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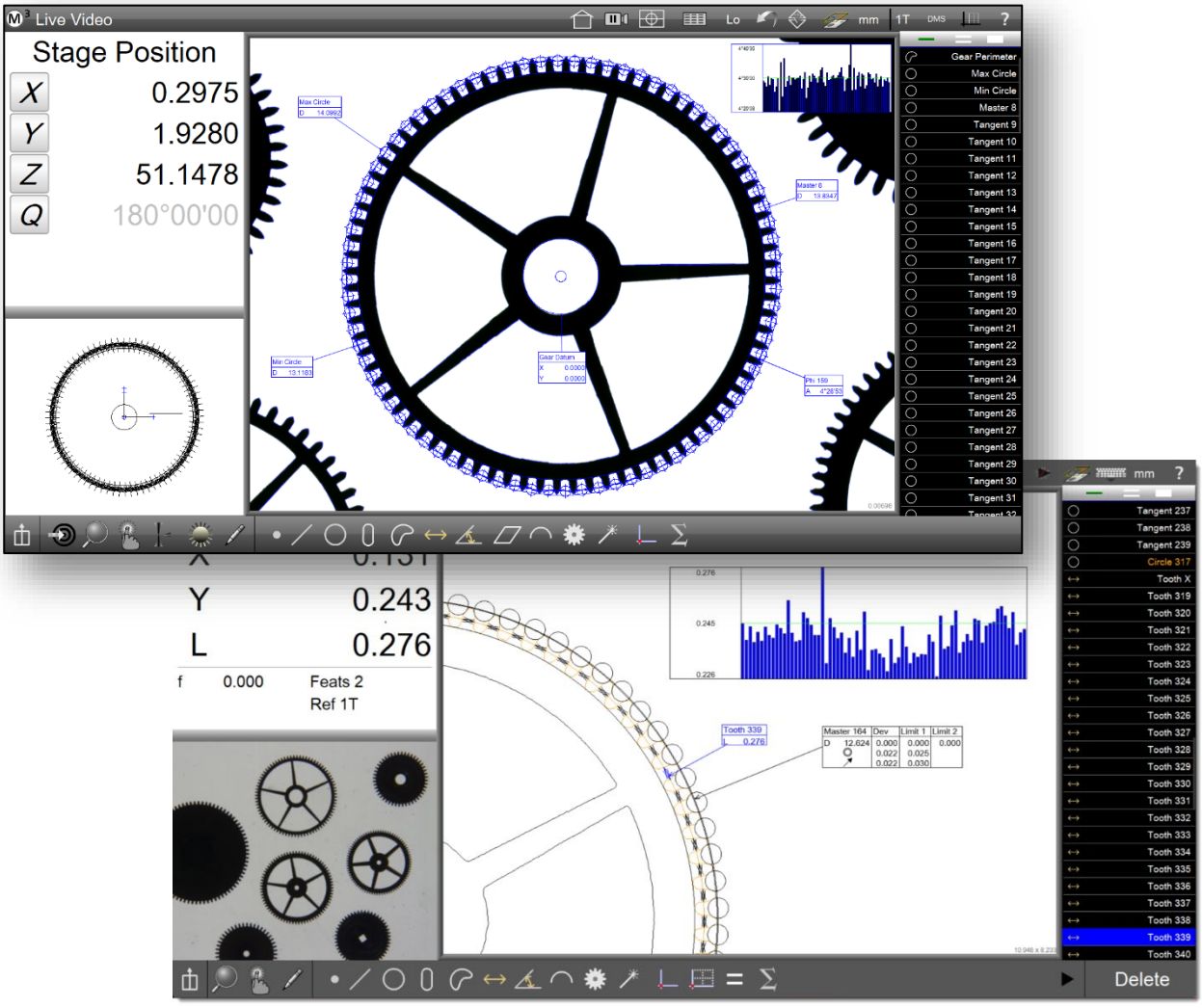

Gear Option for M3V4 Software

User's Guide

July 2023 PN# 15010-00 Rev 6

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User's Guide

Video Edge Detection

MetLogix

RYF AG

RYF AG
Bettlachstrasse 2
CH-2540 Grenchen
Tel +41 32 654 21 00

www.ryfag.ch

RYF SA Succursale
Route de Genève 9c
CH-1291 Commugny
Tel +41 22 776 82 28

ryfag@ryfag.ch

RYF AG (Zürich)
Im Hanselmaa 10
CH-8132 Egg / Uster/ZH
Tel +41 43 277 59 99

CHE-106.926.853 MWST
SWIFT-Code RSOSCH22
IBAN-Nr. CH80 0878 5016 0009 9850 6

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User's Guide

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Contents

Introduction

The M3 Gear optional software package adds many important features and benefits to the standard M3 measuring software application. This document covers the main features of this software option and provides some examples of its use.

Note

The concepts presented in this guide rely on an understanding of the basic features and functions of the M3 software application. Please make sure that you are familiar with the M3 software before proceeding.

Gear Option Features and Benefits

Quick and Accurate Inspection of Critical Gear Characteristics

Inspect important characteristics of spur type gears using the intuitive touch screen interface of the M3 measuring software. Inspect spur gears for:

- Max and Min Gear Diameter
- Gear Tooth Width
- Master Gage Circle Diameter
- Phi Angles of Gear Teeth

In-built Gear Inspection Macros

Generate automated gear inspection routines using ***standard*** and ***master*** gear macros. Operators can follow on-screen step by step instruction for pre-defined *standard* and *master* inspection macros. Results are generated instantly for the corresponding gear routine.

Gear Tooth/Phi Angle Graph

Display gear tooth width and phi angle results in bar graph form to quickly identify out of specifications results. Change the position size and color of the graph to enhance your reports and printouts.

Gear Statistics and Tolerances

Generate results statistics, including min, max, range and average for your gear measurements. Apply Concentricity and Runout tolerance controls to your results to complete your automated routines.

Important Note

The use of the Gear option requires the M3 version V4.20.00 software or later and that the options are enabled for your system. In addition, the Encoder Interface Module being used must have the required hardware option programming to support this feature. Please contact your MetLogix representative for information regarding enabling the options for your system.

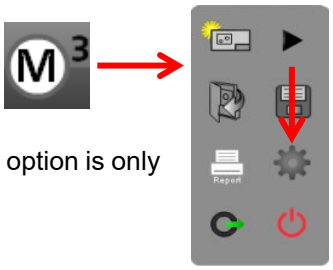
Is My Software Configured for the Gear Option?

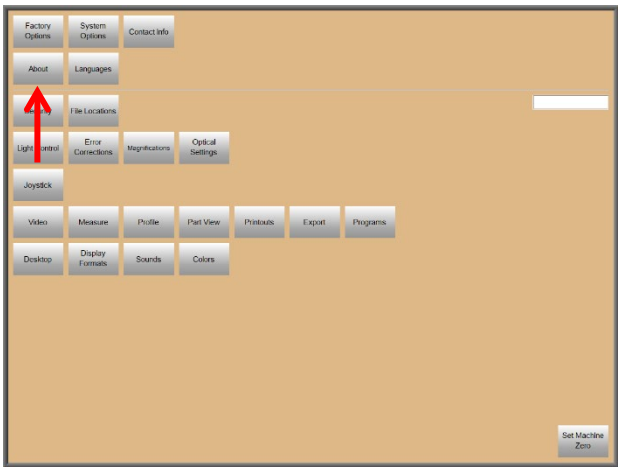
Systems that support the Gear option capability will display the software version number and supported options in the About Settings screen of the M3 System menu. To determine your M3 system software version and option support:

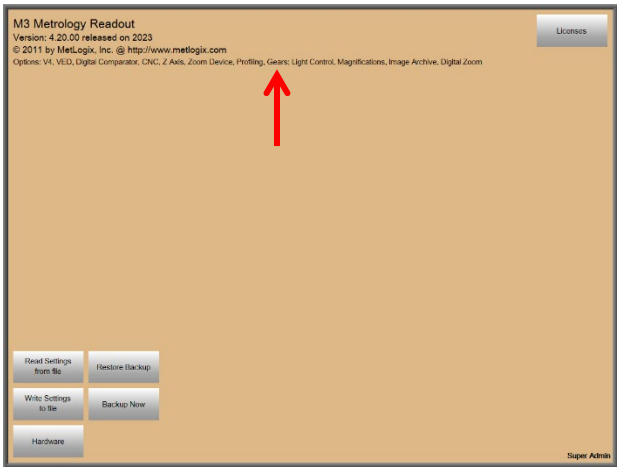
1) Press the M3 logo in the System toolbar to display the System menu.

2) Press the Settings button to display the M3 Settings screen menu.

3) Press the About button to display the M3 version number and option support. This option is only supported in version 4.20.00 or greater.







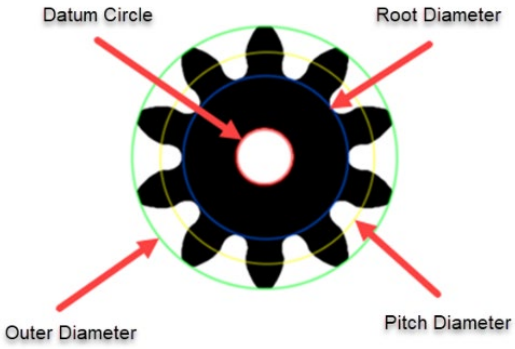
Gear Measurements

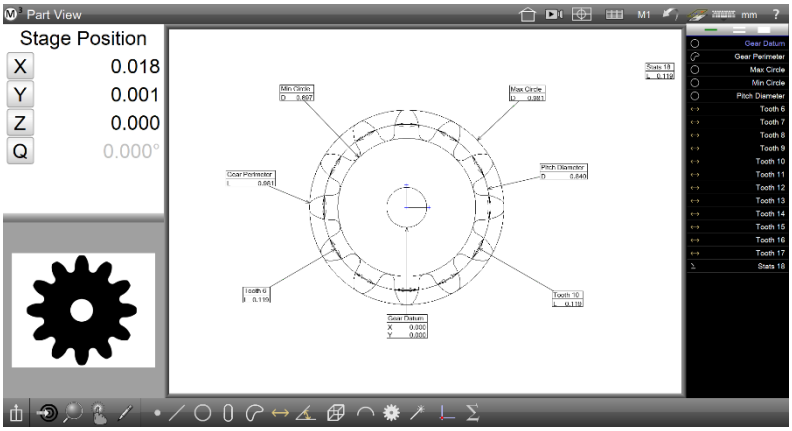
The Gear measurement can be used to measure the following features:

- Standard gear
  - Outer diameter
  - Inner diameter
  - Tooth width
  - Tooth statistics
- Master gear
  - Pin tangent circles
  - Pin super-circle
  - Phi angles (angle to hub, from one pin center to the next).

Standard Gear

The standard gear measures outer diameter (max), inner diameter (min), tooth width and provides tooth statistics if desired.





Standard Gear Measurement

The standard gear can be measured manually or using the provided standard gear measuring macro. Using either the manual or macro procedure to measure the standard gear follows the same set of steps to generate the desired features. The difference is that when using the macro, the M3 auto-names the features as they are measured while in the manual method, the operator may need to rename the features after they have been measured for better identification. The general steps are:

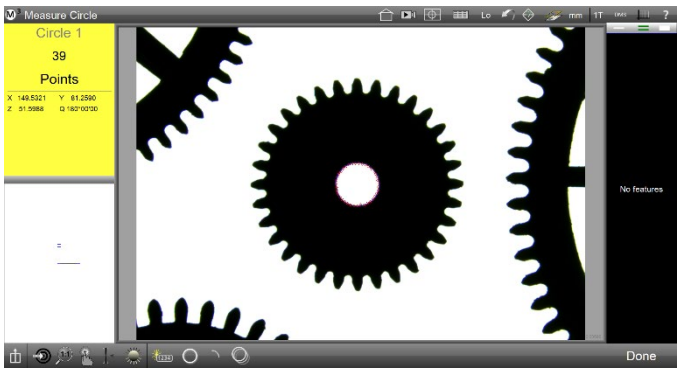
1) Teach a registration pattern or probe a registration feature set.
2) Measure a datum feature at the center of the gear.
3) Use the blob tool to measure the perimeter of gear as a blob feature.
4) Construct a circle from the blob feature. Use the **ChangeType** button to toggle this circle to Max circle.
5) Construct a circle from the blob feature. Use the **ChangeType** button to toggle this circle to Min circle.
6) Create a circle feature (pitch diameter) using given pitch circle values from the gear design.
7) Construct a distance feature from the blob feature and the pitch circle. M3 will automatically construct tooth distances (tooth width) at the pitch circle circumference and post them in the Feature List.
8) Use the Stats function to calculate the tooth stats.

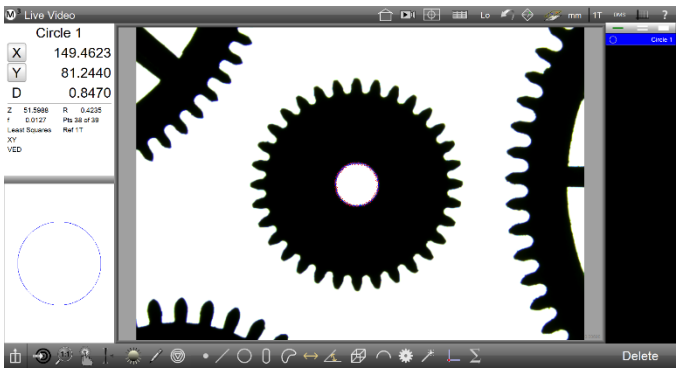
Manual Workflow

To measure a standard gear manually:

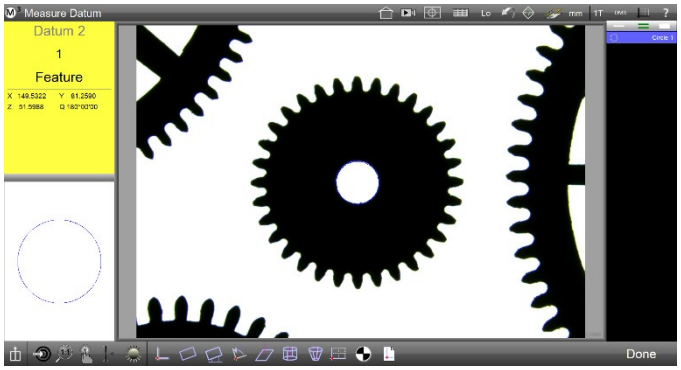
1) Teach a registration pattern or probe a registration feature set.

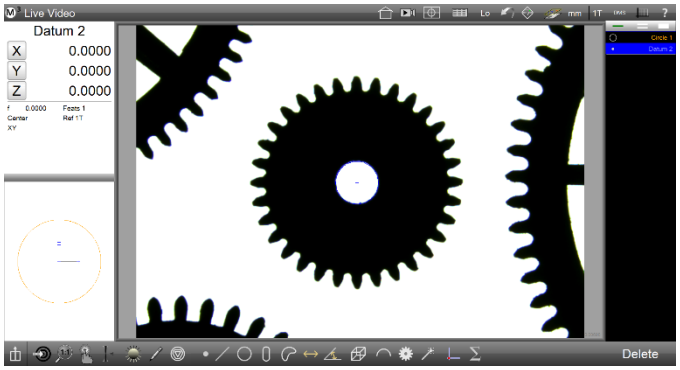
2) Press the measure circle button and probe the center diameter.



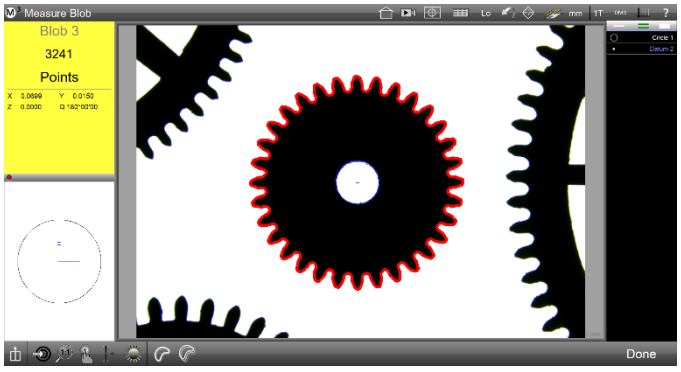


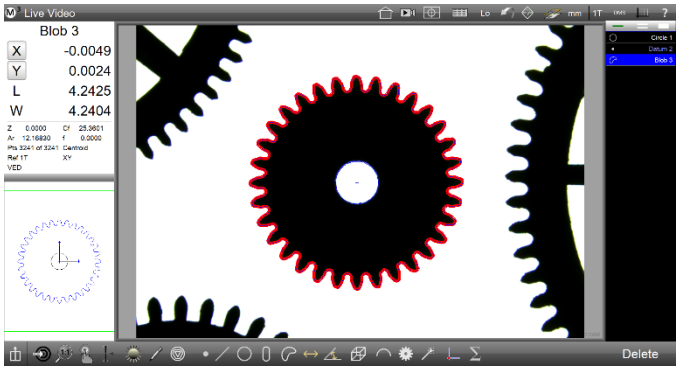
3) Construct a datum from the measured circle or select the circle and press the X and Y buttons to datum on the circle.



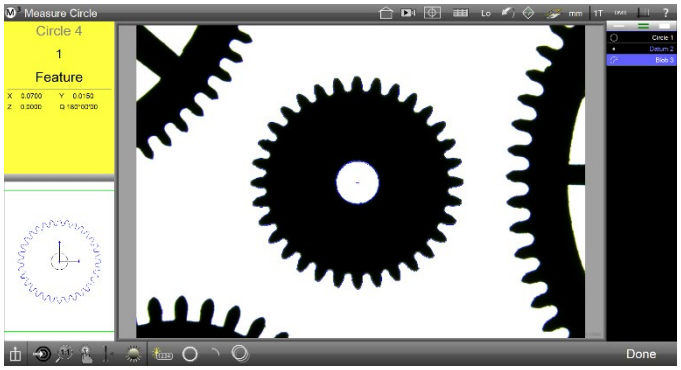


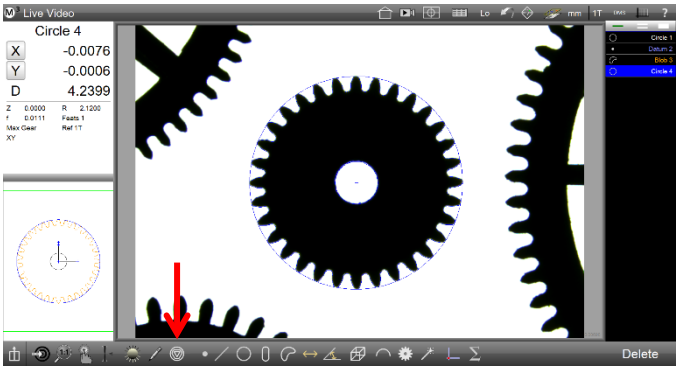
4) Press the measure blob button and probe the perimeter of the gear. Then press the Done button.



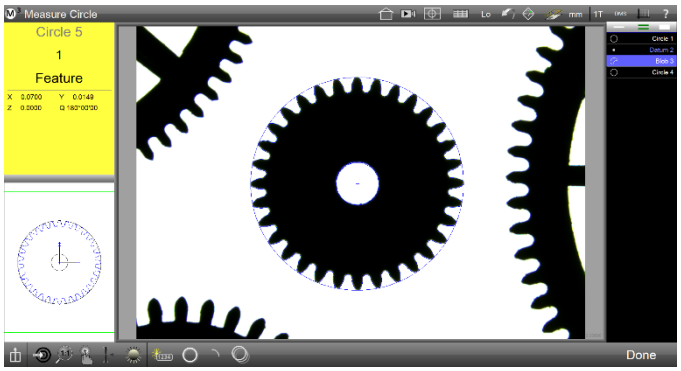


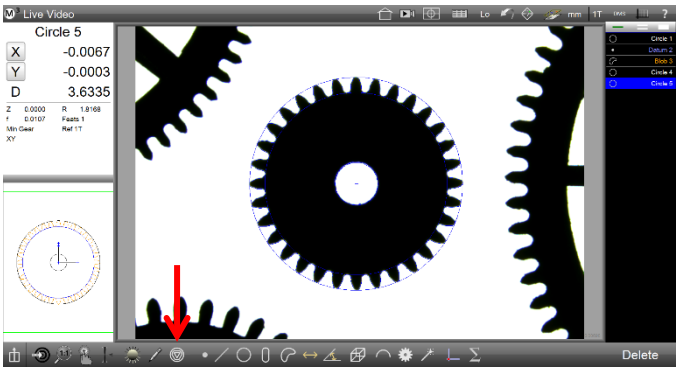
5) Press the measure circle button then select the measured blob. Then press the Done button. While this circle is selected, press the ChangeType button twice to change it to Max Gear.



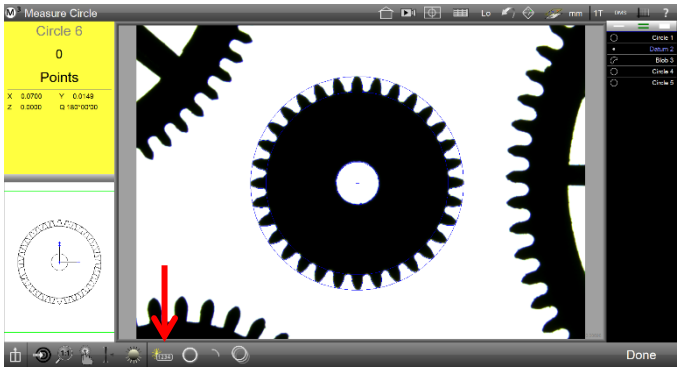


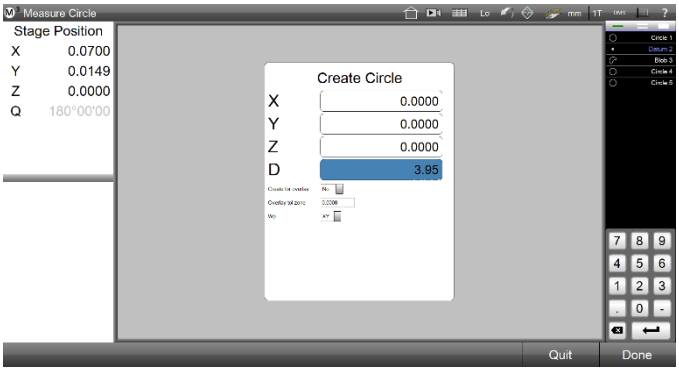
6) Press the measure circle button then select the measured blob. Then press the Done button. While this circle is selected, press the ChangeType button three times to change it to Min Gear.



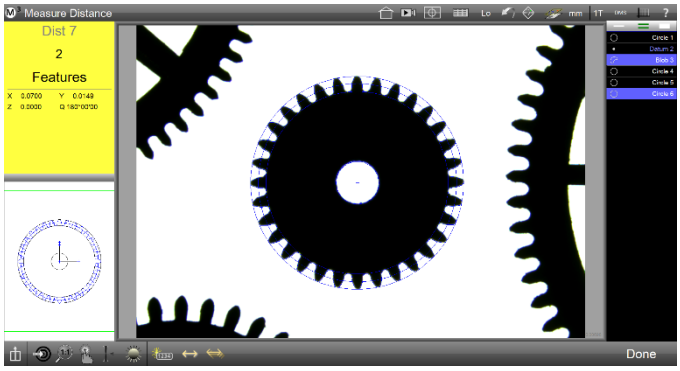


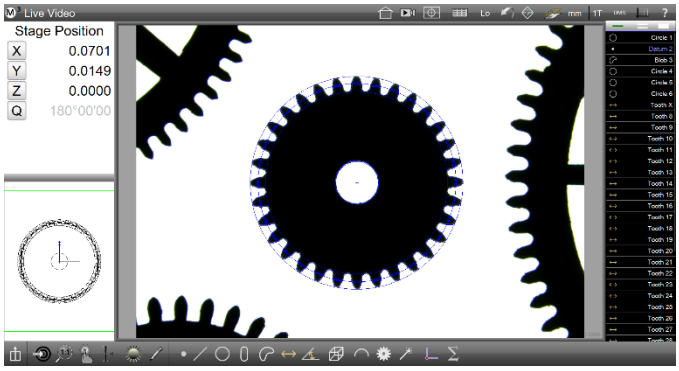
7) Press the measure circle button then press the Create button. Enter values 0 for X and Y. For the diameter, enter the desired pitch diameter then press the Done button.



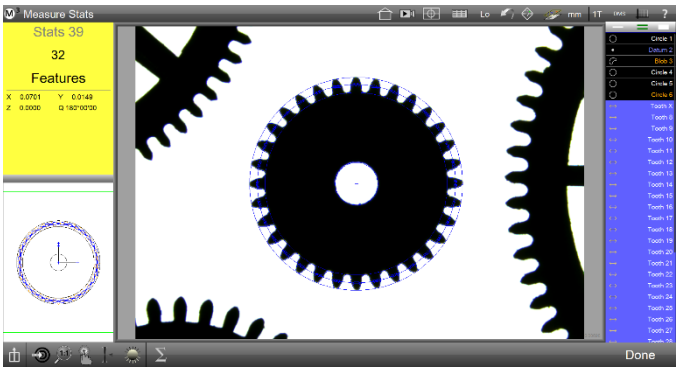


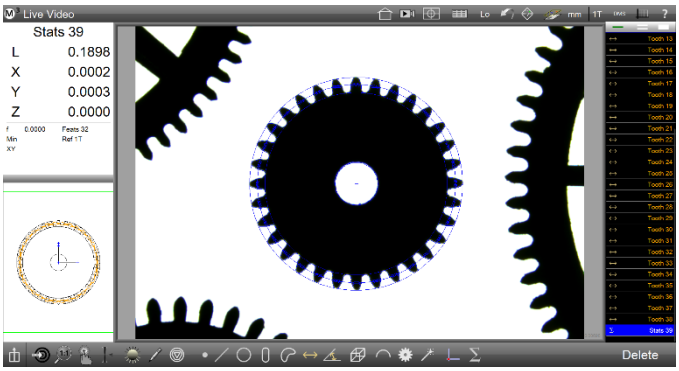
8) Construct a distance feature from the blob feature and the pitch circle. M3 will automatically construct tooth distances (tooth width) at the pitch circle circumference.



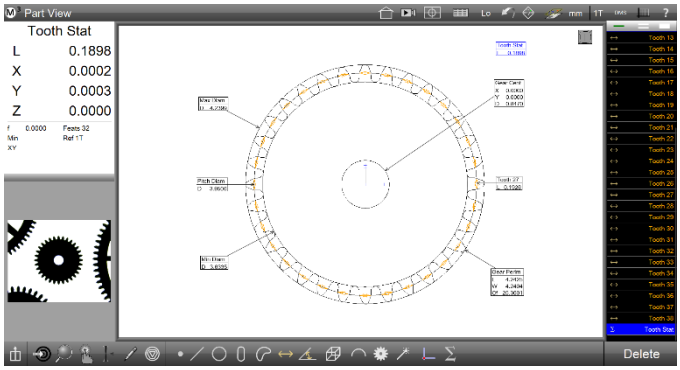


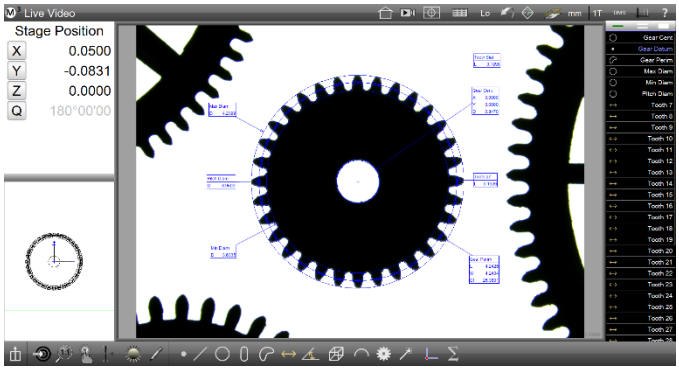
9) Use the Stats function to calculate the tooth stats.





10) Rename the features and annotate the measurements as desired.





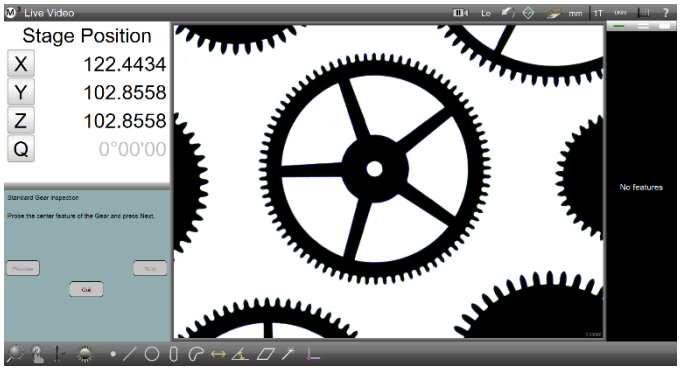
Standard Gear Macro Workflow

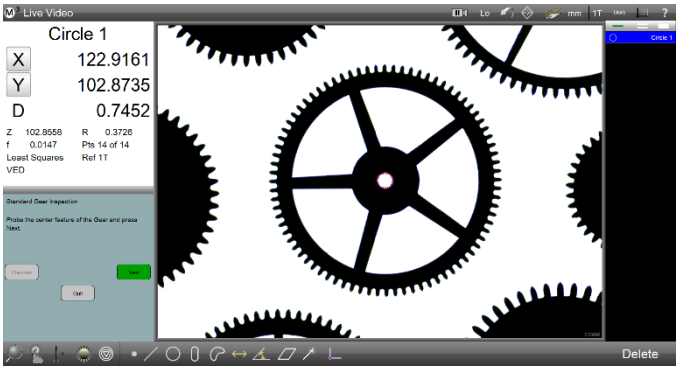
To measure a standard gear using the macro:

1) Teach a registration pattern or probe a registration feature set.

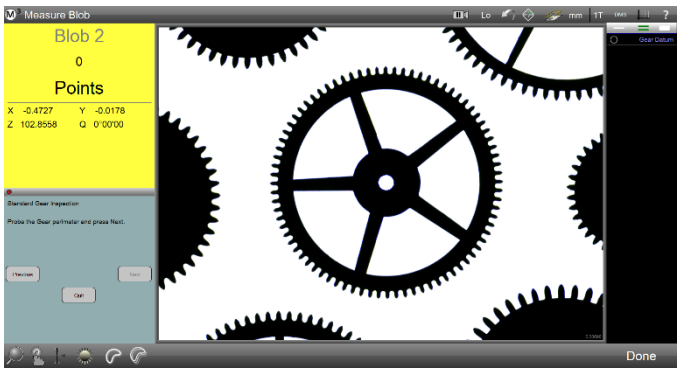
2) Press the measure gear button then press the standard gear button. A macro will be presented on the Part view viewport (bottom left viewport). Follow the prompts presented by the macro to complete the standard gear measurements.

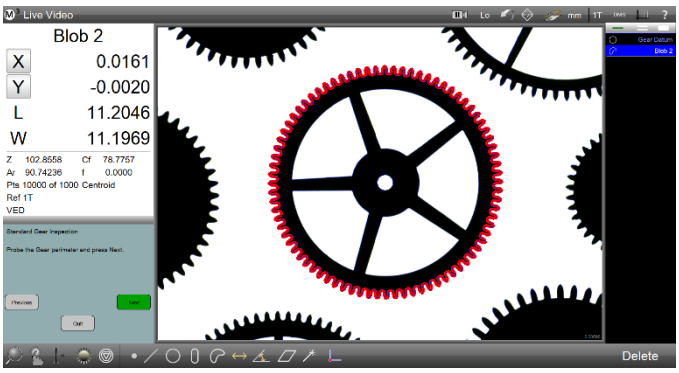
3) Probe the center feature of the Gear and press Next.



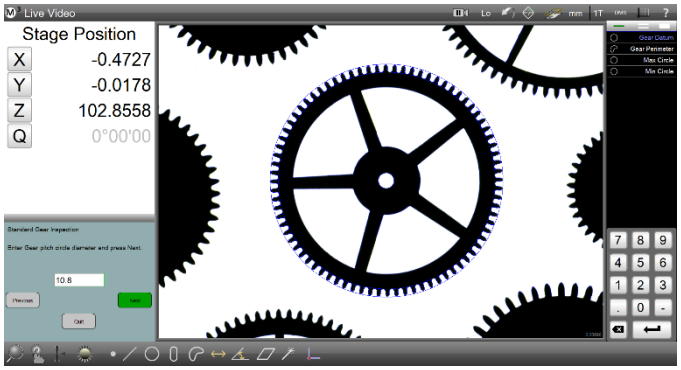


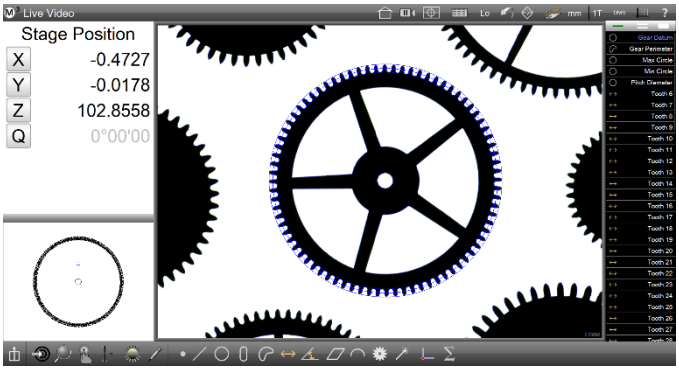
4) Probe the Gear perimeter. Once complete, press the Done button (bottom right) and then press Next.





5) Enter Gear pitch circle diameter and press Next.



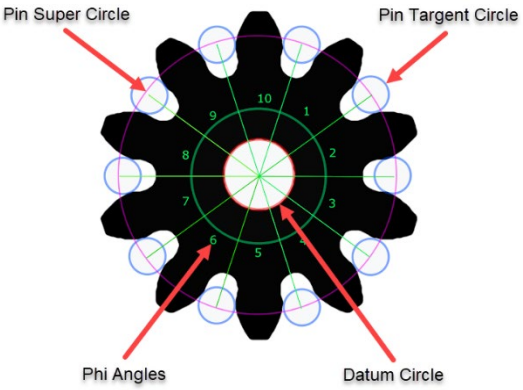


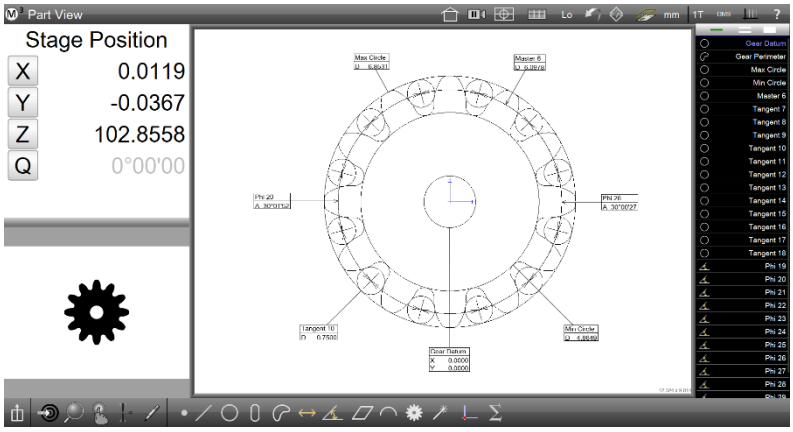
6) Use the Stats function to calculate the tooth stats.

7) Tolerance and annotate the measurements as desired.

Master Gear

The master gear measures tangent circles, super (*master*) circle, Phi angles (angle to hub, from one pin center to the next), and provides tooth statistics if desired.





Master Gear Measurement

The master gear can be measured manually or using the provided master gear measuring macro. Using either the manual or macro procedure to measure the master gear follows the same set of steps to generate the desired features. The difference is that when using the macro, the M3 auto-names the features as they are measured while in the manual method, the operator may need to rename the features after they have been measured for better identification of the measured features. The general steps are:

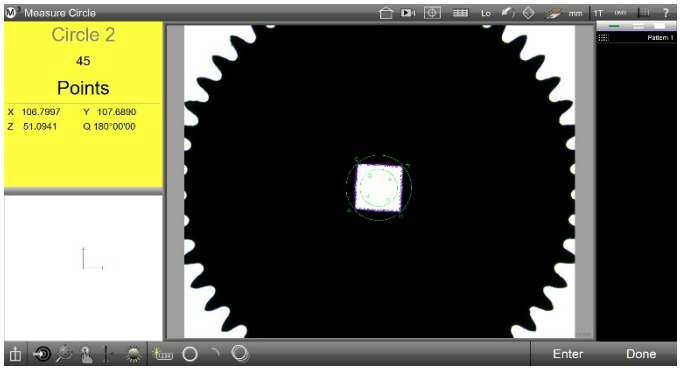
1) Teach a registration pattern or probe a registration feature set.
2) Measure a datum feature at the center of the gear.
3) Use the blob tool to measure the perimeter of gear as a blob feature.
4) Construct a circle from the blob feature. Use the **ChangeType** button to toggle this circle to Max circle.
5) Construct a circle from the blob feature. Use the **ChangeType** button to toggle this circle to Min circle.
6) Create a circle feature (check pin diameter) using given check pin diameter values from the gear design.
7) Construct a circle feature from the blob feature and the (check pin diameter) circle. M3 will automatically construct:
    a. One tangent (*check pin*) circle for each tooth valley.
    b. One super-circle constructed from the circle centers of all tangent (*check pin*) circles,
    c. One angle result, *Phi*, constructed between each adjacent tangent (*check pin*) circle centers with the gear hub being the vertex of the angle.
8) Use the Stats function to calculate the gear stats.
9) Tolerance and annotate the measurements as desired.

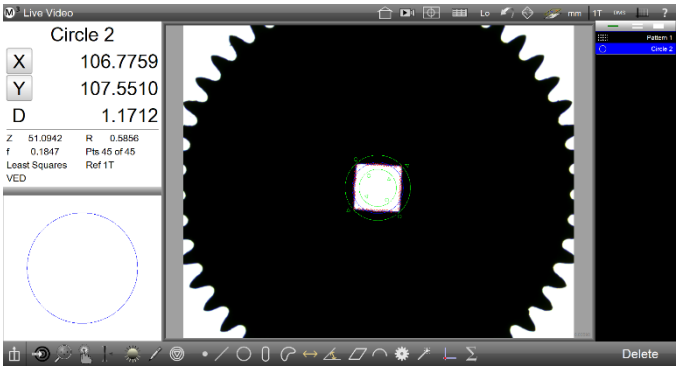
Manual Workflow

To measure a master gear manually:

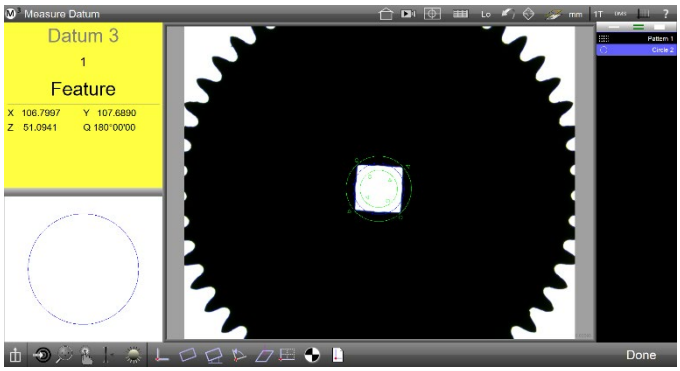
1) Teach a Registration Pattern or probe a Registration Feature set.

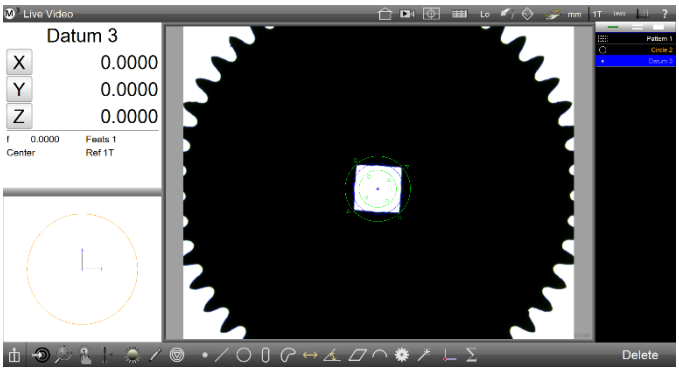
2) Press the measure circle button and probe the center diameter.



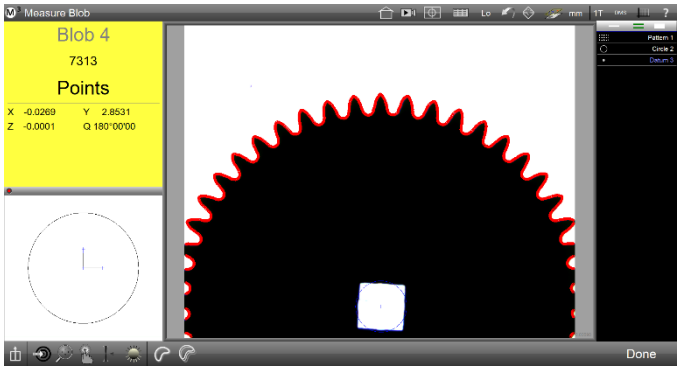


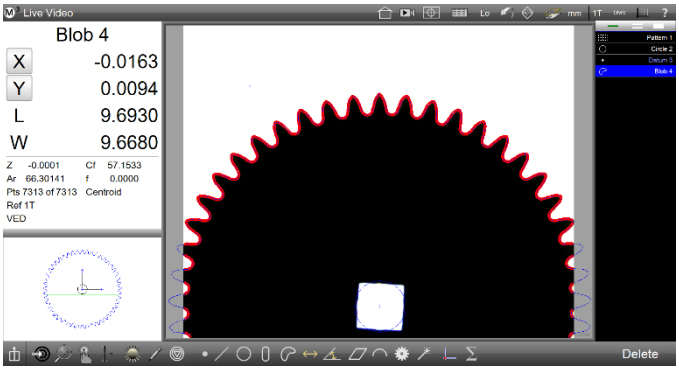
3) Construct a datum from the measured circle or select the circle and press the X and Y buttons to datum on the circle.



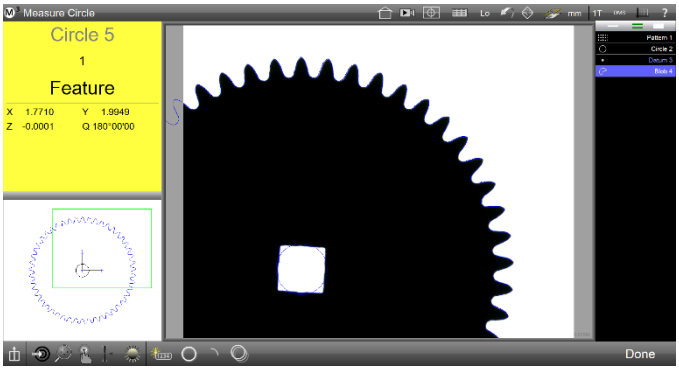


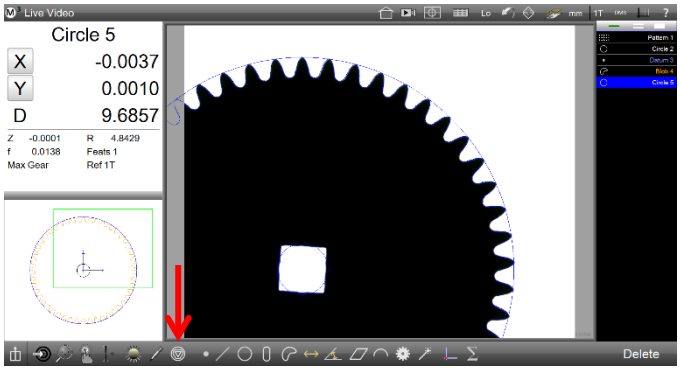
4) Press the measure blob button and probe the perimeter of the gear. Then press the Done button.



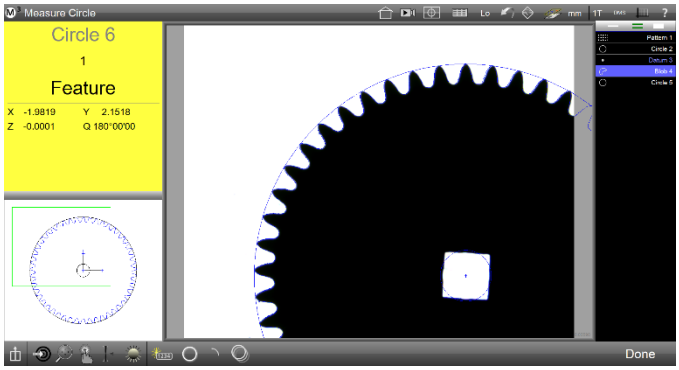


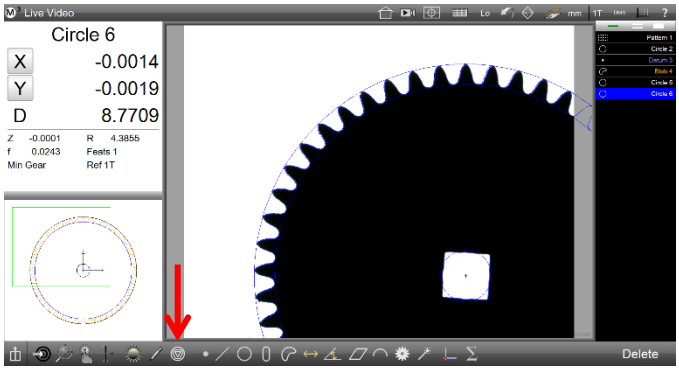
5) Press the measure circle button then select the measured blob. Press the Done button. While this circle is selected, press the ChangeType button twice to change it to Max Gear.



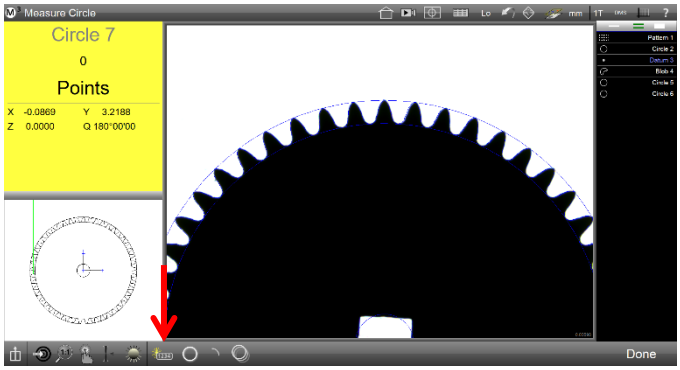


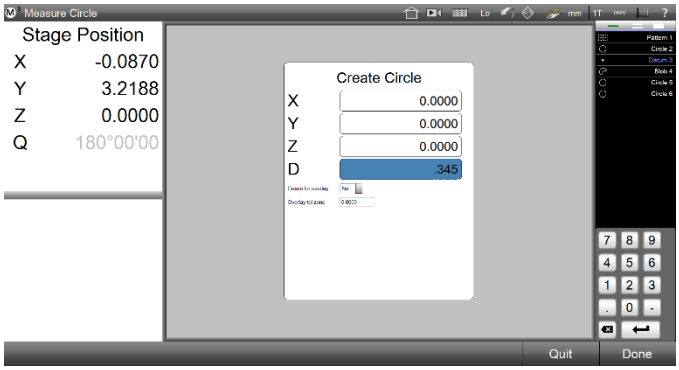
6) Press the measure circle button then select the measured blob. Press the Done button. While this circle is selected, press the ChangeType button three times to change it to Min Gear.



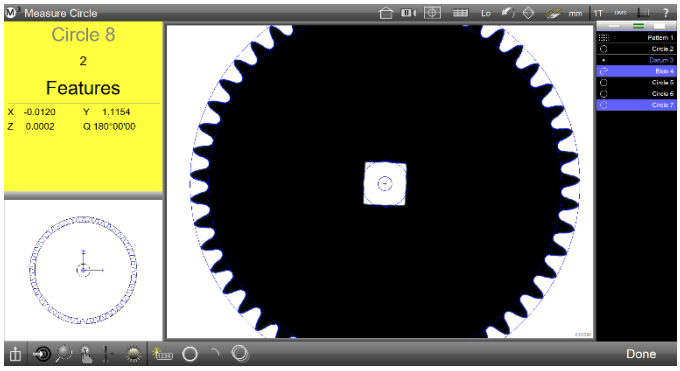


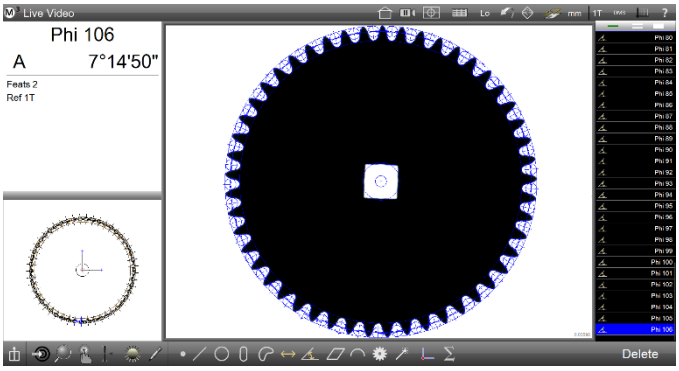
7) Press the measure circle button then press the Create button. Enter values 0 for X and Y. For the diameter, enter the desired tangent (*check pin*) diameter then press the Done button.





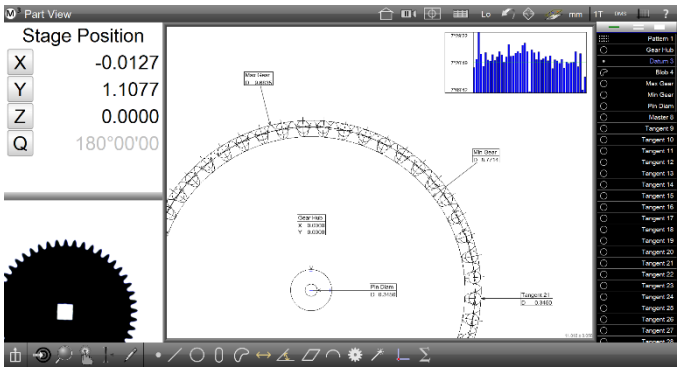
8) Construct a circle feature from the blob feature and the tangent (*check pin* diameter) circle. M3 will automatically construct tangent (*check pin*) circles, a super-circle and *Phi* angles from these tangent circles.

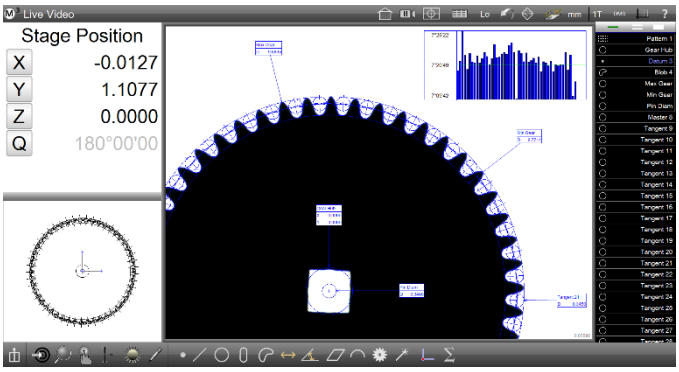




9) Use the Stats function to calculate the *Phi* stats.

10) Rename, tolerance and annotate the measurements as desired.





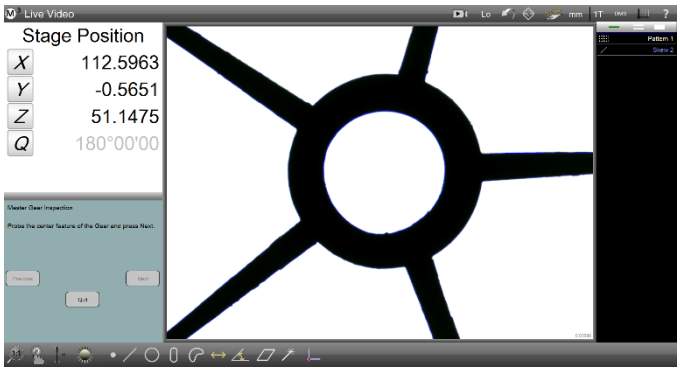
Master Gear Macro Workflow

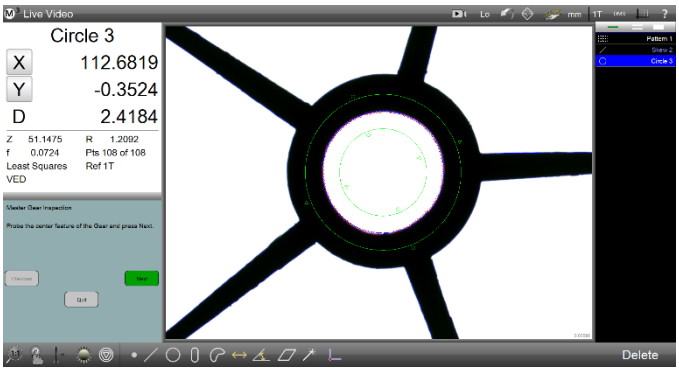
To measure a master gear using the macro:

1) Teach a registration pattern or probe a registration feature set.

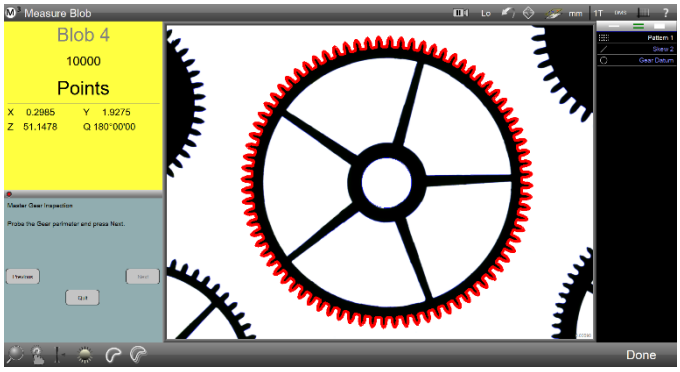
2) Press the measure gear button then press the master gear button. A macro will be presented on the Part view viewport (bottom left viewport). Follow the prompts presented by the macro to complete the master gear measurements.

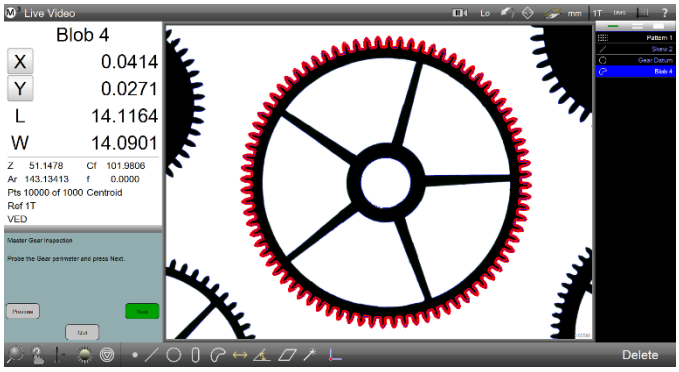
3) Probe the center feature of the Gear and press Next.



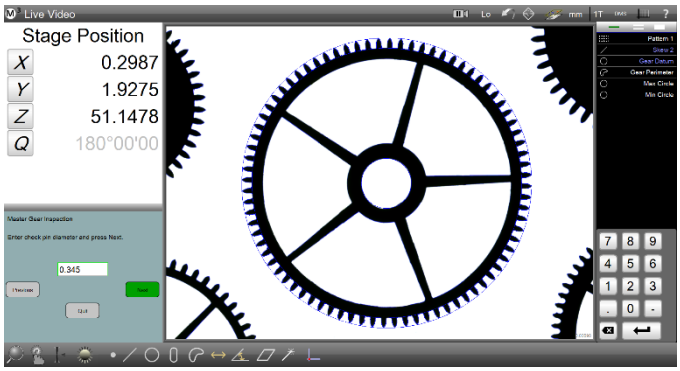


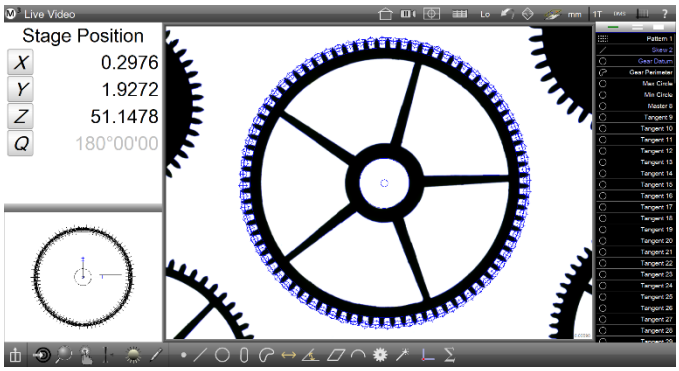
4) Probe the Gear perimeter. Once complete, press the Done button (bottom right) and then press Next.





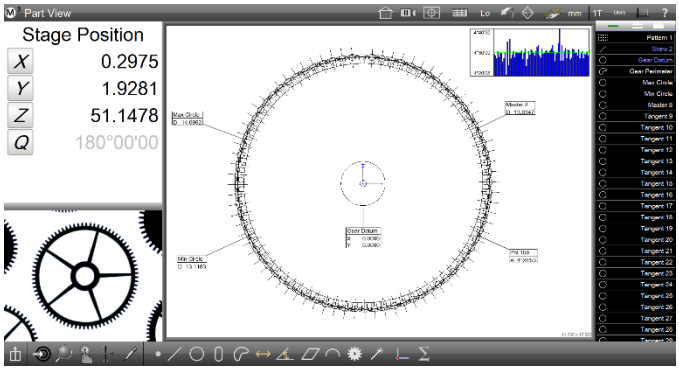
5) Enter Gear check pin diameter and press Next.

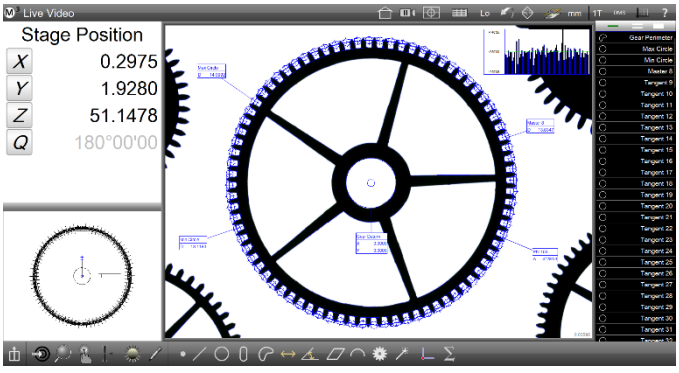




6) Use the Stats function to calculate the tooth stats.

7) Tolerance and annotate the measurements as desired.



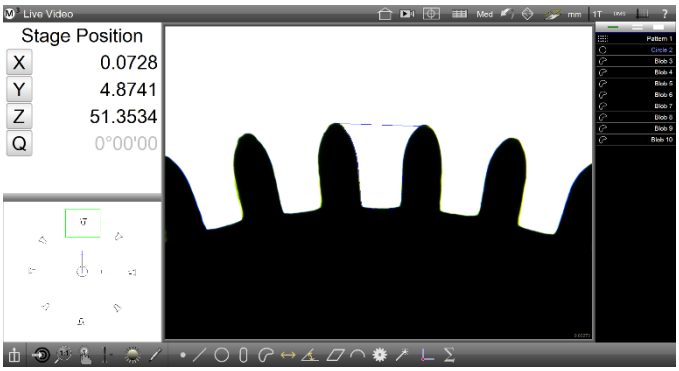


Master Gear Single Probe

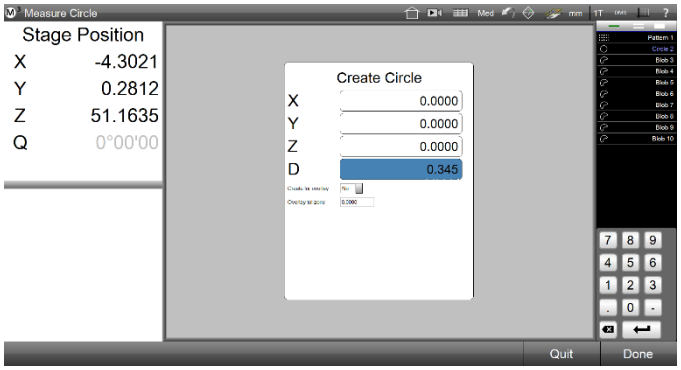
When measuring a master gear on very large gears, it may be necessary to measure a small number of teeth to determine master circle and a sample set of phi angles. This can be accomplished using the master gear single probe method. To use the single probe method:

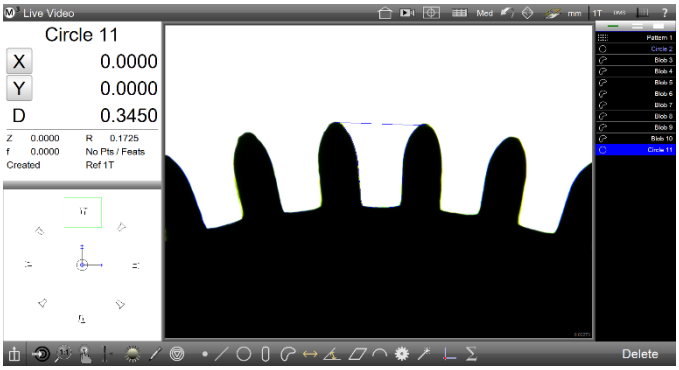
1) Teach a registration pattern or probe a registration feature set.

2) Probe a set of well distributed blob features, by probing the tooth *valley* edge using the blob VED tool.

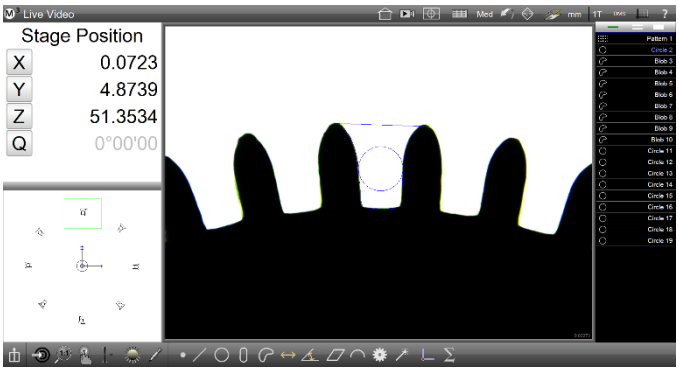


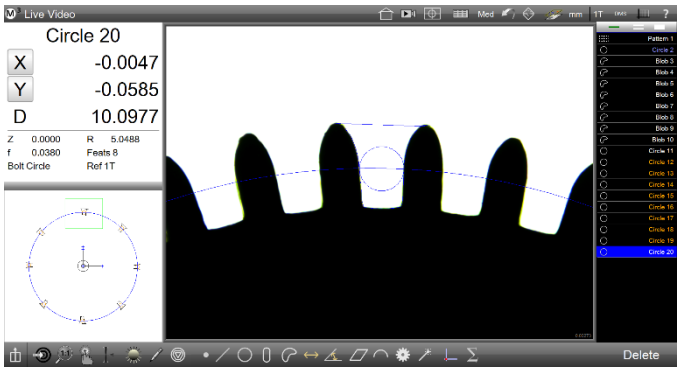
3) Press the measure circle button then press the Create button. Enter values 0 for X and Y. For the diameter, enter the desired tangent (*check pin*) diameter then press the Done button.





4) Construct tangent (*check pin*) circles between each blob and the created *check pin* circle. Then construct a master circle from the pangent circles.





Similar steps can be used to construct phi angles as desired.

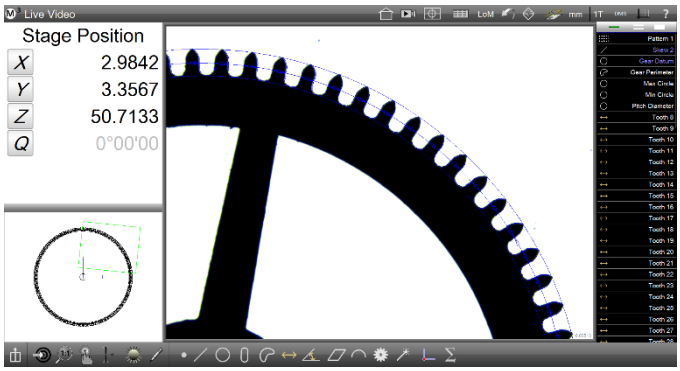
Gear Annotations

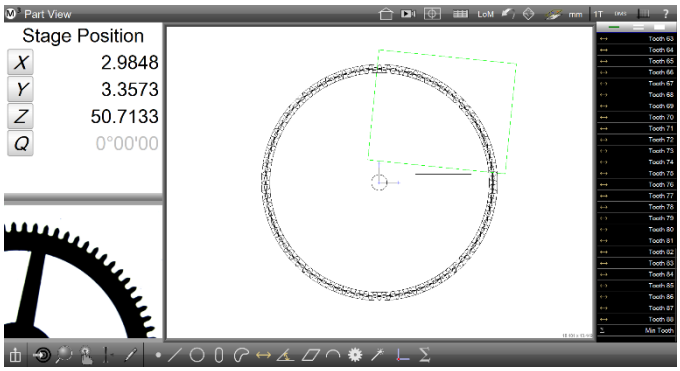
The M3 system provides a simple way to quickly annotate a set of features. This process is called *pinning*. To pin a set of annotation data on the Part View or Video display, simply select the features to be annotated from the Feature List, activate the annotation function, and press the Pin button. Example:

1) Measure standard gear using either the manual or macro workflow as described in previous sections.

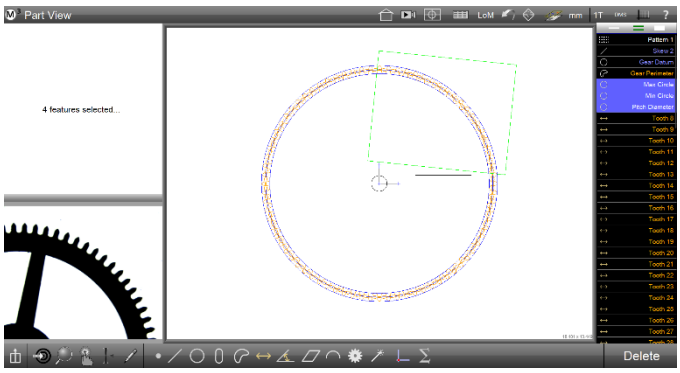
2) Construct a Stat feature from all the measured teeth (the default Stat is min).

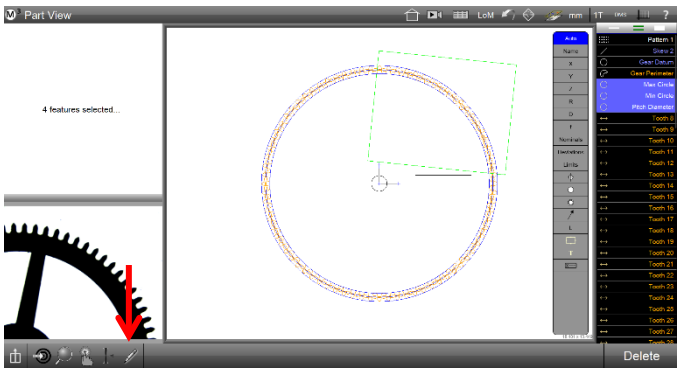
3) Once done, click on the Part View viewport to bring it to the main viewport.



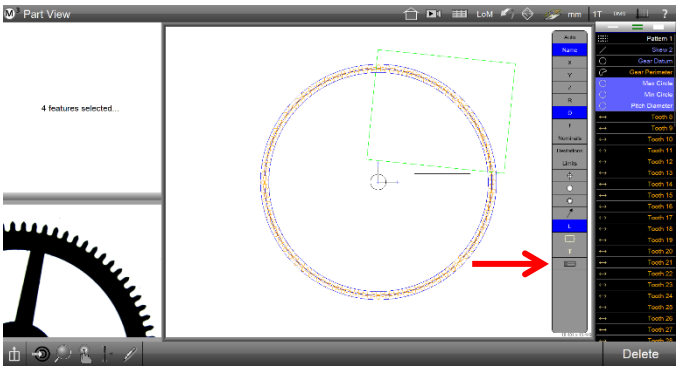


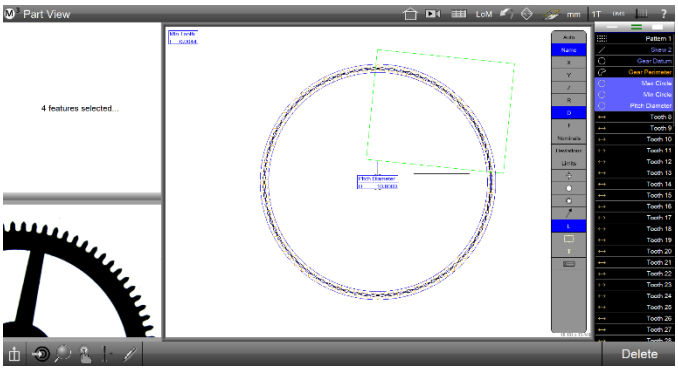
4) Select all the desired features to be annotated from the Feature List (max circle, min circle, pitch diameter and min stat features are selected in this example). Activate the annotation function.



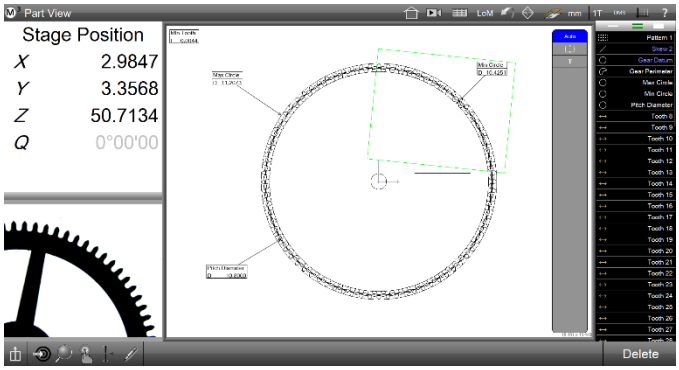


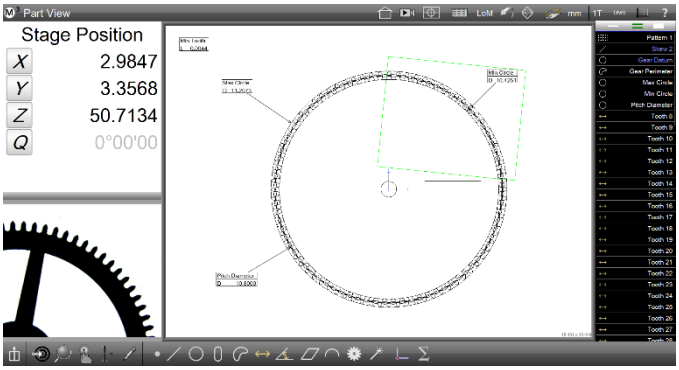
5) Select the desired coefficients to be included in the annotations then press the Pin button.





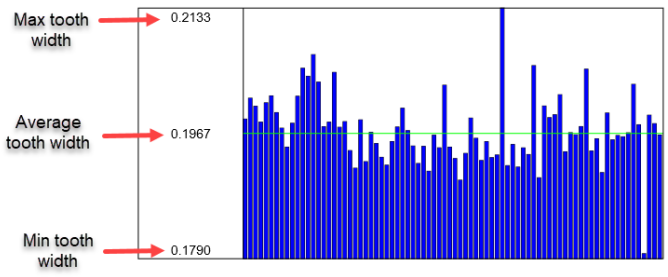
6) Some feature annotations may be overlayed and will have to be repositioned. Drag the annotations and reposition them as desired. Then exit the annotation function by pressing the annotation button.

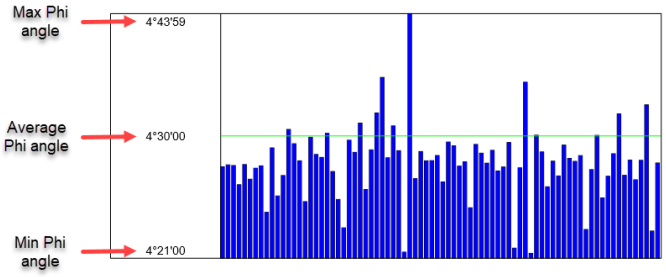




Mini Graph

The tooth widths and the phi angles can be displayed in a graphical form. The Mini Graph displays the minimum, maximum and average tooth widths, or phi angle. This graph is available in the annotation menu.

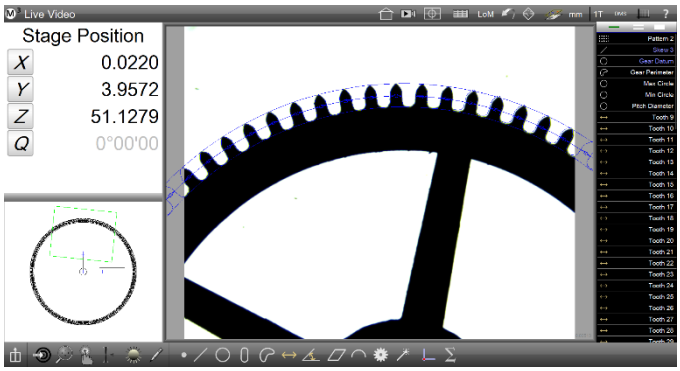


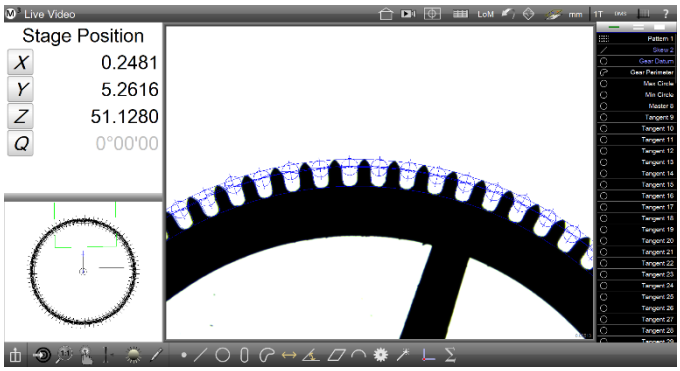


Displaying the Mini Graph

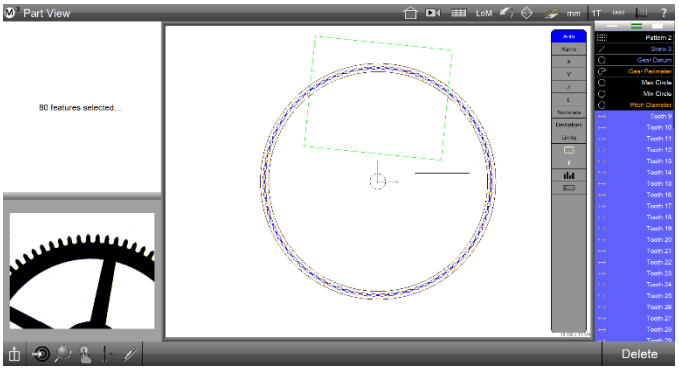
To display the mini graph:

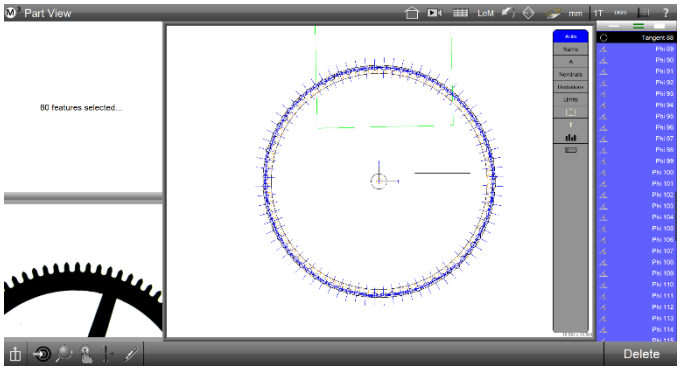
1) Measure the tooth widths using the standard gear measurement workflows, or the phi angles using the master gear measurement workflows.



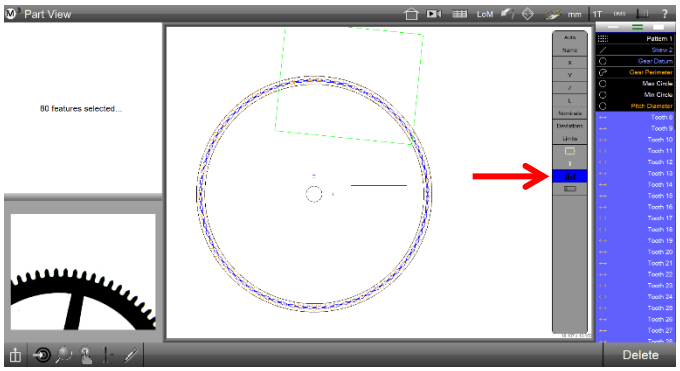


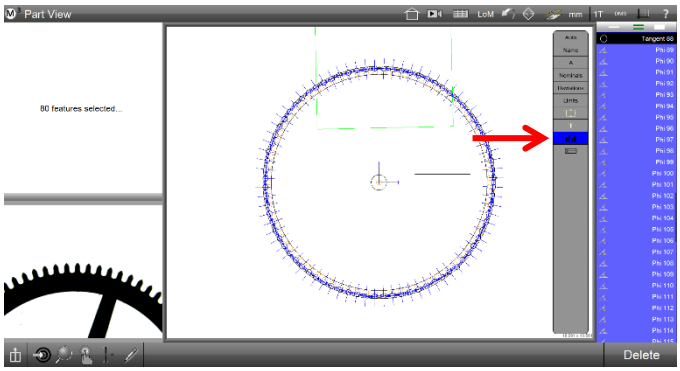
2) Activate the annotation function and then select all desired tooth widths, or phi angles.



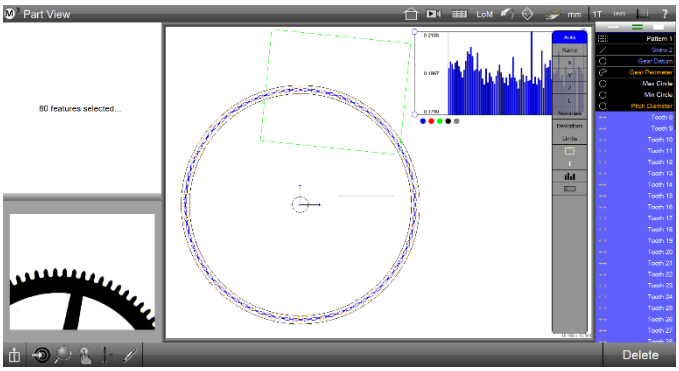


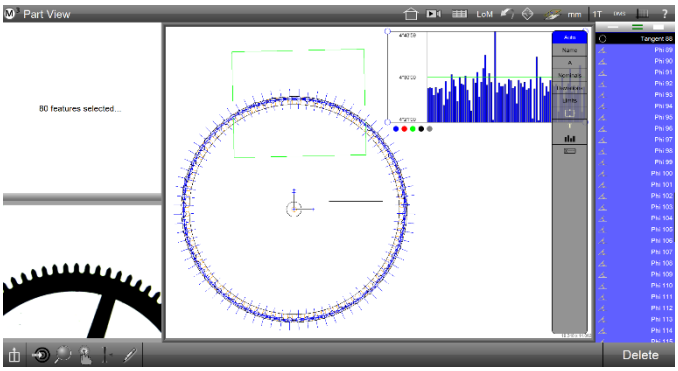
3) Press the mini graph button.



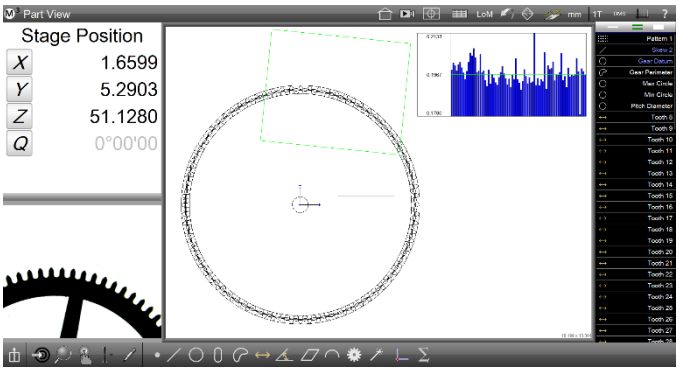


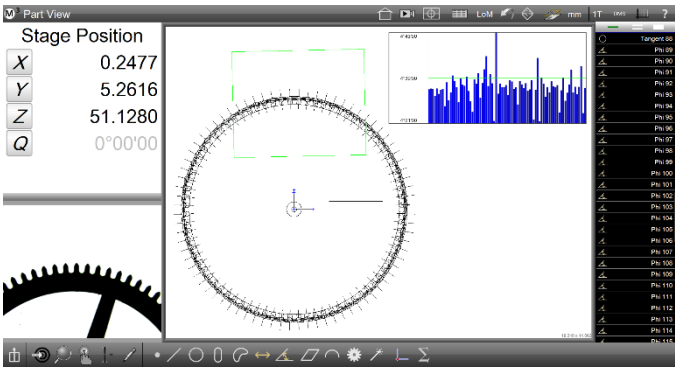
4) Click and hold (left mouse down), then drag the mini graph to position on the main viewport as desired. The graph can also be resized as desired.





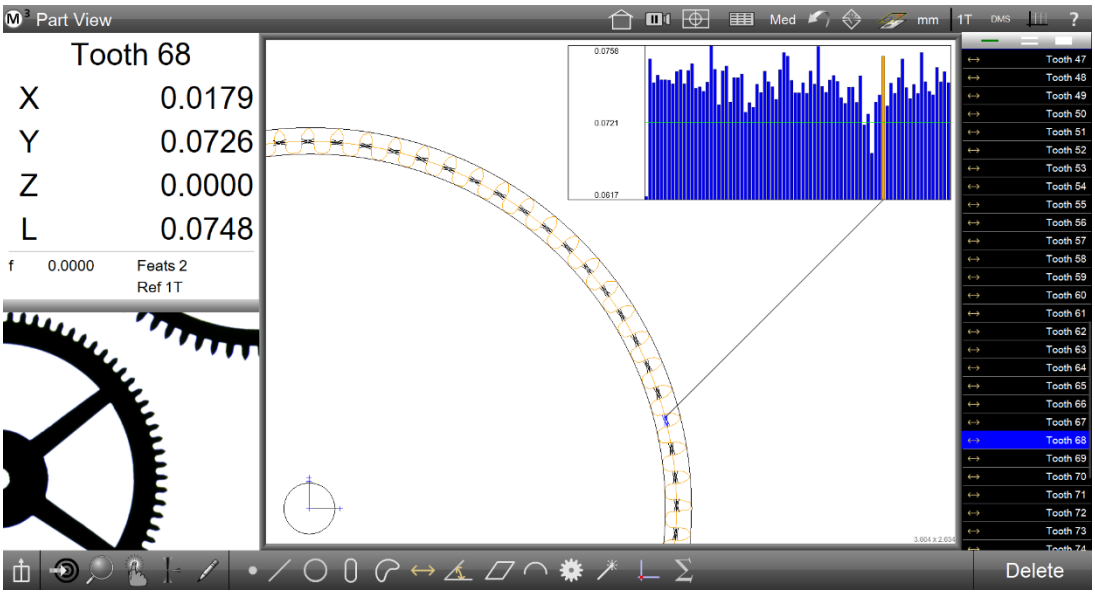
5) Once the mini graph is positioned as desired, more annotations can be added or complete the process by clicking the annotation button.





Mini Graph Data Selection

The mini graph provides a way to easily identify a specific tooth after the measurements are done. The M3 draws a line between the selected tooth on the graph and the tooth on the measurements display in the Part View or Video window.



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