Bus bar copper cladded aluminum CCA

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Copper Clad Aluminum busbars consist of a pure aluminum core and an outside layer of drawn pure copper. The alloys can varied in defined boundaries. A standard to define Copper Clad Aluminum is e.g. ASTM-B1005.

The numbers behind the CCA like in CCA30 define the cross section of the copper in a value of %.
A bus bar with 100 mm² consist of 70 mm² aluminum and 30 mm² of copper.
Therefore the electrical limits can be estimated with the specific resistance of the alloys in use.

An extra letter behind the CCA30 like H or A defines the state of the material
H ➔ cold formed (hard)
A➔ Annealed (weak)

The right way to order a material would therefore be the statement:

E.g.: CCA30A
E.g.: CCA30H
E.g.: CCA20A
…

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: B1005 – 17

ASTM-B1005

Standard Specification for Copper-Clad Aluminum Bar for Electrical Purposes (Bus Bar)[1]

This standard is issued under the fixed designation B1005; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers copper clad aluminum rectangular bar for electrical (bus) applications.

1.2 Six classes of copper-clad aluminum bar are covered as follows:
Class 20A—Nominal 20 volume % copper, annealed.
Class 25A—Nominal 25 volume % copper, annealed.
Class 30A—Nominal 30 volume % copper, annealed.
Class 20H—Nominal 20 volume % copper, hard-worked.
Class 25H—Nominal 25 volume % copper, hard-worked.
Class 30H—Nominal 30 volume % copper, hard-worked

1.3 The values stated in inch-pound units are to be regarded as the standard, except for resistivity and density, where the SI units are the standard. The values given in parentheses are for information only.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[2]
B193 Test Method for Resistivity of Electrical Conductor Materials
B354 Terminology Relating to Uninsulated Metallic Electrical Conductors
E3 Guide for Preparation of Metallographic Specimens
E8/E8M Test Methods for Tension Testing of Metallic Materials
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E290 Test Methods for Bend Testing of Material for Ductility

3. Terminology

3.1 *Definitions*—Refer to Terminology B354 for definition of product terms used in this specification.

4. Ordering Information

4.1 Orders for materials to this specification shall include the following information:
4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),
4.1.2 Quantity in weight or pieces,
4.1.3 Classes, (see 1.2),
4.1.4 Edge contour (Section 12),
4.1.5 Cross-Sectional Dimensions: Thickness and Width (Section 13),

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:
4.2.1 Whether witness of inspection by the purchaser's representative is required prior to material shipment (Section 15),
4.2.2 Whether certification is required (Section 17),
4.2.3 Whether an alternative tensile sampling selection procedure is acceptable (Section 7).

5. Manufacture

5.1 The products covered by this specification shall consist of a solid core of aluminum with a continuous outer copper layer bonded to the core throughout and shall be of such quality that the resulting products comply with the requirements in this specification.

6. Quality Assurance

6.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.06 on Bi-Metallic Conductors.
Current edition approved April 1, 2017. Published May 2017. DOI: 10.1520/B1005-17.
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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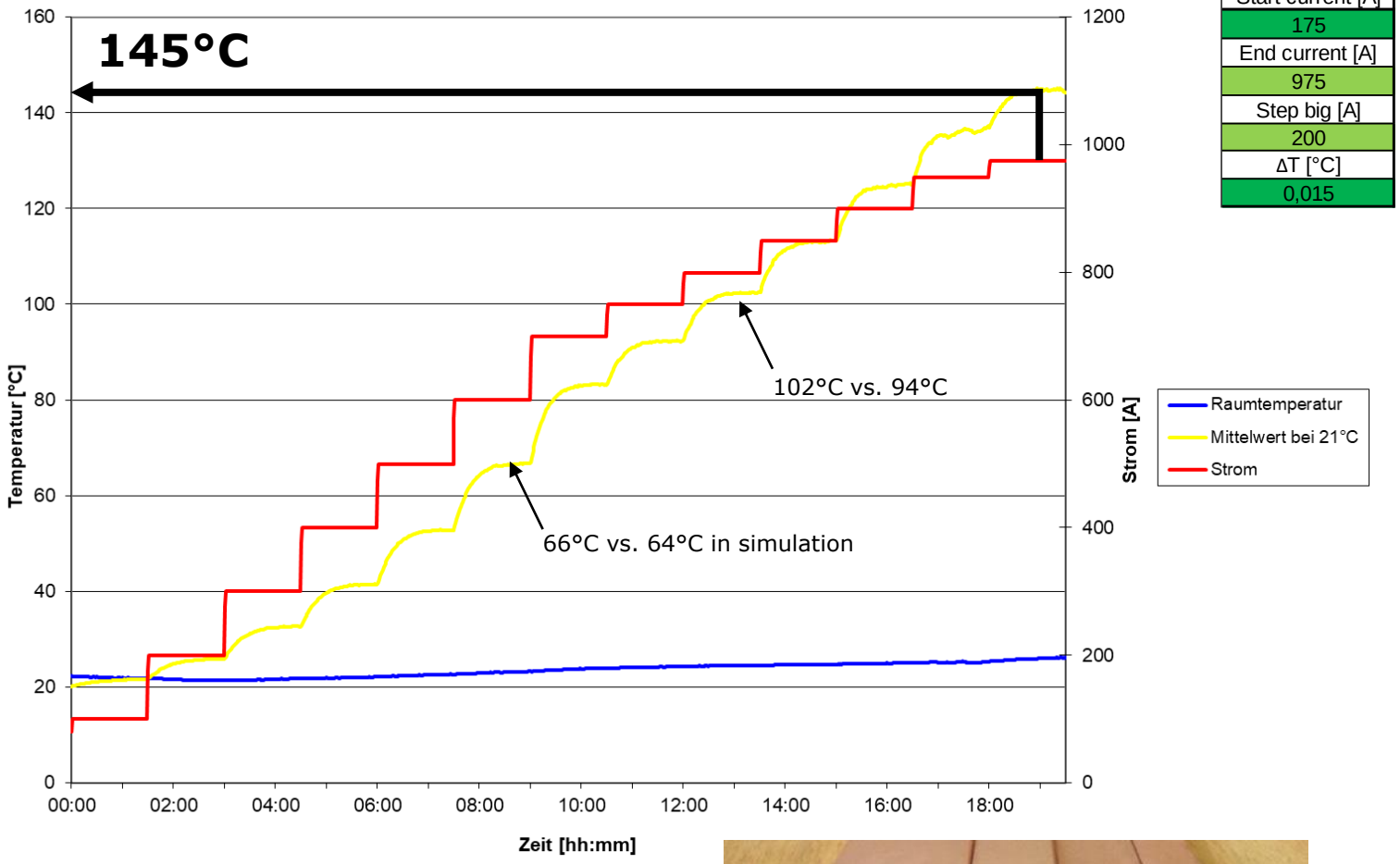
Temperature [°C] and current [A] diagram:

Real measurement



Start current [A]
175
End current [A]
975
Step big [A]
200
ΔT [°C]
0,015

Information for a bare busbar		
Description	Einheit	Wert
Material	-	**Aluminium**
Geometry	-	**Flach**
Width (only for flat bus bars)	[mm]	50
Hight (only for flat bus bars)	[mm]	6
Diameter conductor (round conductors)	[mm]	
nominal cross section (round conductors)	[mm²]	
Perimeter	[mm]	112,00
Cross section conductor	[mm²]	300,00
Electrical resitance per meter	[mΩ/m]	0,081
Strating temperarure for Rho	[°C]	20
Environm. temperature Tumg	[°C]	26
heat capacity c	[J/(m³*K)]	2,43
heat conductivity conductor λ	[W/(m*K)]	237
Sigma σ	[W/(m²*K^4)]	5,67
Surface of the metal	-	Reinaluminium
Wärmestrahlungskoeffizient Epsilon	ε	0,04
Temperaturkoeffizient des Widerstands α	αT [K^-1]	0,00403
Temperature coefficient of Rho	[mΩ*mm²/m]	0,0243
boundary temperature for derating	[°C]	**150**
T max conductor (bare)	[°C]	**132**

Simulation at 975 A ➔ 132°C
(Δ-13°C compared to the real sample)

CCA20 50 mm x 6 mm **(300 mm²)**
Company Chalco

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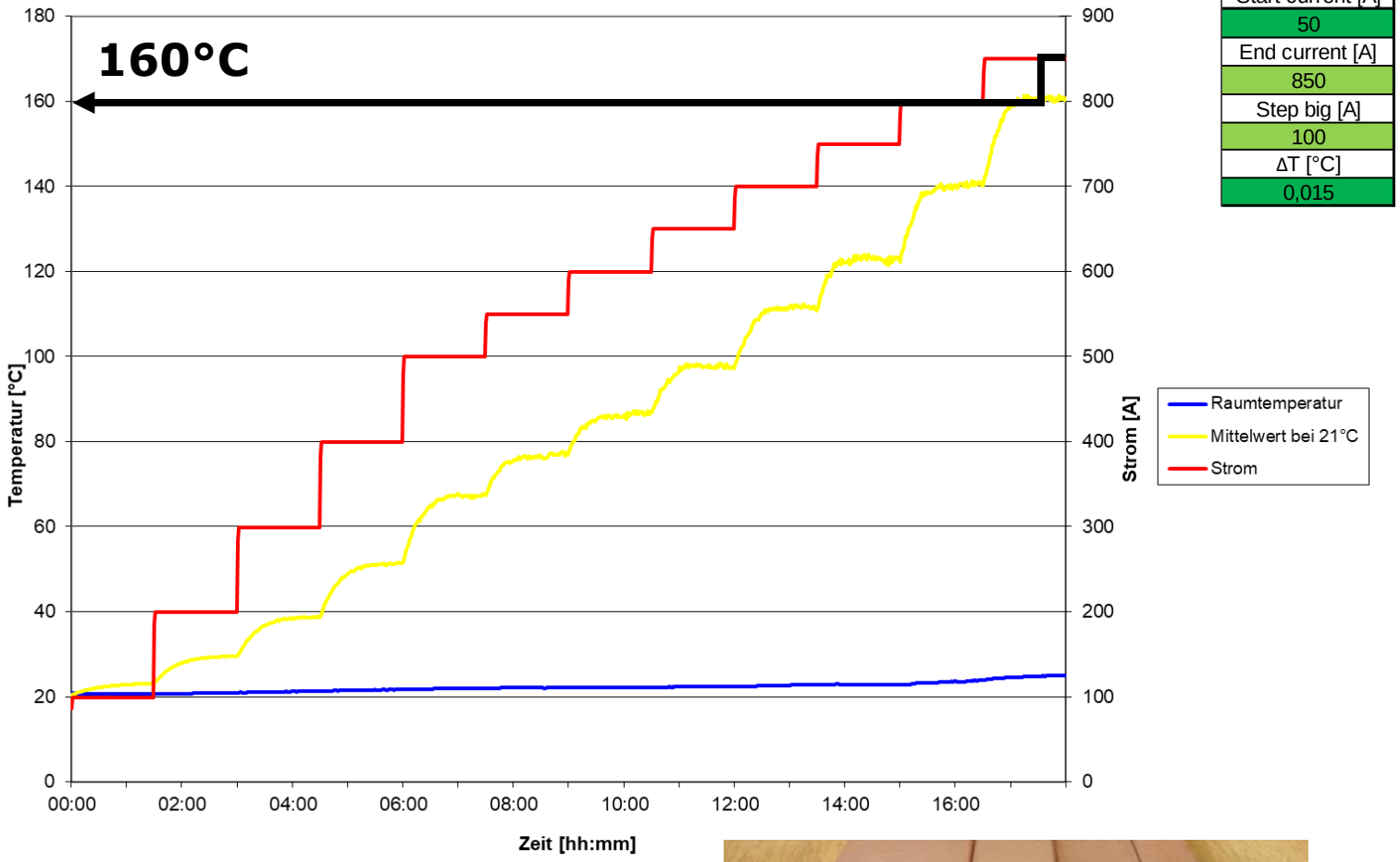
Temperature [°C] and current [A] diagram:

Real measurement



Start current [A]
50
End current [A]
850
Step big [A]
100
ΔT [°C]
0,015

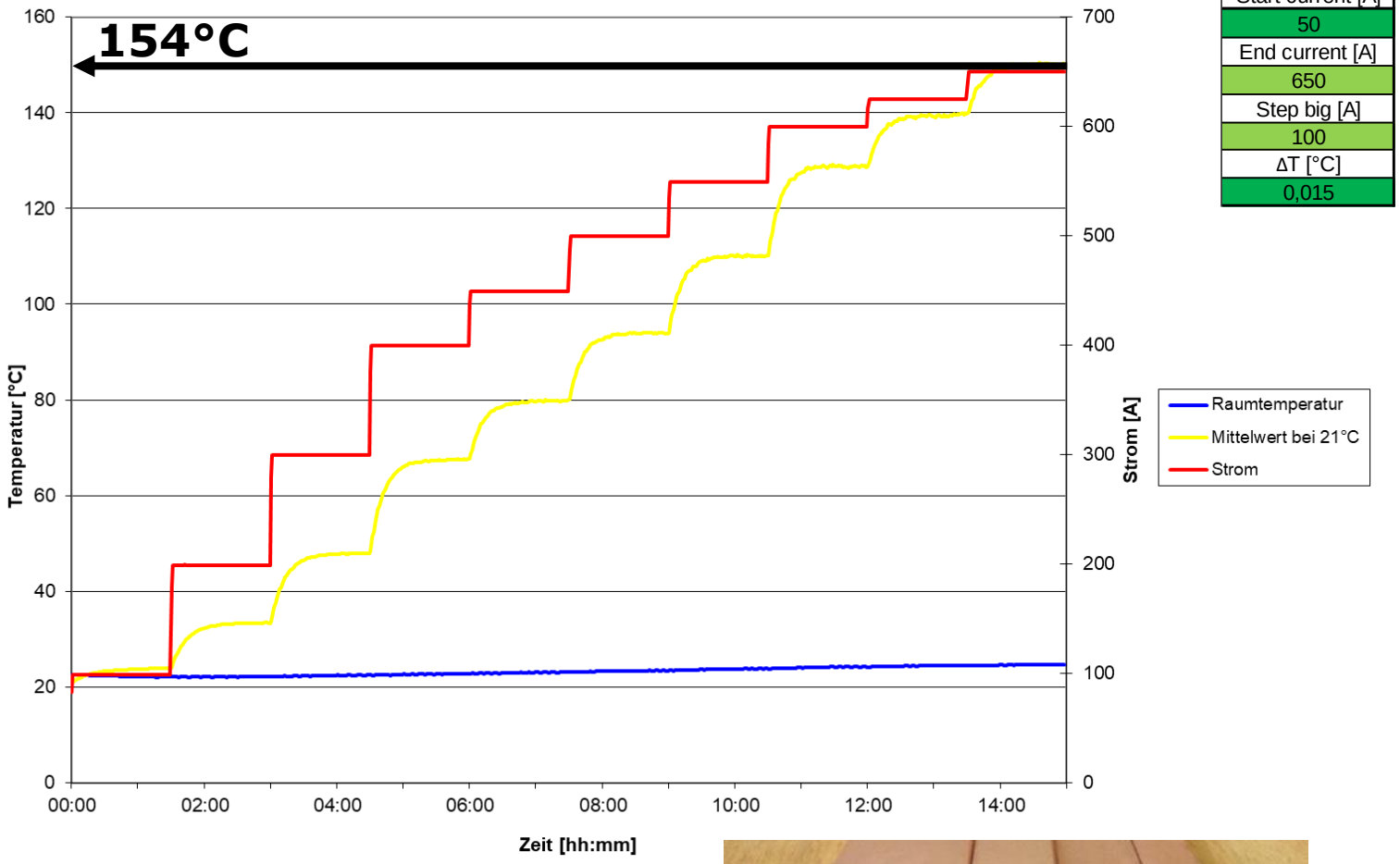
Information for a bare busbar		
Description	Einheit	Wert
Material	-	**Aluminium**
Geometry	-	**Flach**
Width (only for flat bus bars)	[mm]	30
Hight (only for flat bus bars)	[mm]	8
Diameter conductor (round conductors)	[mm]	
nominal cross section (round conductors)	[mm²]	
Perimeter	[mm]	76,00
Cross section conductor	[mm²]	240,00
Electrical resitance per meter	[mΩ/m]	0,100
Strating temperarure for Rho	[°C]	20
Environm. temperature Tumg	[°C]	23
heat capacity c	[J/(m³*K)]	2,43
heat conductivity conductor λ	[W/(m*K)]	237
Sigma σ	[W/(m²*K^4)]	5,67
Surface of the metal	-	Reinaluminium
Wärmestrahlungskoeffizient Epsilon	ε	0,04
Temperaturkoeffizient des Widerstands α	αT [K^-1]	0,00403
Temperature coefficient of Rho	[mΩ*mm²/m]	0,0240
boundary temperature for derating	[°C]	**150**
T max conductor (bare)	[°C]	**156**

CCA20 30 mm x 8 mm **(240 mm²)**
Company Chalco

Simulation at 850 A ➔ 156°C
(Δ+4°C compared to the real sample)

Temperature [°C] and current [A] diagram:

Real measurement



Start current [A]
50
End current [A]
650
Step big [A]
100
ΔT [°C]
0,015

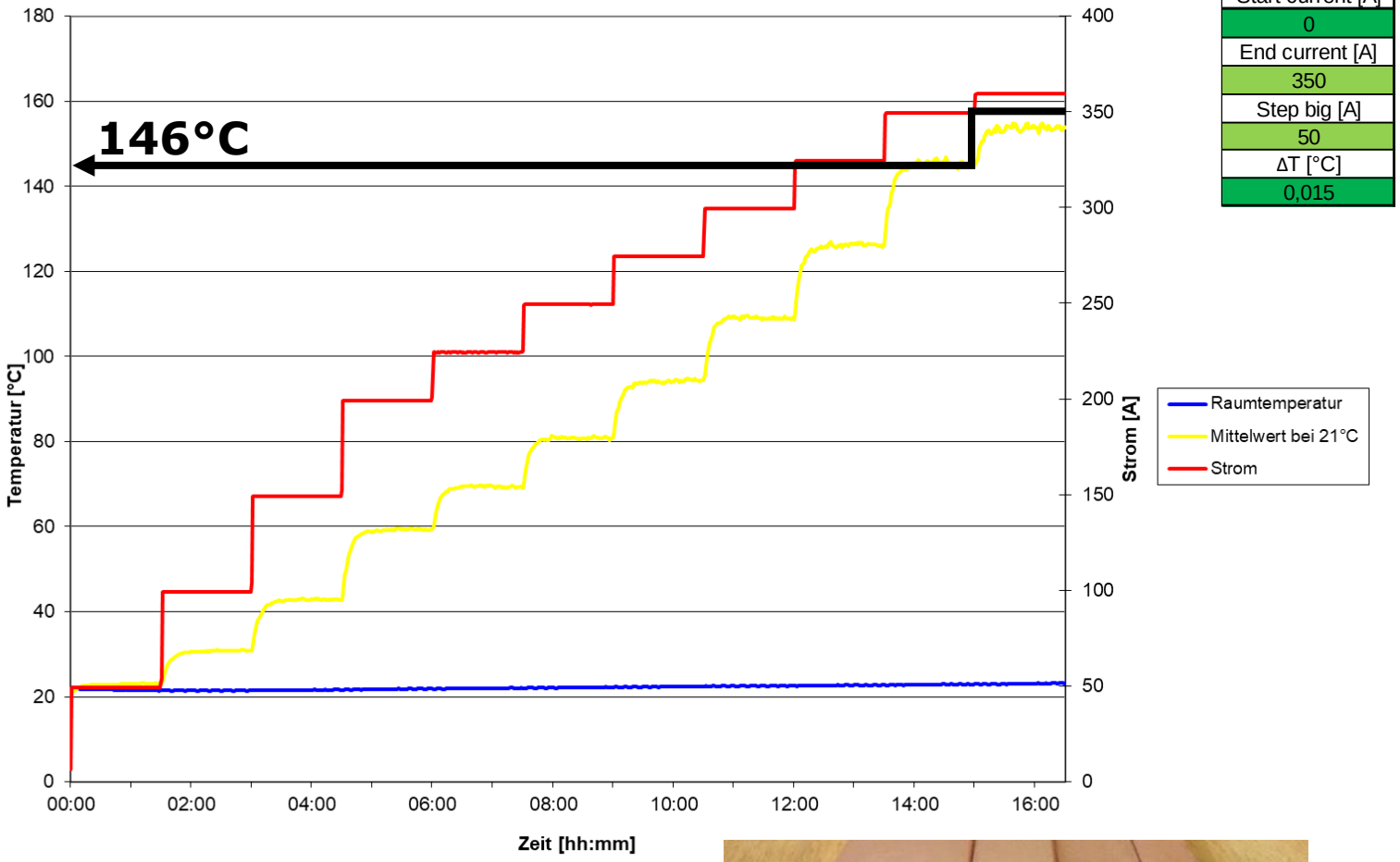
Information for a bare busbar		
Description	Einheit	Wert
Material	-	**Aluminium**
Geometry	-	**Flach**
Width (only for flat bus bars)	[mm]	30
Hight (only for flat bus bars)	[mm]	5
Diameter conductor (round conductors)	[mm]	
nominal cross section (round conductors)	[mm²]	
Perimeter	[mm]	70,00
Cross section conductor	[mm²]	150,00
Electrical resitance per meter	[mΩ/m]	0,156
Strating temperarure for Rho	[°C]	20
Environm. temperature Tumg	[°C]	23
heat capacity c	[J/(m³*K)]	2,43
heat conductivity conductor λ	[W/(m*K)]	237
Sigma σ	[W/(m²*K^4)]	5,67
Surface of the metal	-	Reinaluminium
Wärmestrahlungskoeffizient Epsilon	ε	0,04
Temperaturkoeffizient des Widerstands α	αT [K^-1]	0,00403
Temperature coefficient of Rho	[mΩ*mm²/m]	0,0234
boundary temperature for derating	[°C]	**150**
T max conductor (bare)	[°C]	**153**

CCA20 30 mm x 5 mm **(150 mm²)**
Company Chalco

Simulation at 650 A ➔ 153°C
(Δ-1°C compared to the real sample)

Temperature [°C] and current [A] diagram:

Real measurement



Start current [A]
0
End current [A]
350
Step big [A]
50
ΔT [°C]
0,015

Information for a bare busbar		
Description	Einheit	Wert
Material	-	**Aluminium**
Geometry	-	**Flach**
Width (only for flat bus bars)	[mm]	20
Hight (only for flat bus bars)	[mm]	3
Diameter conductor (round conductors)	[mm]	
nominal cross section (round conductors)	[mm²]	
Perimeter	[mm]	46,00
Cross section conductor	[mm²]	60,00
Electrical resitance per meter	[mΩ/m]	0,405
Strating temperarure for Rho	[°C]	20
Environm. temperature Tumg	[°C]	23
heat capacity c	[J/(m³*K)]	2,43
heat conductivity conductor 2 λ	[W/(m*K)]	237
Sigma σ	[W/(m²*K^4)]	5,67
Surface of the metal	-	Reinaluminium
Wärmestrahlungskoeffizient Epsilon	ε	0,04
Temperaturkoeffizient des Widerstands α	αT [K^-1]	0,00403
Temperature coefficient of Rho	[mΩ*mm²/m]	0,0243
boundary temperature for derating	[°C]	**150**
T max conductor (bare)	[°C]	**158**

Simulation at 350 A ➔ 158°C
(Δ+12°C compared to the real sample)

CCA20 20 mm x 3 mm **(60 mm²)**
Company Chalco

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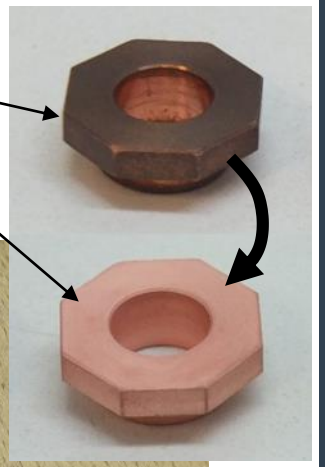
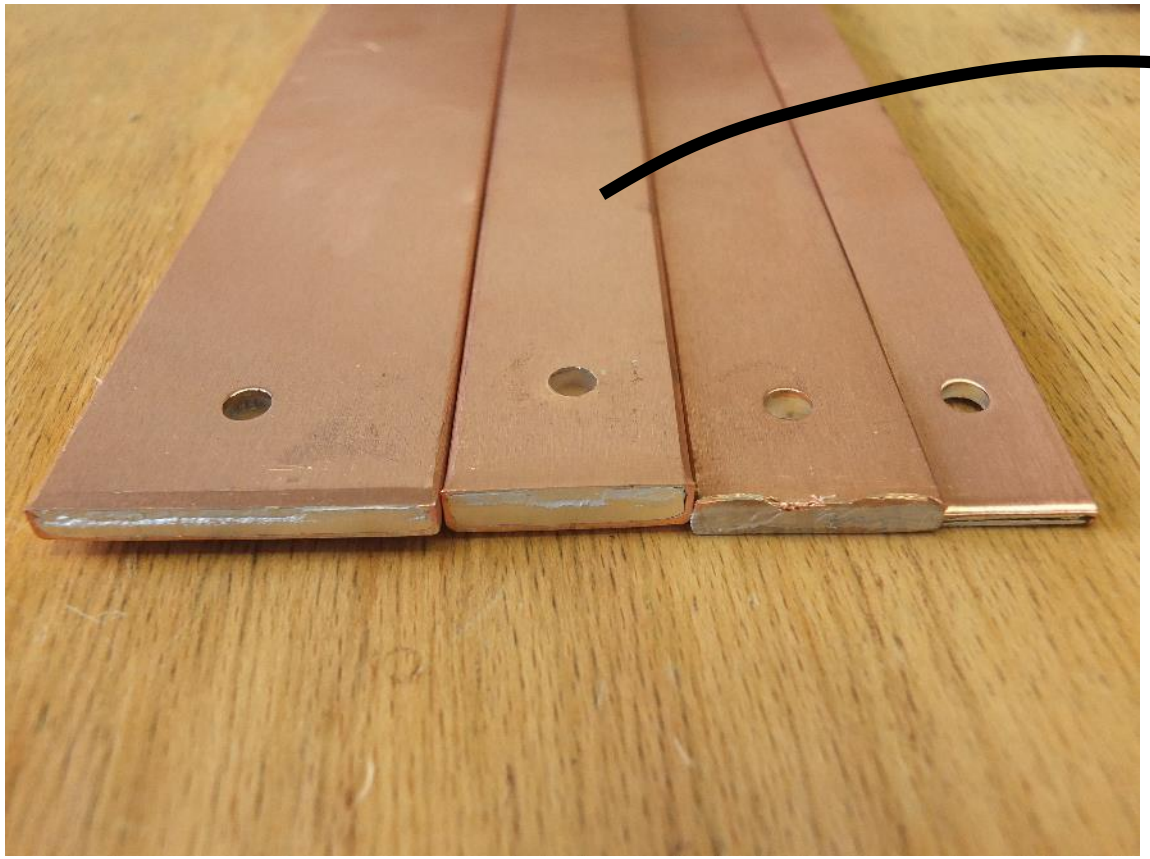
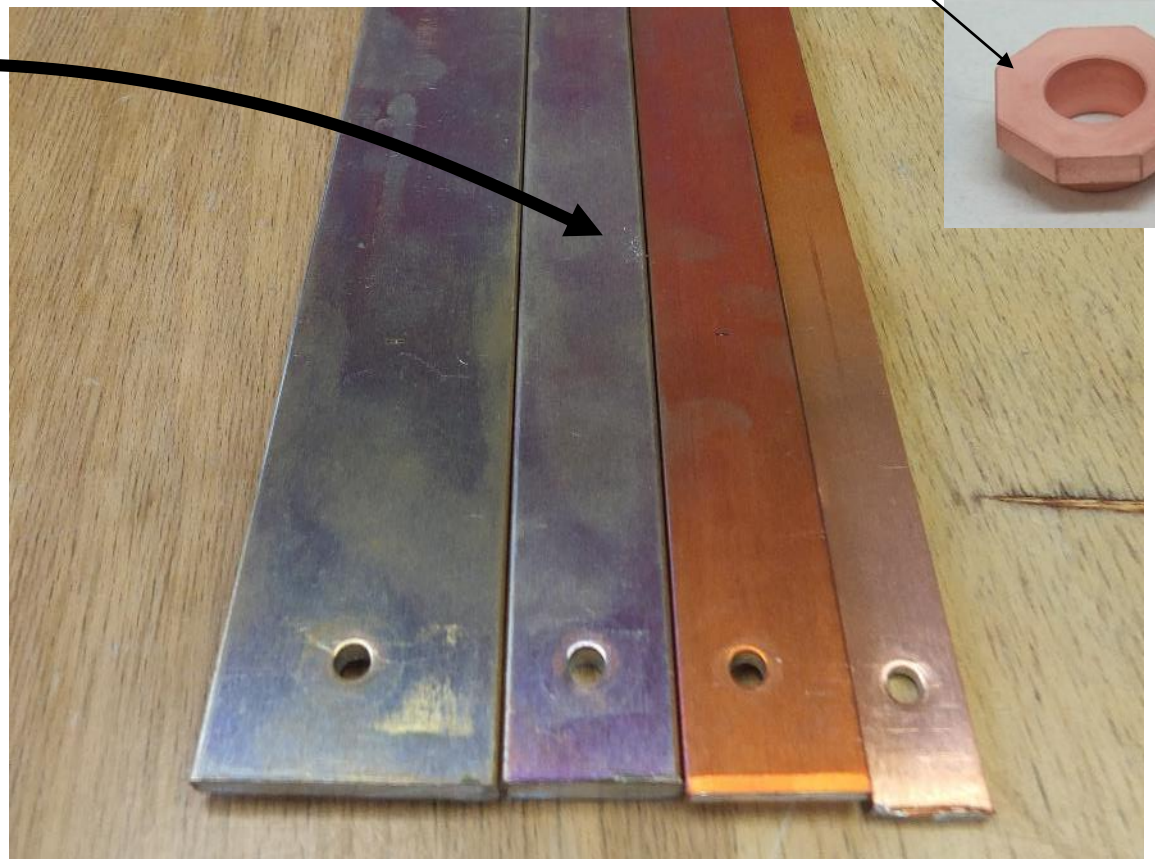
Temperature [°C] and current [A]:







Before the Derating:
Initial oxidation color is the same

After the Derating:
The oxidation color is different for each bus bar

T_{max}: 150°C the oxide is chemically the same but the interference with light is different and the somewhat transparent oxide appears with different colors

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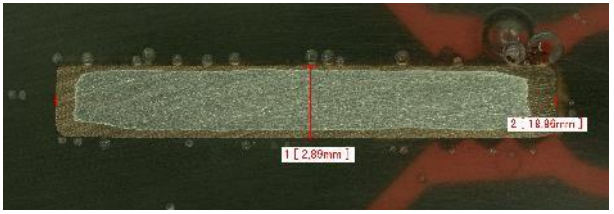
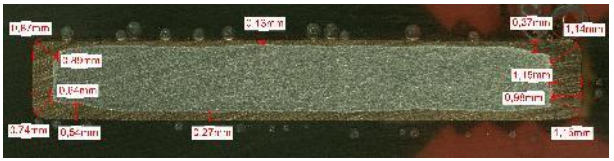
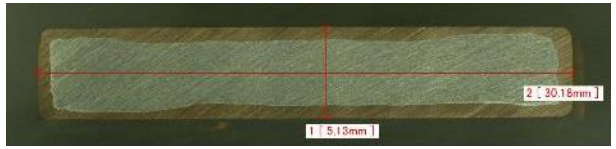
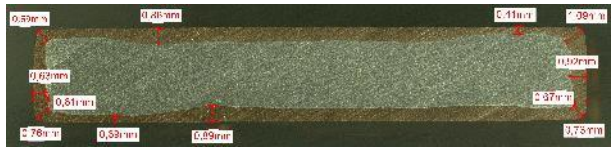
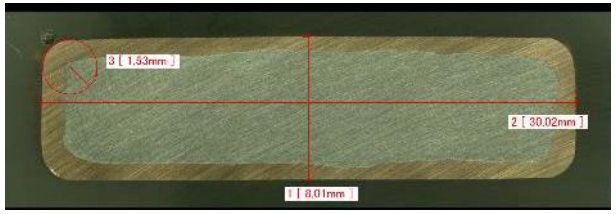
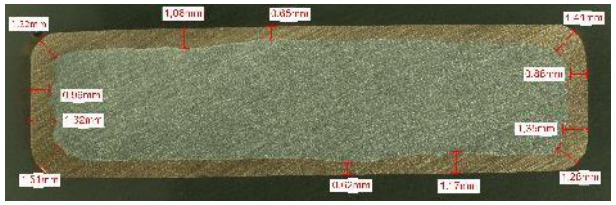
Cross sections

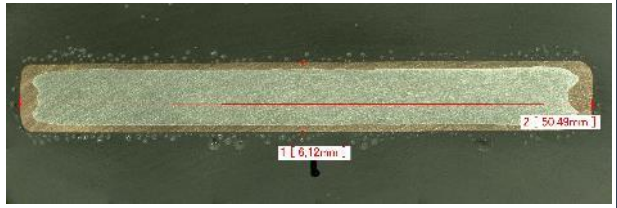
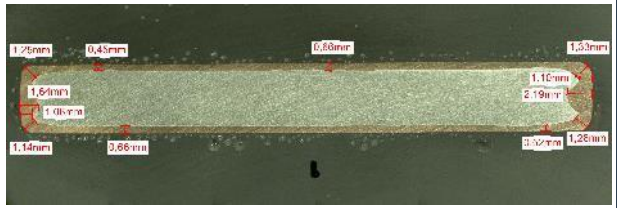
60 mm²

150 mm²

240 mm²

300 mm²

The cross sections show that the copper is not formed homogeneously around the aluminum bar

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