Conductor Mechanical Testing

18 September 2012

Conductor Mechanical Testing

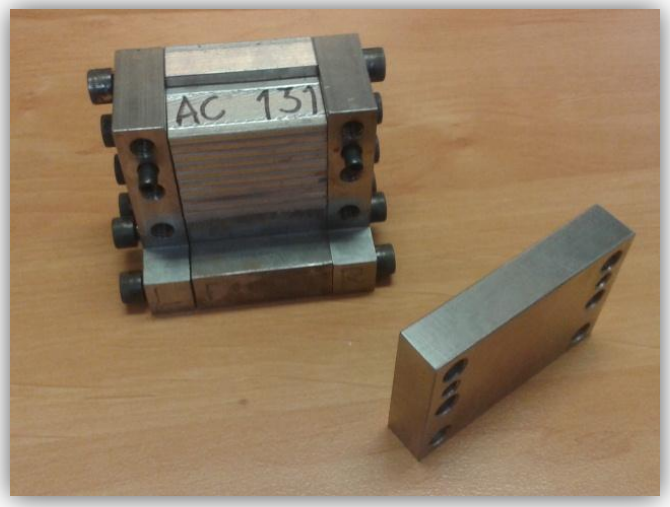
Objectives

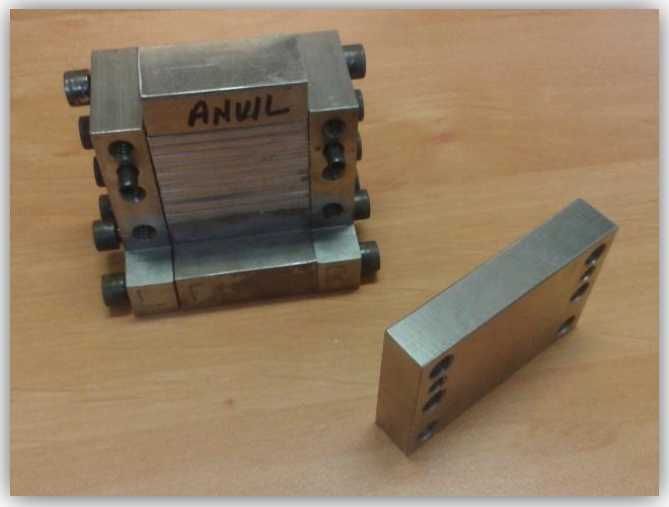
- Conductor samples and test fixture are provided by JLAB.
- The aim of this study is to check the influence of test fixture on results and of a preload at 15kN (20 MPa).
- Compression properties are compared to previous results (2012-09-05 Conductor testing UBS N°5).

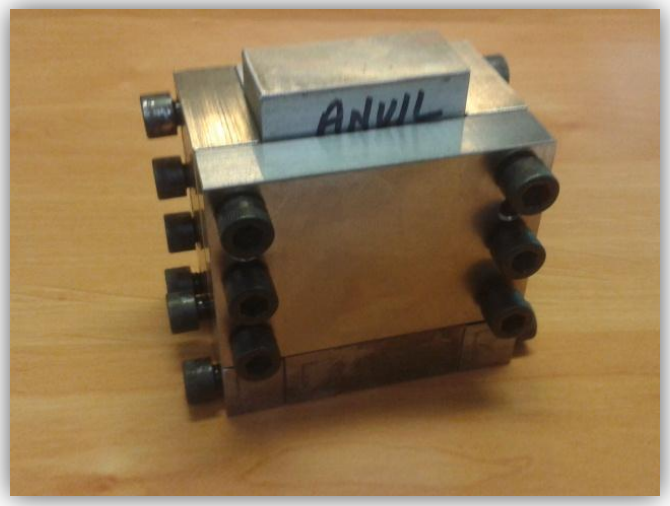
Conclusions

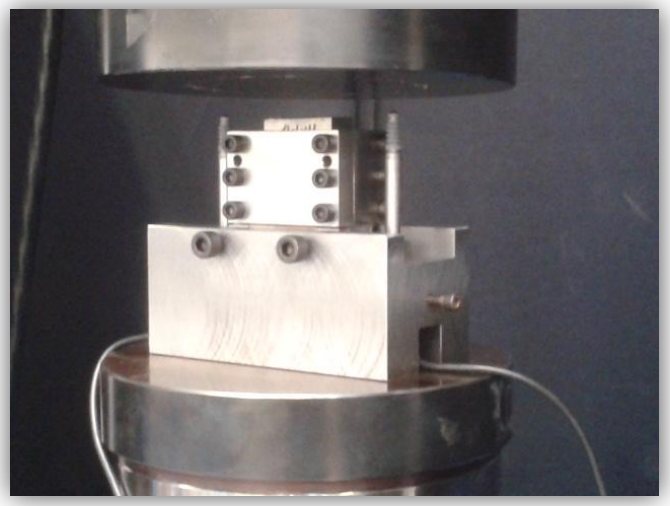
- Compression properties are identical to previous results.
- These new measurements still confirm the conductor must be consolidated according to the analysis and proposal made during the design review held at Sigmaphi on 12 July 2012.

Conductor Mechanical Testing









Conductor Mechanical Testing

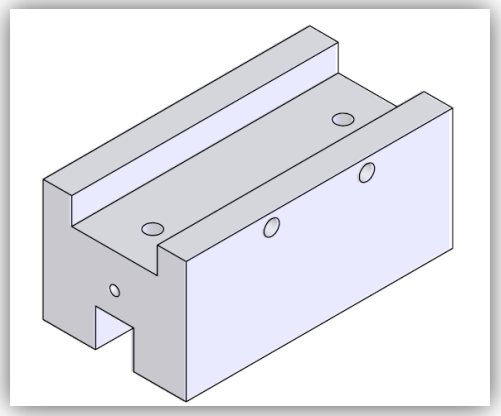
➢ MATERIALS AND METHODS

Displacement measurements

- Direct measurements are impossible because of the assembly. Consequently mechanical probes are used in order to obtain an indirect measure.
- Displacement is given by the average of two probes measurements in order to eliminate ball pivot effects.
- These probes are mounted on an intermediate part to insure their verticality.

Loading conditions

- Screws are tool tightened (contrary to JLAB's protocol).
- A Preload of 1kN is applied on the stack to set up 0% strain.
- A displacement speed of 0.01mm/s is imposed.
- Displacements are measured during 3 loads at 60kN (80 MPa).



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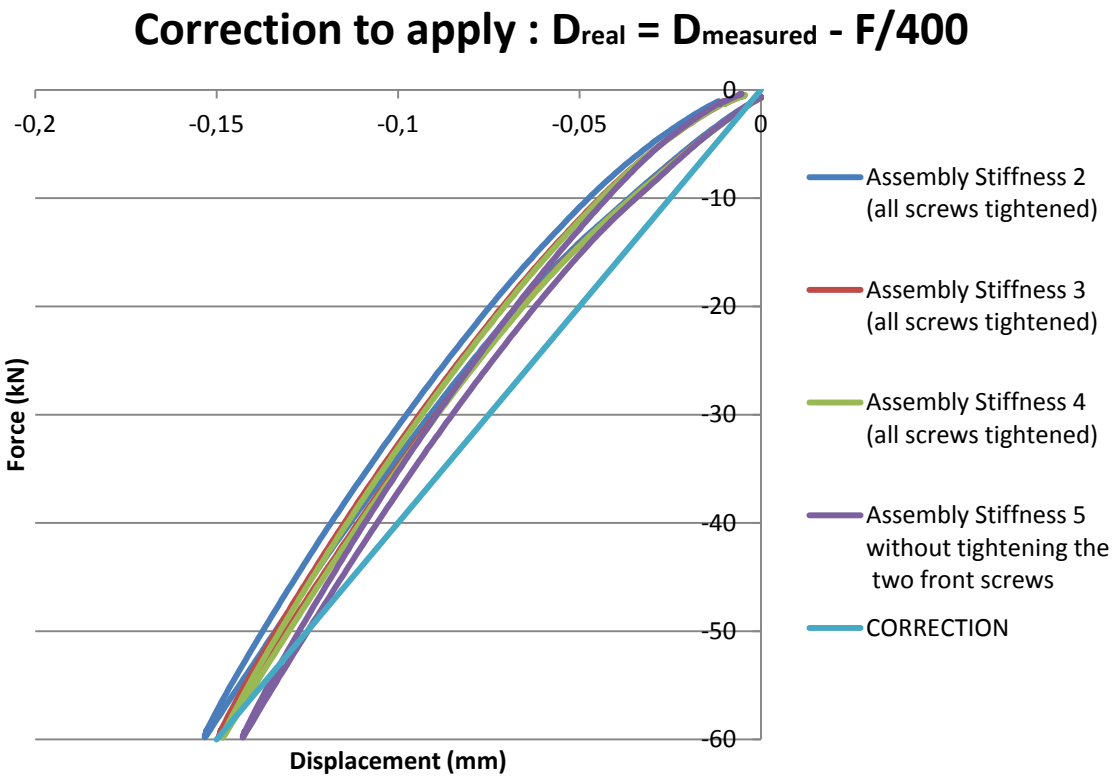
➢ MATERIALS AND METHODS

Stiffness of the assembly

- Assembly will deform during test. Consequently we have to take into account it stiffness. Assembly displacement is measured four times as shown on this figure.
- We observe that this test is very repetitive and force as a function of displacement is quasi-linear.
- Consequently the stiffness of this assembly is of about 400kN/mm.
- This correction is negligible for a test on 10 layers but not for a test on a single layer.



Conductor Mechanical Testing

➢ MATERIALS AND METHODS

Measurements on 10 layers at 60kN without insulation

- AC 111, AC 121 and AC 131
- Top : Anvil / Bottom : no spacer

Measurements on 10 layers at 15kN then 60kN without insulation

- BC 111, BC 121 and BC 131
- Top : Anvil / Bottom : no spacer

Measurements on 10 layers at 15kN then 60kN WITH insulation

- BT 51 to BT 60
- Top : Anvil / Bottom : no spacer
- Insulation = Kapton + BStage

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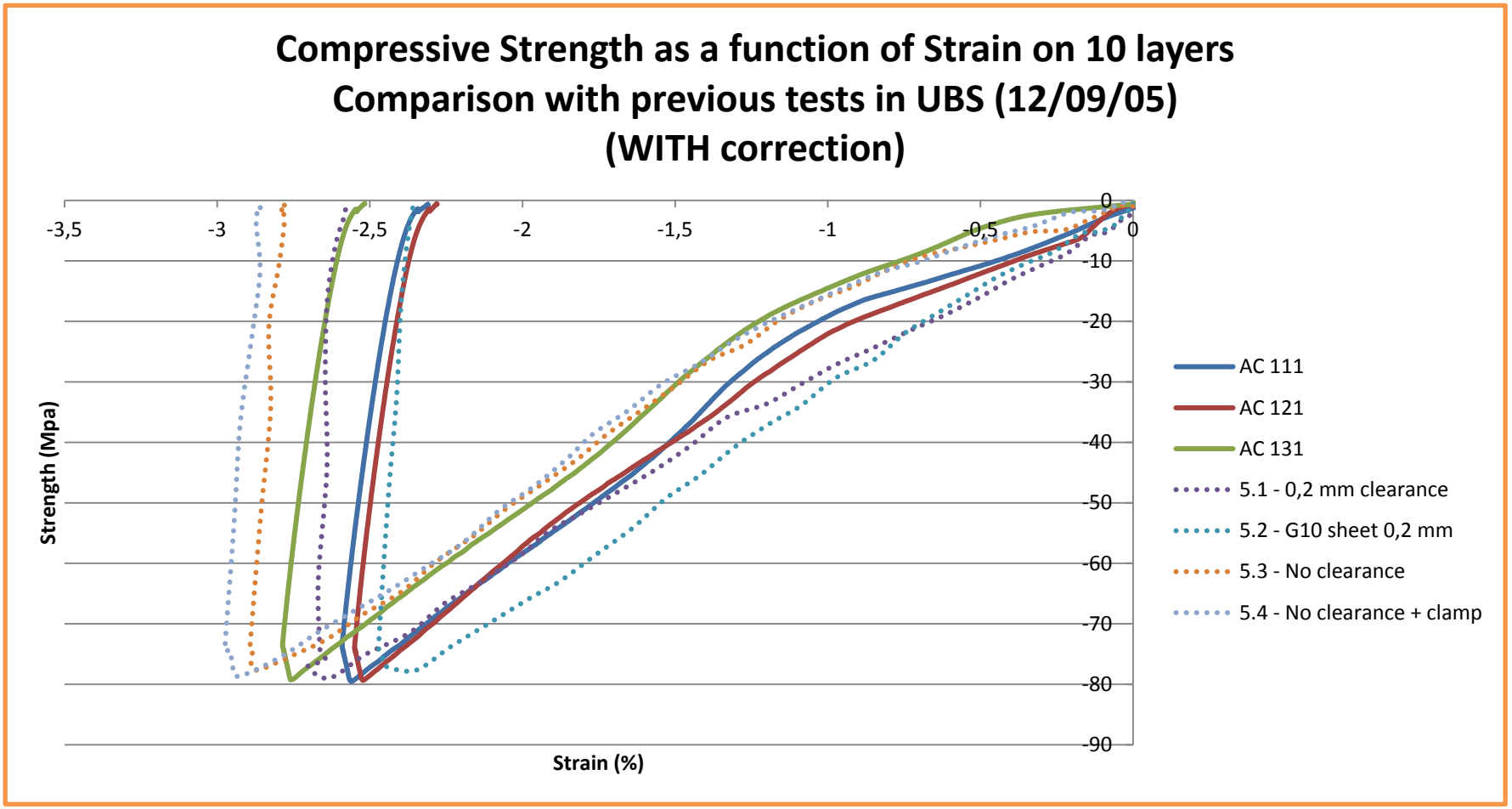
➢ **10 LAYERS AT 60kN without insulation**



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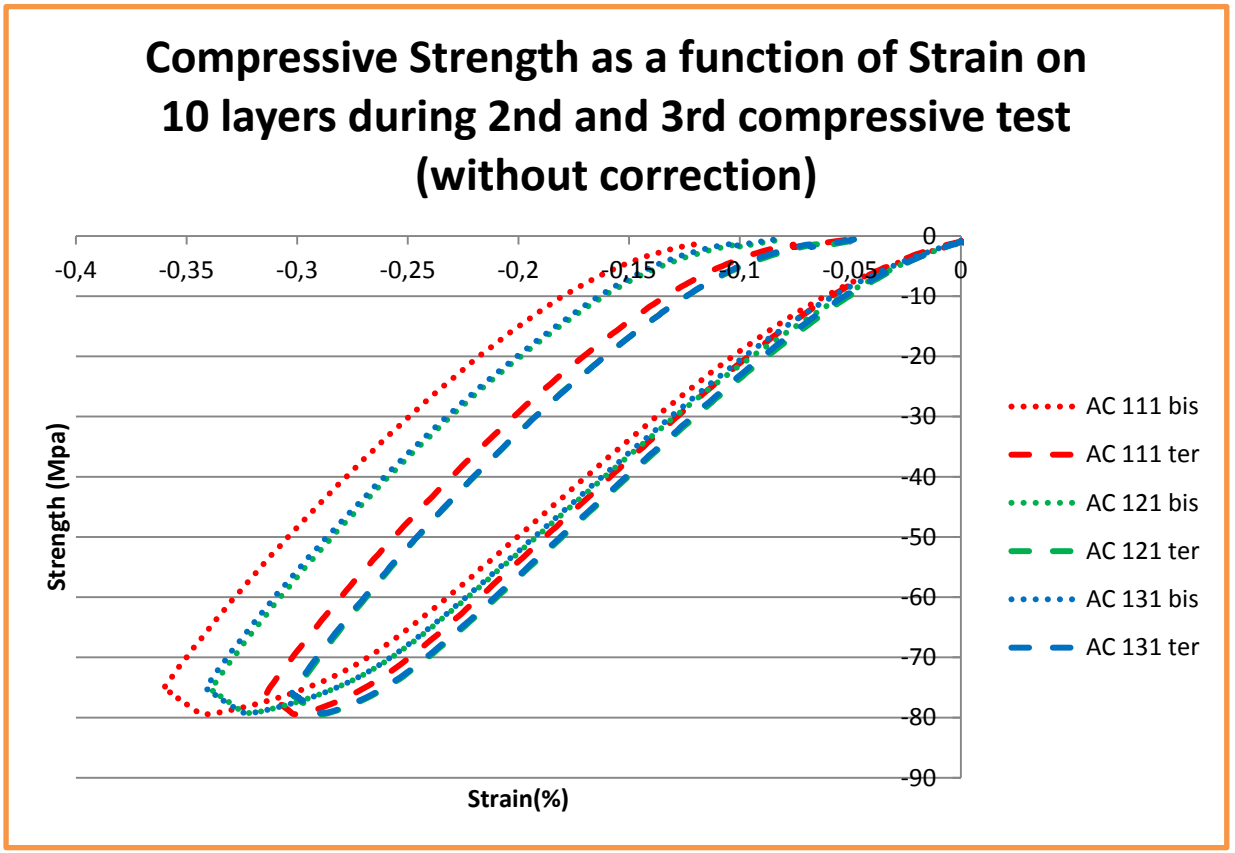

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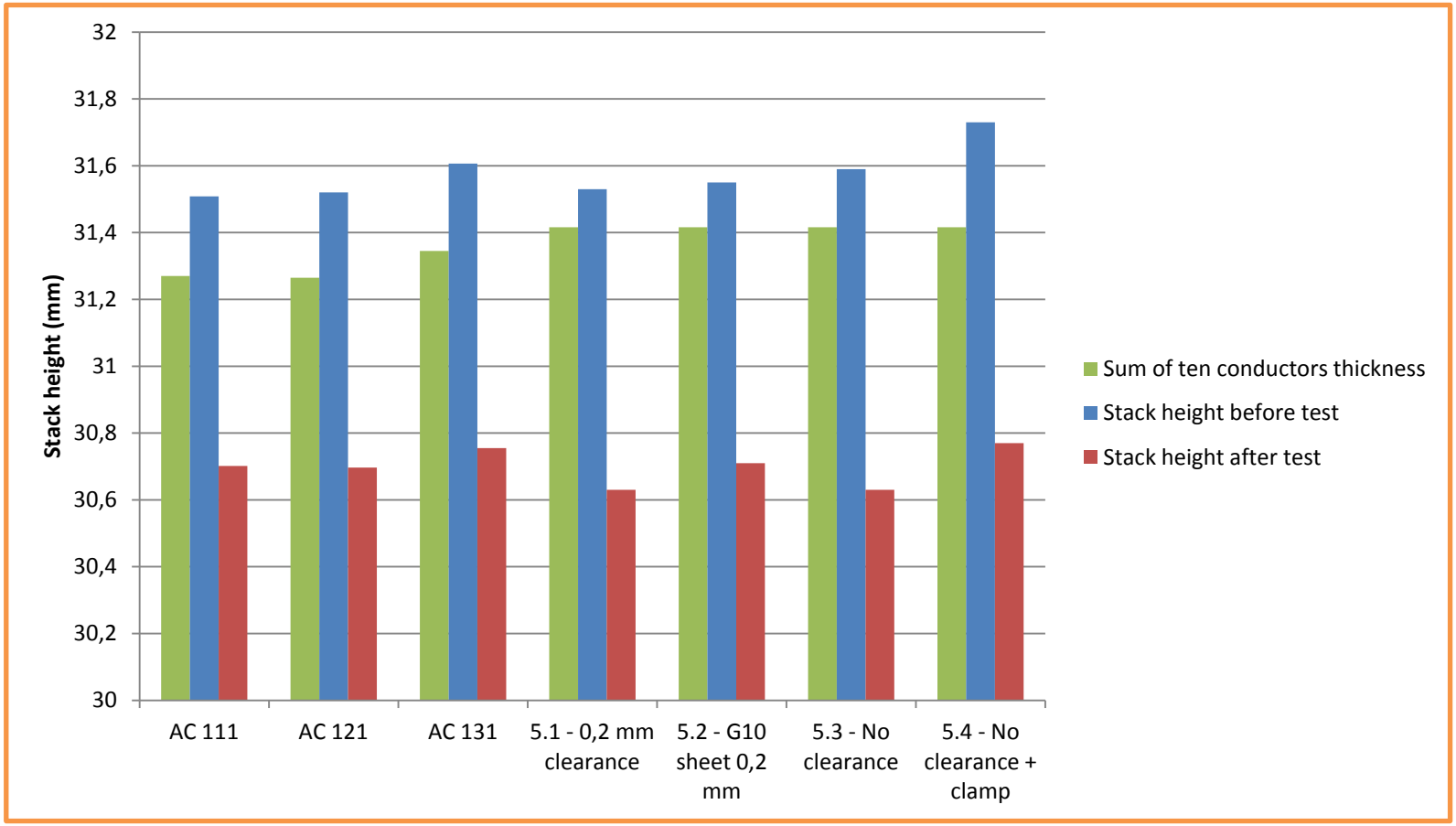

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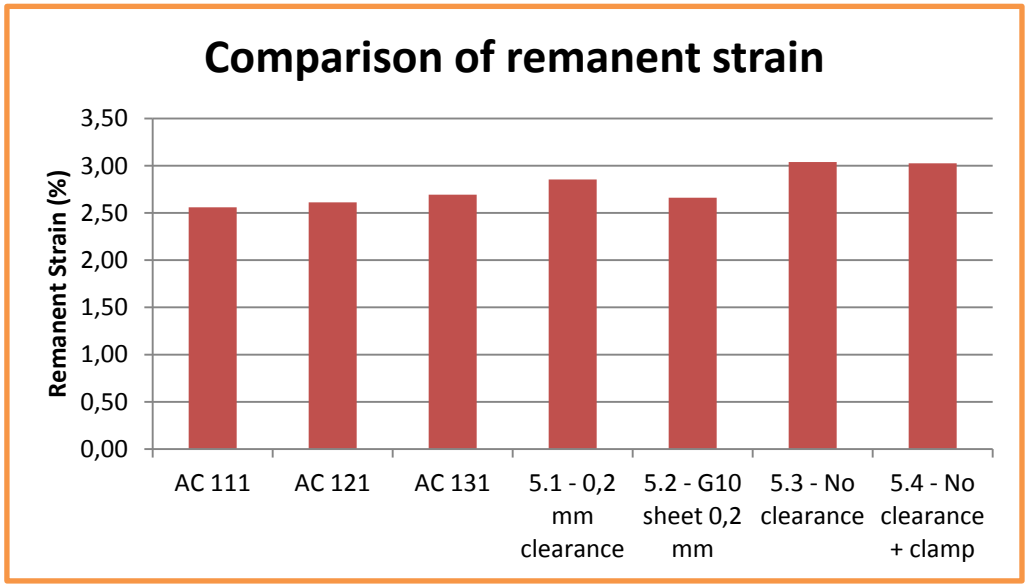
➢ **10 LAYERS AT 60kN without insulation**



CONCLUSIONS

- Compression properties are identical to previous results for a stack of ten layers.
- Test fixture has a negligible influence on stack strain.
- This implies that strain may occur preferentially into the conductor by filling the voids. It will be confirmed by tomography before and after compression test.

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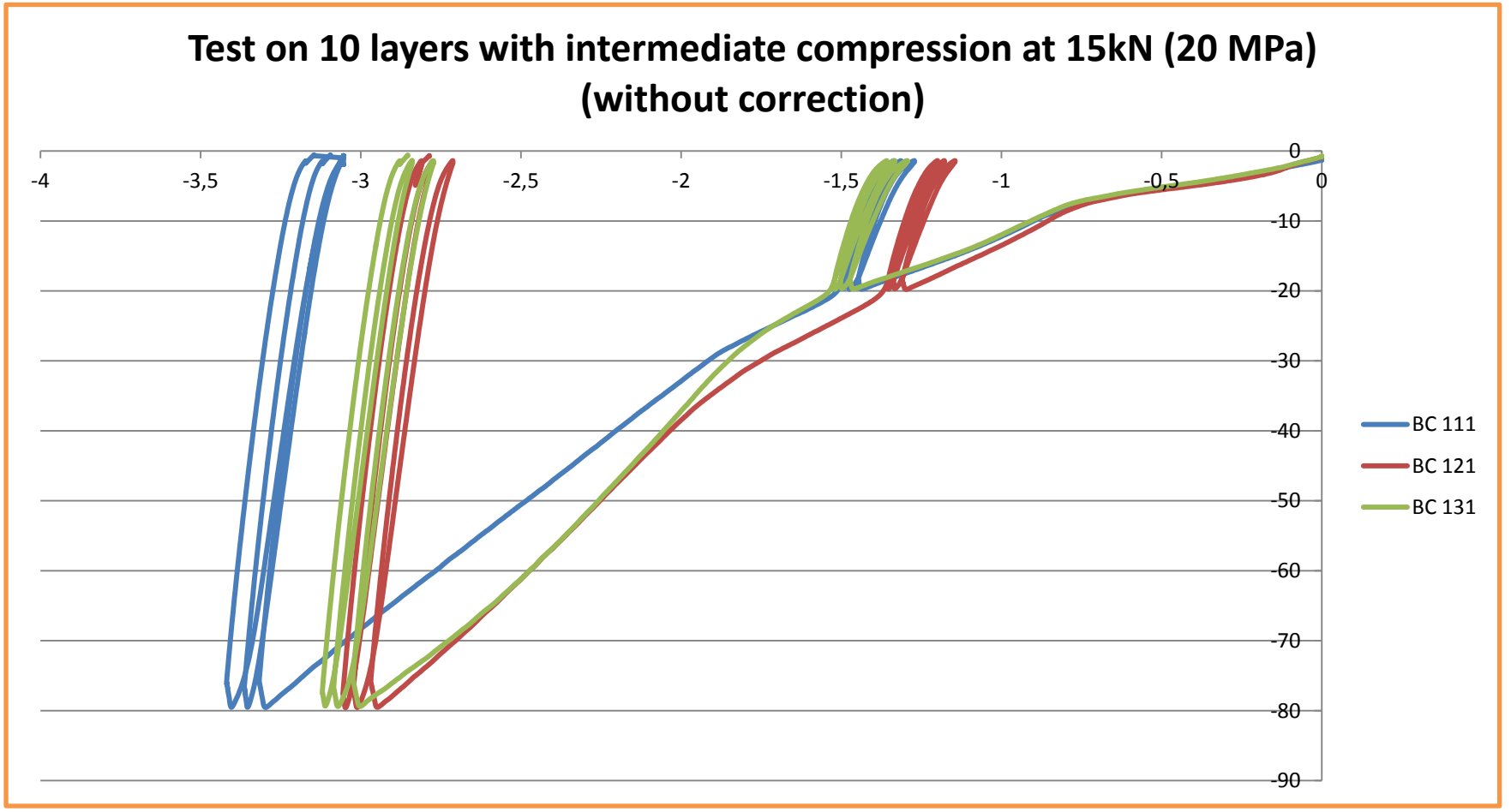
➢ **10 LAYERS AT 15 kN THEN 60kN without insulation**



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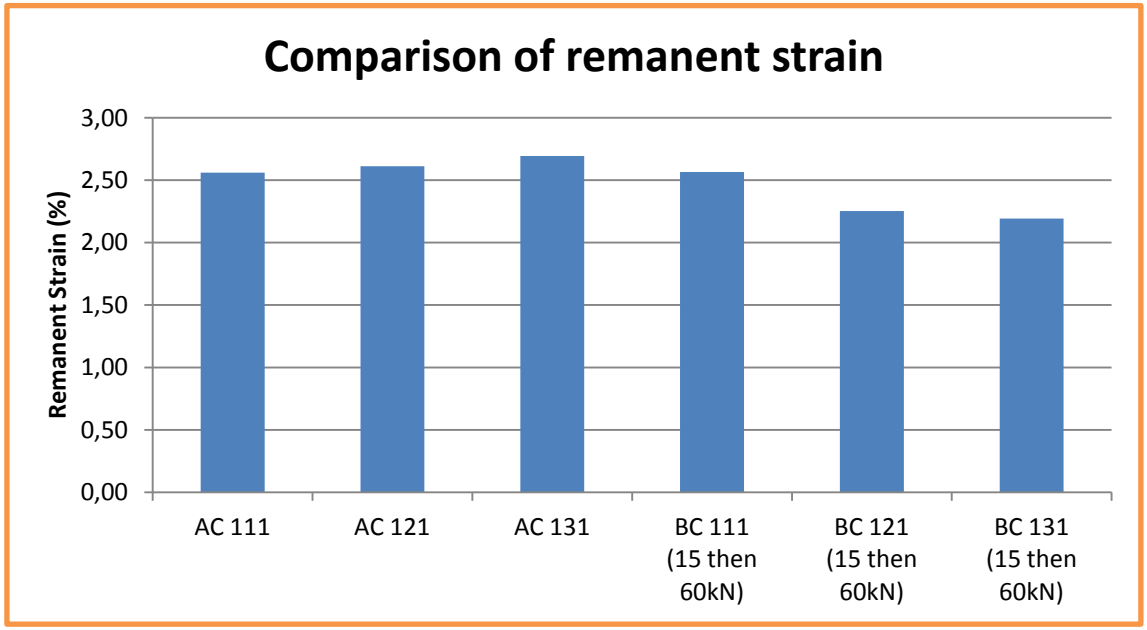
- **10 LAYERS AT 15 kN THEN 60kN without insulation**



CONCLUSIONS

- The preload at 15kN has no influence on stack stiffness.
- The stress-strain curve of the conductor is characteristic of a hardened material.
- The stress-strain curve has three gradients which may be caused by several types of voids.

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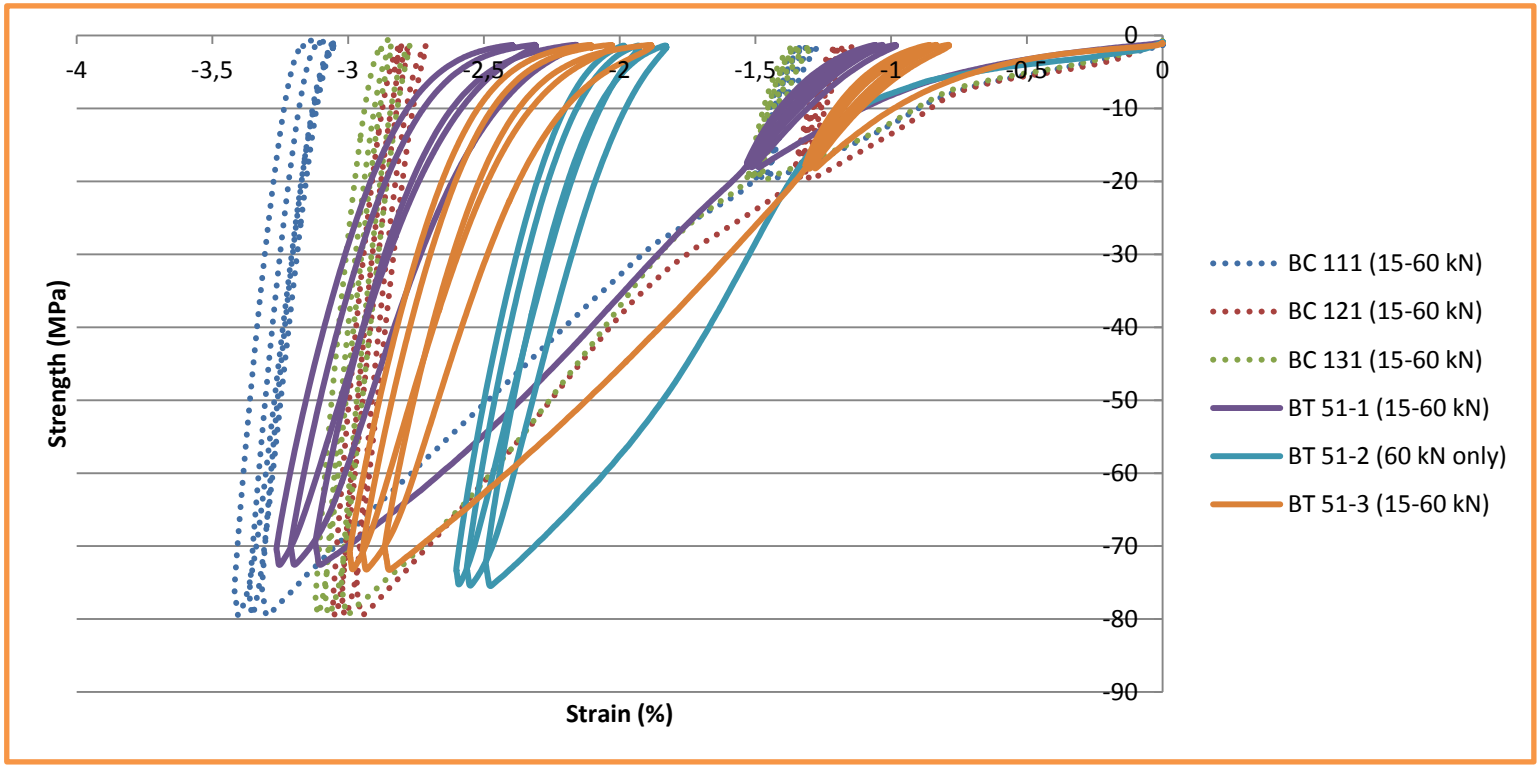
- **10 LAYERS WITH insulation (BT 51-1 to 51-3)**
- **and WITHOUT insulation (BC 111 to BC 131)**



CONCLUSIONS

- Compression results are similar for conductors with and without insulation : there is no improvement of mechanical properties thanks to the insulation.