High Quality Termination, Project Management Fundamentals for Studio Design

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Audio Engineering Society
Pacific Northwest Section

January 2009 Meeting

About Aaron:

- Broadcast Systems installer for over a decade
- Large Scale installations include:
  - EMP
  - XBOX Studios
  - ESPN
  - DirectTV
  - High Definition 53’ Expando Trailers
  - High End Residences and Mega Yachts

Tonight's Meeting:

- High Quality Audio and Video Cable Termination
- JW Tel-Tronics recommendations and best practices
- Based on NASA workmanship Standards
  - we will refer to these throughout the evening
- Break
- 2nd part of the meeting will focus on Project Management Fundamentals for Studio Design and Installation

High Quality Audio and Video Cable Termination

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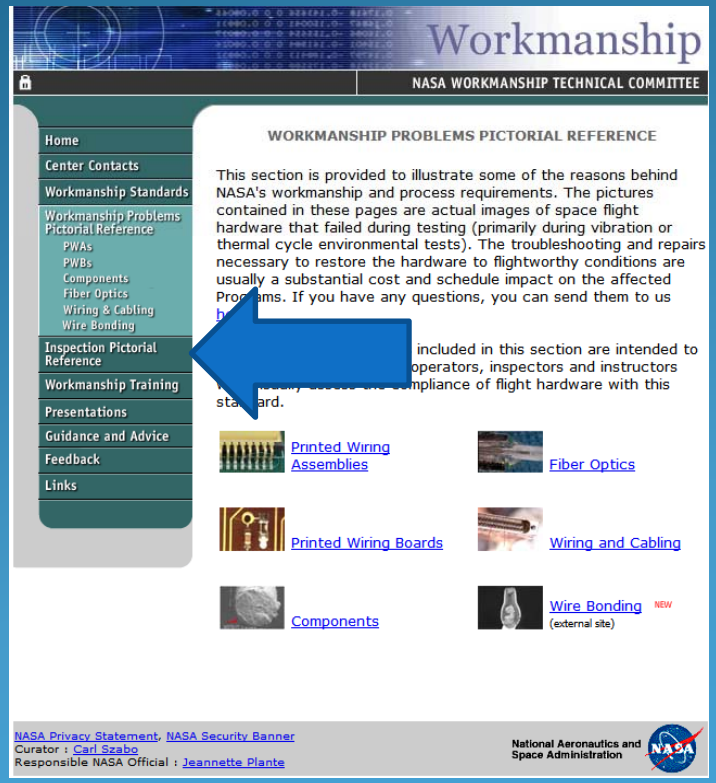
NASA Workmanship Standards:



- http://workmanship.nasa.gov/
- A quality assurance resource
- Available to the community online – and downloadable in PDF format
- Inspection Pictorial Reference
- We will focus on the most common cable terminations used in typical studio environments

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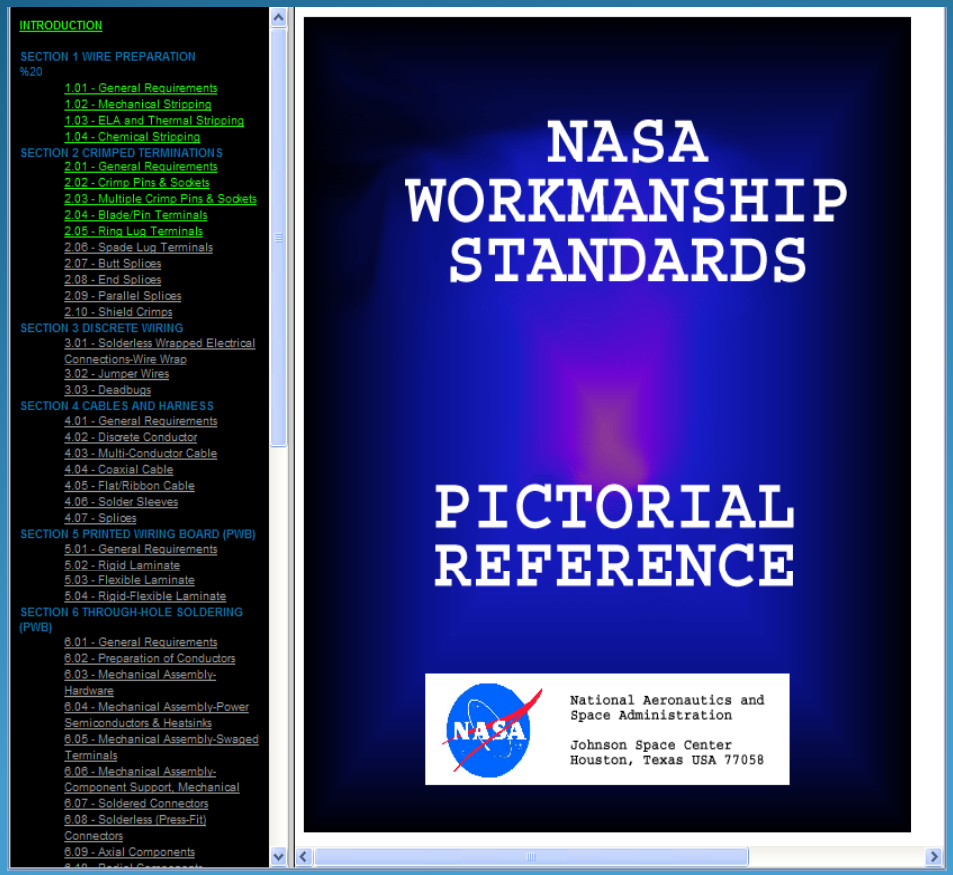

- Wire Preparation
  - General Requirements
  - Mechanical Stripping
- Crimped Terminations
  - General Requirements
  - Pins and Sockets
  - Multiple Crimp Pins
- Solder Cups
  - SOLDERED ELECTRICAL CONNECTIONS – NASA-STD 8739.3 with Change 3

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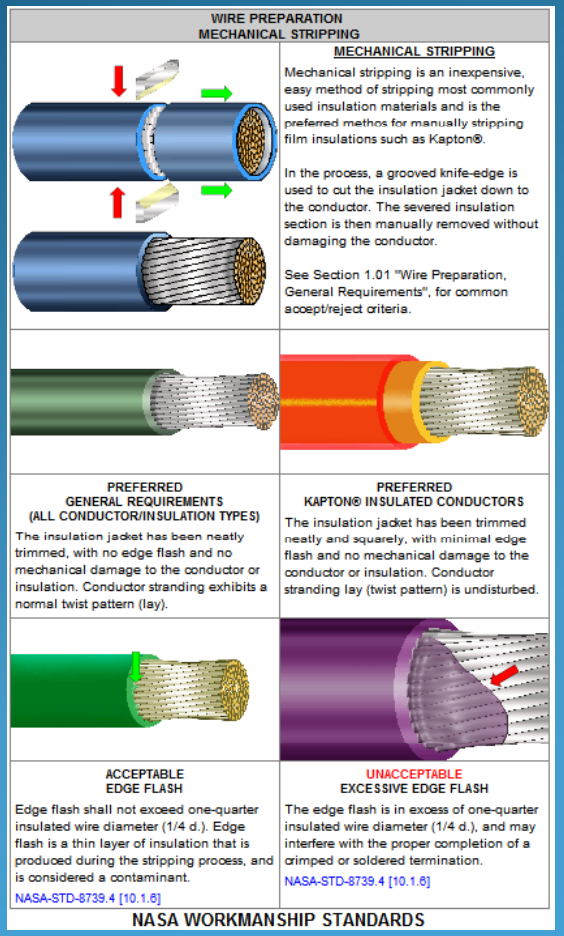
Wire Preparation: Mechanical Stripping



- Three quality levels:
  - Preferred
    - Perfect quality workmanship – zero defect
  - Acceptable
    - Minor defects – not critical to performance or reliability
  - Unacceptable
    - Damage and defects leading to potential failures over time – not reliable

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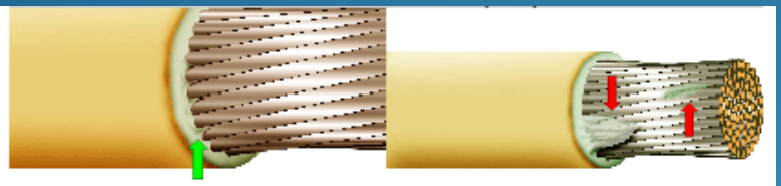
Wire Preparation: Common Mechanical Stripping Issues



ACCEPTABLE
EDGE FLASH

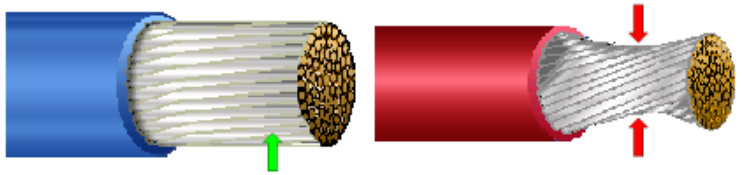
Edge flash shall not exceed one-quarter insulated wire diameter (1/4 d). Edge flash is considered a contaminant, which may interfere with crimped or soldered terminations.

NASA-STD-8739.4 [10.1.6]

UNACCEPTABLE
EDGE FLASH/SMEARING

The edge flash is in excess of one-quarter insulated wire diameter (1/4 d), and the stripped section exhibits smearing (melted insulation/film) which is considered a contaminant.

NASA-STD-8739.4 [10.1.6]



ACCEPTABLE
RETWISTED LAY

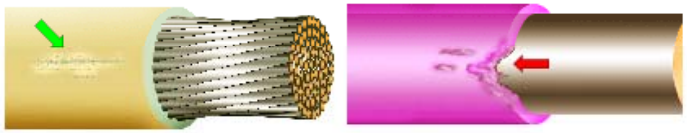
If the twist pattern (lay) of wire strands is disturbed, it shall be restored as nearly as possible to the original pattern. Retwisted lay is acceptable, provided no other damage is evident.

NASA-STD-8739.3 [7.2.4]
NASA-STD-8739.4 [10.1.4], [19.6.1.a.2]

UNACCEPTABLE
OVERTWISTED STRANDS

Strands twisted in excess of the normal twist pattern (lay) exert increased stress on individual strands, and may result in conductor breakage.

NASA-STD-8739.3 [7.2.4]
NASA-STD-8739.4 [10.1.4]



ACCEPTABLE
SCUFFED INSULATION/JACKET

Slight scuffing (a dull or rubbed appearance) of the insulation surface finish is acceptable, provided no other damage is evident.

NASA-STD-8739.3 [7.2.2]
NASA-STD-8739.4 [10.1.2]

UNACCEPTABLE
DAMAGED INSULATION/JACKET

The conductor insulation and /or cable jacket shall not exhibit any damage, such as nicks, cuts, or charring. Conductors/Jackets exhibiting damage (other than minor scuffing) shall not be used.

NASA-STD-8739.3 [13.6.2.a.1]
NASA-STD-8739.4 [19.6.2.a.2]

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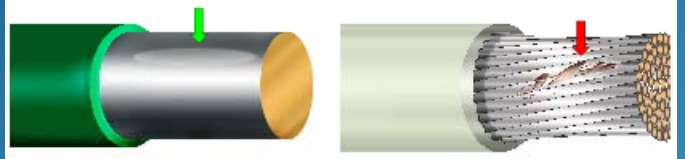
Wire Preparation: Common Mechanical Stripping Issues

WIRE PREPARATION
GENERAL REQUIREMENTS (cont.)



ACCEPTABLE
SMOOTH TOOL IMPRESSION MARKS

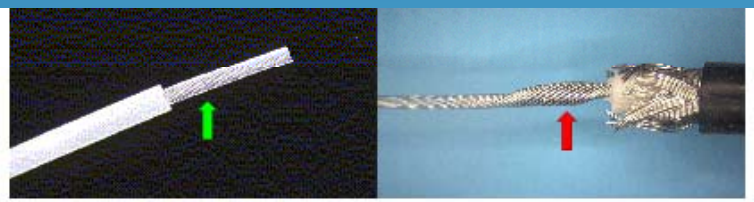
Smooth tool impression marks (slight cuts, nicks, scratches or scrapes) on the conductor surface, which do not expose base metal or reduce cross-sectional area, are acceptable.

NASA-STD-8739.3 [7.2.3]
NASA-STD-8739.4 [10.1.3]

UNACCEPTABLE
CONDUCTOR DAMAGE

Cuts, nicks, scratches or scrapes which reduce the conductor's overall cross-sectional area, reduce the current carrying capability and/or expose conductor base metal are rejectable.

NASA-STD-8739.3 [7.2.3], [13.6.2.a.8]
NASA-STD-8739.4 [10.1.3], [19.6.2.a.2]



ACCEPTABLE
STRANDING LAY/TWIST PATTERN

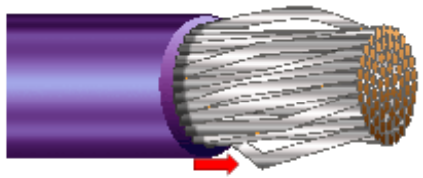
Conductor stranding exhibits a normal twist pattern (lay).

NASA-STD-8739.3 [7.2]
NASA-STD-8739.4 [10.1], [19.6.1.a]

UNACCEPTABLE
DISTURBED LAY

Standard conductors exhibiting a disturbed twist pattern (lay) shall be rejected. Stranding which has been returned to the original lay is acceptable, provided no other damage is present.

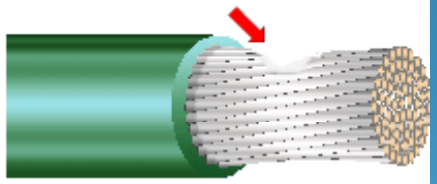
NASA-STD-8739.3 [7.2.4]
NASA-STD-8739.4 [10.1.4], [19.6.1.a.2]



UNACCEPTABLE
BIRDCAGED STRANDS

Birdcaged strands are typically the result of poor handling. The strands may be returned to the original twist pattern (lay), provided no other damage is present.

NASA-STD-8739.3 [7.2.4], [13.6.2.a.4]



UNACCEPTABLE
CRUSHED STRANDS

Crushed strands are an indicator of improper tooling, resulting in reduced conductor cross-sectional area, reduced current carrying capability and reduced reliability.

NASA-STD-8739.3 [7.2.3]
NASA-STD-8739.4 [10.1.3], [19.6.2.a.2]

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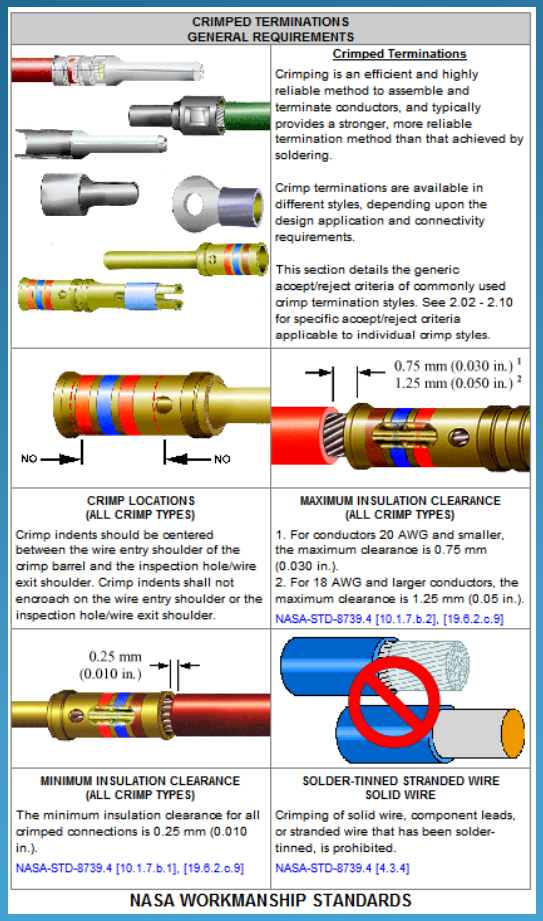
Crimped Terminations: General Requirements



- "Crimping is an efficient and highly reliable method to assemble and terminate conductors, and typically provides a stronger, more reliable termination method than that achieved by soldering."

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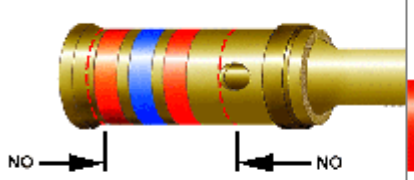
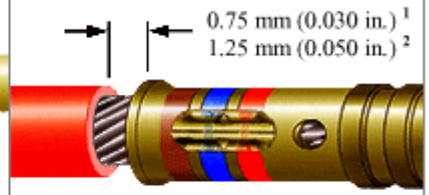
Crimped Terminations: Common Issues



CRIMP LOCATIONS
(ALL CRIMP TYPES)

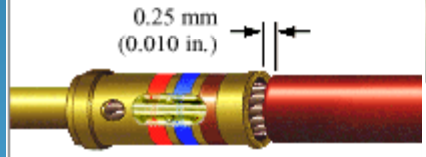
Crimp indents should be centered between the wire entry shoulder of the crimp barrel and the inspection hole/wire exit shoulder. Crimp indents shall not encroach on the wire entry shoulder or the inspection hole/wire exit shoulder.



MAXIMUM INSULATION CLEARANCE
(ALL CRIMP TYPES)

1. For conductors 20 AWG and smaller, the maximum clearance is 0.75 mm (0.030 in.).
2. For 18 AWG and larger conductors, the maximum clearance is 1.25 mm (0.05 in.).

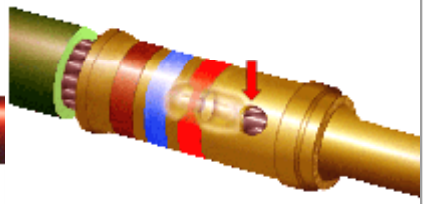
NASA-STD-8739.4 [10.1.7.b.2], [19.6.2.c.9]



MINIMUM INSULATION CLEARANCE
(ALL CRIMP TYPES)

The minimum insulation clearance for all crimped connections is 0.25 mm (0.010 in.).

NASA-STD-8739.4 [10.1.7.b.1], [19.6.2.c.9]



UNACCEPTABLE
IMPROPER CRIMP LOCATION
(INSPECTION HOLE)

The indents shall not encroach on or distort the inspection hole.

NASA-STD-8739.4 [19.6.2.c.7]

SOLDER-TINNED STRANDED WIRE
SOLID WIRE

Crimping of solid wire, component leads, or stranded wire that has been solder-tinned, is prohibited.

NASA-STD-8739.4 [4.3.4]

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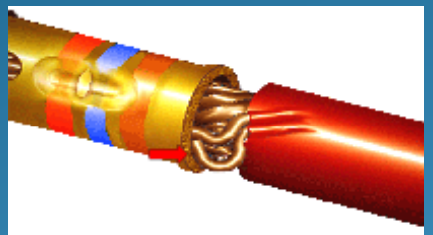
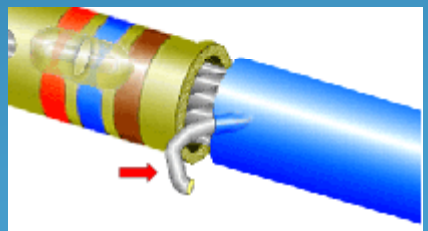
Crimped Terminations: Common Issues



UNACCEPTABLE
BIRDCAGED STRANDS

Birdcaged strands reduce the conductor's overall strength and increase the possibility of shorting.

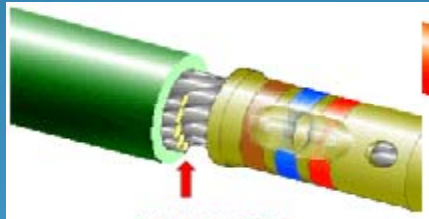
NASA-STD-8739.4 [19.6.2.c.3]



UNACCEPTABLE
PROTRUDING STRANDS

Protruding strands reduce the current capacity of the termination, and present a puncture, sharp object damage or shorting risk.

Best Workmanship Practice



UNACCEPTABLE
WIRE MODIFIED TO FIT

Modifying wires to fit the crimp barrel reduces the current carrying capacity and mechanical reliability of the conductor-crimp termination.

NASA-STD-8739.4 [4.3.5.a], [12.3.3], [19.6.2.a.2]

UNACCEPTABLE
WIRE STRANDS NOT VISIBLE
(PIN/CLOSED BARREL CRIMPS)

Wire strands not visible in the inspection hole indicate that the conductor may not be properly inserted and shall be cause for rejection.

NASA-STD-8739.4 [19.6.2.c.4]

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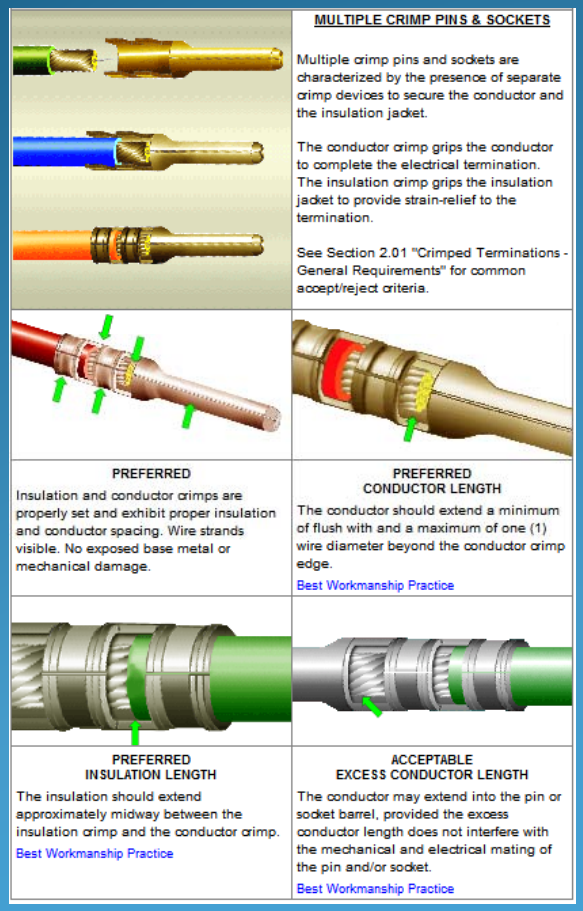
Multiple Crimped Pins & Sockets



- "Multiple crimp pins and sockets are characterized by the presence of separate crimp devices to secure the conductor and the insulation jacket."
- "The conductor crimp grips the conductor to complete the electrical termination. The insulation crimp grips the insulation jacket to provide strain-relief to the termination."

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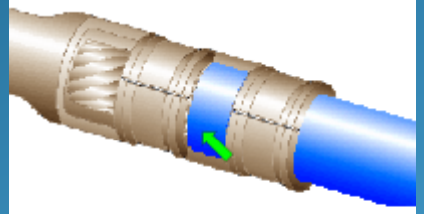
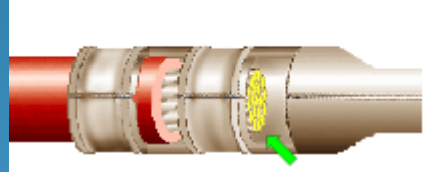
Multiple Crimped Pins & Sockets: Common Issues



ACCEPTABLE
EXCESS INSULATION LENGTH

The insulation may extend to the leading edge of the conductor crimp, provided it can be determined visually that the insulation does not enter the conductor crimp.

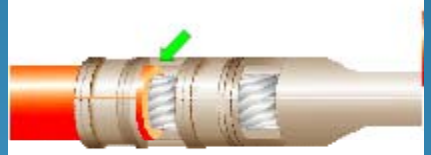
Best Workmanship Practice



ACCEPTABLE
MINIMUM CONDUCTOR LENGTH

The conductor should extend a minimum of flush with the conductor crimp edge.

Best Workmanship Practice



ACCEPTABLE
MINIMUM INSULATION LENGTH

At a minimum, the insulation edge may be flush with the trailing edge of the insulation crimp.

Best Workmanship Practice

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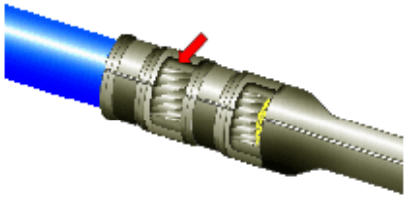
Multiple Crimped Pins & Sockets: Common Issues

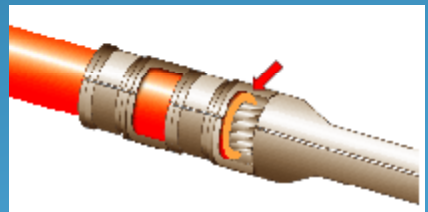


UNACCEPTABLE

IMPROPER STRAIN RELIEF

The insulation jacket must extend beyond the edge of the insulation crimp, and the crimp must fully engage the jacket to ensure proper strain-relief to the termination.

NASA-STD-8739.4 [19.6.2.c.9]

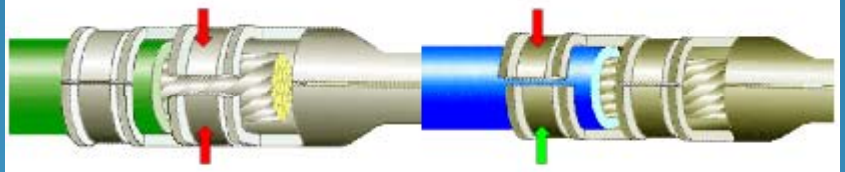


UNACCEPTABLE

INSULATION ENCROACHMENT

Insulation encroachment into the conductor crimp section may interfere with the proper mechanical and electrical termination of the crimp.

NASA-STD-8739.4 [19.6.2.c.9]



UNACCEPTABLE

INCOMPLETE CONDUCTOR CRIMP

An incomplete or improper conductor crimp will produce a conductor-crimp termination with reduced mechanical strength and reduced reliability.

NASA-STD-8739.4 [19.6.2.c.6]

UNACCEPTABLE

INCOMPLETE INSULATION CRIMP (MULTIPLE CRIMP PINS/SOCKETS)

An incomplete or improperly set insulation crimp will produce a termination with reduced mechanical strength and reduced reliability.

NASA-STD-8739.4 [19.6.2.c.6]

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Solder Cups (Connector Type)

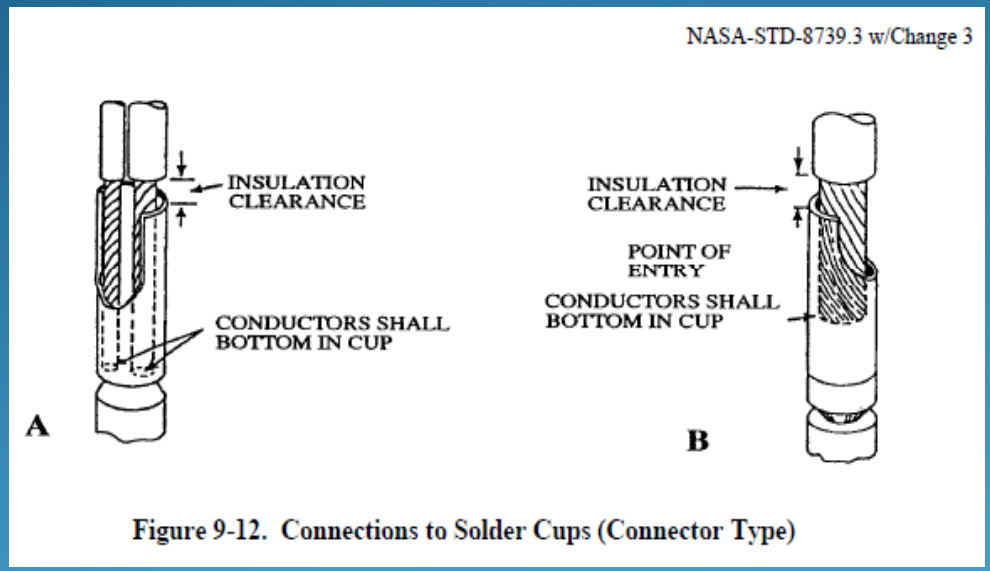

Figure 9-12. Connections to Solder Cups (Connector Type)

- "Conductors shall enter the solder cup as shown in Figure 9-12 (Requirement). Conductors shall be bottomed in the cup and shall be in contact with the inner wall of the cup (Requirement). The maximum number of conductors shall be limited to those that can be in contact with the full height of the inner wall of the cup (Requirement)."

- http://www.hq.nasa.gov/office/codeq/doctree/NS87393.pdf
- **SOLDERED ELECTRICAL CONNECTIONS – NASA-STD 8739.3 with Change 3**

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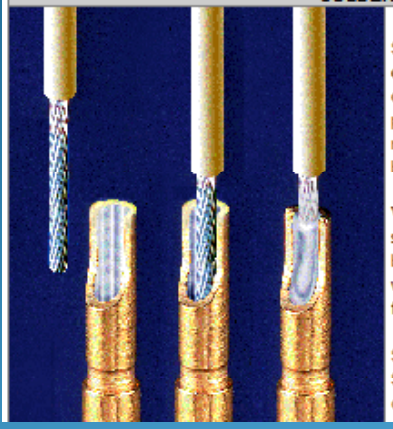
Solder Cups: Preferred and Acceptable Examples

THROUGH-HOLE SOLDERING
SOLDER CUPS



SOLDER CUPS

Solder cup terminals are primarily designed for the in-line solder termination of conductors. This style of terminal is principally designed as a precision-machined pin for insertion into connector bodies.

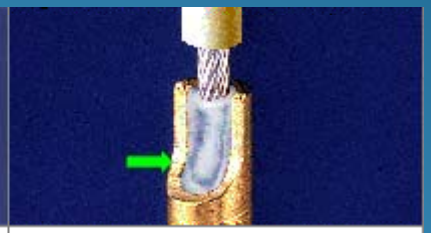
Variations include connectors in which the solder cup pin is captive in the connector body (i.e.: hermetic connectors), or printed wiring board mounted terminals designed for discrete wire terminations.

See Section 6.01 "Through-Hole Soldering, General Requirements", for common accept/reject criteria.

PREFERRED
INTERIM ASSEMBLY

The wire has been inserted straight into the cup, is in contact with the back wall for the full depth of the cup and bottoms in the cup. The assembly exhibits proper insulation gap and the cup interior has been pretinned.

NASA-STD-8739.3 [9.6]



PREFERRED
COMPLETED ASSEMBLY

The solder shall form a fillet between the conductor and the cup entry slot, and shall follow the contour of the cup opening.

NASA-STD-8739.3 [10.2.3]

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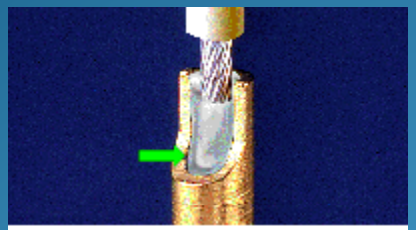
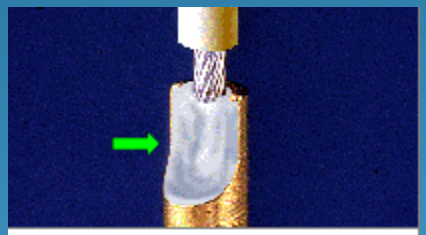
Solder Cups: Common Issues



ACCEPTABLE
MINIMUM SOLDER

The solder quantity is sufficient to follow the contour of the cup opening. The termination is fully wetted with complete, slightly concave, fillets between the wire and the cup wall. Solder fill is at least 75%.

NASA-STD-8739.3 [10.2.3.a]



ACCEPTABLE
MAXIMUM SOLDER

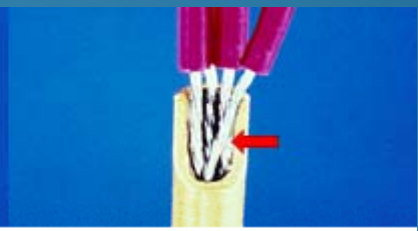
The solder quantity is the maximum acceptable, but does not spill over (exceed the diameter of the cup), or exhibit a convex profile.

NASA-STD-8739.3 [10.2.3.b]

ACCEPTABLE
MULTIPLE TERMINATIONS

The maximum number of conductors that can be inserted into the cup is limited to those that can be in contact with the full height of the back wall of the cup. All wires shall exhibit proper insulation gaps, but do not need to exhibit equal gaps.

NASA-STD-8739.3 [9.6]



UNACCEPTABLE
EXCESSIVE CONDUCTORS

The number of conductors inserted exceeds the number than can be in contact with the full height of the back wall of the cup.

NASA-STD-8739.3 [9.6]

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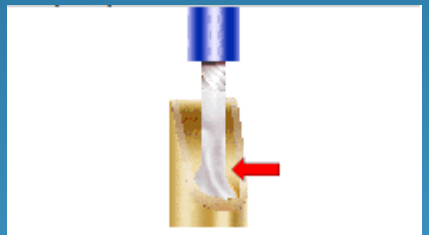
Solder Cups: Common Issues

UNACCEPTABLE
EXCESS SOLDER

The solder does follow the contour of the cup opening and spills over (exceeds the diameter of the cup) with a convex profile.

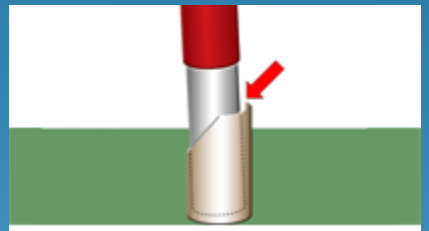
NASA-STD-8739.3 [10.2.3.a], [13.6.2.b.6]



UNACCEPTABLE
INSUFFICIENT SOLDER QUANTITY

The solder quantity is insufficient to follow the contour of the cup opening. The termination is fully wetted, but exhibits incomplete fillets along the conductor. Solder surface is not visible in bottom of cup.

NASA-STD-8739.3 [10.2.3.a], [13.6.2.b.7]



UNACCEPTABLE
IMPROPER INSTALLATION

The wire has been inserted for the full depth, but is not in contact with the back wall of the cup.

NASA-STD-8739.3 [9.6], [13.6.2.a.5]

UNACCEPTABLE
SPILLAGE

The solder deposit interferes with the form, fit or function of the connector.

NASA-STD-8739.3 [10.2.3.b], [13.6.2.b.6]

High Quality Termination, Project Management Fundamentals for Studio Design

Break Time

Project Management Fundamentals for Studio Design and Installation (and whatever service you provide)

Project Management:

- Project Management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements.
- A project is a finite endeavor.
- What is about to be covered can be used as an itemized invoice for Engineering Services – which many in the audience provide…

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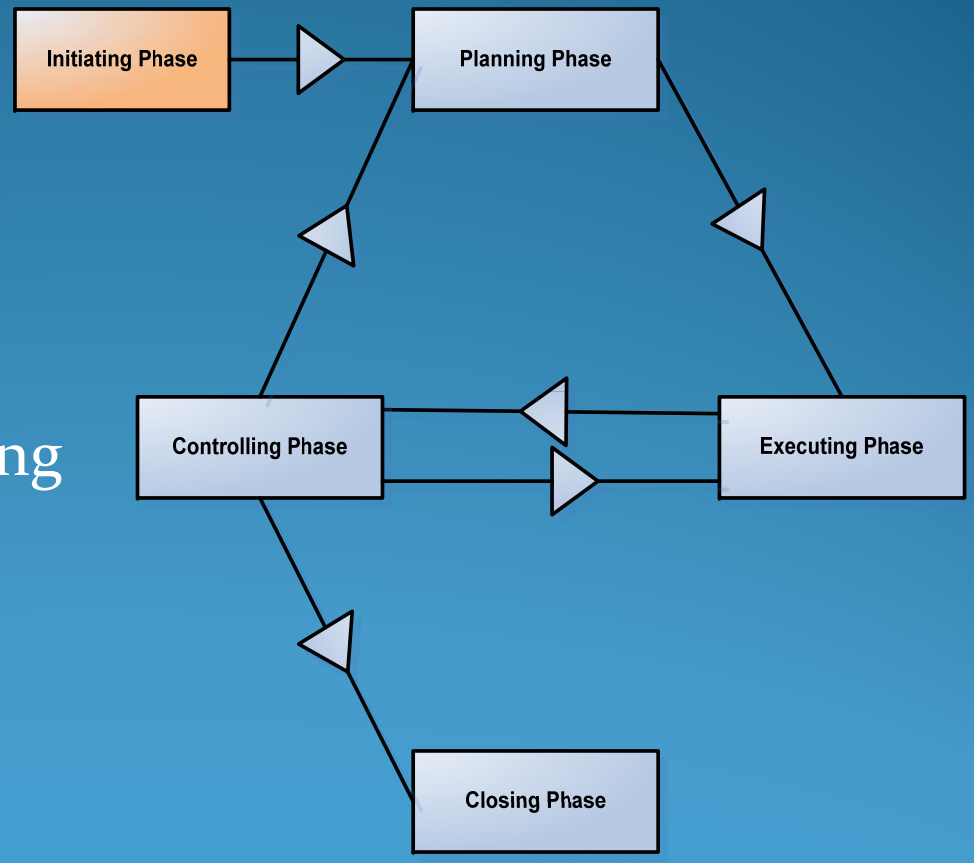
Project Life Cycle

- Initiating
- Planning
- Executing
- Monitoring and controlling
- Closing



Project Planning:

- This is the formalization of processes we naturally use in getting things done:

- Statement Of Work
- Develop Preliminary Scope Statement
- Develop Project Plan
- Execution
- Monitoring and Control
- Closeout Project

Project Planning: Statement of Work

- The clock starts and the project begins with the Statement of Work
- The Statement of Work is an agreement which includes a preliminary scope statement that defines the boundaries for a given project
- Growth is managed via change orders

Project Planning: The Project Plan

Develop Project Plan

- Scope Planning
  - Scope Definition
  - Create WBS (Work Breakdown Structure)
- Time Management
  - Activity Sequencing
  - Activity Duration Estimating
  - Schedule Development
- Cost Management
  - Cost estimating
  - Cost Budgeting
- Quality Management Plan
- Human Resources Plan
- Communications Plan
- Risk Management
  - Risk Identification
  - Risk Response Plan
- Procurement Plan
  - Purchases and Acquisitions
  - Contractors

Project Execution:

- Direct and Manage Project Execution
- Perform Quality Assurance
- Acquire Project Team
- Develop Project Team
- Information Distribution

Monitoring and Control:

- Monitor and Control Work
- Integrate Change Control
- Scope Verification
- Scope Control (avoid the dreaded Scope Creep)
- Schedule Control
- Cost Control
- Quality Control
- Risk Monitoring and Control

Closeout Project:

- Is the Statement Of Work fulfilled?
- Are Change Orders complete?
- Are Acceptance Criteria met?

- Ship it.
- Final Invoice.

High Quality Termination, Project Management Fundamentals for Studio Design

Thank you for attending tonight!

Special thanks to TK Artist Lofts
And Sari Breznau for the meeting space tonight