

From MS/ENB	Our reference Prijo Ulahannan	Phone +91 80 6783 6100	E-Mail Prijo.ulahannan@in.bosch.com	Date: 12-Aug-2022 Report No.: Ather_03_TR
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Report:	Test report
Title:	Terminal (General requirements and mechanical) test
Customer:	Ather India

Document approval		
	Name	Signature
Prepared by	Prijo Ulahannan	
Reviewed by	Mahantesh Ramannavar	

1. Issues (situation, motivation and tasks)

The Ather Company has designed and developed a charging connector for electric vehicles, which is patented. Ather has approached Bosch (BGSW) to validate the charging connector between the vehicle and the charging station according to IS 17017 selective tests as prescribed by Ather requirements

Terminal crimped with terminals (signal :0.50 sqmm & power: 25 sqmm) were used for test. The task was to check the terminal crimp strength with specified force values. Test and acceptance criteria are as per **IS 17017** chapter no.13.1 and 13.3 to check the functionality of the samples.

2. Results, short version

	o.k.	not o.k.
2.1 Visual inspection of plastic parts for cracks and breakage (New condition)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.2 Terminal common requirement for non-rewirable accessories	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.3 Mechanical Tests on Terminals	<input checked="" type="checkbox"/>	<input type="checkbox"/>

The overall result of the examined samples is:

- ☒ **Positive**
☐ **Negative: No further analysis required**

Recommendation for further work: NA

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3. Conclusions and consequences

All terminal samples have passed the test. All the test parameters are within the specified limit of assessment criteria.

4. Results, long version

- Plastic parts and terminals inspected before test for abnormalities like cracks, burrs, rust and breakage. All the samples subjected to test were in good/acceptable condition → **OK**

4.1 Common Requirements of terminals- OK (See chapter 5.4 for criteria)

4.1.1 Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective permanent connections (terminations).

4.1.2 Terminals shall allow the conductor to be connected without special preparation.

4.1.3 Parts of terminals shall be of a metal having, under conditions occurring in the equipment, mechanical strength, electrical conductivity, and resistance to corrosion adequate to intended use.

4.1.4 Terminals shall be properly fixed to the accessory and shall not loosen when connecting and disconnecting the conductors.

4.1.5 Each terminal shall be in proximity to the other terminals

4.1.6 When the conductors have been correctly fitted, there shall be no risk of accidental contact between live parts of different polarity or between such parts and accessible metal parts, and, should a wire of a stranded conductor escape from a terminal, there shall be no risk

4.2 Mechanical Tests on Terminals – OK (See chapter 5.4 for criteria)

4.2.1 Test to check the terminal so that it does not slip out or break clamping unit.

4.2.2 Terminal pull test

5. Details

5.1 Part details:

Sl. No.	Description	Part number	Manufacture date / Received date	Remarks
1	Power terminal	-----	July-2022	Crimped with 25 Sqmm wire
2	Signal terminal	-----	July-2022	Crimped with 0.5 Sqmm wire

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5.2 Equipment details:

Sl. No.	Test equipment	Equipment no.	Remarks
1	UTM	ENB/CL/002-1027832	Location: BGSW
2	Test set up with rotating table	ATS-025	Location: External lab (NABL - TC-7419)

5.3 Sample preparation, test setup and test details:

5.3.1 Terminal common requirement for non-rewirable accessories

1. Visual inspection of plastic parts conducted on all the samples before test.
2. To check the terminal common requirements (13.1.2, 13.1.3, 13.1.6, 13.1.7 and 13.1.9) inspection is done on the parts and checking is performed as per the standard requirements.
3. To check the percentage of copper in the terminal following inspection is made
4. Terminal material details were collected, and measurement of terminal thickness is performed.
5. After that Terminal plating measurements are performed, and values were compared.
6. Same procedure was followed for the all the other samples

5.3.2 Mechanical Tests on Terminals

1. Visual inspection of plastic parts conducted on all the samples before test.
2. 3 samples smallest conductor cross- sectional area and three with the largest conductor cross-sectional area are used for test.

Test to check the terminal so that it does not slip out or break clamping unit

3. The end of the conductor is passed through an appropriate-sized bushing in a platen, positioned at a height H below the accessory, as given in Table 7 (See chapter 5.4).
4. The bushing is positioned in a horizontal plane, such that it describes a circle of 75 mm diameter
5. Platen is then rotated at a rate of 10 ± 2 rev/min. Test duration is 15 min per sample.
6. Same procedure was followed for the all the other samples.

Terminal pull test

7. The conductors shall be connected to the clamping unit.
8. Each conductor is subjected to a pull according to the value in Table 8, exerted in the opposite direction to that in which the conductor was inserted. The pull is applied without jerks for 1 min.
9. Same procedure was followed for the all the other samples.
10. See pictures in chapter 6 Enclosure.

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5.4 Test conditions and assessment criteria:

5.4.1 Terminal general requirement - assessment criteria

1. Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective permanent connections (terminations).
 - Compliance is checked by inspection.
2. Terminals shall allow the conductor to be connected without special preparation.
 - Compliance is checked by inspection.
3. Parts of terminals shall be of a metal having, under conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate to intended use.

(Examples of suitable metals, when used within a permissible temperature range and under normal conditions of chemical pollution, are copper or an alloy containing at least 58 percent copper for parts that are worked cold or at least 50 percent copper for other parts)

Current-carrying parts, which may be subjected to mechanical wear, shall not be made of steel. provided with an electroplated coating of silver (Ag) or comparable material of same resistance.

- Compliance is checked by inspection.
4. Terminals shall be properly fixed to the accessory and shall not loosen when connecting and disconnecting the conductors.
 - Compliance is checked by inspection.
 5. Each terminal shall be in proximity to the other terminals
 - Compliance is checked by inspection.
 6. When the conductors have been correctly fitted, there shall be no risk of accidental contact between live parts of different polarity or between such parts and accessible metal parts, and, should a wire of a stranded conductor escape from a terminal, there shall be no risk
 - Compliance is checked by inspection.

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5.4.2 Test to check the terminal so that it does not slip out or break clamping unit

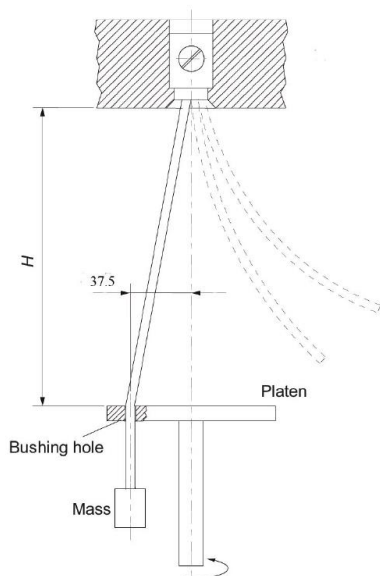


Table 7 Values for Flexing under Mechanical Load Test

(Clause 13.3.1)

Nominal Cross-Sectional area	Diameter of Bushing	Height ¹⁾	Mass
mm ²	mm	mm	kg
1.0	6.5	260	0.4
1.5	6.5	260	0.4
2.5	9.5	280	0.7
4.0	9.5	280	0.9
6.0	9.5	280	1.4
10.0	9.5	280	2.0
16.0	13.0	300	2.9
25.0	13.0	300	4.5
35.0	14.5	300	6.8
50.0	15.9	343	9.5
70.0	19.1	368	10.4
95.0	19.1	368	14.0
120.0	22.2	406	14.0

Asessemnt Criteria:

During the test, the conductor shall neither slip out of the clamping unit nor break near the clamping unit. Terminals shall not, during this test, damage the conductor in such a way as to render it unfit for further use.

5.4.3 Termianl pull test

Table 8 Value for Terminal Pull Test

(Clause 13.3.2)

Nominal Cross- Sectional Area	Pulling Force
mm ²	N
1	35
1.5	40
2.5	50
4	60
6	80
10	90
16	100
25	135
35	190
50	236
70	285
95	351
120	427

Asessemnt Criteria:

During the test, the conductor shall not slip out of the terminal nor shall it break at, or in, the clamping unit.

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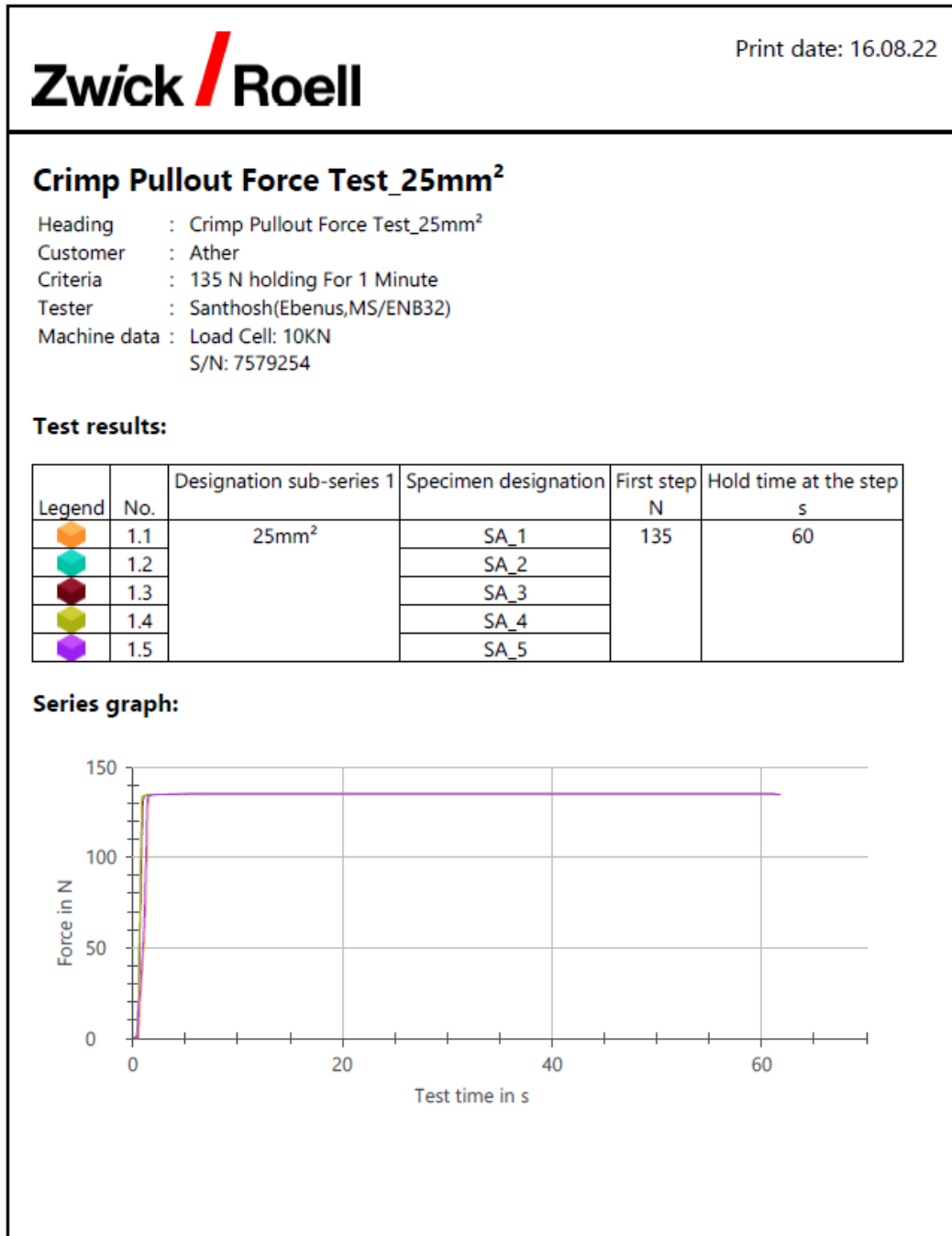
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6. Enclosure

6.1 Characteristic curves for mechanical test on terminals



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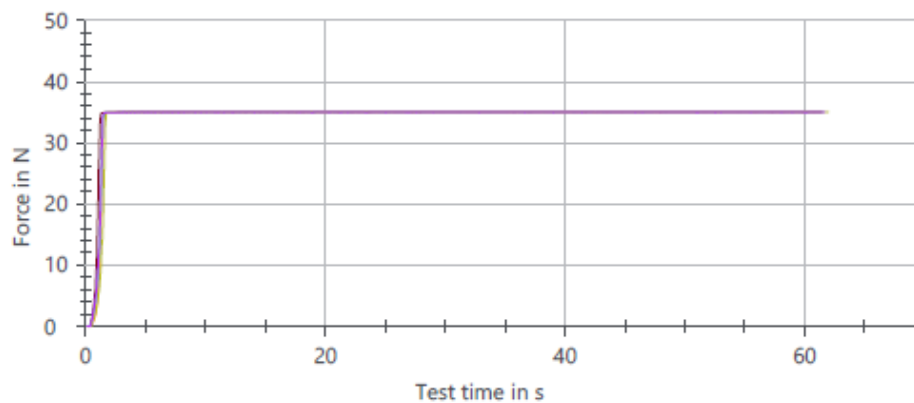
Crimp Pullout Force Test_0.5mm²

Heading : Crimp Pullout Force Test_0.5mm²
Customer : Ather
Criteria : 35N Hold For 1 Minute
Tester : Santhosh(Ebenus,MS/ENB32)
Machine data : Load Cell: 10KN
S/N: 7579254

Test results:

Legend	No.	Designation sub-series 1	Specimen designation	First step N	Hold time at the step s
	1.1	0.5mm ²	SA_1	35	60
	1.2		SA_2		
	1.3		SA_3		
	1.4		SA_4		
	1.5		SA_5		

Series graph:



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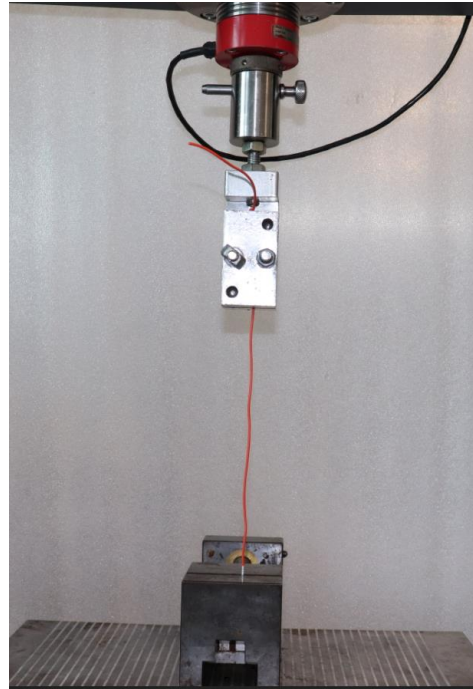
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6.2 Test pictures

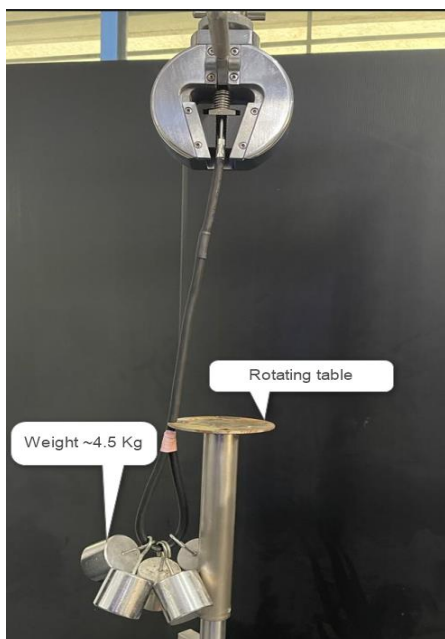
Pic 1: Test set up crimp pull test



Pic 2: Test set up crimp pull test



Pic 4: Test set up terminal slip test



Pic 5: Test set up terminal slip test



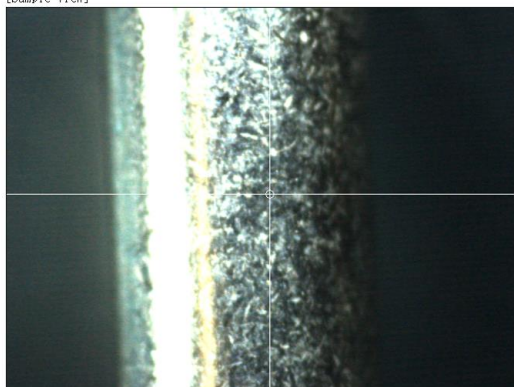
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6.3 Material thickness measurement

Example 1

Measure. system	FT110A ID 0661
Analysis File	Ag_Ni_CuSn4 Base_0.05mmC.ffp
Tube Target Elem	W
Date	2022/ 8/16 17:55

[Sample View]



[Analysis Result]

Ag	0.63 (um)
Ni	1.86 (um)

[Analysis Conditions]

Application Mode	Film Analysis (FP)
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No	Name	Elem	Thickness	Intensity
1	Au		0.24	
		Ag	100.00 (wt%)	308.273 (cps)
	Ni		5.84	
		Ni	100.00 (wt%)	6.384 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	76.930 (cps)
		Sn	4.60 (wt%)	0.000 (cps)

2	Au		2.05	
		Ag	100.00 (wt%)	88.308 (cps)
	Ni		3.05	
		Ni	100.00 (wt%)	70.632 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	254.128 (cps)
		Sn	4.60 (wt%)	0.000 (cps)

3	Au		4.50	
		Ag	100.00 (wt%)	179.496 (cps)
	Ni		1.90	
		Ni	100.00 (wt%)	17.090 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	133.455 (cps)
		Sn	4.60 (wt%)	0.000 (cps)

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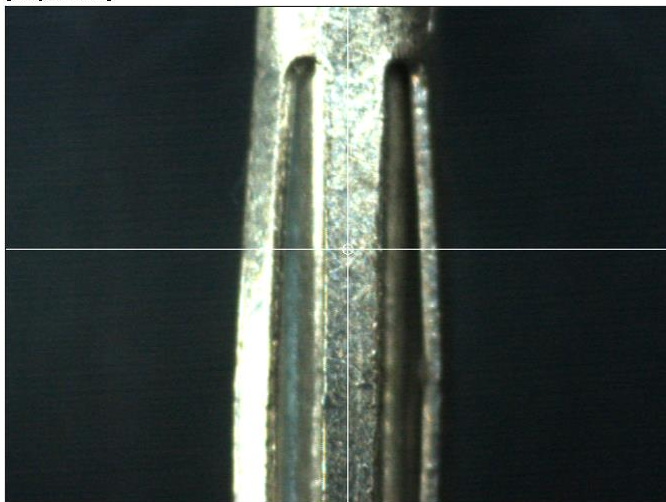
E-Mail
Prijo.ulahannan@in.bosch.com

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Example 2

Measure. system	FT110A ID_0661
Analysis File	Ag_Ni_CuSn4 Base_0.05mmC.ffp
Tube Target Elem	W
Date	2022/ 8/16 17:45

[Sample View]



[Analysis Result]

Ag	0.33 (um)
Ni	3.16 (um)

[Analysis Conditions]

Application Mode		Film Analysis (FP)		
No	Name	Elem	Thickness	Intensity
1	Au		0.24	
		Ag	100.00 (wt%)	308.273 (cps)
	Ni		5.84	
		Ni	100.00 (wt%)	6.384 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	76.930 (cps)
		Sn	4.60 (wt%)	0.000 (cps)
2	Au		2.05	
		Ag	100.00 (wt%)	88.308 (cps)
	Ni		3.05	
		Ni	100.00 (wt%)	70.632 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	254.128 (cps)
		Sn	4.60 (wt%)	0.000 (cps)
3	Au		4.50	
		Ag	100.00 (wt%)	179.496 (cps)
	Ni		1.90	
		Ni	100.00 (wt%)	17.090 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	133.455 (cps)
		Sn	4.60 (wt%)	0.000 (cps)

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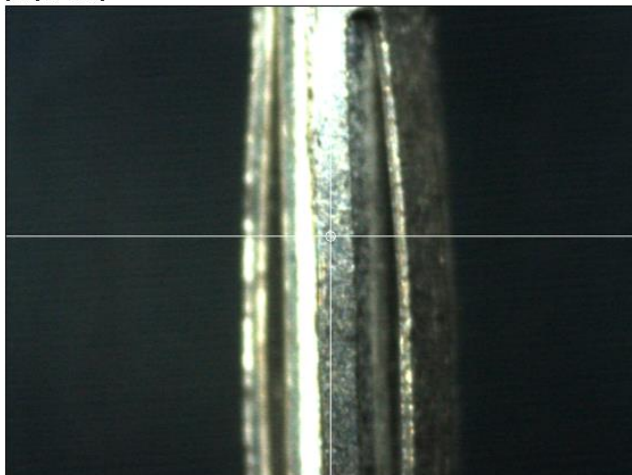
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Example 3

Measure. system	FT110A ID 0661
Analysis File	Ag_Ni_CuSn4_Base_0.05mmC.ffp
Tube Target Elem	W
Date	2022/ 8/16 17:31

[Sample View]



[Analysis Result]

Ag	0.56 (um)
Ni	1.28 (um)

[Analysis Conditions]

Application Mode		Film Analysis (FP)		
No	Name	Elem	Thickness	Intensity
1	Au		0.24	
		Ag	100.00 (wt%)	308.273 (cps)
	Ni		5.84	
		Ni	100.00 (wt%)	6.384 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	76.930 (cps)
		Sn	4.60 (wt%)	0.000 (cps)
2	Au		2.05	
		Ag	100.00 (wt%)	88.308 (cps)
	Ni		3.05	
		Ni	100.00 (wt%)	70.632 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	254.128 (cps)
		Sn	4.60 (wt%)	0.000 (cps)
3	Au		4.50	
		Ag	100.00 (wt%)	179.496 (cps)
	Ni		1.90	
		Ni	100.00 (wt%)	17.090 (cps)
	CuSn4 Base		5000.00	
		Cu	95.40 (wt%)	133.455 (cps)
		Sn	4.60 (wt%)	0.000 (cps)