How to Identify and Handle Measurement Systems / Measurement Processes that Are not Qualified

Morteza Farmani
TEQ® Training & Consulting GmbH

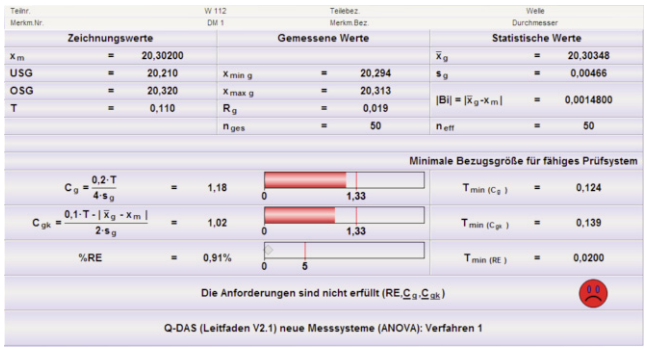
When evaluating characteristics relevant to quality you have to ensure that qualified measurement systems/ measurement processes are applied. In order to achieve this goal, we conduct type-1 study, type-2 study or type-3 study of the measurement systems analysis or determine measurement uncertainty according to VDA Volume 5.

However, the application of these procedures in practice sometimes shows that a measurement system or measurement process is unfortunately not suitable for a specific quality-relevant characteristic.

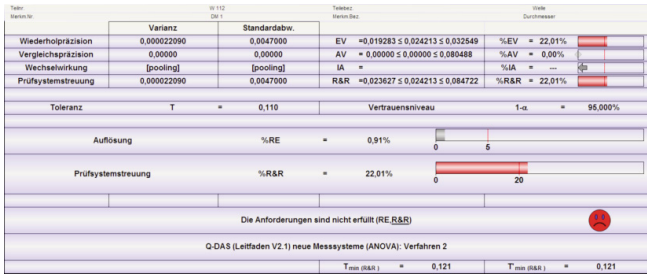
The question we are facing here is, when is a measurement system / measurement process not considered to be qualified?

Several corporate guidelines typically contain the respective specifications. The following examples apply limits that are common and accepted in practice. Some of them are e.g. defined in the Q-DAS® guide V2.1 and can be selected in solara.MP.

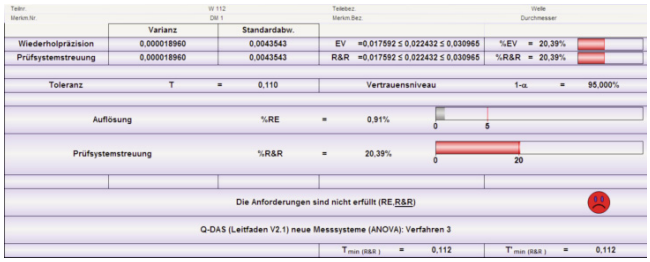
1) Type-1 study: C_g, C_{gk} <1,33



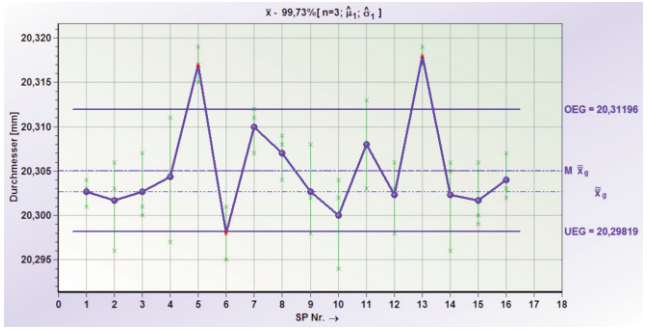
2) Type-2 study:
% R&R > 20% in case of new measurement systems
% R&R > 30% in case of measurement systems in use



3) Type-3 study:
% R&R > 20% in case of new measurement systems
% R&R > 30% in case of measurement systems in use

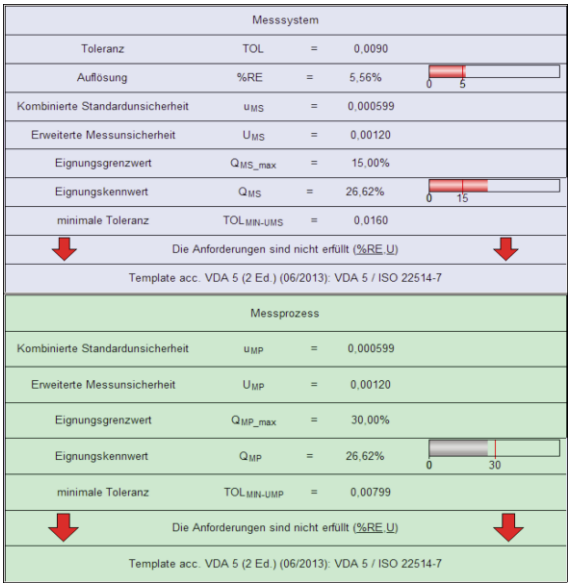


4) Stability of a measuring instrument: Control limits are violated in this quality control chart



5) Measurement uncertainty according to VDA Volume 5: Assesses the uncertainty of the measurement system based on the capability ratio $\%Q_{MS} \geq 15\%$ and the uncertainty of the measurement process based on the capability ratio $\%Q_{Mp} \geq 30\%$.

A measurement system with $\%Q_{MS} \geq 15\%$ is not considered capable accordingly. Measurement processes are not supposed to be capable in case of $\%Q_{Mp} \geq 30\%$.



When the capability of the measurement system or measurement process cannot be established for the respective characteristic, you should take the following steps and answer the following questions:

1) Are the points of measurement clearly defined and does the system/process always take measurements from the right point?
2) Is the place of measurement suitable?
3) Check the quality of the working standards in terms of calibration uncertainty!
4) Check the measurement procedure - warm-up phase, measuring speed.
5) Is the measurement method okay (e.g. tactile measurement, noncontact measurement, test part in mounting device)?
6) Which relevant influence components of the environment, e.g. vibrations, dust, oil, vapor, draft, humidity and temperature variations, do affect the measurement result? How can you eliminate them?
7) Which influences from the test parts, such as cleaning residue, cleanliness, surface properties and form errors, do you expect? Please consider to clean the test objects as prescribed!
8) Did the operators receive appropriate training / are they qualified to conduct the measurement task?
9) Do the operators handle the measuring equipment and test parts with care?
10) Heat transfer – in case of smaller tolerances, the operator should touch the test part with gloves or with tweezers!

If all your efforts to optimize the measurement system and/or the measurement process did not produce the desired effect, please consider the following aspects.

A) Can you extend the tolerance? This option is the economically favorable solution. However, this approach can only be applied subject to agreement with the customer or the developers.
B) Otherwise you need a 100% inspection of the produced parts. In this case, you have to consider the uncertainty of the measurement process at the tolerance limits.
C) Purchase a more precise measurement system. Consult your in-house experts in metrology and the manufacturer of the measurement system about a suitable measurement system.

In case even the measures illustrated under a), b) and c) were not successful, there is only one solution left. You have to implement a special regulation for a limited period of time that has to be arranged with experts in metrology, production planning, production, quality assurance, development and especially with the customer.

In addition, an ongoing review of measurement stability and the measurement of single samples by using more precise measuring equipment (e.g. in the metrology room) should contribute to a better validation.

Q-DAS® GmbH & Co. KG
Eisleber Str. 2
D-69469 Weinheim
Phone: +49 6201 3941-0
E-Mail: q-das@q-das.de
Internet: http://www.q-das.de

TEQ® Training & Consulting GmbH
Eisleber Str. 2
D-69469 Weinheim
Phone: +49 6201 3941-15
E-Mail: office@teq.de
Internet: http://www.teq.de