inspection hole. Less than 50% of overall wire diameter clearance between insulation and contact barrel.
2. Insert wire into the exact center of the correct slot for wire size to be stripped, each slot is marked.
3. Close handles together as close as possible.
4. Partially open handles allowing grips to open, then remove wire before allowing handles to fully open.
5. Release handles, allowing wire holder to return to the open position.
6. Remove the stripped wire



Wire Stripping

Tips

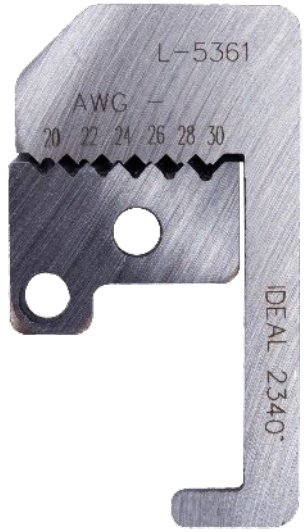
- Wire must be visible in inspection hole. Less than 50% of overall wire diameter clearance between insulation and contact barrel.
- After stripping, strands of wire should be twisted firmly together in the same direction as the normal lay of the wire.
- Stripped wire with nicked or cut strands is not acceptable.



Wire Strippers

Knife-Type Blades

Stripmaster® wire strippers and **knife-type** blades



Wire Stripping

Die-Type Blades

Custom Stripmaster® wire strippers and **die-type** blades

Red Handles (10-14 AWG)

Black Handles (16-30 AWG)

Introduction to Contacts

Pin & Socket

Contact Styles are defined as Pin (male) and Socket (female).

Pin

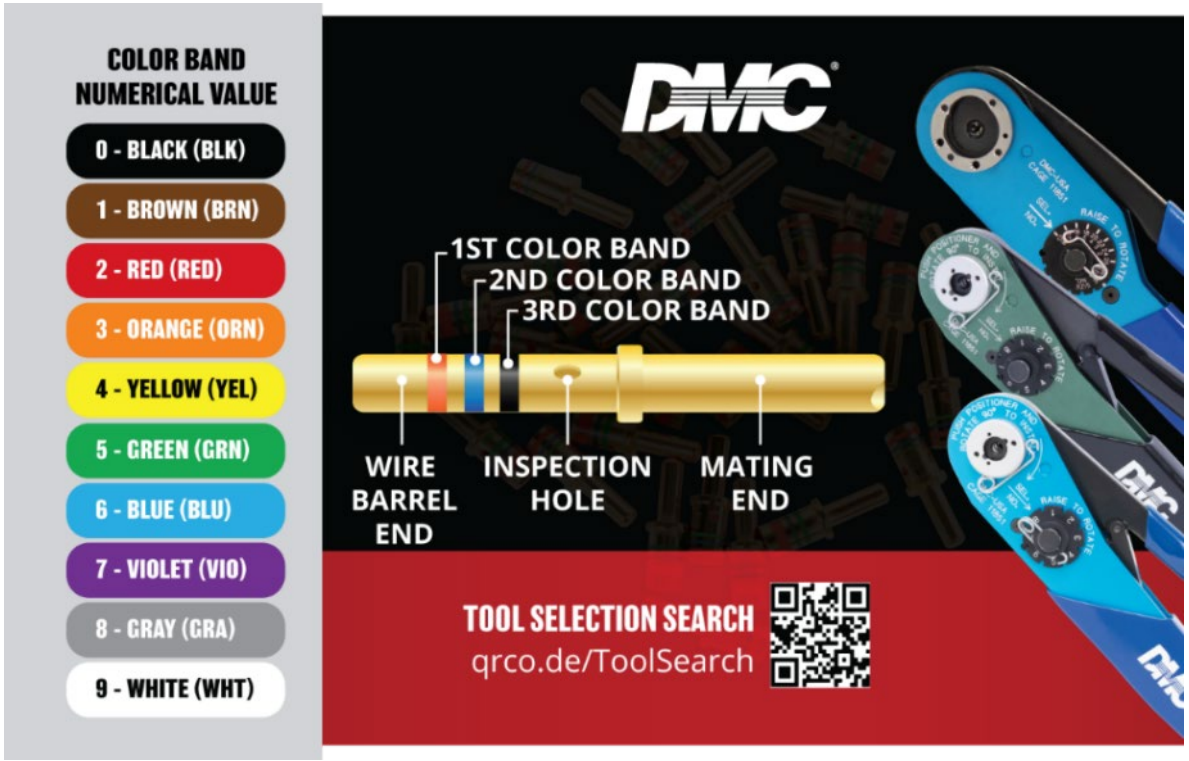
Socket

BIN Codes

How to Identify Contact Part Numbers

M39029-XX/XXX

Color codes or Basic Identification Number (BIN) codes are used to identify contact part numbers.



Contact Identification

Contact Gages

- Contact Gages are used to identify the size of contacts in connectors
- Four contact gages are included with all DMC kits. This is especially useful where two or more contact sizes are present in a single connector.

American Wire Gauge (AWG)

Wire Conductor Size

- American Wire Gauge (AWG) is a US standard for wire conductor size.
- The "gauge" is related to the diameter of the wire.
- The higher the gauge number, the smaller the diameter and thinner the wire.

Tool Selection

Selecting the Proper Tooling

Contact Identification

M39029/XX-XXX using BIN code to select tooling

Pin:

- Orange-Blue-Orange
- BIN 363

Socket:

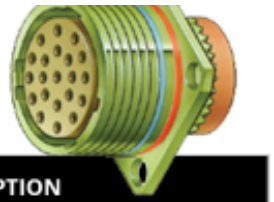
- Orange-Green-Brown
- BIN 351

Selecting the Proper Tooling

Use DMC Resources to Find Tooling

Using DMC's Catalog, search for the contact using the BIN code.

MIL-DTL-38999
SERIES 3



Tri-Start Coupling, Circular, Rear Release Contacts

CONNECTOR P/N	DESCRIPTION
D38999/20	WALL MOUNT FLANGE RECEPTACLE
D38999/24	JAM NUT MOUNT RECEPTACLE
D38999/26	STRAIGHT PLUG
D38999/29	LANYARD RELEASE PLUG (PIN CONTACTS ONLY)

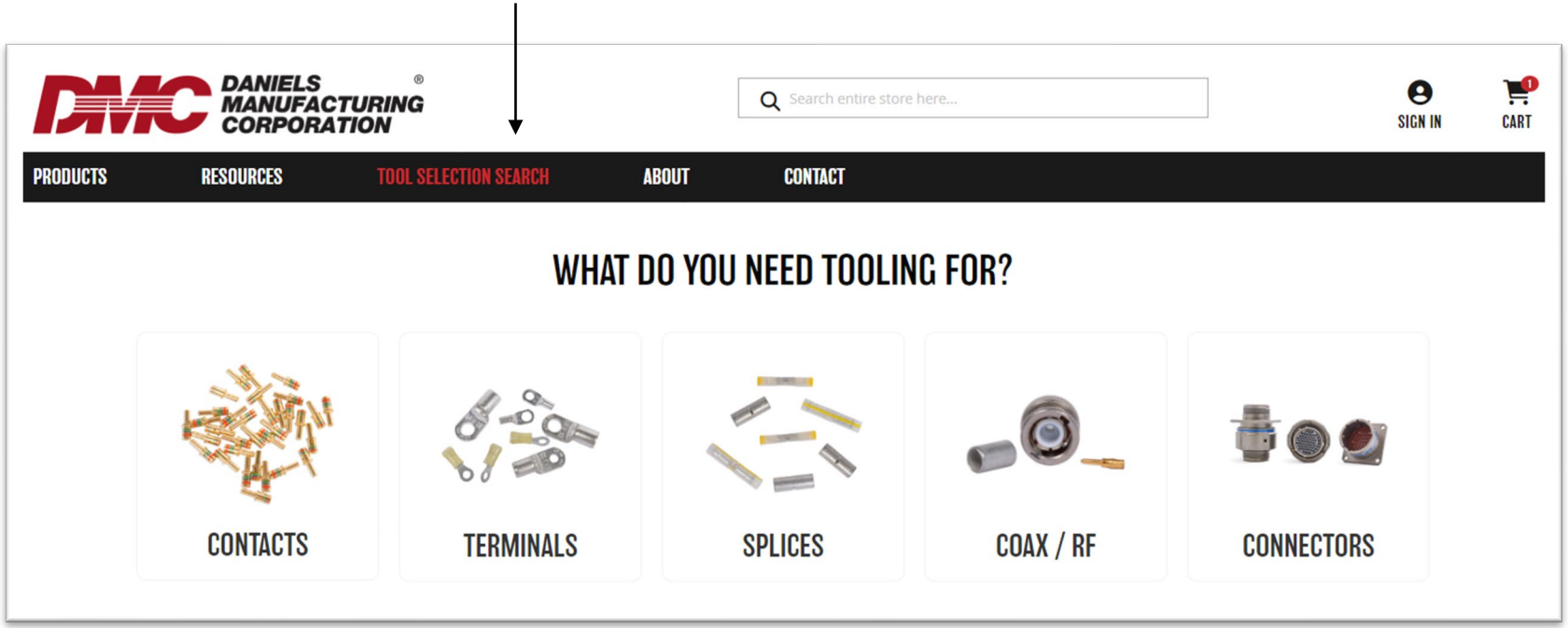
CONNECTOR P/N	DESCRIPTION
D38999/30	LANYARD RELEASE PLUG (SOCKET CONTACTS ONLY)
D38999/31	LANYARD RELEASE PLUG (PIN CONTACTS ONLY)
D38999/34	JAM NUT RECEPTACLE (SOCKET CONTACTS ONLY)
D38999/35	WALL MOUNT RECEPTACLE (SOCKET CONTACTS ONLY)

CONTACT PART NUMBER	BIN			PIN (P) OR SOCKET (S)	MATING END	WIRE BARREL	WIRE RANGE	CRIMP TOOL AND ACCESSORY				ASSEMBLY TOOLS	
								AF8	AFM8	MH860	1716P-1*	INSERTION	REMOVAL
M39029/58-360	3-ORN	6-BLU	0-BLK	P	22	22D	22-28		K42	86-6		DAK95-22MB (ANGLED TWEEZER) OR DAK722-22D (OFFSET TWEEZER)	DRK95-22MB (ANGLED TWEEZER) OR DRK722-22D (OFFSET TWEEZER)
M39029/56-348	3-ORN	4-YEL	8-GRA	S					K40	86-4			
M39029/118-644	6-BLU	4-YEL	4-YEL	P					K42	86-6			
M39029/118-650	6-BLU	5-GRN	0-BLK	P									
M39029/117-632	6-BLU	3-ORN	2-RED	S					K40	86-4			
M39029/117-638	6-BLU	3-ORN	8-GRA	S									
M39029/58-361	3-ORN	6-BLU	1-BRN	P		22M	24-28		K42	86-6			
M39029/56-349	3-ORN	4-YEL	9-WHT	S					K40	86-4			
M39029/58-362	3-ORN	6-BLU	2-RED	P	22	22	22-26		K42	86-6		DAK95-22B (ANGLED TWEEZER) OR DAK722-22 (OFFSET TWEEZER)	DRK95-22B (ANGLED TWEEZER) OR DRK722-22 (OFFSET TWEEZER)
M39029/56-350	3-ORN	5-GRN	0-BLK	S					K40	86-4			
M39029/58-363	3-ORN	6-BLU	3-ORN	P	20	20	20-24		K43			DAK95-20B (ANGLED TWEEZER) OR DAK722-20 (OFFSET TWEEZER)	DRK95-20B (ANGLED TWEEZER) OR DRK722-20 (OFFSET TWEEZER)
M39029/56-351	3-ORN	5-GRN	1-BRN	S						86-7			
M39029/118-646	6-BLU	4-YEL	6-BLU	P									
M39029/118-652	6-BLU	5-GRN	2-RED	P									
M39029/117-634	6-BLU	3-ORN	4-YEL	S									
M39029/117-640	6-BLU	4-YEL	0-BLK	S									

Selecting the Proper Tooling

Use DMC Resources to Find Tooling

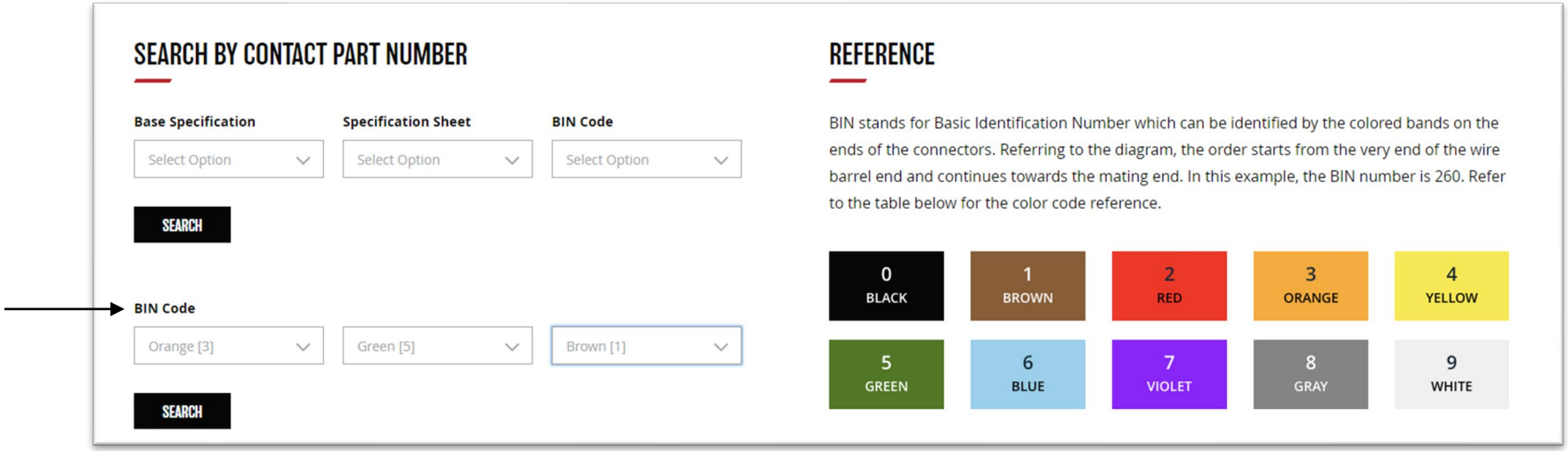
Alternatively, you can use the Tool Selection Search on dmctools.com



Selecting the Proper Tooling

Use DMC Resources to Find Tooling

Select your component. In this case the component is a contact. Next, search for tooling by entering the BIN code or contact part number.



Selecting the Proper Tooling

Use DMC Resources to Find Tooling

All tooling related to the component search will be presented along with general information relating to the component.

TOOLING FOR M39029/56-351

Mating End Sizes	Wire Barrel Size	Pin/Socket	Part No (Current)	Part No (Superseded)	Wire Range	Color Bin
20	20	S	M39029/56-351	MS27490-20	20-24	3 5 1

Specification: MIL-C-39029/56E

INNER/PRIMARY CRIMP TOOL

Military Approved

K43

Positioner

$64.02

Military Approved

MH860

Adjustable Middle Range 8 Indent Crimp Tool

$445.05

Military Approved

86-7

Positioner

$64.02

WA27F

Pneumatic Indent Crimp Tool - Equivalent to AF8

$1,881.98

Military Approved

TH163

Turret Head

$136.60

Introduction to 4/8 Indent Tools

AF8 (M22520/1-01)

4/8 Indent Tools

- Crimp range **12 - 26 AWG**
- Cycle control ratchet
- Produces 8 indent crimp
- Crimp depth controlled by 8 position selector knob
- Go/No-Go performed with G125
- Utilizes turret & single position heads

AFM8 (M22520/2-01)

4/8 Indent Tools

- Crimp range **20 - 32 AWG**
- Ratchet control cycling
- Produces 8 indent crimp
- Crimp depth controlled by 8 position selector knob
- Go/No-Go performed with G125
- Utilizes “K” positioners

Go/No-Go Gages

Crimp Tool Verification

- It is important to periodically gage crimp tools by using an inspection/verification gage (Go/No-Go).
- This step ensures the tool has maintained the settings/tolerances it had when it was manufactured or calibrated.
- 4/8 indent crimp tools can easily be gaged by following the directions on the gage and tool instructions.

Go/No-Go Gages

Crimp Tool Verification

- Set the tool to the specified setting (crimp depth selector) and first insert the “Go”, then the “No-Go” end of the gage into the indenters.
- The “Go” should pass freely between the four indenters, and the “No-Go” should not pass through the indenters.

Locators

Different Options

Turret:

- Turret heads can accommodate different size contacts (selected by color codes)

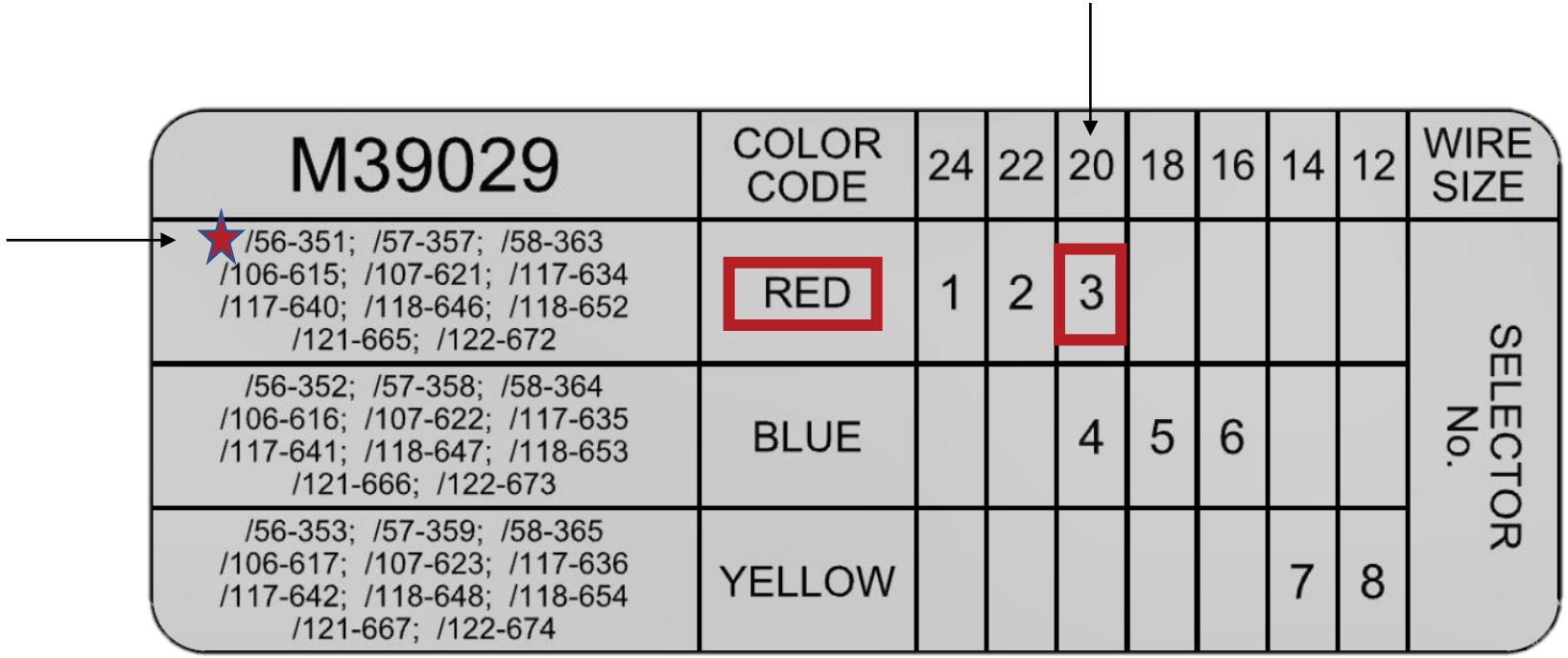
Positioner:

- Positioners are dedicated to a single contact size

Introduction to Crimping

Step 1:

Once you have identified the appropriate tooling, use the data plate to find the correct settings for the tool.

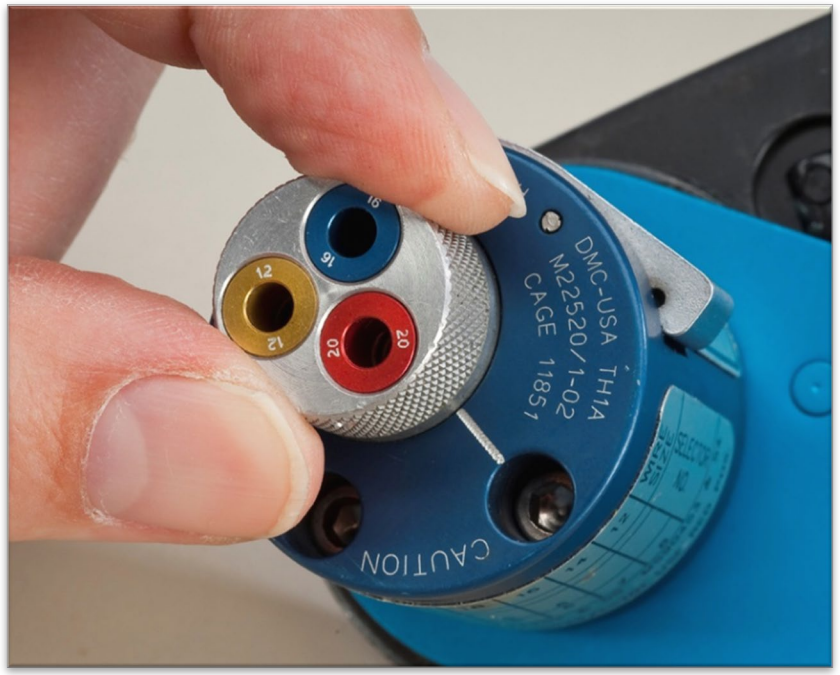


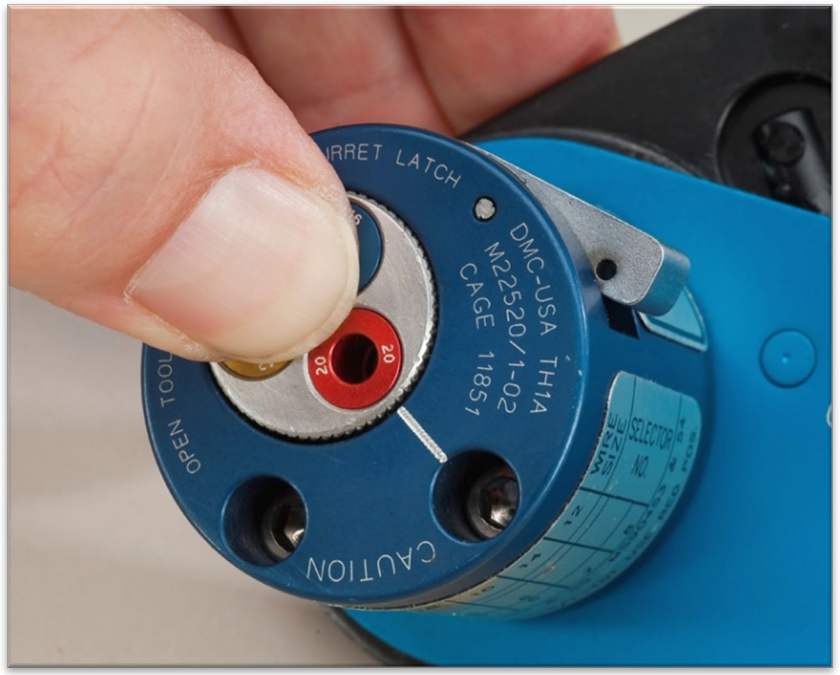
M39029	COLOR CODE	24	22	20	18	16	14	12	WIRE SIZE
/56-351; /57-357; /58-363 /106-615; /107-621; /117-634 /117-640; /118-646; /118-652 /121-665; /122-672	RED	1	2	3					SELECTOR No.
/56-352; /57-358; /58-364 /106-616; /107-622; /117-635 /117-641; /118-647; /118-653 /121-666; /122-673	BLUE			4	5	6			
/56-353; /57-359; /58-365 /106-617; /107-623; /117-636 /117-642; /118-648; /118-654 /121-667; /122-674	YELLOW						7	8	

*Tools under M39029 or AS39029 have superseded older tools

Step 2:

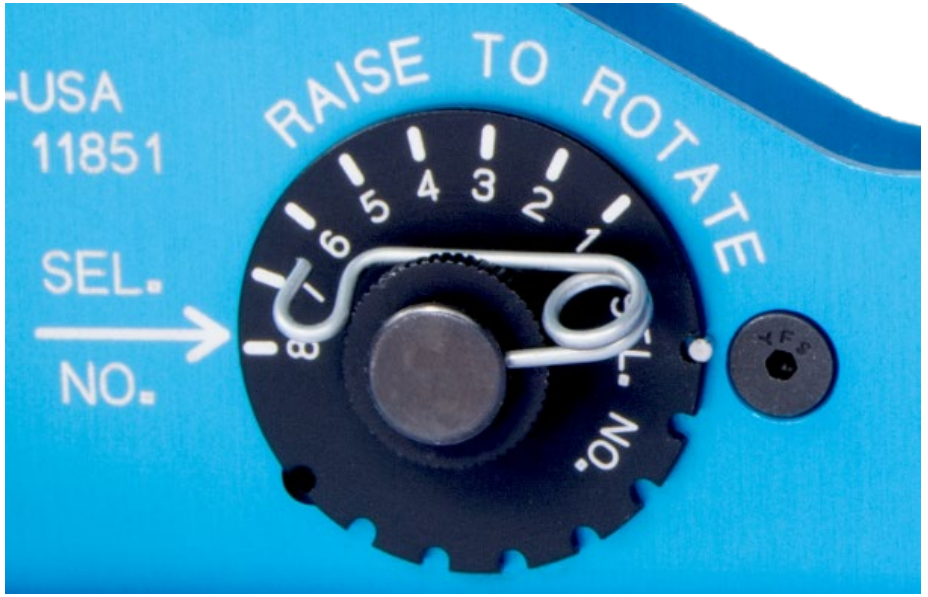
Set the positioner color to red and push the turret knob in.





Step 3:

Next, set the selector setting knob to 3 by lifting and rotating.



Note: The selector setting on the positioner you are using is always the one to use.

Step 4:

Insert the wire into the contact prior to inserting the contact into the tool, or if it is preferable, insert the contact into the tool, then insert the stripped wire into the contact.

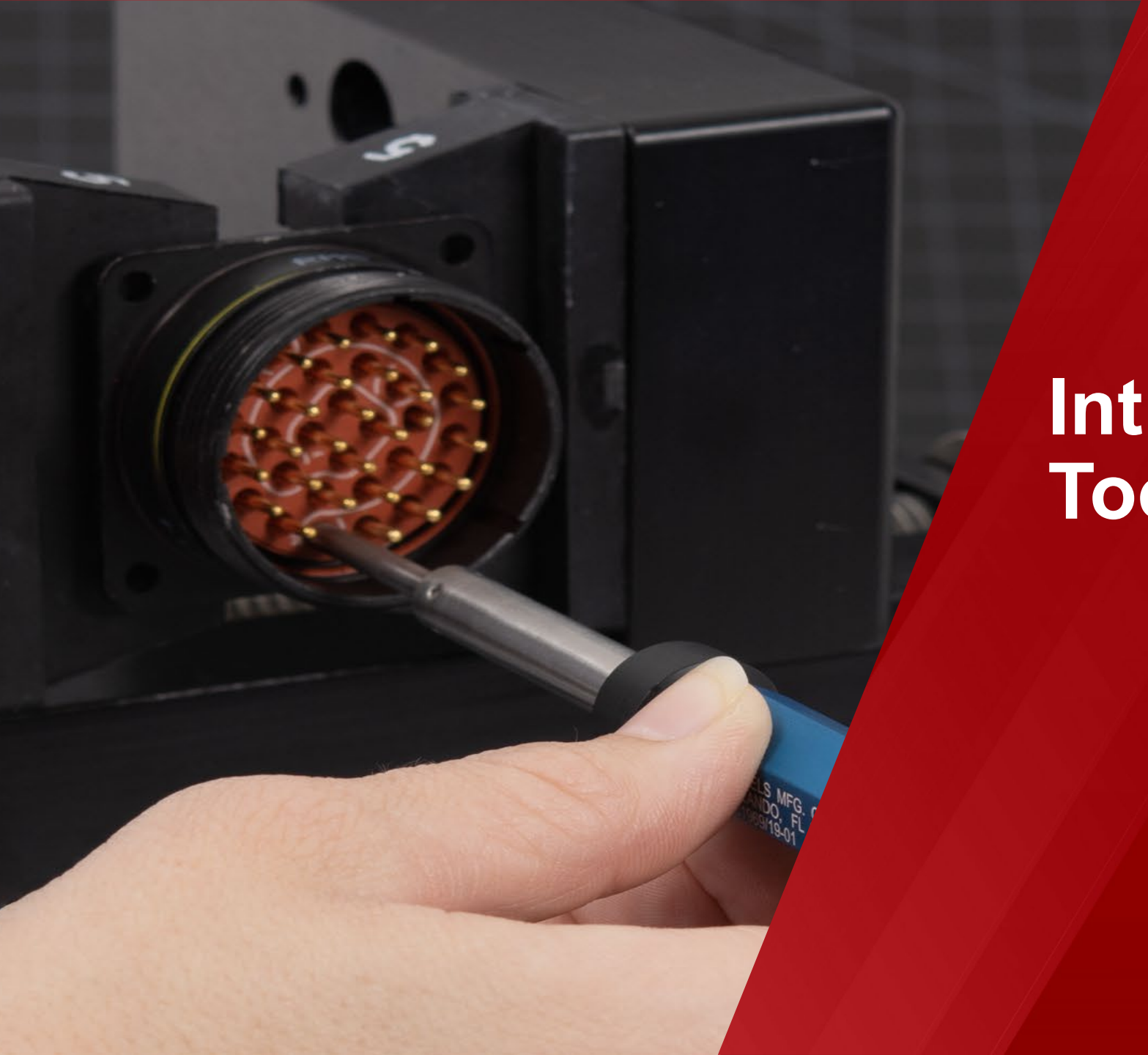
Step 5:

Close the tool until the movable handle fully bottoms, and the ratchet allows the handle to open. Relax pressure and remove the crimped contact.

Step 6:

Inspect the contact

- The crimp location should be midway between the inspection hole and the end of wire barrel.
- Ensure there is wire in the inspection hole
- The gap between the insulation and contact barrel should be less than 50% of the overall wire diameter
- No wire strands should be located outside of the wire barrel
- Look for cracks in the plating material (magnification may be required.)



Introduction to I/R Tools

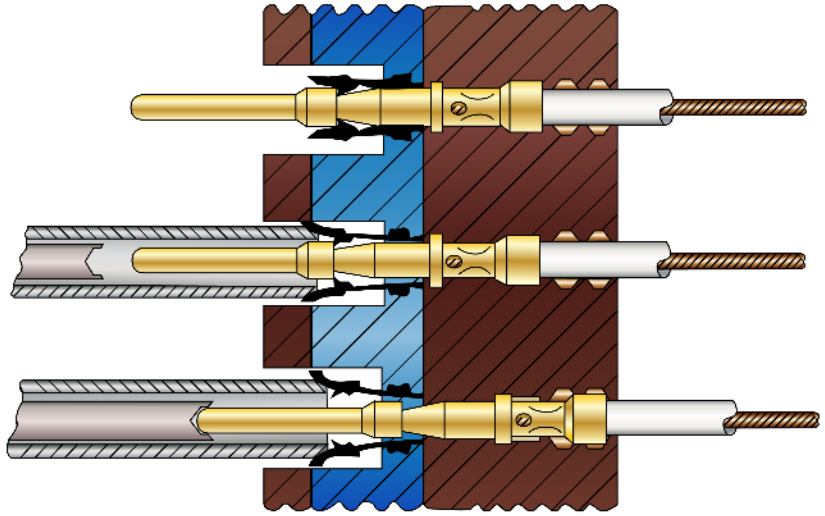
Removal of Contacts

Identifying the Correct Tool

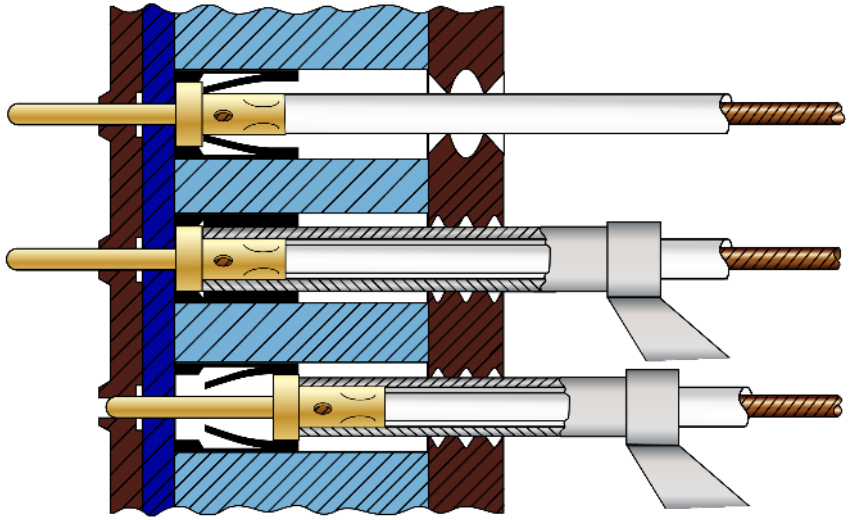
- Identification is key to this process. Begin by identifying the correct tool.
- Verify the correct contacts have been selected and use the predetermined tool to insert or remove the contacts from the connector.

Contact Release Systems

Typical Front Release Connector



Typical Rear Release Connector



Introduction to Connectors

Introduction to Connectors

Receptacles and Plugs

Receptacles have mating socket and often have mounting features such as a flange with holes.

Plugs have prolonged connecting pins.

Introduction to Connectors

- **Blue bands** on connectors generally indicate the connector has contacts that release from the **rear** of the connector (wire side).
- Connectors **without** color bands would likely indicate the connector contacts release from the **front** (mating side).

Introduction to Connectors

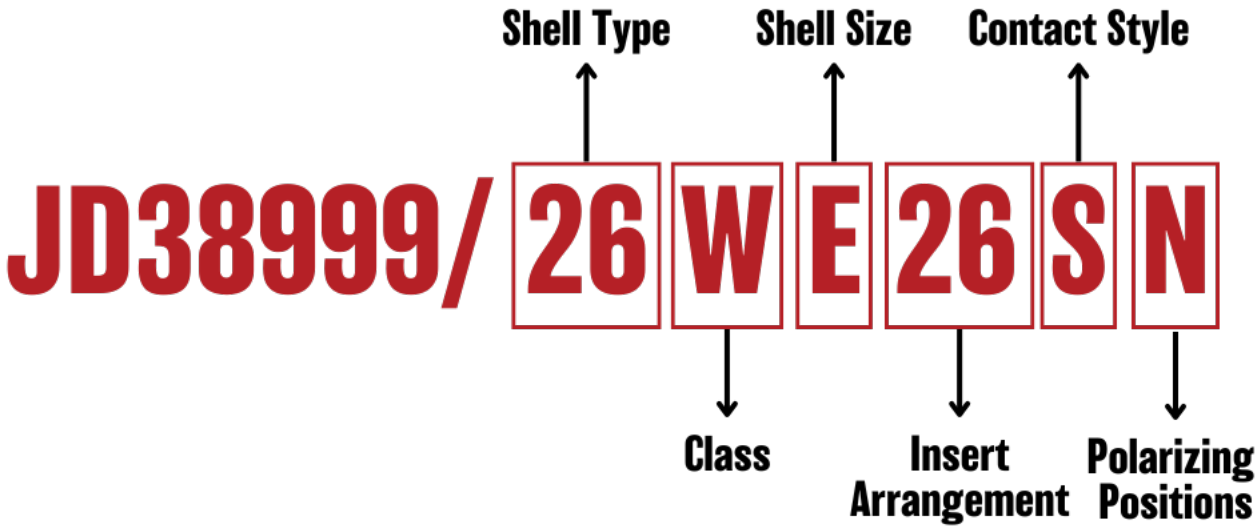
- **Red bands** on circular connectors are usually there as a visual check for the complete mating of threaded connectors.

Connector Part Numbers

Identifying the Type of Connector

D3899/26 = MIL-DTL-38999 Series III (Formerly MIL-C)

- Shell Type: Connector description, i.e., wall mount, jam nut, straight plug
- Class: Material, plating, temperature range, and other design factors
- Shell Size: Diameter of connector
- Insert Arrangement: Layout and size, type of contact
- Contact Style: Pin, socket, solder tail, etc.
- Polarizing Positions: Orientation of keys or insert rotation for proper mating



Introduction to Terminals, Splices and Stamped & Formed Contacts

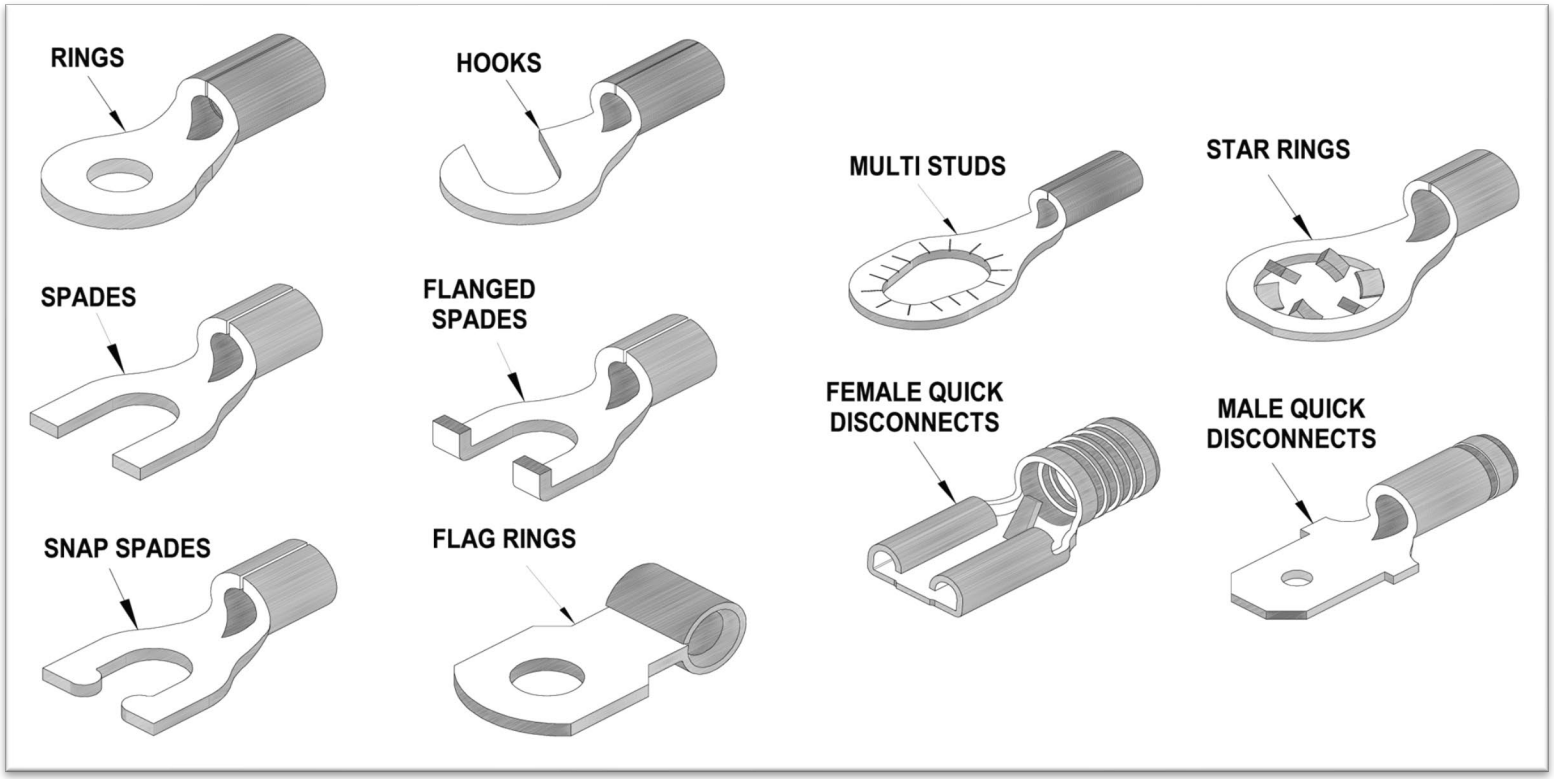
Terminal Colors

- Color shades vary based on material and barrel styles
- PVC and Nylon take the color differently. In the 14-16 AWG range (blue) for example, the PVC barrels will be dark blue. The nylon barrels will be a lighter, translucent blue.
- The color shade has no correlation to the quality of the insulation.

Color Code Wire Range (AWG)	
Yellow	24-26
Red	18-22
Blue	14-16
Yellow	10-12
Red	8
Blue	6
Yellow	4

Tongue Styles

The “tongue” is the end of the terminal that attaches to other components (switch, stud, transformer, etc.).



Stamped and Formed Contacts

- Stamped and formed contacts are created from rolls of copper alloy that have been selected for their conductivity, strength, and temper.
- A series of complex progressive stamping dies form their specific geometry.
- Stamped and formed contacts can be purchased individually or on a reel.

Introduction to Form Crimping

Form Crimp Tools

HX4 (M22520/5-01)

HX4 series crimp tools have a system of interchangeable dies. Crimp dies are snapped into the tool frame and held in place by internal spring clips.

Insulated and uninsulated terminals are standardized under AS7928. The traditional tool for red, blue, and yellow (size 26-10 AWG wire) terminals is the AS22520/5-01 with AS22520/5-100 crimp dies.

Y Dies

Form Crimp Tool

- Y Dies accommodate most coaxial and triaxial connectors and contacts conforming to MIL-DTL-39012, AS39029.
- Dies are also available to accommodate different types of ferrules, splices, and terminal lugs.
- Single, double, and triple cavity configurations are sold in various crimp patterns

Y622

Y501
(M22520/5-100)

Y443

Y Dies

Form Crimp Tool

The new and improved Y111 series dies were built to accommodate IPC requirements and feature an adjustable insulation crimp.

Y1115
(AS22520/5-106)

Y1116
(AS22520/5-107)

Y1117
(AS22520/5-108)

General Maintenance Tools

Crimp Tools for Environmental Splices

The preferred crimping tools for environmental splices are tools that have fixed crimp jaws such as the GMT232 (M22520/37-01) and GMT1090 (M22520/44-01).

Removable dies for the M22520/5 and M22520/10 tools are also available for crimping splices, but access to tight areas sometimes limits their use.

General Maintenance Tools

Crimp Tools for Environmental Splices

The GMT232 (AS22520/37-01) is designed to terminate wire splices conforming to MIL-S-81824 of the following sizes:

Tool Cavity	12-16		16-20		20-26	
Crimp Splice Size	I.D.	O.D.	I.D	O.D.	I.D.	O.D.
	.102	.153	.069	.106	.050	.080
	.097	.147	.064	.101	.045	.075

Splices are to be staggered in a wire bundle to avoid growth of the harness diameter.

LaceLok®

The Smarter Option for Secondary Wire Harness Support

What is LaceLok?

- LaceLok was designed to replace hand-tied lace and cable ties for secondary wire harness support
- Combines the ease of zip ties with the performance of string ties
- Developed by Ideal Industries in 2012
- Acquired and perfected by DMC in 2022
- Mil-Spec Qualified since Dec. 2022
- Listed in SAE AS50881H since Jan. 2023

Disadvantages of Traditional Methods

Hand-Tied Lace

- Applied inconsistently
- Loosen and slide over time
- Repetitive motion injuries
- Abrasion to operators
- Operator fatigue

Zip Ties

- Becomes brittle when exposed to extreme temperatures, chemicals & UV
- Often over tensioned
- Abrasive to wires and nearby components
- AS50881H
- MIL-DTL-32554
- MIL-DTL-32555
- NAVAIR 01-1A-505-1, TO 1-1A-14, & TM 1-1500-323-24-1

Why LaceLok?

Top Benefits of LaceLok

Superior

- Rated for operation in extreme temperatures -65°C to 260°C
- Hydraulic fluid, lubricating oil, and fuel resistant
- Made of abrasion resistant meta-aramid fiber lace
- 40% lighter than large cable ties

Consistent

- Delivers consistent loop force controlled by the fastener
- Terminates consistently at 20 lbs (+/- 2 lbs) of applied tension
- Installs up to 3x faster than most hand-tied lace
- Prevents rework

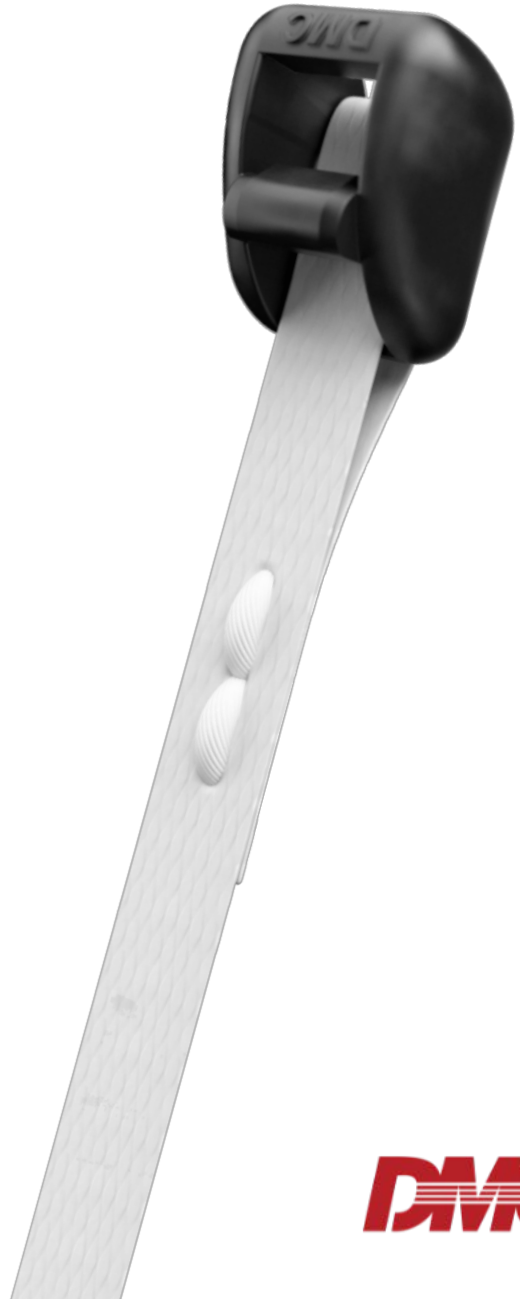
Safer

- Reduces repetitive motion and abrasion injuries
- Reduces operator fatigue

LaceLok Construction

What is LaceLok Made of?

- Lacing Tape
  - Meta-Aramid fiber lace
  - Meets A-A-52084 Lacing Spec
- Fastener
  - High-performance thermoplastic PEEK material
  - Locking pin activates at 20 lbs (+/- 2 lbs) of tension
- Thread
  - Meets MIL-C-572
  - Secures the fastener to the lace until it is activated



LaceLok Construction

Options Available for Purchase

- LaceLok is available in various lengths and colors and is sold in quantities of 100.
- 6”, 10”, 18”, and 24” lengths
- Natural, Natural w/Dark Tracer, Black, Blue, Brown, Grey, Green, Orange, Pink, Red, and Violet
- Common options are natural 10” (LF2-10NA1) and 18” (LF2-18NA1)

Installation

How to Use LaceLok

1

2

3

4

Mil-Spec Numbers

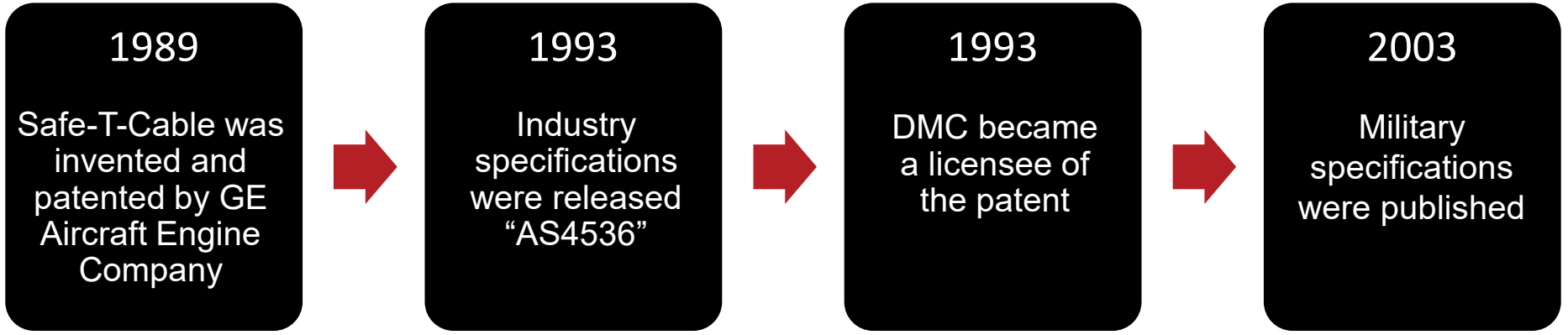
- AS50881H
- MIL-DTL-32554
- MIL-DTL-32555
- MIL-HDBK-522
- NAVAIR 01-1A-505-1
- TO 1-1A-14
- TM 1-1500-323-24-1

Safe-T-Cable®

The Ultimate Fastener Retention System

Safe-T-Cable Introduction

History



Safe-T-Cable Introduction

General Information

Safe-T-Cable Introduction

General Information

- User-friendly alternative to lockwire
- Trusted for its reliability for over 30 years
- Commonly used in aircraft engines and airframes
- Proven reliability in Space, Marine, and other harsh environments
- Continued acceptance for quality control and production enhancement

Safe-T-Cable Benefits

- Reduced installation times
- Access to tight areas
- Quickly learned and repeatable
- Tool-dependent system
- Stronger than wire
- Quick visual inspection
- Improved FOD control

Safe-T-Cable Material

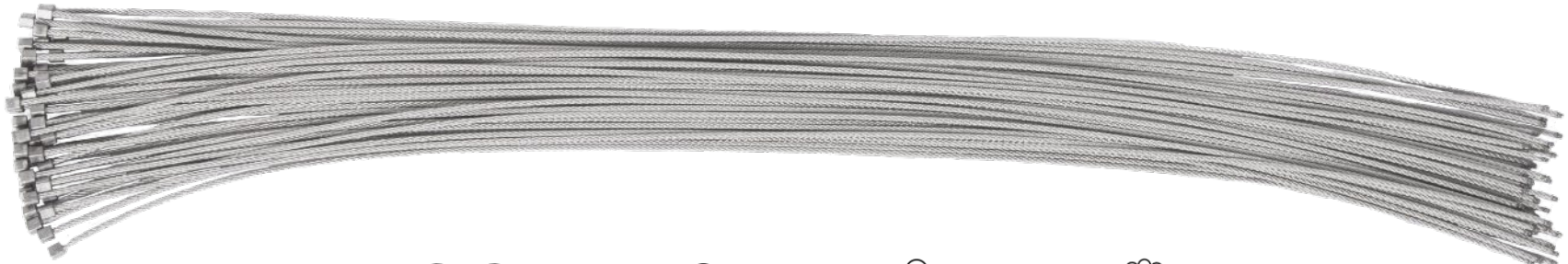
Components

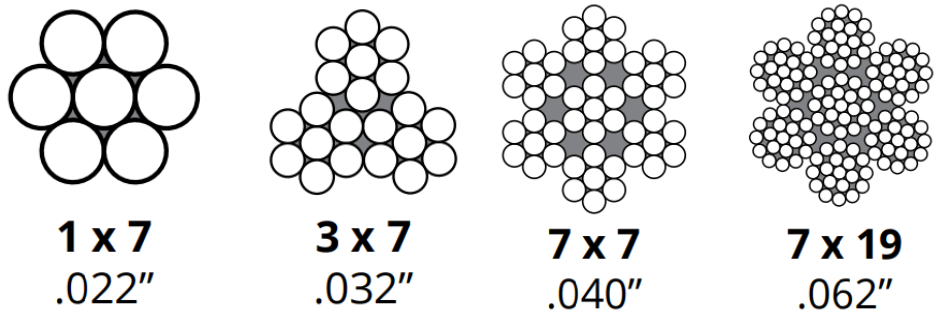
- Safe-T-Cable is comprised of three components: the cable, the end fitting, and the ferrule.
- All three components are made of the same high-performance alloys typically used in aerospace fasteners.
  - 321 Stainless Steel (AS3510) is the standard Safe-T-Cable material used for most engine and airframe applications.
  - Inconel 600 (AS3509) is appropriate for high-temperature and/or non-magnetic applications.
  - Inconel 625 (AS3655) is ideal for marine applications where superior corrosion-resistant properties are necessary.

Safe-T-Cable Material

Cable

- Available in four diameters
- Available in several lengths ranging from 9” – 24”
- Standard, self-looping jumper, flanged, and custom branded cables are available.





Safe-T-Cable Material

Ferrules

- Individual ferrules are precisely manufactured to a size and hardness ensuring maximum tensile strength and their compatibility with the cable assemblies and tools being used.
- Conveniently stored in a disposable, spring-loaded cartridge
- Easily extracted from the cartridge minimizing the possibility of FOD
- Available in standard, elongated, or flanged configurations

Safe-T-Cable Material

Custom-Branded Cable Assemblies

- Custom-branded cable assemblies feature a logo or mark on the end fitting
- Most commonly used for warranty traceability, service location verification, and/or to identify tampering.

Safe-T-Cable Material

Elongated Ferrules

- Elongated ferrules are ideal for installations where the clearance between the fastener head and the surface to which the fastener is attached is limited.
- The radius end and longer shape allow for correct alignment between the tool nose and the fastener
- An excellent choice for low-profile fasteners or hard-to-reach areas

Safe-T-Cable Material

Self-Looping Jumper Cable

- Self-looping jumper cable assemblies provide the user with a means of anchoring a threaded fastener to almost any structure.
- Clear advantage over lockwire on turnbuckles, castellated fittings, and other applications where holes are not provided

Safe-T-Cable Tooling

Overview

- The tool applies the tension, crimps, and cuts the excess cable off
- Adjustable and pre-set tension tools are available
- Manual, battery, and pneumatic power options
- Tools have replaceable noses that can be serviced by the user
- Multiple nose lengths are available to accommodate most applications
- Noses are interchangeable between tools for the same cable size

Safe-T-Cable Tools

Adjustable Tension

- Adjustable tension tools are the most popular Safe-T-Cable tools.
- The rotary tension mechanism on this tool can be adjusted to your precise cable tension requirements.
- Ball bearing slip clutch mechanism allow the user to tension the cable

SCTR323

Safe-T-Cable Tools

Pre-Set Tension

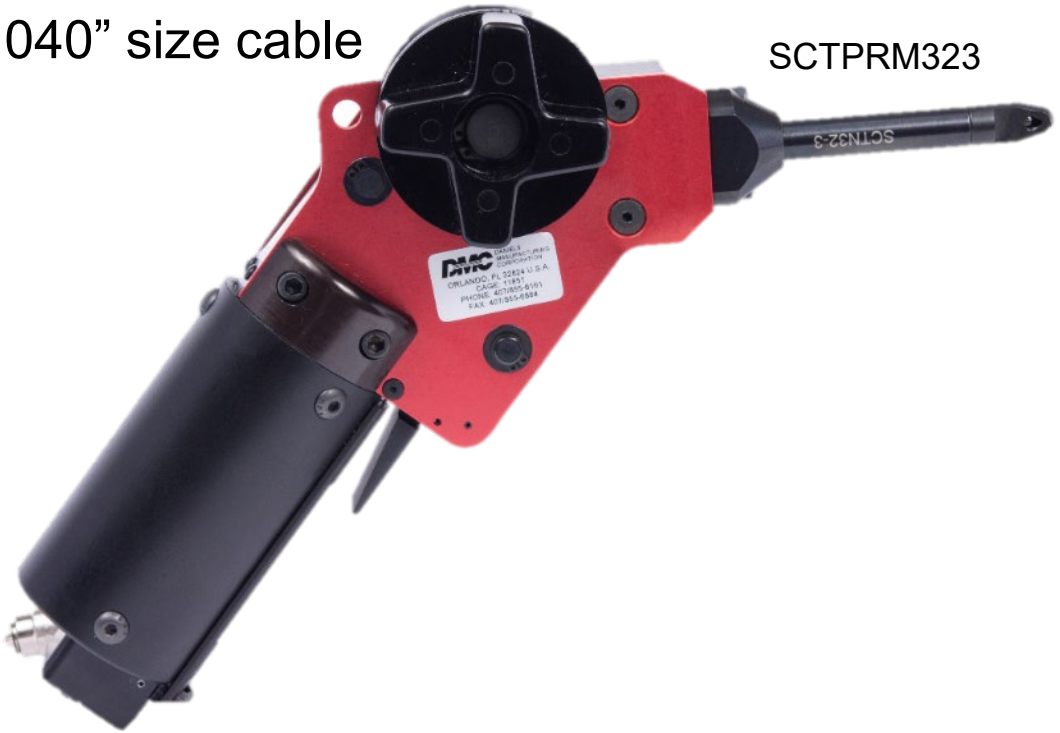
- Pre-Set tension tools have a factory-set tension and can terminate the cable with a single hand.
- Multiple actuations of the tool handle will draw the cable into the tool until all slack is removed from the cable.
- When the tool senses the correct tension (pre-set at the factory), it will shift into the crimp-cut mode and complete the installation of the Safe-T-Cable® on the next closure of the handle.

SCT403

Safe-T-Cable Tools

Pneumatic

- Pneumatic-powered tools are ideal for high-production environments.
- Lightweight
- Ergonomic design
- Available in adjustable tension and pre-set tension options
- Accommodate .022”, .032”, and .040” size cable



Safe-T-Cable Tools

Battery Powered

- Battery-powered tools make crimping cable easier and faster, while also improving operator ergonomics.
- Available in adjustable tension versions
- Covers all cable sizes
  - .022”, .032”, .040”, and .062”
- New features allow the operator to track tool performance, users, and projects. Crimp data is viewable in real-time on the LED display, or can be downloaded via Bluetooth® to an app.

SCTE323C SCTE625C

Verification Equipment

Verification Block

- The torque verification block and a push force tester are used to periodically check the tensioning mechanisms.
- This verification equipment is intended to apply the minimum pull-off loads while ensuring flex limits are met.

SCT-TB1

SCTD013

SCTD0001

Verification Equipment

Motorized Pull Tester

- A motorized pull tester, MPT-250C-SC, may be used to capture and export data from tool indenter setting tests.
- The MPT-250C-SC is made up of the MPT-250C and 15-3318 grip set and is used for tensile testing .022”, .032”, and .040” Safe-T-Cable.

MPT-250C
& 15-3318

Verification Equipment

Spanner Wrench

- Crimp depth may be adjusted by the user
- The Spanner tool is used to unlock the adjustment screw
- Operators can tighten/loosen the adjustment screw behind the tool nose

SCT32084

Standards and Classifications

NAS and SAE

- National Aerospace Standards
  - NASM33540 (MIL-STD-33540) “Safety Wiring, Safety Cabling, Cotter Pinning, General Practices”
- SAE International
  - AS567 Safety Cable, Safety Wire, Key Washers, and Cotter Pins for Production Systems, and Use
  - AS3509 Cable, Safety, Kit, Nickel Alloy, UNS N06600
  - AS3510 Cable, Safety, Kit, Corrosion and Heat-Resistant Steel, UNS S32100
  - AS3618 Cable, Safety, Ferrule, Elongated, Corrosion and Heat-Resistant Steel, UNS S32100
  - AS3619 Cable, Safety, Ferrule, Elongated, Nickel Alloy, UNS N06600
  - AS3655 Cable, Safety, Kit, Corrosion Resistant Nickel Alloy, UNS N06625
  - AS4536 Cable, Safety, Kit, Procurement Specification for Requirements and Use

Standards and Classifications

U.S. Military Use

- Safe-T-Cable is included in many technical manuals (TM) and technical orders (TO) used by the U.S. military and foreign military sales organizations to support aircraft, aerospace, and defense systems.
- TO-1-1A-8
- TO-1-1A-14
- TO-1-1A-15
- TM 1-1500-204-23-6
- TM 1-1500-323-24-1
- NAVAIR 01-1A-505-1
- NAVSEA MIL-STD-763
- ARMY MICOM, Drawing 13210868
- NA 01-1A-505-1
- NA 01-1A-8
- TO 00-25-255-1
- TM 1-1500-323-24-2

Standards and Classifications

Commercial and OEM Use

- GE Aircraft Engines: 70-11-01-400-005 “Standard Practices Manual”
- Pratt & Whitney: PWA 316 “Safety Wire, Safe-T-Cable and Cotter-pin Installation”
- Rolls Royce: JES 138 “Locking Devices and Practices”
- Boeing: BAC 5018 “Installation of Safetying Devices”
- Airbus: AIPI 03-06-003 “Locking by Wire”
- NASA: CR4473 “Test Plan and Report”

Thank You