Titel / *Title*	**Statistic / destructive - nondestructive testing**
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Gültig ab / *Validity date*	29.01.2007
Achtung / *Attention*	Ausdruck ist unkontrolliert und dient nur zur Referenz. *Print-outs are uncontrolled and for reference only.*

1 Purpose

This Corporate Document describes the procedure of short-term capabilities and preliminary capability studies for destructive and non-destructive characteristics.

2 Definitions

MCS => short-term capability (machine capability study)

PCS => process capability study (preliminary)

QCC => Quality Control Chart

<H> => significant characteristic min. requirement of C_{mk} / P_{pk} / T_{pk} > 1.67 ; C_{pk} > 1.33

<K> => critical characteristic min. requirement of C_{mk} / P_{pk} / T_{pk} > 2.00 ; C_{pk} > 1.67

2k trial plan => k factors with 2 parameter => 2x2x...x2 = 2k factor combination
(with 2 factors 22 = 4 combinations)

Process-owner => is responsible for the process, the machine parameter, the process parameter, and which parameter has to be defined, etc.

Tp / Tpk => temporary capable index (similar to Cp / Cpk), which indicates an unstable process (e.g. control limits exceeded) with the requirement of a Pp / Ppk

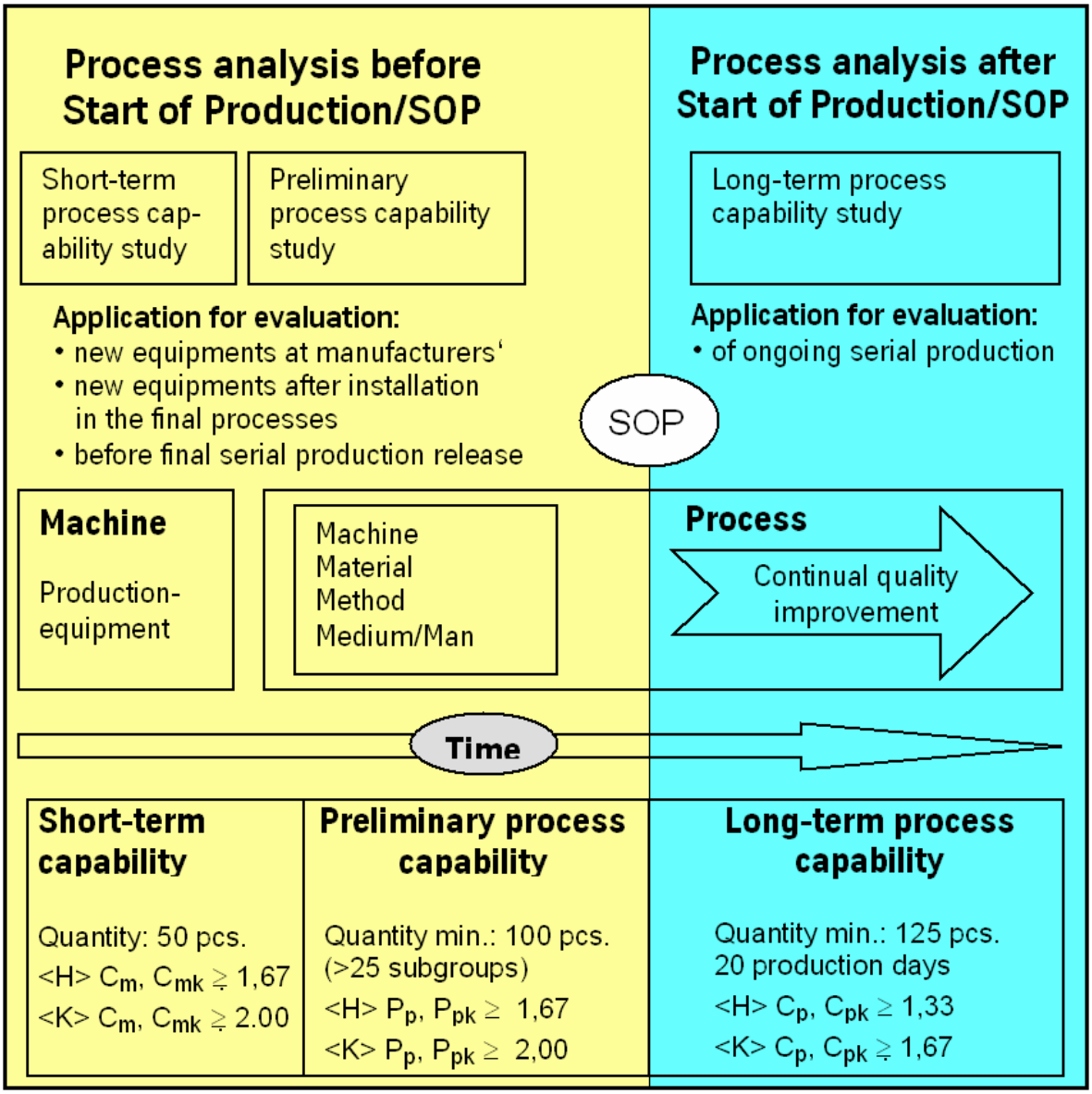
3 Responsibilities

This document is valid for the TKT-Presta Group, also suppliers which perform tests for products who will be delivered at TKT-Presta or a subsidiary.

Responsible for the test is the process-owner (direct influence of the defined characteristic).

4 Procedure

4.1 destructive - nondestructive testing



4.1.1 short-term capability (machine capability):

The same procedure has to be used for an approval of a production machine. Unimportant whether internal or at the supplier, during the hole procedure.
The assessment of the manufacturer occurs according following results:

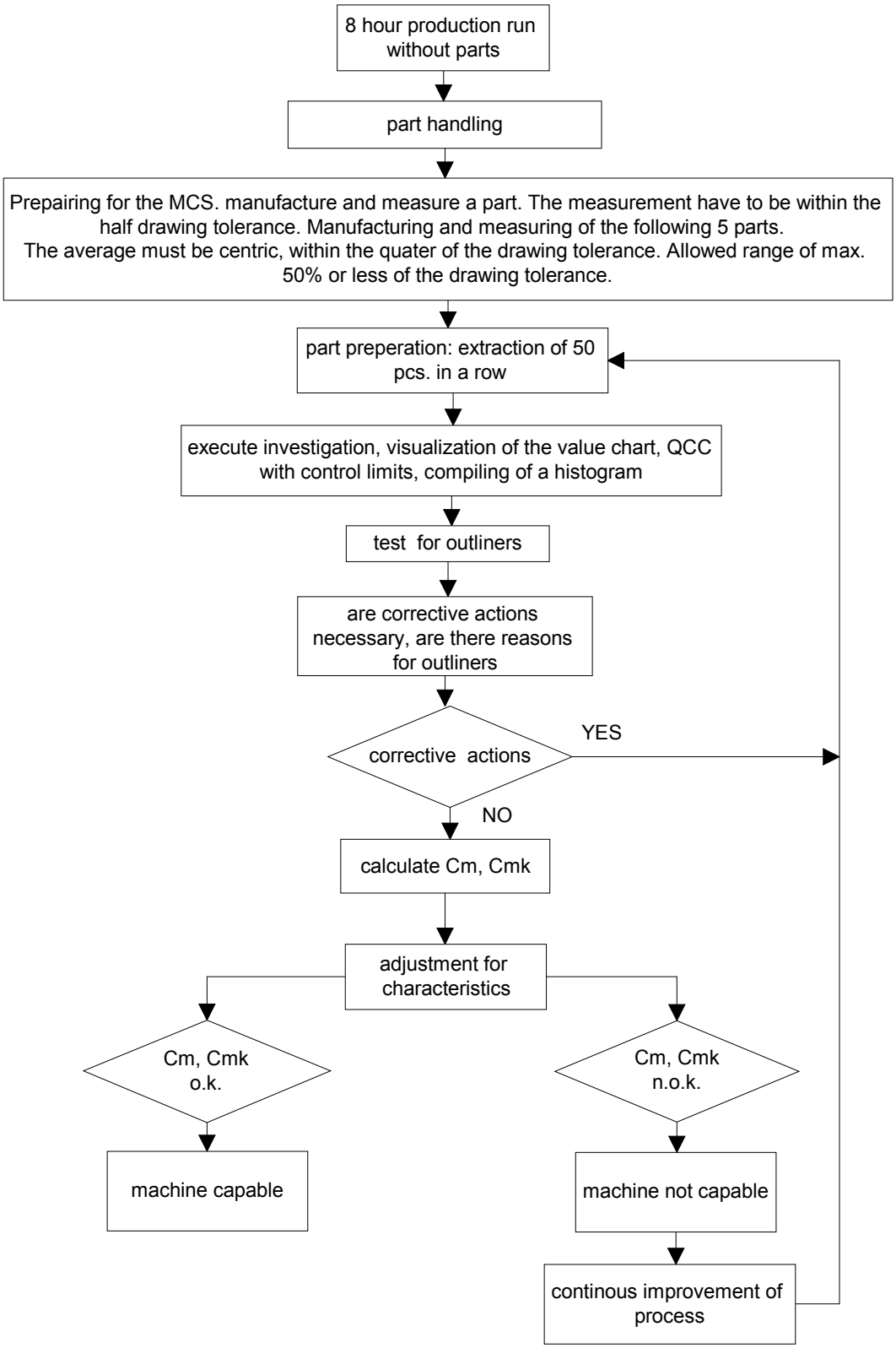
- 8 hour-run without piece
- test of handling (is the handling of the parts acceptable)
- short-term capability C_m and C_{mk}
- documentation of machines

and at the customer according the results of

- 24 hour-run without pieces
- test of part handling, after assembled feeding at customer
- preliminary process capability P_p und P_{pk}.
- Documents of machine, with the updated changes.

The short-term capability takes place at the supplier, underneath his responsibility, with attendance of a TKT-Presta Engineer.
The assessment at the manufacturer (short-term capability) is based on 50 pcs., manufactured in a row, with constant inducement through human, environment, material and manufacturing conditions.
The parts have to be declared, that a clear relation to the machine, jackscrew, and fixture is given. The quality approval with the certification of the preliminary capability study has to be done within the production plant. First, the arranged adjustment parameters have to be used, during the production run.

Procedure for a short-term capability:



The short-term capability index C_m and C_{mk} will be calculated according following formula:

Symbol	Description	Formula
C_m	Short term capability	$c_m = \frac{UTL - LTL}{6 * s}$
C_{mk}	critical short-term capability index; lower index (min[C_{up}; C_{lo}])	$c_{up} = \frac{UTL - \bar{x}}{3 * s}$ $c_{lo} = \frac{\bar{x} - LTL}{3 * s}$
UTL / LTL	upper / lower tolerance limit	
s	standard deviation	
Ξ	average	

The short-term capability index, C_m, includes only the variation, without paying attention regarding the location of the average and describes the proportion of the tolerance vs. process variation.

The index C_{mk} considered also the location of the average toward the tolerance limit.

4.1.2. preliminary process capability

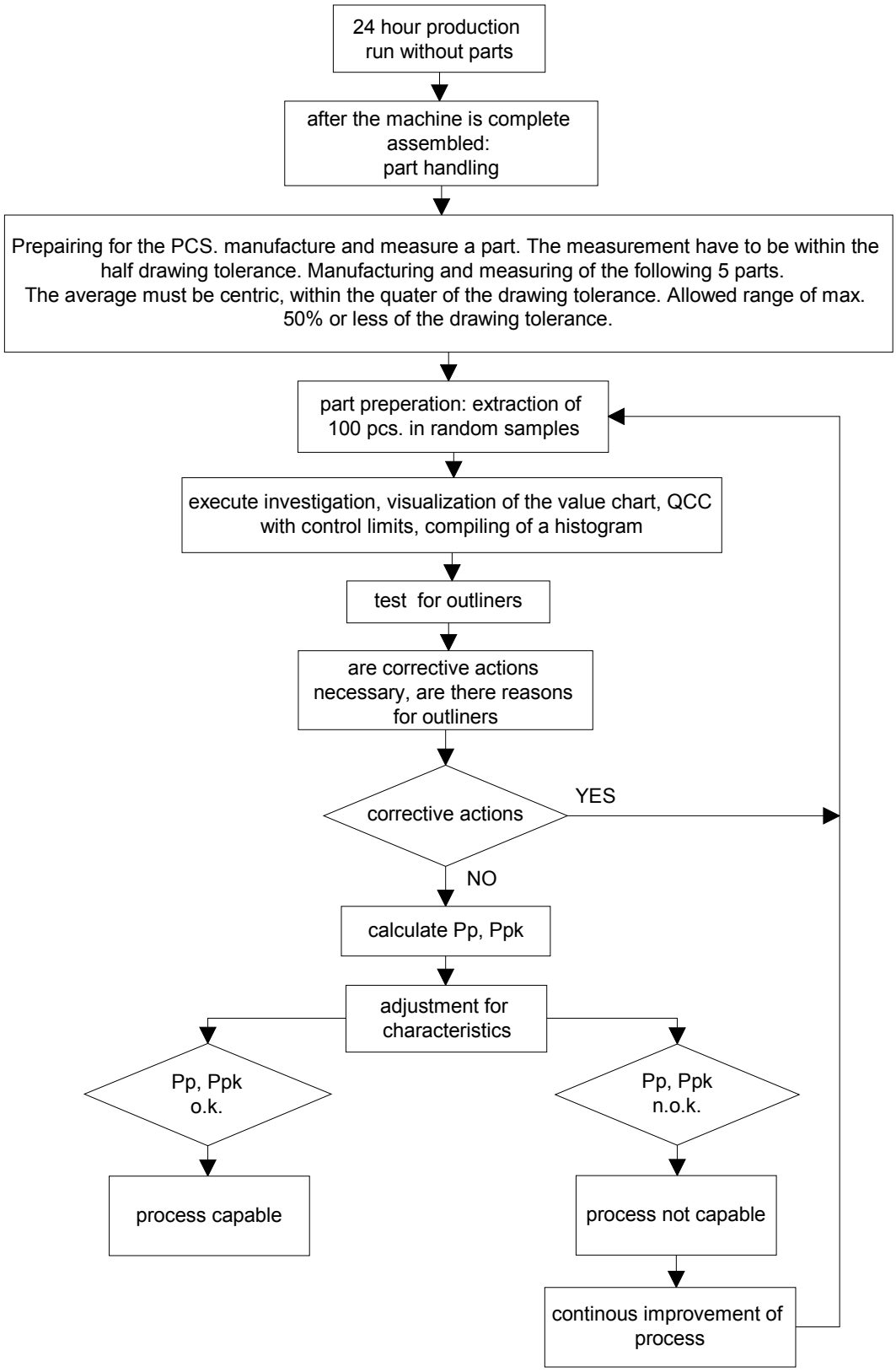
For the evaluation of the preliminary process capability are following actions necessary.
100 measuring values are necessary (within 25 random samples). Each random sample exists of 3 – 5 pcs., which have to be taken under regular production conditions, during the complete production run of a lot.

It is necessary, that the random samples are taken from a lot of minimum 300 pieces regularly.

6 further pieces are be slated for the setup of the machine, further 5 pieces for the trend in order to examine the quality of the parts during the production run.

First of all ascertain, if the process average is constant or not. This can be visualized with a quality control chart (with control limits) also the F-test.

Procedure for the preliminary process capability



The index for the preliminary process capability, P_p and P_{pk} must be calculated with following formula:

Symbol	Deskription	Formula
P_p	preliminary process capability index	$P_p = \frac{UTL - LTL}{6 * \sigma}$
P_{pk}	critical index for the preliminary process capability; lower index (min[P_{un}; P_{ob}])	$P_{up} = \frac{UTL - \bar{x}}{3 * \sigma}$ $P_{lo} = \frac{\bar{x} - LTL}{3 * \sigma}$
UTL / LTL	upper / lower tolerance limit	
σ	standard deviation (estimated value)	
Ξ	average	

5.1.3 attributive characteristics:

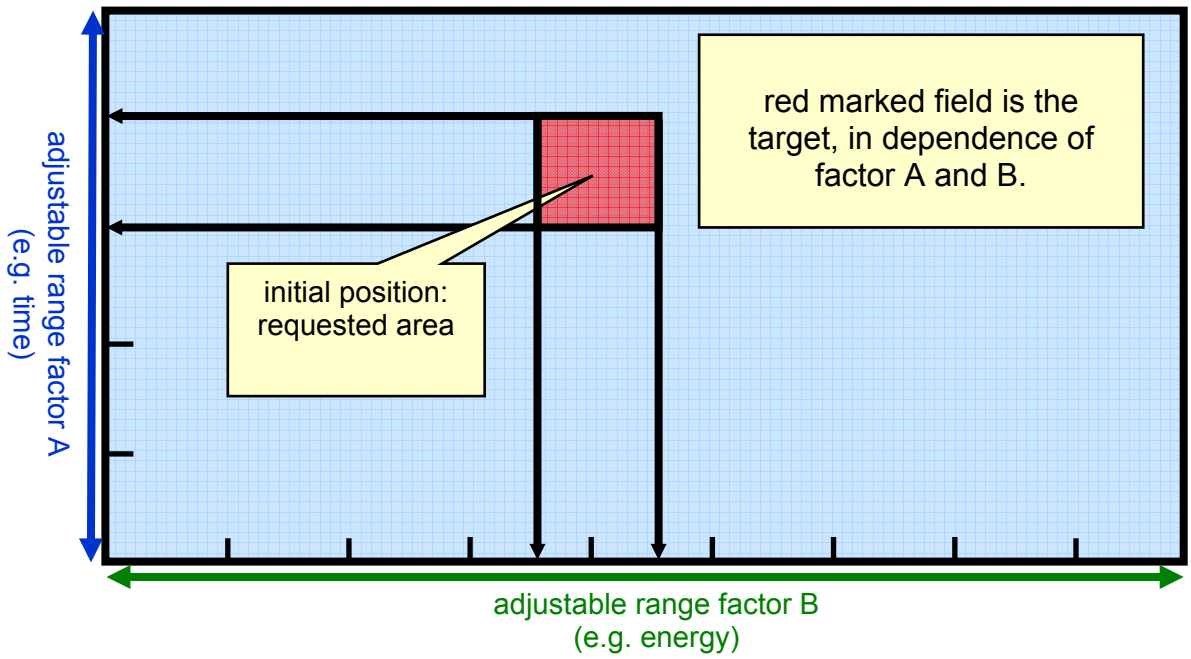
Following requirement is valid for critical- and significant characteristics:

characteristic	prototype phase	pre-launch phase (verification for initial sample report)	serial phase
<K>	100% inspection / 0 defects	100% inspection / 0 defects	100% inspection / 0 defects; annual layout inspection
<H>	100% inspection / 0 defects	300 pcs. / 0 defects	random samples (acc. SPC) / 0 defects; annual layout inspection

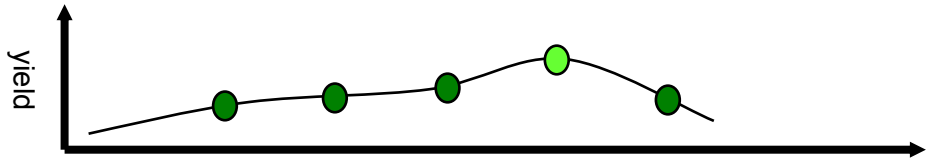
For the short-term capability, the attributive characteristics will not be examined; examination will be done within the initial sample process.

5.2 destructive examinations:

a) The inspection of destructive characteristics can be done according following procedure.
This procedure is not coercively, an extensive examination can also be done.
Via DOE (design of experiment), all the important parameter for the process can be determine.
After the definition and documentation of the important parameters, the process can be control the process with the defined parameters (e.g. zinc plating: with the correlation between the parameter amperage and the plunge period, the process can be controlled; or inductive hardening as an other example).

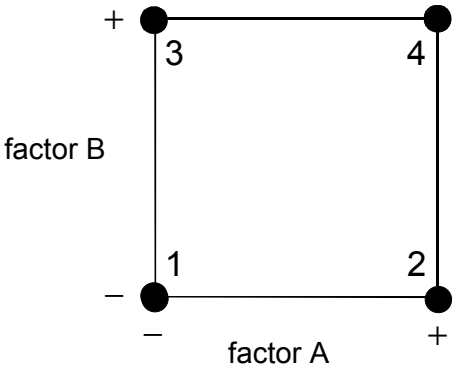


exhibition: the requested area shows the nominal value, which should be chosen.



exhibition: measurement values, which shows the optimum result regarding the yield.

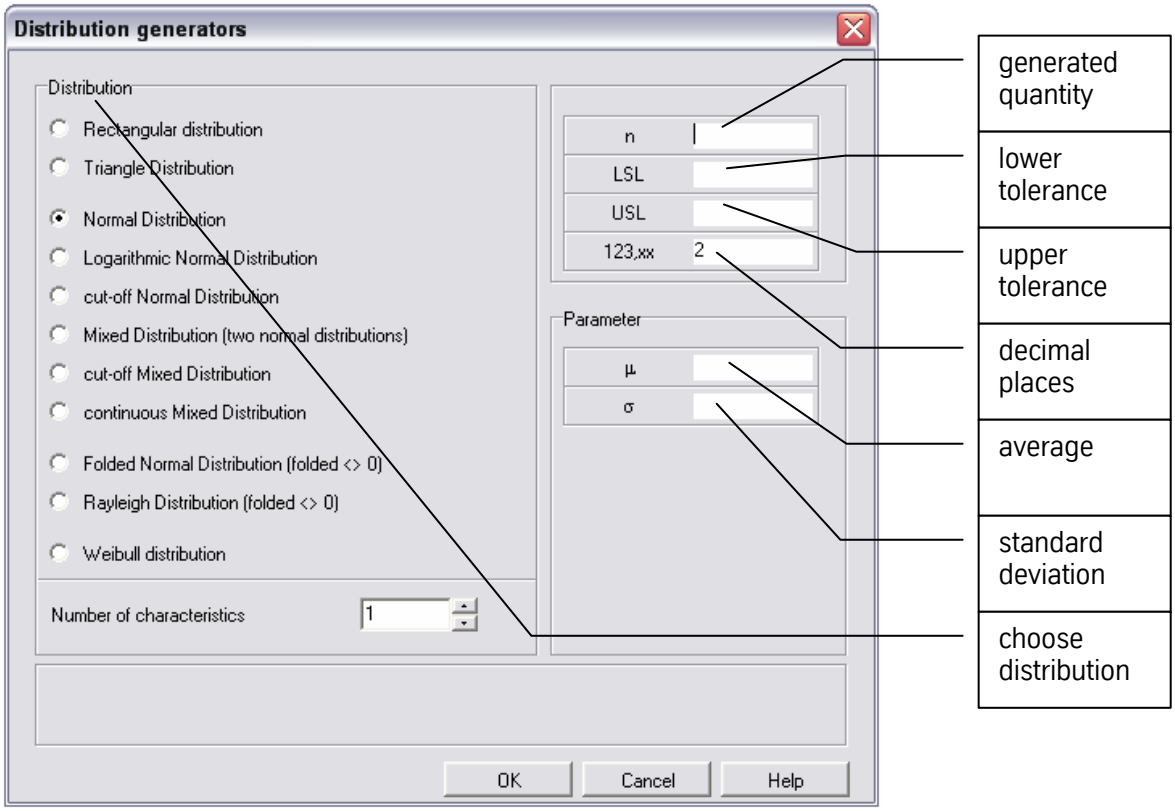
This method is to apply for all factors to figure out, the maximum yield of a parameter. Therefore a 2k – trial plan can be used (see picture below).



syst. no.	factor A	factor B
1	-	-
2	+	-
3	-	+
4	+	+

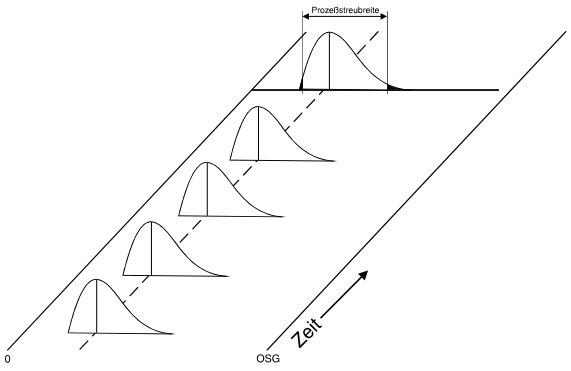
exhibition: 2^k trial test model, with all 4 possible varieties.

b) With the tool „Distribution generators" (qs-STAT tool) a factitious examination can be compiled. Therefore a couple of figures need to be fill out (see picture below).
Necessary is, that min. 25 measurement values are available (e.g. Core hardness, zinc plating, etc, every process / characteristic with a high effort for an examination).



exhibition: *distribution generator*, to find in the menu bar within *Extras*

For a statistical evaluation of a crack inspection is to note, that the evaluation is performed as an unilaterally characteristic. Evaluation according the process model A2.



exhibition: distribution model A2

5 Records retention

Record	Responsibility for archiving	Retention period	Archive
Process data / evalutation	Editor / author	15 years	IT server

6 References

Corporate Documents & Corporate Forms

See cross-references („Querverweise“)

Subsidiary-specific documents

Subsidiary	Document
TKT-Presta	See cross-references („Querverweise“)
TKT-PF	
TKT-PI	
TKT-PM	
TKT-PB	
TKT-PDI / TKT-STC	
TKT-PHS	
TKT-PTH	
TKT-PFC	
TKT-PST	

7 Attachments

See cross-references („Querverweise“)

8 Revision history

Version 1.0 to Version 2.0
Change from TKA to TKT, minor written mistakes corrected

First edition, no history.