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# Pavement surface characteristics - differences in measured parameters and their evaluation and use in different countries

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## Content:

- General summary of findings from a questionnaire survey
  - 12 European countries
    - **skid resistance – friction coefficient** 2019
    - **macrotexture – MPD** 2019
    - **longitudinal unevenness – IRI** 2020
    - transversal unevenness – ruts 2021
- Parameters evaluated from 3D model of pavement surface
  - example from the Czech Republic

## **SR<sub>1</sub>: Devices measuring friction coefficient**

**CZ:** 1 (3) TRT, 1 BV-11, 1 Griptester

**BE:** Flanders r. - [SKM](#) and Griptester, Walloon r. - 2 [SCRIM](#), BRRC - (Odoliograph)

**FR:** 3 [SCRIMs](#), 3 Adhera, 5 Griptester

**DE:** 3 types of devices: [SKM](#), Griptester, SRT-Pendulum+Outflow Meter (OM)

**GB:** [SCRIM](#) - strategic road network, Griptester - on local roads

**AT:** RoadSTAR, Griptester - for research

**DK:** Viafriction

**SE:** 6 devices, including SFT, TWO and PFT

**PL:** 15 SRT-3 (main device), 2 TWO, 1 ViaFriction, 2 T2GO

**ES:** 5 or 6 [SCRIM](#), Griptesters and a device similar to MU-meter

**NL:** [SKM](#) and RAW72

**SI:** 1 SCRIMTEX ([SCRIM](#) with macrotexture) - on national road network, portable SRTs (English Pendulum) - on local roads

## SR<sub>2</sub>: National comparative measurements - how often

**CZ:** yes; irregularly, most recently in 2018

**BE:** yes, once a year

**FR:** yes; every two years for Griptester and SCRIMs, every year for Adhera

**DE:** yes; irregularly, last in 2015, next in April 2019

**GB:** yes, annually for SCRIM, in March usually

**AT:** no, but participate at international harmonization tests (2019 in Nantes)

**DK:** once a year calibration for Viafriction devices is organized in Norway

**SE:** this year we will do the first test, earlier we have used the tests in Norway

**PL:** yes, every year (sometime twice a year), SRT-3 only

**ES:** yes, yearly, organized by CEDEX

**NL:** yes for RAW72, every six weeks

**SI:** SCRIMTEX attended the 1st friction workshop in Nantes in 2017

## SR<sub>4</sub>: Requirements - for new pavement, end of warranty p., ..

**CZ:** new pavement, end of warranty p., to start preparing measure, to implement measur.

**BE:** new wearing courses, during/end of warranty period (only in Flanders)

**FR:** no requirements, generally threshold values on SFC for new pavements (motorway)

**DE:** new pavement, end of w. period, to start preparing measure, to implement measure

**GB:** no requirements for new roads, other than appropriate aggregates,  
HD28 specifies “investigatory levels” i.e. when the section of road should be investigated

**AT:** new pavement, end of w. period, warning level and intervention level

**DK:** new pavement, pavements in use

**SE:** the same requirements for all situations

**PL:** new pavement, end of warranty period, maintenance

**ES:** new pavements, maintenance, DBFM contracts etc can set additional requirements during the lifetime or at the end of life time

**NL:** new pavement, end of warranty p. and monitoring

**SI:** new pavements (acceptance level), time to start preparing measure (warning level) and time to implement measure (intervention level)

## SR<sub>5</sub>: Requirements - difference according to road categories

CZ: uniform for all roads

BE: uniform for all roads

FR: motorways, primary roads (national roads) and secondary roads

DE: uniform for all roads (highways: 80 km/h and federal roads: 60 km/h)

GB: defined by site category, subject to risk assessment (site= 10, 50, or 100m section)

AT: mandatory only on motorways, nevertheless it is used on other roads as well (60 km/h)

DK: uniform for all roads

SE: uniform for all roads

PL: different road classes

ES: national road network. Autonomous regions may have different requirements.

NL: uniform for all roads

SI: uniform for all roads, but differ depending on measurement speed

## **SR<sub>6</sub>: Evaluation classes versus requirements**

**CZ:** 5 classes (1-5); requirements are bound directly to these classes

**BE:** not for tender purposes, for PMS purposes, SKM values are transferred to 0-100 scale

**FR:** 5 classes but they are not public

**DE:** no classification

**GB:** yes, see table in HD28

**AT:** 5 classes (inspired by COST 354), new work approval: limit between class 2 and 3, end of warranty p. – roughly in the middle of class 3

**DK:** no classes used

**SE:** no, but a suggestion is discussed to have requirements for different speed limits

**PL:** 4 classes from A to D, requirements bound to the classes

**ES:** no

**NL:** SKM and RAW72 values for PA, AC for different speeds

**SI:** SCRIMTEX: 5 classes (from very poor to very good); requirement for new pavement is threshold between »Good« and »Fair« classes

## SR<sub>7</sub>: Each device requirements versus reference device

**CZ:** TRT is a [national reference](#) device; other devices are [recalculated](#) to this level

**BE:** [each device](#) (SKM, SCRIM, GripTester, Odolio) [has its own requirements](#)

**FR:** SCRIM is used for road monitoring and is a sort of reference

**DE:** requirements refer to the SKM, for other devices (GripTester, SRT/OM) there exist other requirements, a [correlation is not allowed](#)

**GB:** SCRIM only, no conversion would be appropriate

**AT:** only one device, no conversion necessary

**DK:** OSCAR is a reference device used at the calibration in Norway.

**SE:** most likely reference will be an average (where any outliers will be excluded), there is a conversion done between SFT and PFT, based on measurements done in Nantes

**PL:** SRT-3 is [national reference device](#), all measurements are related to SRT-3

**ES:** SCRIM

**NL:** we are in transition from RAW to SKM, we have a [conversion table](#)

**SI:** SCRIMTEX is the only device used on national roads, no conversion to any other device



## SR<sub>g</sub>: SRI use – in practice and for comparison of devices

CZ: no, the comparative measurement determines the conversion relations directly for the friction coefficient

BE: no

FR: not until now

DE: no, golden SKM device from BASt – comparison once a year (approval) and every 3 month (external monitoring)

GB: no

AT: no

DK: -

SE: no

PL: no

ES: no

NL: is used in very specific situations, there is no normative value for roads

SI: no; ROSANNE project and the 1st friction workshop in Nantes

## MPD<sub>1</sub>: Is this parameter used?

CZ: yes

BE: yes, but currently not really used for PMS purposes

FR: yes

DE: no

GB: yes

AT: yes, there is a system of 5 classes, but no intervention levels or such

DK: yes

SE: yes

PL: yes

ES: there are standard specifications for macrotexture for new pavements. These refer to the MTD. MPD may be used, but then MTD test have to be done on the same pavement to establish the correlation. MPD is used in DBFM contracts.

NL: no, we don't do regular measurements of MPD

SI: no, instead English SMTD is used

## MPD<sub>3</sub>: Requirements - for new pavement, end of warrant., ..

CZ: new pavement, end of warranty p., to start preparing measure, to implement measur.

BE: in the (Flemish) standard tender, MPD is mandatory for exposed aggregate concrete

FR: new pavement

DE: new pavement (only concrete)

GB: yes, e.g. for thin surfacings the initial texture depth requirements are in tables 9/12 and 9/13 MCHW Vol1 series 9000, the retained texture after 2 years is in 9/14

AT: no, only in PMS

DK: no requirement, it is used as an indicator of low friction

SE: new pavements, STA TDOK 2016:0271, end of warranty p., no requirements yet (we are working on suggestions), maintenance standard 2012:074

PL: new and in use paid motorways

ES: -

NL: -

SI: usually these are used for assessment of condition of existing pavements, but sometimes also for acceptance of new ones

## MPD<sub>4</sub>: Requirements - difference according to road types

**CZ:** separately for roads with allowed speed up to 50 km/h and above 50 km/h

**BE:** no difference

**FR:** for different road classes (motorways, primary and secondary roads)

**DE:** no difference

**GB:** different speed limits, geometries (e.g. roundabouts), different aggregate sizes and road classifications (see for example table 9/12 and 9/13 in MCHW Vol1 9000 series), on local roads there is also an urban/rural distinction which affects the required values.

**AT:** not applicable

**DK:** no requirement

**SE:** new pavements, the requirements depends on speed limit and AADT (maintenance standard)

**PL:** only paid highways

**ES:** -

**NL:** -

**SI:** uniform for all roads

## MPD<sub>7</sub>: MPD used to estimate skid resistance?

**CZ:** yes, but only in combination with microtexture (PTV) and only for roads with allowed speed up to 50 km/h, otherwise the measurement of friction coefficient is mandatory

**BE:** no

**FR:** yes, only macrotexture is mandatory but most of road managers make simultaneous measurements of friction and macrotexture to assess the state of the pavement

**DE:** yes, but only in combination with the SRT - called “combined skid resistance and roughness measurement” with the outflow meter (macrotext.) and the pendulum (microtext.)

**GB:** they are linked, any location where the texture depth is category 3 or above should be reviewed from an HD28 perspective

**AT:** no

**DK:** we use the MPD as a screening for surfaces where the ability to drain water in the texture has risked

**SE:** no

**PL:** classification for paid highways is a combination of MTD and skid resistance

**ES:** no

**NL:** -

**SI:** no, but they are both used to assess a pavement's condition

## IRI: Use of IRI, in accordance with EN 13036-5

AT: yes

BE: no - own "roughness coefficient"

CZ: yes

DK: yes

DE: no - own AUN "General Unevenness", main parameter

ES: yes

FR: no - wave band analysis

GB: no - own „eLPV - enhanced Longitudinal Variance “

PL: yes

PT: yes

SI: yes

SE: yes

8x yes

4x no

## IRI<sub>2</sub>: IRI evaluation length

AT: 50 m

BE: - (25 - 100 - 400 m)

CZ: 20 m

DK: 10 m

DE: -

ES: 100 m with step 10 m

FR: -

GB: - (3 - 10 - 30 m)

PL: 50 m

PT: 100 m

SI: 20 and 100 m

SE: 20, 100, 400 m

10 m  
20 m  
50 m  
100 m  
400 m

## IRI<sub>3</sub>: IRI situations for evaluation

**AT:** pavement management on motorways - IRI, new work approval - transitioning to WLP

**BE:** all new wearing courses, in some cases also at the end of warranty period

**CZ:** new pavement layers, end of warranty period, moment when to start planning a corrective measure, moment when it is necessary to carry out the corrective measure

**DK:** only trials on new pavement layers

**DE:** -

**ES:** new pavements; In maintenance contracts requirements are established case by case

**FR:** for some specific research projects

**GB:** new road surface profiles

**PL:** mandatory only for new pavement layers

**PT:** new and rehabilitated pavements; in-service roads (concessionary contracts)

**SI:** new constructions (IRI 20 and 100 m), end of warranty period (IRI 100 m)

**SE:** new build roads, end of warranty p., maintenance limits – values not public



## IRI<sub>4</sub>: IRI requirements (for diff. road classes, traffic speeds)

**AT:** no requirements, only used in pavement management on motorways

**BE:** -, depends on the traffic speed: < 40, < 60, < 80, > 80 km/h

**CZ:** separately for roads with a permitted speed of up to 50 km/h and above 50 km/h

**DK:** trials on new motorways

**DE:** -

**ES:** road categories: motorways, conventional roads (single carriage way)

**FR:** -

**GB:** -, 3 road categories – from motorways to urban single carriageway road

**PL:** in accordance with the road classes

**PT:** defined for different road classes

**SI:** two classes : > and < 2000 AADT per day or 80 ESAL per day

**SE:** new roads: speed limit, AADT and climate zone; maintenance: speed limit and AADT

## Other parameters to evaluate the longitud. unevenness

AT: we are introducing **WLP**

BE: "roughness coefficient" for different wave lengths (2.5, 10, 40 m)

CZ: C = degree of unevenness, usually transferred to the IRI

DK: in a transition phase to use **wave band analysis**

DE: AUN ("General Unevenness", main parameter), **w** ("Waviness"), in the future: **WLP**

ES: no

FR: **wave band analysis** (bi-octave bands - SW, MW, LW)

GB: **eLPV** (wavelengths 3m, 10m and 30m)

PL: -

PT: no

SI: -

SE: not in use right now

plus:

4 m straight edge or planograph

## Validity procedure used to approve suppliers

**AT:** every survey provider must get the accreditation on its own

**BE:** no, we do all the measurements **ourselves** (we are ISO 17025 accredited for it).

**CZ:** tech. regulation TP 207; **authorization** issued by the Ministry of Transport, last in 2018

**DK:** own measurements, validation by the manufacture of devices

**DE:** **à yearly approval** by BASt

**ES:** **certificate** of compliance issued by CEDEX

**FR:** **round robin tests** performed by Cerema

**GB:** QA supplier and technical advisors - TRL

**PL:** no

**PT:** evaluation of used equipment on a **test section**

**SI:** require from the service providers accreditation according to EN 13036-5 and -6

**SE:** every **5 years**, every **year** a small test must be done to remain as a supplier

## IRI calculated from 3D records of road surface

AT: yes, transversal profile scanner in combination with a trajectory

BE: no

CZ: yes - laser scanners from company Leica and Riegl

DK: no

DE: no

ES: yes, form 3D profiles

FR: no

GB: yes

PL: no

PT: no

SI: no

SE: no

4x yes

## Parameters evaluated from 3D model of pavement surface – CZ example

Data from mobile laser scanning, 50 - 80 km/h, DTM

Software: Atlasroad

Parameters: International Roughness Index (IRI)

longitudinal unevenness using simulation of **4m straight edge**

transverse unevenness by simulation of **2m straight edge** (depth of ruts R)

**theoretical depth of water** in wheel paths W

**transverse slope** of the road

Special analyses: relative local **roughness** for a reference area of **1 m radius**

relative detailed roughness for a reference area of **0.2 m radius**

pavement **gradients** in the area

Roadway geometry: shaded digital model

contour plan

paths of **'water drops'** on the road

**runoff concentration**



Seznam map    Legenda




Dvojklikem ukotvit

**Základní vrstvy**

- Ortofoto
- DKM

**Překryvné vrstvy**

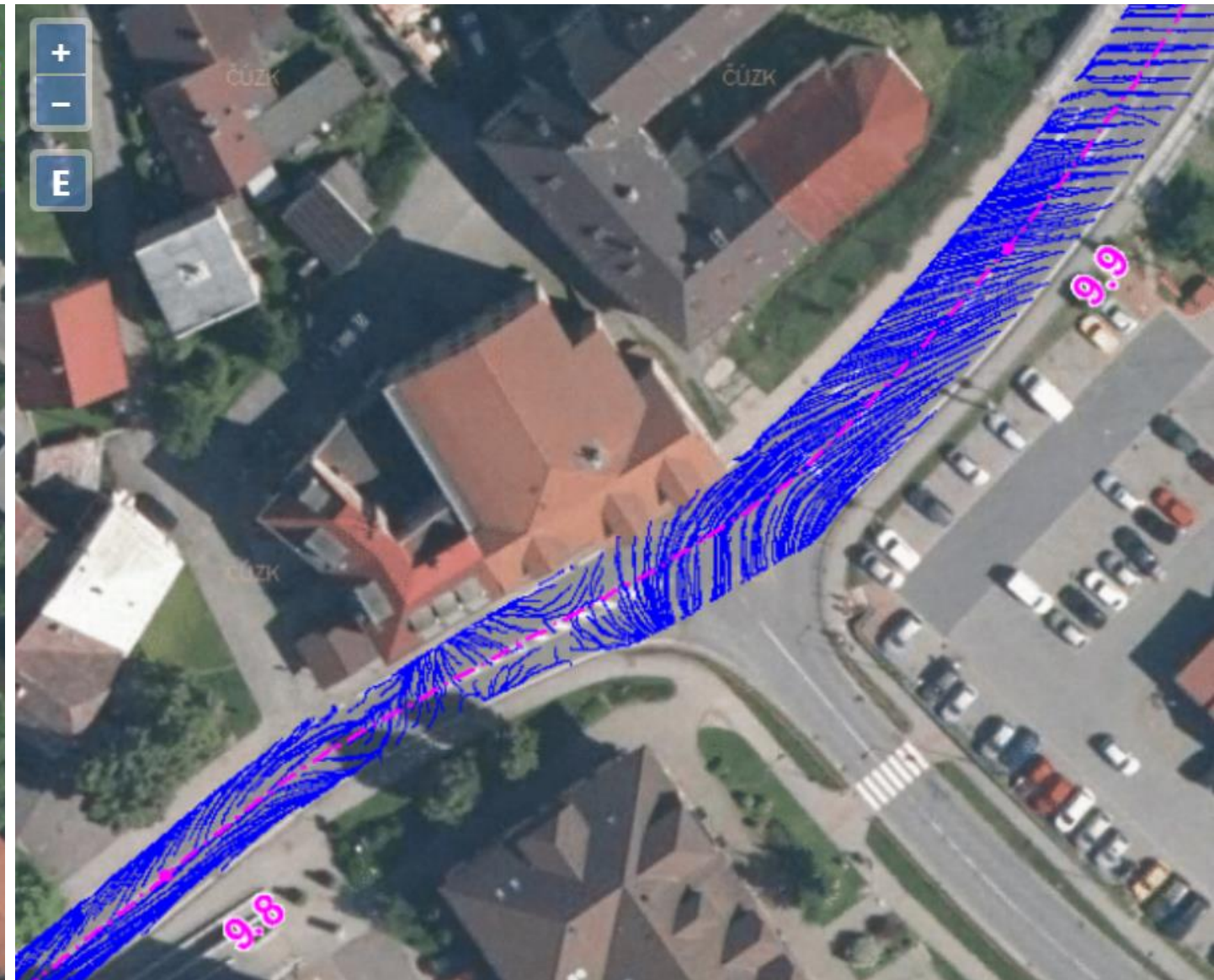
- DMT převýš.4, SZ osvětlení 40°
- DMT převýš.4, SV osvětlení 40°
- Relativní nerovnosti: oblast 1 m
- Relativní nerovnosti: oblast 0.2m
- Koefficient IRI
- Teoretická hloubka vody W
- Podélné nerovnosti: lať 4 m
- Hl. vyjeté koleje R (ref. 2 m)
- Příčný sklon: lať 0.5 m
- Sklon v ploše
- Vrstevnice
- Kapky 1.5 m
- Staničení

Seznam map:   
 Hradec - ukázka  
 Jablunkov  
 Jihlava 1km - ukázka





International Roughness Index (IRI)



Paths of ,water drops' on the road



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# Thank you for your attention!

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