

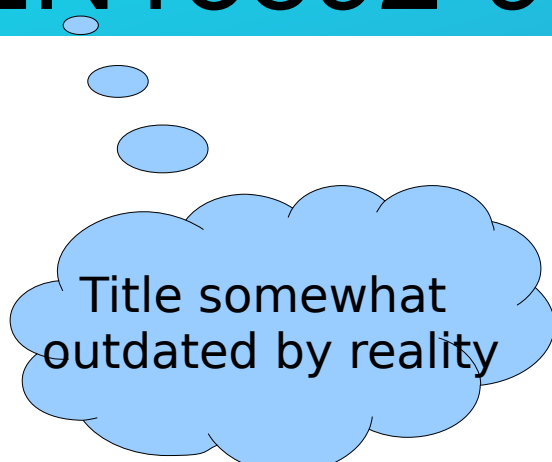
# Testing Systems

Schleibinger Geräte

Multiplivdel. Geräte

# Determination of Shrinkage and Swelling of Screeds in EN13892-9

- Apparatus
- Procedure
- Status of Normation



Title somewhat outdated by reality

Dipl.Ing. Markus Greim  
Schleibinger Geräte Teubert u. Greim GmbH  
Buchbach / Germany

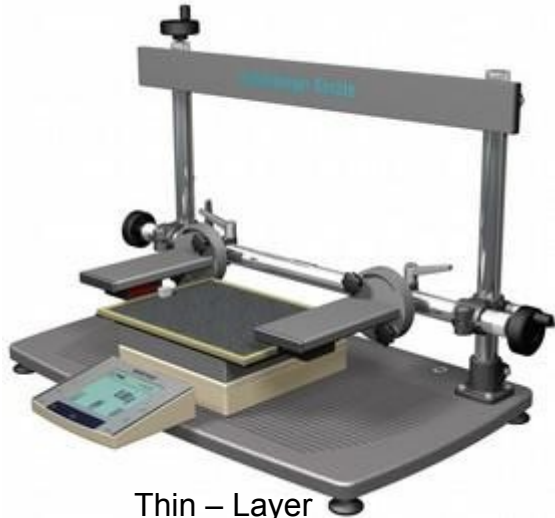




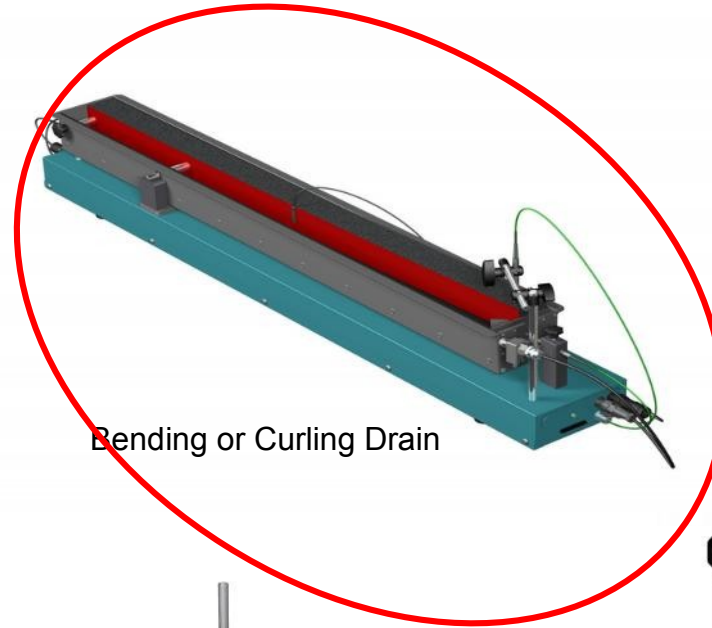




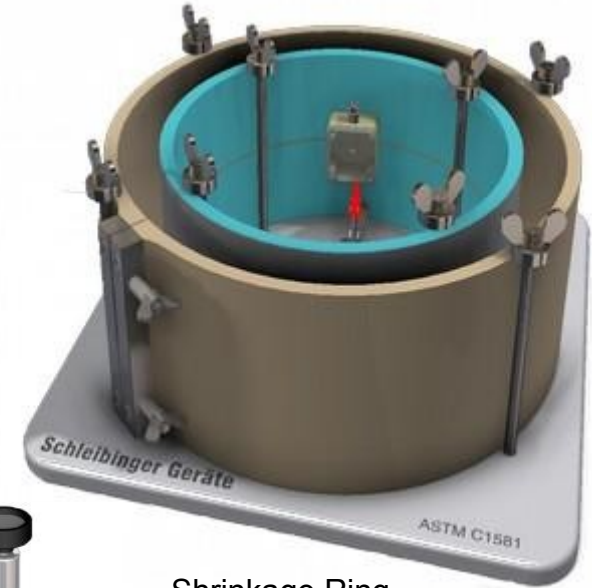
# Schleibinger Shrinkage Measurement



Thin – Layer  
Shrinkage Measurement System



Bending or Curling Drain



Shrinkage Ring



Shrinkage Drain



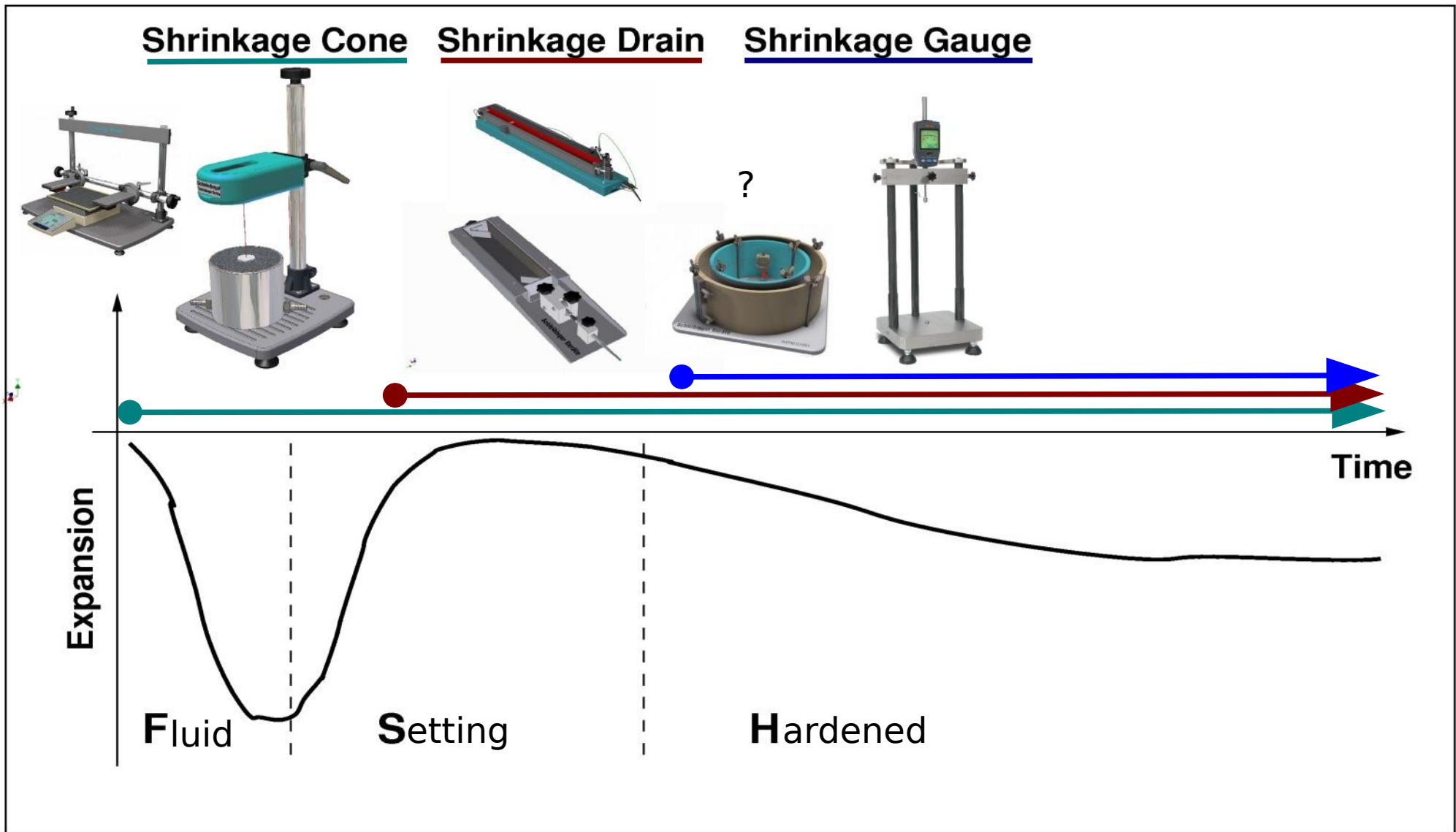
Measurement Gauge



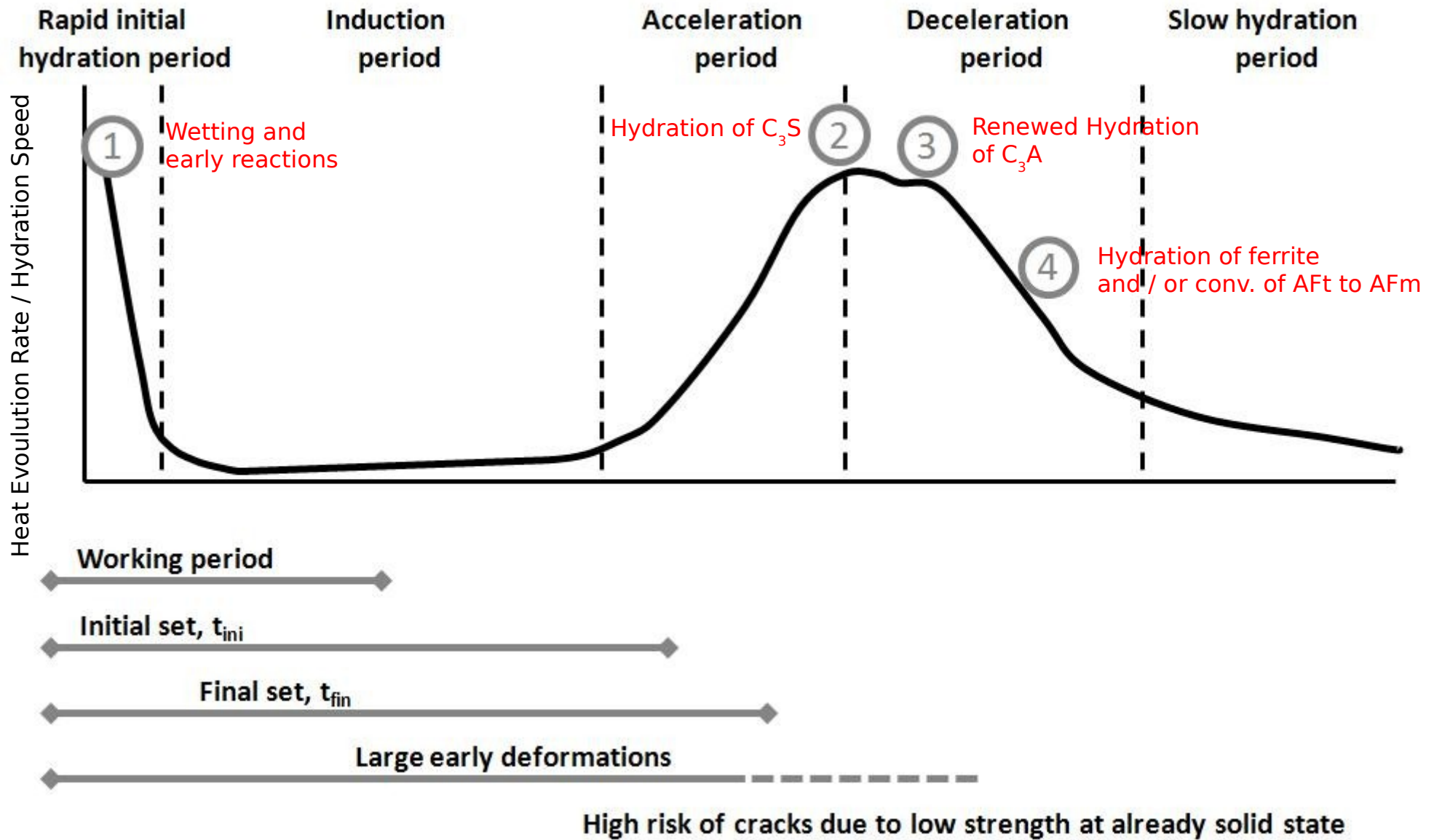
Shrinkage Cone



# Shrinkage over Time



# Characteristic Periods for Early Hydration





# Draft: March 2017

## *”Determination of shrinkage and swelling”*

DEUTSCHE NORM

*Entwurf*

März 2017

DIN EN 13892-9

**DIN**

ICS 91.100.10

Einsprüche bis 2017-04-10

*Entwurf*

**Prüfverfahren für Estrichmörtel und Estrichmassen –  
Teil 9: Bestimmung des Schwindens und Quellens;  
Deutsche und Englische Fassung prEN 13892-9:2017**

Methods of test for screed materials –  
Part 9: *Determination of shrinkage and swelling*;  
German and English version prEN 13892-9:2017

Méthodes d’essais des matériaux pour chapes –  
Partie 9: Disposition du gonflement et retrait;  
Version allemande et anglaise prEN 13892-9:2017

# Final Standard: 20. May 2018

## *"Dimensional stability"*

EUROPEAN STANDARD

**EN 13892-9**

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2018

The hypothesis of linguistic relativity holds that the structure of a language affects its speakers' world view or cognition. Also known as the Sapir-Whorf hypothesis, or Whorfianism  
(c) Wikipedia

ICS 91.100.10

English Version

Methods of test for screed materials - Part 9: Dimensional stability

Méthodes d'essai des matériaux pour chapes - Partie 9  
: Stabilité dimensionnelle

Prüfverfahren für Estrichmörtel und Estrichmassen -  
Teil 9: Dimensionsstabilität

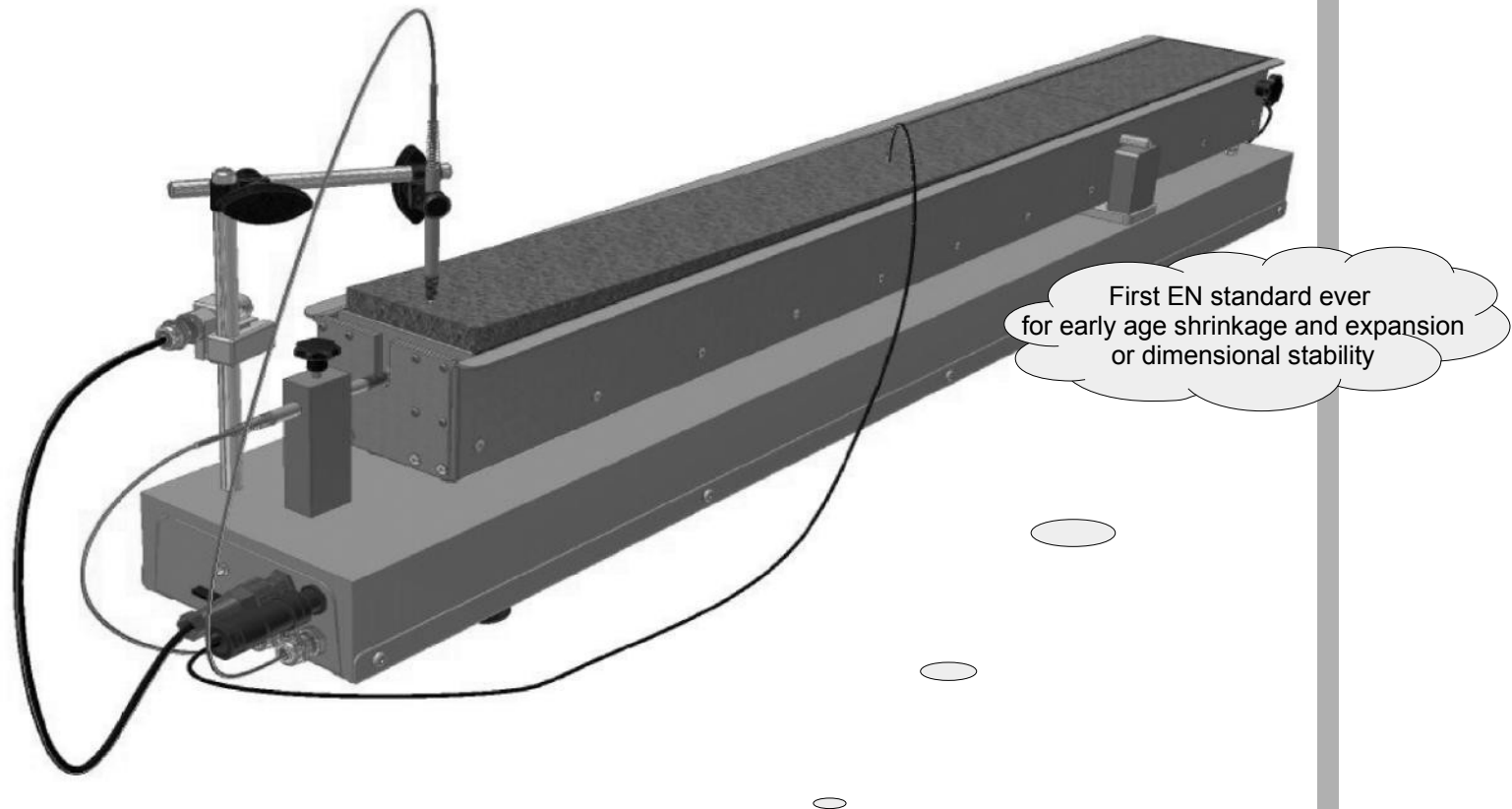
This European Standard was approved by CEN on 20 May 2018.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2019, and conflicting national standards shall be withdrawn at the latest by April 2019.

EU (incl. UK) + Iceland, Norway, Serbia, Switzerland, Turkey  
Not published in German yet (March 2019) !

[www.schleibinger.com](http://www.schleibinger.com)

# EN 13892-9, Section 6: *Curling Profile Apparatus*

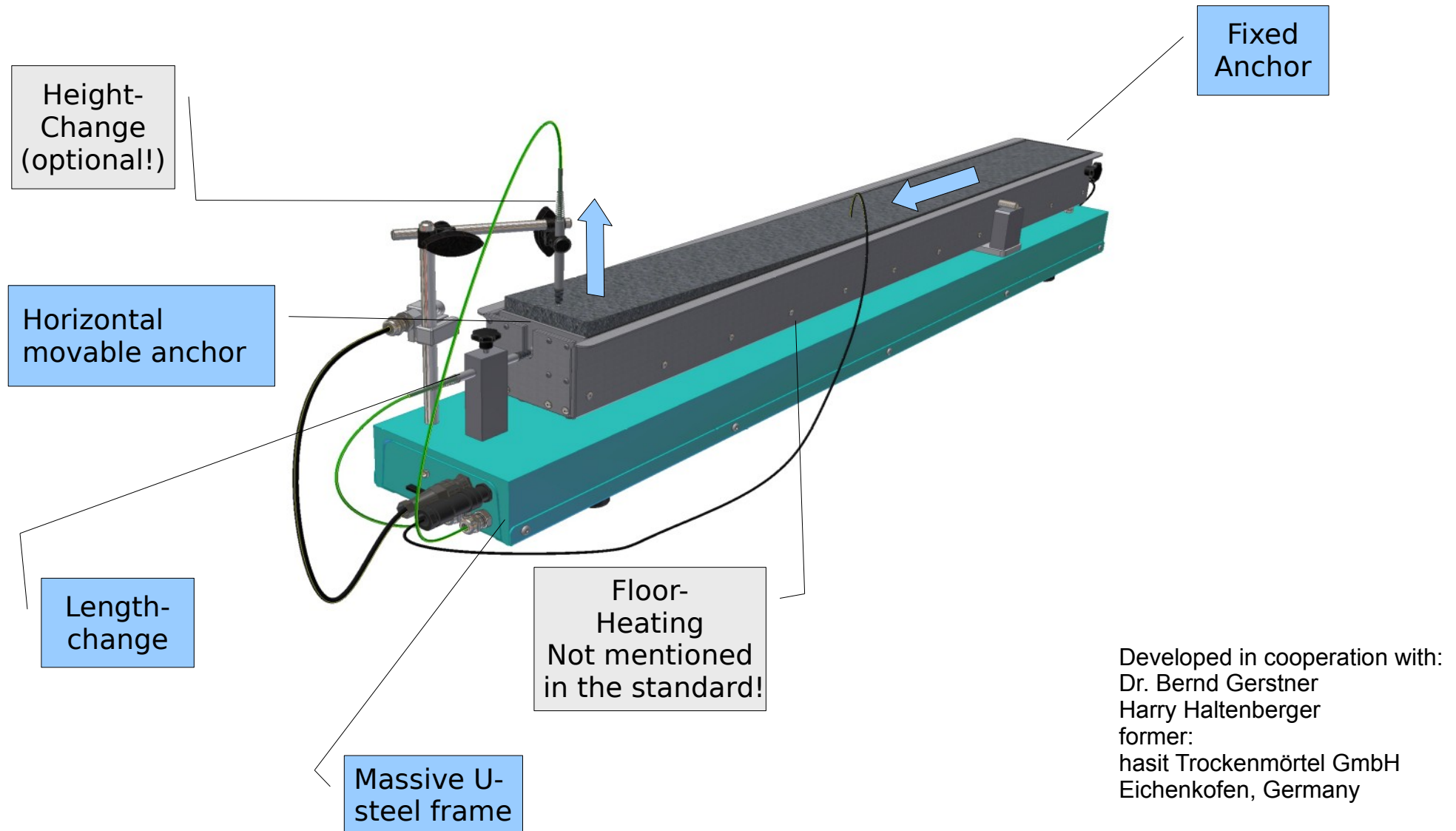


**Figure 1 — Principle illustration of the curling profile apparatus**

Picture: EN13892-9:2018, page 6  
all following citations of the standard  
are marked by a gray shadow,

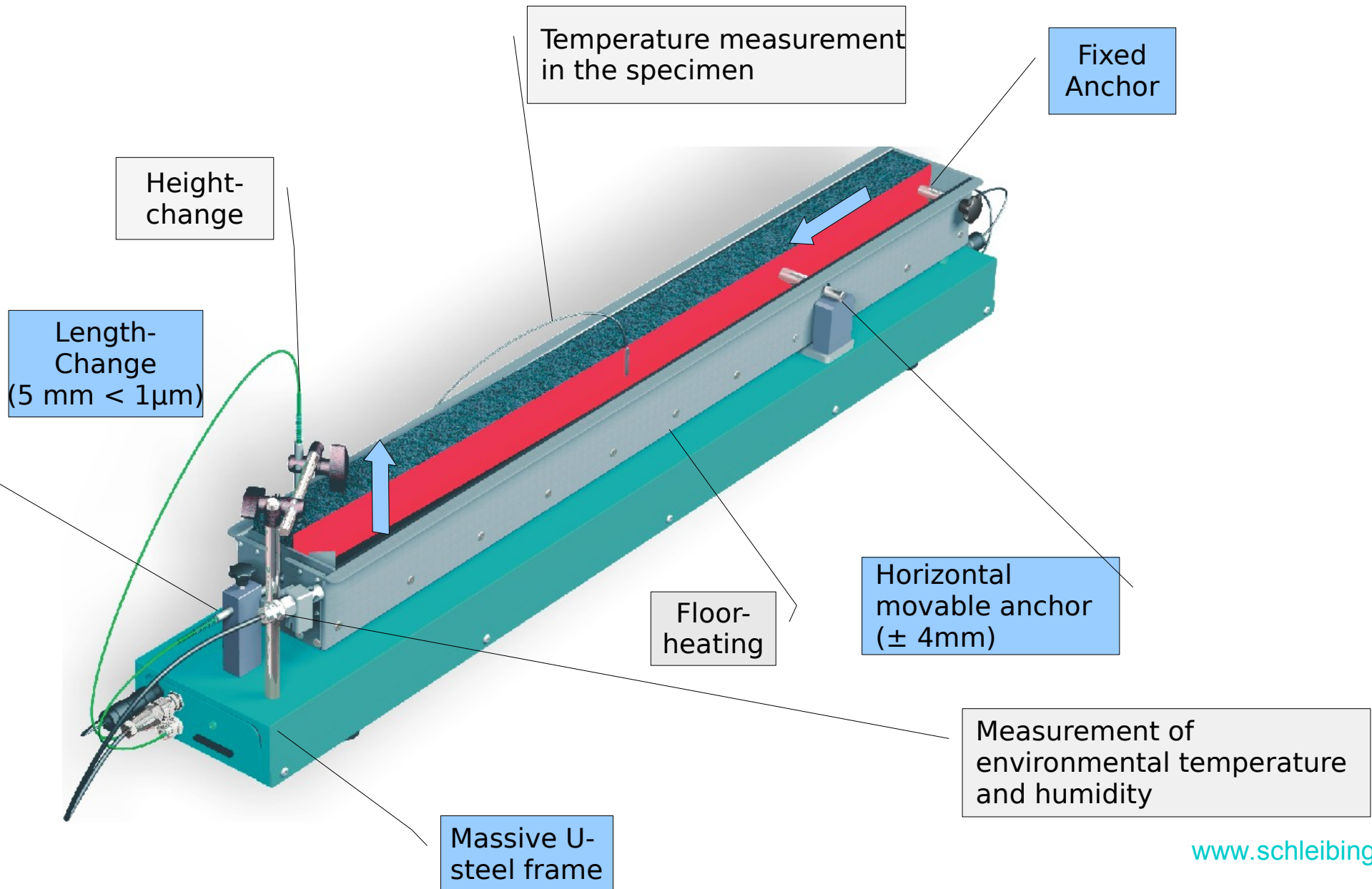


# Schleibinger Curling Drain (2001)

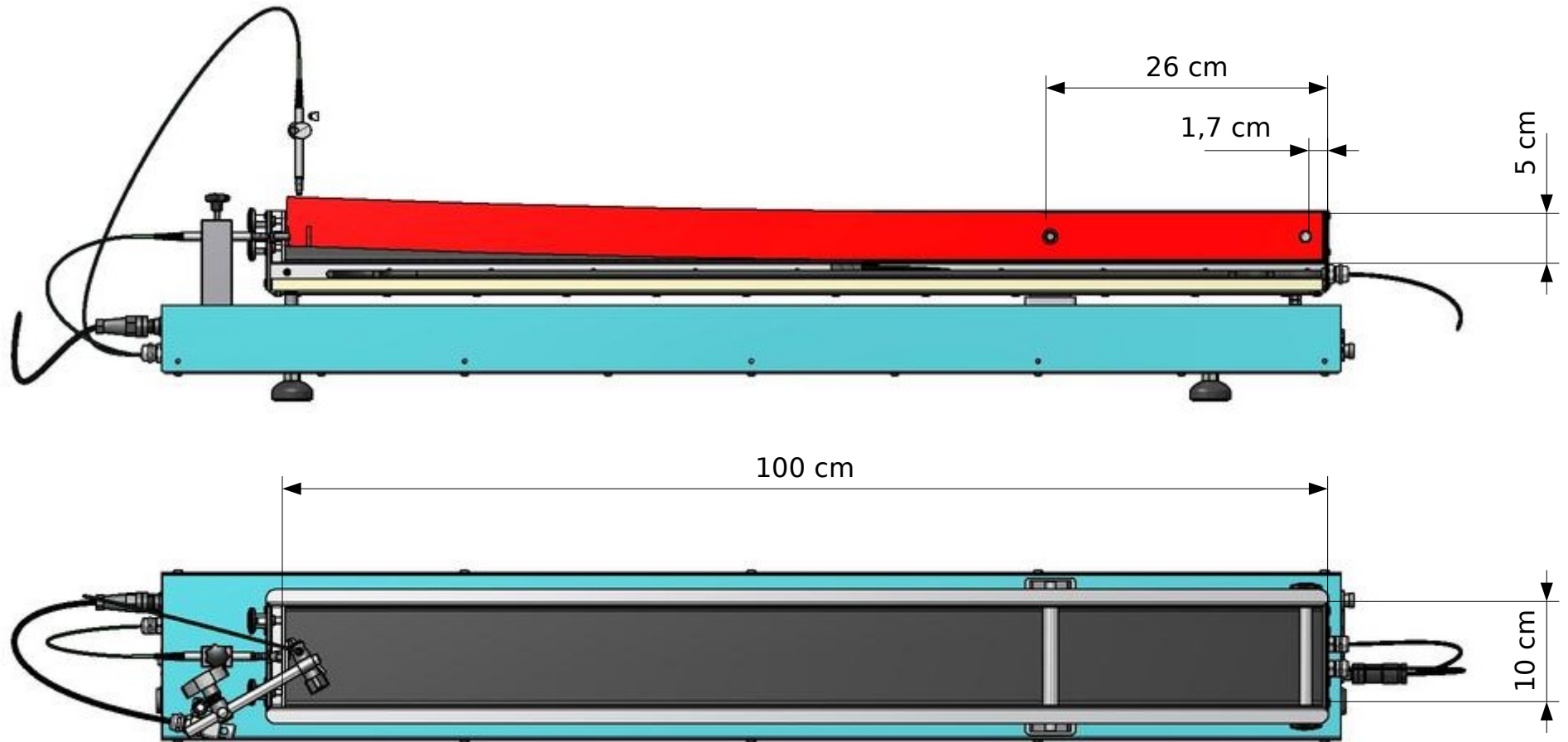


Developed in cooperation with:  
Dr. Bernd Gerstner  
Harry Haltenberger  
former:  
hasit Trockenmörtel GmbH  
Eichenkofen, Germany

# Schleibinger Curling Drain II



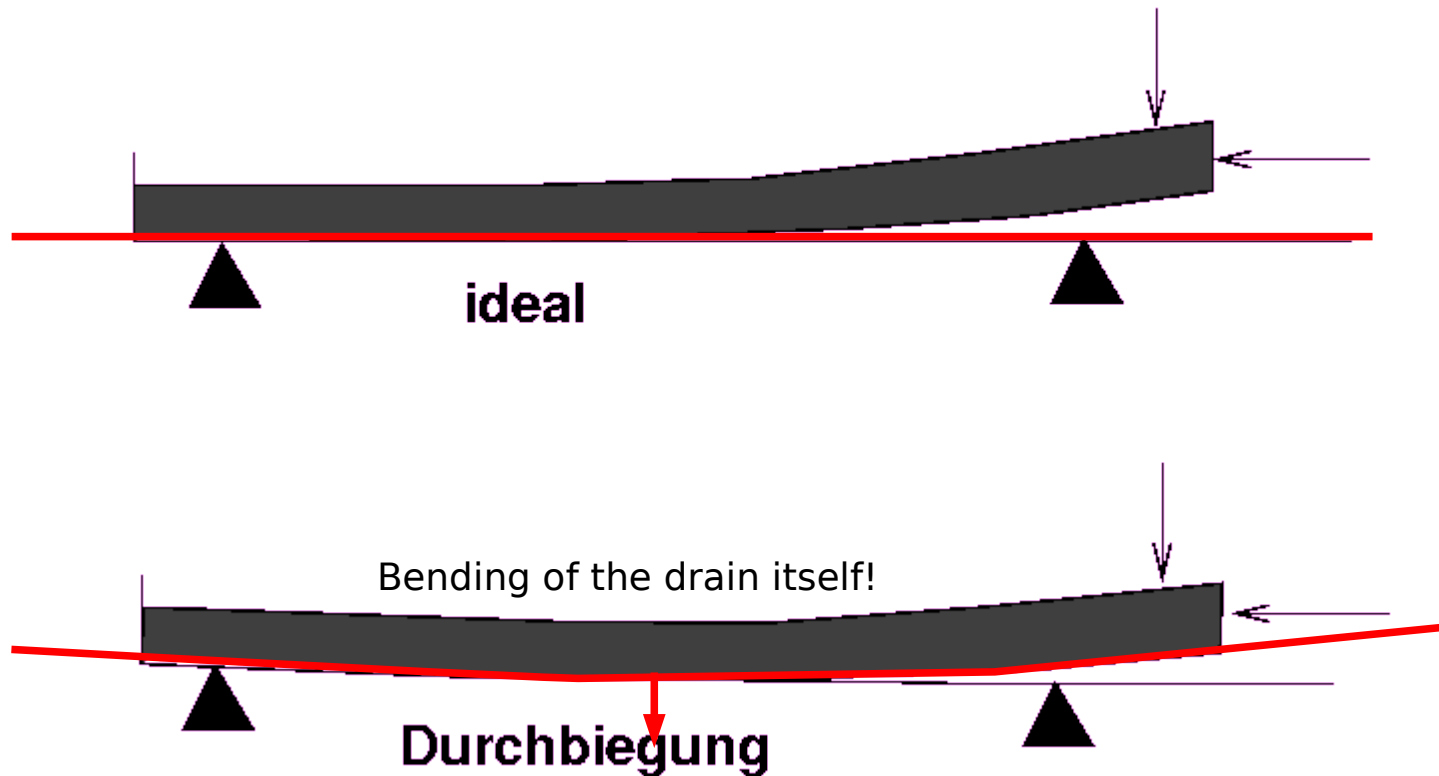
# Side- and Top-View Mechanical Dimensions



Specimen Volume: 5 l



# Curling Measurement..Problems!

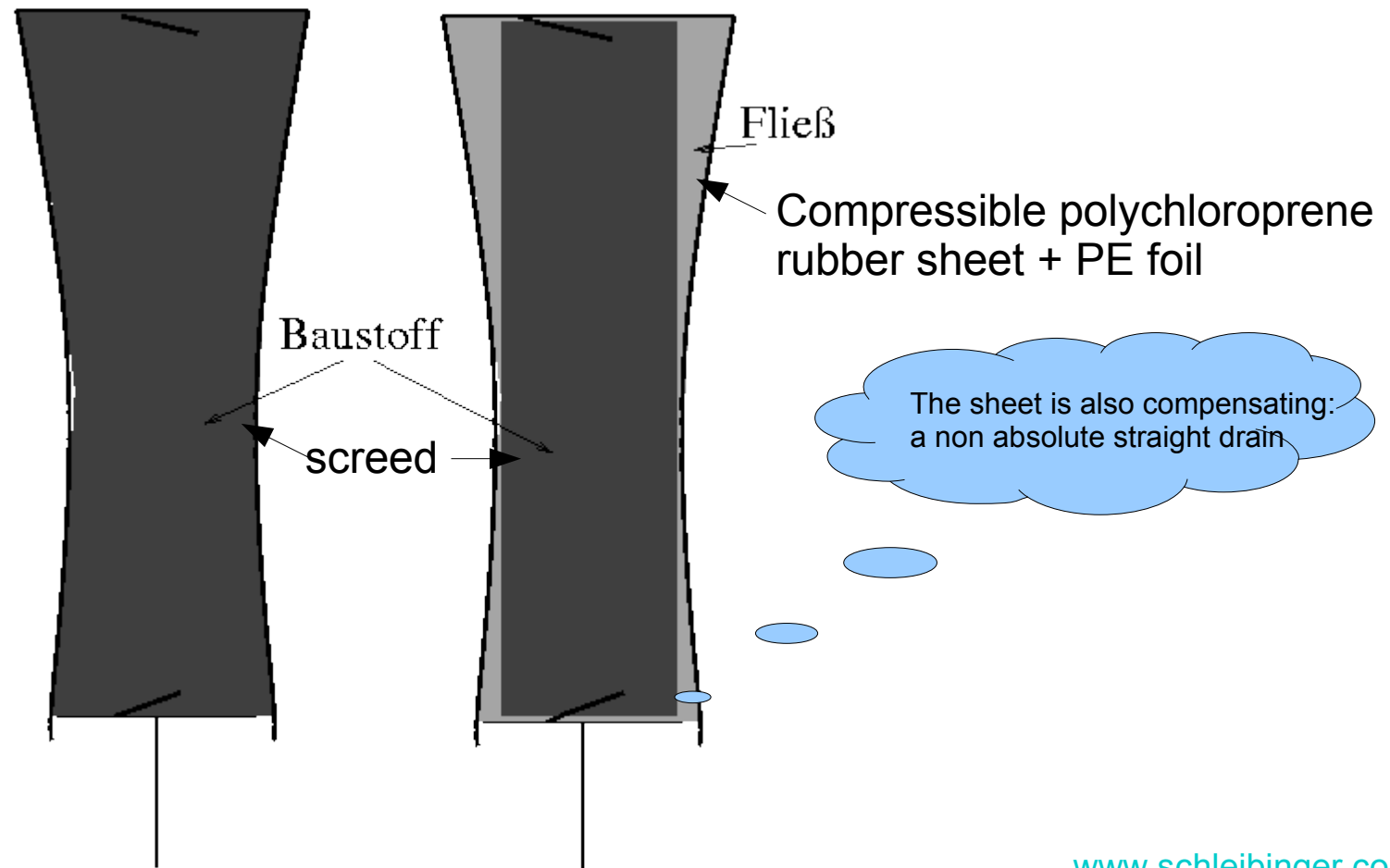


**The Drain must be very strong otherwise the drain is bending itself !**

# Why is a “ 2mm polychloroprene sheet..” required ?

The mould is lined with a 2 mm thick polychloroprene sheet to separate the specimen from the mould and in order to prevent obstruction to free movement even if the specimen should swell.

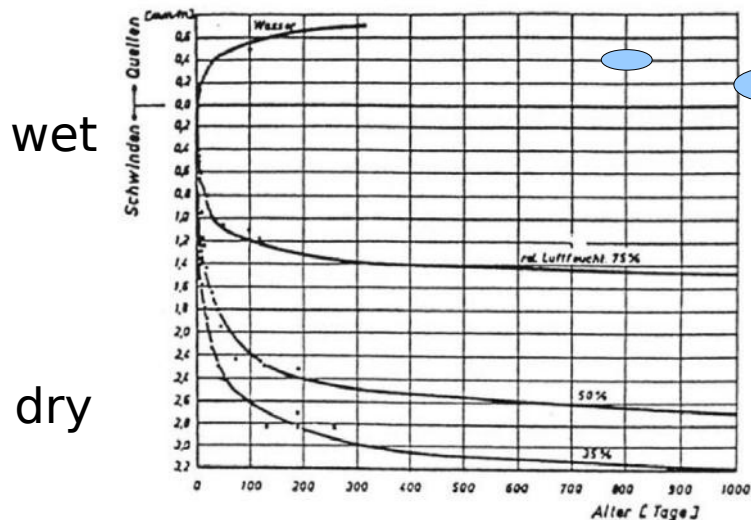
To prevent contamination, the mould is additionally lined with thin (<0,2 mm) polyethylene film.



# Environmental conditions

The dimensional stability (i.e. shrinkage and swelling) of screed materials depends on climatic conditions. Therefore, the entire test procedure shall be carried out in the standard laboratory climate, temperature  $(23 \pm 2)^\circ\text{C}$ , relative humidity  $(50 \pm 5)\%$ .

In order that a single material characteristic is tested, no change of curing or other treatment (e.g. covering the surface) is permitted.



“Shrinkage of prisms is strongly depending in the curing conditions! The EN 13892-9 tries to avoid possible manipulations”

**Bild 8** Schwinden von Zementstein bei Lagerung an Luft von verschiedener relativer Feuchtigkeit bei Beginn der Luftlagerung im Alter von einem Tag (nach Wesche)



Randverformungen bei schwimmenden Estrichen/Heizestrichen – Einflüsse und Folgerungen



# Results: Curve, $L_{start}$ , $L_{max}$ , $L_{end}$ , DL, $\Delta L$ , $\Delta S$ , M



Figure A.1 — Typical length change curve of a calcium sulfate screed material

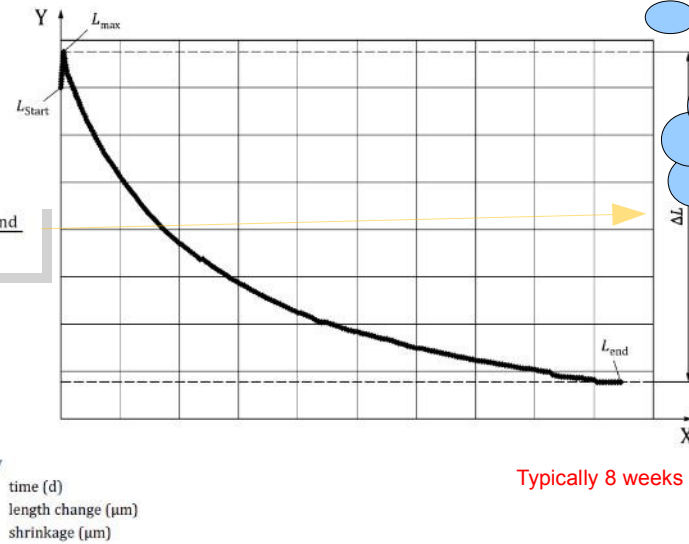


Figure A.2 — Typical length change curve of a cementitious screed material

NO limits defined!

$$DL = \frac{\Delta L}{1 \text{ m}} = \frac{L_{max} - L_{end}}{1 \text{ m}}$$

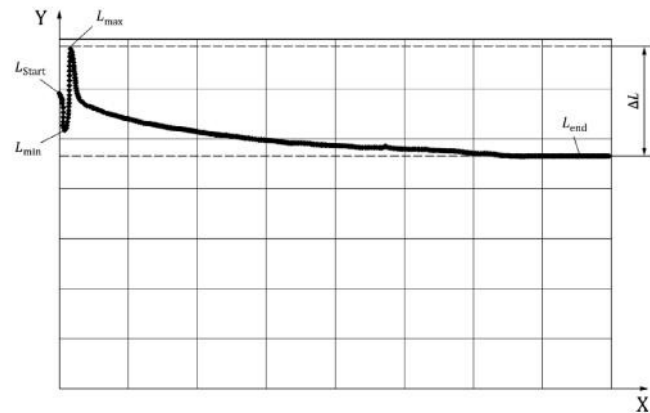


Figure A.3 — Typical length change curve of a shrinkage reduced cementitious screed material

$$DL = \frac{\Delta S}{1 \text{ m}} = \frac{L_{start} - L_{end}}{1 \text{ m}}$$

Moisture @ stop

$$M = \frac{(m_B - m_d)}{m_d}$$

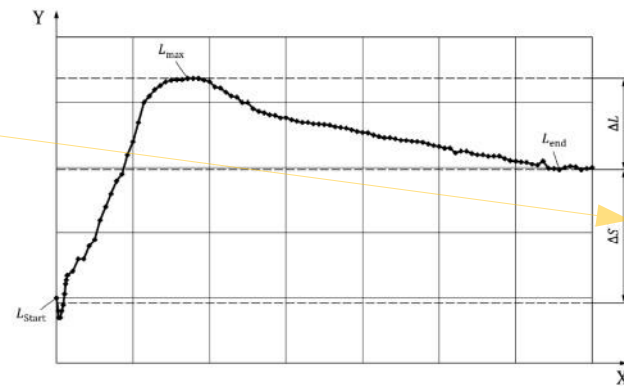


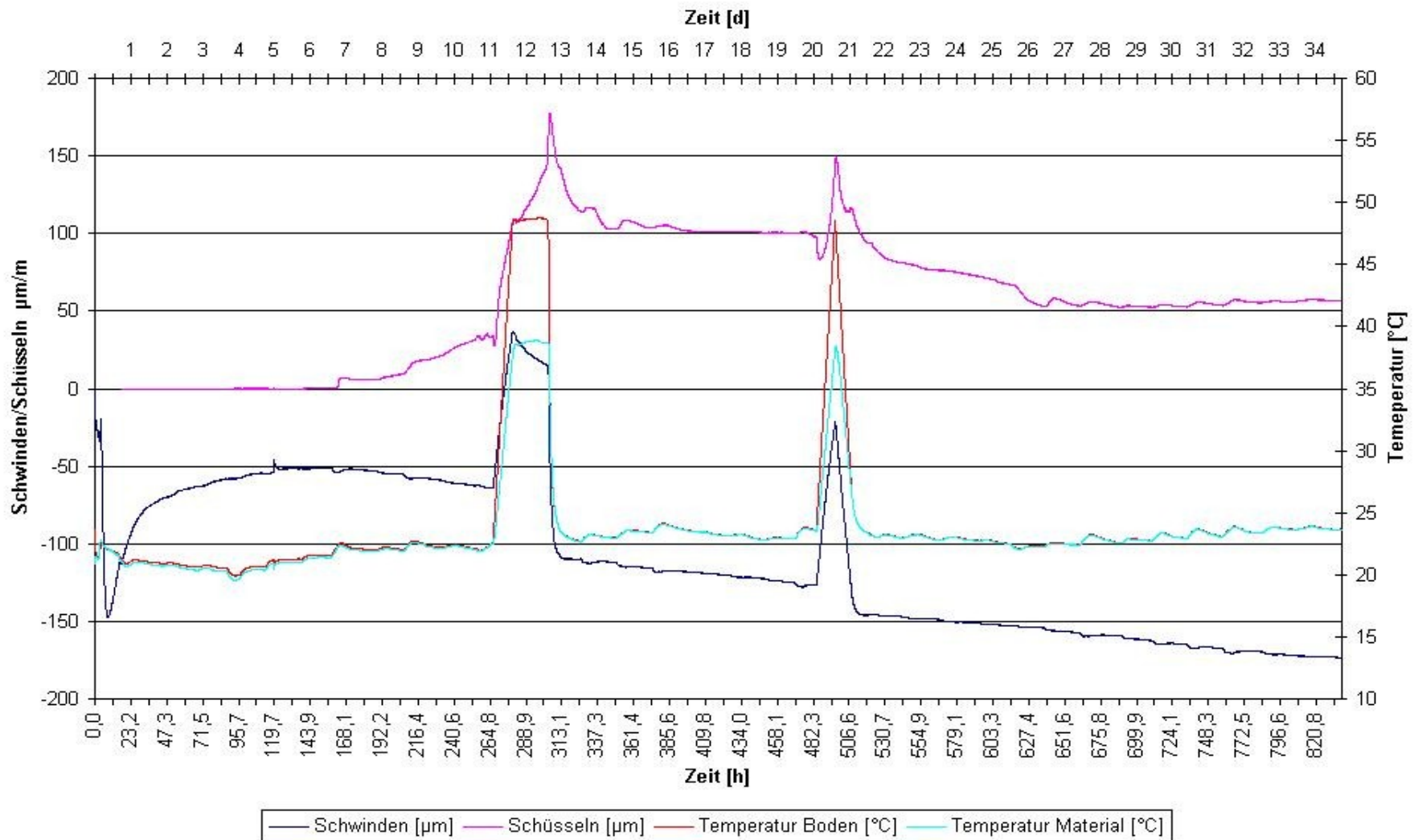
Figure A.4 — Typical length change curve of a swelling screed material

# Conclusion

- The EN 13892-9 “Methods of test for screed – Part 9: Dimensional stability” is the first EN standard at all for measuring the early age shrinkage of constructing materials.
- The title changed from “Determination of Shrinkage and Swelling” to “Dimensional Stability”
- The standard is national mandatory from April 2019 for the EU and EFTA countries.
- The standard defines a *Curling Profile Apparatus* which is quite similar to the *Bending- or Curling Drain* (Schüsselrinne) developed by Schleibinger in 2001
- The tests starts very early: 5 min. after mixing.
- After measurement start the specimen is not touched anymore!
- The specimen surface is not covered, the test is running at lab conditions.
- The tests lasts typically 8..11 weeks and is stopped when the deviation of the actual measurement values is less then 3% in 5 days.
- There is **no** max. limit for shrinkage or expansion defined (yet?).
- The measuring of curling is possible and allowed, but not required (yet?).
- Temperature and humidity recording is not required (yet?).
- The floor heating unit is not used (yet?).

# Bending Drain-Floor Heating Simulation

Heizrinne Schleibinger





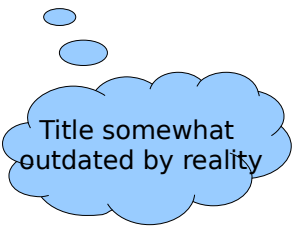
## Testing Systems



Schleibinger Geräte is developing, producing and selling innovative test systems for mineral based constructing materials.

# Determination of Shrinkage and Swelling of Screeds in EN13892-9

- Apparatus
- Procedure
- Status of Normation



Title somewhat outdated by reality

Dipl.Ing. Markus Greim  
Schleibinger Geräte Teubert u. Greim GmbH  
Buchbach / Germany

[www.schleibinger.com](http://www.schleibinger.com)

*My name is Markus Greim. I am co-founder and director of Schleibinger Geräte. Thanks for the invitation and honor to speak here today in this impressive town. Today I will speak about the new EN 13892 dash 9. A new standard for measuring the dimensional stability of screed. I will explain the apparatus and procedure and give you some notes to the status of standardization. I have to point out that I was not a member of one of the responsible national or international standardization committees. So all my comments are my private opinion.*

*The title of my presentation was defines last October and is somewhat outdated, I will explain this later on.*

# Some of our Customers..



Some very short words about our company: We are producing for nearly 30 years now testing instruments for the constructing materials industry.

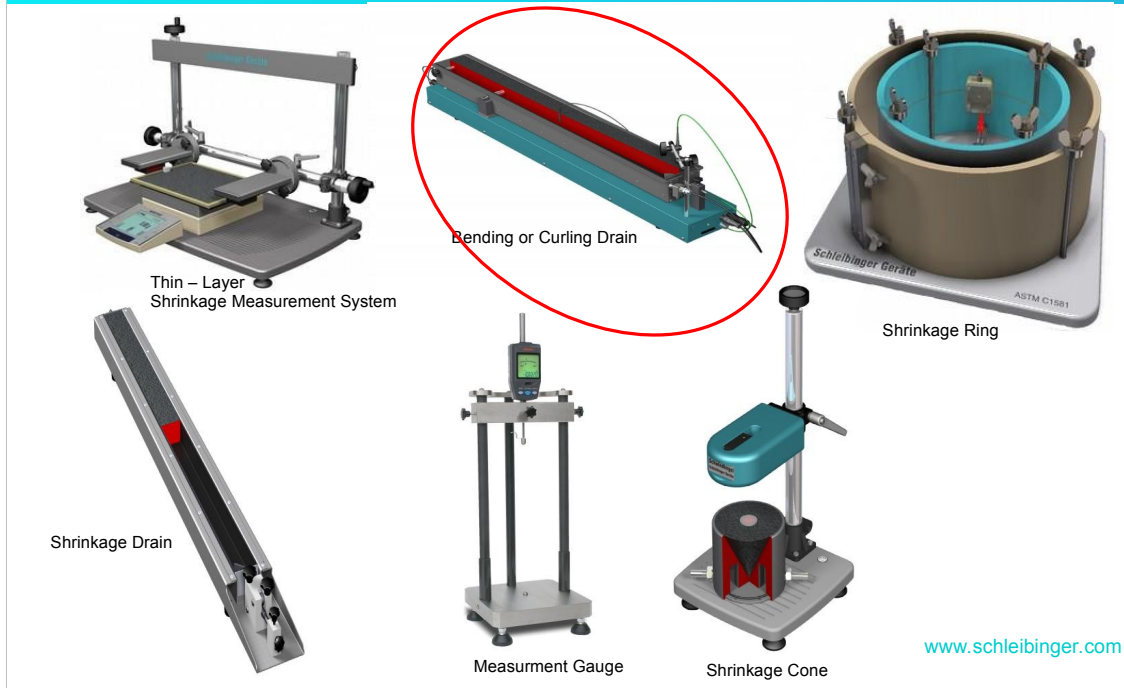
Here you may see some of our customers. One third are cement and binder manufacturers, one third additive suppliers and about one third research institutes. We are exporting about 30% into the EU and 35% in countries outside the EU.







# Schleibinger Shrinkage Measurement



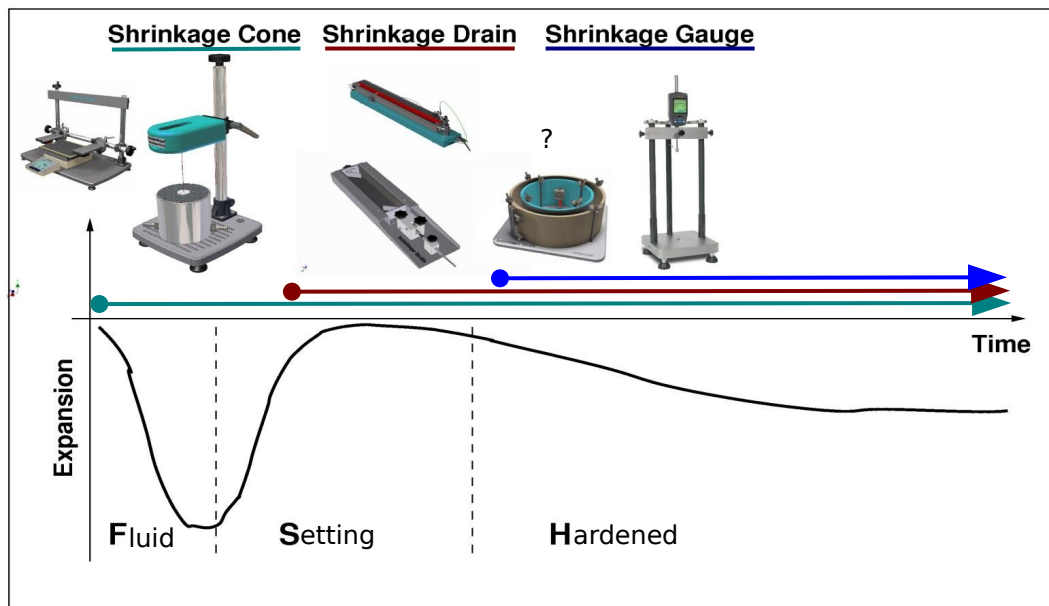
*Unfortunately we never know when and if shrinkage will introduce strains and cracks. Therefore its necessary to measure shrinkage as soon as possible, best from the mixture process.*

*Here you see 6 Instruments. One is the classical length indicator for tests after setting. This was up to now the classical test after 48 hours at prisms of 160 x 40 x 40 mm.*

*All others are filled with fresh material starting he test directly after mixing.*

*Please have a short look to the Bending drain, you will see it again in the next slides.*

# Shrinkage over Time



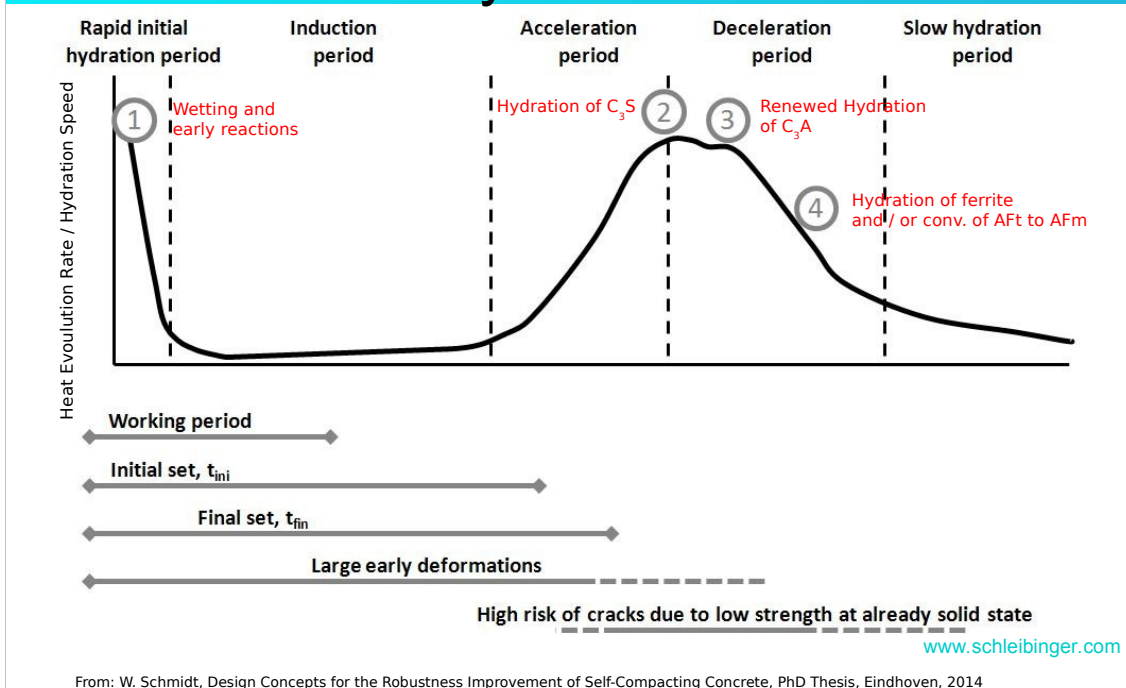
[www.schleibinger.com](http://www.schleibinger.com)

In the lower part of the slide you see a typical shrinkage curve after time of cement based materials.

After a shrinkage in the plastic state (air evaporation etc.) first growth of needle shaped crystals give an expansion, and later on this needles are replaced by more dense sphere shaped particles.

For technical and also economical reasons, there are different instruments for each part of this curve existing.

# Characteristic Periods for Early Hydration



Here you see that the heat evolution (Hydration speed) correlates very well with the different shrinkage mechanisms.



Draft: March 2017

*”Determination of shrinkage and swelling”*

DEUTSCHE NORM		<i>Entwurf</i>	März 2017
	DIN EN 13892-9	<b>DIN</b>	
ICS 91.100.10	<i>Entwurf</i>		Einsprüche bis 2017-04-10
<b>Prüfverfahren für Estrichmörtel und Estrichmassen – Teil 9: Bestimmung des Schwindens und Quellens; Deutsche und Englische Fassung prEN 13892-9:2017</b>			
Methods of test for screed materials – Part 9: <b>Determination of shrinkage and swelling;</b> German and English version prEN 13892-9:2017			
Méthodes d'essais des matériaux pour chapes – Partie 9: Disposition du gonflement et retrait; Version allemande et anglaise prEN 13892-9:2017			

[www.schleibinger.com](http://www.schleibinger.com)

Back to the EN 13892-9. After several years of discussions a first draft was published as prEN in Germany in March 2017, in other countries some months before. The title was, as the title of my presentation “Shrinkage and Swelling”

# Final Standard: 20. May 2018

## *"Dimensional stability"*

EUROPEAN STANDARD

EN 13892-9

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2018

ICS 91.100.10

English Version

Methods of test for screed materials - Part 9: Dimensional stability

Méthodes d'essai des matériaux pour chapes - Partie 9  
: Stabilité dimensionnelle

Prüfverfahren für Estrichmörtel und Estrichmassen -  
Teil 9: Dimensionsstabilität

This European Standard was approved by CEN on 20 May 2018.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2019, and conflicting national standards shall be withdrawn at the latest by April 2019.

EU (incl. UK) + Iceland, Norway, Serbia, Switzerland, Turkey  
Not published in German yet (March 2019) !

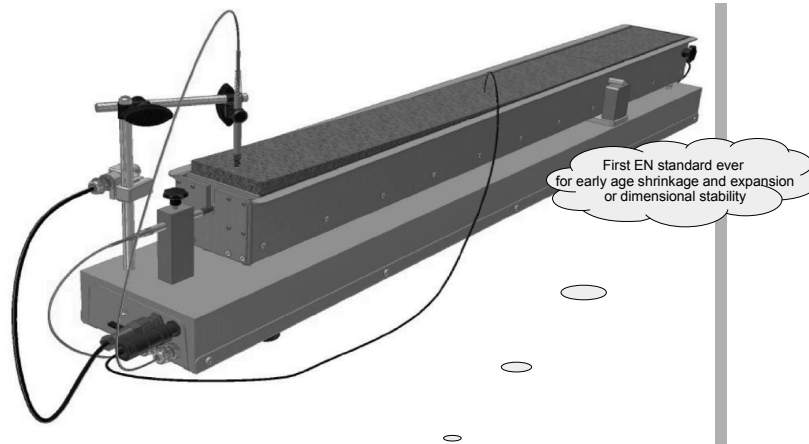
[www.schleibinger.com](http://www.schleibinger.com)

The hypothesis of linguistic relativity holds that the structure of a language affects its speakers' world view or cognition. Also known as the Sapir-Whorf hypothesis, or Whorfianism (c) Wikipedia

In May 2018 the final version was published. The title has changed to "Dimensional Stability" which sound a little bit smoother or euphemistic. Its important to say that only the title has changed, the content compared to the draft, was kept untouched.

The standard is legally binding from April 2019, next month. It relates to all EU countries including the U.K. I think as well as Switzerland, Norway, Iceland and Turkey.

## EN 13892-9, Section 6: *Curling Profile Apparatus*



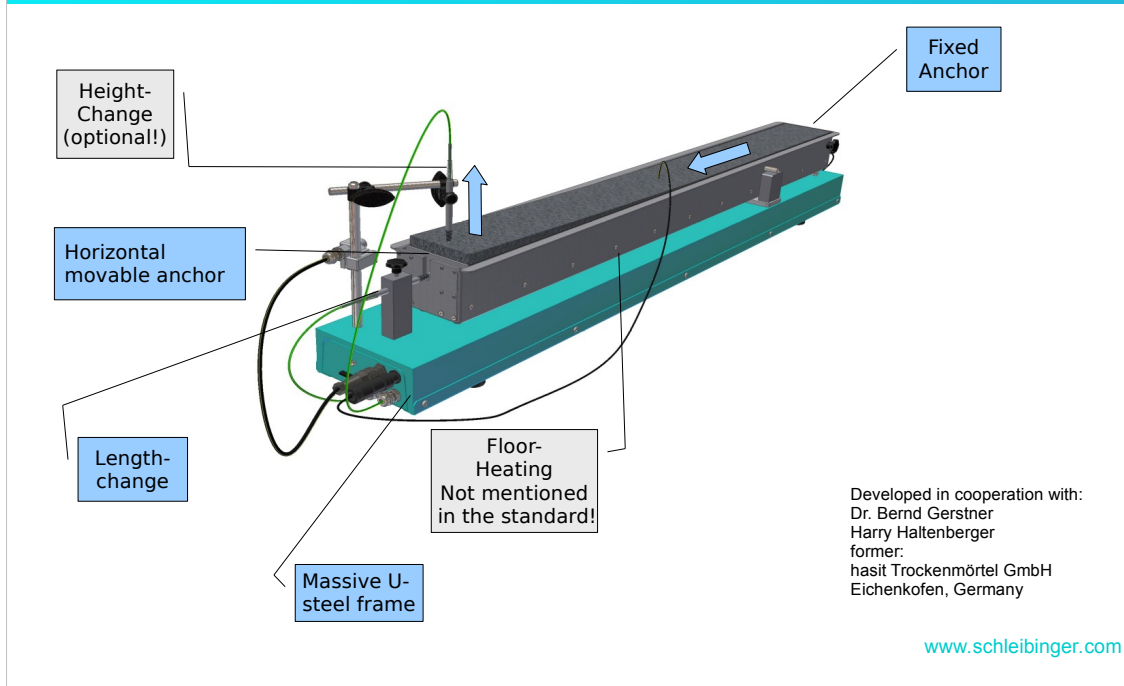
**Figure 1 — Principle illustration of the curling profile apparatus**

Picture: EN13892-9:2018, page 6  
all following citations of the standard  
are marked by a gray shadow.

[www.schleibinger.com](http://www.schleibinger.com)

Here you see Figure 1 of the standard. The required instrument is called here “Curling Profile Apparatus” even if only the length change of the specimen is measured.

## Schleibinger Curling Drain (2001)



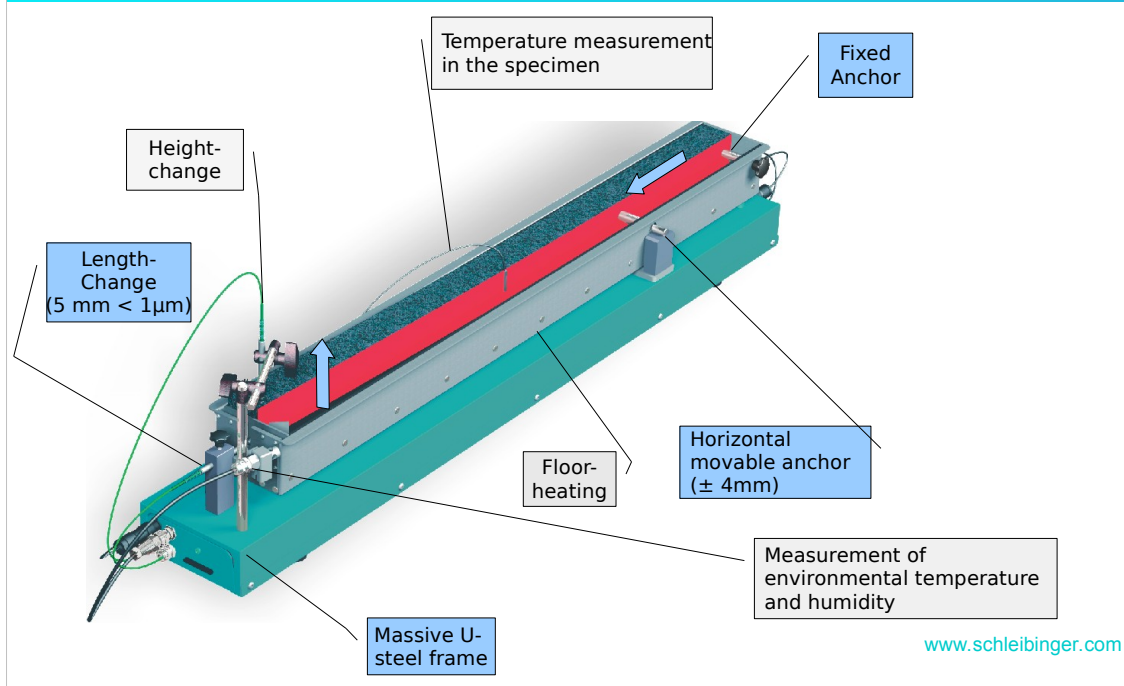
In 2001 Schleibinger has developed, in cooperation Bernd Gerstner and Harry Haltenberger from Hasit, the so called Curling or Bending Drain, in German Schüsselrinne. If you may compare this picture with the last slide you may find some similarities I guess.

Again: only the length change measurement is required for the standard.

The components with the blue legends are mandatory for the EN 13892-9. The components with the gray legends are not required, but the standards allows optional also the masurement of the curling.



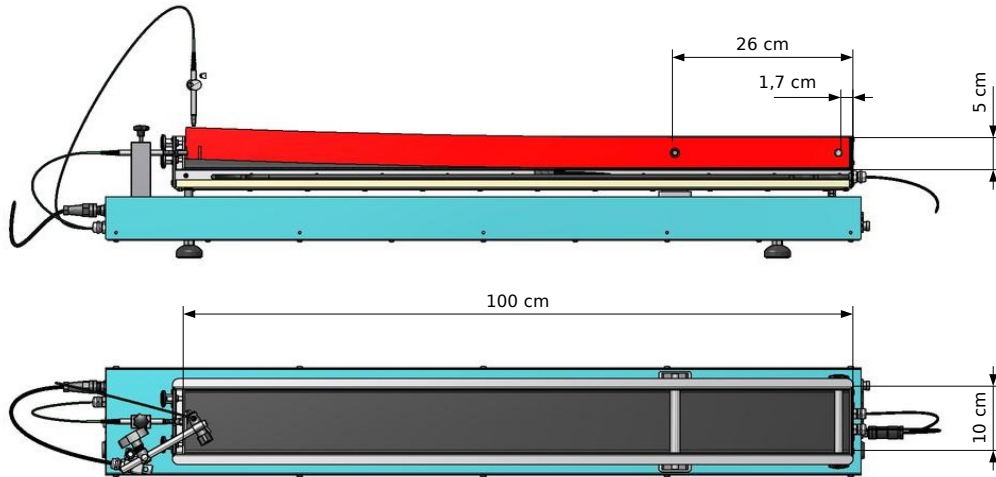
# Schleibinger Curling Drain II



Here another picture where the specimen is cut in the middle. You may see the two anchors, the standard is speaking about dowels, on the right side and the movable anchor or dowel on the left side.

The dowel in the middle is laying movable on a vertical support which is the force transmission point if the specimen is curling.

## Side- and Top-View Mechanical Dimensions



Specimen Volume: 5 l

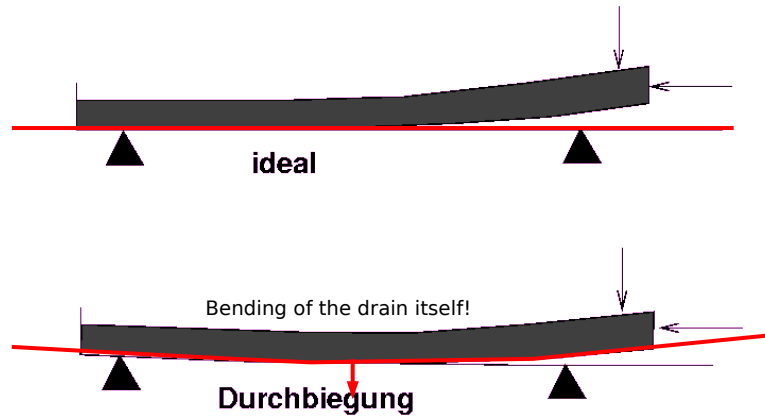
[www.schleibinger.com](http://www.schleibinger.com)

Here you see the mechanical dimensions. The specimen is 1 meter long, 10 cm wide and 5 cm depth. Five liters of screed are required.

The standard allows also thinner layers of screed, but then the dowels have to be modified.

Here you see again the dowel in the middle which is laying movable on a vertical support which is the force transmission point if the specimen is curling.

## Curling Measurement..Problems!



**The Drain must be very strong otherwise  
the drain is bending itself !**

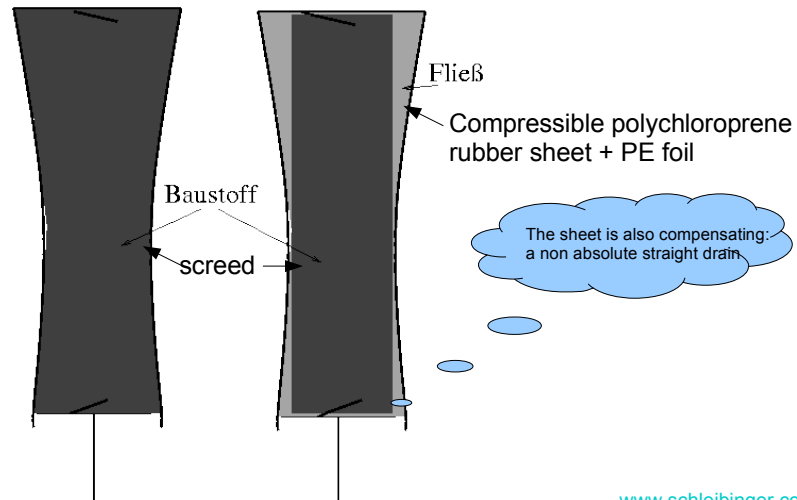
[www.schleibinger.com](http://www.schleibinger.com)

Over the force transmission points all the forces are supported not by the tin drain but by the very rigid U steel, where the drain is based on.

# Why is a “ 2mm polychloroprene sheet..” required ?

The mould is lined with a 2 mm thick polychloroprene sheet to separate the specimen from the mould and in order to prevent obstruction to free movement even if the specimen should swell.

To prevent contamination, the mould is additionally lined with thin (<0,2 mm) polyethylene film.



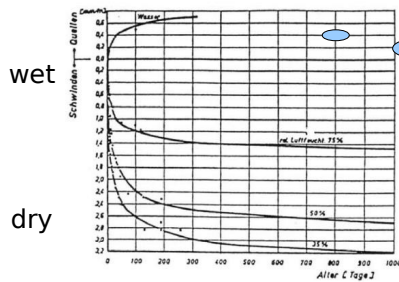
The standard requires a 2 mm polychloroprene sheet around the specimen as well as an additional 0.2 mm PE foil.

The sheet compensates friction by swelling of the material as well as a not 100% absolute straight drain

# Environmental conditions

The dimensional stability (i.e. shrinkage and swelling) of screed materials depends on climatic conditions. Therefore, the entire test procedure shall be carried out in the standard laboratory climate, temperature ( $23 \pm 2$ )°C, relative humidity ( $50 \pm 5$ )%.

In order that a single material characteristic is tested, no change of curing or other treatment (e.g. covering the surface) is permitted.



“Shrinkage of prisms is strongly depending in the curing conditions! The EN 13892-9 tries to avoid possible manipulations”

Bild 8 Schwinden von Zementstein bei Lagerung an Luft von verschiedener relativer Feuchtigkeit bei Beginn der Luftlagerung im Alter von einem Tag (nach Wesche)

Randverformungen bei schwimmenden Estrichen/Heizestrichen – Einfluss und Folgerungen  
von Werner Grottel  
veröffentlicht in Bautechnik (Juni 1987)

[www.schleibinger.com](http://www.schleibinger.com)

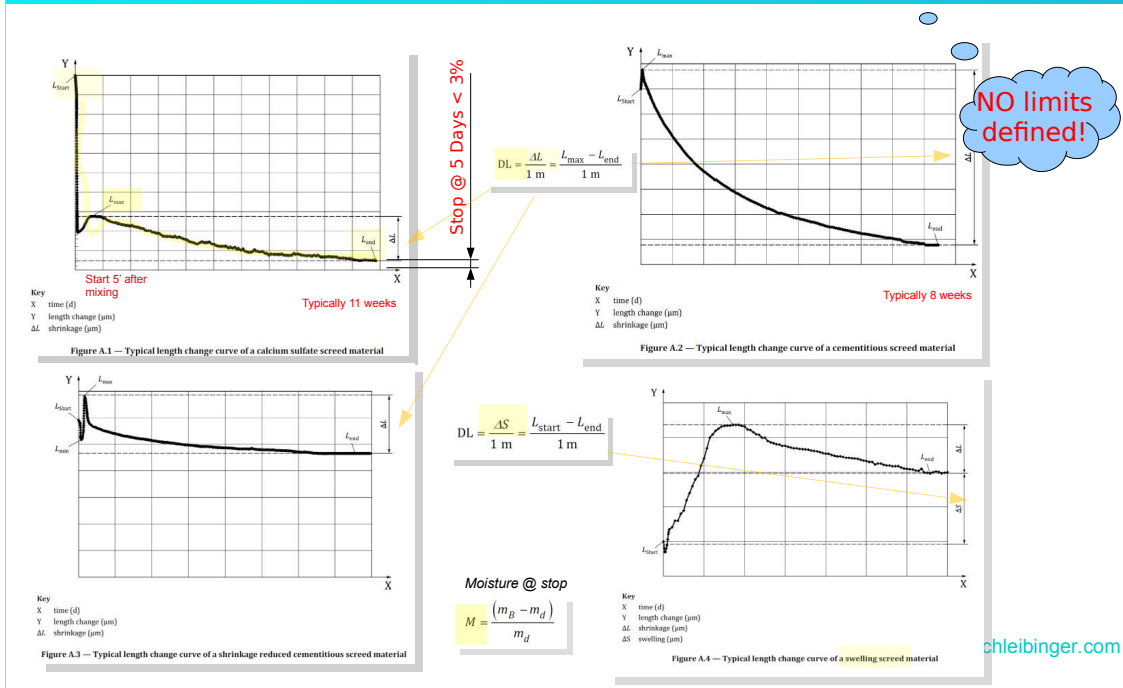
As we know from the textbooks, here a picture from Professor Wesche, the shrinkage and expansion strongly depends on the curing conditions.

The EN 13892-9 define here the standard lab conditions of  $23^{\circ}\text{C} \pm 2\text{K}$  and  $50 \pm 5\%$  rel. humidity.

The top surface of the specimen will be NOT covered!



# Results: Curve, $L_{start}$ , $L_{max}$ , $L_{end}$ , $DL$ , $\Delta L$ , $\Delta S$ , $M$



Here you see 4 curves from the Annex A of the standard.

The test starts directly after mixing and making a mini slump test 5 minutes after mixing.

The test is finished when the deviation of the length is less the 3% of the actual value within 5 days.

The standard is mentioning typically duration of 8 weeks for cementitious and magnesite screed and 11 weeks for calcium sulfate materials.

In test report the curve itself, the moisture content at the end of the test (tested by drying at 105°C resp. 40° for calcium sulfate).

The dimensional stability is described with the parameters  $L_{start}$ ,  $L_{max}$ ,  $L_{end}$  and the rel parameters  $DL$ ,  $\Delta L$  and  $\Delta S$ .

In the standard are NO maximum or minimum acceptance limits described!

# Conclusion

- The EN 13892-9 “Methods of test for screed – Part 9: Dimensional stability” is the first EN standard at all for measuring the early age shrinkage of constructing materials.
- The title changed from “Determination of Shrinkage and Swelling” to “Dimensional Stability”
- The standard is national mandatory from April 2019 for the EU and EFTA countries.
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- The measuring of curling is possible and allowed, but not required (yet?).
- Temperature and humidity recording is not required (yet?).
- The floor heating unit is not used (yet?).

[www.schleibinger.com](http://www.schleibinger.com)

## Conclusion and Summary

The EN 13892-9 “Methods of test for screed – Part 9: Dimensional stability” is the first EN standard at all for measuring the early age shrinkage of constructing materials.

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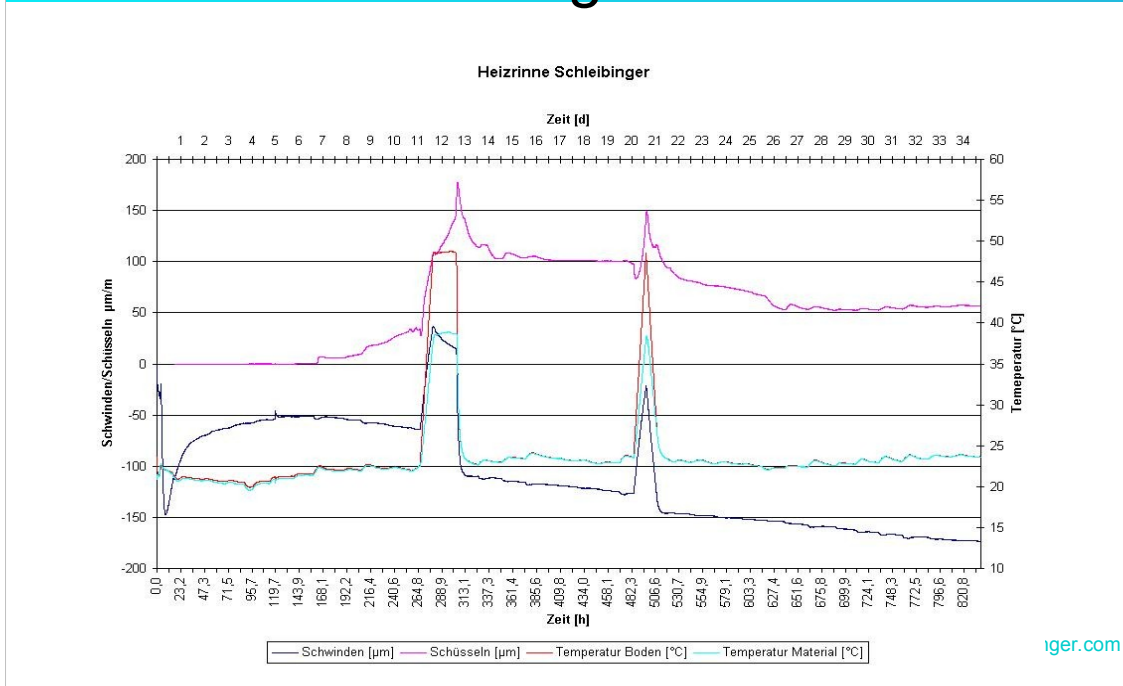
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Temperature and humidity recording is not required (yet?).

The floor heating unit is not used (yet?).

**THANKS FOR YOUR ATTENTION!**

# Bending Drain-Floor Heating Simulation



*Some results of curling and length change with and w/o floor heating.*