

# Testing for Data Quality

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- Important of Data Quality
- Background
- Potential Test Methods to Address Requirements
- Conclusion

- Over the past several days, we heard the important work being FDC, APC, R2R and e-Mfg
- We have also heard about Data Quality at the EECDT and e-Mfg presentation, as well as problems associated with data not available (TI talk) and inaccurate metrology measurement causing the APC system to be adjusted incorrectly
- The Quality of the Data (availability, accuracy, timeliness...) is of extreme important for successful operation of the tool and the Fab

- Senior level executives of the member companies of SEMATECH expressed concerns about Data Quality and its importance in making decisions for e-Diagnostics, APC, R2R, FDC etc.
- SEMATECH working group formed to address concerns
- Initial DQ requirements documented (TR#02064280A-ENG)
- SEMI Task Force formed to address requirements and standards. Present members are from Brooks, SEMATECH and Si Automation
- Si Automation has analyzed the initial requirements (data content) and has developed initial test methods to address them.

**Requirement:** ... the same data that the equipment supplier requires for the purposes of tool control and any parameter from said control.....the amount is an agreement between supplier and user.

## **Test Method:**

Use of a flexible, programmable system that can not only interface with SECS/GEM to capture data but can interface directly to tool with I/O (sensors, sub assemblies), comm. Standards (TCP/IP, ModBus, serial ports etc...) and any other defined interface. SilverBox Software Suite (SBSS) has this capability and can be used to meet this requirement.

**Requirement:** ... data shall be provided in compressed form where it is determined that the volume of the data is high enough to affect the timely delivery of data.

## Test Method:

Both raw and compressed data can be collected, compressed data will be decompressed and compared. The supplier to provide the decompression algorithm if it not a standard documented one.

SBSS offers three ways to achieve decompression

- Use SBSS script language to manipulate compressed data.
- Develop an SBSS library (dll) implementing the decompression algorithm.
- Use directly a library (dll) provided by the tool vendor.

**Requirement:** ...data shall be provided with a sampling rate at least twice, as a minimum, the period of the shortest anomaly or signature to be detected on the signal.....

## Test Method:

The tool vendor will document what sampling rate is supported for trace report or equivalent methods through the data port.

The tester will verify the data is actually sampled at this rate by collecting it directly from the tool sensors.

**Requirement:** ... resolution of no less than .1% of normal operating range

## Test Method

We could collect data from both Secs/Gem and I/Os and deduct the resolution and accuracy. Secs/Gem format supports a resolution of up to 8 bytes which is enough to for this matter.

**Requirement:** ... an absolute accuracy of no less than .05% of normal operating range

## Test Method

We could collect data from both Secs/Gem and I/Os and deduct the resolution and accuracy.

**Requirement:** ...all sensors ...should have either self checking or to be detectable by the equipment controller....means verifying proper operation and reporting this.....

## Test method:

The tool supplier documents the method and provides a signal in anyway (secs/gem, e-diag port AO, DO, sensor bus...) the hardware platform running SBSS can receive it. A fault may be induced in the tool to insure it is caught.

**Requirement:** ...Data collection must have the ability to be triggered based on a command from the host, on a recipe step, a specified equipment event or a combination of specified equipment events

## Test Method:

SBSS "Data Collector" has the capability to trigger data collection under various circumstances:

- Secs/Gem event report reception.
- SVID value change (Step Id, chamber temperature...).
- Digital/Analog input value change.
- ...

Note: with enough knowledge of the process, we could test the trigger events are sent at the relevant time. We collect data continuously and make sure the events are received at the correct time.

**Requirement:** ...data shall be made available to internal or external systems within 50 milliseconds of being sampled....

## Test Method

Collect data from both the tool data port and the sensor. Data comparison will show data delivery time.

## Main Issue

Accuracy of the time synchronization between the tool and the sensor has to be in the millisecond range. Impossible to achieve using the Secs Gem protocol.

**Requirement:** ... all sensors providing data shall provide the means of tracking their make, model, serial number. And last bench calibration date.

## Test Method:

- If the sensor is capable of communicating directly via a protocol like Modbus, some specified memory addresses could be dedicated to this information.
- If the tool vendor specifies a log file where this information is available, the SBSS has a method to extract it through the network.
- If the sensor is fully integrated, this information should be available through a specified SVID. The tester would perform a simple status query to get them.

**Requirement:** ...all data must be time and date stamped....and synchronized...time-stamping must correspond to the occurrence of the corresponding event or sample value.....

## Test Method:

- Obtain the event time stamp through the tool data port.
- Collect significant sensor information using fast data collection rate.
- Time stamp the change of value of one or several sensors telling us the corresponding event occurred.
- Compare "Sensor time stamp" and "Tool Event time stamp".

## Main issue:

Millisecond range synchronization seems impossible to achieve using the Secs Gem protocol.

- Based upon the initial set of requirements in the SEMATECH document, Si Automation has purposed an initial set of test methods to start with.
- Si Automation will continue to work with the SEMI Task Force in more fully define these Data Quality requirements and continue to look to ways to test them.