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# Report and minutes No 15

from the meeting **29-30 August 2017** at Esab AB in Laxå, Sweden.

Attendance

Lars Cederqvist, SKB, Sweden (chair)
Mathias Lundin, Swedish Welding Commission, Sweden (secr)
Jan Backlund, Sapa AB, Sweden
Jeroen deBacker, TWI, UK
Joakim Hedegård, Swerea Kimab, Sweden
Henrik Hindsefelt, Sapa AB, Sweden
Andreas Jansson, Esab, Sweden
Peter Kjällström, Esab, Sweden
Kristofer Larsson, Esab, Sweden
Rebecka Nilsson, Esab, Sweden
Maria Nyman, Esab, Sweden
Oskari Piepponen, Posiva OY, Finland
Sven-Olof Sjövåg, Sapa Profiler AB, Sweden
Tommy Skoglund, Sapa Profiler AB, Sweden
Jörgen Säll, Esab, Sweden
Ana Silva Magalhães, University West, Sweden
Pedro Vilaça, Aalto University, Finland
Anders Westfeldt, Esab, Sweden
Louise Viklund, Saab Aerostructures, Sweden

## Minutes from the meeting

### 1. Opening of the meeting

The chair Lars Cederqvist opened the meeting, welcomed everyone and started the meeting. The host Peter Kjällström also welcomed everyone to Esab in Laxå.

### 2. Approval of the agenda

The agenda was approved.

### 3. Minutes of the last meeting 2016-11-09 at University West (PTC)

The minutes of the last meeting 9 November 2016 at University West (PTC) was approved.

## 4. Short presentation of the organization and activities of new participants

A short round of presentation was conducted. New to the group where:

Louise Viklund from Saab Aerostructures. She is a production engineer working with FSW and the cargo door project manager for that in Clean Sky project.

Maria Nyman has worked 1,5 year as a design and project manager for FSW robotic.

Oskari Piepponen is new welding engineer at Posiva OY. Started in December 2016.

Joakim Hedegård, Swerea, is research manager. Started up the Joining Center in the late nineties.

Hannes Raudsepp is application manager for submerges arc welding as well as FSW.

Sven-Olof Sjövåg is welding coordinator at Sapa Profiler.

Tommy Skoglund is FSW specialist at Sapa Profiler.

Jan Backlund working with innovation at Sapa since 1996.

The new participants where especially welcomed to the group.

## 5. Presentations

Note that only three of nine presentations was made available for circulation.

### 5.1 New joint geometry and other R&D at Posiva, Oskari Piepponen, Posiva

Oskari presented a redesigned tube lid with new joint geometry.

Ongoing project FISST (Full Scale In Situ System Test) in 2018 which involve full scale testing of manufacturing and assembly of canister components.

Finnish canister is the same size and alloy as the Swedish.

### 5.2 Welding of High Speed Trains, Anders Westfeldt, Esab

Anders presented that the rail car industry has embraced the FSW joining technology in full scale (**Appendix 1**). He noticed that there is a consolidation going on in the industry where the many manufacturers now are down to five main players on the market.

Main focus and benefit is to reduce the cost, reduce the weight and the environmental impact.

Classic application manufacturing panels by welding narrow profiles.

Full length panels are FSW joined up to 26 m, not any more partly fusion welded. But also including structural components such as coupling components (t25 to t30 mm) and cross girders (t15 to t20).

In conclusion, a large-scale conversion from MIG to FSW in aluminum train car field.

### 5.3 Development of next generation robot FSW head with stationary shoulder, Rebecka Nilsson, Esab

Rebecka talket very shortely on Esabs new program NxG Robotic FSW head for equipping conventional and stationary models heads. Multi robot integration (Kuka, ABB, Fanuc, Hittachi, Yaskawa)

Kuka is now the primary FSW robot, are also good integrators compared to others. Yaskawa in Asia is increasing their capacity. There is an increase in capacity that is the reason for the project.

### 5.4 Evaluation of vapour deposition coatings for improved performance of SSFSW tools, Jeroen de Backer

Jeroen talked about PVD and CVD coatings for FSW coatings in the TWI Stir Coat project. It is a study of coting of stationary shoulder tools where the challenge is wear on the tool.

Low friction coating on the probe and wear protective coating on the shoulder to decrease tool ware. Have made wear tests with 12 welds of 800 mm.

Have tested some 10 different coatings where DLC probably gave the best performance as shoulder coating (also TiAlN/VN) and for the probe $TiB_2$ gave the best results.

Jeroen also touched on TWI studies on high temp FSW tool technology and trials with different tool materials. For steal but also for titanium. Is going back to conventional tools for titanium.

Jeroen also touched on some TWI projects on robotic FSW. One example of electronic encapsulation with 0,5 mm lids. Experiments with edge joining where FSW is applied on the sheet edge joining two or multiple sheets.

### 5.5 Features and Case Study of Hybrid Friction Stir Channeling (HFSC), Pedro Vilaça, Aalto University

Pedro gave an overview of the organization and activities on FSW at Aalto University (**Appendix 2**).

Pedro specifically talked about “Hybrid Friction Stir Channeling” (HFSC) using the forming of the channel defect for an application to use the channel in the product. The latest in this process is combining welding and channeling. Have made case studies on heatsink prototypes.

### 5.6 Temperature measurements during FSW, Ana Magalhães (former Silva), University

Ana presented basics on Tool-Workpiece Thermocouple (TWT) method for temperature measurements during FSW.

Ana presented studies made to test the reliability of the method welding just bead on plate in alloy 6081, with constant welding parameters.

The method can present the temperature distribution in a post processed figure. Noted that this is not simulation but real.

Noted that the higher temperature appear in the corner regions of the tool where the temperature is above the solidus temperature of the material.

Ana gave example of using the temperature measurement for process control changing the rotation of the tool, however, not varying the welding speed.

### 5.7 Research activities at Swerea Kimab and KTH, and joining dissimilar material, Joakim Hedegård, Swerea Kimab

Joakim gave a quick overview of the activities at the Center for Joinging and Structures (CJS) at Swerea Kimab (**Appendix 3**).

Running projects in three basic areas automotive industry, heavy industry and stainless steels industry applications.

Joakim presented the results of Wallop Ratanathavorn dissertation at Swerea Kimab and KTH.

One part of that was within the framework of XPRES and on the topic “Hybrid joining of thermoplastics to aluminum. The tensile strength is similar to that of adhesive bonding.

Also the thesis cover joining of AA5754 to DP1000 (steel). The probe is not penetrating the interface between the materials or the surface of the steel sheet.

Have also investigated the forming and properties of different intermetallic phases (Al-Fe IMCs).

Weld pitch, the ratio between the rotation and welding speed.

Pedro mentioned studies on this topic at Aalto.

### 5.8 Ongoing projects at Nordic FSW Centre, Lars Cederqvist, SKB

Lars presented ongoing projects at SKB, e.g the depth controller(s), laser sensor.

Lars also talked on the Nordic friction stir Welding center that is built up in Oskarshamn. Help and support from studies on FSW, and also NDT examination that was developed at SKB.

Ongoing projects for motor blocks for Volvo and bobbin FSW on 20 mm thick AA5083 for ABB.

### 5.9 Welding of fuel tanks for Ariadne 6, Anders Westfeldt & Andreas Jansson, Esab

Anders and Andreas gave this presentation after lunch in conjunction to the technical visit, see below, on the delivery of welding equipment for the FSW of the Ariadne 6 fuel tanks.

Andreas, that was the technical leader for the project, went through the main items of the project. Capability to weld up to t15, with a max z force 60 kN.

## 6. Messages and Reports – conferences, articles etc

Upcoming events:

- 5th International Conference on Scientific and Technical Advances on Friction Stir Welding (FSWP2017), 11-13 October 2017 in Metz, France. Hosted by IS.

- 12th International Symposium on Friction Stir Welding (12ISFSW), 26-28 June 2018 Quebec, Canada. Abstracts due November 30, 2017.

Pedro noted the activities in the International Institute of Welding IIW Commission III meeting during IIW Annual Assembly July 2017 in Shanghai where there were 45 presentation on FSW. Pedro is chair IIIb.

The upcoming IIW annual assemblies are in Bali 2018 and Bratislava 2019

Members in Swedish Welding Commission, Svetskommissionen (or its Nordic equivalents), have access to IIW, for documents, information, correspondence and participation. Info at www.iiwelding.org.

## 7. License and patent issues

Summary of earlier conclusions:

Un-featured tools are possible to use without violating the patent since December 2012

Featured tools are possible to use without violating the patent from,
- January 2015 in Europe
- September 2015 in US

Spread sheet online covering all patents, www.twi-global.com/EasysiteWeb/getresource.axd?AssetID=195120&type=Full

Esabs patent on Stationary shoulder. 8 month left on the patent. Different expiration date between Europe and US. Have had infringements. TWI have a permit from ESsab to use it. Talk to Esab if desire to use it.

## 8. Short report on FSW standardisation activities in IIW

Slow progress. Comments handled, no new drafts ready for balloting.

Revision objective is to make it easier to apply for companies. Relatively high requirements on the procedure specification.

Sapa use it for subcontracting. Siemens and Bombardier have their own FSW standards. However, their requirements are a little bit higher.

## 9. Information projects – Inventory

Tabled.

## 10. Working Program and member issues (prospective participants etc)

Webra have a production facility in Eskilstuna.

## 11. Arrangement for subsequent meeting(s)

Alternatives are Swerea Kimab, SKB or Sapa. Time proposed around second half of May 2018.

## 12. Closure of the meeting

The chair thanked everyone for their contribution and closed the meeting.

## Short notes from Technical tour of Esab Laxå

During lunch break the R&D and manufacturing facilities of Esab in Laxå where exhibited. Equipment for welding of fuel tanks for Ariadne 6 ready for delivery was one of the highlights.

Meeting secretary

Mathias Lundin