

Surface properties for laser measurements TN20

Technical Note for the KLIPPEL R&D and QC SYSTEM (Document Revision 1.0)

White matt surfaces are required for the used laser sensors for their best performance. Different options to enhance the optical properties are presented and compared in this tech note.

Tools and chemicals for surface coating are listed together with information to suppliers. As the chemicals used are typically hazardous goods they cannot be added to the KLIPPEL measurement systems, they must be ordered locally from specialized distributors.

Compatibility of the materials:

In any case of adding material to the transducer diaphragm the compatibility of the materials have to be checked. The used glue and especially the chemicals in the sprays could influence or in worst case destroy the DUT to be coated.

Unaffected properties:

Laser scanning measurements compared without and with coating could indicate if the added coating has influenced the DUT. Especially spraying from a too short distance should be avoided. If the propellant gas gets to the diaphragm in liquid form this could change the diaphragm properties significantly while drying.

- Spray to the DUT from a meaningful distance, typically 20 – 30 cm. Check instructions on the spray can.
- Always move the spray can sidewise to spray only a thin layer to the DUT. Wait for drying. Force drying if needed with some air. Check the result after drying and add another thin layer if needed.

Single-point resonance frequency measurements further quantify the influence to the added mass by the coating.

Poor optical properties at the uncoated measurement could be acceptable for this comparison purpose. If no valid response could be measured without coating e.g. at a transparent diaphragm, comparing the shift of the resonance peak from an electrical impedance measurement is another option.

1 Single-Point Measurements

As long as the overall transducer movement should be measured only a single measurement point is required, thus only this point needs to be prepared for laser measurements. This measurement point is typically placed at the center of the dust cap or if this is not possible, e.g. at coaxial drivers, close to the voice coil position at the cone.

1.1 Without Surface Coating

Actual laser sensors use powerful light intensity management algorithms. Therefore, measurements without surface coating is possible. That allow them to measure even at black speaker cones. Although this is a compromise and for best performance any of the following coating options are recommended.

PROS:

- Valuable samples remain unviolated
- Moving mass remains unaffected

CONS:

- Optical properties could influence the accuracy
- Not possible for transparent DUTs
- Hardly possible for shiny DUTs



1.2 Sticker

Depending on the cone material, structure and curvature sticker could be used to provide optimal laser reflection properties. Simple white paper sticker but also dedicated laser target sticker with optimal reflection properties could be used.

PROS:

- Most stickers could be removed without backlogs
- Valuable samples remain nearly unviolated
- Moving mass gets only slightly affected
- Additional moving mass could easily be determined before attaching to the DUT

CONS:

- Parasitic vibrations due to stickers that are not perfectly glued to the cone
- A partly glued sticker on a convex dust-cap is a bad compromise that could cause measurement errors!
- Hardly applicable at small DUTs



Resources:

- Office paper sticker
- Dedicated laser targets
 - <https://www.mr-chemie.de/en/products/reflecon-reference-points/>
 - <https://messpunkte.de/en/shop/targets-retroreflective/>

1.3 Paint

What's a so called "klippeled" loudspeaker? A transducer with a painted small white dot on the dust-cap. The often preferred quick-and-dirty solution if a permanent partial painting is acceptable. The shown Example Speaker delivered with a KLIPPEL R&D System comes with such a paint dot, as it was used for inhouse reference measurements.

PROS:

- Can easily and quickly be applied
- Causes no problems with parasitic vibration

CONS:

- Depending on the kind of paint it cannot or hardly be removed without backlogs
- Added mass can hardly be determined – but it is often negligible
- Compatibility with the diaphragm materials must be checked
- Hardly applicable at small DUTs



Resources:

- Any paint compatible with the diaphragm material is suitable.
- Correction fluid for office paperwork. The KLIPPEL standard since many years. The type with the included small brush works well on transducers.
 - <https://eu.bic.com/de-de/stationery/tipp-ex-fluid-corrector>

1.4 Tarnish

An alternative to paint is using powder tarnish. Recommend for multi-point measurements where the whole cone must be coated. But it could also be applied on small areas for single-point measurements by using it from a pen.

PROS:

- Can easily and quickly be applied, directly at the measurement environment, no spray mist
- Causes no problems with parasitic vibration
- Easy to wipe off with a cloth or brush
- Washes off easily with water

CONS:

- Added mass can hardly be determined – but often negligible
- Compatibility with the diaphragm materials must be checked
- Hardly applicable at small DUTs

Resources:

- <https://www.mr-chemie.de/en/products/reflecon-tarnish-90-piccolo-pen/>
- <https://www.mr-chemie.de/en/products/mr-703-w-jumbo-pen/>

2 Multi-Point Measurements

Multi-point laser displacement measurements such as with the [KLIPPEL Scanning Vibrometer](#) require a full surface diaphragm coating for best performance. At difficult or transparent materials, it is mandatory.

2.1 Without Surface Coating

The same pros and cons are valid for multi-point measurements as described in [chapter 1.1](#). Furthermore, the [KLIPPEL Scanning Vibrometer](#) includes a measurement point consistency check for every point measured. Two repeated measurements at the same point will be compared allowing to detect outliers caused by optical problems. By checking the ratio of valid points to the total measurement points, the quality of measurement results could be judged and the need of coating determined.

2.2 Sticker

Stickers are not an option to cover the whole diaphragm and surround area.

2.3 Paint

Painting could be an option if permanent and consistent coating is required. Spraying it to the transducer is recommended. But it has drawbacks that must be considered compared to the following coating spray option. See pros and cons at [chapter 1.3](#).

2.4 Coating Spray

Coating sprays can be subdivided in permanent and sublimating types. Permanent sprays should be used if the DUT remains a test object. Sublimating sprays are perfect for prototypes when only temporary testing is required. No time-consuming cleaning is needed, and the DUT shows no backlogs afterwards.

Dedicated 3D-Scanning sprays are available, but also so called “wet developer” sprays are typically used in material inspection processes such as crack finding in metal parts.

PROS:

- Can easily and quickly be applied
- Causes no problems with parasitic vibration
- Sublimates without buildup (sublimating type)
- Easy to wipe off with a cloth or brush (permanent type)
- Applicable to nearly all kind of DUTs

CONS:

- Added mass can hardly be determined – but often negligible
- Compatibility with the diaphragm materials must be checked



Resources:

- <https://www.mr-chemie.de/en/reflecon-3d-scanningspray/>
 - Permanent: <https://www.mr-chemie.de/en/products/reflecon-tarnish-90/>
 - Sublimating: <https://www.mr-chemie.de/en/products/reflecon-tarnish-13/>
 - Sublimating: <https://www.mr-chemie.de/en/products/reflecon-topotrack/>
- <https://www.helling.de/3d-entspiegelungsspray/>
- <https://www.karldeutsch.de/produkte/chemische-produkte/eindringmittel/entwickler-reiniger/>
- <https://3d-printmaster.de/AESUB-Orange-Scanningspray-400ml>

Notes:

- Check the listed resources for their worldwide representatives.
- Search for locally available alternatives.
- Let KLIPPEL know (support@klippel.de) if we should add a supplier.
- Let KLIPPEL know if you are using additional techniques and tools.

Find explanations for symbols at:

<http://www.klippel.de/know-how/literature.html>

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