History Data Groups

Overview

Data Groups are used to fetch data from the source defined in a **Connector** and place it in a report. The configuration of a group does <u>not</u> require any knowledge of how information is organized in the **Connector**.

A **History Data Group** is interface to a Historical Server, such as a historian or OPC-HDA server, to extract raw or summary values over a time period. Where possible, they take advantage of the calculations supported by the server however, they can also perform a wide variety of advanced calculations using the raw data from server.

Configuring a **History Group** does <u>not</u> require any knowledge of how information is organized in the historical server. Instead, the connection to the server simply requires the selection of items, the type of calculation and the time period.

Before a group can be configured, a connector to the Historical Server is required.

Quick Access

Data Groups can be accessed for modification by selecting a template from the main window of the **Project Explorer** and clicking the group from the template items in the bottom of the Left View.

Another direct method is to use the **Connector Group** application for creating and modifying **Data Groups**. From the **Project Explorer** select **Tools** tab, **Diagnostic**, **Connector Groups** to display all the connectors defined for the project and the data groups that are using them.
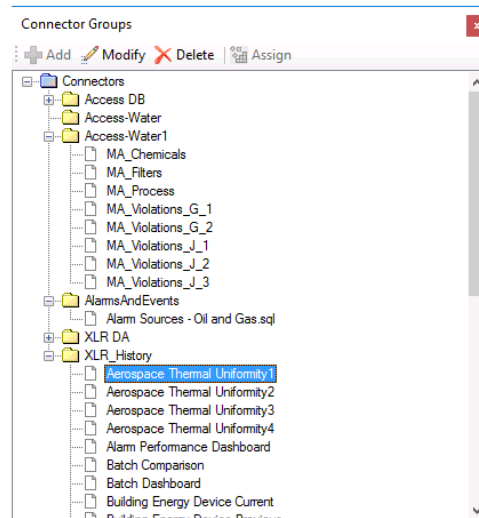
If a data group references a connector that does not exist, it is displayed with a red image. In this case, the group can be re-assigned to a different connector by selecting **Assign** and choosing the new connector.

Group Builder

When a new group is created, the user is prompted to select the group type. Note that the group types available depend on the connector.
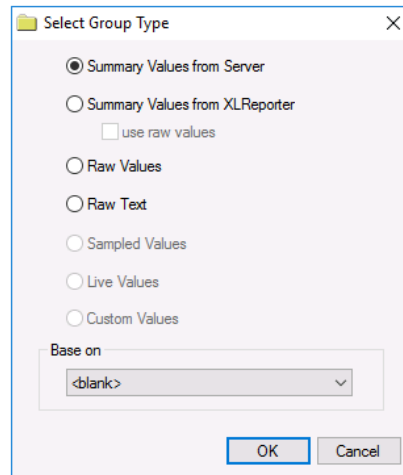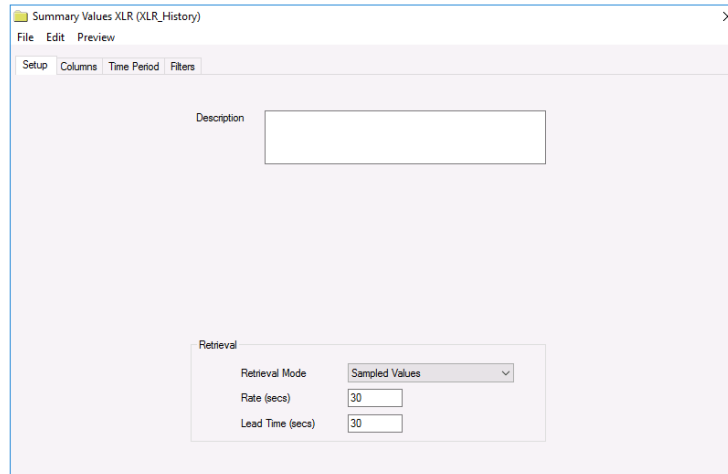

- **Summary Values from Server**

  Summary values are calculated by the Server e.g., flow average for each hour of the day.

- **Summary Values from XLReporter**

  Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server e.g., flow average for each hour of the day when the pump is running (see **XLReporter Calculations**).

- **Raw Value**

  Numeric values from the Server.

- **Raw Text**

  Text values from the Server.

- **Sampled Values**

  Sampled values from Server e.g., flow value at start of each hour of the day.

- **Live Values**

  Live values from the Server.

- **Custom Values**

  Custom values queried from any table/view in the historian database. This launches the **Database Data Group**.

  This option is only available when the historian is a relational database like Microsoft SQL Server or MySQL.

To create a new group from an existing, set **Base on** to the name of the existing group. This can be useful if you have multiple groups that use the same items or if you are converting groups from one historian connector/type to another.

Setup Tab

The **Setup** tab is used to specify a **Description** and **Retrieval** settings for group type **Summary Values from XLReporter**.

Summary values are calculated by **XLReporter** from data from the Server. The **Retrieval Mode** specifies whether the data from the Server will be the **Raw Values** or **Sampled Values**. In general, using **Sampled Values** performs the calculation faster whereas **Raw Values** performs the calculation more accurately.

If the mode is set to **Sampled Values**, the **Rate** determines the frequency of the samples.

Note that the caption of the builder shows the name of the group and the connector it is using. For example, the text *Raw values – ProcessData (MyHistorian)* indicates that the group name is *ProcessData* and that it interfaces to the connector *MyHistorian* to return *Raw values*.

The **Lead Time** is subtracted from the **Start Time** of the **Time Period** tab before the values are retrieved from the server. This is used for time weighed calculations.

For specific Connector settings see the document under **DATA CONNECTIVITY** for the specific vendor that is providing the historical data.

Columns Tab

The **Columns** tab is used to specify the item **Name**(s), **Calculation**, **Scaling** and **Heading** of the group. Up to 40 names are supported by a group.
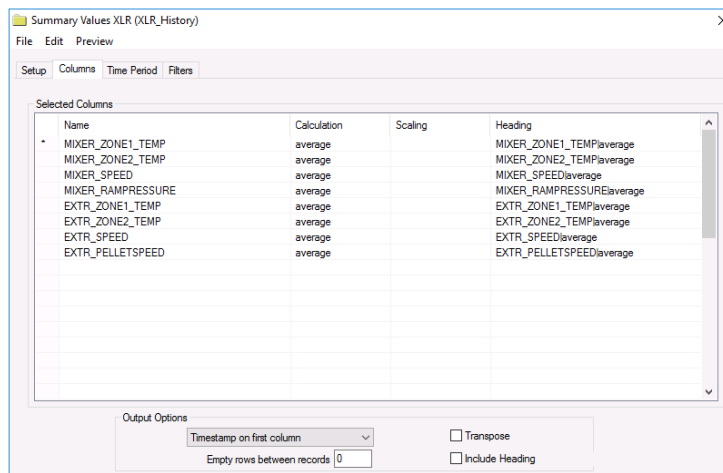
Browsing and Selecting Item Names

To add an item, select a cell in the **Name** column, and click the browse button (…) to open the item browser. A **Name** can be one of three choices:

- **Literal name**. Actual name of the item (as configured in the server). A literal name can be selected from the **Online** browser or from a **Catalog**.
- **Variable name**. A variable item is a placeholder that is assigned a literal item name at the runtime of a report. Variable names can be selected from the **Variables** branch of the item browser and can be a **User-Defined** or a **Register** variable. User defined variables are not limited to the *{Tag X}* syntax – these can be assigned to any expression, e.g. *{Temperature}* or *{Pressure}* by typing in the name.
- **Static Variable name**. Fixed text.

Variables (displayed in {}) provide a way to assign the item names externally, e.g., when the group is used on-demand, the item name is selected.

Static Variables (displayed in *{}) are considered fixed text for display only and is not used for data retrieval. In the item browser, select **Treat As Text** to configure.

Grid rows are moved relative to each other, **Insert**ed or **Delete**d by right clicking on the left most column or using the up/down and insert/delete keys on the keyboard.

When empty rows are set between two items, the output of the group will contain empty rows/columns. Use empty rows to prevent calculations in the template from being overwritten by the output of the group.

For group types that perform calculations, the calculation is performed over each **Interval** of the **Period** specified in the **Time Period** tab. The list of calculations is either specific to the Server or those provided by **XLReporter (**see **XLReporter Calculations)**.

The **Scaling** is applied after the calculation has been performed. (see **Scaling**).

The **Heading** is included in the output if **Include Heading** is set. The **Heading** can be a specific item or a variable. In the case of variables, additional parsing data can be specified to limit the text length (see **Heading**).

By default, the output has each selected column as a column. By selecting **Transpose**, each selected column is displayed as a row.

Time Period Tab

The **Time Period** tab is used to specify a **Period** and **Interval** which collectively determine the number of rows of values produced by the group.

For example, suppose the calculation is average, the **Period** is 1 day, and the **Interval** is 1 hour, then the output will be 24 hourly averages.
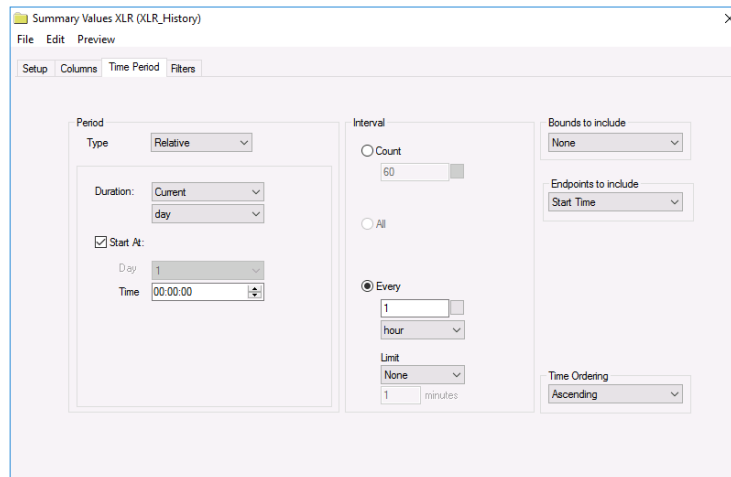
The types of **Periods** available are **Relative**, **Offset**, **Variable**, **Database** and **Endpoint**.

Relative Period

Relative calculates the **Period** used using a **Duration** and **Start**. The **Duration** is specified in terms of the *Current* or *Previous* duration unit. An optional **Start At** defaults to the current time if not specified.
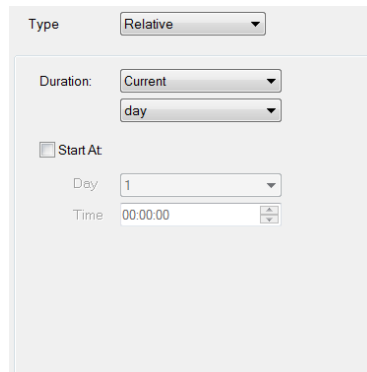
Example: Suppose the settings **Duration** *Month*, **Start At** *not checked*. The start/end of the **Period** on 12 April will be:

	start	end
Current	12 April	12 May
Previous	12 March	12 April

Example: Suppose the settings **Duration** *Day*, **Start At** *08:00*. The start/end of the **Period** on 12 April 10:00am will be:

	start	end
Current	12 April, 8:00 AM	13 April, 8:00 AM
Previous	11 April, 8:00 AM	12 April, 8:00 AM

Offset Period

Offset calculates the **Period** using a **Duration**, **Start** and **Offset**. The **Offset Period** is a generalization of the **Relative Period** to provide a higher level of customization.

Example: Suppose the settings **Duration** *1 Day*, **Start At** *8:00am*. The start/end of the Period on 12 April 10:00am for various offsets will be:

	start	end
No offset	12 April, 8:00 AM	13 April, 8:00 AM
Offset minus 1 day	11 April, 8:00 AM	12 April, 8:00 AM
Offset minus 1 month	12 March, 8:00 AM	13 March, 8:00 AM

Note that the first two examples produce the same result as **Relative Period**.

Variable Period

Variable calculates the **Period** from a combination of fixed values and variables (see **Variables**) for the start and end. The end of the period can also be expressed in terms of a **Duration**.

Using **Variables**, external methods can be used to specify the **Period**. For example:

- A user can define the **Period** on demand.
- The scheduler can store the start and end of the **Period** for each batch or machine cycle.
- The group can be processed for a table of discrete time period values in the worksheet using a By Row Iteration Data Management Connection (See **Data Management).**

Database

Database calculates the **Period** from a pre-defined **Database Data Group (See Database Data Groups)**. The settings for the **Start** and **End** are identical to **Variable** described above except that instead of a variable, a column name is selected.

If the **Database Group** returns more than one set of start/end pairs, then the group is repeatedly executed for each pair.

Using a **Database Data Group**, external methods can be used to specify the **Period.** If multiple periods result from the database, they are processed **repeatedly**. For example:

- A database group is configured to get the time of the minimum and maximum values from a process. The history group can use this to retrieve process data from these times.
- A database group returns alarm timestamps from the alarms that occurred on a particular day. The history group can use this to retrieve values at the time of every alarm for that day.

Note make sure to select a column that returns a date or time.

Endpoint

Endpoint calculates the **Period** from a flexible set of parameters for the **Start** and **End**. This selection is a generalization of **Relative** and **Offset** for custom settings. Data Groups originating from an **XLReporter** project configured in version 11 or below may default to this type when upgraded to versions 12 and above.

The **Start** is configured by selecting **Current day**, **Current day of week** or **Current day of month**. The **Start At** time indicates the start time. If this is not checked, it defaults to the current time. An optional **Offset** is applied to the start by the amount specified.

The **End** is configured by selecting **Duration**, **Current day**, **Current day of week** or **Current day of month**. The **Duration** is from the **Start**.

Example: Suppose the setting for **End** is **Duration**, *1 Day*. The start/end of the Period on 12 April, 10:00am will be:
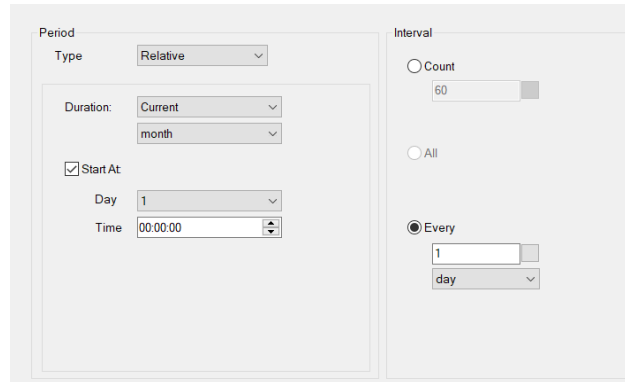
Start	start	end
Current day	12 April, 10:00am	13 April, 10:00am
Current day, **Start At** 8:00am	12 April, 8:00am	13 April, 8:00am
Current day, **Offset** 1 Day	11 April, 10:00am	12 April, 10:00am
Current month, **Day** 1,**Start** 8:00am	1 April, 8:00am	2 April, 8:00am

End Date and Time Considerations

At runtime the **End Date** and **Time** are calculated based on the configuration in the **Time Period** tab. However, there are additional considerations made for the following:

- **End Date** and **Time** is invalid. For example, if this is set to *Variables* which are not set to a valid date and time.
- **End Date** and **Time** is before **Start Date** and **Time**
- **End Date** and **Time** is beyond the current time

In these cases, the **End Date** and **Time** is set to the current date and time when the group is executed. A practical application of this is a report showing daily values from the historian over the month. If the user wants to generate this report every day to see the daily values up to the current day, they can configure the **Time Period** as:

The report can be scheduled to run every day to return the values from the first of the month up to the current day.

Interval

The **Interval** determines the number of samples returned over the time period. For raw data retrieval, this value limits the number of values returned. For calculated data retrieval, this value represents the number of intervals over which each calculation is performed.

- **Count**

  For raw data retrieval, this represents the number of raw values returned. For summary calculation it is used to divide the Period into equal time intervals. The value can be a **Variable**.

- **All**

  This setting is only used for raw value retrieval. All the raw values in the **Period** are returned.

- **Every**

  This setting is only for summary value retrieval. The interval specified is used to divide the **Period** into equal time intervals (it may be adjusted if when it is not a multiple of the **Period**). The value can be a **Variable**.

  If the calculation is performed by **XLReporter** then a **Limit** can also be specified which is defaulted to *None*. This setting determines if the entire interval is considered for the calculation or the **First/Last** minutes specified e.g., by setting an interval of 1 hour and a **Limit** of 5 minutes will produce a summary for the five minutes of each hour.

Bounds to include

The **Bounds to include** determines whether the **Next**, **Previous**, or **Both** intervals are included in the samples returned over the time period. By default, this setting is set to **None**.

- **None**

  Only **Intervals** within the specified **Period** are returned.

- **Previous**

  The previous interval is returned as the first record of the data group e.g., if the **Time Period** is configured as **Relative Current Day**, **Start At** *00:00:00* **Every** *1 hour*, then the last hour of the previous day is returned before the values for the current day are returned.

- **Next**

  The next interval after the end time is returned as the last record of the data group e.g., if the **Time Period** is configured as **Relative Current Day**, **Start At** *00:00:00* **Every** *1 hour*, then the 01:00:00 hour of the next day is returned after the values for the current day are returned.

- **Previous and Next**

  Both the previous interval and the next interval after the end time are returned with the intervals contained within the period. e.g., if the **Time Period** is configured as **Relative Current Day**, **Start At** *00:00:00* **Every** *1 hour*, then the last hour of the previous day is returned before AND the *01:00:00* hour of the next day is returned after the values for the current day are returned.

Endpoints to include

The **Endpoints to include** determines whether the **Start Time**, **End Time**, or both are returned with the samples. By default, this is set to **Start Time**.

This setting is also directly influenced by the **Bounds to include** dropdown list above it. A **Bounds to include** set to *None* will allow full selection of the **Endpoints to include** options. A **Bounds to include** set to *Previous* will force **Endpoints to include** to *Start Time*. A **Bounds to include** set to *Next* will force **Endpoints to include** to *End Time*. Lastly, a **Bounds to include** set to *Previous and Next* will force **Endpoints to include** to *Start and End Time*.

- **None**

  Neither the start nor the end time interval is returned.

- **Start Time**

  The first interval of the period returned is the interval at the start time. For example, if the **Time Period** is configured as **Relative Current Day Start At** *00:00:00* **Every** *1 hour*, is ran on *2022-01-01*, then the *2022-01-01 00:00* record is the first record returned.

- **End Time**

  The last interval of the period returned is the interval that starts at the end time. For example, if the **Time Period** is configured as **Relative Current Day Start At** *00:00:00*, **Every** *1 hour*, is ran on *2022-01-01*, then the *2022-01-02 00:00* record is the last record returned.

- **Start and End Time**

  Both the start and end time intervals are returned.

Filters Tab

The **Filters Tab** is used to filter the samples. They are supported by most historians and are always available for **Summary Values from XLReporter**.

The filter grid consists of a **Name** column and four **Criteria** columns. Within each **Criteria**, up to eight **Conditions** can be specified. A **Criteria** is calculated by AND (ing) each Condition. The **Filter** is calculated by OR (ing) each **Criteria**.

Item	Criteria	Or...	Or...	Or...
Process\Flow	>50			
Process\Speed		>5		
Process\Weight				

In the above example, the filter criteria is *Flow >50 **OR** Speed>5*

Item	Criteria	Or...	Or...	Or...
Process\Flow	>50			
Process\Speed		>5		
Process\Weight	=100			

In the above example, the filter criteria is (*Flow >50 **AND** Weight=100) **OR** Speed>5*

The operators for the Conditions are:
- **Numeric**

<	less than
<=	less than or equal
=	equal
<>	not equal
>=	greater than or equal

- **Bitwise**

^	all bits set
~	any bit set
!^	all bits not set
!~	any bit not set

- **Text**

IS	equal
IS NOT	not equal
START WITH	starts with
NOT START WITH	does not start with
END WITH	ends with
NOT END WITH	does not end with
CONTAIN	contains
NOT CONTAIN	does not contain
IS NULL	is null or empty
IS NOT NULL	is not null or empty

The value for a **Condition** can either be fixed or a **Variable**.

Calculations

XLReporter Calculations are performed over each **Interval** for the **Period** defined in the **Time Period** tab.

The calculations are based on either raw or sampled values using a **Connector** to identify the historian, sampled values being the preferable method. For example, suppose a calculation is required from a historian that is logging every second. If *raw retrieval* is used then 86400 samples will retrieved for the calculation whereas if *sampled retrieval* (every minute) is used then this is reduced to 1440. Raw retrieval is more accurate, sampled retrieval is faster.

Before the calculations are performed, the samples are filtered using the settings on the **Filter Tab**.

Calculations are either **raw** or **weighted**. For **raw** calculations, the actual sample value is used. For **weighted** calculations, the derived samples value (from a stepwise curve) and the length of time is used. Typically for process values **weighted** is used.

For example, t0 to t1 represents an **Interval** and 3 values are recorded as shown.
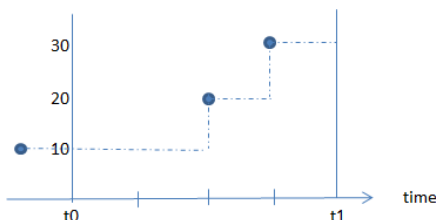
The raw average for the Interval is $20 + 30 / 2 = 25$. The time weighted average using the stepwise curve (shown in dashes) is $(10 * 2 + 20 + 30) / 4 = 17.5$. Note the propagation of the 10 into the interval.

When browsing for items in a group that supports calculations, the **Calculations** dialog appears allowing you to select one or more calculations to apply to every item selected. When a calculation is checked, the label has a number appended to it. This number indicates the order of the calculations for each selected item.

If a calculation has already been set, when browsing to change the calculation, the **Replace calculation in all matching rows** is available.
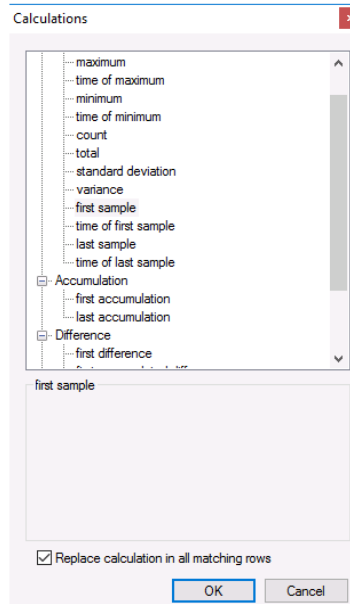
When this option is selected and **OK** is clicked, any row in the group that is set to the original calculation set when the dialog was opened is updated with the new calculation selected. For example, if the row was originally set to *minimum* and you re-browse, select *maximum* and check the **Replace calculation in all matching rows** option, on OK any row that was set to *minimum* is now set to **maximum**.

General

- **Interpolated**

  The first interpolated sample in the interval.

- **First Sample**

  The first sample in the interval.

- **Time of First Sample**

  The timestamp of the first sample in the interval.

- **Last Sample**

  The last sample in the interval.

- **Time of Last Sample**

  The timestamp of the last sample in the interval.

- **Maximum**

  The largest sample in the interval.

- **Time of Maximum**

  The timestamp of the largest sample value in the interval. If the largest sample occurs multiple times over the interval, the timestamp returned is the first occurrence of the maximum in the interval.

- **Minimum**

  The smallest sample value in the interval.

- **Time of Minimum**

  The timestamp of the smallest sample value in the interval. If the smallest sample occurs multiple times over the interval, the timestamp returned is the first occurrence of the minimum in the interval.

- **Count**

  The count of the number of samples that satisfy the specified **Condition**.

- **Integral**

  The weighted total, based on fractions of the day, multiplied by the **Scaling**.

- **Average**

  The average of the samples in the interval.

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

- **Total**

  The total of the samples.

- **Standard Deviation**

  The standard deviation of the samples in the interval.

For a finite population with equal probabilities at all points,

$$\sigma(X) = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})^2}$$

- **Variance**

  The variance of the samples in the interval calculated as the square of the standard deviation. See Standard Deviation.

  The variance is a measure of how far a set of values is spread out from the average. A value of 0 indicates that the values are identical to the average, whereas a small variance indicates that the values are close to the average.

- **Good Quality**

  The count or percentage of samples with good quality in the interval.

Accumulation

The accumulation is a running total of the samples in the interval.

- **First Accumulation**

  The accumulation of the first sample in each interval.

- **Last Accumulation**

  The accumulation of the last sample in each interval.

Difference

The difference is used to calculate consumption from energy meters and totalizers. The **Type** setting of indicates if the value is *rising* (energy meter) or *falling* (weigh scale). The **Rollover** setting is used if the value resets when it reaches a specific value. If the value does not reset, set this to 0. The **Reset** indicates what the value is set to when the **Rollover** setting is reached. The **Calculate by** setting defines how the difference is calculated.

- **First Difference**

  If **Calculate by** is *prev. value*, for each interval, this calculates the difference between the first sample of the current interval and the first sample of the previous interval.

  If **Calculate by** is *next value*, for each interval, this calculates the difference between the first sample of the next interval and the first sample of the current interval.

- **First Accumulated Difference**

  If **Calculate by** is *prev. value*, for each interval, this calculates the accumulated difference between the first sample of the current interval and the first sample of the last interval.

If **Calculate by** is *next value*, for each interval, this calculates the accumulated difference between the first sample of the next interval and the first sample of the current interval.

- **Last Difference**

  If **Calculate by** is *prev. value*, for each interval, this calculates the difference between the last sample of the current interval and the last sample of the previous interval.

  If **Calculate by** is *next value*, for each interval, this calculates the difference between the last sample of the next interval and the last sample of the current interval.

- **Last Accumulated Difference**

  If **Calculate by** is *prev. value*, for each interval, this calculates the accumulated difference between the last sample of the current interval and the last sample of the last interval.

  If **Calculate by** is *next value*, for each interval, this calculates the accumulated difference between the last sample of the next interval and the last sample of the current interval.

Advanced

- **Mean Kinetic Temperature**

  The Mean Kinetic temperature (MKT) is a simplified way of expressing the overall effect of temperature fluctuations during storage of transit of perishable goods. The **Actn.kJ/mol** setting is the heat activation, default to 83.144 kJ/mol. The **Temp.Unit** is the unit of temperature.

$$T_K = \frac{\frac{\Delta H}{R}}{-\ln\left(\frac{t_1 e^{\left(\frac{-\Delta H}{RT_1}\right)} + t_2 e^{\left(\frac{-\Delta H}{RT_2}\right)} + \cdots + t_n e^{\left(\frac{-\Delta H}{RT_n}\right)}}{t_1 + t_2 + \cdots + t_n}\right)}$$

Where:

T_K is the mean kinetic temperature in kelvins
ΔH is the activation energy (typically within 60–100 kJ·mol⁻¹ for solids or liquids)
R is the gas constant
T_1 to T_n are the temperatures at each of the sample points in kelvins
t_1 to t_n are time intervals at each of the sample points

When the temperature readings are taken at the same interval (i.e., $t_1 = t_2 = \cdots = t_n$), the above equation is reduced to:

$$T_K = \frac{\frac{\Delta H}{R}}{-\ln\left(\frac{e^{\left(\frac{-\Delta H}{RT_1}\right)} + e^{\left(\frac{-\Delta H}{RT_2}\right)} + \cdots + e^{\left(\frac{-\Delta H}{RT_n}\right)}}{n}\right)}$$

Where:

n is the number of temperature sample points

Sample Analysis

The sample analysis calculations are provided to evaluate the behavior of process values like temperatures and pressures over a period of time.

Up to two **Conditions** can be specified in order to restrict how the values are considered. In addition, a **Deadband** can be specified so that if a sample value has not changed by the absolute value or percentage specified, it is not considered as part of the calculation.

- **Sample Count**

  The count of the samples that satisfied the **Condition**(s) and **Deadband** specified.
- **Sample Duration**

  The amount of time the samples that satisfied the **Condition**(s) and **Deadband** specified. This can be expressed as a number of days or as a percentage of the entire interval.

Performance Analysis

Performance Analysis is used to calculate utilization and performance such as the number of times and the duration a signal is in/out of specified conditions e.g., SPEED>0. The calculations are performed on either raw samples or samples derived from a stepwise curve. Note, the duration calculations can only be performed with samples derived from a stepwise curve.

For the **State** calculations, up to two **Conditions** can be specified in order to restrict how the values are considered. In addition, a **Deadband** can be specified so that if a sample value has not changed by the absolute value or percentage specified, it is not considered as part of the calculation.

- **Sample Count**

  The count of how many times a value satisfied the **Condition**(s) and **Deadband** specified.

- **Sample Duration**

  The amount of time the value satisfied the **Condition**(s) and **Deadband** specified. This can be expressed as a number of days or as a percentage of the entire interval.

- **ON Count**

  Count of how many times the value changed from 0 to non-zero (rising edge). By default, values less than 0.5 are considered off, and values greater than 0.5 are considered on.

- **OFF Count**

  Count of how many times the value changed from non-zero to 0 (falling edge). By default, values less than 0.5 are considered off, and values greater than 0.5 are considered on.

- **ON Duration**

  Amount of time value is non-zero. This can be expressed in days or as a percentage of the entire interval. By default, values less than 0.5 are considered off, and values greater than 0.5 are considered on.

- **OFF Duration**

  Amount of time value is zero. This can be expressed in days or as a percentage of the entire interval. By default, values less than 0.5 are considered off, and values greater than 0.5 are considered on.

- **Availability**

  The amount of time the value is 0 expressed in days.

Energy

Energy Management calculates the energy release/emissions produced by the consumption of various fuels.

- **Produced Energy**

  The energy is calculated for a **Fuel Type** (*gas*, *coal*, *petroleum*) in the specified **Energy** (*KWhr, KCal, MCal, MJ, GJ, BTU*).

- **Produced Emission**

  The emission is calculated for a **Fuel Type** (*gas*, *coal*, *petroleum*) for the specified **Gas** (CO_2 – carbon dioxide)

  For more information see http://www.eia.gov/tools/faqs/faq.cfm?id=82&t=11

Pulse Analysis

Pulse analysis calculates "peak" and "valley" information about a value. Momentary changes in the signal can be filtered from the calculation by specifying an optional **Deadband** in terms of an **Absolute** change in the value or a **Percent** change.

- **Pulse Count**

  Count of the number of pulses for a specified pulse type (**positive** or **negative**) and **Threshold**. For example, if the pulse **Type** is **positive** and the **Threshold** is *80*, then the **Pulse Count** increments for the complete cycle of increasing beyond 80 and the decreasing below 80.

- **Pulse Maximum**

  Maximum value of all the **positive pulses** only.

- **Time of Pulse Maximum**

  The timestamp when the **Pulse Maximum** occurred.

- **Pulse Minimum**

  Minimum value of all **negative pulses** only.

- **Time of Pulse Minimum**

  The timestamp when the **Pulse Minimum** occurred.

Scaling

The value produced by a data group can be **Scaled** using a **Formula** or limit **Conditions**.

Formula scaling provides three operators with values.

Example: An item contains the flow rate in gallons/minute. To calculate the total flow in MGD perform an average on the item value and then scale with ***1440/100000***.

Example: An item contains the temperature in Fahrenheit. To convert to Celsius scale, use the formula ***-32*5/9***.

Condition scaling provides up to three **Limits** that provide up to four ways the value can be scaled. The scaling supported are:

- Specific Value
- Column Value
- Column Value that has an applied Formula

Example: When an item value is below 0.001, display the text *negligible* otherwise show the value.

Example: When an item value is below 100, display blank otherwise scale the value by 1000.

Example: A digital item contains the state of a pump. When the value is less than 0.5 display **OFF**, otherwise **ON**.

Example: An item contains the temperature of an oven. Display **LOW**, **MEDIUM,** and **HIGH** at specified temperature thresholds.

Heading

When **Include Heading** is selected on the main display, up to two headers can be included in the output of the group. To change a heading of a defined item, select the cell in the **Heading** column and enter the heading manually. To change a heading for a variable item, select the cell in the **Heading** column and click the browse pushbutton […].

Headings can be fixed text, a **Variable,** or a combination of both. A variable would normally be used when the item name is also a variable.

When a **Variable** is used, sub strings can be created using the **Parse Mode**. The following options are available:

- **Before Start**

    Substring contains all the characters before the **Start** character
- **After End**

    Substring contains all the characters after the **End** character
- **Between Start and End**

    Substring contains all the characters between the **Start** the **End** character

When either **Heading 1** or **Heading 2** is a variable and the field of the variable is changed, e.g., from *Nickname* to *Description*, that change can be applied to all the other headings in the group by checking the **Apply to all rows** setting under the appropriate heading.

Preview

Preview is opened from the **Preview** menu option. To preview the output of the group settings, click the **Refresh** pushbutton.

Multiple instances of **Preview** can be opened to compare data.

If the group contains **Variables**, they are listed in the display so that values can be specified.

Variables

When variables are used in data groups, their usage becomes more flexible since the variables can be given a value when it is deployed.

Example: A group contains a variable representing an item which is set by the scheduler on an event.

Example: A group containing variables for the start and end times so that they can be set from an on-demand report.

The following group settings can be specified as a variable:
- Names
- Headings (including parsing)
- Start Time and Offset
- End Time and Offset
- Interval
- Filter conditions

Name Variables

When a variable is used for the Name under the Columns tab, there are 3 different values that are available from that variable:
- Name (e.g., *{Item 1}*)
- Nickname (e.g., *{Item 1:Nname}*)
- Description (e.g., *{Item 1:Desc}*)

These additional variables can be used in the **Heading** in the group or as a **Variable** connection in the template to display more information in the report.

Data Errors

If there are issues in retrieving data, rather than showing an erroneous value, a symbol may appear in the report.

Symbol	Description
???	The quality of the value returned from the server is bad.
###	The item specified is not valid.
@@@	The connection to the data server failed.
!!!	Value error
%%%	No memory

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