2012

TP D-StB 12

TECHNICAL SPECIFICATIONS FOR DETERMINING PAVEMENT LAYER THICKNESSES IN ROAD CONSTRUCTION

FORSCHUNGSGESELLSCHAFT FÜR STRASSEN- UND VERKEHRSWESEN

Task force asphalt construction
Technical committee: measurement methods

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P r e l i m i n a r y o b s e r v a t i o n s:

The new German standard TP D-StB 12 is replacing the former version TP D-StB 89 and is following the specification DIN EN 12 697, part 36; DIN EN 13 863, part 1 and DIN EN 13863, part 3.

Contents

English translation of Section 2.2 of the German TP D-StB 12 test specifications for determining pavement layer thicknesses in road construction[1]

2.2 Electromagnetic thickness measurements using pulse induction technology

2.2.1 Application

This technology is applicable to asphaltic concrete pavement layers (also hot mix asphalt) and to base courses with cement binders[2], unreinforced concrete pavements as well as to unbound aggregate layers without binders.

The maximum measurement depth is provided in the calibration protocol.

Weather-related limitations to utilization specified by manufacturers must be observed when using the measuring devices.

2.2.2 Method description

This method measures the thickness of one or several layers above an electro conductive non-magnetic antipole (reflector) in asphalt layers and a magnetic antipole (reflector) in base courses with cement binders using pulse-induction technology (see figure 4).

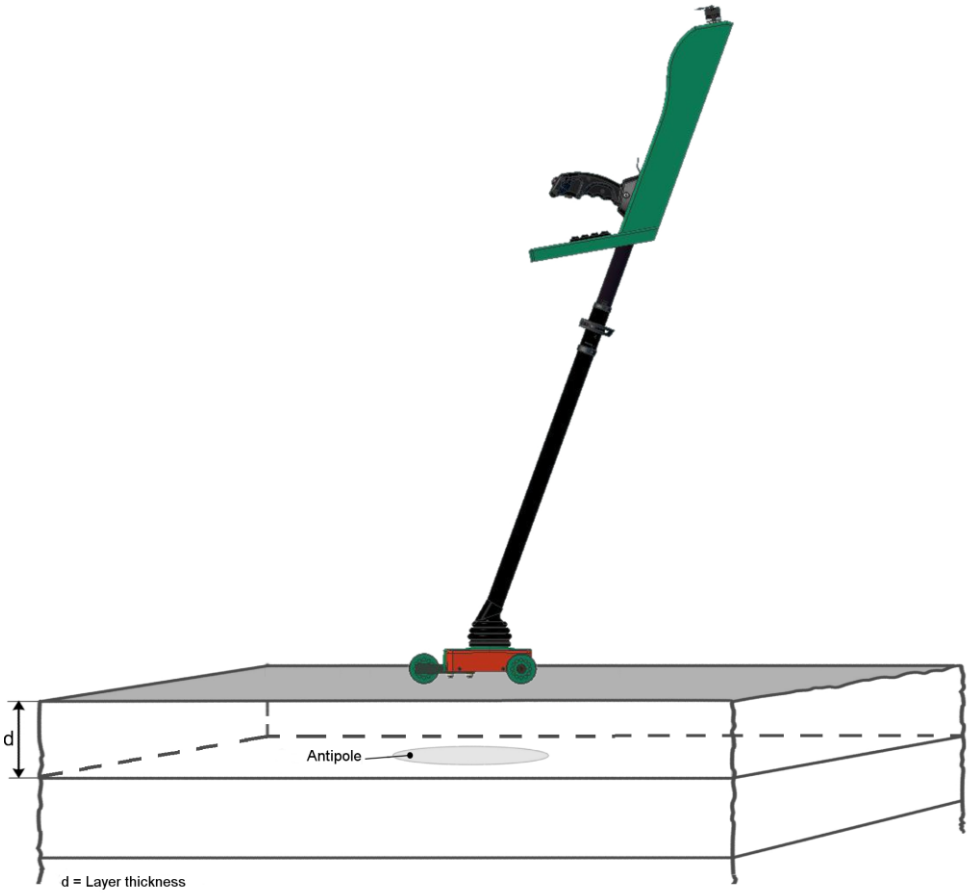


Figure 4: Electromagnetic thickness measurement using pulse induction technology

[1] With minor supplementary amendments for the US

[2] In North America these are cement or fly-ash treated base material under the concrete or asphaltic concrete pavement layers

A probe with a current-carrying coil and several sensors is positioned above the surface of the layer to be measured. When the flow of current in the coil is turned on and off briefly (pulses), the coil generates a time-dependent magnetic field that penetrates the layer. This magnetic field induces eddy currents in the antipole which decay and in turn generate a time-dependent magnetic field that is transmitted back to the probe. For better distinction, the field of the current-carrying coil is called "emission field" and that of the antipole "response field".

The sensors at the layer surface record the response field's rate of decay over time.

The measurement results take antipole thickness into account.

2.2.3 Devices and testing materials

- Electromagnetic thickness measuring device (pulse-induction technology)

- Antipoles of aluminum for asphalt pavements: minimum dimensions for foils and sheet metals 30 cm x 70 cm, minimum thickness of foils 100 µm, minimum thickness of sheet metals 300 µm or circular plates of aluminum AlMg3/W19 with diameters and thicknesses for different measurement depths as defined by the manufacturer (see table below)

- Antipoles of sheet steel or coated scratchproof and alkali-resistant aluminum for layers with cement binders, unreinforced concrete pavements and for layers without binders: minimum dimensions 30 cm x 70 cm, minimum thickness of sheet steel 300 µm or coated circular plates of aluminum with diameters and thicknesses for different measurement depths as defined by the manufacturer (see table below)

- Antipoles for use on milled surfaces: circular plates of aluminum as defined by the manufacturer

- Antipoles with square dimensions of 33 cm x 33 cm or 16.5 cm x 16.5 cm may be used alternatively[3]

Preference is to be given to circular plates with diameters as listed below for the different measurement depths. The measured depths refer to the bottom side of the circular plates used.

[3] Comment of MIT Mess- und Prüftechnik GmbH: traditionally only used in Southern Germany

Table 1: Antipole dimensions in relation to maximum measurement depth including material description

Designation	Maximum measurement depth	Material description
AL 30x50 AL 30x60 AL 30x70 AL 30x 100	40 cm 50 cm 50 cm 50 cm	Rectangle Width: 30 cm Length: 50 to 100 cm Material: aluminum; 0.100 to 0.300 mm
AL 33x33 AL 16.5 x 16.5	40 cm 30 cm	Square: 33 x 33 cm or 16.5 x 16.5 cm Material: aluminum; 0.100 to 0.300 mm
AL RO 07 AL RO 12 AL RO 30	12 cm 18 cm 35 cm	Circular plate ⌀ 7 to 30 cm Material: aluminum; 0.5 to 1.0 mm
ST RO 30	35 cm	Circular plate ⌀ 30 cm Material: steel; 0.65 mm

2.2.4 Calibration

Only thickness measuring devices with a valid calibration certificate may be used.

Thickness measuring devices must be calibrated when new and thereafter at yearly intervals. Calibration must be performed additionally after repairs and technical modifications. A certification of the current calibration (calibration protocol and calibration label) must be kept at the construction site.

Calibration may only be performed by a BASt[4]-authorized calibration institution.

For more detailed information on authorized calibration institutions and description of the calibration procedure visit:

http://www.bast.de/DE/FB-S/Qualitaetsbewertung/Anerkennung/Kalibriestellen-Schichtdicke.html

2.2.5 Samples

No sampling required.

2.2.6 Measurement

Before starting the day's first measurement, the thickness measuring device's functionality must be tested. For this, the measuring device is passed over a layer with an integrated

[4] Abbreviation: BASt – German Federal Highway Research Institute

reflector and the layer thickness determined. This is followed by another measurement at the same location using a non-metallic wheeled spacer that has the same geometry as the probe and increases the installed layer thickness by a defined amount. The difference between layer thickness measurement results with and without the spacer must not be more than the specified accuracy of the device plus 1 mm.[5] In case the deviation is higher, the measuring device must be sent to the manufacturer for validation.

During asphalt paving of traffic circulation areas as well as construction of base courses with cement binders and concrete paving, the antipoles are installed according to the schematic diagram in figure 2 and their positions marked to make them easier to find:

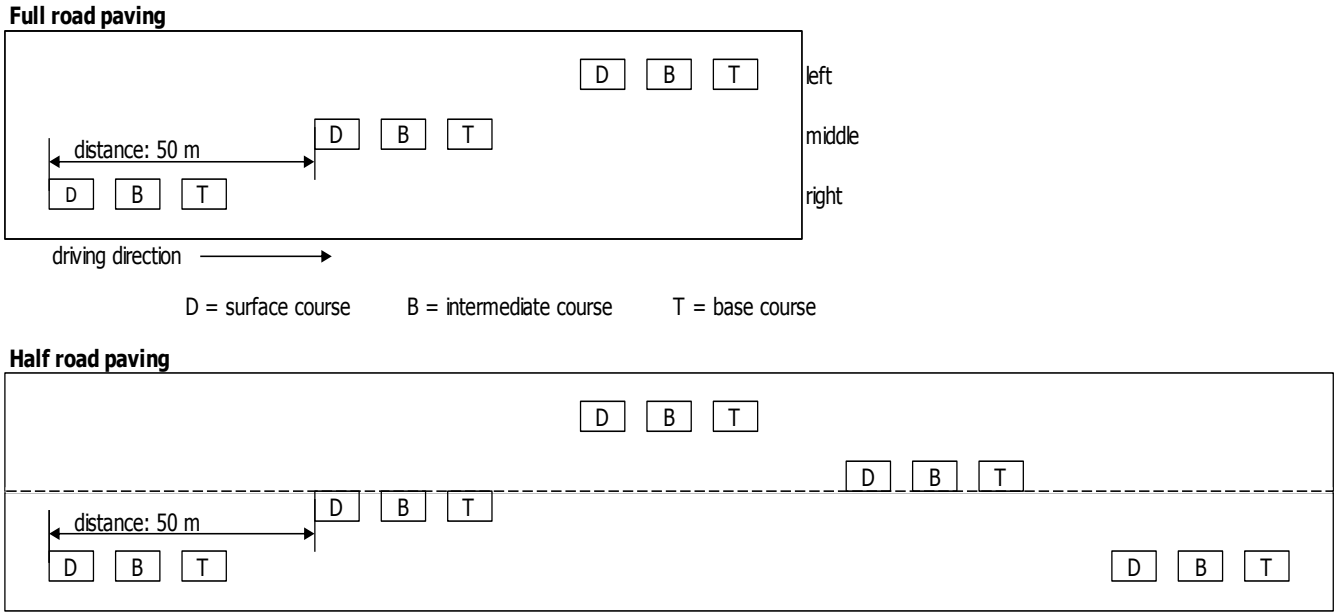


Figure 2: Layout drawing for the antipoles[6]

They must be placed at the bed of the measurement site in an undamaged state, fully planar and fixed directly before each individual layer is installed **prior to** the spraying procedure. No metallic objects that cause interference with the measurements may be present within a radius of no less than one meter around the antipole. If multiple antipoles are placed at one measurement site, the distance from edge to edge of each antipole must be at least one meter. A minimum distance of one meter must also be kept from the curbside.

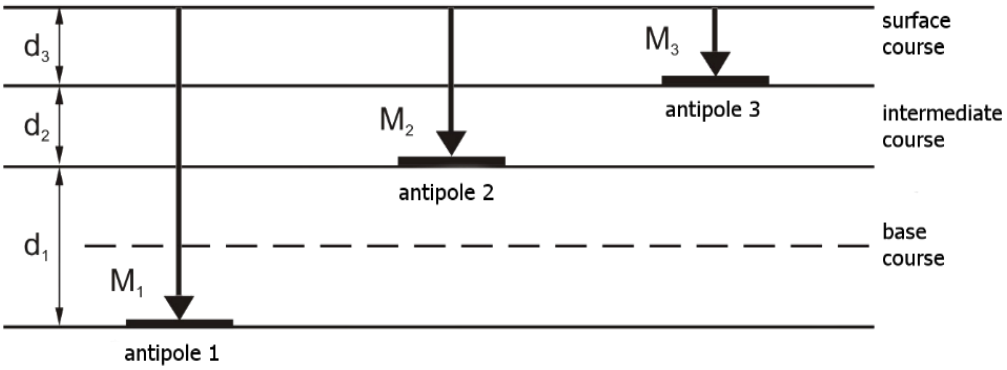
For layers without binders, sheet metal or circular plates must be used. Sheet metals are fixed to the base at each corner with a nail of stainless steel (length of the nails maximally 5 cm, diameter maximally 3 mm, distance from the edge maximally 2 cm), circular plates of steel can be fixed in their middle with a nail (stainless steel, length maximally 5 cm, diameter maximally 3 mm). It is not permitted to nail circular aluminum plates onto the base. Circular plates or self-adhesive foils can be used on asphalt layers. For layers of gap-graded asphalt mix, foils or circular plates with a minimum thickness of 150 µm must be used.

[5] For MIT-SCAN-T2 devices: ±0.5% of the measurement value + 1 mm (3/64 in)
[6] The distance between two measuring points usually has to be 50 m. The relatable surface of one measurement has not to be more than 500 m^2. The distance between the measuring points can be reduced on local demands.

Before measurement, the antipole must first be located and the antipole type correctly set up in the measuring device. For measurement, the measuring device is passed over the center of the antipole along a defined measurement path of 1.5 m length (path-controlled measurement). If rectangular foils and sheet metals are used, the device must pass over their center axes. The measurement direction is perpendicular to the long side of the foil, as a rule, this is transverse to the direction of traffic. The measurement direction is irrelevant for circular plates.

After paving multiple layers, the thickness of each individual layer is determined as shown in figure 3. Thickness values are rounded to 1 mm.

In layer thickness measurements of asphalt pavements, the value (M_3) measured over antipole 3 provides the thickness of the surfacing, and the thicknesses of the other layers are obtained with values M_1 and M_2 measured over antipoles 1 and 2, respectively, by subtraction (see figure 3).



Calculation of thickness:

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

Figure 3: Measurement scheme for measurements with the pulse-induction technology on asphalt pavements

In layer thickness measurements of concrete pavements, the value (M_1) measured over antipole 1 provides the thickness of the concrete pavement (upper and lower concrete) (see figure 4).

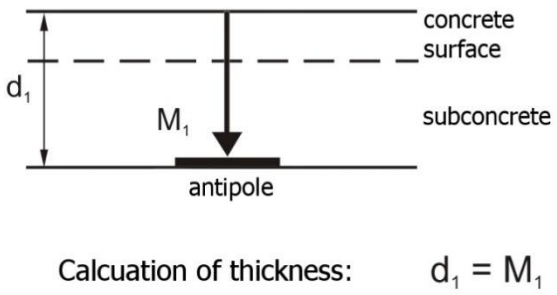


Figure 4: Measurement scheme for measurements with the pulse-induction technology on concrete pavements

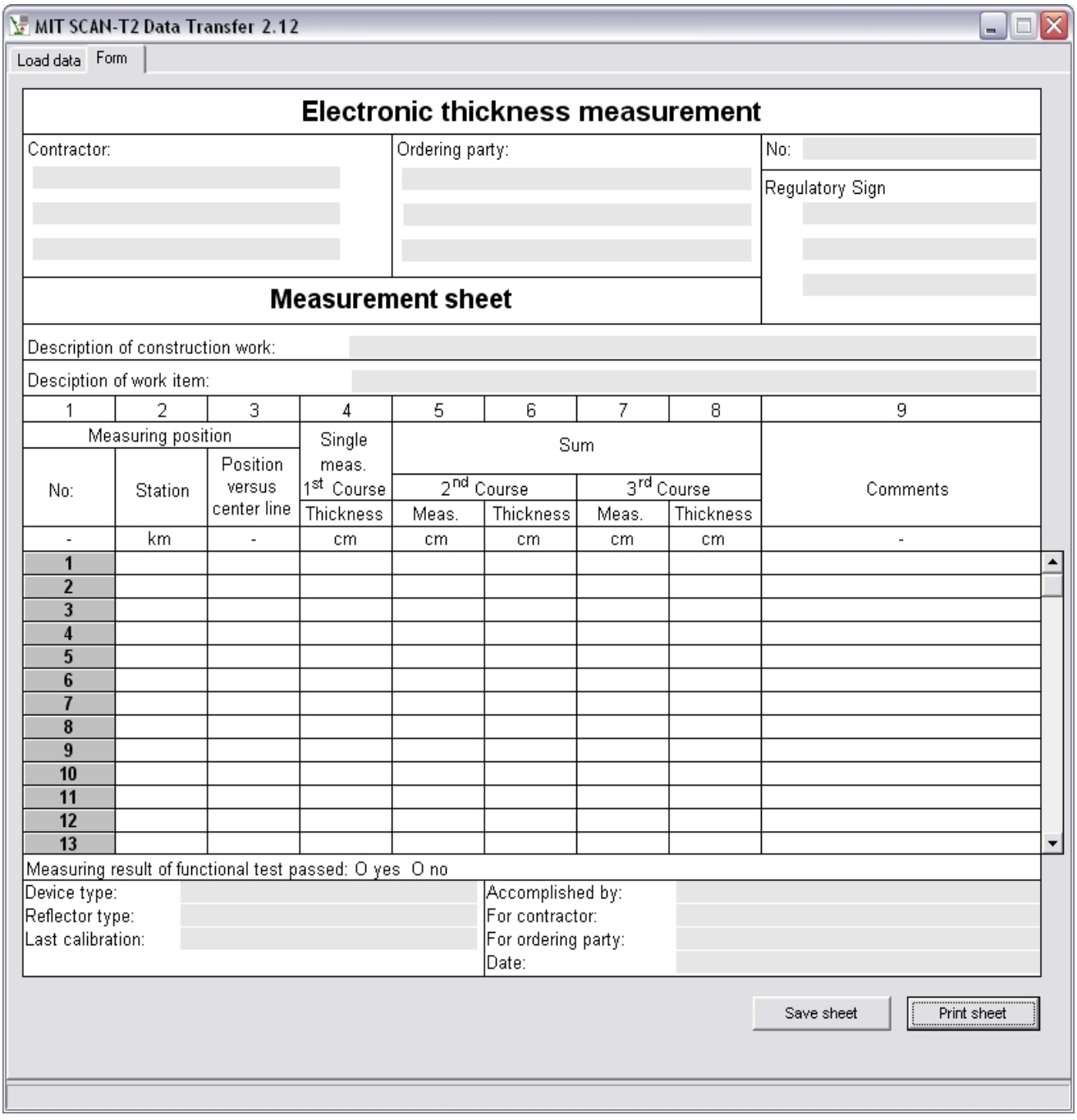
2.2.7 Test report data

The test report must contain at least:

- Time and place of measurement
- Device model and last calibration date
- Antipoles used
- Position of the measuring points
- Results of the layer thickness measurements
- Comments (e.g. antipoles not found or damaged).

A blank form is included in appendix A (test report) for documentation of measurement results obtained with the electromagnetic thickness measuring method (pulse-induction technology).

Appendix: Test report Electronic thickness measurement



MIT SCAN-T2 Data Transfer 2.12

Load data | Form

Electronic thickness measurement

Contractor:

Ordering party:

No:

Regulatory Sign

Measurement sheet

Description of construction work:

Desciption of work item:

1	2	3	4	5	6	7	8	9
Measuring position			Single meas. 1st Course	Sum				
No:	Station	Position versus center line		2nd Course		3rd Course		Comments
			Thickness	Meas.	Thickness	Meas.	Thickness	
-	km	-	cm	cm	cm	cm	cm	-
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								

Measuring result of functional test passed: O yes O no

Device type:

Reflector type:

Last calibration:

Accomplished by:

For contractor:

For ordering party:

Date:

Save sheet | Print sheet