

# QualityWindow

The continuous improvement software



## Quality Window Application Admin

Setting Variable Limits

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## Overview

Variable limits, often referred to as control limits, are boundaries used to monitor, control, and improve the performance of a process. They define acceptable ranges for process variables, ensuring that the process operates consistently and meets quality standards.

As a leading SPC/SQC analysis tool, Quality Window allows administrators to manage limits down to specific data points or variables. Limits can be set for any numeric or calculated variable and support the following limit types:

- **Specification Limits (White):** Define the maximum and minimum acceptable values for a product or process, based on customer, regulatory, or design requirements. When values fall outside the specification limit, they typically indicate a defect or reject-level value.
- **Control Limits (Red):** These are indicators of process stability and are generally based on the process's inherent capability (calculated using standard deviations). They act as an early warning system for deviations before hitting specification limits.
- **Warning Limits (Yellow):** Thresholds that signal the process is approaching control limits, enabling early intervention.
- **Target Value (Green):** The ideal value a process should aim to achieve for optimal performance.

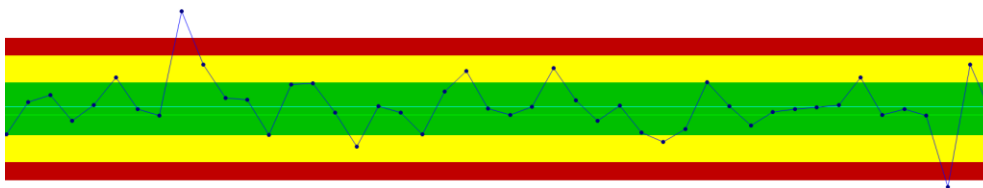
## How Quality Window uses Limits

Quality Window incorporates process control limits to enhance visualization and analysis, helping users quickly interpret and respond to process performance. Here's how it uses these limits across key features:

**Logsheet Colors:** Cell backgrounds are colorized based on where the value resides within the limit ranges. This allows for an intuitive, at-a-glance understanding of process performance.

400	7.5	7.8
500	6.2	4.5

**Control Charts:** Color bands visually indicate where data falls within the process limit ranges, making it easier to understand process variation and performance.

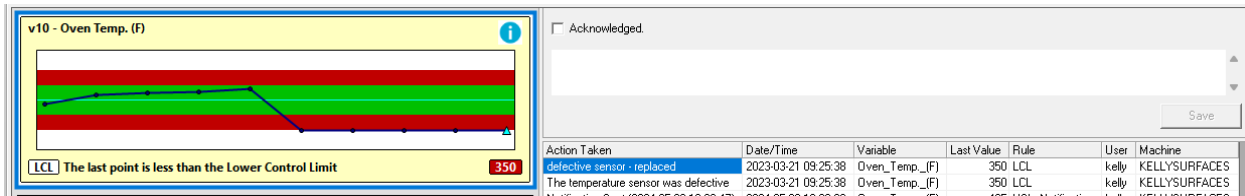


**Statistics:** Quality Window provides numerous [statistics](#) that are calculated based on data performance relative to the defined limits, such as “Calculated percent above upper control limit.”

## Quality Window Application Admin - Setting Variable Limits

Description	Statistic	Value
Obs % OSL	O%OSL	16.327
Obs ppm OSL	OppmOSL	163265
Calc ppm OSL	CppmOSL	224700
Calc. Lower Warning Limit	CLWL	331.7
Calc. Upper Warning Limit	CUWL	453.3
Current USL (Fixed/Calc)	USL - cur	450.1
Current UCL (Fixed/Calc)	UCL - cur	425.1

**Rule Violations and Alarms:** Quality Window enables administrators to set variable rules that when violated throw alarms. Rules can be defined based on what zone or limit a data point fall in.



## Variable Minimum and Maximum Constraints vs. Limits

Do not confuse limits with the **Minimum** and **Maximum** property values of a variable definition in Quality Window. The Minimum and Maximum properties constrain data entry to values within defined bounds but do not serve as process or reject-level specification limits. Instead, they are data entry constraints that prevent users from entering values outside acceptable ranges.

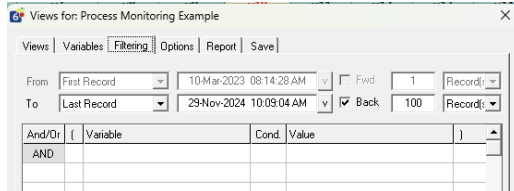
## Setting Limits

Each numeric or calculated variable allows limits to be set in one of three ways:

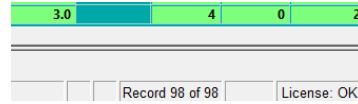
1. **Fixed:** Manually entered by the administrator.
2. **Blank:** No limits are set, and corresponding zones are disabled.
3. **Calculated:** Automatically derived using data currently loaded in the Logsheet (based on the applied filter, also referred to as current “Population”).

## How do Calculated Limits work?

In Quality Window, all calculations including Calculated Limits are calculated on the fly based on the currently in memory records. This means that as filters are applied, or records are added, calculated limits will be re-calculated and may change.



Example of a Filter



Status Bar displaying Record count

## How are Calculated Limits calculated?

- **Specification Limits:**  $\pm 4$  times the standard deviation + Selected Target Value.
- **Control Limits:**  $\pm 3$  times the standard deviation + Selected Target Value.
- **Warning Limits:**  $\pm 1.5$  times the standard deviation + Selected Target Value.
- **Target:** Average value.

The **Selected Target Value** depends on whether the target value is fixed or calculated. This is determined by the property **Limits Centered On**, which can be set to Fixed Target or Calculated Target.

**Note:** Setting the variable property to **Fixed Target** when you have a **Calculated Target** will result in centering on a **Calculated Target**.

Limits Centered On	Fixed Target
Active Rules	Fixed Target
Required	Calculated Target

## Methods for Calculating Limits

Quality Window provides multiple methods for calculating limits via the “**Calc. Limits Based On**” variable property. These methods are categorized as:

1. **Loaded Population Calculations:** Use the entire in-memory dataset (Used for Population and MR Estimate methods).
2. **Criteria-Based Calculations:** Use subgroups of consecutive data points meeting specific criteria (used for High/Low Variation and High/Low Average methods).

### Loaded Population Calculations

These methods use the entire population of records loaded in memory. The currently loaded records are always determined by the currently configured [filter](#).

**Population Method:**

- **How It Works:** Calculates limits using the standard deviation of the entire dataset currently in memory.
- **When to Use:** Best for larger or stable datasets with consistent process performance.
- **Pros:** Reflects overall process capability.
- **Cons:** May dilute recent trends if older data no longer represents the current performance of a process.

**MR Estimate (Moving Range Estimate) Method:**

- **How It Works:** Calculates limits using the standard deviation of the moving range between adjacent data points ( $MR = |X_i - X_{i-1}|$ ).
- **When to Use:** Ideal for small datasets.
- **Pros:** Better suited for short-term analysis.
- **Cons:** Less precise for long-term trends or large datasets.

**Criteria-Based Calculations**

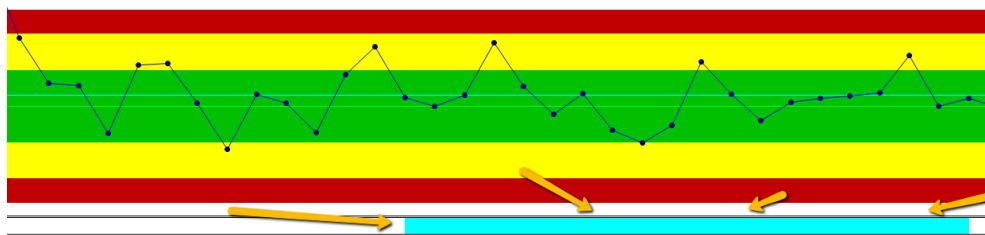
These methods use scans for a subgroup of consecutive records to calculate limits based on the application’s Limit Method Criteria settings on the General Tab:

- **Percent of Data to Use (Default: 20%):** Defines the subgroup size as a percentage of the loaded records.
- **Minimum Data Points (Default: 20):** Ensures a minimum subgroup size.
- **Maximum Data Points (Default: 100):** Limits the maximum subgroup size.

Limit Method Criteria	
Percent of data to use	20
Minimum number of data points	20
Maximum number of data points	100

*Limit Method Criteria on General Tab of QW Application*

Quality Window will display the selected subgroup of records on the control chart as a teal band below the chart as shown below:



### High/Low Variation (Cr – Capability Ratio):

- **How It Works** Calculates Limits by using the standard deviation of a subgroup with the smallest or largest variation (Capability Ratio).
- **When to Use:**
  - Low Variation: For optimal performance and tight control.
  - High Variation: For stress-testing or understanding instability.
- **Pros:** Tailored limits reflecting variability extremes.
- **Cons:** Low Variation may trigger false alarms; High Variation may reduce sensitivity.

### High/Low Average:

- **How It Works:** Calculates Limits by using the standard deviation of a subgroup with the smallest/largest averages.
- **When to Use:**
  - Low Average: For tighter control around low-range values.
  - High Average: For focusing on upper-end performance.
- **Pros:** Provides targeted insights for specific performance ranges.
- **Cons:** May overlook broader process trends.

## Appendix A: Limits Cheat Sheet

Method	How It Works	When to Use	Pros	Cons
<b>Population</b>	Uses SD of the entire dataset currently in memory.	For large, stable datasets.	Reflects overall process capability.	Dilutes recent trends if older data is outdated.
<b>MR Estimate</b>	Uses the SD of the moving range between consecutive points of the entire data set in memory.	For small datasets or limited data	Simple to implement; provides short-term variability insights.	Less precise for long-term trends or when working with larger datasets.
<b>High/Low Variation</b>	Uses SD of a subgroup with the smallest/largest variation (Capability Ratio - Cr).	<b>Low:</b> For tight control. <b>High:</b> For stress-testing.	Tailored limits reflecting variability extremes.	Low Variation: May trigger false alarms.
<b>High/Low Average</b>	Uses SD of a subgroup with the smallest/largest averages.	<b>Low:</b> For low-range control. <b>High:</b> For upper-end performance.	Provides targeted insights into performance trends.	May overlook overall process trends.

## Limit Types Overview

Limit Type	Definition	Formula	Color Code
<b>Specification Limits</b>	Define acceptable values based on customer or regulatory requirements.	$\pm 4 \text{ SD} + \text{Target}$	<b>White</b>
<b>Control Limits</b>	Statistically derived boundaries for process stability.	$\pm 3 \text{ SD} + \text{Target}$	<b>Red</b>
<b>Warning Limits</b>	Thresholds signaling a process is nearing control limits.	$\pm 1.5 \text{ SD} + \text{Target}$	<b>Yellow</b>
<b>Target</b>	Ideal value for optimal performance.	Average/Mean value	<b>Green</b>

## Key Settings in Quality Window Applications

Setting	Description	Default
<b>Percent of Data</b>	Defines the subgroup size as a percentage of loaded records.	20%
<b>Minimum Data Points</b>	Ensures a minimum subgroup size for criteria-based calculations.	20
<b>Maximum Data Points</b>	Limits the maximum subgroup size for criteria-based calculations.	100