Bekaert

Dramix® eyeD Inspector

User Guide

Everything you need to know to effectively use the device.

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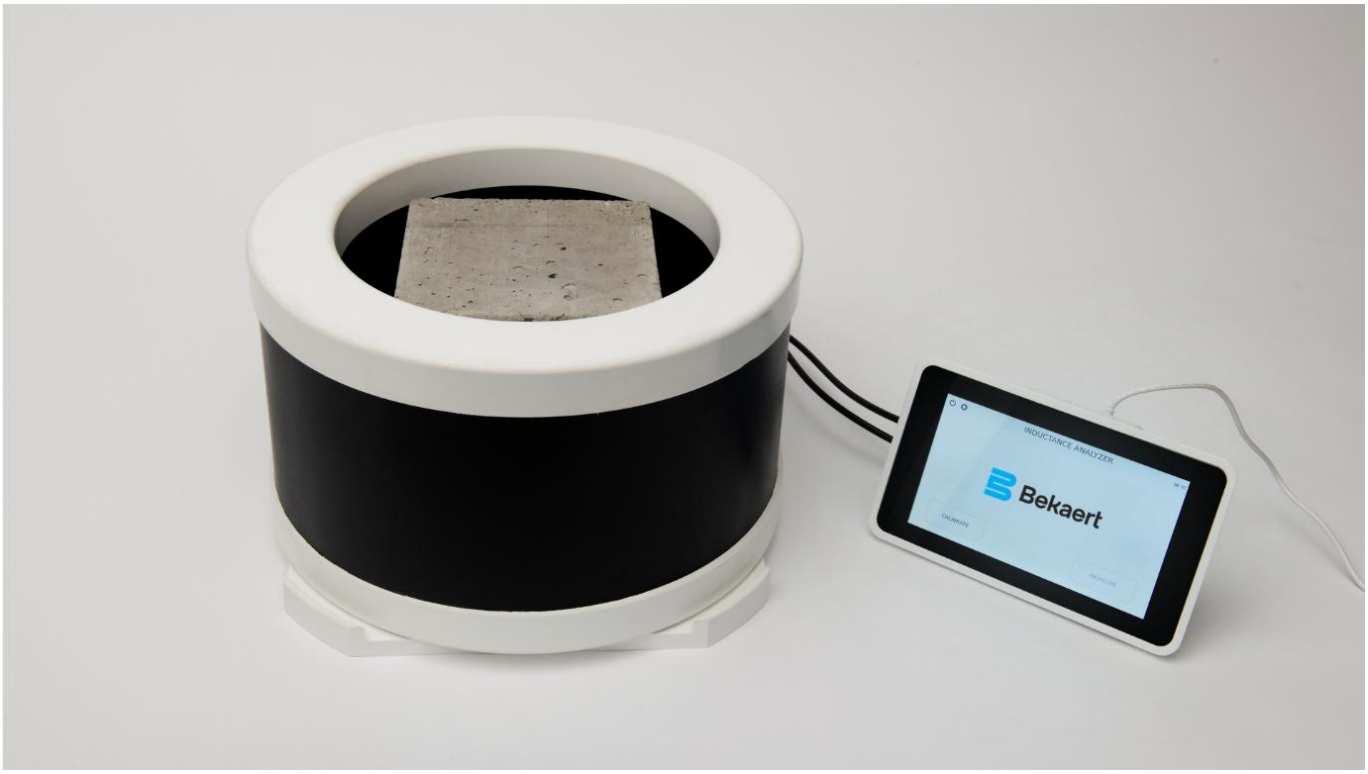


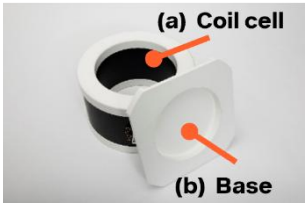
Introducing the Dramix® eyeD Inspector

The Dramix® eyeD Inspector is a testing device designed to measure fiber orientation and dosage in concrete test specimens. By giving you a clear view of how fibers are distributed, it helps you verify that your project meets design requirements before you commit to continuous production. With the Dramix® eyeD Inspector, you can reduce risks, optimize performance, and save time on every job.

Parts & accessories

The Dramix® eyeD Inspector consists of the following parts and accessories:

1 **Measurement platform**
a) Coil cell
b) Base



2 **Electronic device with touch screen**

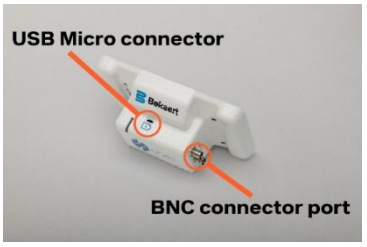
3 **Two BNC coaxial cables**

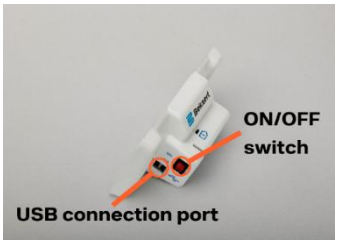
4 **Power supply cable**

How to install

Powering on the Dramix® eyeD Inspector

1. **Connect the two BNC coaxial cables**
   Connect one end to the electronic device and the other to the coil cell. The BNC connector ports are on the rear lateral side of the device. It is not important which cable is plugged into which port.
2. **Connect the power supply cable**
   Connect the power supply cable to the electronic device and plug it into the power source. The USB Micro connector is located at the rear center of the device.
3. **Turn the 'ON/OFF' switch to 'ON'**
   Switch the device from 'OFF' to 'ON' using the 'ON/OFF' switch on the rear lateral side. The green 'Power LED' will light up, and the device will begin the power up sequence.





Note: No green light? Check if the electronic device is connected to a power source and switched on.

Main menu

When the startup sequence is completed, the main menu window appears.

1. **'Settings' button**
   Click the 'Settings' button to access settings for screen brightness.
2. **Internal temperature**
3. **'Calibration' button**

Measurement menu

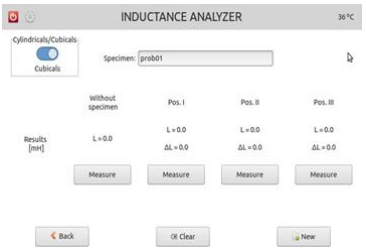
1 ’Measure’ button

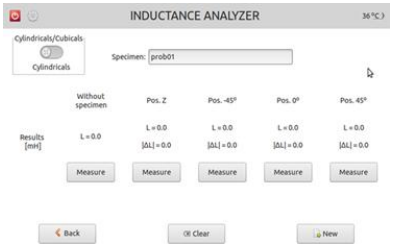
Click to access the measurement menu.

> **Note:** The initial internal calibration is required before starting measurements and this button will remain disabled until the first calibration is performed.

2 Mode selector

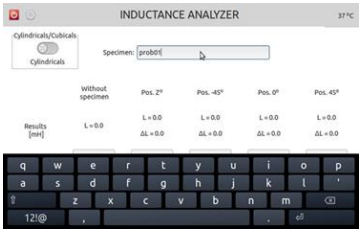
Toggles the mode selector between 1. cubical or 2. cylindrical specimen measurement modes.





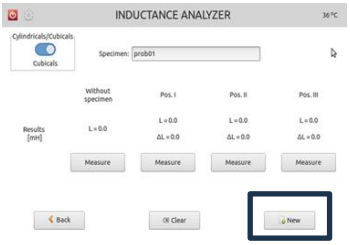
3 Specimen name

Enter the name of specimen in the text box. This field is automatically selected when the measurement menu opens.



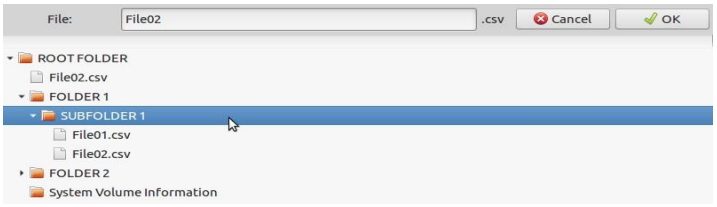
4 Create a new file

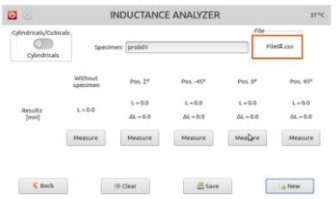
a) Insert the USB memory device into the USB port of the electronic device.
b) Press the ‘New’ button. This will initiate the process of creating a new file for your measurements.



5 **Choose destination folder**

a) Select the desired folder on the USB memory. This will be the place where the file will be saved.
b) Enter a name for the new file.
c) Confirm the name of the file. The file name will now appear on the measuring screen.





6 **Save data**

Tapping the “Save” button will store the current measurement in the selected file.

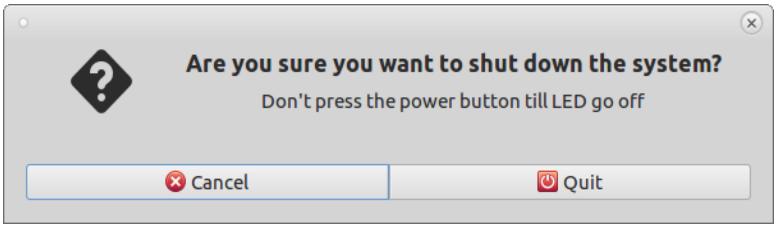
Powering off the Dramix® eyeD Inspector

1 Press the ‘OFF’ button.

2 Press ‘Quit’ to confirm shut down of the device.

3 Wait until the green light turns off.

4 Switch the ‘ON/OFF’ button from ‘ON’ to ‘OFF’.



⚠ **Warning:** Turning off the switch directly may cause system memory corruption.

Measurement procedure

Preliminary measurement guidelines

Before and during measurements, these are the essential conditions to follow:

1. **Calibration and temperature consistency**
   The initial internal calibration of the equipment and the inductance measurements should be performed under similar temperature conditions.
2. **Avoid nearby metal objects**
   During the use of the equipment, there should be no metal objects nearby (e.g. metal furniture, metal laboratory tools). These objects may affect the magnetic field generated in the coil. A safety distance of 1.0m is recommended.
3. **Specimen requirements**
   The equipment is designed for specific specimen types:

Geometry of the specimens	Material of the specimens
Cubes 100×100×100 mm or 150×150×150 mm	**Concrete mixtures** There are no specific restrictions on the concrete mix, as long as it does not contain materials that could interfere with the magnetic field.
Cylinders ϕ100×100 mm or ϕ150×150 mm	**Steel fibers** Only steel fibers are supported, regardless of their shape or composition. The fiber content must be between 20 kg/m³ and 120 kg/m³.

⚠ **Warning:** Using specimens outside the specified geometry or material limits may result in unreliable measurements.

How to start inductance measurement of specimens

The Dramix® eyeD Inspector measures changes in magnetic inductance along the X, Y, and Z axes to assess the steel fiber content in reinforced concrete.

1. **Powering on the device**
   Turn on the Dramix® eyeD Inspector.
2. **Select calibration**
   In the main menu, run the initial internal calibration of the electronic device.
3. **Go to the measurement menu**
   After calibration, go to the measurement menu.
4. **Choose specimen type**
   Toggle the mode selector for measuring cubical or cylindrical specimens.
5. **Name the specimen**
   Enter name of the test specimen to be measured.

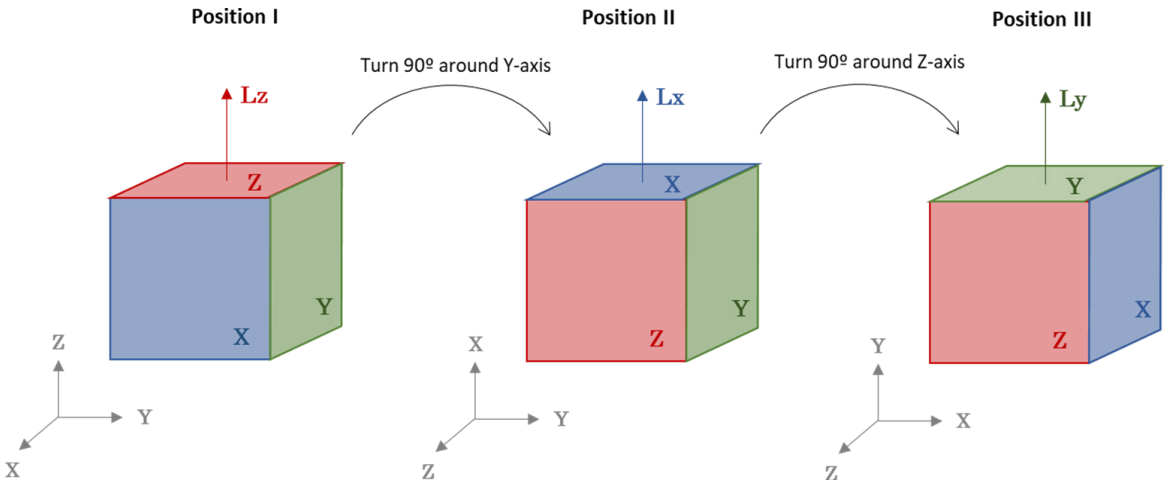
How to perform measurements

1 **Warm-up period**
After powering-on the equipment, wait approximately 10 minutes before taking measurements. This is to ensure the consistency and reliability of the measurements.

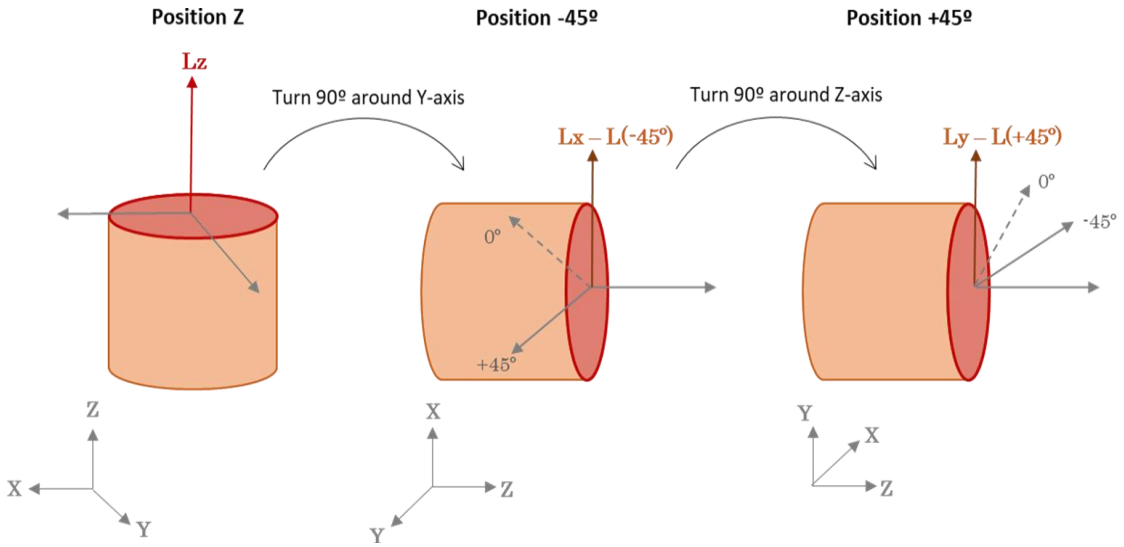
2 **Initial baseline measurement (without specimen inside the coil)**
Before placing any specimen (cubical or cylindrical) into the coil, begin by measuring the inductance without a specimen inside the coil.

3 **Specimen measurement**
Place the specimen inside the coil and rotate it along the three principal axes (X, Y, and Z) to perform three different measurements.

For cubical specimen



For cylindrical specimen



Each measurement should be repeated twice, while also calculating the mean value.

a) Measure the specimen in all three orientations and save the results as ‘Specimen_a’.

b) Repeat the measurements on the same specimen in each orientation and save as ‘Specimen_b’.

c) After testing, calculate the average of ‘Specimen_a’ and ‘Specimen_b’ for each orientation during post-processing, using the CSV file saved on the USB drive.

d) The average value should be used as the representative inductance measurement for the specimen.

Note: For cylindrical specimens, the measurement at ‘Pos. 0°’ is not required for obtaining the content of fibers (this is an additional measurement that should not be evaluated).

4 **Saving measurement data**

After completing the first set of measurements, press the ‘New’ button to create and save a new CSV file on the USB drive.

For subsequent measurements, you may choose to add data to the existing CSV file by selecting the ‘Save’ button or create a new CSV file by selecting the ‘New’ button again.

Powering off the equipment

After completing all measurements:

1 Press the ‘OFF’ button.

2 Press ‘Quit’ to confirm shut down of the device.

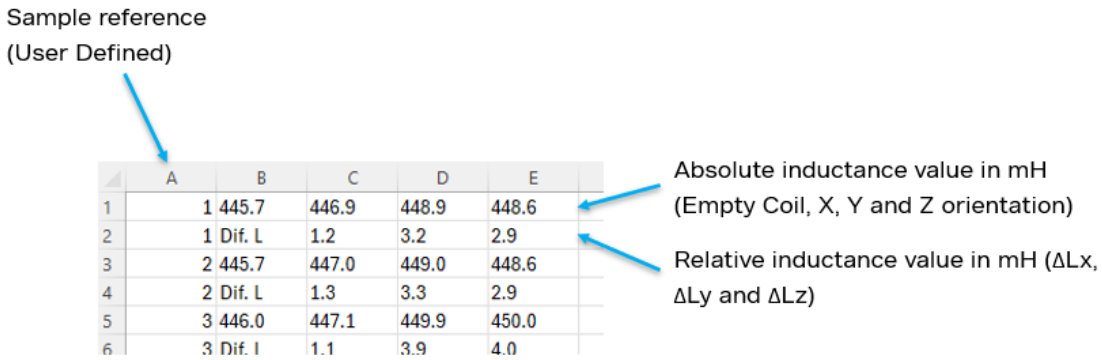
3 Wait until the green light turns off.

4 Switch the ‘ON/OFF’ button from ‘ON’ to ‘OFF’.

Software guide

Output of the device

The Dramix® eyeD Inspector stores its test results on the USB storage device in a .csv file. Each measurement consists of two lines. Columns are separated by a semicolon (";") and the decimal separator is a point (".")



	A	B	C	D	E
1	1	445.7	446.9	448.9	448.6
2	1	Dif. L	1.2	3.2	2.9
3	2	445.7	447.0	449.0	448.6
4	2	Dif. L	1.3	3.3	2.9
5	3	446.0	447.1	449.9	450.0
6	3	Dif. L	1.1	3.9	4.0

In all calculation files, only the absolute inductance values are used (empty coil Le and inductance values for each orientation Lx, Ly and Lz.

Note: For cylindrical specimens, the measurement at 'Pos. 0°' is not required for obtaining the content of fibers (this is an additional measurement that should not be evaluated). Lx corresponds to the measurement at 'Pos. -45°' and Ly corresponds to the measurement at 'Pos +45°'

Calibration

The eyeD Inspector cannot measure the steel fibre dosage out of the box; it needs to be calibrated first.

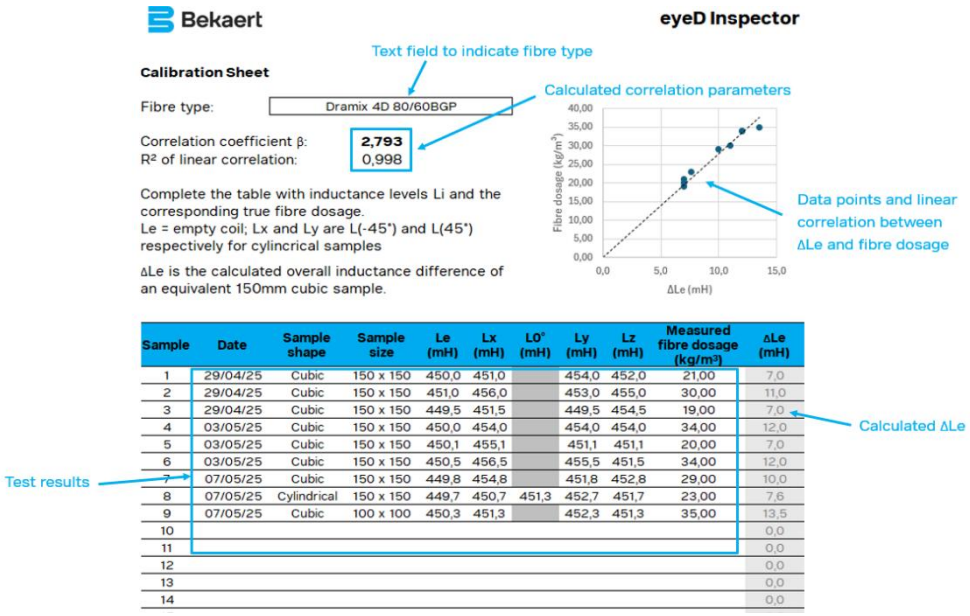
As each steel fibre type has its own specific magnetic properties, a separate calibration is required for each fibre shape and material.

The goal of calibration is to specify the relation between the Inductance Variation ($\triangle$ Le) and the fibre dosage by measuring a series of samples containing a known fibre dosage. Because the relation is linear with coefficient β, at least 2 samples are required to fit a correlation. Using more samples will improve the accuracy of the calibration.

$$\text{Dosage} = \beta \Delta L_e$$

The following parameters are required for each sample:

1. **Sample shape and size.**
2. **Inductance measurements of the empty coil (Le) and with the sample in three orthogonal orientations (Lx, Ly and Lz)**
3. **Fibre dosage, determined by crushing the sample and carefully collecting and cleaning all steel fibres or by making samples with an exact amount of steel fibres in a small batch of concrete making sure that all fibres end up in the sample.**



Note 1: The equivalent relative inductance △Le is calculated as the sum of the three orthogonal measurements Li combined with the empty coil measurement, with a correction based on the sample shape and size. This approach allows the correlation to be independent of the sample shape and size.

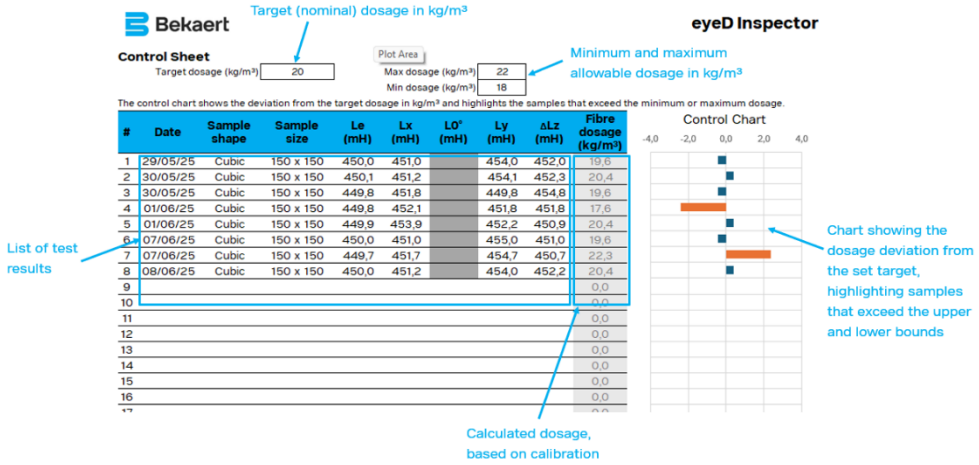
Note 2: For the calibration to be useful and reliable, it is recommended to produce and test samples with varying fibre dosages. Consider adding test samples with a higher dosage than what is to be expected in the field or production, to avoid extrapolation.

Control

The eyeD Inspector can be used as part of a Quality Assurance (QA) system to monitor steel fibre dosage in a production environment. A possible setup could be to cast cubic specimens at regular intervals and determine the fibre dosage with the eyeD Inspector before the samples are crushed to determine the compressive strength.

The “Control” tab converts the output of the eyeD Inspector into steel fibre dosages, based on the data in the “Calibration” tab.

A chart is generated to show the deviation of each sample from the preset target dosage, marking samples that exceed the minimum or maximum allowable dosage limits.



Calculate

When dealing with multiple dosages in a laboratory environment or when samples are taken in the field (drilled cores) it is recommended to use the “Calculate” tab.

Just as with the “Control” tab, data is collected in the input table. It is automatically converted to a steel fibre dosage based on the “Calibration” tab.

The Control chart is removed to show the relative fibre contribution in each orientation. This measure is to be interpreted as a preferred orientation of the fibres within the sample. If the orientation of the sample within the large specimen (a slab or a precast element) is carefully documented prior to drilling, this information can be related to the global orientation of fibres in the larger specimen.

Three possible outcomes can occur:

1. **One orientation shows a significantly higher contribution, indicating that fibres are predominantly oriented parallel to this axis (for example: sample 1 in the figure).**
2. **Two orientations show a significantly higher contribution, indicating that the fibres are predominantly orientedin a plane parallel to these axes (for example the XZ plane in sample 4 in the figure).**
3. **All three contributions are roughly equal, indicating a random distribution of the fibres (for example: sample 2in the figure).**

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Calculation Sheet

Fibre dosage is estimated based on the data in the calibration sheet. The calculations are only valid for concrete using the same fibre type in a dosage that does not exceed the dosages used for calibration. Le = inductance of the empty coil. Lx = L(-45°) and Ly = L(45°) respectively for cylindrical samples. Orientation estimations are independent of fibre type; no calibration is required.

#	Date	Sample shape	Sample size	Le (mH)	Lx (mH)	L0° (mH)	Ly (mH)	ΔLz (mH)	Fibre dosage (kg/m³)	Orientation X	Y	Z
1	15/06/25	Cylindrical	150 x 150	450,0	451,0	458,0	458,0	451,2	36,3	14%	69%	17%
2	15/06/25	Cylindrical	150 x 150	449,5	452,5	453,5	453,5	453,5	39,1	29%	35%	35%
3	15/06/25	Cylindrical	150 x 150	449,8	451,8	450,6	450,6	454,8	27,7	31%	13%	56%
4	15/06/25	Cylindrical	150 x 150	451,2	453,5	451,7	451,7	453,2	17,1	45%	13%	42%
5	15/06/25	Cylindrical	150 x 150	451,0	455,0	453,3	453,3	452,0	26,0	49%	34%	17%
6	15/06/25	Cylindrical	150 x 150	450,0	451,0	455,0	455,0	452,0	28,4	16%	54%	30%
7	15/06/25	Cylindrical	150 x 150	450,2	452,2	455,2	455,2	451,2	28,4	30%	54%	16%
8	15/06/25	Cylindrical	150 x 150	449,9	451,1	453,9	453,9	452,1	26,0	20%	48%	32%
9									0,0			
10									0,0			
11									0,0			
12									0,0			

List of test results

Relative fibre contribution in each orientation

Calculated dosage, based on calibration

Note 1: The calibration is only reliable to be used for dosages that do not exceed those used during calibration. When the calculated dosage is higher than the dosages used during calibration (=extrapolating) consider adding extra test results in the “Calibration” tab.

Note 2: The fibre orientation output is independent of the fibre type, so no calibration is required for this measurement to produce reliable data.

Frequently Asked Questions

- **Are there limitations on the dosage that can be measured?**

  Theoretically, no. Best results are achieved with dosages higher than 20kg/m³. With lower dosages, the inductance variation due to the presence of steel fibres reduces. This will decrease the accuracy of the device.

- **Are there limitations on the sample size?**

  The maximum sample size that fits the eyeD Inspector is a cube of 150mm or a cylinder of 150mm diameter and 150mm height. The samples should be “cubical” (same height and width) to allow them to be centered properly in the magnetic field.

  The minimum sample size is a 100mm cube or cylinder. Smaller is not recommended as it will decrease the inductance variation and accuracy of the device.

- **How are the fibre contributions determined?**

  Although simply looking at the measured ΔLx, ΔLy and ΔLz can already give a good impression of the fibre orientation in the sample, the values shown in the “Calculation” tab are taking the specimen shape into account as well as empirical corrections for fibre distribution and deviations in the magnetic field homogeneity.

- **Does the eyeD Inspector comply to the Spanish standard UNE83518?**

  Yes, the test method follows the approach that is described in UNE83518.

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