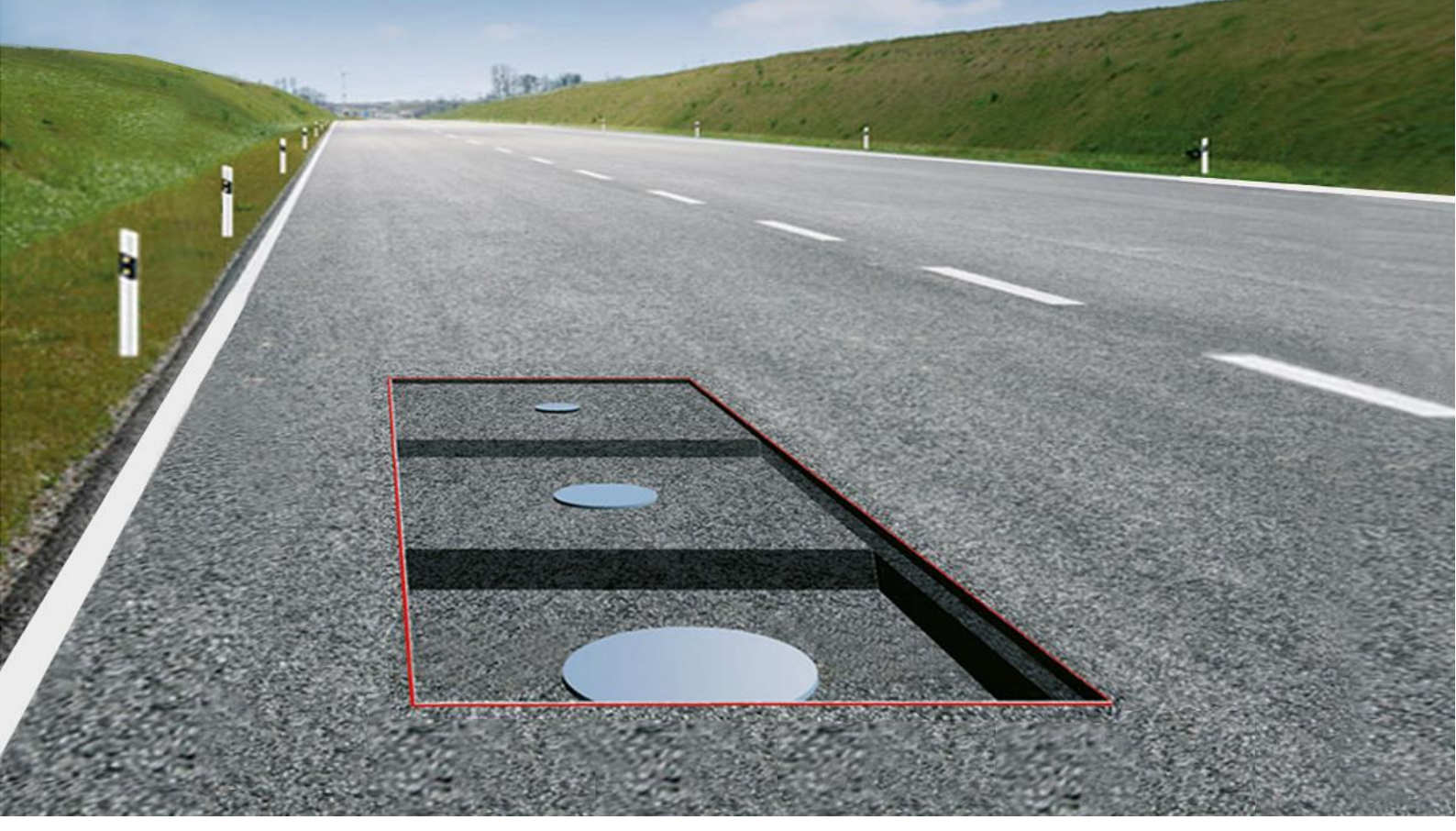

MIT-Reflectors

User Manual

ZERSTÖRUNGSFREIE MESS- UND PRÜFTECHNIK

Manual MIT-Reflectors

for the non-destructive measurement of layer thickness

ZERSTÖRUNGSFREIE MESS- UND PRÜFTECHNIK

MIT Mess- und Prüftechnik GmbH

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Liability

The manufacturer assumes no liability for any damages arising from

- failure to observe the instructions in this manual
- use of the device for unintended purposes and/or
- non-compliance with the safety instructions

The manufacturer assumes no liability for printing errors or any other inaccuracies within the instruction manual.

Safety instruction

When carrying out the measurement, pay attention to the local safety regulations.

Referenced Documents

- ASTM E3209 – 19 "Standard Test Method for Pavement Thickness by Magnetic Pulse Induction"
- TP D-StB 12 "Technical specifications for determining pavement layer thicknesses in road construction", issued by FGSV Verlag GmbH, Germany

1 Measuring method and requirements

1.1 Measuring method

The electromagnetic layer thickness measuring with the measuring instrument MIT-SCAN-T3 and previous versions uses the pulse induction method. The method requires the use of a reflector as an anti-pole under the layer to be measured.

The probe of the MIT-SCAN-T3 contains one transmitting coil and four sensors.

The current-traversed coil generates a magnetic field in regular intervals, the "Emission" field (see Fig. 1 Emission field). This pulsed magnetic field induces an electric current flow in the built-in anti-pole (see Fig. 2 Eddy currents). The eddy currents in turn generate a time-dependent magnetic field, called the "Response" field (see Fig. 3 Response field).

During a measuring run via the reflector, within the grid of a few millimeters, impulses are sent and signals received. The data density ensures the high reliability and accuracy of the measuring method.

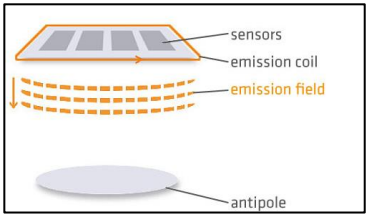


Fig. 1 Emission field

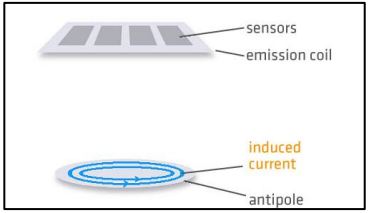


Fig. 2 Eddy currents

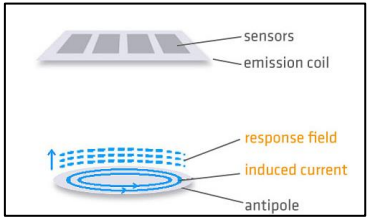


Fig. 3 Response field

Attention!

Only the standardized and prefabricated reflectors specified in TP D StB-12 may be used (see page 10, Table 1 Types of anti-pole according to TP D-StB 12)!

Please also consider:
Preparing the measuring site: page 8, Fig. 4 Layout plan

1.2 Creating a measuring point

In Germany and many other countries worldwide, the layer thickness measurement in asphalt or concrete is compulsory (see ZTV Asphalt-StB 07 in conjunction with TP D-StB 12, EN 12697-36, RVS 11.03.21 and ZTV Beton-StB 07 as well as ASTM E3209 – 19). The respective measuring point is prepared for self - or external monitoring and is equipped with one or more reflectors.

One **measuring point** includes all reflectors, which allow the measurement of all layers in one place. The respective reflector is located below the layer, which is to be measured. The environment of the measuring point should be as free as possible of extraneous metal in order to avoid a disturbing influence on the measuring signal. Reflectors are to be laid at a distance of at least 1.5 m from one another and respectively from road installations (for example rain water inlets or dowel bars etc.). The measuring point is usually marked on the edge of the road.

Each individual layer thickness value is to be measured, as specified under ZTV Asphalt-StB 07, at measuring points spaced out at regular intervals across the construction area. Accordingly, the lengthwise space that is to be kept generally is 50 m between measuring sections.

In roads with widths up to 5 m, the measuring sites are arranged alternately right and left. In multilane roads, three measuring points are arranged in the right, middle and left lane so that they form a straight line that is perpendicular to the edge of the road. The distance between measuring sites is 20 m in short construction sites (length up to 500 m) and 50 m in longer construction sites. However, no less than 20 measuring sites are required for data acquisition. This provides a sufficiently high statistical reliability for evaluating the construction performance*.

To assure the layer composite, the reflectors have to be covered sufficiently. The **minimum cover** specifies the material thickness that must at least be installed between the reflector and the surface of the pavement.

The layout drawing shown on the next page (see Fig. 4 Layout plan) specifies the type and number of reflectors to be used and their location/ position in the road. The schematic laying of reflectors simplifies the subsequent measuring process. Furthermore, the measuring points can be found quickly and easily later on.

* Note:
The contracting party and the construction company may agree upon arrangement that deviate from the regulations if required in specific situations.

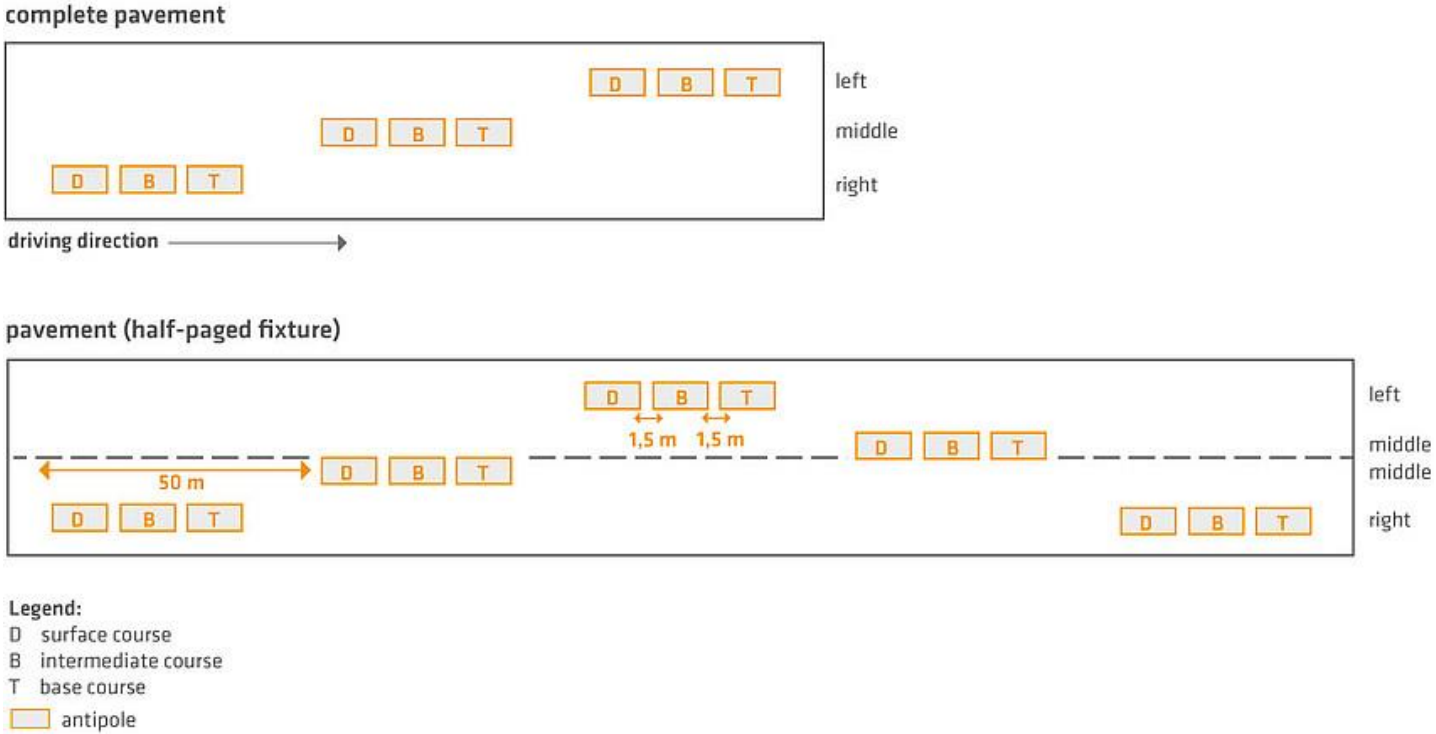


Fig. 4 Layout plan

1.3 Measurement environment

Metallic objects should not be present within a radius of 1.5 m around a measurement point, such as:

- manhole covers and drains
- road restraint systems (crash barriers)
- other reflectors
- cars and construction machinery

Wearing safety footwear – such as steel-toed boots – has no influence on the measurement as long as they are not too close to the probe.

Conditions that have no impact on the measurement are:

- wet roads
- hot asphalt
- slightly freezing temperatures

2 Reflectors

Overview of permitted, standardized measuring reflectors:

Name	Description	Max. depth	Standard measuring range
AL RO 07 **AL RO 12** **AL RO 30**	Circular plate Diameter: 7, 12 and 30 cm Mat. thickness: 1 mm / 0.5 mm Material: Aluminum	12 cm 18 cm 35 cm	1.5 - 12 cm 1.5 - 18 cm 4.0 - 35 cm
AL RE 30x50 **AL RE 30x60** **AL RE 30x70** **AL RE 30x100**	Rectangular as foil or sheet Width x Length: 30 x 50 … 100 cm Mat. thickness: 0.1/ 0.15/ 0.3 mm Material: Aluminum	40 cm 50 cm 50 cm 50 cm	1.5 - 40 cm 1.5 - 50 cm 1.5 - 50 cm 1.5 - 50 cm
AL SQ 16.5x16.5 **AL SQ 33x33**	Squared as foil Width x Length: 16.5 x 16.5 cm or 33 x 33 cm Mat. thickness: 0.1 mm / 0.15 mm Material: Aluminum	30 cm 40 cm	1.5 - 30 cm 1.5 - 40 cm
ST RO 30	Circular plate Diameter: 30 cm Mat. thickness: 0.65 mm Material: Steel	35 cm	4.0 - 35 cm

Table 1 Types of anti-pole according to TP D-StB 12

2.1 Quality assurance

The reliability and the accuracy of the electromagnetic layer thickness measurement depend in particular on the quality of the measuring reflector. The German standard **TP D-StB 12** as well as **ASTM E3209 - 19** specifies a selection of suitable standardized measuring reflectors with which all construction methods and layer thicknesses up to 50 cm depth can be measured non-destructively. Please note that aluminum should not be used in concrete due to harmful chemical reactions.

MIT-Reflectors are always subjected to quality control. A certificate is issued for each batch. If required, this certificate may be viewed or requested at MIT by the user. MIT sheets and circular plates are stamped with the company logo to avoid confusion with any reflector imitations not validated for use with the measuring system.

Please use only reflectors of certified and suitable quality. Deviating product properties of the reflector cause incorrect measurements. Please check your bidding and pay attention to reflectors of proven quality. If non-certified measuring reflectors from other suppliers are used, MIT Mess- und Prüftechnik GmbH assumes no liability for the accuracy of the measurement results.

Note:

- Devices are validated / calibrated for the use with specified reflectors.
- Packaging carries the quality seal (see Fig.5).
- Reflectors must be of verified quality.
- MIT reflectors carry the MIT company logo.
- The packaging is labeled with the batch number.

Fig. 5 Quality seal

In order to check a built-in reflector for its material properties, a reflector test can be carried out with the layer thickness measuring device MIT-SCAN-T3 or former version MIT SCAN-T2. Please refer to the operating instructions of your measuring device for information on the test procedure and the interpretation of the displayed value.

2.2 MIT Circular plates

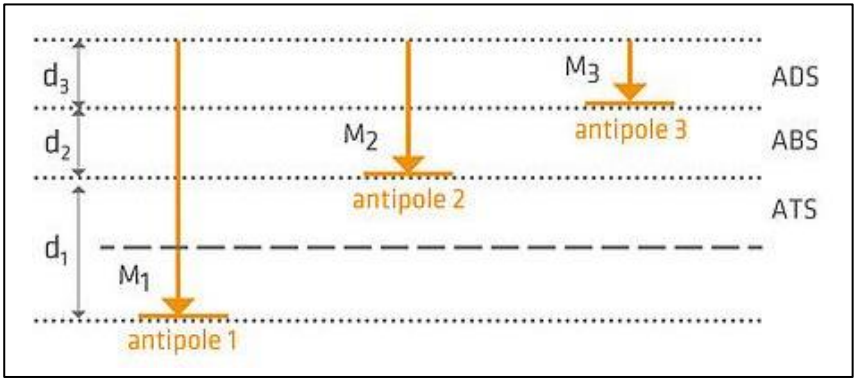
Fig. 6 Measurement path over circular plates

Circular plates are available in aluminum and steel. They can be easily laid out. They are robust against accidental damage during installation and thus ensure highly precise measurements. The direction of the measurement path over the reflector can be selected arbitrary. Enabling measurements to be performed in unfavorable conditions, e.g. directly next to curbstones.

Aluminum circular plates can be fixed securely with an adhesive (see page 14), whereas steel circular plates can be fixed with a stainless, steel nail. Fixing aluminum plates with a nail will have influence on the measuring results.

2.2.1 Aluminum circular plates for asphalt pavements

Asphalt roads consist of several layers. Each layer has a different thickness, material composition and grain size / sieve grading curve. To monitor the layer build-up, the thickness of each layer is measured individually:



Legend Fig. 7:

--- Border of multi-layer pavement
M_1 Measurement above respective anti-pole
d_1 Layer thickness
ADS Asphalt surface course
ABS Asphalt intermediate course
ATS Asphalt base course

Calculation of thickness:

$d_1 = M_1 - M_2$
$d_2 = M_2 - M_3$
$d_3 = M_3$

Fig. 7 Calculation of thickness in asphalt pavements

Aluminum circular plates are available in diameters of 7 cm, 12 cm and 30 cm (see page 10, Table 1 for application and measuring range).

Fig. 8 Stamped MIT circular plate

Fig. 9 MIT Reflector adhesive

Under binder and cover layer, blanks with the smallest possible diameter are used. With increasing depth, the response signal of the reflector gets weaker. In order to measure larger layer thicknesses, a reflector with a larger diameter must be used. The 30 cm circular plate is suitable for layer thickness measurements up to 35 cm.

MIT circular plates are not only mechanically robust and thus technically reliable but are also easier to install.

Circular plates are also useable on milled surfaces, within compact asphalt as well as on hot asphalt.

According to TP D-StB 12, the reflector has to be laid immovably. The nailing of the aluminum plate to the ground is **not** permitted. MIT Mess- und Prüftechnik GmbH offers a bitumen-based adhesive (see Fig. 9), which can be easily, cleanly and economically applied. This two-component adhesive has no interfering influence on the layer composite. It hardens within a few minutes and lasts a long time (about 70 reflectors/ cartridge).

2.2.2 Steel circular plate for concrete pavement

The current German TP D-StB 12 regulations have taken account of the requirements given in the standards DIN EN 12 697-36, DIN EN 13863-1 and DIN EN 13863-3.

Only galvanized steel reflectors are permitted in concrete road constructions because the reflector can be destroyed prematurely by chemical reactions occurring between the aluminum and the alkaline concrete material and gas formation can damage the concrete.

The electromagnetic properties of ferromagnetic materials and magnetic susceptibility are highly temperature-dependent. Steel circular plates are therefore not suitable for use in asphalt pavements.

The steel circular plate can be centrically fixated with a stainless, steel nail.

The adjacent picture Fig. 10 shows the middle of a slab with a 30 cm steel circular plate that is to be installed at a distance of 2.50 m from the reinforcement / basket in the concrete pavement.

Fig. 10 Steel reflector plate

In concrete road construction, the overall thickness of the roadway slab is of particular interest (see Fig. 11 below). As the construction of the slab usually does not exceed 30 cm, the MIT steel circular plate is the ideal reflector for layer thickness measurements in concrete.

Legend Fig. 11:

--- Boundary of multi-layer pavement
M1 Measurement above respective anti-pole
d1 Layer thickness

Calculation of thickness:

d1 = M1

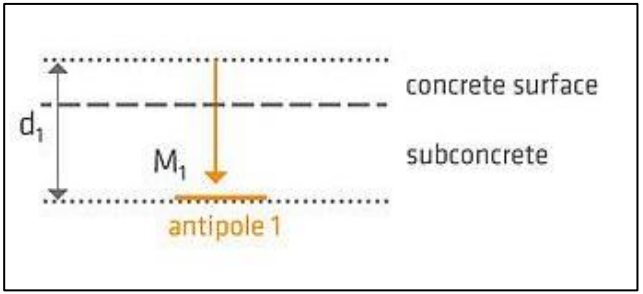


Fig. 11 Calculation of thickness in concrete pavement

The measuring range of the steel circular plate is 35 cm and thus completely covers the required depth range. Additional reflector formats are not required.

2.3 Rectangular reflectors

Rectangular reflectors are available in various thicknesses and sizes. Depending on the tender and the use, the material and format may be set. Fig. 12 shows a schematic representation of a measuring site. Rectangular foil formats should be installed parallel to the direction of the traffic. Rectangular reflectors are passed over perpendicular to their long sides. During the measurement the center of the reflector needs to be passed.

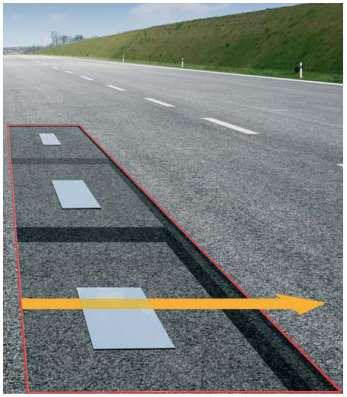


Fig. 12 Measuring path over rectangular reflectors

2.3.1 Rectangular and square foils

Aluminum foils are available in different sizes and thicknesses. In accordance with the German standard TP D-StB 12 a minimal material thickness of 0.1 mm is required. Foils thinner as 0.1 mm are not recommended for this measuring technique. They may be damaged during installation and produce unreliable measurement values.

Foils may **not** be used on milled surfaces. Ready-made sizes are preferable to those cut from a roll because inaccurate trimming may produce incorrect sizes. Deviations from the standardized reflector size leads to erroneous signals and to inaccurate measurments.

2.3.2 Rectangular sheets

Aluminum sheets are also available in different sizes. They have a material thickness of 0.3 mm. Sheets are used on milled surfaces and in depths of 40 - 50 cm. The maximum measuring depth is 50 cm for formats of sizes 30 x 70 cm or 30 x 100 cm.

Rectangular reflector sheets must be installed parallel to the direction of travel and overrun perpendicular to the longitudinal side (see Fig. 12).

When sheet metal formats are used, minimum cover requirements must be observed to ensure the layer structure.

3 Delivery range of MIT Mess- und Prüftechnik GmbH

Reflector	Size	Article No.	Measuring range
Aluminum circular plate	Ø 7 cm Ø 12 cm Ø 30 cm	707101 707102 707103	1.5 - 12 cm 1.5 - 18 cm 4.0 - 35 cm
Aluminum rectangular foil	30 x 70 cm 30 x 100 cm	707105 707106	1.5 - 50 cm 1.5 - 50 cm
Aluminum rectangular sheet	30 x 70 cm 30 x 100 cm	707109 707110	1.5 - 50 cm 1.5 - 50 cm
Aluminum squared foil	16.5 x 16.5 cm 33 x 33 cm	707107 707108	1.5 - 30 cm 1.5 - 40 cm
Steel circular plate	Ø 30 cm	707104	4.0 - 35 cm

Table 2 MIT-Delivery range

Online-Shop

MIT-Reflectors can be ordered directly online:

www.mit-dresden.de/shop

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Gostritzer Str. 63 · D - 01217 Dresden

Phone: +49 351/87181-25

E-Mail: sales@mit-dresden.de

Shop: www.mit-dresden.de/shop