CALIBRATION OF DATA ACQUISITION SYSTEM MEASUREMENT OF WELD PARAMETERS

by

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"Calibration of Data Acquisition System Measurement of Weld Parameters"

Tim Roberts
SAVANNAH RIVER PLANT

The purpose of this talk was to outline the calibration and use of the MacSym Data Acquisition System to measure welding parameters in the Tritium Facility's pinch welders. The point was stressed at the outset of the presentation that these parameters measured are not in any way the final criteria for accepting or rejecting a weld. Rather, the physical dimensions of the weld are the basis for accepting a weld, namely the thickness and closure length. So these welding parameters serve as ranges and boundaries to stay within in order to give the highest level of repeatable success.

The seven weld parameters measured are: piston pressure, line pressure, motion, current, energy, line voltage, and force. Each of these measurements are made with installed equipment that is calibrated with standards that are traceable to NBS (National Bureau of Standards). In turn, the DAS is calibrated by adjusting the software to match the installed equipment in it's measurements. Also, the DAS provides continual monitoring and display of the weld parameters before and after the weld has been made. A printout is also given of parameters during the weld to give further record of weld data to back up installed measurement instruments not connected to the DAS.

Piston pressure is measured by a strain gage transducer. Signal conditioning and excitation are given by the DAS. The measurement and display of the DAS are calibrated to +/- 3psi by an adjustment in the DAS. Line pressure is also measured by a pressure sensor and is conditioned and calibrated in the same way to +/- 3psi. A current to voltage transformation is made by the DAS.
Motion is measured by a Kaman Sciences Displacement System. Displacement between the welding electrodes is measured in mils, and an accuracy of +/- 2 mils is achieved. The calibration is done by using precision spacers and adjusting both the measuring system and the software of the DAS.

Current is measured by the DAS using a precision current shunt resistor. The DAS samples the current output and calculates the maximum RMS current. The measurement is actually the voltage across the shunt. The DAS also measures the half cycles of the weld. Calibration is done by adjusting the software to match a standard input.

Line Voltage supplied to the welders is measured by a voltage transducer. The accuracy is calibrated to +/- 2 Volts by adjusting the software in the DAS. The line voltage is kept in a certain range for each type of material to give the needed current.

The energy of the weld is also measured and displayed by the DAS. Instantaneous current and voltage are multiplied in real time to give the power of the weld. The energy is then found by integrating the power over the weld time. No changes in the DAS software are needed since the current and voltage are calibrated separately.

The final parameter mentioned was the force between the electrodes. Force is measured by a strain gage force cell. The excitation and signal conditioning are found in the DAS itself. The accuracy over the given range of the forces used is calibrated to +/- 20 lb. The calibration adjustment of the software for the force is the same as the other measurements except that a subprogram is called to make the number changes in the software automatically. This saves time and the risk of miscalibration is lowered.

In the future the Tritium Facility will strive to improve its calibration of weld parameters by keeping close watch on the development work being done by other plant support groups and by keeping design changes flexible to change with new requirements. The other weld measuring calibrations will be altered to provide automated adjustment similar to the force parameter's subprogram. As design specifications remain in constant flux, adaptability will remain a crucial concern.

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OVERVIEW
PARAMETERS MEASURED

- PISTON PRESSURE
- LINE PRESSURE
- MOTION
- CURRENT
- ENERGY
- LINE VOLTAGE
- FORCE

DAS CALIBRATION
CALIBRATION
OF
DATA ACQUISITION SYSTEM
MEASUREMENT OF
WELD PARAMETERS

TIM ROBERTS, TRITIUM FACILITY
PISTON PRESSURE

- A PRESSURE TRANSDUCER
- EXCITATION AND SIGNAL CONDITIONING IN THE DAS
- CALIBRATION BY A STANDARD, AND SOFTWARE ADJUSTMENT
- CALIBRATED TO +/- 3 PSI.
LINE PRESSURE

- PRESSURE SENSOR
- EXCITATION AND SIGNAL CONDITIONING IN THE DAS
- CALIBRATION ADJUSTMENT IN THE SOFTWARE BY COMPARING TO A STANDARD
- CALIBRATED TO +/- 3 PSI.
MOTION

- Measured by a Kaman Sciences Displacement Measuring System
- Displacement in mils of separation
- An accuracy achieved of +/- 2 mils
- Calibration by precision spacers
- The displacement system is adjusted for calibration.

DAS CALIBRATION
CURRENT

- The current is measured by the DAS using a 30,000 amp current shunt.
- The DAS samples the current output and calculates the maximum RMS current.
- The measurement is taken from the voltage across the precision shunt resistor.
- Calibration is done by using known standards and achieved by adjusting the software.

DAS CALIBRATION
INSTANTANEOUS WELD CURRENT AND VOLTAGE ARE MULTIPLIED IN REAL TIME TO GIVE WELD POWER.

ENERGY IS GAINED BY INTEGRATION OF POWER OVER THE WELD TIME.

CALIBRATION OF THIS MEASUREMENT RESULTS FROM CURRENT AND VOLTAGE CALIBRATIONS.

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DAS CALIBRATION
LINE VOLTAGE

- The line voltage is measured by a voltage transducer.

- Accuracy is calibrated to +/- 2 volts of the reading.

- Calibration is done by adjusting the software.
FORCE

- FORCE IS MEASURED BY A STRAIN GAGE FORCE CELL
- EXCITATION AND SIGNAL CONDITIONING IN THE DAS
- ACCURACY IS CALIBRATED TO +/- 20 LBS. OVER THE GIVEN RANGE OF THE FORCE CELL.
- CALIBRATION ADJUSTMENT IN THE SOFTWARE IS DONE BY A SUBPROGRAM WHICH AUTOMATICALLY ADJUSTS THE VALUE OF THE MEASUREMENT IN RELATION TO A STANDARD FORCE CELL'S READING.
FUTURE CALIBRATION
OF ALL WELD PARAMETER
MEASUREMENTS
BY THE DAS

- AUTOMATED ADJUSTMENT SUBPROGRAMS LIKE
  THAT OF THE FORCE MEASUREMENT.

- FOLLOW UP CLOSELY WITH DEVELOPMENT WORK
  DONE BY EED ON IMPROVING THE MEASUREMENTS
  AND CALIBRATIONS OF WELD PARAMETERS.

DAS CALIBRATION