

SIXTEENTH ANNUAL

**BiTS**™

**Burn-in & Test Strategies Workshop**

March 15 - 18, 2015

Hilton Phoenix / Mesa Hotel  
Mesa, Arizona



**Archive – Session 4**

## Session 4

Rafiq Hussain  
Session Chair

BiTS Workshop 2015 Schedule

## Performance Day

Tuesday March 17 8:00 am

### Material Magic

#### "Reliability and Failure over Time"

Mike Gedeon - Materion

#### "Using Cold Heading Technology and Deutsch Coat to Produce Test Probes & Spring Contacts "

Jimmy L. Johnson - Tyco Electronics

#### "APEX Glass for Burn-In and Test Sockets"

Jeb H. Flemming & Tim Foster - 3D Glass Solutions, Inc.

#### "C3 Coating : Solution for IC Testing"

Bert Brost & Valts Treibergs - Xcerra Corporation

Nakaya Katsura - Kobelco Research Institute, Inc.

## Copyright Notice

The presentation(s)/paper(s) in this publication comprise the Proceedings of the 2015 BiTS Workshop. The content reflects the opinion of the authors and their respective companies. They are reproduced here as they were presented at the 2015 BiTS Workshop. This version of the papers may differ from the version that was distributed in hardcopy & softcopy form at the 2015 BiTS Workshop. The inclusion of the presentations/papers in this publication does not constitute an endorsement by BiTS Workshop or the workshop's sponsors.

There is NO copyright protection claimed on the presentation content by BiTS Workshop. However, each presentation is the work of the authors and their respective companies: as such, it is strongly encouraged that any use reflect proper acknowledgement to the appropriate source. Any questions regarding the use of any materials presented should be directed to the author(s) or their companies.

The BiTS logo and 'Burn-in & Test Strategies Workshop' are trademarks of BiTS Workshop. All rights reserved.

## Using Cold Heading Technology and Deutsch Coat to Produce Test Probes & Spring Contacts

**Jim L. Johnson**  
**Tyco Electronics**



2015 BiTS Workshop  
March 15 - 18, 2015



## Discussion Topics

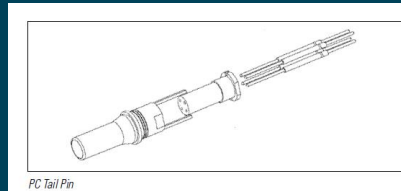
- What is Cold Heading?
- Advantages of cold heading vs. screw machining.
- What kind of parts can be made using cold heading technology?
- Selective plating Au cost savings.
- Advantages of Deutsch Coat compared to Au over Ni plating.
- Wish List

## The Cold Heading Process Contact Types

Power, 5105



Quadrax



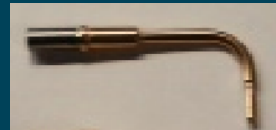
Solder Cup



Signal



PCB



Crimped



Coax



Thermocouple

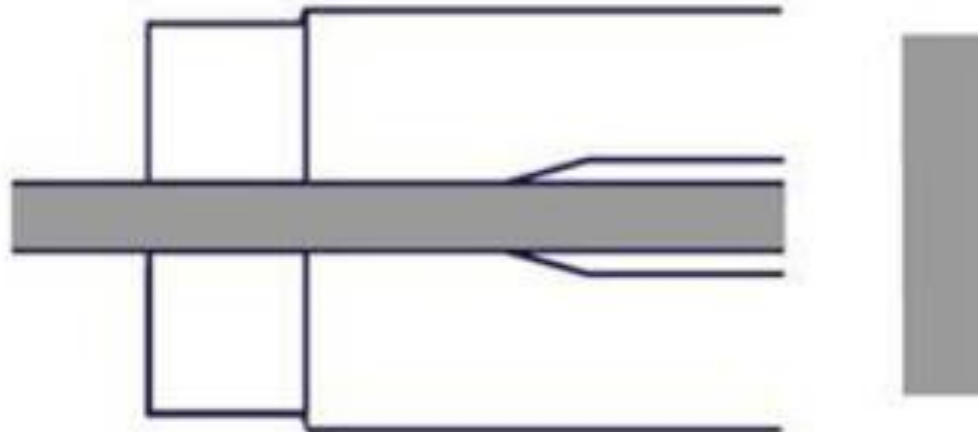


Aluminum



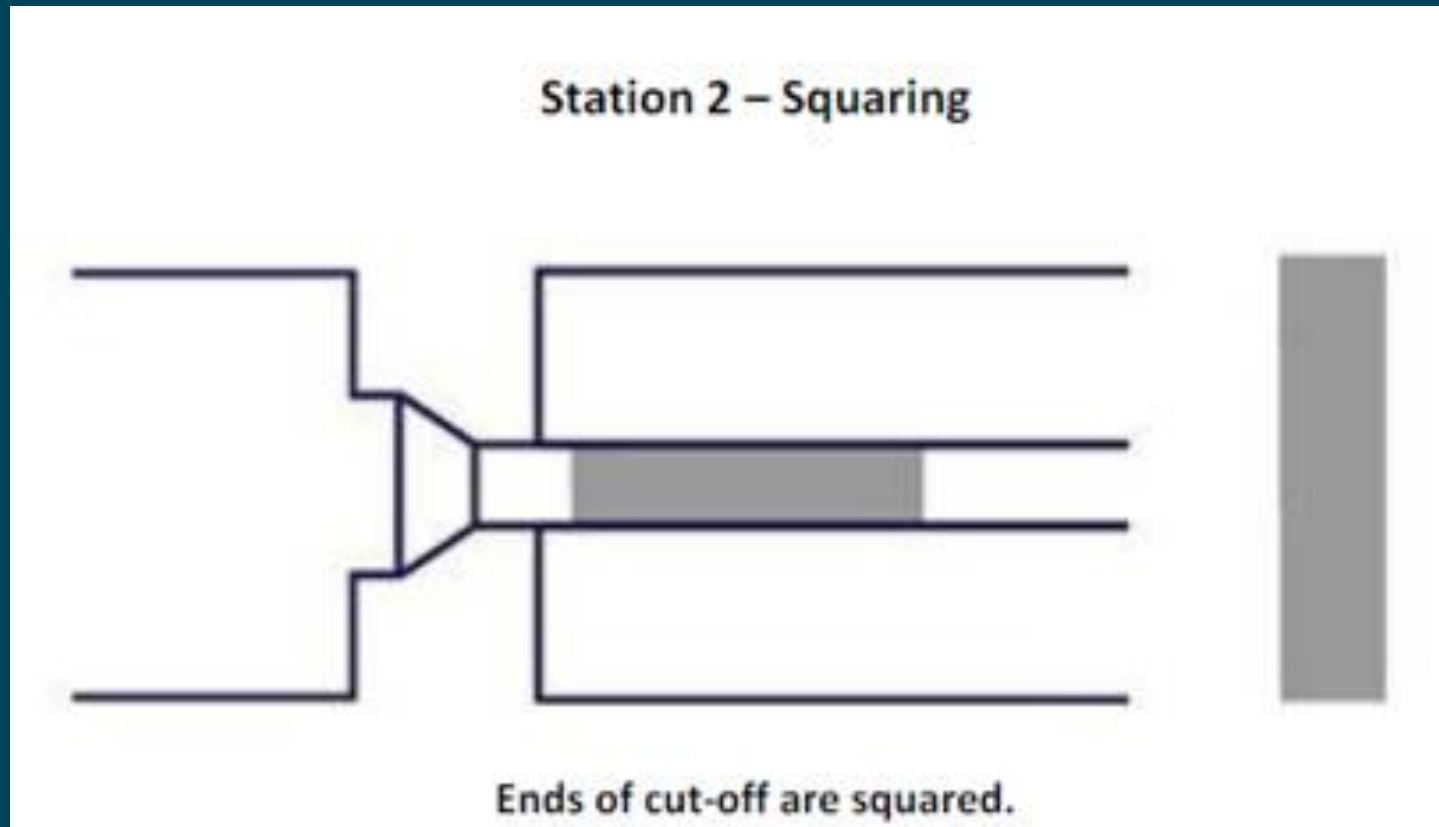
# The Cold Heading Process

Simplified Representation of Deutsch Cold Heading Process  
Station 1 – cut-off



Coiled wire is fed into cold-former.  
Slug is cut off to specified length.

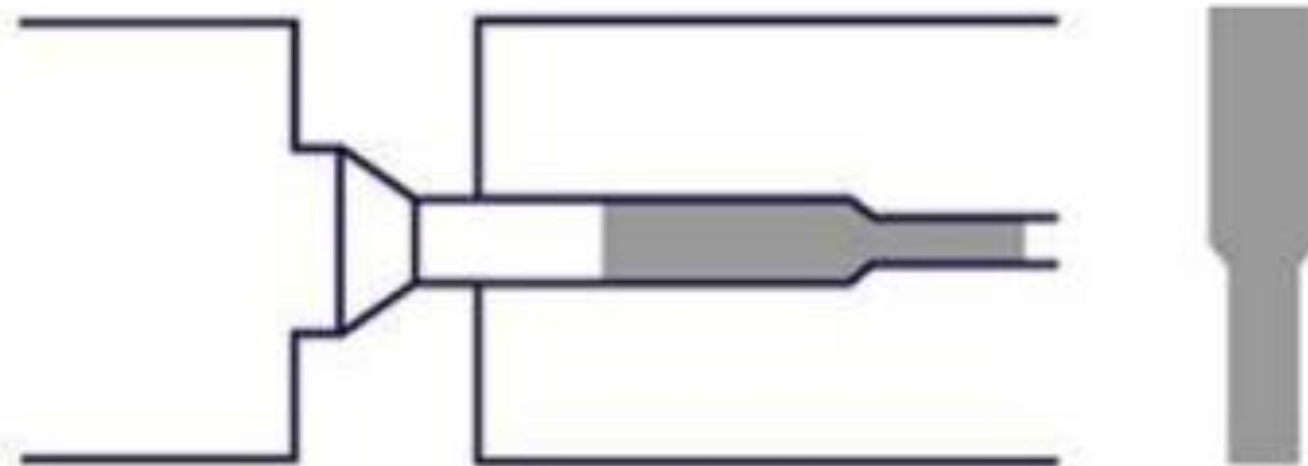
# The Cold Heading Process





# The Cold Heading Process

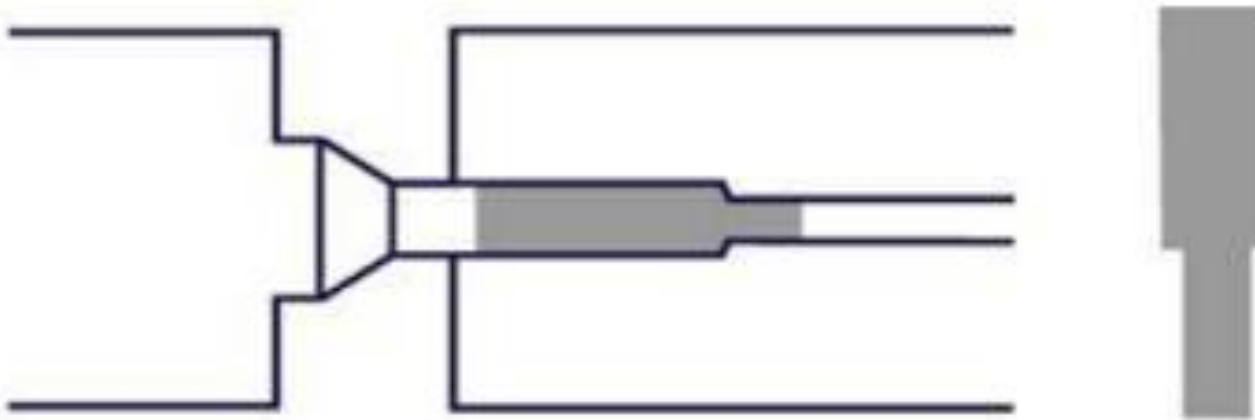
## Station 3 – Impact extrusion



Extrusion punch forces squared cut-off through die orifice forming the smaller diameter.

# The Cold Heading Process

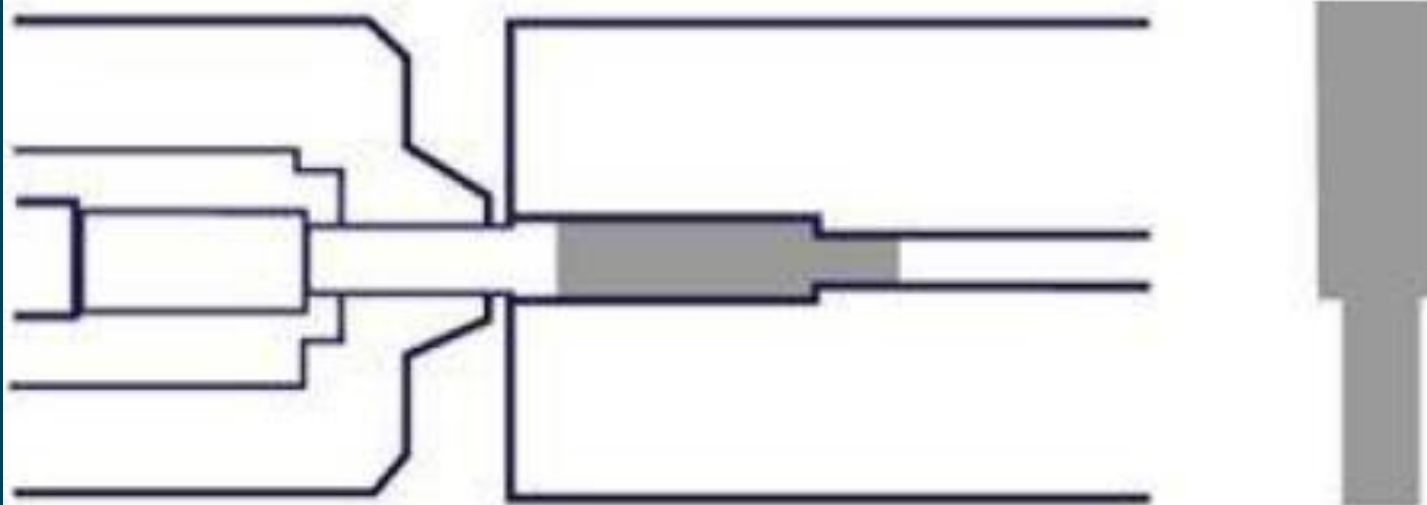
Station 4 – 2<sup>nd</sup> blow extrusion



Shoulder is squared, and centering marks formed in ends to assist in subsequent operations.

# The Cold Heading Process

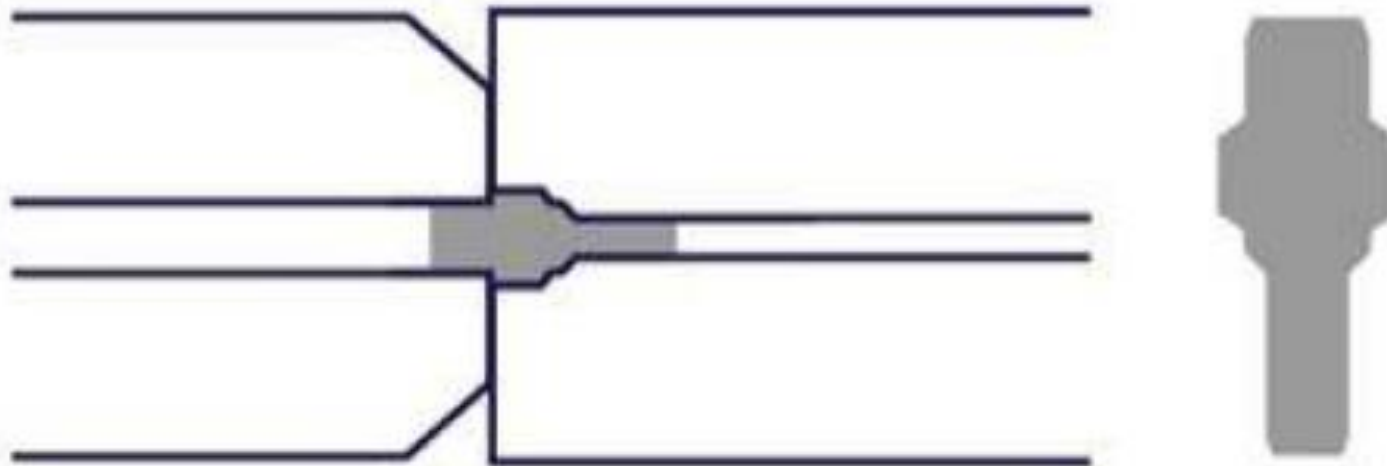
Station 5 – Backward extrusion



Center hole is formed through backward extrusion.

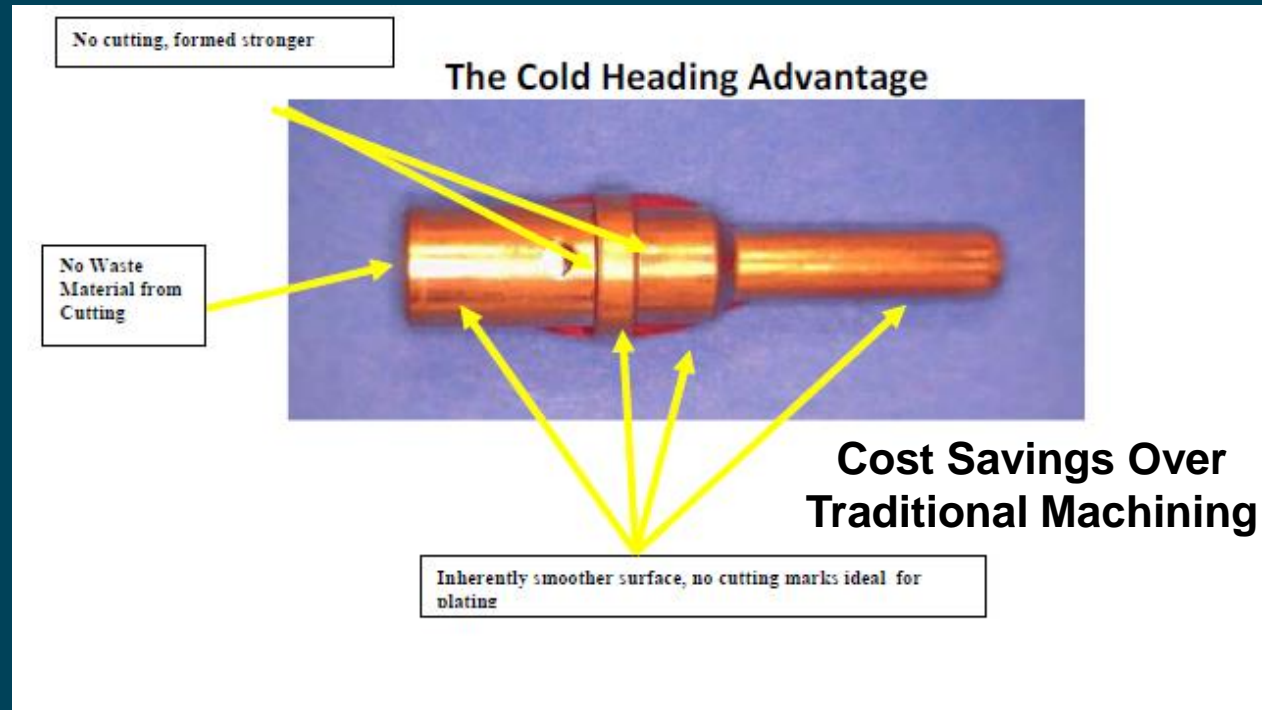
# The Cold Heading Process

Station 6 – Forward extrusion



Taper is formed above large shoulder.  
Two smaller shoulders are formed and stem is  
forward extruded.

# The Cold Heading Process



## Frequently Used Materials:

- C19150, Leaded Copper Nickel
- C17410, Low Be, Copper Beryllium
- C17510, Low Be, Copper Beryllium
- C17200, Hi Be, Leaded Copper Beryllium

## TE-Oceanside Contact Production



Cold Heading

Proprietary Equipment

Secondary Ops  
Machining



Secondary Ops  
Z.A. & H.T.

Proprietary Equipment

Assembly,  
Painting



Assembly, Interference  
Fit Sleeves



Plating

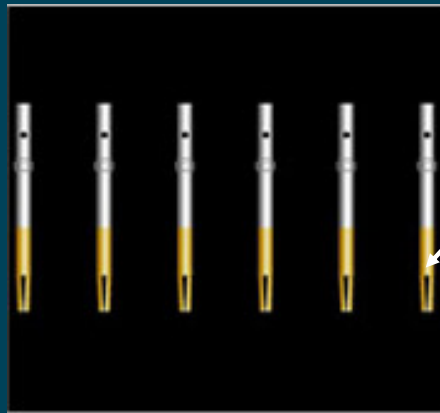


Using Cold Heading Technology & Deutsch Coat to Produce Test Probes and Spring Contacts

# Selective Au Plating



- Selective gold plating technology is used to apply precious metal mainly in the contact area, reducing the amount of gold required resulting in a lower cost.
- It is not unusual for the plating cost associated with electrical contact to make up 70% of the overall cost.
- The shoulder (see example) and center of gravity are used to align contacts properly for selective plating using vibratory bowl feeders and walking beams



**Selective plated at contact area with Au**

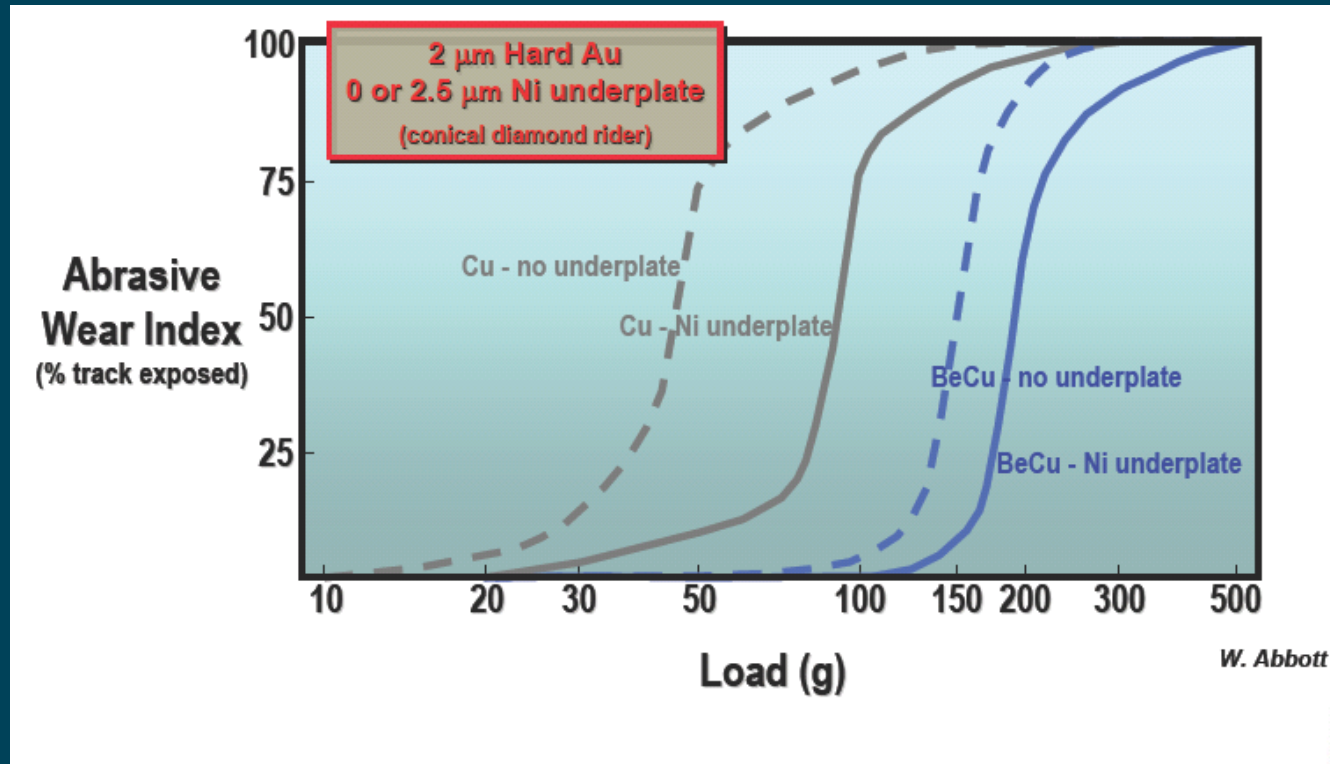
**Selectively plated with heavy Au in contact area & Au flash all over**



**Shoulder**

# Deutsch Coat Contacts

## Plating Wear





# Deutsch Coat Contacts

## Advantages of Deutsch Coat

- Harder than gold
- Improved wear resistance
- Lower cost than gold
- Extremely corrosion resistant

## Disadvantages of Deutsch Coat

- Higher stress deposit compared to gold plating



## Typical Test Plan for M39029 Contact Qualification

ENVIRONMENTAL LABORATORY REQUEST FOR TESTING						
PROJECT: Low Cost Contact				FOR LAB USE ONLY		
Revision C				TEST REPORT NO.: DTR		
REQUESTED BY: James Friedhof			DATE IN: 141208		DATE DUE:	
PURPOSE: To test Next generation low cost contact to AS39029 and Mil-Dtl-38999 requirements				ASSIGNED TO:		
ITEM NO	TEST SPECIMEN	TYPE		SOURCE	QTY.	DESCRIPTION
		STD.	MOD.	PROTO	STOCK	
Group A 1-30	M39029/56-351 38941-20		X	X		30
Group B 31-60	6162-360-2090 38941-20	X			X	30
Group C 61-90	38943-20L 38941-20	X			X	30
ASSEMBLY INFORMATION: Plug Connector: DTS26F19-325N Receptacle Connector: DTS20F19-32P Backshell: MS5049/38319N						
WIRE TYPE: AS22759-9 WIRE LENGTH:						
SPECIAL TOOLS						
SPECIAL EQUIPMENT:						
TEST SEQUENCE	TEST SPEC. OR STANDARD	PARA. REQUIREMENT	PARA. METHOD	INSTRUCTIONS		
<b>GROUP 1 AS39029</b>				Group A: Items 1-10 Group B: Items 31-40 Group C: Items 61-70 Each group 5 pieces Min Wire/5 pieces Max wire		
Low signal contact resistance	AS39029	3.5.3.1	4.7.4			
Contact resistance (25 deg)	AS39029	3.5.4	4.7.5			
Contact Eng and Sep	AS39029	3.5.5	4.7.6			
Thermal shock	AS39029	3.5.6	4.7.7			
Contact Eng and Sep	AS39029	3.5.5	4.7.6			
Resistance to probe damage	AS39029	3.5.7	4.7.8			
Contact Eng and Sep	AS39029	3.5.5	4.7.6			
Contact Resistance (25 deg)	AS39029	3.5.4	4.7.5			
Low signal contact resistance	AS39029	3.5.3.1	4.7.4			
Contact resistance (25 deg)	AS39029	3.5.4	4.7.5			
<b>GROUP 2 AS39029</b>				Group A: Items 11-20 Group B: Items 41-50 Group C: Items 71-80 Each group 5 pieces Min Wire/5 pieces Max wire Wire Connector per attached Drawing		
Low signal contact resistance	AS39029	3.5.3.1	4.7.4			
Contact resistance (25 deg)	AS39029	3.5.4	4.7.5			
Contact Eng and Sep	AS39029	3.5.5	4.7.6			
Durability	AS39029	3.5.9	4.7.10			

**Durability** is the major difference between stand contacts plated using Ni and Au and contacts using the Deutsch Coat

# Typical Test Plan for M39029 Contact Qualification

## 3.5.9 Durability (Types A, B and D)

When tested as specified in 4.7.10, the contacts shall show no evidence of defects detrimental to the mechanical or electrical performance when subjected to 500 mating cycles.

**Deutsch Coat increases durability  
by 3X to 1500 cycles**

## 4.7.10 Durability (Types A, B and D) (see 3.5.9)

Contacts shall be installed in a qualified connector and shall be subjected to 500 cycles of mating and unmating at a rate of 300 cycles per hour maximum. The depth of the engagement shall not be less than 70% of the minimum bore depth (see Figure 5). The connector coupling devices may be removed for this test.

The low signal level contact resistance of mated contact pairs shall be measured in accordance with EIA-364-23 at 25 °C  $\pm$  3 °C with the pin contact engaged to a depth of .7L (see Figure 5).

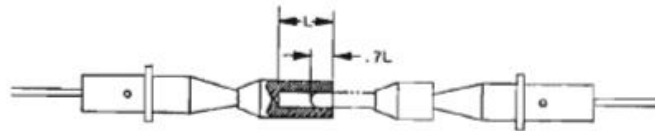


FIGURE 5 - DEPTH OF ENGAGEMENT FOR CONTACT RESISTANCE AND ENGAGEMENT AND SEPARATION FORCE TESTS

## Wish List

- Find a partner(s) for evaluating the feasibility to cold head BiTS test probes
- Determine if it is cost effective to use cold heading to produce components of a traditional spring probe in lieu of machining

## References

# 39029 Test Groups

TABLE 12 - QUALIFICATION INSPECTION (TYPES A AND B CONTACTS) (CONTINUED)

Inspection	Requirement Paragraph 1/	Test Paragraph	Number of Sample Units to be Inspected					
			Max Wire Size		Min Wire Size			
			Size 12 and Smaller	Size 10 and Larger	Size 12 and Smaller	Size 10 and Larger	Size 12 and Smaller	Size 10 and Larger
GROUP IV								
Examination of product	3.1, 3.3, 3.4, 3.6, 3.7	4.7.1						
Permeability 2/	3.5.1	4.7.2						
Preparation of samples	---	4.3.2						
Examination-wired contacts	---	4.7.1.1						
Axial concentricity (wired)	3.5.2.2	4.7.3.2						
Low signal level contact resistance 2/	3.5.3.1	4.7.4	8	-	4	-	4	-
Contact resistance (size 12 only)	3.5.4	4.7.5						
Industrial gas 5/	3.5.14	4.7.15						
Contact resistance (size 12 only)	3.5.4	4.7.5						
Low signal level contact resistance 2/	3.5.3.1	4.7.4						
Contact strength 2/	3.5.15	4.7.16						
GROUP V 2/								
Examination of product	3.1, 3.3, 3.4, 3.6, 3.7	4.7.1						
Permeability	3.5.1	4.7.2						
Axial concentricity (unwired)	3.5.2.1	4.7.3.1						
Preparation of samples	---	4.3.2	8	4	4	2	4	2
Examination-wired contacts	---	4.7.1.1						
Axial concentricity (wired)	3.5.2.2	4.7.3.2						
Crimp tensile strength	3.5.8	4.7.9						
GROUP VI 8/								
Examination of product	3.1, 3.3, 3.4, 3.7	4.7.1	4	-	-	-	-	-
Plating porosity 5/	3.5.16	4.7.17						
GROUP VII 8/								
Examination of product	3.1, 3.3, 3.4, 3.7	4.7.1	4	2	-	-	-	-
Plating thickness	3.5.17	4.7.18						
GROUP VIII 2/								
Examination of product	3.1, 3.3, 3.4, 3.7	4.7.1						
Preparation of samples	---	4.3.2	8	-	4	-	4	-
Examination-wired contacts	---	4.7.1.1						
Low signal level contact resistance	3.5.3.1	4.7.4						
Contact resistance (25 °C)	3.5.4	4.7.5						
Humidity-temperature cycling	3.5.21	4.7.22						
Low signal level contact resistance	3.5.3.1	4.7.4						
Contact resistance (25 °C)	3.5.4	4.7.5						

1/ Individual requirements paragraphs may exempt certain sizes or types of contacts from some tests in the sequence.

2/ Type A only.

3/ Not applicable to wire barrel size 28 and smaller.

4/ Initial qualification only.

5/ Integrity of color code not required after test.

6/ For socket contacts, conduct tests prior to assembly of hoods and springs. Unassembled parts shall be submitted to the qualifying activity.

7/ For localized gold finished contacts only.

8/ Test Group shall only be performed by the qualifying activity.

# 39029 Test Groups

SAE

AS39029C

Page 30 of 93

## 4.4.2.2 Type C

The contacts shall be submitted for qualification inspection specified in Table 13, in the order shown.

TABLE 13 - QUALIFICATION INSPECTION (TYPE C CONTACTS)

Inspection	Requirement Paragraph 1/	Test Paragraph	Number of Sample Units to be Inspected
GROUP I			
Examination of product	3.1, 3.3, 3.4, 3.7	4.7.1	
Axial concentricity (unwired)	3.5.2.1	4.7.3.1	8 samples size 16 and smaller
Preparation of samples	—	4.3.1	
Axial concentricity (wired)	3.5.2.2	4.7.3.2	
Contact engagement and separation force	3.5.5	4.7.6	
Vibration 2/ 3/	3.5.10	4.7.11	
Shock (specified pulse) 2/ 3/	3.5.11	4.7.12	
Contact engagement and separation force	3.5.5	4.7.6	
GROUP II 4/			
Examination of product	3.1, 3.3, 3.4, 3.7	4.7.1	
Axial concentricity (unwired)	3.5.2.1	4.7.3.1	8 samples size 16 and smaller
Preparation of samples	—	4.3.1	
Axial concentricity (wired)	3.5.2.2	4.7.3.2	
Contact engagement and separation force	3.5.5	4.7.6	
Crimp tensile strength	3.5.8	4.7.9	

1/ Individual requirements paragraphs may exempt certain sizes or types of contacts from some tests in the sequence

2/ Not applicable to wire barrel size 28 and smaller

3/ Initial Qualification only

4/ Test Group shall only be performed by the qualifying activity