



INTRODUCTION

Calibration Process Manager

MudCats is a 32 bit, Windows 9x, NT, or 2000 based program, designed for standalone or Client/Server SQL database applications. It has been specifically designed and developed to satisfy /ANSIISO/IEC-17025, 21 CFR Part 11, ANSI/NCSL Z-540, 10CFR 50 Appendix B, ISO-9002, GMP, and other stringent quality requirements for calibration data collection.

MudCats Calibration Process Manager provides the tools to create, manage and automate datasheet, and perform analyses of the collected data. The system has multiple tools to facilitate the translation of equipment specifications into electronic datasheets. These electronic datasheets can then be used to collect and store calibration data for up to eight instruments simultaneously. Automation scripting can be added to these datasheets to configure instruments, capture data, perform mathematical operations, communicate with external software, and even create instrument test points dynamically. While test point data is being collected, MudCats will indicate the degree to which an instrument is in or out of tolerance.

MudCats enhances your existing laboratory system for all disciplines. MudCats is a new kind of metrology software tool that compliments your current system and processes, creating a whole new world of benefits. MudCats works in engineering and at the bench to simplify and speed up the calibration process.

Calibration Tools

- **Datasheet Editor**

While creating a datasheet, what you see in the editor is exactly what you will see when the datasheet is printed. There are many ways to create datasheets using MudCats. While using integrated tools, such as the tolerance calculator and test point wizards, is by far the easiest, you can always enter test point data directly into the datasheet cells. Formatting of this data is completely automated. You enter the text and MudCats will determine the necessary font size, spacing, and line splitting for each data column. This automatic formatting ensures a uniform look and feel to all of the MudCats datasheets.

- **Integrated Tolerance Calculator**

The integrated tolerance calculator allows a datasheet designer to generate test point row data by merely entering nominal test point values and equipment specification data. The tolerance is calculated, formatted, and then the new test points are inserted into the datasheet. The calculator uses a smart rounding system to appropriately round tolerance values. The calculator supports both standard specifications (% of I.V., ppm of I.V., % of F.S., ppm of F.S., $\pm n$ Units of measure, and \pm db) and custom specifications. Custom specifications are more complex specification components such as: " $\pm 0.025\%$ of I.V. per volt above 750 volts". Custom specifications can be defined by the user, then used in combination with the standard specification components in the tolerance calculator. See the section below on custom tolerance calculators for more detail.



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- **User definable custom tolerance calculators**

The Custom tolerance calculator is used to calculate tolerances, based on specification components that are more complex than the standard specification components (% of I.V., ppm of I.V., % of F.S., ppm of F.S., $\pm n$ Units of measure, and \pm db). These more complex specification components are things such as: “ $\pm 0.025\%$ of I.V. per volt above 750 volts”. MudCats provides a special set of tools that allow you create your own library of custom specification statements and then use them in combination with the standard specification components in the tolerance calculator.

- **Equation system**

The equation system is the workhorse of mathematical operations in MudCats. Equations are constructed with a user-friendly equation editor. The system uses standard operands, a function library, user-defined variables, and conditional clauses in equations. The equation system is used throughout MudCats to create and execute equations in such operations as: custom calculators, units conversion, automation scripting math commands, etc.

- **Datasheet test point generation wizards**

When creating datasheets, development productivity and format continuity are important factors. This is where datasheet generation wizards fit the bill. These wizards allow for the predefinition of test point values, tolerance format, function-tested descriptions, and datasheet boilerplate information. A single datasheet wizard can contain multiple test point definitions. Selecting one of these test point definitions will automatically configure the tolerance calculator with predefined numeric and tolerance formats, and set up an array of test points. When the new test points are inserted into the datasheet, the Step Number and Function Tested descriptions are taken from the wizard test point definition. Any of the predefined values can be overridden, if necessary.

- **Datasheet generation wizards**

Datasheets can be created using special datasheet wizards. These wizards prompt the user for specification data and then generate an entire datasheet.

- **Per row specification tracking**

The tolerance calculator embeds the equipment specification data used to calculate tolerances, into applicable datasheet rows. A composite value for the standards' requirement ($0.25 * \text{Tolerance}$) is also embedded. This information is displayed for each datasheet row.

Multiple Channel Data Collection

For many types of instruments, it is much more efficient to collect data for more than one instrument at the same time. MudCats allows you to do this, providing the instruments use the same datasheet. Up to eight simultaneous sets of measurement data can be collected with MudCats. Each set of measurement data is referred to as a “Channel”. Each channel has a display module for “As Found”, “As Left”, and “Out of Tolerance” data. All eight channels can be displayed and edited simultaneously.



- **Automatic Out of Tolerance detection**

When a measured value is recorded for an instrument channel, MudCats will compare the value to the instrument's tolerance, indicate the out of Tolerance status, and display the percentage of the tolerance consumed.

- **Data collection via automation scripting**

Instrument data can also be collected through the use of MudCats' automation scripting system. This allows data collection from GPIB, or RS-232. Custom user prompts can also be scripted, as well as the result of scripted mathematical operations. For more information, see "Automation Scripting" below.

- **Storage and retrieval of collected data**

Measurement data collected for each channel is stored independently. This data can be recalled or reprinted at any time. The data can be either recalled into any one of the eight instrument channels, or opened as an independent datasheet.

Automation Scripting

- **Integrated automation scripting**

MudCats allows you to add automation scripting commands to any row of a datasheet. Scripting datasheet rows independently has many advantages, but chief among them is the direct interaction between a row's script commands, test point data, and measurement data. With this direct correlation you can apply automation commands to a specific row or section of a datasheet by simply selecting the applicable datasheet row. If only one section of a datasheet is to be automated, no action is required in any unaffected row. Even when scripting is available for a section/row of a datasheet, it can also be treated as just that, a simple datasheet row. The user can simply enter the measurement data or run the applicable part of the script.

Editing the automation script for a datasheet is simple. Script commands for a datasheet row are displayed whenever a row is selected in the datasheet editor. The script editor makes it simple to cut and paste a series of commands from one datasheet row to another datasheet row, or even to another datasheet. When copying and pasting entire datasheet rows, the datasheet editor will also copy and paste all applicable commands.

- **Scripting of preexisting datasheets**

Any datasheet can have scripting commands added to it. The result is incremental development. Whenever a datasheet is created, framework for an automation process is being built. When scripting is undertaken, this work does not have to be repeated. As a result of the direct relationship of the script to the datasheet row, evaluation of measured values to the calibration tolerances is internally handled, with no scripting required.

- **Datasheet scripting**

The usual starting place for an automation script is a previously created datasheet. Having said that, scripting commands can be added to a blank datasheet if desired. The training requirements for script authors will vary with the nature of the scripts being written. If, for example, a mathematically intensive script is being written, the author must have the requisite math skills. As far as the actual scripting process is concerned, the direct relationship of datasheet rows and script commands keeps the process relatively easy.



- **GPIB or RS-232 interfaces**

Scripting commands are available for both GPIB and RS-232 operations.

- **Datasheet generation**

One of the more powerful features of MudCats is the ability to use scripting commands to actually build a datasheet. Scripting commands are available to prompt the user for specification data, manipulate the tolerance calculator, perform math operations, and generate test points. This type of scripting is very useful as replacement for generic datasheets. Creating self-generating datasheets for instruments such as torque wrenches, pressure gauges, micrometers, etc., is very easy.

- **Mathematical operations**

The automation scripting system features commands that make full use of the MudCats equation system described above.

- **Interaction with external applications**

Included in the scripting commands for MudCats are Object Linking and Embedding (OLE) commands. These commands allow the scripting system to share data with external applications, e.g., Mathcad, Word, and Excel.

- **Calibration instructions**

Calibration instructions can be created with the MudCats' Rich Text Format (RTF) instruction editor or imported from another word processor. Additionally, up to five graphics can be attached to each step for further detailed information. The instructions are displayed using a script command.

- **Reusability**

Groups of commands can be saved to a file. These files are intended to serve as a command group library. Groups of commands can be inserted directly into a script from any one of these files. Groups of commands can also be cut and pasted across rows or even across datasheets.

Units of Measure

MUDCATS intelligent Units of Measure converter automatically interprets measurement units for the nominal values in the calibration datasheet. The Units of Measure engine also automatically converts measurement units between the UUT and applied standards. The Units of measure can also be used as a stand-alone units converter for quick conversions.

Specification Tracking

SpecTrack is a MudCats module that contains a library of calibration standards accuracy specifications and uncertainties.

SpecTrack enables MudCats to assign calibration standards, and their related function, range and accuracy specifications to datasheets and applicable UUT calibration data. Standards accuracy specifications are entered through a unique user interface which provides a systematic, logical architecture for building specification data. Standards specifications are divided by Function, Parameter, Range, Accuracy, Resolution, and other metrological criteria to properly identify the specification.

Specification data stored in SpecTrack is used throughout MudCats in the calculation of Estimated Measurement Uncertainty (EMU), Test Accuracy Ratios (TAR), and failure analysis.



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Mobile Support

- **PRO-REMOTE** (*Optional*)
MudCats can be used in the field to collect calibration data and merge data into the main system.

Engineering Tools

- **Estimated Measurement Uncertainty (EMU)**
MudCats automatically calculates each test point's EMU, using principle sources of error from standards accuracy specifications, inverse normal distribution function, in-tolerance probability, and uncertainty contributed by the measurement system resolution. These sources of error are combined with a suitable coverage factor and expressed as EMU.
- **Test Accuracy Ratio (TAR)**
MudCats automatically calculates each test point's TAR between the UUT and the applicable standard's function and range.
- **Failure Analysis**
This feature enables the user to automatically evaluate out-of-tolerance conditions by tracking the function, range and test point information between each standard and the unit under test.

Failure analysis pertains to compliance with ANSI/ISO 17025 paragraph 4.9 b) or ANSI Z540-1 paragraph 8.2. That is, the laboratory shall examine the effect of non-conforming work or equipment defects (out-of-tolerance conditions) on other work. Most labs keep track of what standards are used to calibrate what equipment. Therefore, the starting point for failure analysis is an out-of-tolerance condition on a standard and a list of items on which the standard was used. It is then up to the evaluator to retrace each calibration to determine whether or not the individual range and test point that failed on the standard was actually used on the UUT, to quantitatively assess what effect the failure had, and to notify the client if the effect was significant. Imagine doing this if the standard is a multifunction meter calibrator and the UUT list contains 100 items, across the laboratory's inventory of standards.

MudCats enables this evaluation to be performed automatically by tracking the function, range and test point information between each standard and UUT. By knowing the applicable specifications and the magnitude of the failure, it determines whether or not the failure had an adverse effect on the calibration. It produces a list of items that were actually affected, and the magnitude of the error. This powerful feature frees up engineering time that can be rededicated to other valuable activities.

- **Failure Report**
Failure analysis reports are generated by selecting the calibration standard, function and range within a specified date range. This report indicates each UUT calibrated by the selected standard, grouped by individual Asset ID number, and the specific function, ranges, and test points affected.



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- **Interval Analysis**

MudCats Calibration Process Manager collects and stores parametric calibration data on a point-by-point basis. MudCats employs the NCSL RP-1 A3 method for calibration interval analysis, accumulated calibration history for a given item to test whether the item's assigned interval is appropriate. The test is statistical in nature. The result of a test is whether to adjust or not based on whether or not calibration results are consistent with expectations.

While other interval methods (the Incremental Response Method in particular) allow an item to find its correct interval and remain there, it does not do so expeditiously. Often, periods as long as five to sixty years are required to reach intervals commensurate with established reliability targets. In addition, although the correct interval is reached eventually, considerable fluctuations occur in the process along with unnecessary calibration costs.

Management Tools

- **Security**

MudCats incorporates advanced security features including;

- Comprehensive User Manager
- Detailed Audit Trail
- Configurable audit trail reports

The User Manager allows the System Administrator to set user access and permission levels within MudCats. User's activities are automatically tracked and logged in the audit trail for database traceability and compliance to 21 CFR Part 11 audit requirements.

- **Storage options**

There are two ways to store MudCats datasheets and measurement data: independent files or SQL database system, depending on the version.

- **Datasheet files**

A Datasheet file contains all of the test point data, specifications, automation script commands, and calibration instructions for a single datasheet.

- **Calibration files**

A calibration file is a simplified version of a Datasheet file. No automation scripting or calibration instructions are stored. The calibration file also stores the UUT's measurement data. The calibration file can be either recalled into one of the UUT channels or reopened independently as a datasheet, with UUT measurement data.

- **MudCats automated cataloging system**

MudCats features an automated cataloging system of all datasheets and calibration files. The catalog can be used to locate a datasheet or a calibration file. The datasheet catalog is searchable by model, manufacturer, equipment description or calibration procedure.

- **Barcodes**

MudCats supports barcode data entry for Asset ID and Test Report numbers.

Workload Distribution

- **Datasheet creation**

Datasheets can be created by any user with the prerequisite technical knowledge of the unit under test. The actual process of creating datasheets requires minimal training.



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- **Datasheet approval**

Datasheets must be approved by the appropriate authorized individual before they can be inserted into the database for use. Datasheets are initially created in file format, and must be approved, and e-signed prior to submittal into the database. This process ensures proper datasheet validation and approval in accordance with both industry quality standards and owner's quality procedures. Datasheet approvals are controlled by the customer, so adequate controls should be in place for the review, acceptance and approval of datasheets prior to use.

- **Datasheet revision control**

Calibration datasheets and subsequent revisions are maintained and controlled through MudCats exclusive datasheet approval process. Datasheets are created in an ASCII file based format outside of the SQL database. Datasheets can only be saved into the MudCats database by users authorized to approve datasheets. Upon review and approval, datasheets are e-signed, and time and date logged as new or as a revision, as determined by the authorized user.

When a datasheet is revised, the old datasheet is inactivated, yet maintained in the system, thus preventing the use of retired datasheets, and only allowing the currently approved datasheet for use.

Summary

MUDCATS offers a wide range of features and benefits, each has been incorporated to make the calibration process faster, easier and more accurate. Including Calibration Tools like;

- Multi-Channel Data Collection
- Automation Scripting
- Datasheet Generation Wizard
- Test Point Wizard
- Tolerance Calculator

MUDCATS also offers Engineering Tools for data analysis, including;

- Automated Estimated Measurement Uncertainty
- Automatic TAR calculation
- Failure Analysis
- Interval Analysis

