Objectra


## Summary

The Coating Drill measures coating thicknesses from 5 to 1500 µm in a simple, rapid and accurate way. Almost all coatings, such as paints, plastics, zinc and other metals, foils etc., can be measured on almost any substrate, e.g. metals, wood, plastics and concrete.


The working principle is very simple. A conical hole is drilled through the coating down to the substrate with a special drill steel, which has a defined bit angle. Then the thickness is measured with a measuring microscope, which goes with the drill. For a paint system with two or more different paints, the layers usually can be measured separately. The method is destructive, but the resulting hole is very small, the diameter about 1 mm or less, and can in most cases be repaired relatively easily.

As a demonstration of the possibilities a few practical cases are given, where the drill method has been used for control of carbonation protection, wet room, steel door and antiquarian objects coatings.

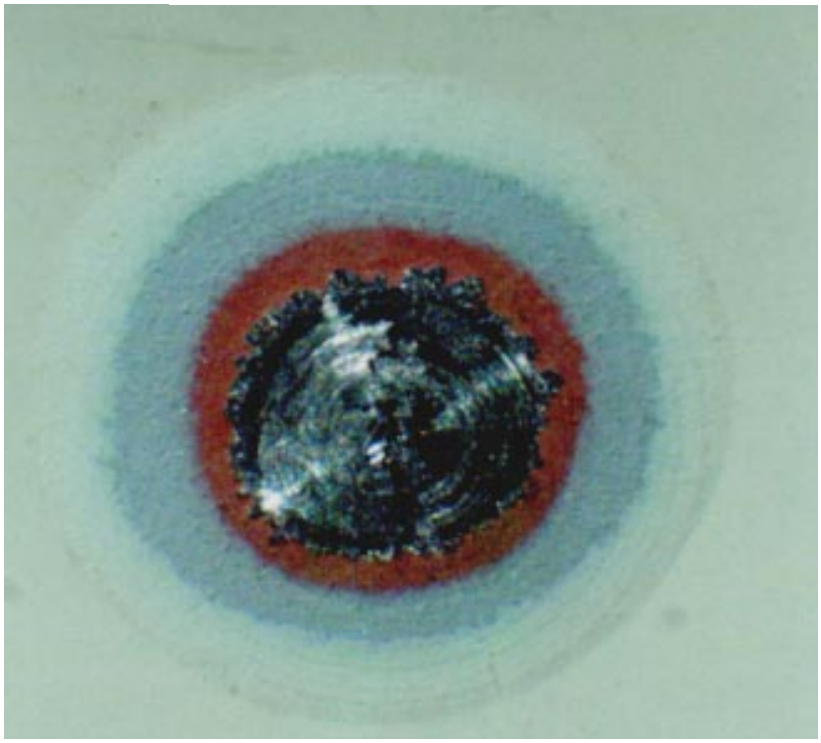

*Fig 1. A bore hole through the paint layer, bore angle 5,71°. In the centre, the steel substrate can be seen, then the brown primer layer (25ìm), the intermediate grey paint layer(40 ìm) and the white top paint layer(70 ìm). The concentric circles are uneven due to the fact that the different paint layers are hand painted. (The photograph taken by SP, the Swedish Testing and Research Institute).*

## Measurement of and distinguishing between the separate layers of a coating system

Measurement of film thickness is continuously performed on corrosion protective painting, separate layers as well as the total thickness when the work is finished. The quality and lifetime of the protective coating depend on that all specified paint layers have been applied and that all of them have the specified thickness.

Film thickness measurement is decribed in ISO 2808. One of the methods is making a small hole in the coating and measuring the film thickness with a dial indicator. Measuring with Coating Drill uses the same principle with a hole down to the substrate, but it is also possible to measure every layer in a complete paint system separately. A hole in a three layer system is shown in figure 1.

Since the substrate has no influence on the measurement with the Coating Drill, the method can be used on almost all substrates including different metals, wood, plastics, concrete and fabrics.

## The Coating Drill

The Coating Drill consists of a turnable drill, made of hardmetal where one end drills a hole with an angle of 5.71°, the other end 45° (fig. 2). The drill is guided by a hole in a metal plate for greater precision. The plate is placed on the surface to be measured, the drill is placed in the hole and turned around with a light pressure by the finger until the point of the drill has just entered the substrate (fig. 3). Then the film thickness is measured with the measuring microscope.

# Coating Drill

## A general method for coating thickness measurement

The 5.71° drill is used for film thicknesses up to about 150 µm (one scale unit is 1 µm), the 45° drill from about 100 to 1500 µm (one scale unit is 10 µm). Usually, the standard measuring microscope with a magnification of 40x is sufficient for accurate measurement, but for very thin films a magnification of 100x is recommended (fig. 4).

Multiple layers can be measured in one single hole if there is colour or structure differences between them, so they can be identified. Surprisingly small differences are needed. This possibility is a great advantage, and independent measurement of multiple layers on a coated surface is not possible with non destructive methods.

*Fig 2. Hardmetal bore used in the coating Drill*

*Fig 3. Drilling with the Coating Drill on a window-frame*

edges. However, the test panel can be cooled in a freezer or, in the field, the test area cooled by carbon dioxide snow or liquid air. Then the paint or rubber becomes harder and drilling is possible.

## Accuracy

The accuracy of the measurement values is about ± 3 %, i e at the same level as for the common non destructive, inductive magnet or eddy current instruments.

## Advantages

- Precise, rapid
- Both for laboratory and field use
- Measures each layer of a multiple layer system independently
- Can be used on all substrates

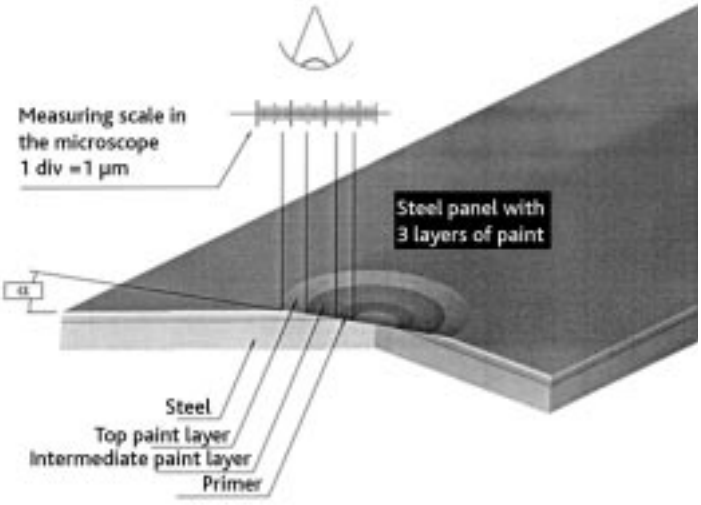


*Fig 4. The principle for measuring with the Coating Drill and the measuring microscope.*

The Coating Drill, the measuring microscope and the case are shown in fig. 5.

## Sample preparation

Generally, no preparation of the surface is needed, all there is to do is to drill the hole and measure. However, surfaces and layers giving bad contrast and soft materials need some preparation.

If the hole shows bad contrast between the intact surface and the drilled sloping surface in the hole, marking of the surface is needed. This can be done with any marker which stays on the surface and does not migrate into the coating, e.g. crayons or board markers in a differing colour. The hole is then drilled in the marked area.

The drill is hard enough for drilling in common metals, but soft layers like flexible paints or rubbers may cause problems with deformed or torn hole

- Can be used for most coatings, also magnetic and conductive
- Robust, simple, no need for electricity
- Portable, weight about 1.5 kg

## Other common film thickness measurement methods

The common inductive magnet and eddy current instruments are non-destructive but cannot be used for non-magnetic or non-conductive substrates and can only measure the total film thickness of non-conductive coatings.

Microscopy measurements often involve fixation in an epoxy resin, cutting and polishing to get a nice cross-section, which can be measured under the microscope. Those methods give a high accuracy but are destructive and requires a lot of work and time.

Finally, there are instruments available, e g the Paint Inspection Gage, which work with the same principle as the drill

*Fig 5. Measuring microscope, Coating Drill and case.*

but makes a scratch with a defined cutting angle instead of a hole. The scratch makes more damage to the surface and is then more difficult to repair.

## Practical cases

Case 1 Is the carbonation protection paint performed correctly?

A group of apartment blocks made of concrete required surface treatment with carbonation protective paint to stop beginning damage on the facades. The applied film thickness was checked with the drilling method and found to be too thin throughout. After wet film measurement was introduced in the work and dry film thickness was spot tested with the drilling method, the project could be finished with fulfilled quality requirements.

Case 2 Why do certain bathrooms go mouldy?

In some multi-storey blocks it was established that some bathrooms went heavily mouldy, others not. At inspection with the drill method it was found, that none of the mouldy bathrooms had a water-resistant wet room primer, which was specified.

Case 3 Is there a primer on all steel doors?

At a simple routine inspection with the drill method, it was found that on some steel doors in a large shipment the primer was missing.

Case 4 Studies of coatings on antiquarian objects

In connection with painting and restoring of antiquarian objects, the number of layers, their chronological order and their colours have been determined with the drilling method.

Finally The Coating Drill is used in several laboratories for development and control of coatings used in the coil coating industry.