

Self-threading electrical discharge machine – hot cell modifications and the first year of active machining

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Electrical discharge machining (EDM) is very useful when fabricating metallic samples that requires tight dimensional tolerances, e.g. samples for mechanical tests such as tensile testing, ring compression testing and crack propagation testing. If the samples are radioactive with high dose rates, like samples from reactor vessels or fuel cladding, the operator of the EDM must be shielded from the machine i.e. the EDM must be put in a shielding cell.

The old EDM at Studsvik (Sodick A280L) had reach its end-of-life after more than 20 years of active machining. At the end the cutting wire was broken repeatedly and on this machine the wire had to be threaded manually requiring man entry into the cell. The repeated man entry yielded unnecessary high radiation doses to the personal. So, Studsvik decided to replace the machine with a new self-threading EDM.

Requirements of the new EDM

The new EDM had to fulfil the following requirements:

- It needed to have the electronic control system separate from the machining system, so the control system can be placed outside of the hot cell.
- It needed to fit the existing hot cell without too much modification of the hot cell.
- It needed to be able to automatically thread new wire to avoid unnecessary man entries in the hot cell.
- The EDM must be fitted with an in-cell filter system to remove solid debris from the working fluid.

The choice of fell on FANUC ROBOCUT α -C400iA a modern self-threading EDM with separate control, see Figure P9.

Hot cell modifications of the EDM

A new filtered EDM fluid filter system was designed and fabricated. It compromises a coarse and a fine filter, see Figure P10. The filtering system is located within the hot cell and the filters can be exchanged by use of manipulators. The fluid is stored in an in-cell tank. Before the fluid is released to the on-site active sewage system the fluid is filtered by the in-cell system.

All electrical wires connecting the control system to the EDM system was extended and some integrated electronics were moved out of the EDM-system, see Figure P10. Also, since the EDM is placed inside a hot cell some unnecessary operator protections was removed. These changes to the EDM spurred several warnings and errors in the control system but it was all sorted out by close co-operation with FANUC technicians.

The hot cell was cleaned out and repainted. A new 7-inch-thick lead door was installed so that the new and higher EDM could be transferred into the cell, see Figure P11. The cell is divided into a

sample mounting section and an EDM section, each operated by two simple manipulators. On the roof of the hot cell a long manipulator is situated. It is used to pick up object that is unreachable with the other manipulators. To help the operator to see all corners of the cell it has been equipped with a IP-camera and a portable waterproof web-camera.



Figure P9: The FANUC ROBOCUT α-C400iA has controls (right) separated from the EDM system (left).



Figure P10: In-cell filters for EDM-fluid (left) and EDM under modification (right)



Greppen flyttade högre upp samt bockade för att få något rejälare att ta tag i. Fungerar mycket bra efteråt.



Figure P11: A new 7-inch door was fitted to the hot cell (left). Operator control panel of the installed EDM (center). A steerable in-cell IP-camera helps the operator to see all corners of the cell.

First year of active machining

The new EDM has been producing active samples for mechanical testing for about a year now. The self-threading feature of the machine has significantly reduced the dose to the operators since man-entry for wire threading is not needed any more. The quality of the machined samples is as good or even better than with the old machine. One lesson learned is that modern technology (especially software) can frighten old operators. Over the first year no radiation related malfunction of the EDM have occurred.