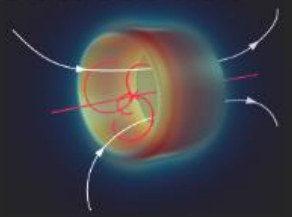
SUPERCONDUCTING DETECTOR MAGNET WORKSHOP

12–14 Sept 2022
CERN
Europe/Zurich timezone



Status Report on Coextrusion Facilities in Europe for Detector Magnet Superconductors

Benoit CURÉ, CERN

Coextrusion facilities in Europe

Outline

- **Status of companies that performed the coextrusion of ATLAS and CMS conductors,**
- **Status of communications with industry on coextrusion to date,**
- **Further investigations,**
- **Conclusion.**

Companies that performed coextrusion for the LHC detector magnets

ATLAS Conductors:

Barrel and End cap toroids:

- VAC Vacuumschmelze , Hydro aluminium (Seneffe, B) (later EAS). *Facility closed in 2014.*
- Alcatel Cable Suisse (later Nexans). *Facility dismantled (2022). Expert left company in 2016.*

No more contact or information available.

Central Solenoid: (Japan)

- Furukawa Electric Co. Ltd,
- Hitachi Cable Co. Ltd.

Ref: H. H. J. Kate, "ATLAS superconducting toroids and solenoid," in IEEE Transactions on Applied Superconductivity, vol. 15, no. 2, pp. 1267-1270, June 2005, doi: 10.1109/TASC.2005.849560.

CMS Conductor:

- Alcatel Cable Suisse (later Nexans). *Facility dismantled (2022). Expert left company in 2016.*

Ref: B. Blau et al., "The CMS conductor," in IEEE Transactions on Applied Superconductivity, vol. 12, no. 1, pp. 345-348, March 2002, doi: 10.1109/TASC.2002.1018416.

Status of communication to date

Investigation on other potential suppliers:

No new company identified yet.

Looking for manufacturer with coextrusion capacities:

- Continuous process,
- Semi-continuous process (short stop)
- With Rutherford cable exposed to max temperature < ~350°C for short time.
- Using typically extrusion press or Conform process.

We expect to find such companies in the high power cable market.

→ These are mostly **global corporations**, or subcontractors of them, inside international groups.

→ The **compatibility** of the production plans of these companies with our needs (and our schedules) should be considered, once potential companies are identified.

Status of communication to date

Investigation on other potential suppliers:

Data retrieved from on-going project: Panda solenoid conductor

BINP, Novosibirsk, Russia
FAIR, Darmstadt, Germany
GSI, Darmstadt, Germany

"(…) Developments with Rutherford cable to co-extrusion/ **conklad** in a pure Al"

Source: Evgeniy Pyata, BINP,
Asian Forum for Accelerators and Detectors WG, March 2021

Subcontractor **Saransk Cable Optic, Russia**, for Panda magnet conductor.

Latest information retrieved:
Prototyping, pre-industrialization, and production were planned end 2021 to summer 2022.

Status of communication to date

Investigation on other potential suppliers:

About the Conklad™ process: machinery for cladding or sheathing wires and cables with aluminium (e.g. cladding copper wire with aluminium).

BWE Ltd, Beaver Industrial Estate,
Ashford, Kent, TN23 7SH, England

Commercialized by **BWE Ltd, UK** (formerly Babcock Wire Equipment)

- BWE Ltd is a British engineering company specialising in **continuous rotary extrusion** (CRE) machines for many different applications and cold pressure welding machines for the cable and wire industry.
- This company owns the registered names **Conform™ , Conklad™ and SheathEx™** together with a number of critically important patents associated with the processes and their development.
- **In 1976** the Company was awarded the first licence to develop, manufacture and supply Conform™ Continuous Rotary Extrusion Machines, by the inventors, the United Kingdom Atomic Energy Authority.
- **In the 1980's BWE pioneered the development of cladding and sheathing** using the Conform continuous rotary extrusion (CRE) method. This work led to the introduction of **Conklad™**, which has become the industry standard for many applications.

Source: bwe.co.uk

This company has been contacted by CERN.

Further contacts are planned with BWE to discuss about feasibility, prototyping and identify potential contractors using this technology.

Further investigations

Look into alternative design options if coextrusion facilities are not available (or prohibitive for our applications).

→ **Soldering of Rutherford Cable to Aluminum stabilizer**

- Was used successfully in the past.

  But on magnets with lower energy density.

  The shear stresses between SC cable/aluminum stabilizer must be strong enough.

  Example with CMS (*Ref.: C. Pes, Mechanical 2D analysis of the CMS winding, 1998, CEA/Saclay)*

  Computed shear stress Rutherford cable/ high purity aluminium (without safety factor) = **10 MPa** (loads considered: cooldown from RT to 4K, energization to 4T at 4K).

- **Studies and prototyping needed.**
- Such an R&D program can be beneficial **to other conductor developments with aluminium as a stabilizer** (e.g.: Al-stabilized conductors with HTS-tapes).

Conclusion

- Looking for coextrusion facilities in industry, available for prototyping and production, according to the schedules of the various project.
- No new manufacturer identified yet, references are needed.
- Alternative solutions have to be looked at, with dedicated studies and prototyping.