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1 Objective

This document describes a standardized procedure for measuring individual parts and assemblies for suppliers of tooling and equipment.

Measurements carried out by suppliers according to this guideline are part of the acceptance process for tooling and equipment.

2 Scope

This standard has to be applied for all measurements of individual parts and assemblies at tooling and equipment suppliers for KIRCHHOFF Automotive. It is relevant for measuring pre-production parts supplied to KIRCHHOFF as well as for sample parts produced during Buy-Off.

It is applicable for measurements with measuring machines and optical systems.

3 Preparation of measurements

3.1 Applicable specifications

- 🔵 CAD-Data
- 🔵 Drawings incl. tolerances and alignment acc. to ASME Y14.5 M / ISO 1101 / RPS
- 🔵 Standards

3.2 Strategy of the measurement

- 🔵 Measuring with part clamped on a gauge
- 🔵 Measuring with the part securely fixed on the measuring table with supports

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3.3 Planning of the measurement

The dimensional report must include in this order:

- ☉ Alignment of the component according to drawing. Other alignments or "Best fit" are not allowed.
- ☉ Hole positions and hole diameters
- ☉ Mating surfaces
- ☉ Functional areas
- ☉ Defined measuring points (if applicable)
- ☉ All other areas
- ☉ Trim edges
- ☉ material thickness in areas with critical thinning (for individual parts)
- ☉ Measuring of Radii (for individual parts)

4 Performing of measurements

4.1 Alignment of components

Components have to be aligned physically or in calculatory figures in such a manner, that the maximum deviation from the desired position at the datums of the component does not exceed $\pm 0,1$ mm in the event of a physical alignment (gauge / measuring fixture) and does not exceed $\pm 0,05$ mm in the event of an alignment in calculatory figures. In case of an alignment in calculatory figures a maximum deviation less than $\pm 0,01$ mm should be aspired.

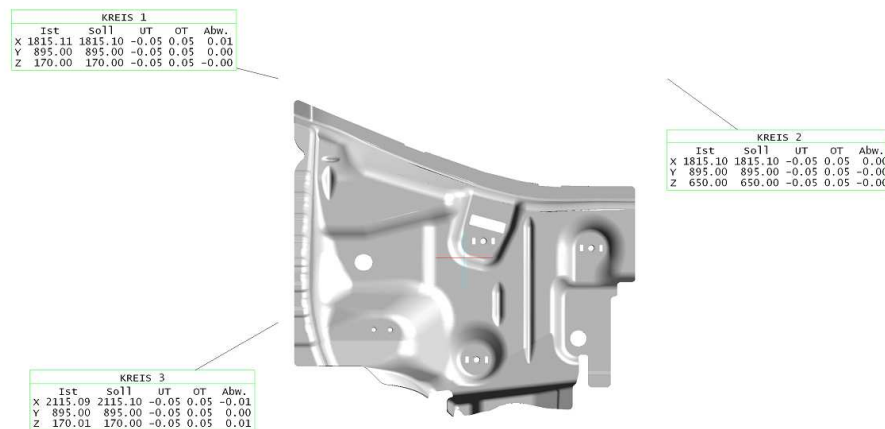
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4.1.1 Physical alignment with a gauge or measuring fixture

It must be indicated in the dimensional report, if the measurement is performed with a gauge or measuring fixture. This can be done either with a picture or a comment in the dimensional report.

It is not permitted to distort the components. In case of a physical alignment with a gauge, the clamps have to be applied exactly at the defined datum surfaces.

Redundant dimensioning by using more datums and clamps than necessary following the 3-2-1 rule, is only permissible in case of unstable components and if the additional datums are defined in the drawing. The clamping forces permissible are maximum 30 N for individual parts and 50 N for assemblies per datum.



If KIRCHHOFF provides a measuring fixture for assemblies, it has to be used by the equipment supplier. The measuring fixture has to be aligned using the three bushings in the baseplate.

For individual parts, a gauge has to be used in case of redundant dimensioning.

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The alignment of a fixture has to be documented in the dimensional report including target value and actual value in all three directions X, Y and Z. The maximum deviation from the target position at the datums of the fixture must be within maximum $\pm 0,05$ mm.

4.1.2 Alignment in calculatory figures

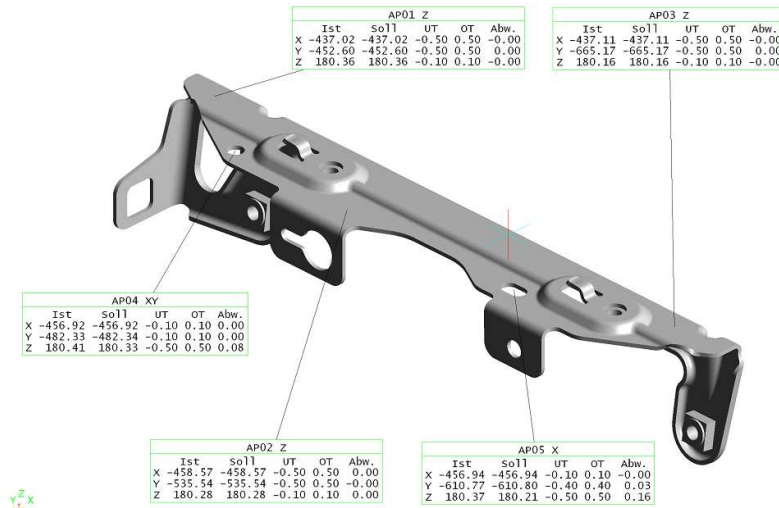
The alignment in calculatory figures is done directly at the component. Stable components may be fixed with standard equipment on the table of the measuring machine like supports, magnets, etc. Not stable components have to be fixed with a gauge or measuring fixture.

The maximum measured deviation from the datum targets location defined in the drawing or the measurement plan and the actual coordinates used for alignment is 3 mm.

Preferably the exact position of the datum targets established is used in the CNC-operating mode for alignment. The designation of the datum targets must correspond to the designation defined in the drawing or measurement plan.

The alignment including nominal coordinates and actual values has to be mentioned in the dimensional report. The maximum deviation at the datum position should not exceed $\pm 0,05$ mm. It is not permitted to clamp the parts, whenever a gauge or measuring fixture is not used.

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4.2 Hole pattern

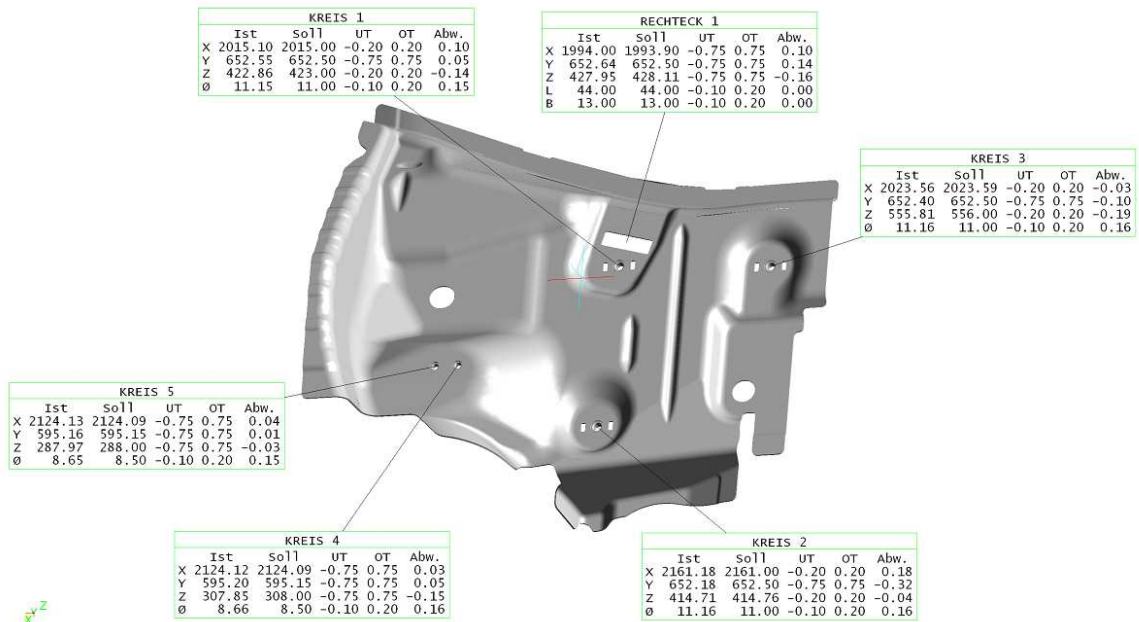
A dimensional check of the hole pattern means checking the position and size of holes in relation to each other or to defined edges or the reference points.

All holes on a component are checked irrespective of their purpose.

Deviations from nominal position are shown in all three axial directions. Hole diameters are shown, too. The positions of screws, bolts and nuts are shown in the same way, but without mentioning the diameter.

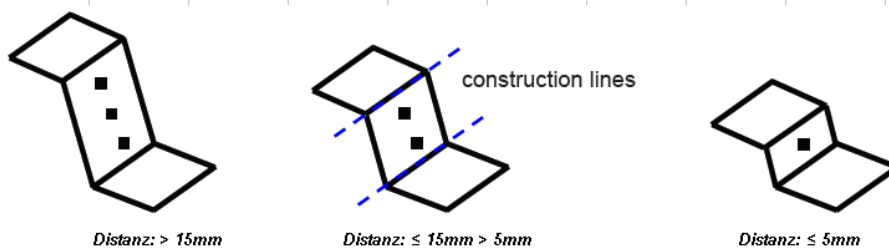
Shaped holes are measured in the same way as trim edges, as long as the drawing does not define a tolerance for the hole position.

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4.3 Form

If the distance between two construction lines is > 15 mm at least three measuring points are required. In case of a distance of two construction lines ≤ 15 mm and > 5 mm at least two measuring points are required. If the distance between two construction lines is ≤ 5 mm one measuring point is sufficient.



In all other cases the quantity of measuring points is defined in the table below. Generally the quantity of measuring points has to be adequate compared to the feature size. With reference to form and trim edge the distance between two measuring points must not exceed 100 mm.

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The following table should be used as a guidance:

Feature size	distance / quantity of measuring points
> 1000 mm	100 mm
> 700 mm und \leq 1000 mm	80 mm
>400 mm und \leq 700 mm	50 mm
>200 mm und \leq 400 mm	40 mm
>100 mm und \leq 200 mm	25 mm
>30 mm und \leq 100 mm	4 measuring points
>15 mm und \leq 30 mm	3 measuring points
\leq 15 mm	min. 2 measuring points

4.4 Specified measuring points

In case of specified measuring points which are defined by KIRCHHOFF or the OEM, this points have to be measured by the supplier in addition to the other characteristics mentioned in section 4. They are defined in the drawings or special measuring plans. Preferably the exact position of the points is measured with a CNC-measuring machine. In case a CNC-measuring machine is not available, the actual measurement have to be max. +/- 1 mm away from the required position.

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The results for the measuring points have to be reported on at least one separate page of the dimensional report.

4.5 Flanges

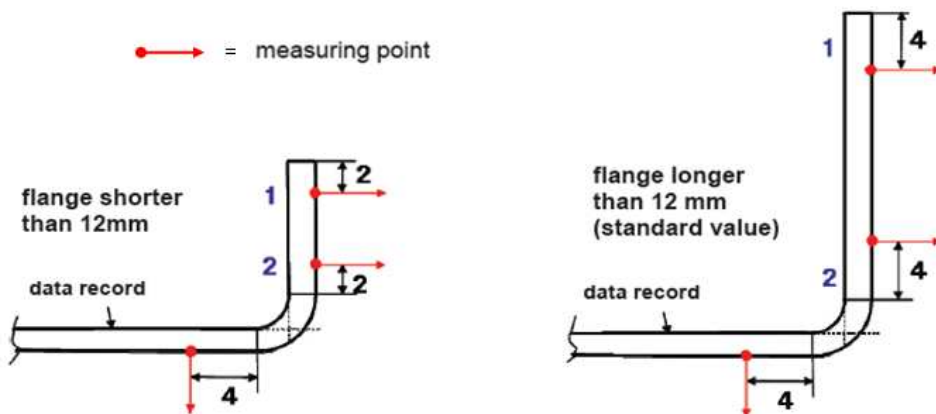
In case of a flange length ≤ 12 mm only one contour line has to be measured with staggered measuring points (see sketch below).



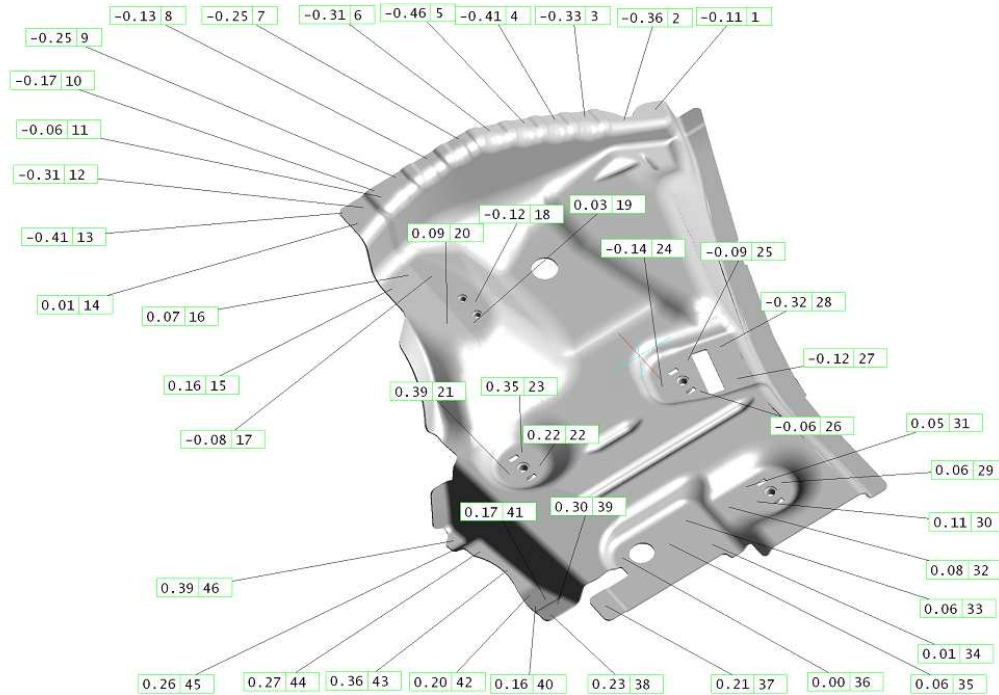
In case of a flange length > 12 mm a second contour line has to be measured.



The measuring strategy depends on the flange length. In case of a flange length ≤ 12 mm the contour line should be measured at least 2 mm away from the radius insert or trim edge. In case of a flange length > 12 mm the two contour lines should each be measured 4 mm away from the radius insert or the trim edge.



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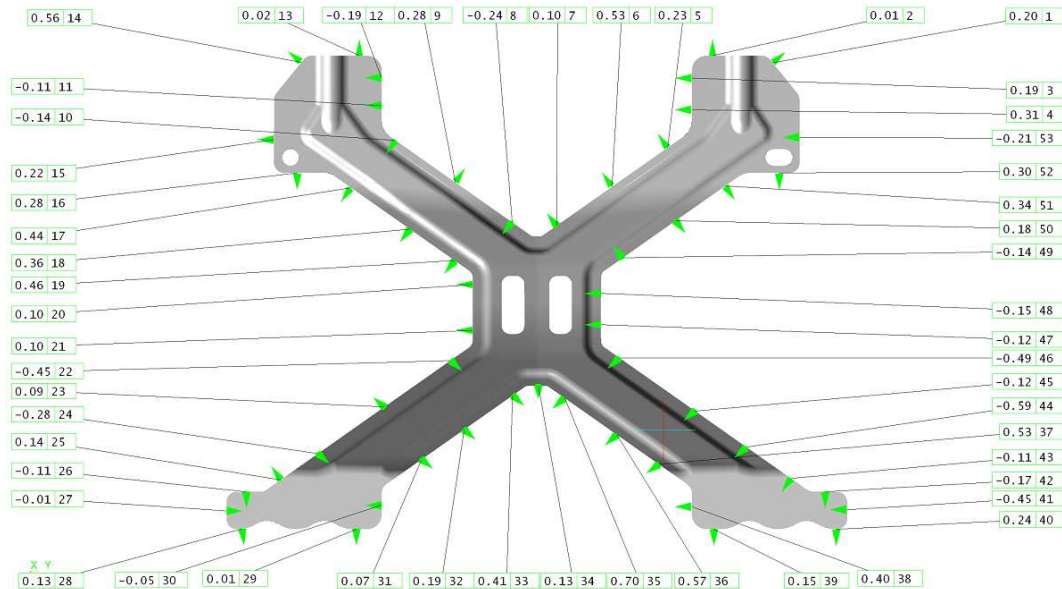
For form the total deviation is shown in the dimensional report as a vector perpendicular to the surface.

4.6 Trim edge

In a dimensional trim edge check, all trim edges - such as cut-outs contours, etc. - are measured. At least two measuring points are required if the distance between two construction lines is > 15 mm. At least one measuring point is required if the distance between two construction lines is ≤ 15 mm.

In all other cases the density of measuring points has to be in accordance with the table shown in section 4.3. Cut-outs which are not specified in the CAD-data, but which are technically necessary for the separation of scrap, are not taken into account when measuring trim edges.

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Trim edge deviations are always shown as the total deviation.

4.7 Big Assemblies

For big assemblies the measurement of some characteristics, e. g. trim edges, flanges, form can be skipped, if agreed in advance with KIRCHHOFF.

4.8 Optical Systems

If optical systems are used, the measuring results for form and flanges should be shown in false colours, too.

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4.9 Thinning

The measuring of material thickness can generally be done with an external caliper gauge, ultrasonic equipment or with an inductive measuring device.

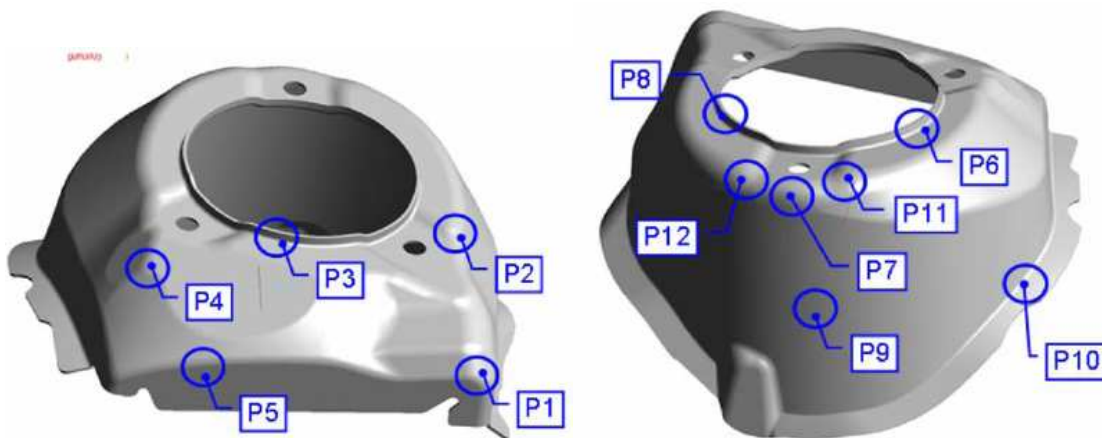
At deep drawn parts the material thinning has to be checked and documented in areas with a high degree of material extension. Whenever possible, the forming simulation should be used to identify those areas.

Absolute values and percental values for thinning have to be shown in a table with reference to a pictorial representation.

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Example:

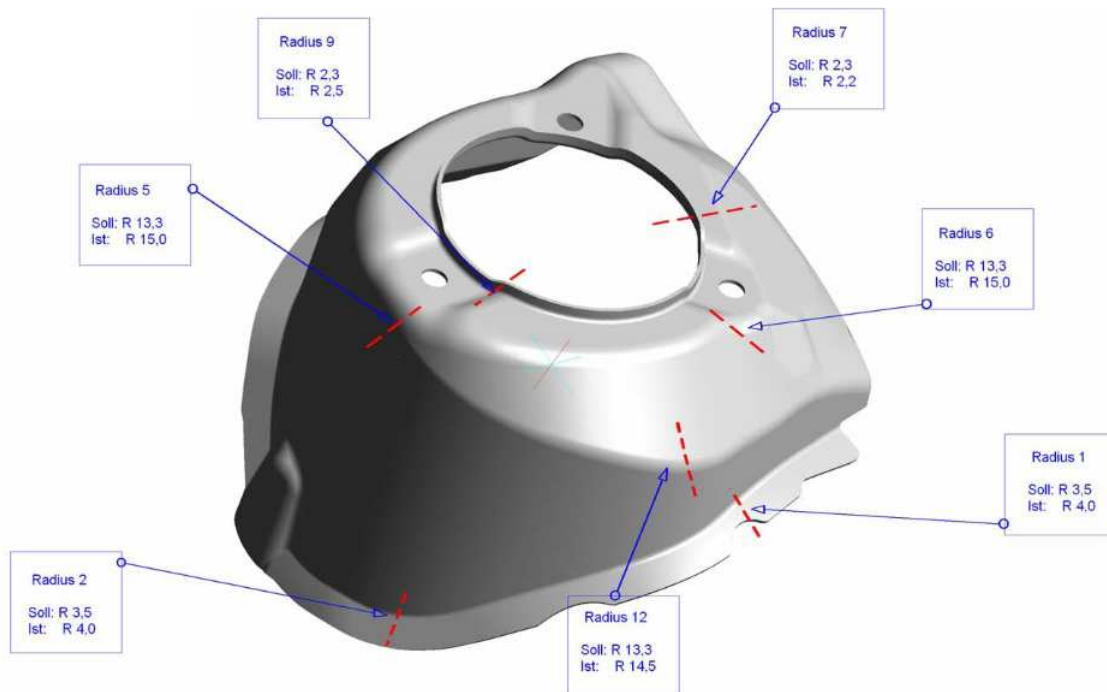
Measure ment Point	Material before forming [to mm]	Measured values [to mm]	Thinning [to %]
P1	2,25	2,09	-7%
P2	2,25	2,01	-11%
P3	2,25	2,01	-11%
P4	2,25	1,98	-12%
P5	2,25	2,01	-11%
P6	2,25	2,04	-9%
P7	2,25	2,12	-6%
P8	2,25	1,87	-17%
P9	2,25	2,18	-3%
P10	2,25	1,98	-12%



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4.10 Measuring of radii

All radii smaller than 15 mm have to be checked. Radii equal or bigger than 15 mm are treated as a surface. The results should be documented including target value and actual value. It is sufficient to use a radius template for measuring.



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5 Dimensional reports

The dimensional report must at least include the following information on each page:

- 🔵 KA-Number
- 🔵 Customer Part-No.
- 🔵 Manufacturing date of measured parts
- 🔵 Cavity (if applicable)
- 🔵 Date of measurement
- 🔵 Gauge/Fixture No. if applicable
- 🔵 Tolerances must be mentioned on each page.
- 🔵 Item number of measured part
- 🔵 Operator of measuring machine
- 🔵 Page number

The report has to show the component in the installation position in the vehicle. This requirement can be waived for measuring certain areas of the part.

One PDF-File per part measured is required. Separate pages are not accepted.

The report has to be submitted to the responsible CME Tooling Engineer by E-Mail.

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