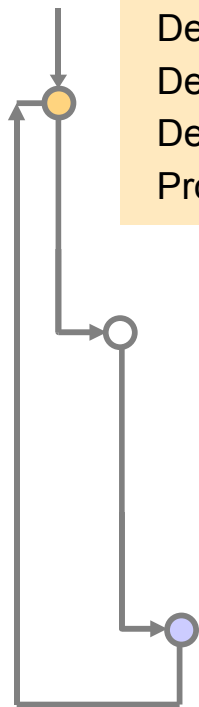


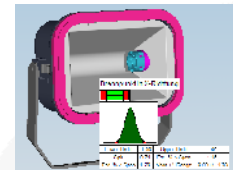
Statistical 3D tolerance analysis (VisVSA, Siemens PLM – own licence) with the scope of function control and tolerance optimisation



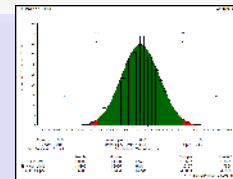
Definition of the scope: Description of the functional dimension
Description of the product: nominal 3D geometry and GD&T
Definition of the process: production, assembly, measurement
Process quality: statistical parameters of the components



*Simulation of the tolerance afflicted components
= calculation of the tolerance chain*



Process report for the quality control
Evaluation of the estimated overall tolerance / statistical parameters
(process capability, reject rate, distribution type)



Contributor report for the cost control
Targeted enlargement or reduction of tolerances
(as wide as possible and as small as useful)

Statistical Tolerance Analysis - Example

Definition of the target

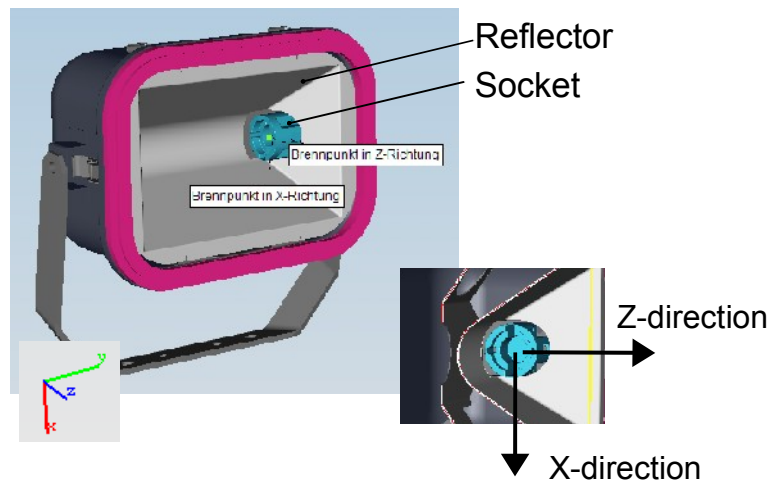
○ Definition of the scope (target of the analysis)



General description of the function

The position of the focal point in the reflector describes the quality of the lamp concerning photometric functions. The target of the analysis is to calculate the overall tolerance of the position of the socket in the reflector (after the assembly).

Transposition
into measurable
Parameter



Scope for the overall tolerance:

Radial displacement between the socket and the reflector in the focus point (measured in X- and Z-direction):
tolerance: $0 \pm 1 \text{ mm}$
(reject rate: $< 1\%$)

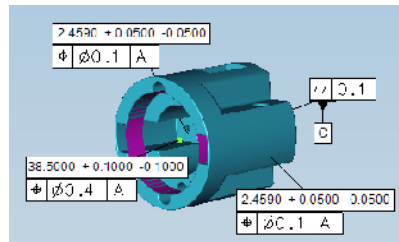
Statistical Tolerance Analysis - Example

Description of the components and the process: modelling

Input information for the tolerance analysis

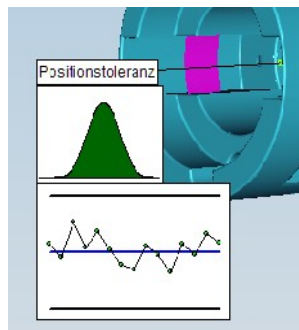
Definition of the geometrical deviation (GD&T) and statistical parameters for the components

Example: socket



The nominal 3D geometry get the shape and position tolerances to describe the allowed tolerance.

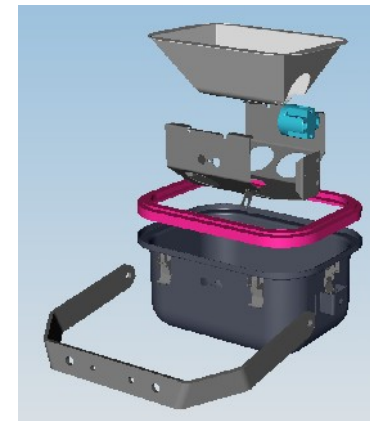
Any tolerance are provided with the statistical process parameters (e.g. c_{pk} , ppm).



Building up the assembly processes

Description of the assembly concept

- assembly sequence
- positioning devices
- fixing concept



Exploded view for example to show the assembly sequence

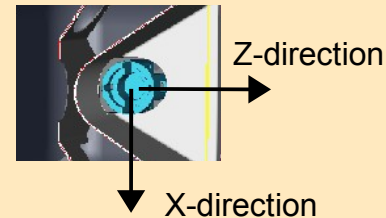
Statistical Tolerance Analysis - Example

Result: process report to control the quality

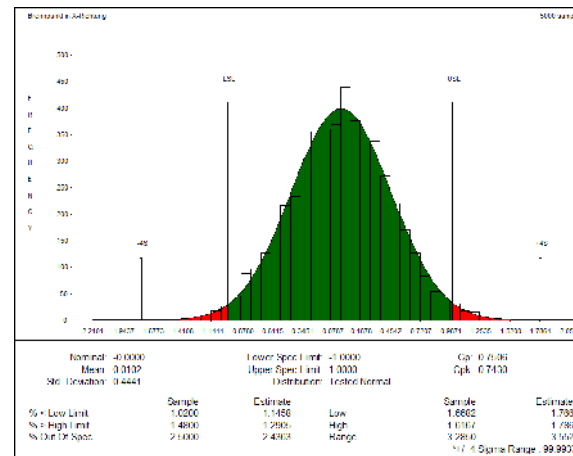
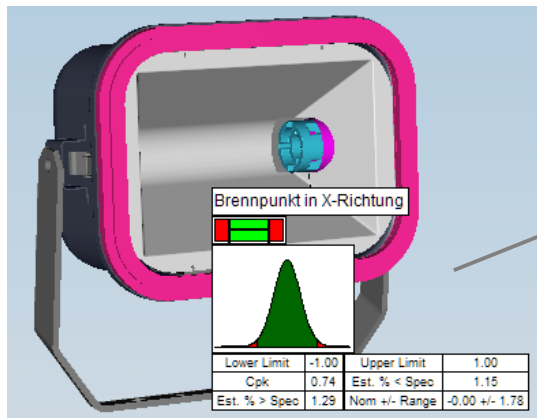
- Process report for the position of the socket in the reflector (X-direction)

Targets for the measurement:

Overall tolerance: $0 \pm 1\text{mm}$
(Reject rate: $< 1\%$)



Results of the calculation:
Overall tolerance: $0 \pm 1,78\text{mm}$
(Reject rate: $2,44\%$)

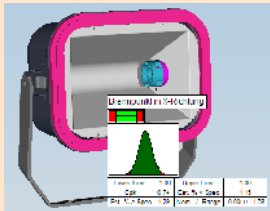


Conclusion: The requirements cannot be reached. The tolerances have to be optimised on base of the contributor report.

Statistical Tolerance Analysis - Example

Result: Contributor report for the optimisation

- Contributor report for the position of the socket in the reflector (X-direction)



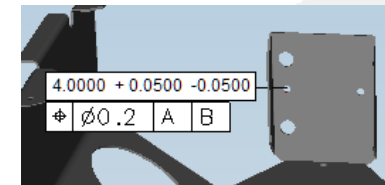
The requirements cannot be reached. Therefore the measures for the components and processes have to be defined to optimise. The basis here is the contributor report.

The contributor report describes the chain of tolerances with the additional information of the percentual influence on the measurement result.

Brennpunkt in X-Richtung
Nominal : -0.0000
Process Variance : 0.1972
HLM Variance : 0.2639

Contributors	Effect
1. ST_5101_02 Rahmen_innen - Hole1_o _Anlage Buchse -> Bohrung D4+-0,05 Pos. +0,1 -> Min: -0.050 Max: 0.050; POS Dia 0.200 A B	34.02%
2. ST_5101_02 Rahmen_innen - Hole2_u _Anlage Buchse -> Bohrung D4+-0,05 Pos. +0,1 -> Min: -0.050 Max: 0.050; POS Dia 0.200 A B	33.84%
3. ST_5101_07 Buchse - Assembly Op: AssyOp Buchse-Rahmen -> Floating Locators	28.97%
4. ST_5101_03 Reflektor - Hole_Brennpunkt -> D5,7+-0,2 Pos 0,5 -> Min: -0.200 Max: 0.200; POS Dia 0.500 B	1.48%
5. ST_5101_07 Buchse - Hole3_Leuchtmittel -> D38.5+-0.1 Pos. 0.4	0.95%

1. influence:
Tolerance of the hole in the frame to position the socket



Conclusion: the positioning of the socket in the frame shows the main influence (96,83%) on the overall tolerance and has to be optimised.
Measures to optimise: reducing the gap by defining a precise position of the socket to the frame in X- and Z-direction (hole/slot).

Ing.-Büro Herkelmann GmbH

Contact person

With our competence round about the systematik of „Dimensional management“ we gladly support your product and process development.

Together we follow the targets of:

- ☑ Quality control of the product functions by early evaluating the tolerance effected assemblies in use of statistical 3D tolerance analysis
- ☑ Cost optimisation by systematic widening respectively reducing the tolerances of components and processes

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