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Interrupted Surfaces & Data Removal

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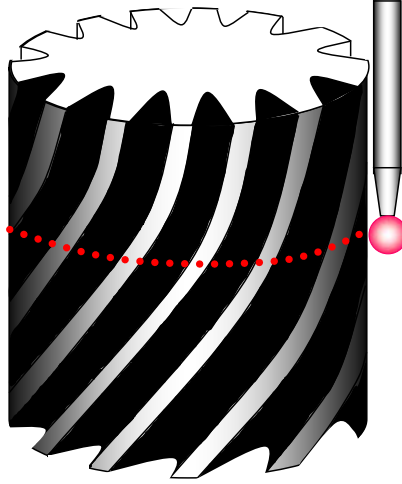
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Associated Problems

- Roundness Measurement on a Helical Surface



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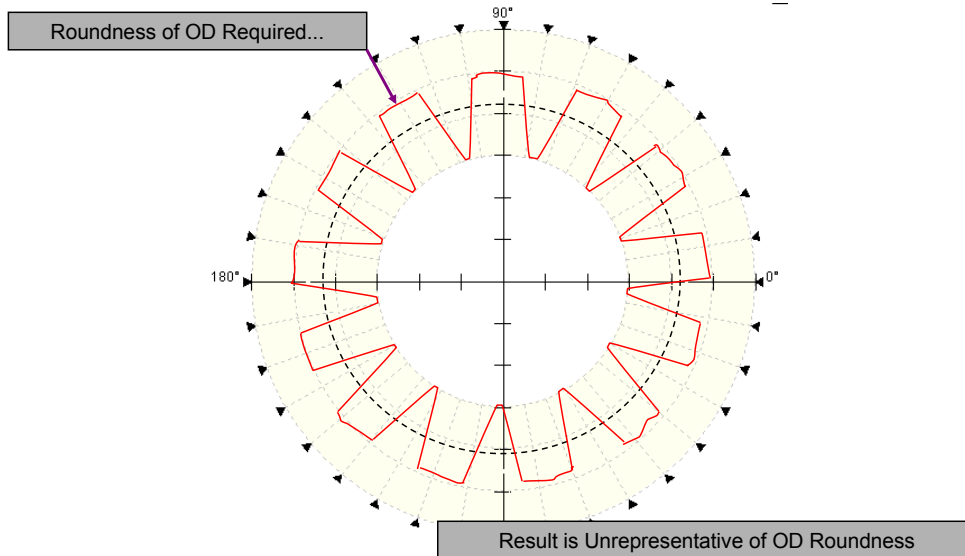
Many parts have interrupted surfaces but still require roundness measurement.

Splined shafts, gears, air bearings, parts with keyways etc.

These interruptions cause problems to the user and need to be removed prior to analysis at the measurement stage or during the analysis stage.

Other problems that need to be considered are the effects of filtering on interrupted surfaces.

Associated Problems



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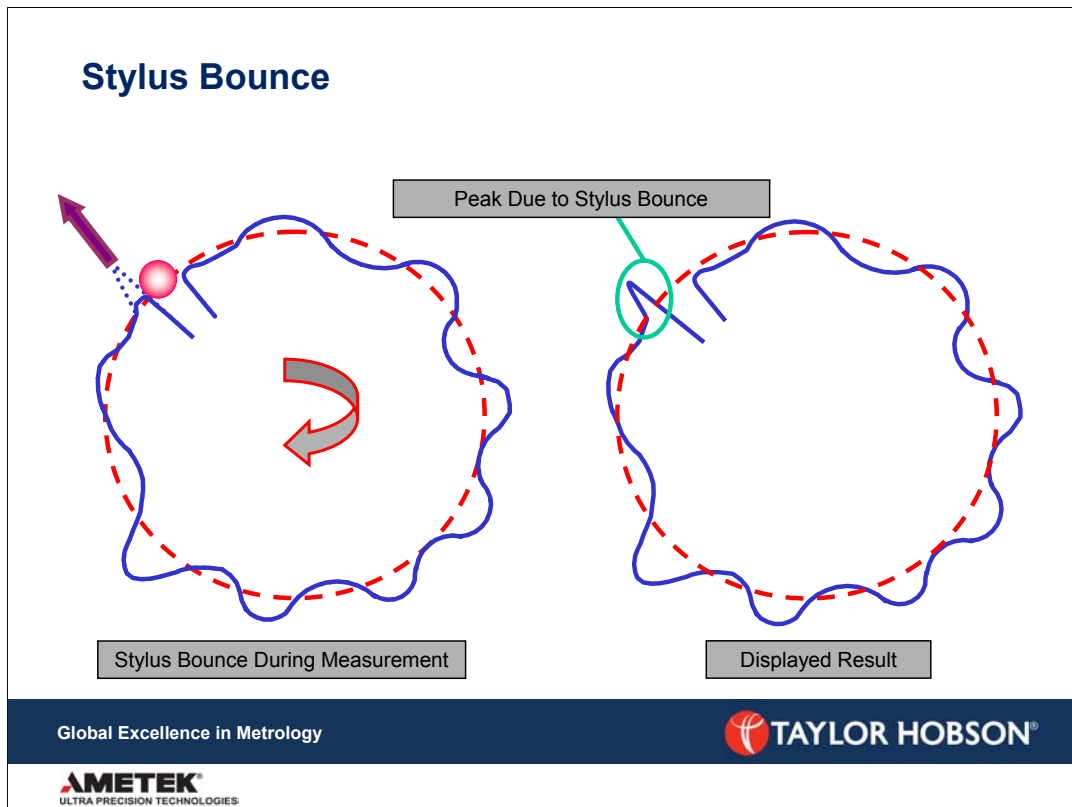
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In the example above we can see the results of measurement taken on a splined shaft, the area of interest is the roundness of the external area of the shaft.

However when the measurement is taken the stylus will fall in and out of the holes on the interrupted surface, the roundness result will be too high and will not be representative of the true surface.

A further and more immediate problem would be damage to the stylus tip caused by the stylus colliding with the edges of the hole.

This problem can be overcome in a number of ways.



Another error to be aware of is the effect of sharp changes on the profile, if the stylus tip drops down a hole and back out again the chances are that it will cause the stylus to bounce.

This will usually manifest itself as a peak at the trailing edge of the hole or interruption on the component.

However care must be taken on interpretation as it is quite possible that the process by which the part was manufactured could also have produced this effect.

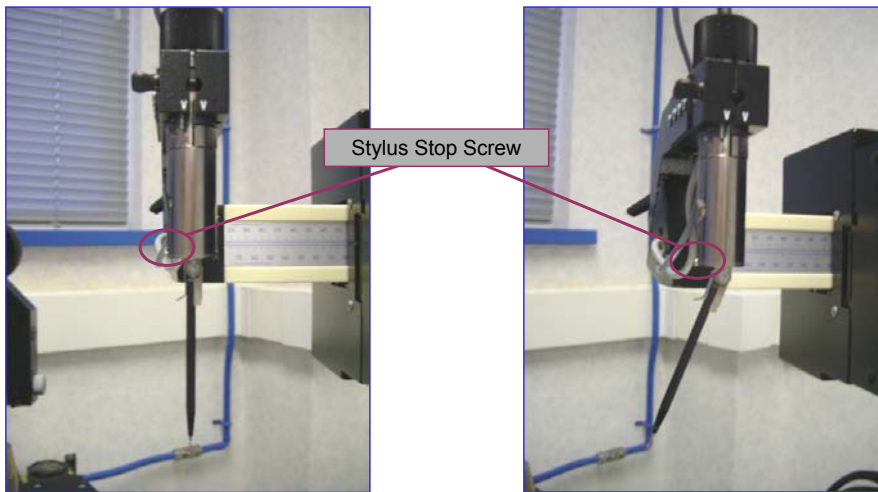
To reduce this error there are a number of options:

Reduce the speed of measurement

Mechanically restrict the gauge deflection (see stop attachments)

Increase the stylus tip diameter

Stylus Stop



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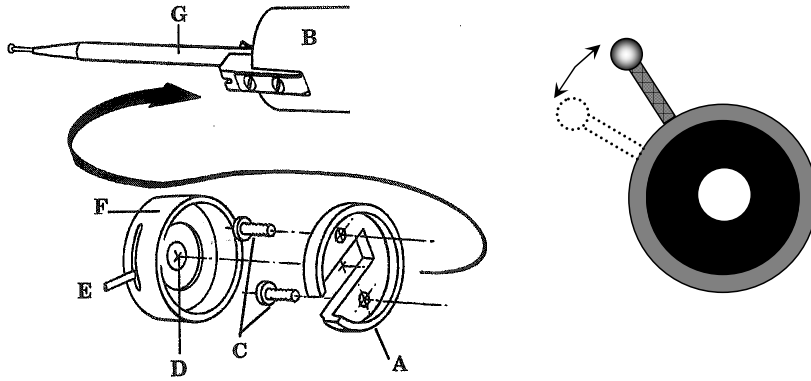
If the holes on the part are small it may be that there is not a problem for the stylus tip, however if the holes are large we need other means of stylus damage prevention.

There are many ways of limiting the stylus movement one of these methods is shown above.

This is called a stop and consists of an adjustable sprung loaded screw. The screw can be adjusted to mechanically restrict the movement of the stylus. This can be done with the stylus at an angle as well as with the stylus in line with the gauge.

Now when measurement is made the gauge reading will be limited.

Stylus Stop Attachment



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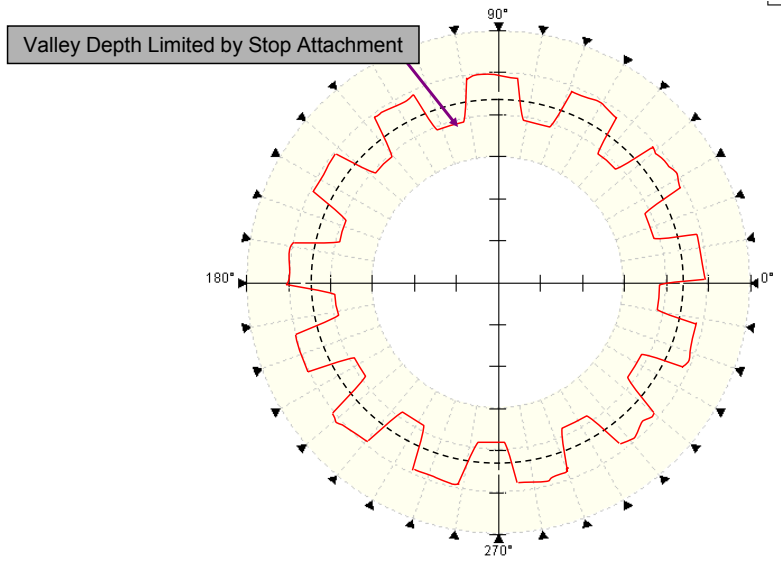
If the holes on the part are small it may be that there is not a problem for the stylus tip, however if the holes are large we need other means of stylus damage prevention.

There are many ways of limiting the stylus movement one of these methods is shown above.

This is called a stop attachment and consists of an adjustable iris much like a camera iris, as the iris aperture is decreased the movement of the stylus is limited.

Now when measurement is made the gauge reading will be limited.

Stylus Stop Attachment



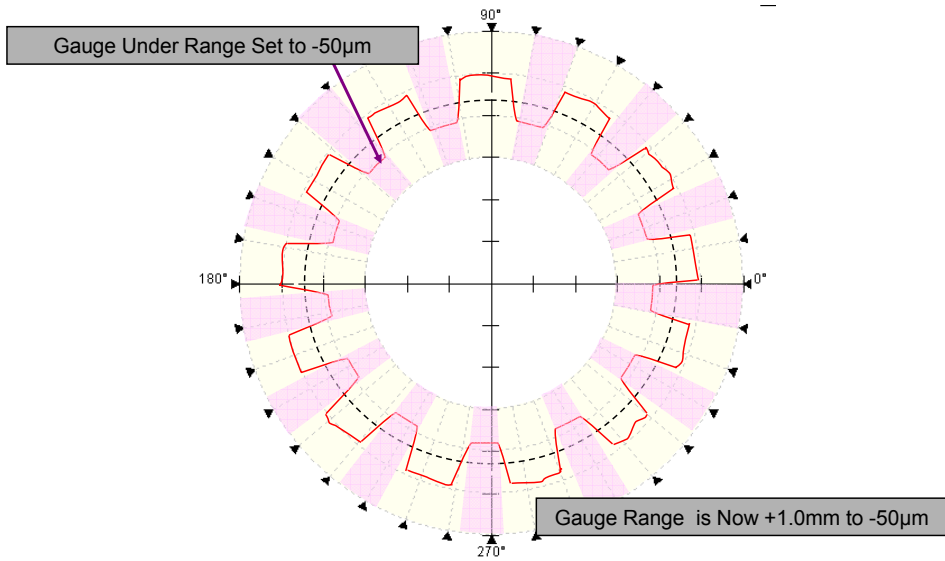
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The valleys on the results shown here have now been limited by the stylus stop attachment and are of equal value in depth, however we still need to remove the valleys in order to assess the roundness of the outer area.

Gauge Under Range



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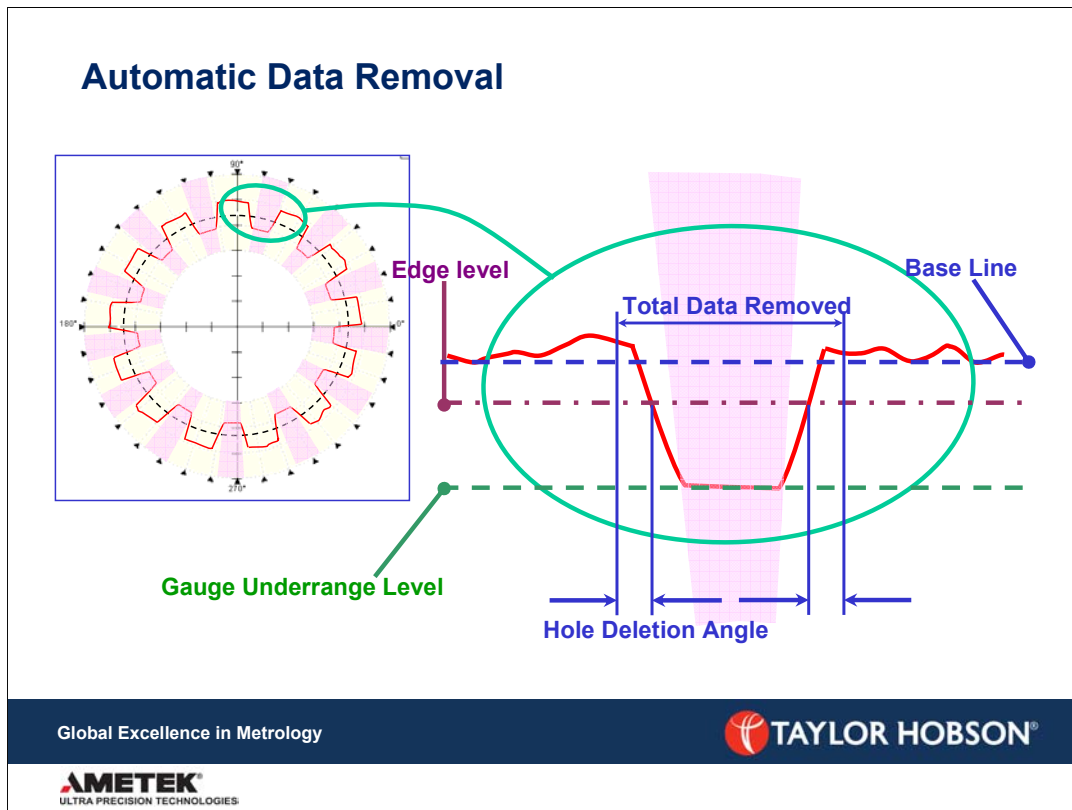
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In some measuring systems it is possible to limit how much the gauge can read, this is done by setting a gauge underrange.

For example if the gauge has a range of $\pm 1\text{mm}$ we can set a value of $-50\ \mu\text{m}$ this will set the new range at 1mm upper limit and 0.05mm lower limit.

This means that whenever the gauge drops below a reading of -0.05mm data will not be recorded and these areas will appear as hole on the resultant profile (see above).

Now there are holes on the surface we can remove residual errors, these being the tails of the edges not yet removed.



Above is an example of how to remove this residual data.

Once the hole have been established a base line is fitted to the remaining surface, this base line will involve some algorithm that fits a new reference circle that ignores spurious data.

The operator now sets an edge level. This is usually a negative value and is a new reference circle that is at a given value below the base line fit.

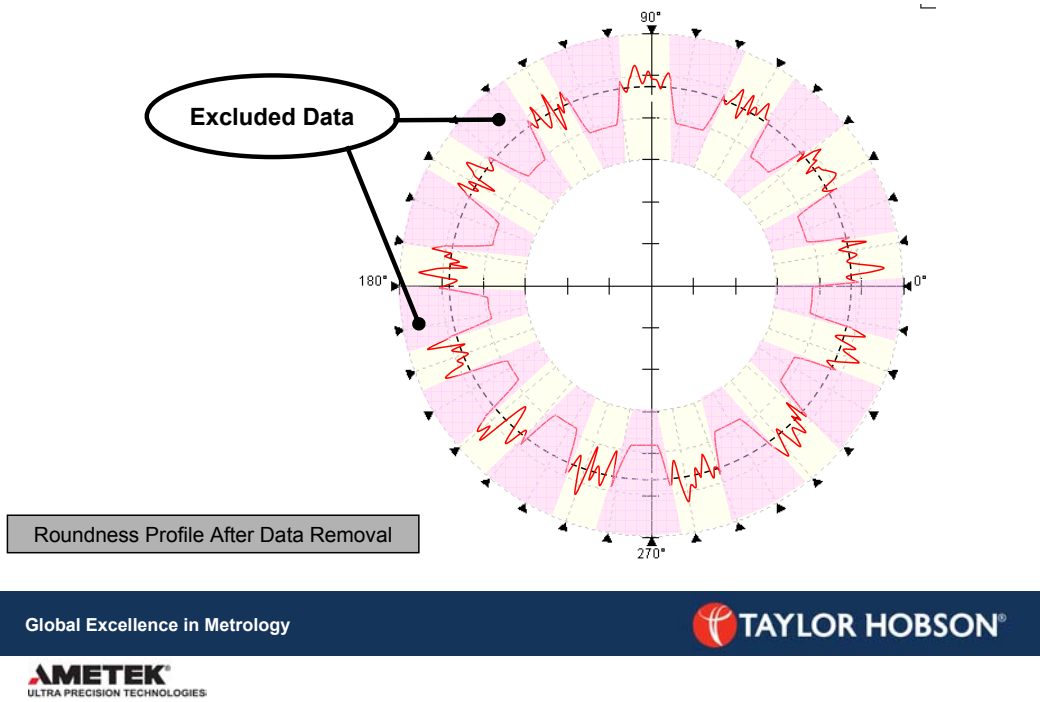
Care must be taken here in choosing the correct edge level value, this value should normally be set to a value greater than the expected roundness error.

Positions are now marked wherever the edge level cuts through the tails of the residual hole data. Note positions are only marked at the points where there are real holes created by the gauge underrange facility.

The next stage is for the operator to decide how much of the data he wishes to be removed, he does this by specifying a hole deletion angle.

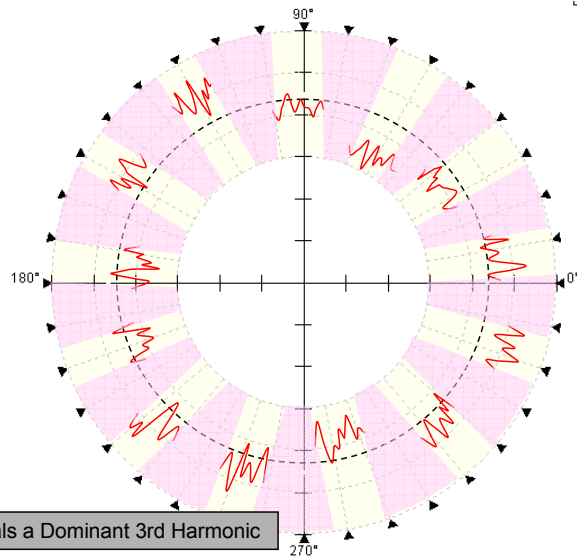
This angle will be set in terms of degrees and the amount of data removed will be an angle either side of the marked points at the edge levels.

Automatic Data Removal



The profile above shows the areas marked in pink that have been removed you can also see the increased detail due to a greater magnification.

Automatic Data Removal



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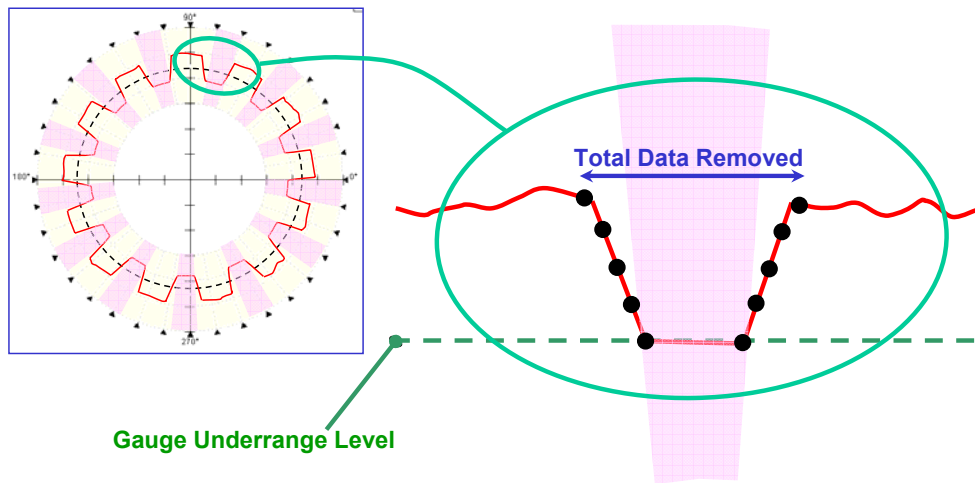
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Once the magnification has been increased the user is able to see more detail.

In the example above it is possible to see a third harmonic, because it is not possible to analyse harmonics on interrupted surfaces, the ability to remove holes and increase the magnification not only gives the operator the correct roundness result but also gives more detail about the surface.

Automatic Data Removal – Points Deleted



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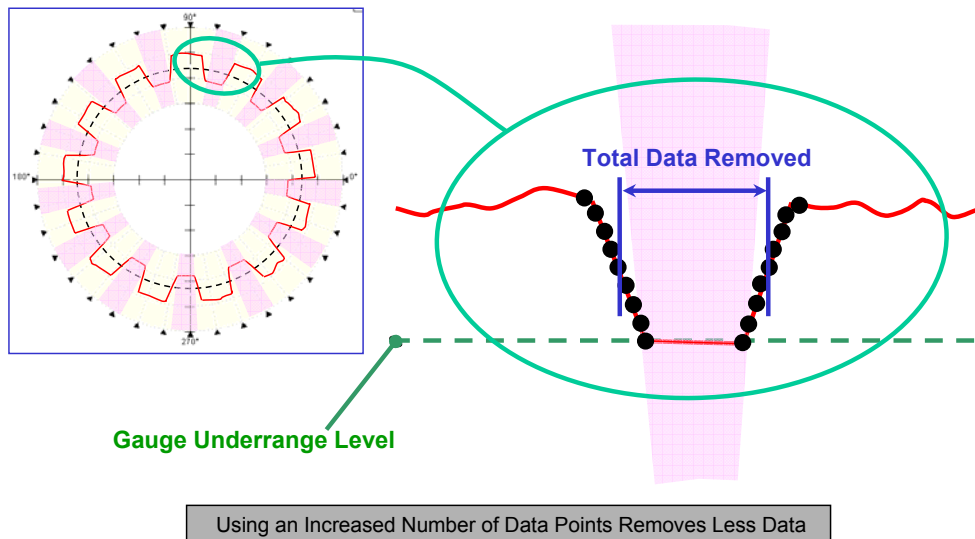
Above is another example of how to remove residual data.

Any roundness measurement made on a surface will consist of a number of data points, because the gauge underrange facility has already marked the holes the operator can select data point removal.

In the above case if the operator selects 5 data points then starting from each edge 5 data points will be removed.

This sort of method although useful has some limitation, on some software it is possible to select the number of data points for analysis.

Automatic Data Removal – Points Deleted



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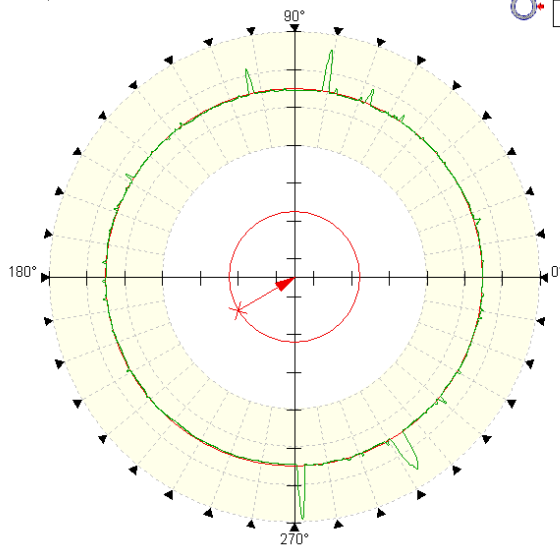
If we again look at the above example we can see that if more data points were used for analysis then less of the edge would be removed.

Another limiting factor would be the actual diameter of the component.

The larger the diameter of the part the more the effect of removing data and the smaller the part the less is removed for the same amount of data.

Automatic Asperity Removal

Scale 10 $\mu\text{m}/\text{div}$.



Roundness Result - Including
Asperities

RONt 14.73 μm

Ecc 13.28 μm

Ecc Pos 30.3°

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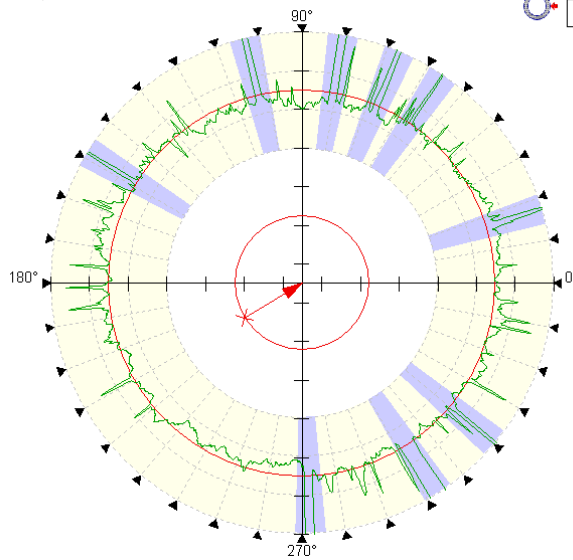
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An Asperity is a non-component feature such as dirt, in other words something that should not be on the component surface.

The above result shows values for the RONt, Eccentricity and Eccentricity position. The asperities on the surface will have a significant effect on the these parameter values.

Automatic Asperity Removal

Scale 1 $\mu\text{m}/\text{div}$.



Roundness Result - Excluding Asperities

RONt 1.76 μm

Ecc 13.23 μm

Ecc Pos 31.0°

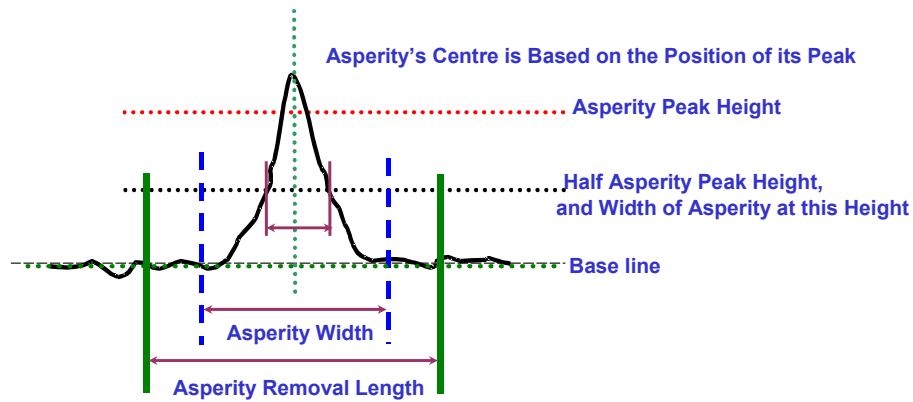
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With the asperities removed the values for the RONt, Eccentricity and Eccentricity position have changed.

Automatic Asperity Removal



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The purpose of Asperity removal is to exclude non-component features such as dirt and areas around these asperities from the measurement data to leave a real surface ready for further analysis. The above diagram illustrates a detected asperity, along with the user specified parameters that determine whether it is a real asperity and the amount of surface that will be marked as an "Asperity Exclusion".

Summary

- Many parts have interrupted surfaces but still require roundness measurement.
 - These interruptions cause problems to the user and need to be removed prior to analysis at the measurement stage or during the analysis stage.
- There are many ways of limiting the stylus movement
 - Stylus Stop or Gauge Under Range
- There are two methods to remove any Residual Errors
 - Automatic Data Removal or Points Delete
- An Asperity is a non-component feature such as dirt
 - Automatic Asperity Removal can be used

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