

## Development of Wire Electric Discharge Machine in Hot Cell

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### 1. Introduction

CANDU pressure tube in Pressurized heavy water reactor(PHWR) is irradiated by neutrons during reactor operation. In order to evaluate changing the mechanical properties for safety and life-time, the surveillance test for pressure tube should be performed with various types of specimens as shown Fig. 1. In particular, the delayed hydride cracking(DHC) test among the surveillance test is essential to operate PHWR safely.[1]

In the present study, wire electric discharge machine was developed to fabricate DHC specimens in hot cell. The feasibility of the wire electric discharge machine was demonstrated using unirradiated pressure tube.

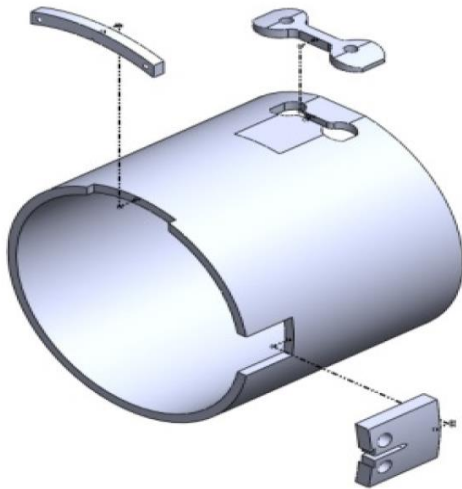


Fig. 1. Surveillance Test Specimens

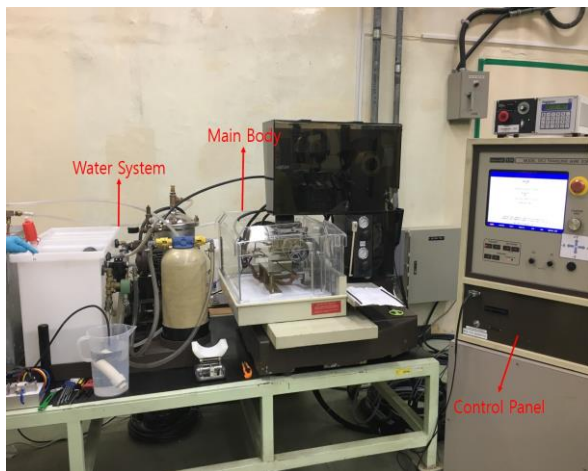


Fig. 2. Wire Electric Discharge System

### 2. Methods

This machine is consist of main body, control panel, water system as shown Fig. 2. Machining is performed in main body and cooling water is provided by water system. Brass Wire thickness is 0.25mm and cooling water is deionized water.

In order to accurate machining, wire tilt calibration should be performed to X axis and Y axis. Wire tilt calibration is used for calibration block with two touch sensor and edge-find as shown Fig. 3. After wire tilt calibration, X axis center calibration was performed for machining at pressure tube center.

Once machining is started, heat by electric discharge is generated and cooling water is sprayed to cool down the specimen. Cooling water should be low conductivity to keep machined surface quality and machining speed. Conductivity is confirmed by green light in control panel as shown Fig.4. In case of red light, cooling water is circulated to ion-exchanger automatically and then green light is on as conductivity decreases.

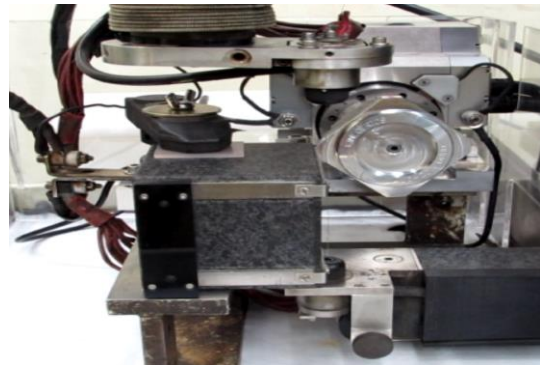


Fig. 3. Wire Tilt Calibration Block



Fig. 4. Conductivity Confirmation

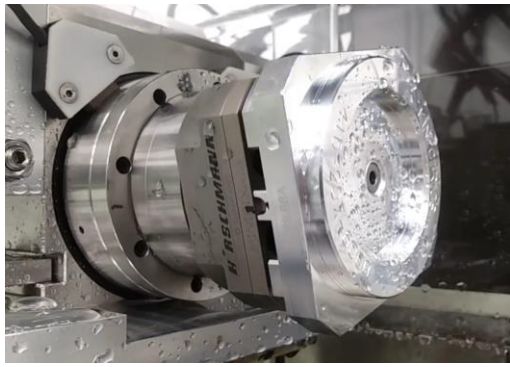


Fig. 5. Hirschmann's Fixture

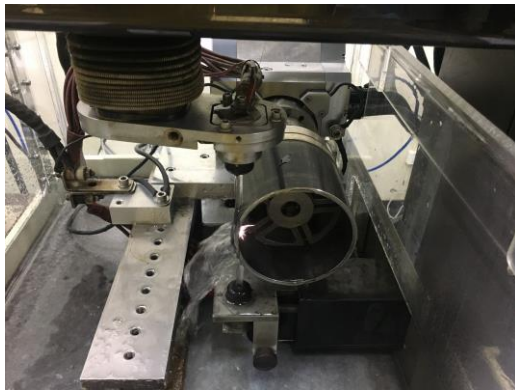


Fig. 6. Fabrication of Specimen

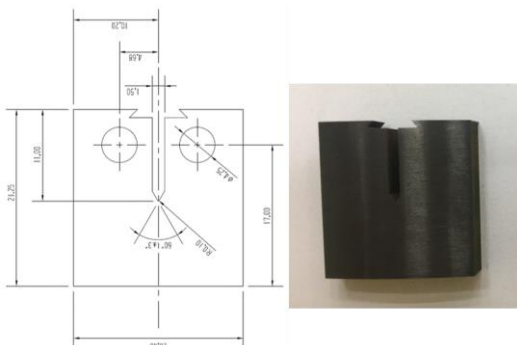


Fig. 7. Dimension and Completed Specimen

Pressure tube was fixed Hirschmann's fixture. Fig. 5 shows Hirschmann's fixture. It is easy to move the pressure tube to the next hotcell when troubleshooting. Also, It is pneumatic and adjustable for angle.

CCT(Curved Compact Tension) program was run in control panel. And then machining was started, cooling water was sprayed as shown Fig. 6. Run time is about 3 hours per 1 CCT specimens. After completion, CCT specimens were harvested by manipulator.

### 3. Results

Fig. 7. shows dimensions and completed specimen by wire electric discharge machine. 2 holes of final specimen was machined by milling machine. And then

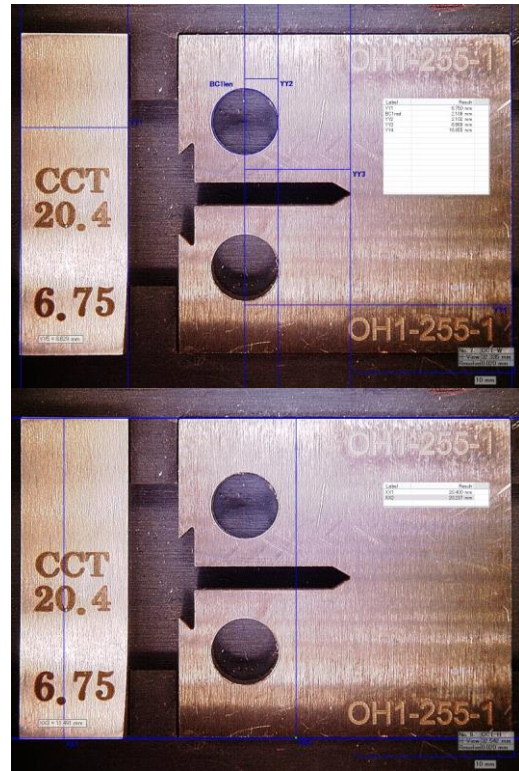


Fig. 8. Result of Dimension Measurement

dimension measurement was carried out by Hirox KH7700. As a result, width of specimens is 20.237 mm. Distance of center of hole to end of notch is 6.668 mm. Machining error is less 0.2 mm.

### 4. Conclusions

Electric discharge machine was developed to fabricate specimens of pressure tube surveillance test. CCT among the surveillance test specimen was successfully fabricated. This machine will be applicable for various types of specimen in hot cell.

### REFERENCES

- [1] S. Ahn, W. Oh, Y. Chung, D. Kim, Y. Choo, K. Hong, K. Kim, Y. Kim, Prediction of Delayed Hydride Crack Velocity in the Irradiated Zr-2.5Nb CANDU Pressure Tube Materials, 5<sup>th</sup> JAERI-KAERI JOINT SEMINAR, pp. 10, 2005.