

Sent to: members of AG 52 FSW  
Processing and B Pekkari

## Report and minutes

No 8

from the meeting **7-8 February 2012** at SKB in Oskarshamn, Sweden.

### Present:

Lars Cederqvist, SKB, Sweden (chair)  
Mathias Lundin, Swedish Welding Commission, Sweden (secr)  
Gunnar Bolmsjö, University West, Sweden  
Anna-Karin Christiansson, University West, Sweden  
Sören Claesson, SKB, Sweden  
Jeroen deBacker, University West, Sweden  
Johan Fremling, SAPA Technology, Sweden  
Olof Garpinger, SKB, Sweden  
Isak Nielsen, SKB, Sweden  
Henrik Nyström, SAPA GAD, Sweden  
Ulf Ronneteg, SKB, Sweden  
Eva Lind-Ulmgren, Swerea Kimab, Sweden  
Timo Salonen, Posiva OY, Finland  
Henrik Schmidt, HBS Engineering, Denmark  
Mikael Soron, ESAB, Sweden  
Stefan Stoltz, ESAB, Sweden  
Mikael Tigerström, SKB, Sweden and  
Anders Westfeldt, ESAB, Sweden

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### *Minutes from the meeting 8 February*

1. Opening of the meeting (08.45 h)  
The chairman Lars Cederqvist opened the meeting wishing everyone welcome SKB.
2. Approval of the agenda  
The agenda was approved noting that presentations under item 5 will be slightly changed.
3. Minutes (nr 7) of the last meeting 2011-05-10/11 in Finspång, Sweden  
The chairman briefly went through the minutes which were approved with the following change.  
§ 5 f) Timo noted that the Olkilouto site will be ready for final disposal year 2020, not 2025. SKB disposal facilities should be ready approximately at 2025.
4. Short presentation of the organisation and activities of new participants  
Round the table short presentation of all participants was made.
5. Presentations
  - a) *Development of NDT (X-ray, ultrasonic and eddy current) at SKB, Ulf Ronneteg*  
Ulf presented (**Appendix 1**) NDT activities for the canister project.  
Why do we need NDT? Detect joint line hooking (JLH) and cavities on or close to the surface.  
The aim is to support the development of the application, produce documentation for approval.

Ulf presented experiences with digital RT and phased array UT.

UT showed good detection capability for JLH. Cavities are really demanding for RT.

Ulf pointed out that the weld is only a small volume of the whole canister material, all must be tested.

Ulf also presented recent development with tests with Eddy Current (ET).

On-going work is evaluation of RT detectors and optimization of UT.

Ulf pointed out the difficulties to determine size and distinguish JLH and incomplete penetration.

*b) Adjustable force regulator to achieve constant tool depth, Lars Cederqvist & Isak Nielsen*

Lars presented (**Appendix 2**) the work on getting a flash free weld with adjusting the axial force during welding.

The study aimed to check how the changing of the force to get the right weld geometry influences the process (parameter?) window. Noted that the production of defects is very dependent on the axial force, which makes the use of position control not adequate.

Lars showed that there must be a limited span within which the force can vary, meanwhile controlling the temperature.

Isak presented test results and challenges concerning the control of the tool depth and the compensation for the thermal expansion.

There was an extended discussion on the control and thermal expansion.

*c) StirRoFlex at University West, Jeroen De Backer*

Jeroen presented (**Appendix 3**) on the recent findings in the StirRoFlex project.

Study on the influence of side tilt angle on overlap application. A change  $\pm 4^\circ$  (advancing and retreating side respectively) had no significant effect on the distribution of defects. He concluded that this proves robustness for 3D applications.

He compared with the last meeting presentation on the influence of path deviation.

He also presented results on the deflection of the robot. When measuring the deflection of each robot axis joint one can predict the total tool deflection depending on the deflection in the robot. The axis joints furthest from the weld point generate the largest deflection, axis 1, 2 and 3.

Jeroen has submitted two papers to Welding Journal on surface quality.

Jeroen showed a demonstrator on a jet engine turbine application.

*d) FSW/FSP projects at HBS Engineering, Henrik Schmidt*

Henrik presented (**Appendix 4**) the status of the projects he is involved in. He is planning courses in simulation of FSW in the fall of 2012. He showed a number of modelling examples.

He presented his involvement in the SignaStir project, partners and work packages. He presented some preliminary results on simulating Laser Ultrasonic Testing (LUT) on a FSW cross section.

*e) FSW/FSP R&D at ESAB, Mikael Soron*

Mikael presented the R&D activities at ESAB, however, without pictures since much of the activities have secrecy issues due to commercial interests.

He discussed Bobbin Tool Welding where TWI sponsors a project to develop the bobbin technology.

Further he mentioned Add-Stir and corner welding to e.g. produce fillet welds which he claimed showed excellent results.

He also mentioned evaluation of weldability of high temperature application materials such as stainless, Inconel, etc.

He also approached the issue of fixtures and support structures.

For the NxG process package with the aim to develop a new control system platform for enhanced process control and monitoring, there will be more info during 2012.

He also mentioned that Esab will look more in to High-speed spindle welding, tool and tool material studies, new material studies.

f) *FSW activities at Fogningscentrum KIMAB (Signastar, Stiroflex, Xpress), Eva Lindh-Ulmgren*

Eva presented (**Appendix 5**) activities at Swerea Kimab.

Xpress is Vinnova founded with mainly KTH partners but also Swerea and Mälardalen University, plus a number of companies. The vision is adaptive and sustainable manufacturing of future products. It involves a lot of simulation and virtual reality. The aim is to go from experimental models to physical models in 15 years.

The main drivers for the project are the reduction of CO<sub>2</sub> emission and reduction of life cycle cost.

Eva showed results from a study of FSW of hybrid joints, aluminium to polymer (thermoplastic), AA5754 to Polypropylene (PP). The process create chipping on the faying side of the aluminium and melding the polymer that will diffuse in to the chipped area creating a bond. She also showed tensile test results.

SignaStar aims to demonstrate and characterise the capability of non-contact testing for FSW welds. Laser Ultrasonic Testing (LUT) where the infrared laser is like a hammer applied to the surface to generate sound waves. LUT gives the possibility to test ruff surface, limited access due to shape and location.

g) *StiroFlex, Gunnar Bolmsjö*

Gunnar first showed a youtube clip with robotic FSW on SAAB aluminium body in white application. Search "fsw robotic" or "fsw gbolmsjo".

Gunnar presented (**Appendix 6**) the background and status of the StiroFlex project and its 9 work packages.

He mentioned Conference Joining in Car Body Engineering 17-19 April in Germany.

He also noted the focus on FSW in combination with adhesive bonding.

The project target is to make the process industrially available, show flexible solutions, show robustness in the process, applicable joint design and maintain competence.

6. Messages and Reports – conferences, articles etc

The following events where mentioned.

Friction Stir Welding and processing 26-27 January 2012 in France, see [www.fswp2012.org](http://www.fswp2012.org).

9<sup>th</sup> international symposium on Friction Stir Welding (TWI Conference ) 15-17 May 2012 in Alabama USA.

9<sup>th</sup> International Conference on Trends in Welding Research 4-8 in Chicago, USA

10<sup>th</sup> International Seminar Numerical Analysis of Weldability 24-26 September 2012 in Graz-Seggau, Austria

Elmia Svets och Fogningsteknik 8-11 May 2012 in Jönköping, Sweden. Possible seminar was discussed but skipped.

Nordic Welding Conference, NWC (SE: Nordiskt Svetsmöte, NSM) 4-5 October in Oslo.

7. Licence and patent issues

Possible get more info from TWI in May. Nothing more.

8. Short report on FSW/FSSW standardisation activities in IIW

The standard series on FSW was published in the end of 2011:

ISO 25239-1 Friction stir welding – Aluminium – Part 1: Vocabulary

ISO 25239-2 Friction stir welding – Aluminium – Part 2: Design of weld joints

ISO 25239-3 Friction stir welding – Aluminium – Part 3: Qualification of welding operators

ISO 25239-4 Friction stir welding – Aluminium – Part 4: Specification and qualification of welding Procedures

ISO 25239-5 Friction stir welding – Aluminium – Part 5: Quality and inspection requirements

Johan Fremling presented (**Appendix 7**) the basic content of the standard series.

Similar project on spot welding, FSSW, is started and processed in IIW C-III-B-WGB4

9. Information projects – Inventory

Mathias repeated the intention to list activities for the spreading of information of FSW to a broader audience. E.g. Article in Svetsen Magazine after TWI conference in Alabama or a presentation on welding of the copper canisters at Elmia Svets & Fogningsteknik.

Further inventory was postponed.

10. Working program and member issues (prospective participants etc)

Mathias reported on the contact with Cryo AB for participation in the group. They are only thinking of FSW and have not yet initiated any activities. We can approach them later.

Stefan Stoltz will email a contact he has at Webra and ask for their interest in participation in the group.

Anna-Karin will ask Volvo Aero if they want to participate.

A brief look through the list of members lead to the deletion of some members' former employees, and that left the field of FSW.

11. Arrangement for subsequent meetings

The next meeting was decided for **13-14 November 2012 at Swerea Kimab, Stockholm.**

Possible presentations from Kimab on e.g. corrosion and creep. The members are invited to propose further presentations for the agenda/program.

12. Closure of the meeting

The chairman thanked everyone for their attendance and contribution.

Meeting secretary



Mathias Lundin

**Tour of the SKB canister laboratory facilities**

Lars and the coworkers at SKB presented the equipment for welding of the canister lid as well as the equipment for the NDT. The group got to witness welding of 60 mm copper with FSW.