# ROADS PAVEMENT FORUM

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Performance Grade Binder

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# Overview

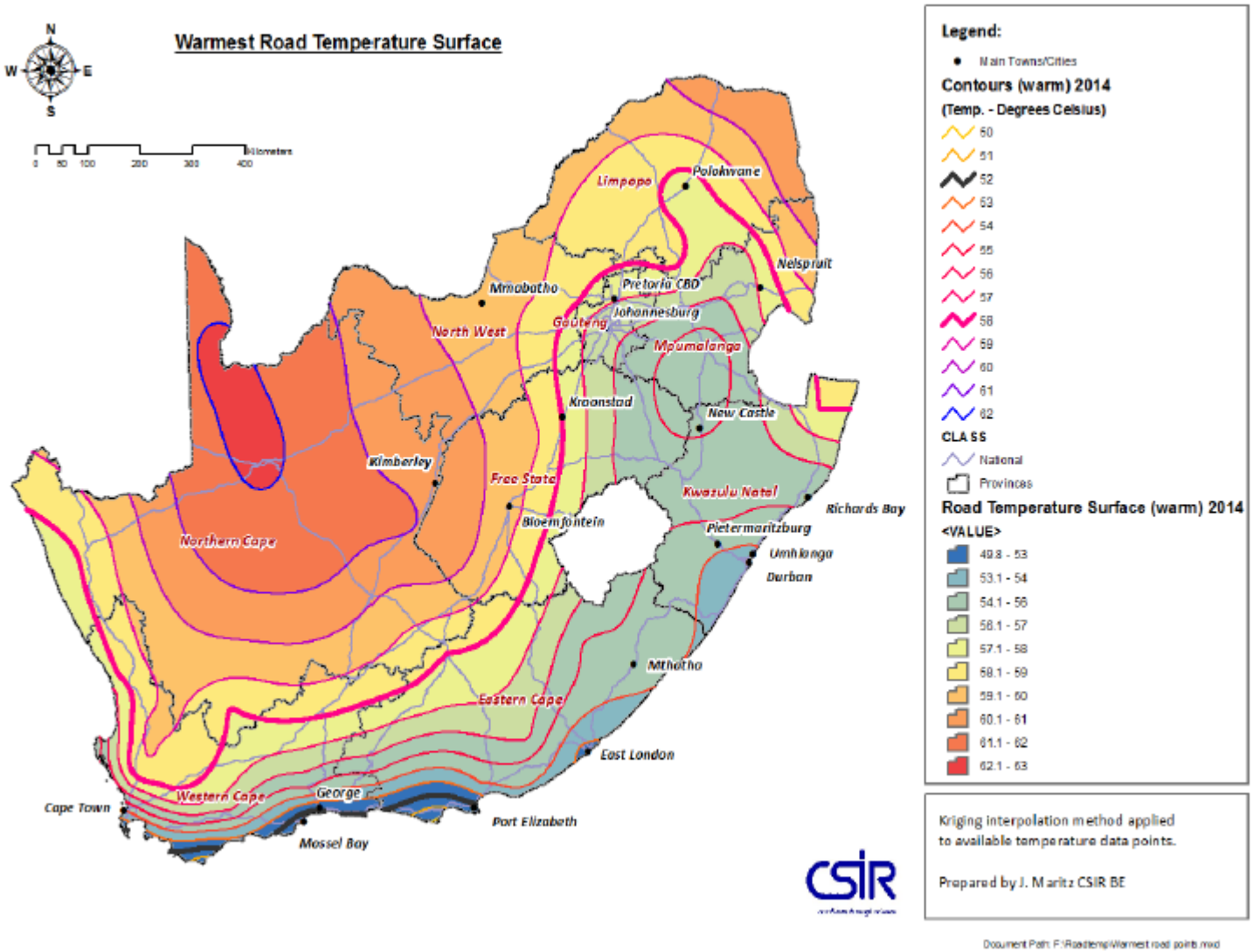
- Specification framework
- Benefits of PG specification
- Implementation plan
- SA binder production
- Example results
- PG equivalency with SANS and TG1
- Research
- Finger printing

# Specification Framework

| Test Property | Note | South African Performance Grades | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 58S-22 | 64S-16 | 70S-10 | 58H-22 | 64H-16 | 70H-10 | 58V-22 | 64V-16 | 70V-10 | 58E-22 | 64E-16 | 70E-10 |
| Max pavement design temperature (°C) | | 58 | 64 | 70 | 58 | 64 | 70 | 58 | 64 | 70 | 58 | 64 | 70 |
| Minimum grading temperature (°C) | | -22 | -16 | -10 | -22 | -16 | -10 | -22 | -16 | -10 | -22 | -16 | -10 |
| G* and δ at [($T_{max}$ + $T_{min}$)/2+4]°C | 1.10 | Compulsory report only – see detail description of report only item | | | | | | | | | | | |
| G*/sinδ @10rad/s (kPa) @ T = $T_{max}$ | 1.2 | > 1.0 | | | | | | | | | | | |
| Viscosity at 165°C (Pa.s) ≥ 30 $sec^{-1}$ | 1.3 | ≤ 0.9 | | | | | | | | | | | |
| Storage Stability at 180°C (% diff in G* at $T_{max}$) | 1.4 | < 10 | | | | | | | | | | | |
| Flash Point (°C) | | 230 | | | | | | | | | | | |
| | 1.5 | After RTFO Ageing | | | | | | | | | | | |
| G* and δ at [($T_{max}$ + $T_{min}$)/2+4]°C, | 1.10 | Compulsory report only – see detail description of report only item | | | | | | | | | | | |
| Mass Change (% m/m) | | < 0.3 | | < 1.0 | | | | | | | | | |
| $J_{nr}$ at $T_{max}$ ($kPa^{-1}$) | | < 4.5 | < 4.5 | < 4.5 | < 2.0 | < 2.0 | < 2.0 | < 1.0 | < 1.0 | < 1.0 | < 0.5 | < 0.5 | < 0.5 |
| Ageing ratio [$G^*_{RTFO}$ / $G^*_{Original}$] | 1.8 | < 3.0 | | | | | | | | | | | |
| | | After RTFO plus PAV Ageing | | | | | | | | | | | |
| G* and δ at [($T_{max}$ + $T_{min}$)/2+4]°C, | 1.10 | Compulsory report only – see detail description of report only item | | | | | | | | | | | |
| S (60s) at $T_{min}$ + 10°C , MPa | | < 300 MPa | | | | | | | | | | | |
| m (60s) at $T_{min}$ + 10°C | | > 0.300 | | | | | | | | | | | |
| $\Delta T_c$ (°C) = $T_{c,S}$ – $T_{c,m}$ | 1.7 | > -5 | | | | | | | | | | | |
| Ageing ratio [$G^*_{PAV}$ / $G^*_{Original}$] | 1.8 | < 6.0 | | | | | | | | | | | |

Note: Introduced a PG 70 for purposes of seal work

# Climatic regions



# Traffic classes

| Design traffic (million E80) | Traffic Speed (km/h) | | | Asphalt mix design level |
|---|---|---|---|---|
| | < 20 | 20 - 80 | >80 | |
| < 0.3 | S | S | S | IA |
| 0.3 - 3 | H | S | S | IB |
| > 3 - 10 | V | H | S | II |
| > 10 - 30 | E | V | H | |
| > 30 | E | E | V | III |

# Benefits of PG Spec for SA?

- Binder selection based on traffic, climate
- Product innovation reliably assessed eg PMBs
- Permanent deformation reliably evaluated
- Long Term Ageing finally assessed, for thin layers in SA context!!
- Durability – stress relaxation holistically assessed (not fatigue versus LT fracture)
- Resource economy in test apparatus & methods (but bitumen sample size IT and LT!)
- No binder grade proliferation

# Implementation plan

- Introduction to industry on 25th January 2016
- Workshops to inform industry March 2016
  - 15th in Johannesburg
  - 16th in Cape Town
  - 17th in Durban
  - 18th in Port Elizabeth
- Bitumen Rheology Masterclass June 2016
  - 21-23 June 2016 in Johannesburg
  - International experts
  - Workshop with DSR UG
- Two-year parallel implementation
  - Include data analyses and research
- Final implementation
  - SANS 90% complete

# Available facilities

- Much Asphalt Central Laboratory
- Sasol SA Energy, Technology Bitumen Lab
- CSIR Advanced Materials Testing Laboratory (2 sets of results submitted)
- Labco SANRAL Regional Laboratory
- Soilco Pietermaritzburg
- Soilco Westmead
- SRT East
- Soillab Pretoria
- National Asphalt Cliffdale

# Example results

| Property | Test Samples | | | | Grades Requirements | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A0916 | A0920 | A0918 | A0922 | 58S -22 | 58H -22 | 58V -22 | 58E -22 | 64S -16 | 64H -16 | 64V -16 | 64E -16 | 70S -10 | 70H -10 | 70V -10 | 70E -10 |
| Max pavement design temperature (°C) | Region not specified | | | | 58 | 58 | 58 | 58 | 64 | 64 | 64 | 64 | 70 | 70 | 70 | 70 |
| Minimum grading temperature (°C) | Region not specified | | | | -22 | -22 | -22 | -22 | -16 | -16 | -16 | -16 | -10 | -10 | -10 | -10 |
| G*/sinδ at 70°C** @10rad/s (kPa) | Fail | Fail | Pass (1.36) | Pass (1.17) | | | | | | | | | ≥1.0 | | | |
| G*/sinδ at 64°C** @10rad/s (kPa) | Fail (0.761) | Fail (0.642) | Pass (2.35) | Pass (2.12) | | | | | ≥1.0 | | | | | | | |
| G*/sinδ at 58°C** @10rad/s (kPa) | Pass (1.74) | Pass (1.37) | Pass (4.30) | Pass (3.95) | ≥1.0 | | | | | | | | | | | |
| Viscosity at 165°C $\gamma \geq 30$ sec$^{-1}$ (Pa.s) | 0.086 | 0.079 | 0.376 | 0.329 | ≤0.9 | | | | | | | | | | | |
| G*, δ | Appendix C | Appendix C | Appendix C | Appendix C | Report only | | | | | | | | | | | |
| Storage Stability (%) | 1.9 | 1.1 | 1.6 | 4.5 | <10 | | | | | | | | | | | |
| Flash Point (°C) | 264 | 260 | 260 | 252 | ≥230 | | | | | | | | | | | |
| After RTFOT Ageing | | | | | | | | | | | | | | | | |
| Mass Change (% m/m) | -0.055 | +0.051 | -0.090 | -0.316 | <0.3 | <1.0 | | | <0.3 | <1.0 | | | <0.3 | <1.0 | | |
| $J_{nr}$ at 70°C (kPa$^{-1}$) (ER%) | - | - | 1.8386 (51%) | 1.2897 (67%) | | | | | | | | | ≤4.5 | ≤2.0 | ≤1.0 | ≤0.5 |
| $J_{nr}$ at 64°C (kPa$^{-1}$) (ER%) | - | - | 0.8590 (59%) | 0.4158 (82%) | | | | | ≤4.5 | ≤2.0 | ≤1.0 | ≤0.5 | | | | |
| $J_{nr}$ at 58°C (kPa$^{-1}$) (ER%) | 3.1936 (0%) | 3.6317 (0%) | 0.3595 (68%) | 0.2184 (83%) | ≤4.5 | ≤2.0 | ≤1.0 | ≤0.5 | | | | | | | | |
| G*, δ | Appendix C | Appendix C | Appendix C | Appendix C | Report only | | | | | | | | | | | |
| Ageing ratio (RTFOT/Original) | 1.7 | 1.9 | 1.6 (34°C) | 1.6 (34°C) | <3.0 | | | | | | | | | | | |
| After PAV Ageing | | | | | | | | | | | | | | | | |
| Max creep stiffness at test temperature* (MPa) [S ≤ 300 MPa] | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | -12 | | | | -6 | | | | 0 | | | |
| Min m-value at test temperature* [m ≥ 0.300] | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | Pass @-12°C, -6°C & 0°C | -12 | | | | -6 | | | | 0 | | | |
| $\Delta T_c$ (°C) | -2.0 | -1.0 | -3.3 | -1.3 | >-5 | | | | | | | | | | | |
| G*, δ | Appendix C | Appendix C | Appendix C | Appendix C | Report only | | | | | | | | | | | |
| Ageing ratio (PAV/RTFOT) | 3.4 | 3.6 | 3.9 (34°C) | 3.9 (34°C) | <6.0 | | | | | | | | | | | |

# Indicative costs

| Specification | Cost per test |
|---|---|
| SANS BT1 | ± R 5 000 |
| TG1 | ± R 9 000 |
| PG | ± R 10 000 |

# Snapshot SA Binder Classification

| 40/50 | 60/70 | 80/100 | 150/200 |
|---|---|---|---|
| X | ~~PG64-16~~ | PG58-22 | X |
| PG64-16 | PG58-22 | PG58-22 | X |
| PG64-16 | PG64-22 | PG58-16 | PG52-22 |
| PG70-22 | PG64-16 | PG58-22 | PG52-22 |

Base bitumens remain the same –
should not affect export of bitumen

# PG Equivalence to SANS

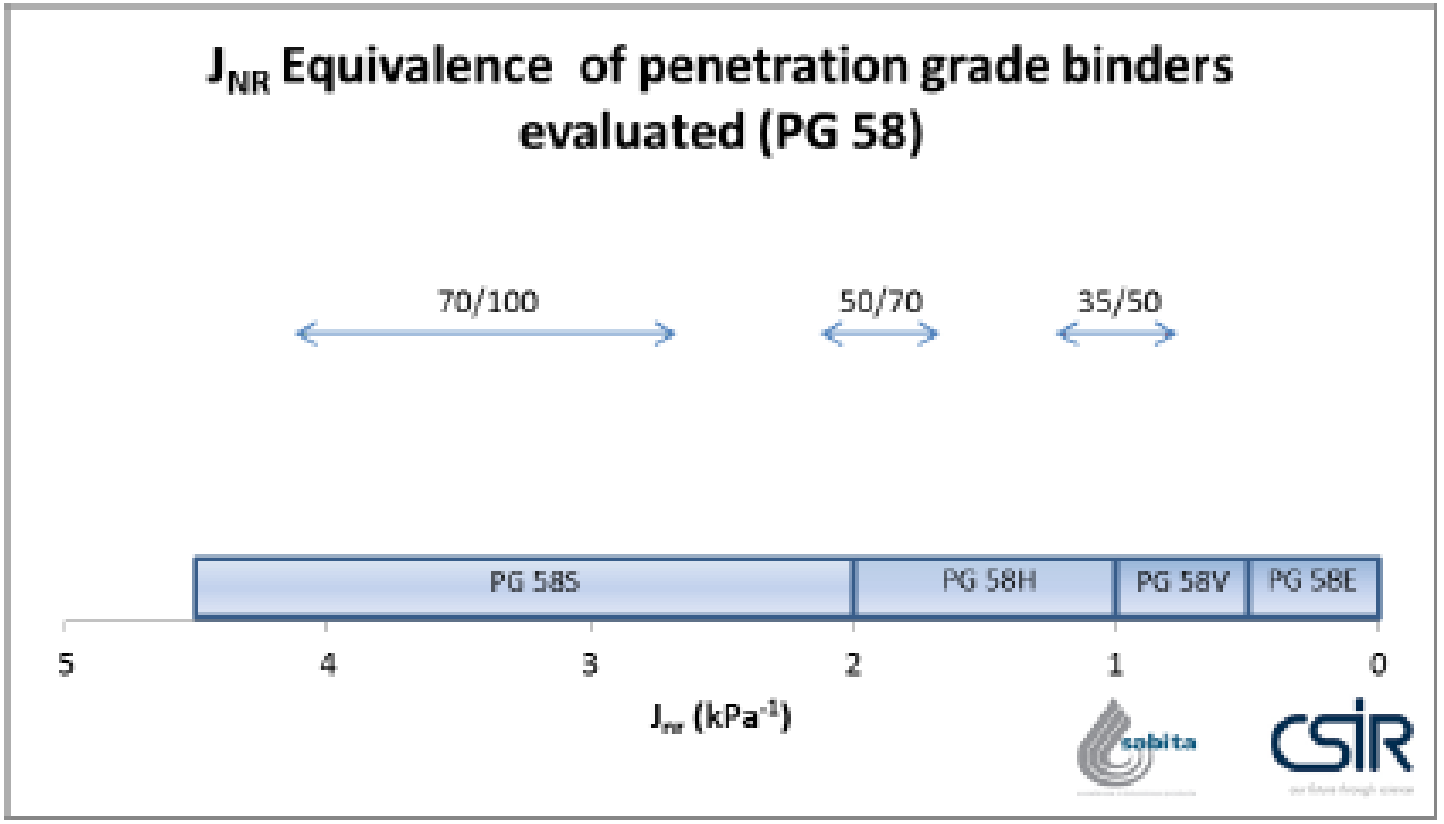



Figure 3: $J_{NR}$ equivalence of penetration grade binders evaluated (PG 58)[1]

# PG64 Equivalence to TG1

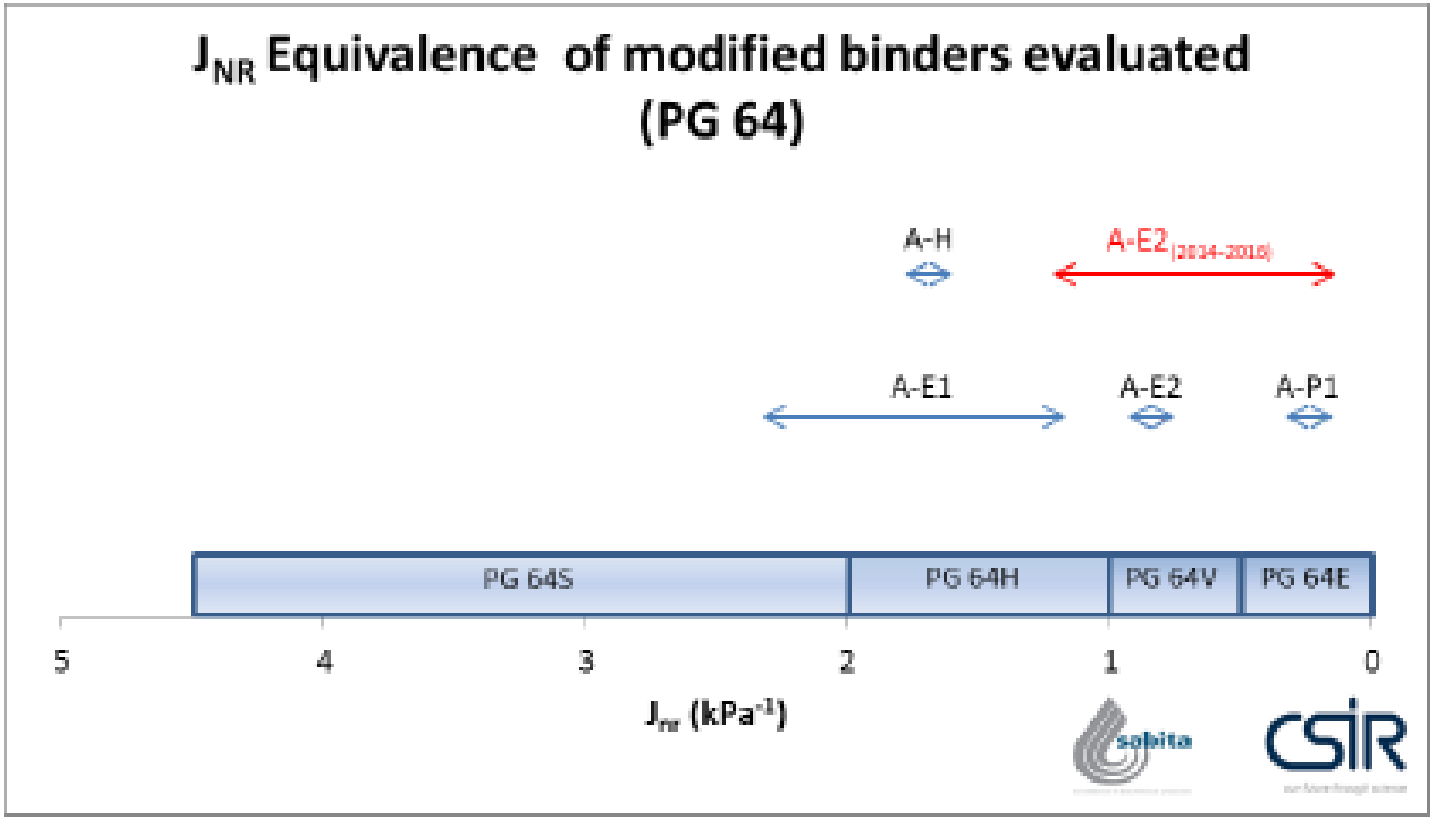



Figure 4: $J_{NR}$ equivalence of modified binders evaluated (PG 64)[1] – in red is the updated range of A-E2 binders tested between 2014-2016.

# Public/private partnership

- SANRAL already sponsored SAPDM
- SABITA sponsored initial research

- SANRAL to sponsor research now
  - Direct contribution for project work - R2.5m
  - Bursaries for 3 M-students
- SABITA will contribute through its members
  - Much committed R 750 000 and laboratory
  - Tosas committed to a SR-1 research
  - Colas contribute with **Storage Stability** and **QA** research
- Provinces and Metros indicated buy-in with implementation

# Bitumen finger printing

- Need is for a reference of what is available
- Request to do full suit if tests as per PG spec
- Plus detail master curves

# Conclusion

- New PG specifications hold benefits
- Implementation will be done over two years
  - Progress will pick up pace
- PG specifications introduced in workshops
  - Done, but will do more next year
- Advanced course to explain principals
  - Done
- Research in progress to tweak specifications
- Finger printing exercise required to build a database
- SANS specifications progressed well

THANK YOU