Experiences of EN 12697-16 in Sweden, (Prall)

S:t Petersburg 6-7 April

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Overview of road industry in Sweden

Swedish Transport Administration

Some numbers

- State roads: 98 500 km (80% paved roads, 20% gravel roads)
- Municipal roads and streets: 41 600 km
- Private roads with state subsidies: 76 300 km
- Private roads without state subsidies: Large amount!

Overview of road industry in Sweden

Total production of hot and warm mix asphalt 2015

Surface course	Binder course	Base course
55 %	25 %	20 %

- Warm mix asphalt 2015: **0,700** million tons total

Company in the asphalt industry in 2015

Production only	Production & Laying	Laying only
0	11	80

In brief

VTI

Swedish National Road and
Transport Research Institute

VTI is an independent and internationally prominent research institute within the transport sector

Founded 1923

Located in Linköping, Stockholm, Göteborg, Borlänge and Lund

VTI's research areas

- Infrastructure maintenance
- Vehicle technology
- The environment
- People in the transport system
- Planning and decision making processes
- Traffic analysis
- Traffic safety
- Transport economics
- Transport system
- Pavement technology

Wheeltracking equipment

The susceptibility of bituminous materials to deform is assessed by the rut depth formed by repeated passes of a loaded wheel over an asphalt concrete slab at a fixed temperature.

Material testing system

An advanced servo-hydraulic material testing system

Many applications, mainly for mechanical testing of materials intended for use in pavement layers

Measuring of stiffness modulus, creep, fatigue, shear and triaxial tests

Vti:s Road Laboratory

Departments in our laboratory

- Binder/bitumen
- Unbound material, Aggregate
- Asphalt

Standard methods

EN-methods

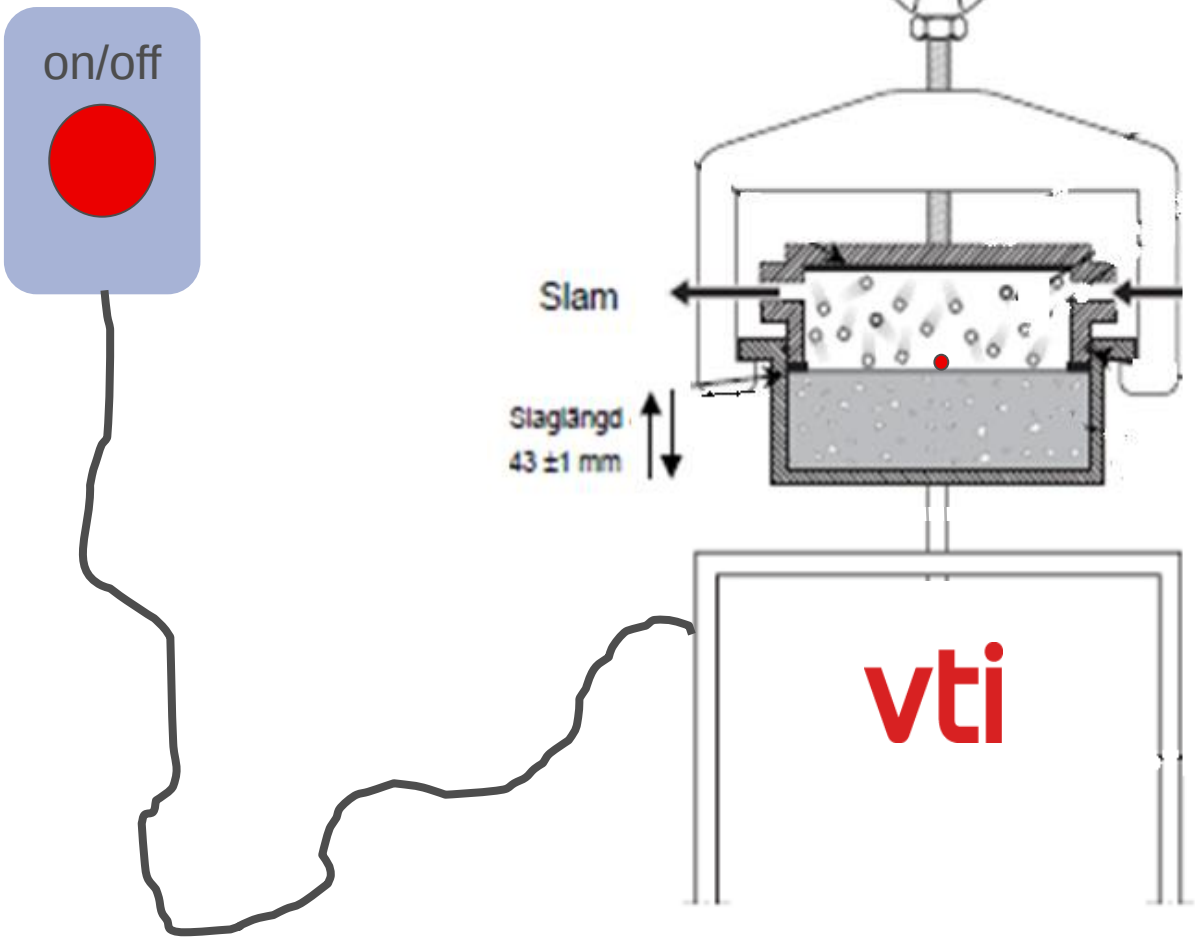
ASTM et al

In house developed methods

Accreditated according to EN ISO/IEC 17025

Certified according to EN ISO 9001 &14001

EN 12697-16:2016
Abrasion by studded tyres
Method A: Prall


on/off
Slam
Slaglängd
43 ±1 mm
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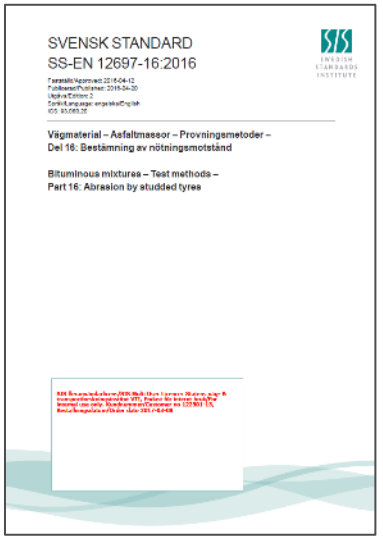
EN 12697-16:2016 Prall

Scope

Determining the suspectibility of abrasion by studded tyres. Test on cylindrical specimen of bituminous mixtures


SVENSK STANDARD
SS-EN 12697-16:2016

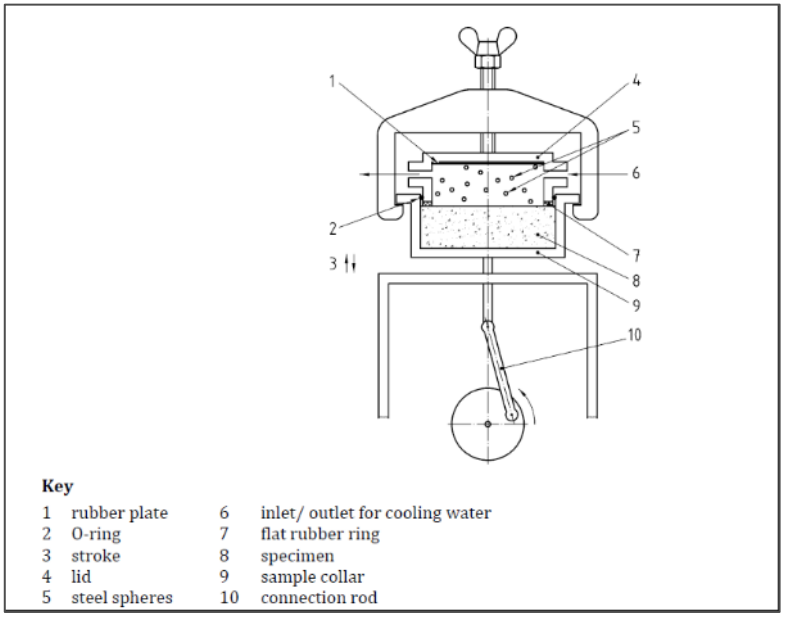
Vägmaterial – Asfaltmassor – Provningsmetoder –
Del 16: Bestämning av nötningsmotstånd

Bituminous mixtures – Test methods –
Part 16: Abrasion by studded tyres

EN 12697-16:2016 Prall

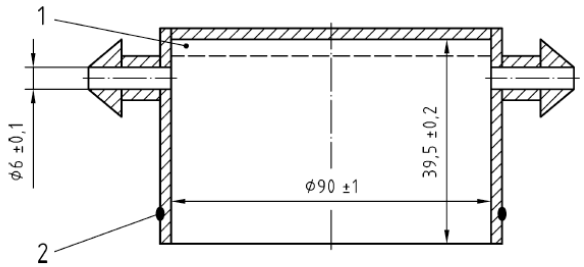
Apparaturs

- Stroke height (43 ±1 mm)
- Water temperature (5 ±1 °C)
- 40 steel spheres diameter between 11,50 and 12,01 mm
- The hardness: 58-65 HRC
- The total weight steel balls: 265-285g
- Frequency (950 ±10 stroke/min)
- Abrasion time (15 min ±10 sek)



Key

1	rubber plate	6	inlet/ outlet for cooling water
2	O-ring	7	flat rubber ring
3	stroke	8	specimen
4	lid	9	sample collar
5	steel spheres	10	connection rod



Key

1 rubber plate
2 O-ring

Round Robin test 2016 Prall

Ambition

Test normal mix types from highly trafficked roads

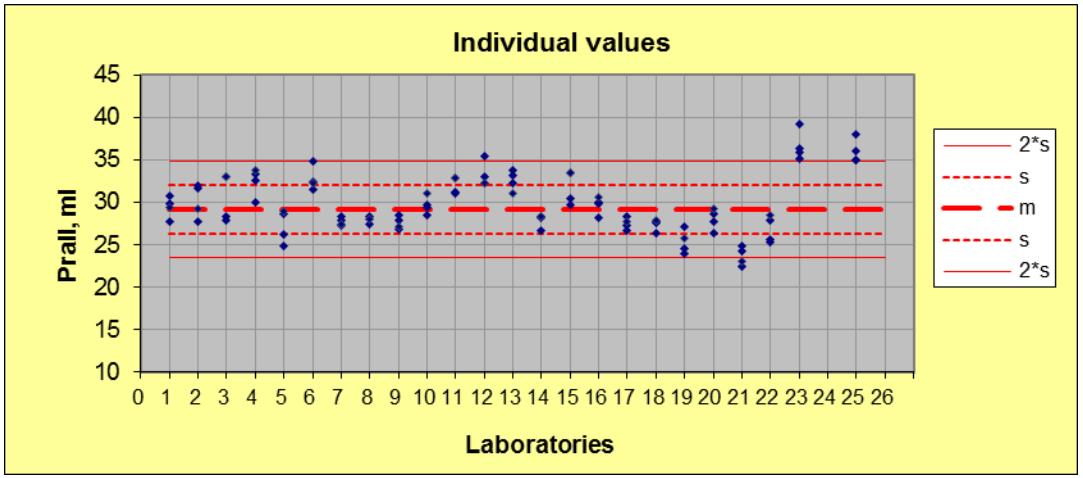
Delivered and was conducted between October to November 2016

Three mixes:

1. SMA11 70/100 (Peab)
2. SMA16 70/100 (Skanska)
3. AC16 70/100 (NCC)

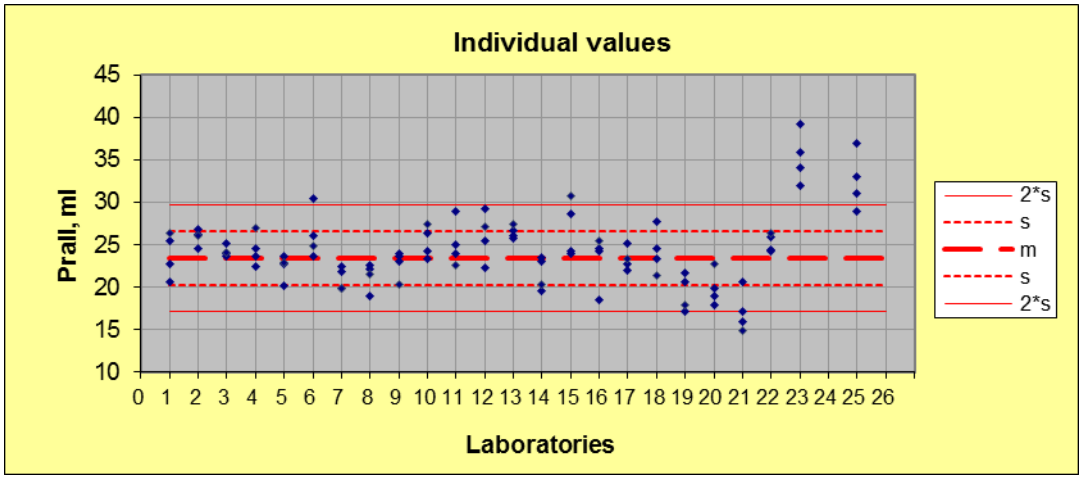
Results

Material 1: SMA11 70/100



Material 1
Mean: 29,1 ml

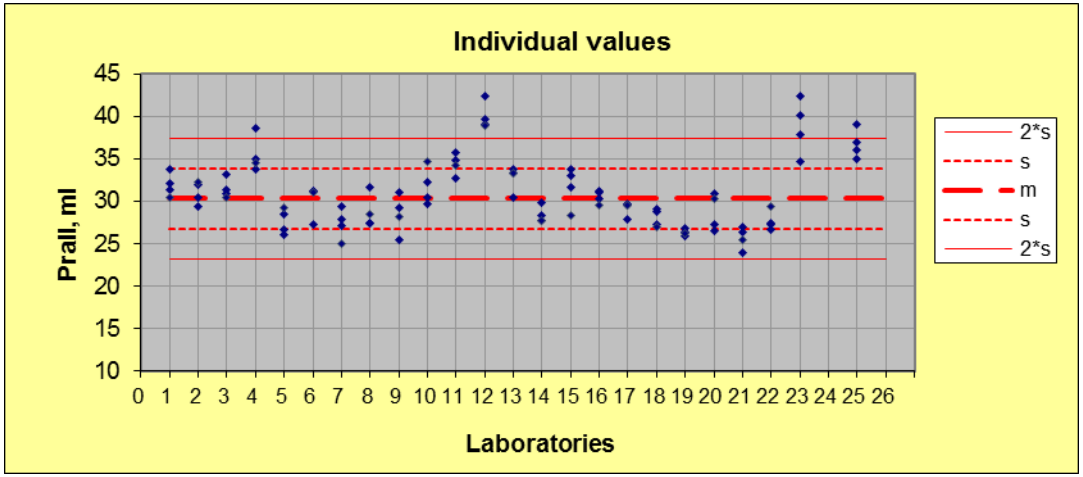
Material 2: SMA16 70/100



Material 2
Mean: 23,4 ml

Results

Material 3: AC16 70/100



Material 3
Mean: 30,3 ml

Statistical evaluation

Prov	m	r	R	r-%	R-%	$r_{standard}$	$R_{standard}$
Material 1	29,1	3,9	8,1	13,5	27,6	**15 %**	**27 %**
Material 2	23,4	6,0	8,9	25,8	38,2		
Material 3	30,3	4,6	10,2	15,1	33,5		
Mean:	27,6	**4,9**	**9,0**	**18,1**	**33,1**		

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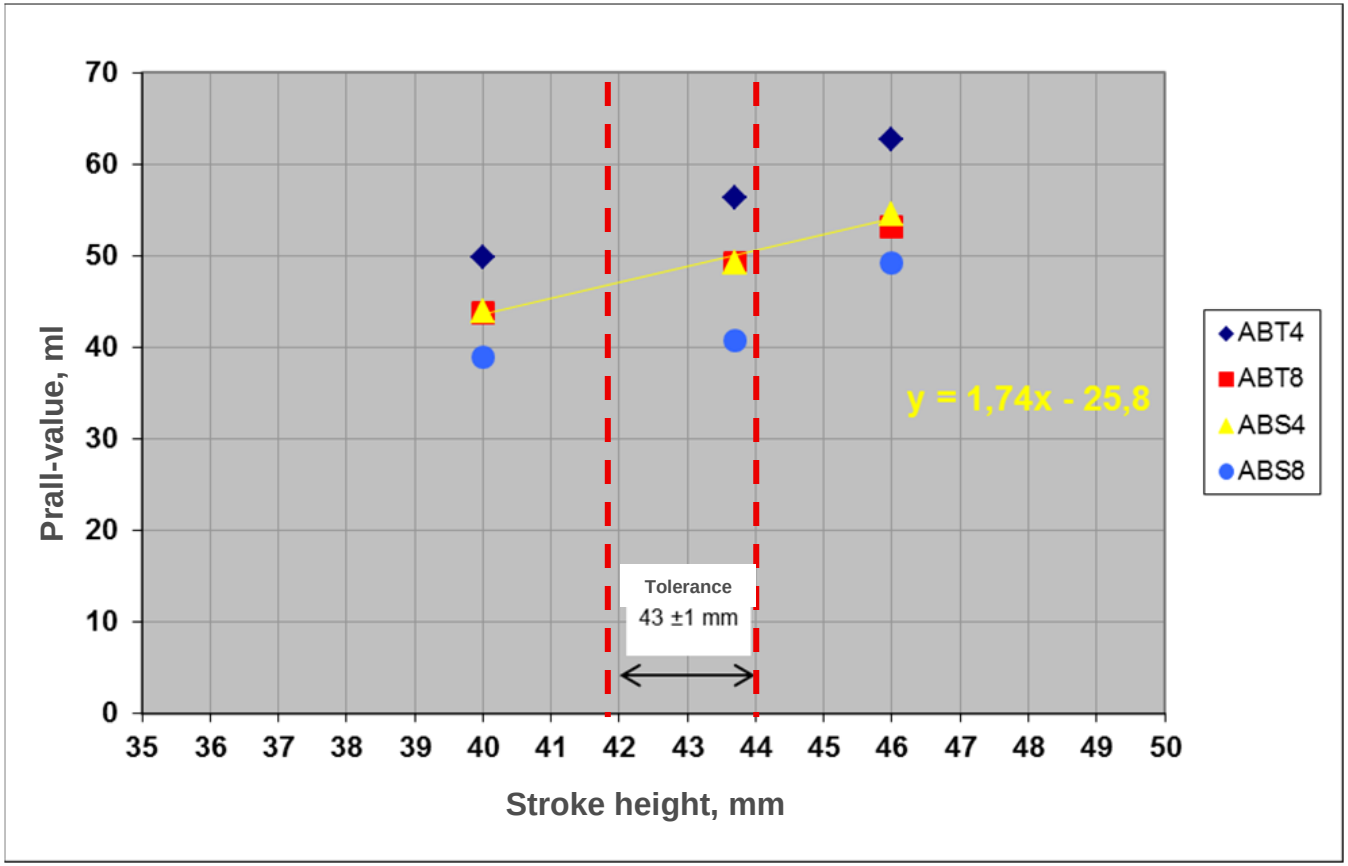
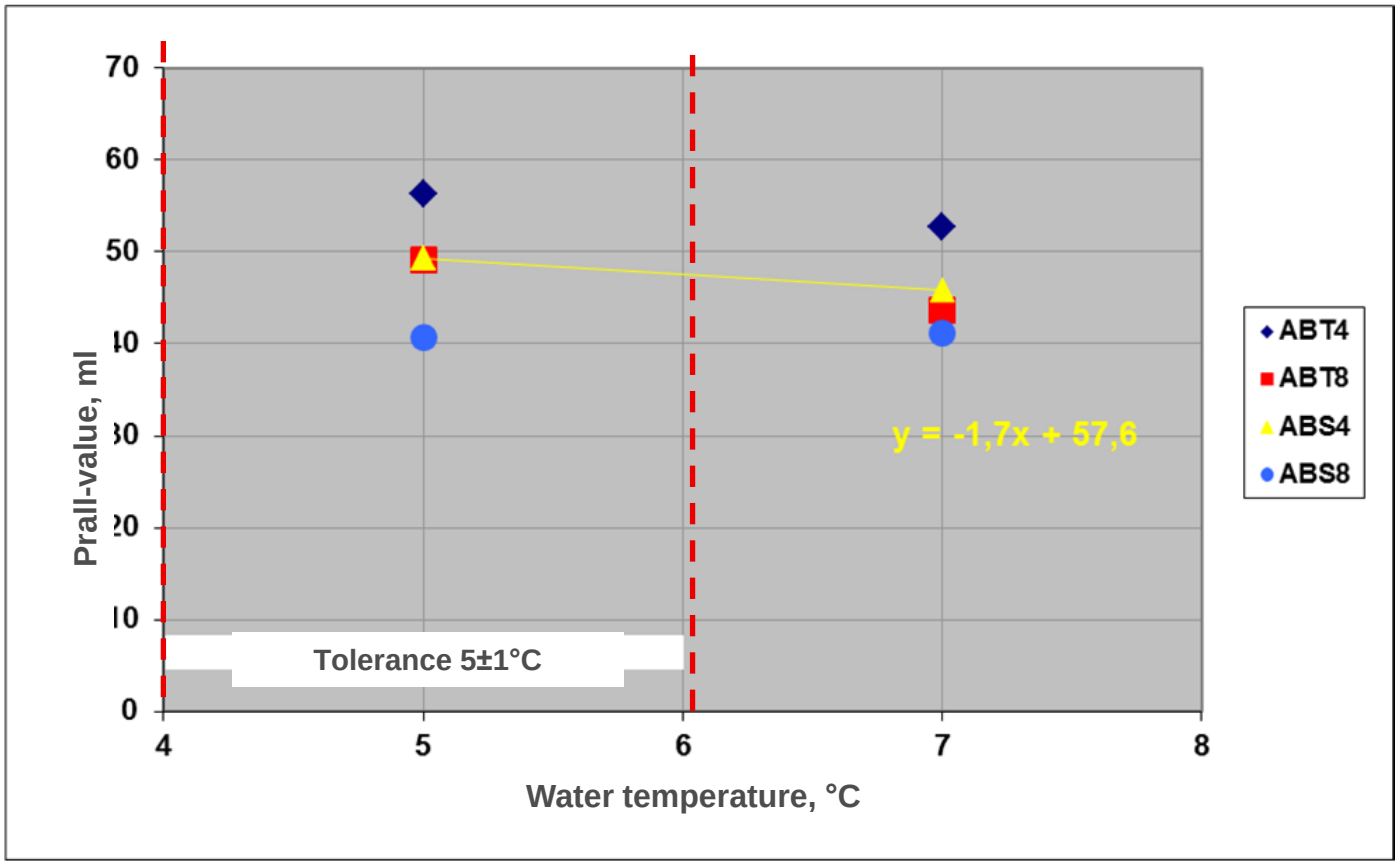
Equipment- and operator dependency

Sensitivity to stroke height



Sensitivity to stroke height, approximately ±1 ml uncertainty

Sensitivity to water temperature 1

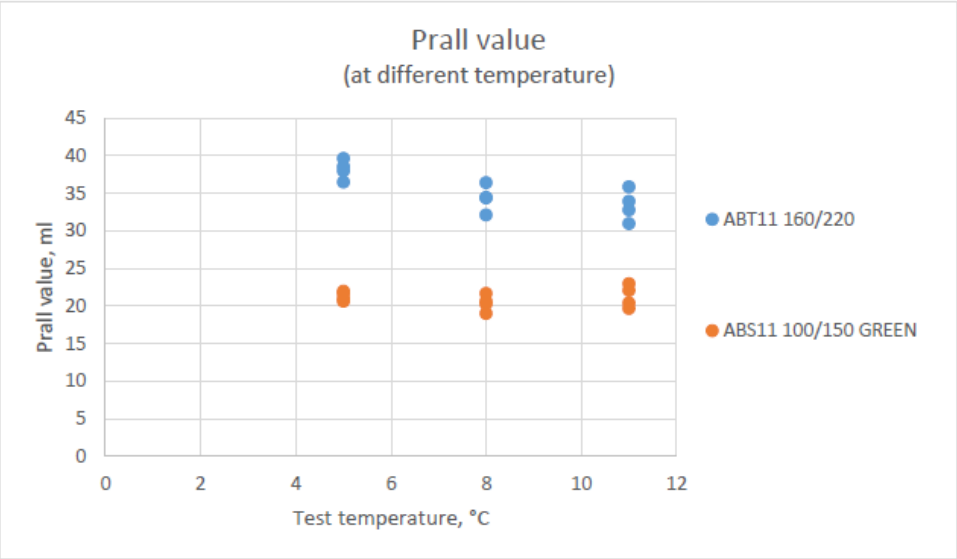


Sensitivity to water temperature, approximately ±2 ml uncertainty

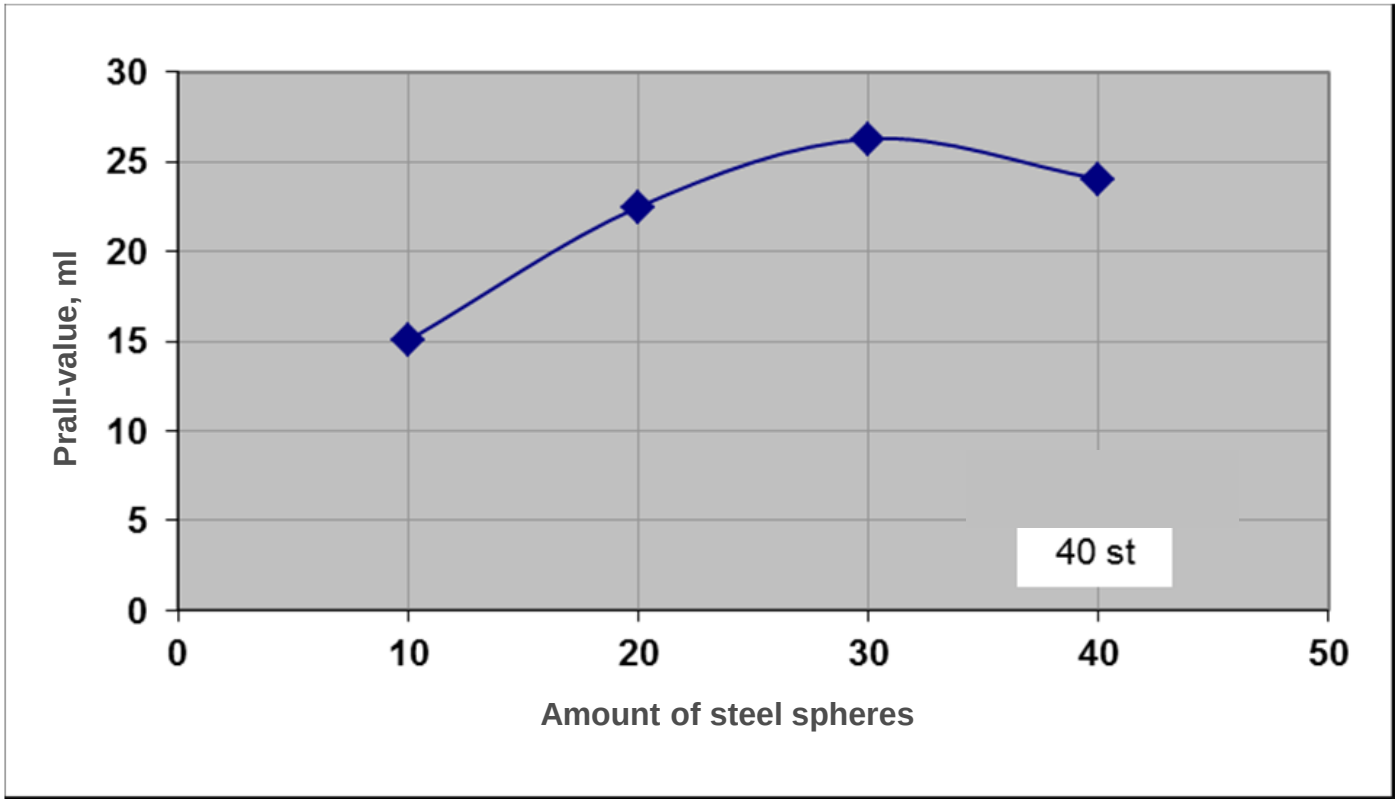
Sensitivity to water temperature 2

Table 14 SMA11 100/150 GREEN

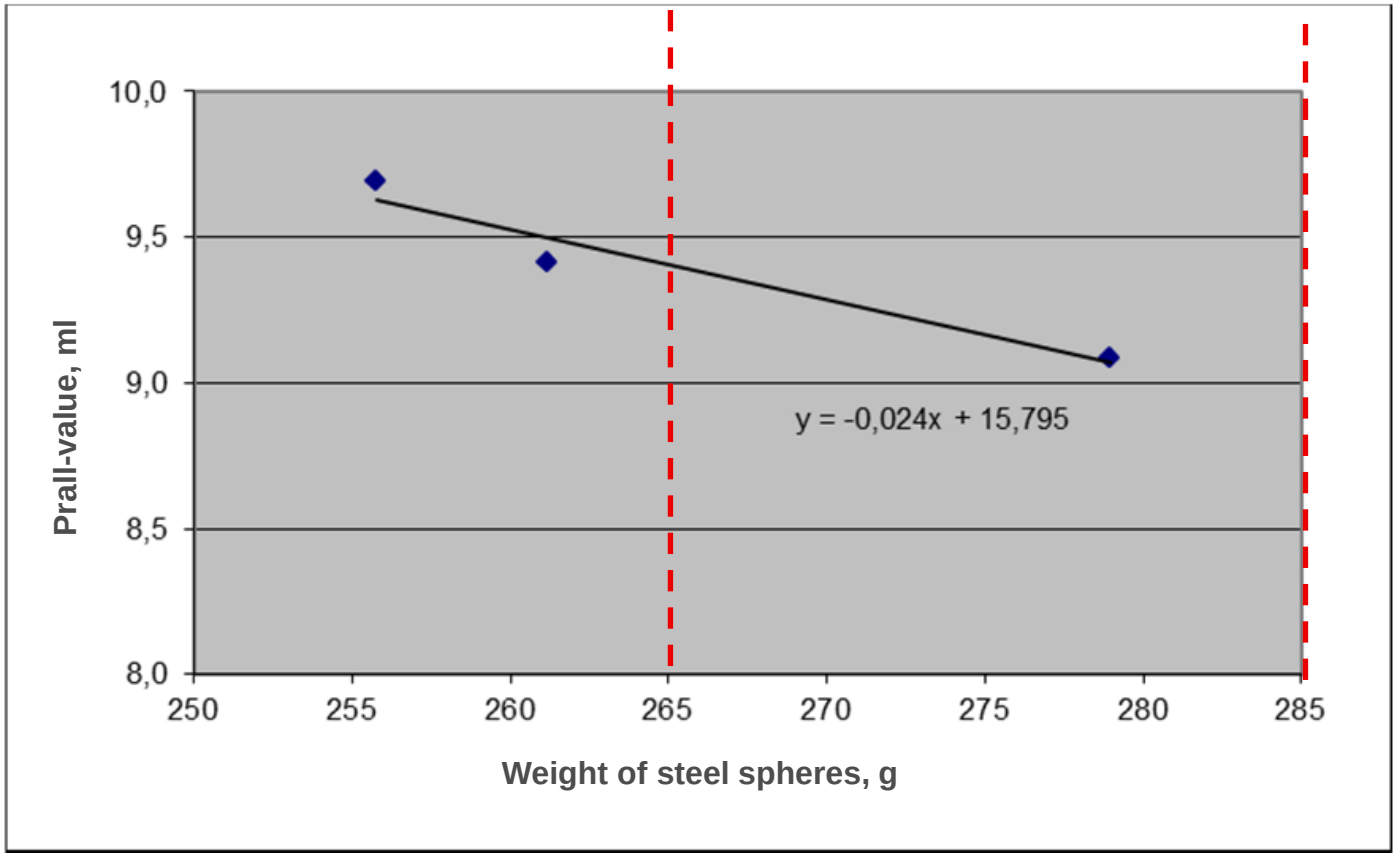
Test temperature	Individual values				Average	s	V-%
+5 °C	20.6	21.7	22.0	21.0	21.3	0.6	2.8
+8 °C	19.0	21.7	20.3	20.6	20.4	1.1	5.4
+11 °C	20.5	22.1	23.0	19.7	21.3	1.5	7.1



Sensitivity to amount of steel spheres

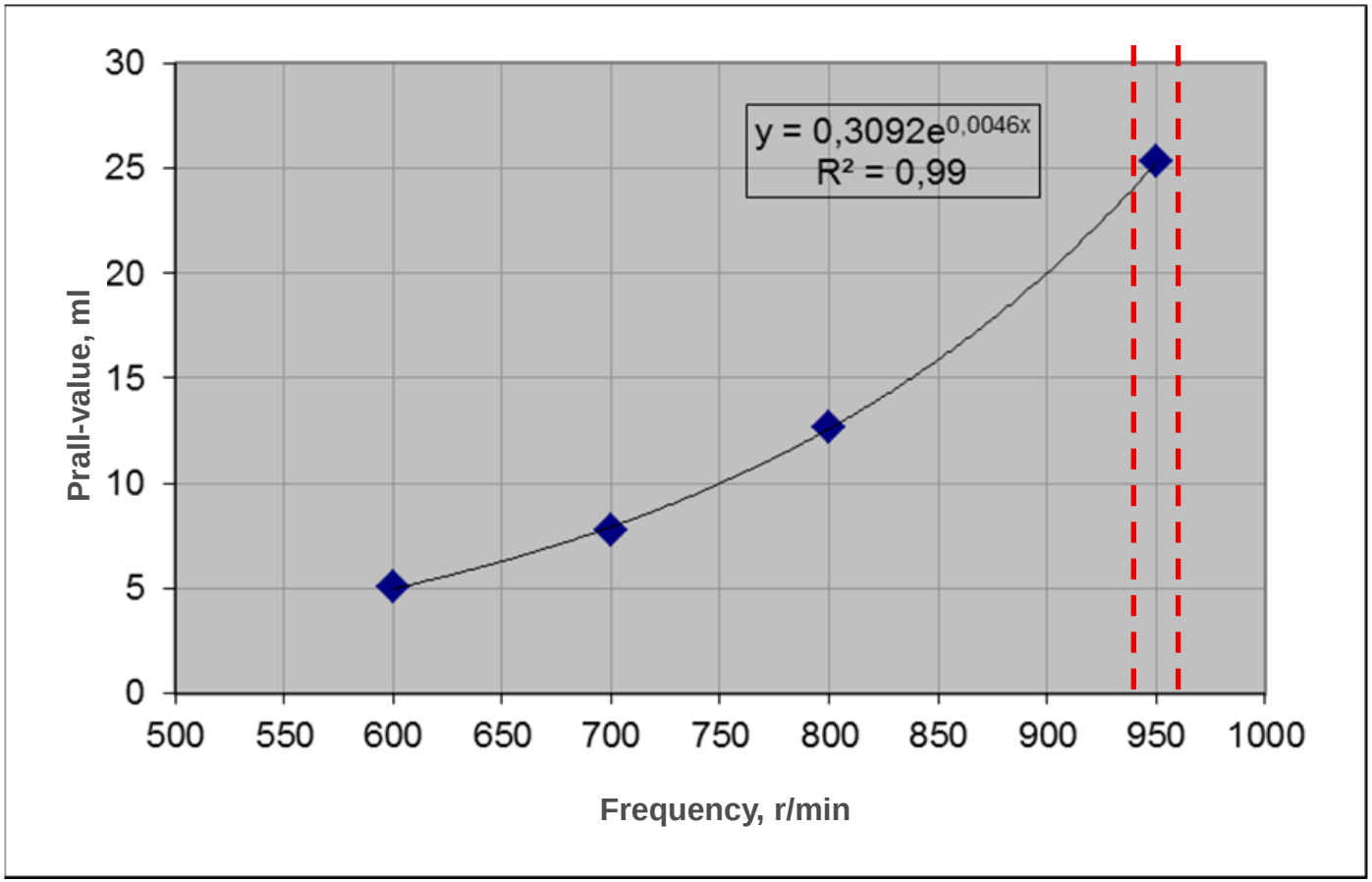


Sensitivity to weight of steel spheres



Sensitivity to weight of steel spheres, approximately ±0,25 ml uncertainty

Sensitivity to frequency



Sensitivity frequency, approximately ±1 ml uncertainty

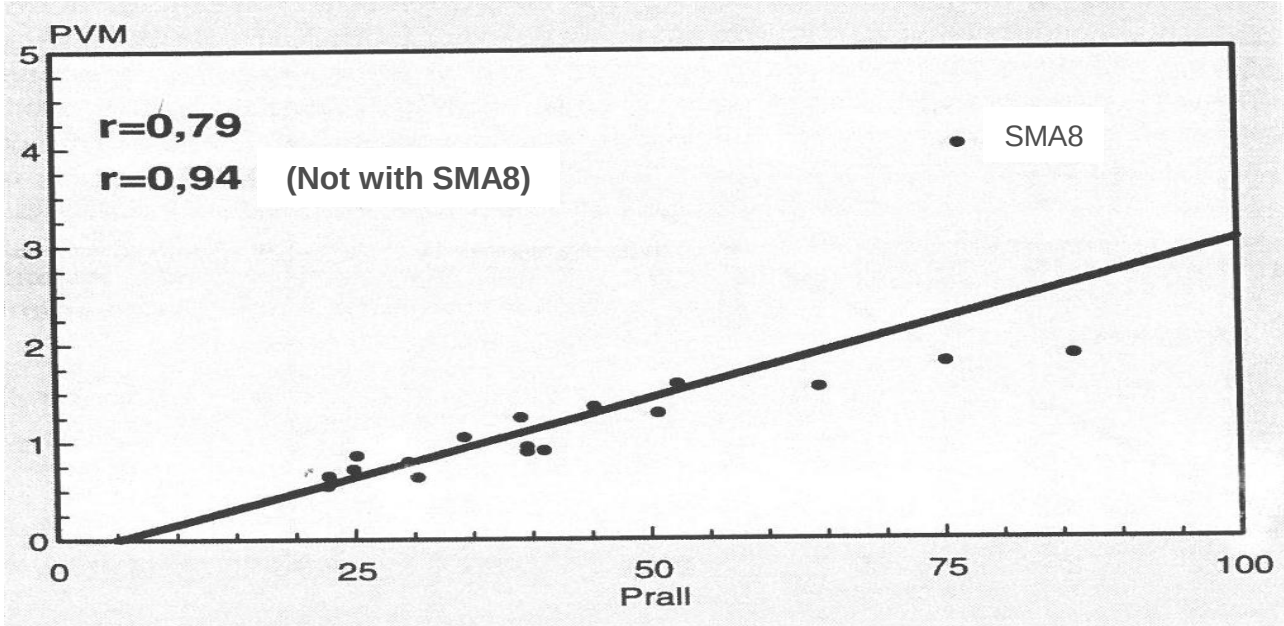
Correlations to field conditions

- Circular road simulator

Correlation between road simulator and field r > 0,95

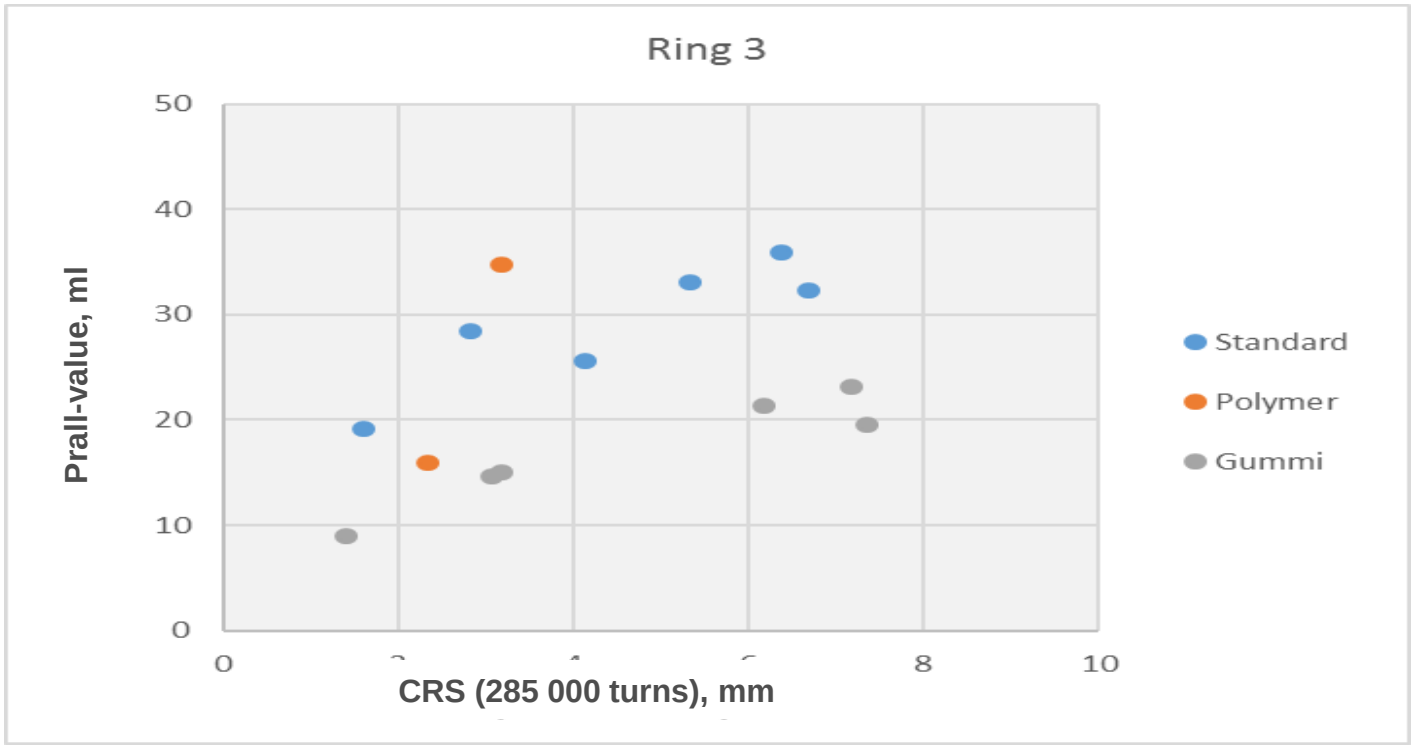
Correlations to field conditions

Correlation between
road simulator and Prall r > 0,90



Some results on different mixes with different binder

Prall underestimates according to wear in circular road simulator on Rubber-binder



Conclusions

- Expected summarised uncertainty due only to the acceptable tolerances:

$$\sqrt{2^2 + 3^2 + 0{,}5^2 + 0{,}5^2 + 2^2} \approx 4$$

- Repeat- and reproducibility could be better

- Correlation between prall and field is very good

Thank you for your attention!

Questions?

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