European norms for Asphalt Concrete

CE marking in the Netherlands

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Contents

- CE marking
- Functional approach and pavement design in the Netherlands
- Example testing asphalt concrete (EN 13108-1)

- RAW 2015 (how does it work out)

Europe

- 6 Essential Requirements for the general safety of structures:
  - Mechanical resistance and stability
  - Safety in case of fire
  - Hygiene, health and the environment
  - Safety in use
  - Protection against noise
  - Energy economy and heath retention

Total package Asphalt

- 53 norms:
- 10 norms for mixtures:NEN-EN 13108 series: Bituminous mixes
  - 7 product norms
  - 1 norm for RA
  - 2 quality norms:
    - Type testing
    - Production control
- 43 norms for test methods (NEN-)EN 12697 series: Test methods for hot mix asphalt (all tests are CE normalized)

NEN-EN 13108 series

Norm	Description
NEN-EN 13108-1	Part 1 Aphaltconcrete
NEN-EN 13108-2	Part 2 Very thin ashalt concrete
NEN-EN 13108-3	Part 3 Soft Asphalt
NEN-EN 13108-4	Part 4 Hot Rolled Asphalt
NEN-EN 13108-5	Part 5 Stone Mastix Asphalt
NEN-EN 13108-6	Part 6 Gussasphalt
NEN-EN 13108-7	Part 7 Porous Asphalt
NEN-EN 13108-8	Part 8 Asphaltgranulate
NEN-EN 13108-20	Part 20 Type testing
NEN-EN 13108-21	Part 21 Factory Production Control

Possible tests according EN for stiffness and fatigue

Stiffness (EN 12697-26)	**Fatigue (EN 12697-24)**
•Two point bending test on trapezoidal specimens (2PB-TR) •Threepoint bending test on prismatic specimens (3PB-PR) •Indirect tension test on cylindrical specimens (IT-CY) •Direct tension-compression test on cylindrical specimens (DTC-CY) •Direct tension on cylindrical (DT-CY) or prismatic specimens (DT-PR)	•Two point bending on trapezoidal specimens •Two-point bending test on prismatic shaped specimens •Three point bending test on prismatic shaped specimens •Four-point bending test on prismatic shaped specimens •Indirect tensile test on cylindrical shaped specimens.

CE marking asphalt (is off plant)

- Type testing with Declaration of Conformity (EN 13108-20)
- Factory Production Control with certification of production (EN 13108-21)

Initial Type Testing

- Possibility to choose in advance as a country:
  - Empirical line
  - Functional line

- ETA (European Technical Approval) and innovation
  - European Technical Approval for asphalt not defined in the productnorms.
  - ETA: declares product is fit for application.
  - Notified Body must be involved.

CE Marking

- Each mixture should have a CE marking
- This tells the client what type/quality of mixture he is buying
- Two methods:
  - empirical method
  - fundamental method

CE Marking empirical method

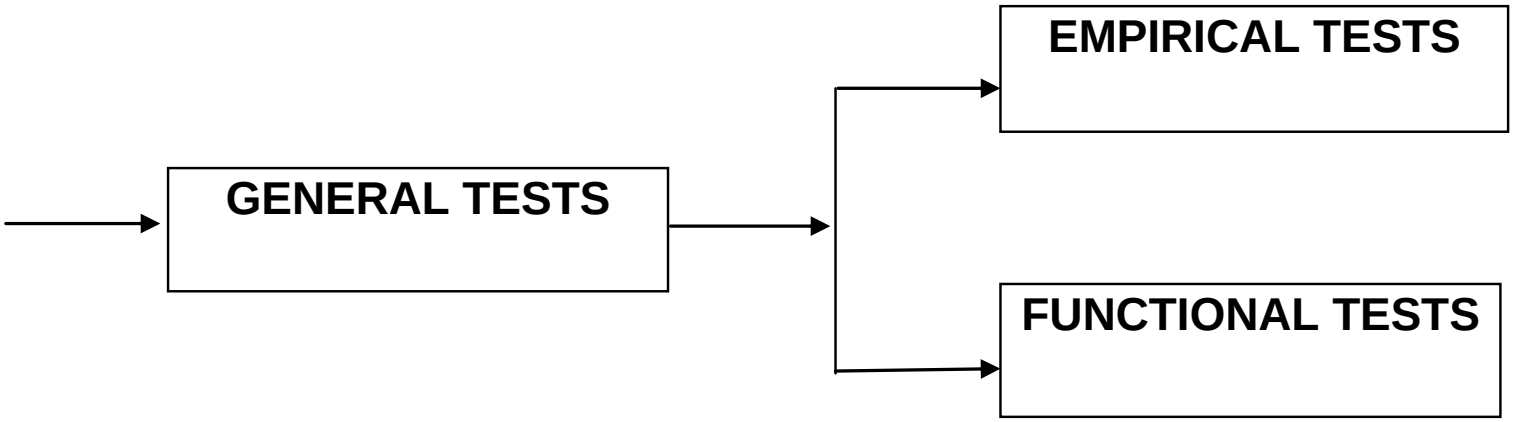
- Gradation
- Binder content
- Marshall values for airport mixtures
- Voids content
- Voids in mineral skeleton
- Voids filled with bitumen

- SMA, PAC and thin surfacings are rated in the Netherlands with this method. For these 3 mixture types there is no fundamental approach

CE Marking fundamental method for asphalt mixtures

- No specs anymore for:
  - composition
  - gradation
  - volumetrics
  - Marshall
- CE marking specifies stiffness, resistance to fatigue, permanent deformation and moisture resistivity

Test scheme for Type testing



Requirements for asphalt concrete (13108-1)

General	Functional
•Composition and grading •Voids •Water sensitivity •Resistance against wear by spikes (cold climates) •Resistance against permanent deformation (wheeltrack test) •Resistance against fuels (airports) •Resistance against de-icing (airports)	•Stiffness •Resistance against fatigue •Resistance against permanent deformation (cyclic compression test)

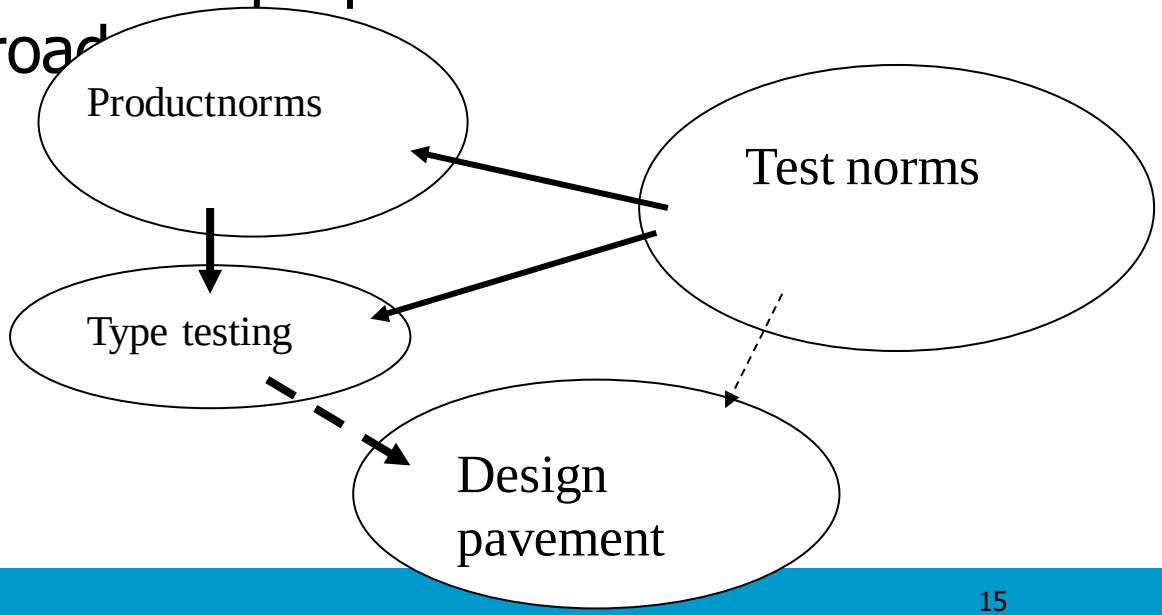
Tests chosen in the Netherlands for roads

General properties (all mixes)	Functional properties (asphalt concrete)
Water sensitivity: •Indirect tensile test	Stiffness: •Four point bending (4pb) Fatigue: •Four point bending (4pb) Permanent deformation: •Triaxial test

Consequence: contractor needs also facility for producing slabs

CE marking and design

- Starting point (assumption/hypothetis):
  - Mechanical properties of a mix are determined who are related to the same properties of the final product in the road



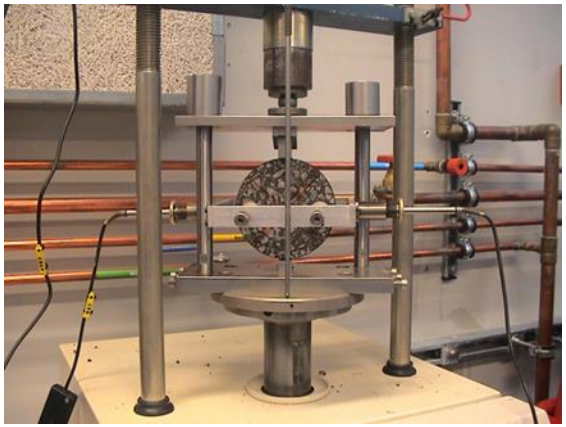
Choices for the Netherlands in relation to design

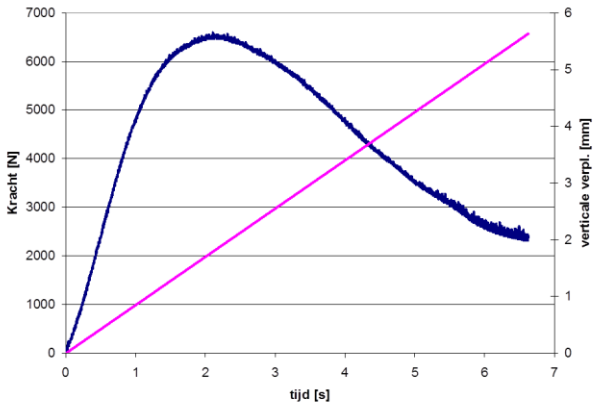
- Stiffness is determined at 20 C and 8 Hz (effective design temperature and mean speed heavy traffic)
- Fatigue at 20 C and 30 Hz (temperature is clear, 30 Hz in relation to test duration)
- Permanent Deformation: temperature and stress situation surface layer is different from base layers

Indirect tensile test: water sensitivity

- Monotonic test to failure
- Displacement controlled (50 ± 2 mm/min)

- Determination of indirect tensile strength





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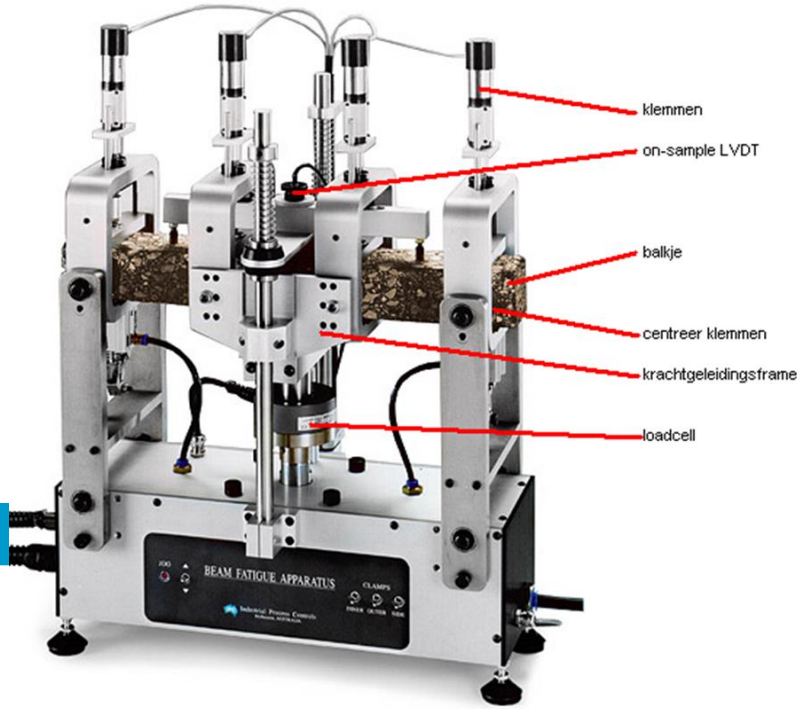
Four point bending test (4pb)

- Stiffness: frequency sweep (displacement controlled)
- Fatigue (displacement controlled)



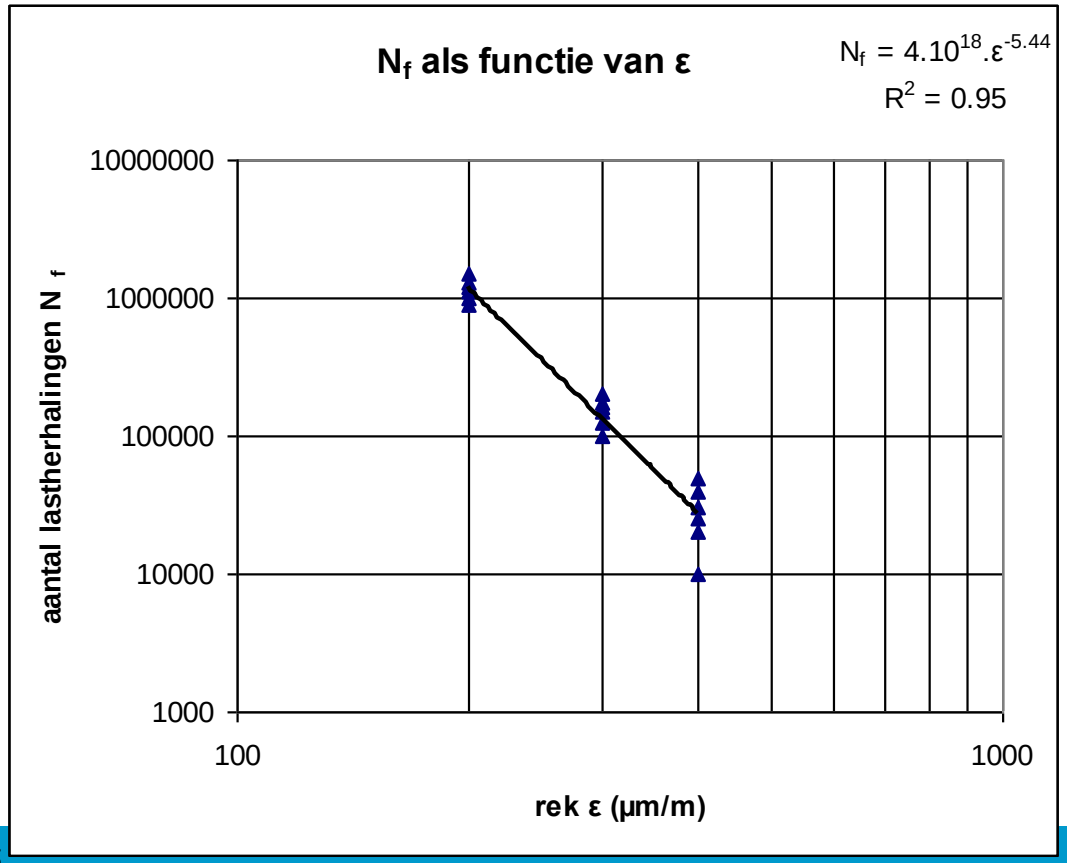
Stiffness mastercurve at 20 C

Number of specimen	4 (+2 reserve)
Compaction	Slab compaction
Test temperature	20 C
Frequency	Frequency sweep (8 Hz compulsary)
Loading	Sine: displacement controlled 50 ±3 μm/m
Number of load repetitions	Approx. 100

Fatigue

Number of specimen	18
Compaction	Slab compaction
Test temperatuur	20 C
Frequency	30 Hz
Loading	3 strain levels (6 tests per strain level)
Fatigue life	Repetitions reduction stiffness to half of its initial value

Example fatigue line (1 temp, 1 frequency) on log-log scale



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Resistance against permanent deformation

- Dynamic triaxial test

- Determination of elastic and/or visco-plastic deformation characteristics at realistic conditions

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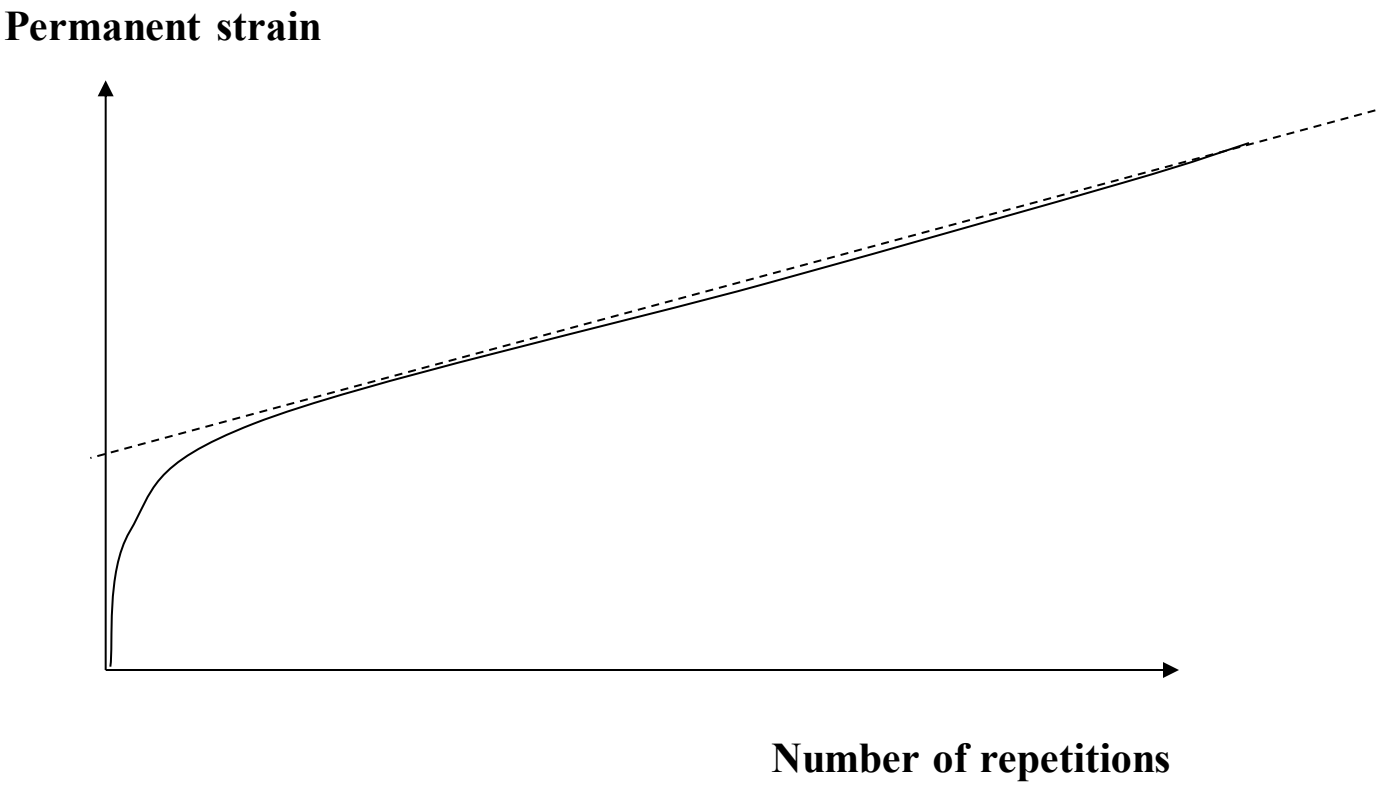
Triaxial test

	Surface layer	**Binder, base layer**
Compaction	gyrator	gyrator
Diameter	100 mm	100 mm
Height (D≤16 mm)	60 mm	60 mm
Height (D>16 mm)	80 mm	80 mm
Storing temperature	15° C	15° C
Test temperature	50° C	40° C
Axial signal	haversine	haversine
Loading time axial signal	0.4 s	0.4 s
Rest period axial signal	0.6 s	0.6 s
Amplitude axial stress (σ_v)	0.30 MPa	0.20 MPa
Confinement (σ_c)	0.15 MPa	0.05 MPa
Peakloading ($\sigma_{1,max}$)	0.75 MPa	0.45 MPa
Max repetitions	10.000	10.000

Creep curve triaxial test: slope determination



Original classes used in 2005

Class	A	B	C	D	E	F
ITSR [%]	**≥ 90**	**≥ 80 en < 90**	**≥ 60 en < 80**	**≥ 40 en < 60**	**≥ 20 en < 40**	**< 20**

Class	A	B	C	D	E	F
Stiffness [MPa]	**≥ 14000**	**≥ 9000 en < 14000**	**≥ 5500 en < 9000**	**≥ 3600 en < 5500**	**≥ 1500 en < 3600**	**< 1500**

Class	A	B	C	D	E	F	G	H
Fatigue ε_6 [µm/m]	**≥ 310**	**≥220 en < 310**	**≥160 en < 220**	**≥135 en < 160**	**≥115 en < 135**	**≥100 en < 115**	**≥ 50 en < 85**	**< 50**

Class	A	B	C	D	E	F	G	H
f_c [µ/s]	**< 0.1**	**≥ 0.1 en < 0.2**	**≥ 0.2 en < 0.4**	**≥ 0.4 en < 0.8**	**≥ 0.8 en < 1.2**	**≥ 1.2 en < 1.6**	**≥ 1.6 en < 2.0**	**≥ 2.0**

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Duration Type testing and system approach

- Duration type testing: estimation 30 days
- How important is a shorter duration for a producer???
- Family Approach is also an option to reduce testing programme (13108-20)
- If CE marking is approved for a mix this is valid for 5 years (under the condition…). This is the same time period as the cycle of RAW evaluation.
- Each 5 years the results will be evaluated and reconsidered by a committee

RAW 2015: properties for DAC surfacing and base layers

asfaltbetonmengsels voor deklagen Asphalt concrete mixes for surfacings				
eigenschappen Properties	categorie-indeling eigenschappen (zie tabel 81.2.15 voor verklaring categorie-indeling)			
	DL-IB	DL-A	DL-B	DL-C
V_{min} ten minste Voids minimum	2,0	2,0	2,0	2,0
V_{max} ten hoogste Voids maximum	6,0	4,0	6,0	6,0
ITSR ten minste ITSR at least	80	80	80	80
S_{min} ten minste Stiffnes min	5500	3600	4500	5500
S_{max} ten hoogste Stiffness max	11000	7000	9000	11000
f_c ten hoogste Perm. Def.	0,2	4,0	1,4	0,6
ε_6 ten minste fatigue	100	130	115	100

asfaltbetonmengsels voor onderlagen Base layers				
eigenschappen	categorie-indeling eigenschappen (zie tabel 81.2.15 voor verklaring categorie-indeling)			
	OL-IB	OL-A	OL-B	OL-C
V_{min} ten minste	2,0	2,0	2,0	2,0
V_{max} ten hoogste	7,0	7,0	7,0	7,0
ITSR ten minste	70	70	70	70
S_{min} ten minste	7000	4500	5500	7000
S_{max} ten hoogste	14000	11000	14000	14000
f_c ten hoogste	0,2	1,4	0,8	0,4
ε_6 ten minste	90	100	80	90

RAW 2015: SMA

- SMA-NL 5: 4,0 % (V/V);
- SMA-NL 8A: 4,0% (V/V);
- SMA-NL 8B: 5,0% (V/V);
- SMA-NL 11A: 4,0% (V/V);
- SMA-NL 11B: 5,0% (V/V).

Tabel 81.2.8 *Korrelverdeling van steenmastiekasfalt (% m/m)*

door zeef	SMA-NL 5	SMA-NL 8A	SMA-NL 8B	SMA-NL 11A	SMA-NL 11B
11,2 mm		100	100	92 - 100	92 - 100
8 mm	100	92 - 100	92 - 100	NR	NR
5,6 mm	92 - 100	NR	NR		
4 mm	NR				
2 mm	28 - 38	23 - 33	20 -30	20 - 30	19 - 29
0,5 mm	NR	NR	NR	NR	NR
0,063 mm	9,5 - 13,5	8,0 - 12,0	7,0 - 11,0	7,0 - 11,0	6,0 - 10,0

NR: No Requirement: geen eis

Opm.: Als karakteristieke grove zeef is in afwijking van het bepaalde in NEN-EN 13108-5 niet zeef D/2 voorgeschreven.

Tabel 81.2.9 *Eigenschappen van steenmastiekasfalt*

eigenschap	SMA-NL 5	SMA-NL 8A	SMA-NL 8B	SMA-NL 11A	SMA-NL 11B
bindmiddelgehalte	$B_{min\ 7,4}$	$B_{min\ 6,8}$	$B_{min\ 6,8}$	$B_{min\ 6,6}$	$B_{min\ 6,6}$
minimum vullingsgraad	VFB_{minNR}	VFB_{minNR}	VFB_{minNR}	VFB_{minNR}	VFB_{minNR}
maximum vullingsgraad	VFB_{maxNR}	VFB_{maxNR}	VFB_{maxNR}	VFB_{maxNR}	VFB_{maxNR}
afdruipen	D_{NR}	D_{NR}	D_{NR}	D_{NR}	D_{NR}
watergevoeligheid	$ITSR_{80}$	$ITSR_{80}$	$ITSR_{80}$	$ITSR_{80}$	$ITSR_{80}$

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Future

- We started in 2005 with the functional approach parallel to the empirical approach as it was.
- In 2010 we moved fully to the funtional testing for all continously graded asphalt mixtures.
- Each 5 years the used classes will be evaluated with industry and roads agencies
- At the moment 12 contractors have all equipment (+) for functional testing!!!!!!
- We are now in the process to compare the design off plant with the performance of the mixture in the real pavement (see paper Sandra Erkens at CAPSA 2015).