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PROCESS CHAMBER ASSURANCE TOOL

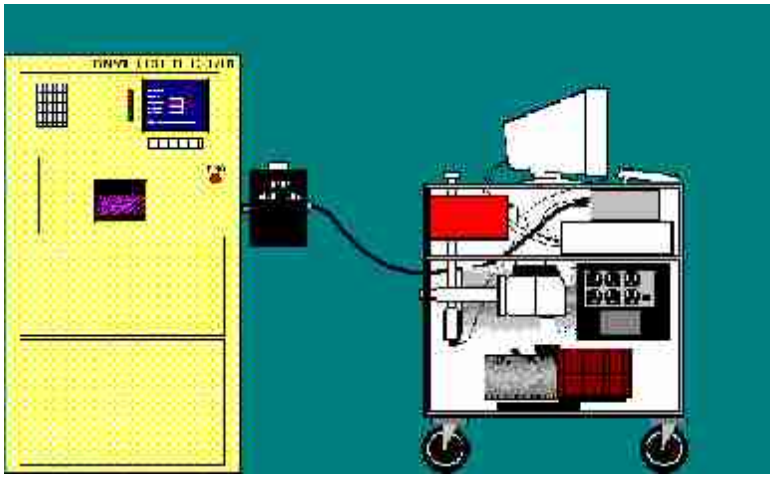
DEDICATED TO IMPROVING PROCESS PERFORMANCE

DESIGNED TO TEST MASS FLOW CONTROLLERS, PRESSURE SENSORS, PUMP PERFORMANCE AND CHAMBER INTEGRITY, THE CAT IS USED PRIMARILY FOR:

- PERFORMANCE MONITORING OF PROCESS TOOL COMPONENTS TO PREVENT UNSCHEDULED DOWN TIME AND MAINTENANCE
- FINGERPRINTING OF HIGH YIELD PROCESS TOOLS FOR SYSTEM MATCHING WITH LIKE TOOLS
- BRINGING NEW AND DOWN SYSTEMS ONLINE AND IN SPECIFICATION
- SETTING A BASELINE STANDARD BEFORE RUNNING A PROCESS

In-Situ Analysis

Unlike independent, off line component testing, the CAT checks the process tool components while they are in place on the tool. Pressure sensors are tested without being removed. MFCs tested without interference, using the process gas used under normal operation. Pump performance and chamber integrity are tested with all components in place, creating a more accurate picture of performance.



Independent Auditor

The key to the CAT's performance is the independent NIST traceable reference. The reference is an accurately calibrated assembly which provides the calibration components for process chamber testing. Even though most process tools have some of their own diagnostic tools and processes, the components used for testing are typically the very components being tested. Using the independent reference and applying the gas laws and the NIST traceable reference, the CAT assures creditable results.

What are the CAT Tests?

The CAT is designed to test the gas handling components of the process tool which include *pressure sensors, mass flow controllers, pump performance* and *chamber integrity.* The National Institute of Science and Technology (NIST) *rate of rise* methodology is used to assure accurate results. Users may select which components and which tests to run. The tests include the following.

Pressure Sensors

Zero Offset-

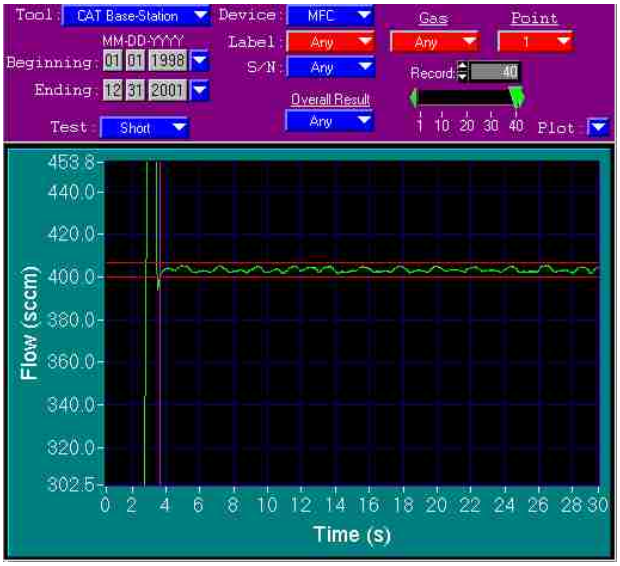
The CAT accurately references pressures below 10^{-5} Torr. By comparing tool and reference base pressures, with the reference attached to the process tool, the pressure sensor zero offset is established.

Pressure Sensor Quality-

The accuracy and linearity of the pressure sensor are tested. Users can define the pressure band for testing and evaluate the linearity deviation over the designated range.

Noise –
Both mechanical vibration and electrical interference affect the pressure sensor performance. The noise test allows the user to set control bands for acceptable noise levels and observe any degradation of performance over time.

Mass Flow Controllers



MFCs are tested on the tool, flowing process gases for true performance evaluation. Each MFC is tested for deviations in linearity, zero offset and gain. Between 1 and 10 flow rates may be defined. Tests performed at each flow rate include average flow rate, maximum flow, flow stability and time to controlled flow.

Zero offset, gain and deviation in linearity-
Based on the MFC running more than three flow rates, the testing checks the overall linearity and accuracy of the MFC performance. The user will be able to tell if the MFC is out of specification and needs to be replaced, recalibrated or calibration compensated (see CCM option). The user may define the acceptable tolerance level for their needs creating a viable pass or fail parameter.

Time to control, flow average, overshoot, flow deviation and rate of rise time-

Again the user has the option to set the control parameters. The *time to control* test shows how long the MFC required from start to attaining controlled flow at the set flow rate. *Maximum flow* displays the overshoot flow rate before coming into control. *Flow stability* shows the deviations from the set flow rate after coming into control. All are factors key to maintaining process stability.

Process Chamber Tests
Effective Volume-
This test provides a value related to the internal volume of the process chamber. If the temperature of the chamber is known, an accurate value for its true volume is provided to the user. Changes in this measurement in future tests would indicate a change in temperature or changes in the actual volume.

Leak-up rate-
The CAT checks the chamber leak rate in mTorr/minute. In many cases, real and virtual leaks can be differentiated.

Pumping Stack Performance
The CAT performs a sensitive measurement of pump dynamic performance and repeatability. The time required to achieve a user-defined working target pressure is measured. The pump speed at a user-

defined pressure is also provided. By creating a history of test results, users can detect minor changes in performance before a critical shut down occurs, gaining considerable savings in both time and money.

TREND ANALYSIS

All of the test results are stored in a database for future reference. By analysing a body of data results, trending may help predict failures on tool components such as MFCs, manometers and pumps. For example, after testing an MFC for a couple of weeks, we can see that the mean flow has started rise over the last few days. Even though the MFC is still in spec, the trend analysis predicts that the MFC will be out of spec in about three weeks. Such trend analysis is very valuable in helping to schedule down time for repairs and for knowing what repairs are needed.

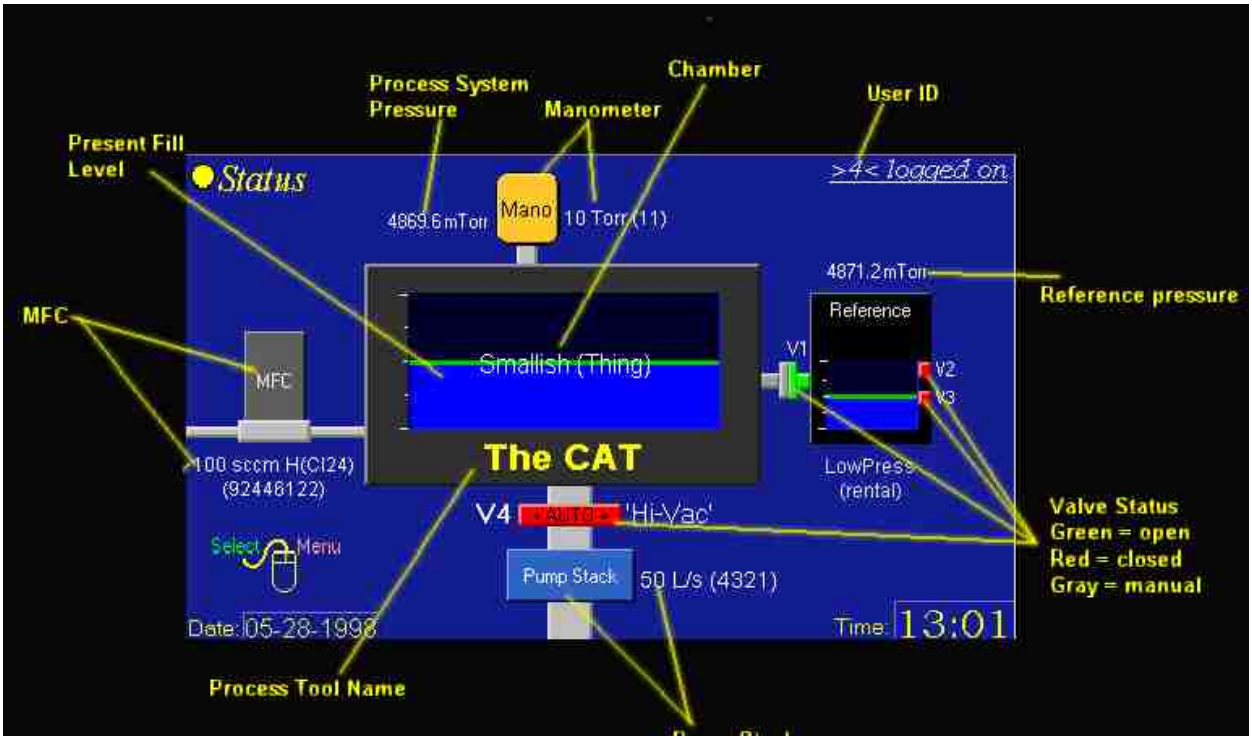
User Friendly Features

WINDOWS SOFTWARE INTERFACE

The control software operates under Windows 95 (or Windows 98). Cue cards and help screens navigate operators through the test procedures making testing a simple operation. A great deal of flexibility allows engineers to design the full array of test or focus on one area of concern.

SECURITY

The CAT software features four levels of security. Operators may run all of the configured tests. Service security level users may run tests and view configurations to assure the CAT is working properly. Engineer level users may define the test specifications for each process tool and components. Finally, the Owner has full access to all controls including defining the security levels of the other users.



SYSTEM STATUS

The status view displays the active system with the components presently under test.

Graphic representations of gas flows and valves opening provide a birds eye view of the overall configuration.

Setting up configurations for multiple process chambers is made simple by the pre-loaded defaults and copy configuration features. Each CAT system comes pre-loaded with factory specifications for most MFCs and manometer types. Selecting the model number automatically loads the default settings. Also, once a process system's configuration is completed, copying the configuration for like process systems is just a couple of mouse clicks away.

MECHANICAL FEATURES

The CAT has four swivel wheels to assure easy movement into corners and narrow race ways. The small foot print of 20" by 24" adds to the maneuverability. A retractable power cord and flexcoil reference connection prevent unwanted cables dragging behind when moving from process to process. Stainless steel skins ensure class 1 clean room compliance.

Typical Use

The CAT system may be configured to test several different process tools. Test time on each tool may vary depending on the desired target. However, typically, users apply the CAT to a maximum of 30 tools per week. Running a full battery of test on a given tool ranges between 30 minutes to an hour, depending on defined parameters.

Return on Investment

The CAT is a yield enhancement tool. Several users have used the CAT/VDS technology to pinpoint problems in matching tools running like processes but achieving lower yields. It must be said, the CAT helps define the problem quickly saving man hours and down time. We will not add those numbers to the equation because they are unpredictable. However, to do a sample ROI, we will apply the following modest assumptions. If your microchip product is worth a modest $2 each and you have 250 wafer starts a week and the CAT system helps improve yield from 87% to 92% on 5 process tools, the CAT system pays for itself in 4 weeks.