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ontario asphalt pavement council
A council of ORBA

APRIL 10
2025

SHERATON HAMILTON HOTEL
116 King St W, Hamilton, ON L8P 4V3

SPRING OPERATIONS SEMINAR (SOPs) 2.0

asphalt ontario rides on us

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ASPHALT CEMENT 101

TOWARDS BETTER SPECIFICATIONS

OAPC SPRING OPS SEMINAR

Hamilton, April 10, 2025

TONY KUCHAREK

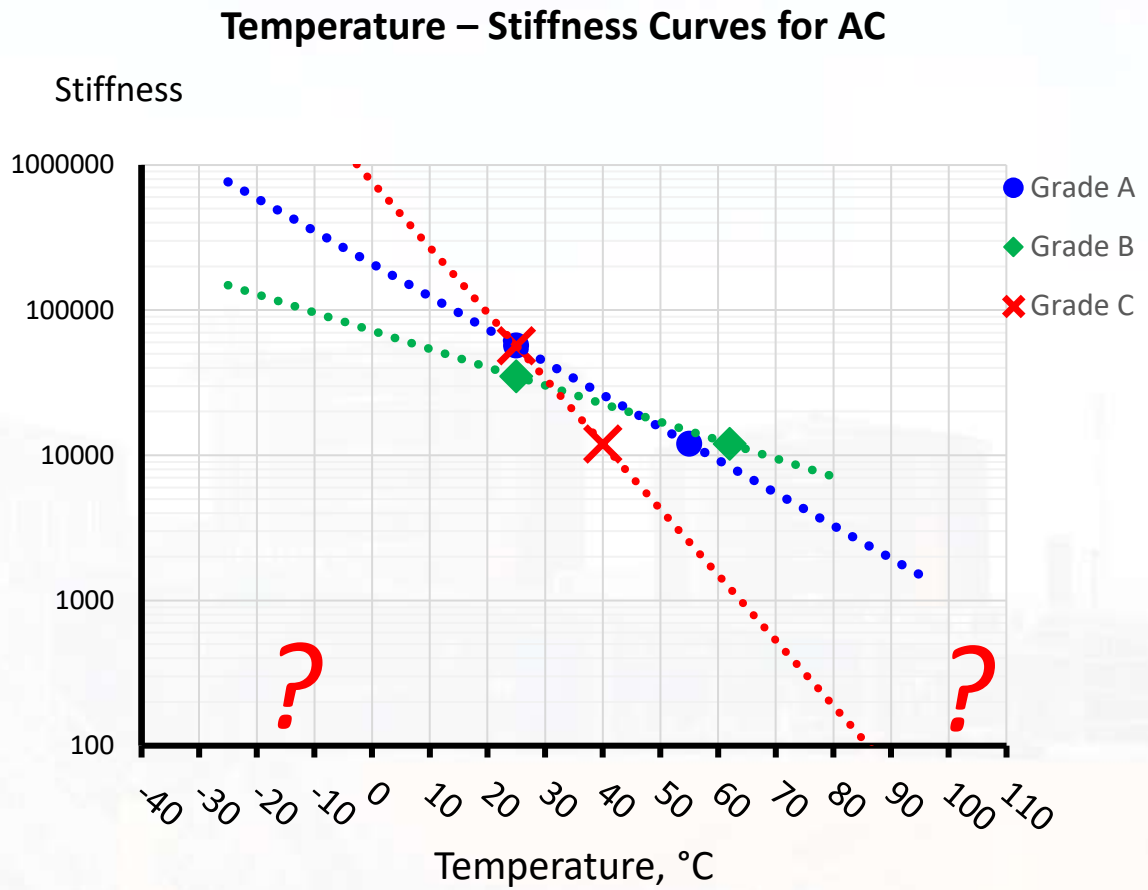
McASPHALT

OVERVIEW

- Asphalt cement general behaviour
- Asphalt cement specs and grades
- Why and how we modify asphalt
- Ontario specifications – today and tomorrow

DESIRED AC PROPERTIES

- Wide viscoelastic region
  - Become brittle at low temp
  - Become liquid at high temp
- Low temperature susceptibility
- Good resistance to aging – short and long term
  - Low volatility of lighter ends
  - Low oxidation rate
- Good chemical compatibility with aggregate



ASPHALT CEMENT SPECIFICATIONS

Specifications are required performance criteria for the asphalt binders

Descriptive specs (recipe specs)

- Ingredients and their dosage is specified (or banned)

Performance-related specs

- Empirical Specs
- Fundamental Specs

Performance-based specs

- Real performance captured in service

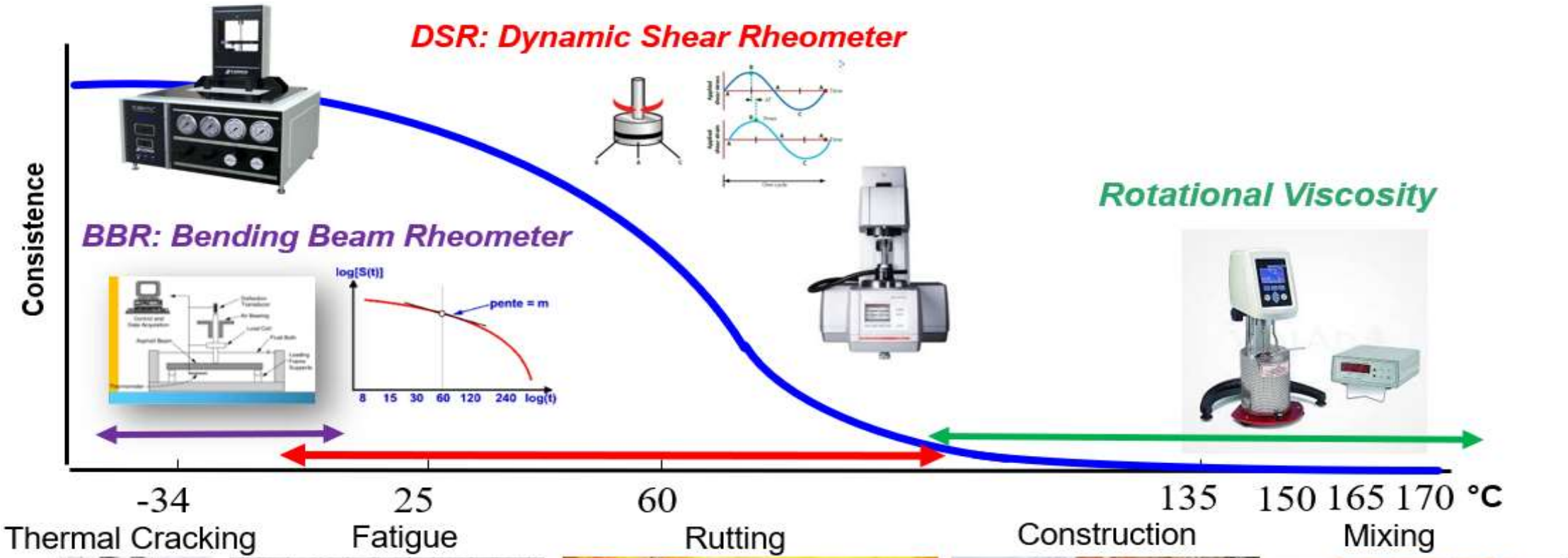
LARGELY DISCONTINUED — They do not translate in quality materials

EMPIRICAL
- Penetration
- Viscosity

FUNDAMENTAL
- PG Spec
- MSCR Spec

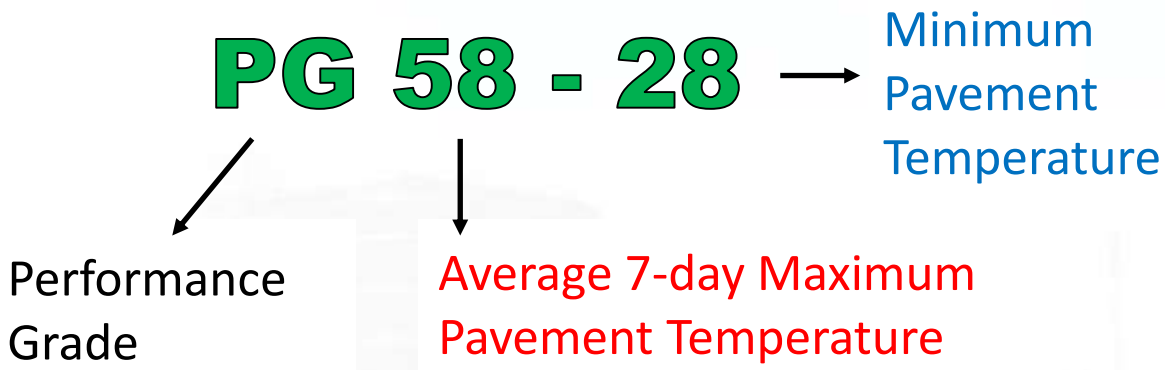
ULTIMATE GOAL — Mix performance specs the closest concept today

PG GRADING


DSR: Dynamic Shear Rheometer
BBR: Bending Beam Rheometer
Rotational Viscosity
Consistence
log[S(t)]
pente = m
8 15 30 60 120 240 log(t)
-34
25
60
135 150 165 170 °C
Thermal Cracking
Fatigue
Rutting
Construction
Mixing

PG GRADE OF ASPHALT CEMENT

- Grade system based on LTPP
- 6500 weather stations in NA
- Air temperature converted



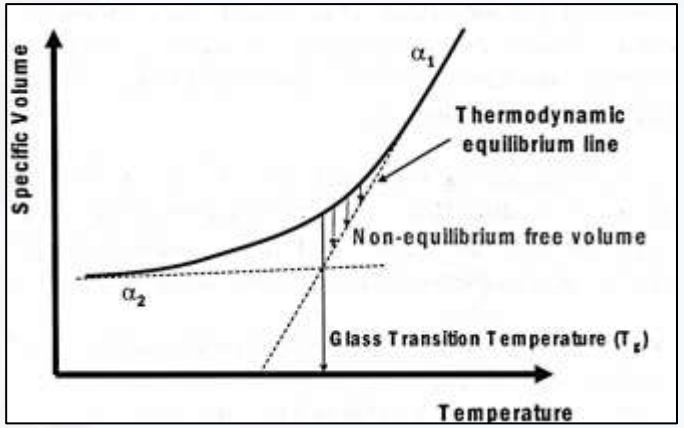
- PG High – 20mm below surface
- PG Low – at pavement surface

PHYSICAL (ISOTHERMAL) HARDENING - EBBR

- Reversible physical hardening of asphalt at low temperature (72 H conditioning)
- Extended BBR – specified ONLY in ON

- Low temp limiting grade - LTLG **POINT**
- Grade Loss **SHAPE**

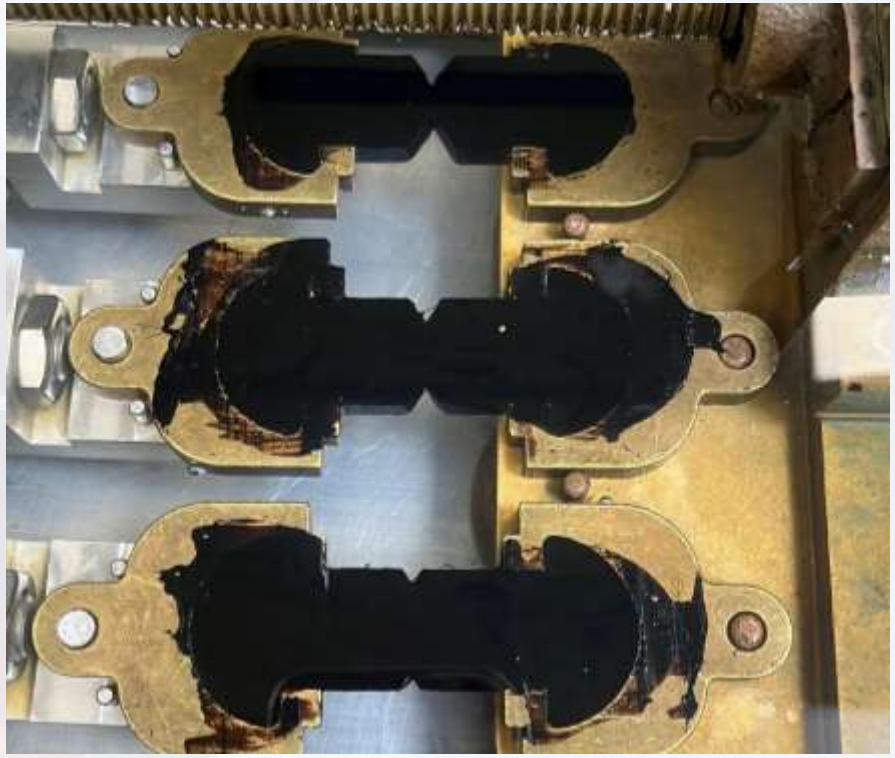
- Any bitumen with a grade loss over 6 degrees is deemed unsuitable for cold climate pavements
- >90 % of ON asphalts lose between 3-6 degrees



Source: Bahia (top image)

DOUBLE EDGE NOTCHED TENSION (DENT)

- Developed and specified in Ontario
- Tested on PAV residue, 15˚C
- Measures essential work of ductile fracture; strain tolerance using a force-ductility concept
- Almost impossible to pass if bitumen is not modified



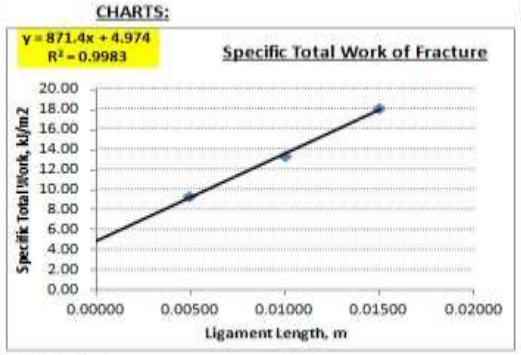
DENT TEST REPORTING SHEET

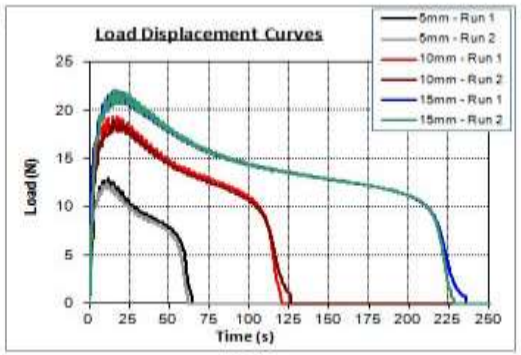
Sample:	PG 58-34 P CA	Test Temp, C:	15.0
Source:	R&D	Pull speed, cm/min:	5.0
Test Date:	2/16/12	McA Ref No:	11-407

RESULTS:

ligament length	5	10	15	mm
ℓ, average measured ligament length	0.00496	0.00997	0.01502	m
B, average measured sample thickness	0.01000	0.01000	0.01000	m
W_t, total work of fracture, average	0.4662	1.3404	2.7269	J
w_t, specific total work of fracture	9.40	13.45	18.16	kJ/m^2
w_e, specific essential work of fracture	4.9740			kJ/m^2
bw_p, specific plastic work of fracture	0.8714			MJ/m^3
d_t, CTOD, average	19.3802			mm

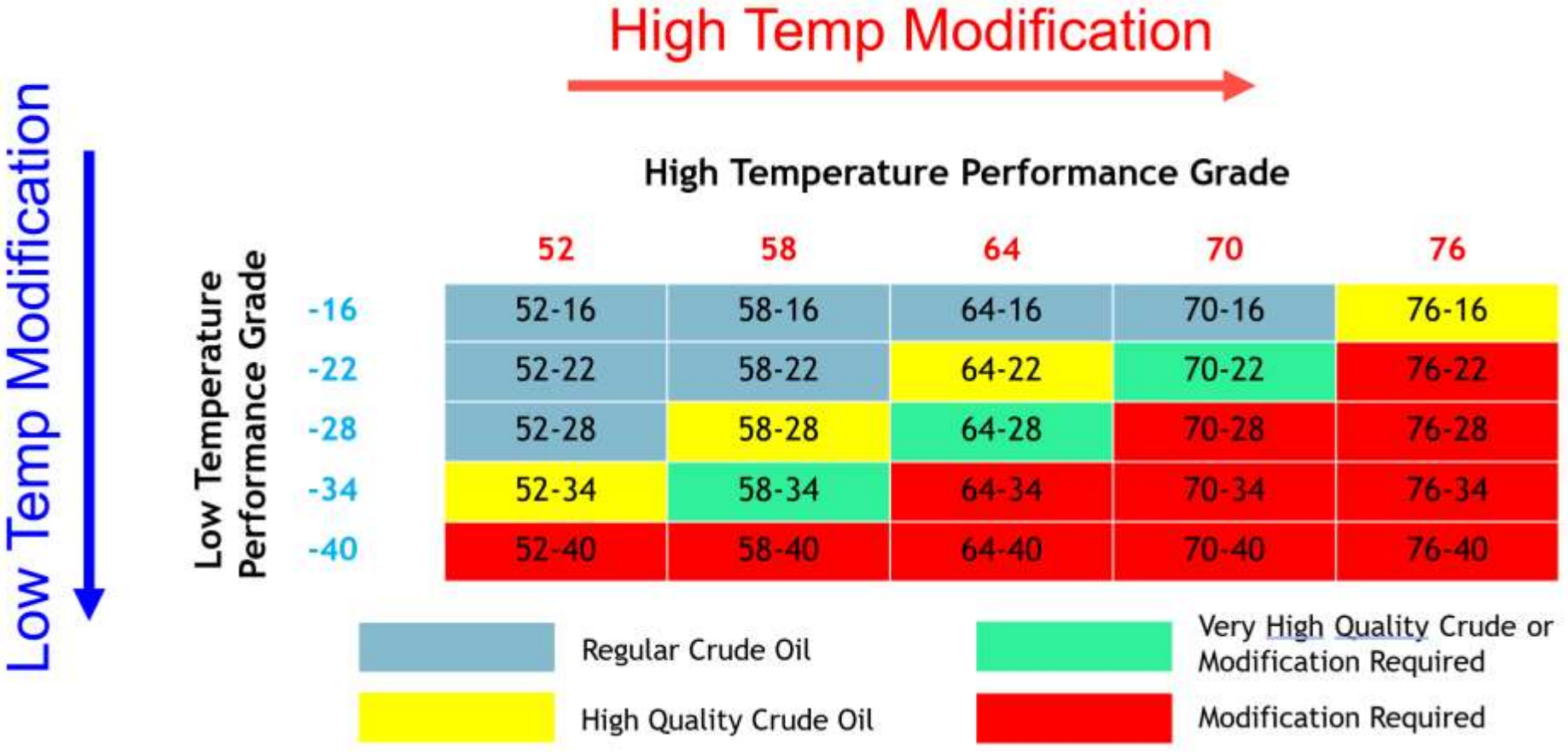
CHARTS:





COMMENTS:

NEAT VS MODIFIED

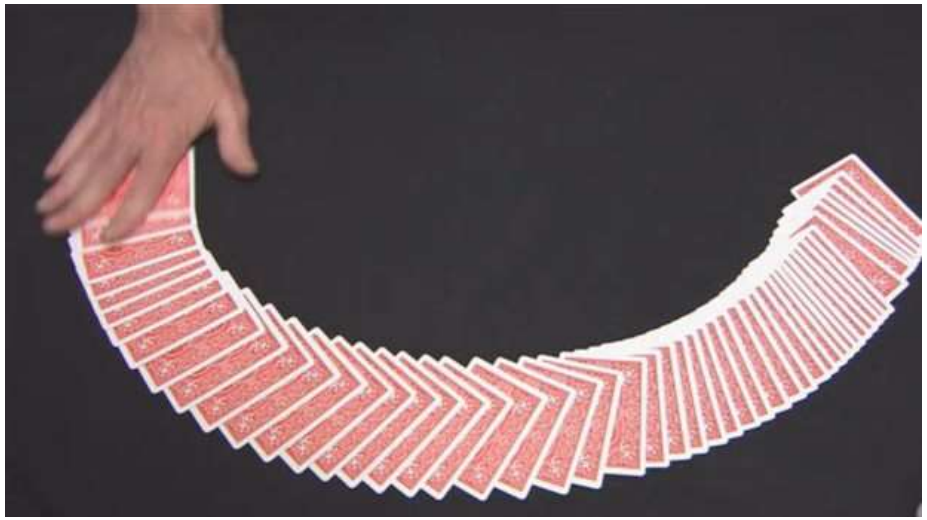


MAIN ASPHALT MODIFICATION TYPES

- **Polymers** – products abbreviated “PMA’s” or “PMB’s”
  - **Elastomers** – SBS, SB, SBR, RET
  - **Plastomers** – LDPE, HDPE, EVA, EPDM
- **Hydrocarbons** – waxes, fluxes, oils, VGO, REOB
- **Extenders** – sulfur, lignin, biochar
- **Fillers** – CR*, HL, Fly Ash, baghouse fines, carbon black
- **Fibers** – cellulose, mineral, PET, PP, fiberglass
- **Process based** – air blowing, steam distillation
- **Chemical** - Oxidants, antioxidants, acids, anhydrides
- **Antistrips** – amines, imidazolines, phosphate esters, silane
- **WMA** – surfactants, zeolites, paraffins
- **PPA** – could qualify into several categories

WHAT DRIVES SELECTION OF MODIFIER

- Specification
  - Most require elastic behaviour, as MSCR or PG Plus
  - Some specs mandate or encourage CR usage (US)
  - Many specs ban specific modifiers (PPA, REOB)
- Price
- Raw material availability
- Aggregate compatibility
- Environmental regulations
- Experience and expertise



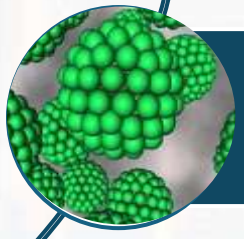
MAIN MODIFICATIONS IN ON TODAY

SBS/SB

High PG grades, MSCR Rec, DENT

FLUXES

Low PG grades, EBBR, DENT

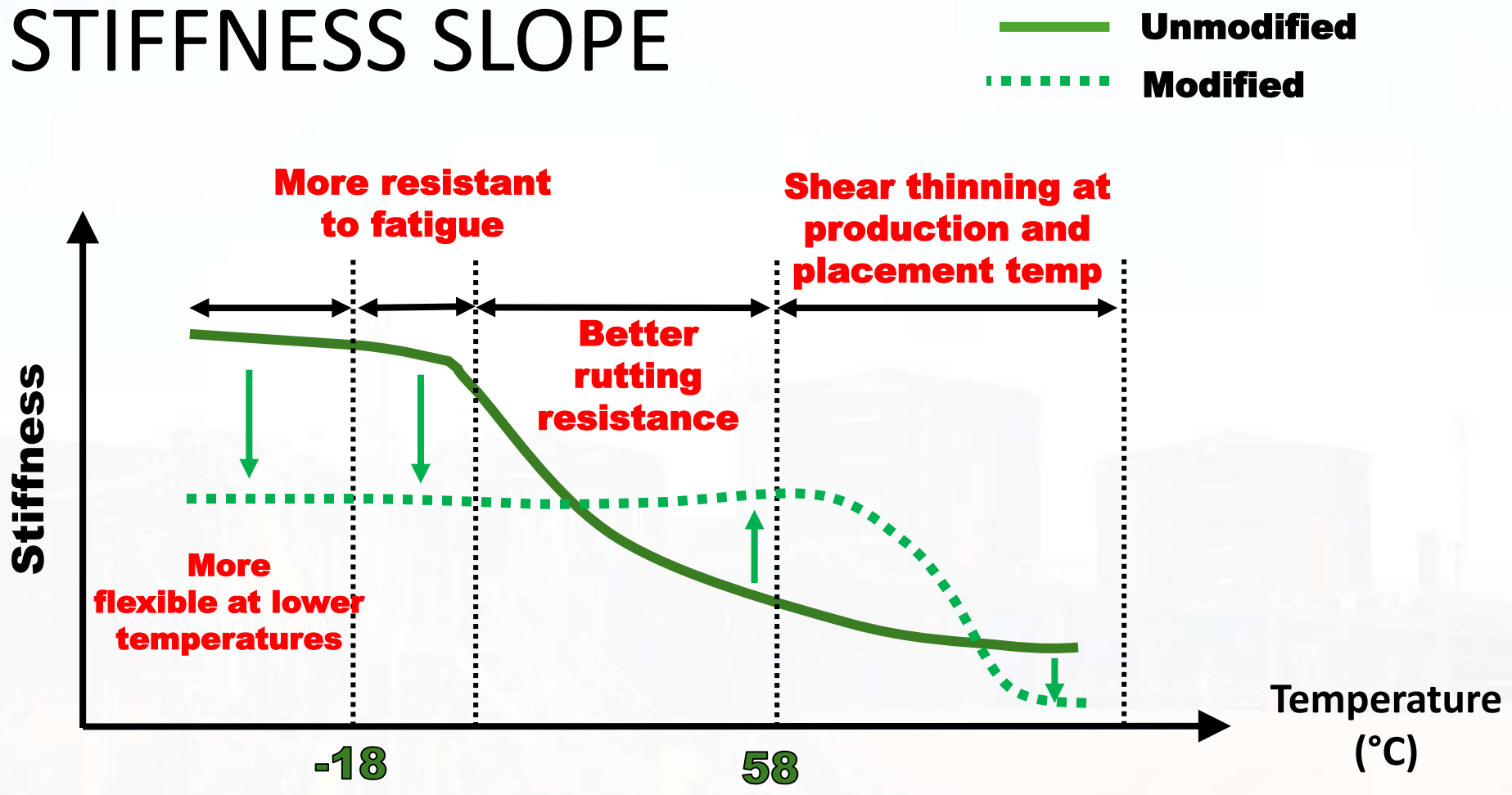


WMA – AS

Moisture damage, Temp reduction, HMA Density

FLATTER STIFFNESS SLOPE

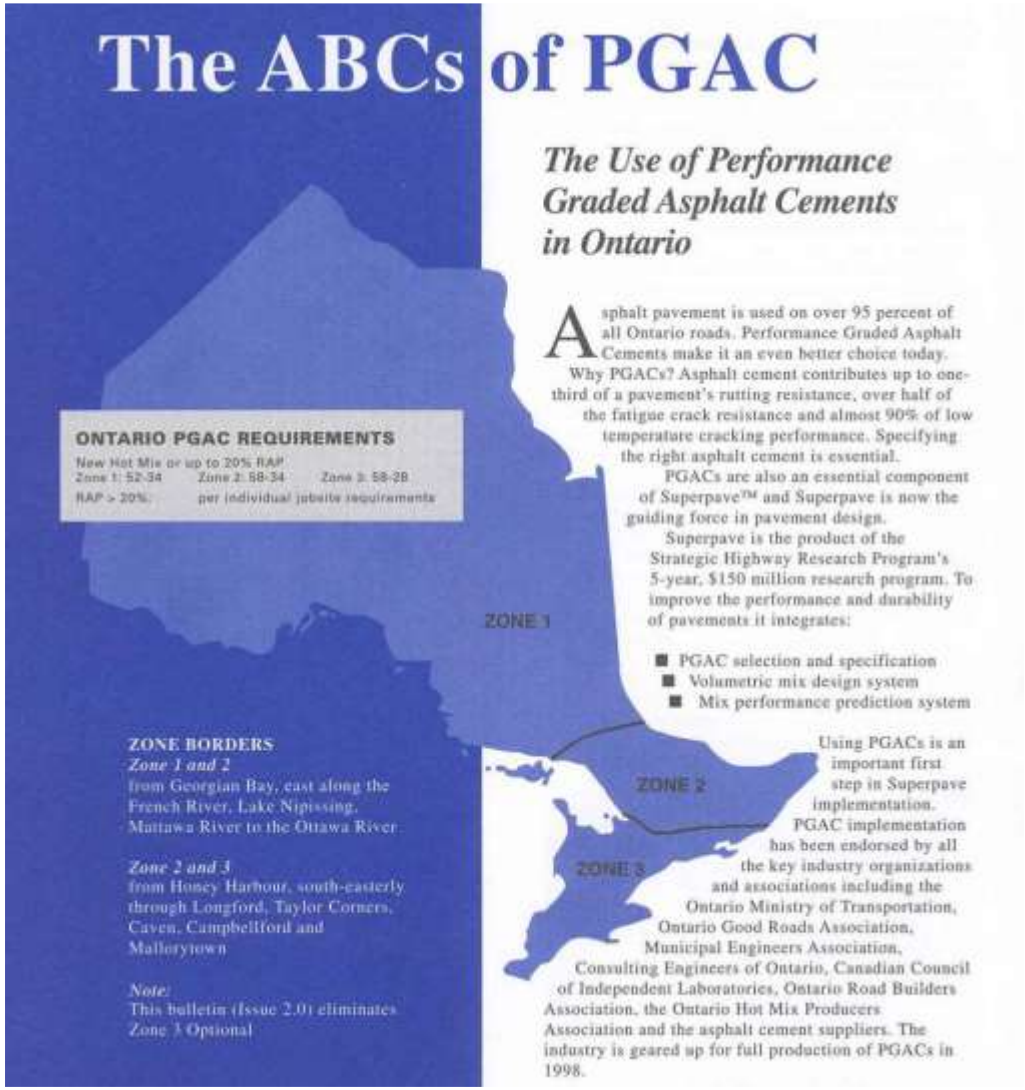
- PMA's flatten the slope of the temperature dependency



ONTARIO SPECIFICATIONS TODAY

PG SPEC IN ONTARIO

- Adopted in the late 90's
- 3 climatic zones – 3 base grades
  - Zone 1 – PG 52-34
  - Zone 2 – PG 58-34
  - Zone 3 – PG 58-28
- Prior to PG there were Pen grades
  - 85/100
  - 150/200
  - 300/400



ADJUST TO TRAFFIC LOADING (GRADE BUMPING)

Highway Type	Increase from Standard	Optional Additional Grade Increase (Note 1)
Urban Freeway	2 Grades	N/A
Rural Freeway **Urban Arterial**	1 Grade	1 Grade
Rural Arterial **Urban Collector**	Consider increasing by 1 grade if heavy truck traffic is greater than 20% of AADT	1 Grade
Rural Collector **Rural Local** **Urban/Suburban Collector**	No Change	1 or 2 Grades

Notes:

A. Upgrading of the high temperature grade is recommended for use in both surface and top binder courses, i.e., top 80 to 100 mm of hot mix.

B. Alternatively, Multiple Stress Creep Recovery (MSCR) graded PGAC acceptance criteria, according to Appendix B and Appendix Table A-3, can be used.

1. Consideration should be given to an increase in the high temperature grade for roadways which experience a high percentage of heavy truck or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting.

ONTARIO SPECS AND MODIFIED AC SUFFIXES

NO SUFFIX

- PG XX-YY
- Neat or modified
- No EBBR
- No DENT
- No MSCR
- No direct additives restrictions

$

AASHTO M320

X

- PG XX-YY X
- Always modified
- EBBR at -YY
- DENT
- MSCR
- No direct additives restrictions

$$

OPSS.PROV 1101

J

- PG XX-YY J
- Always modified
- EBBR at -YY+3
- DENT
- MSCR
- Direct additives restrictions

$$

OPSS.MUNI 1101

XJ

- PG XX-YY XJ
- Always modified
- EBBR at -YY
- DENT
- MSCR
- Direct additives restrictions

$$$

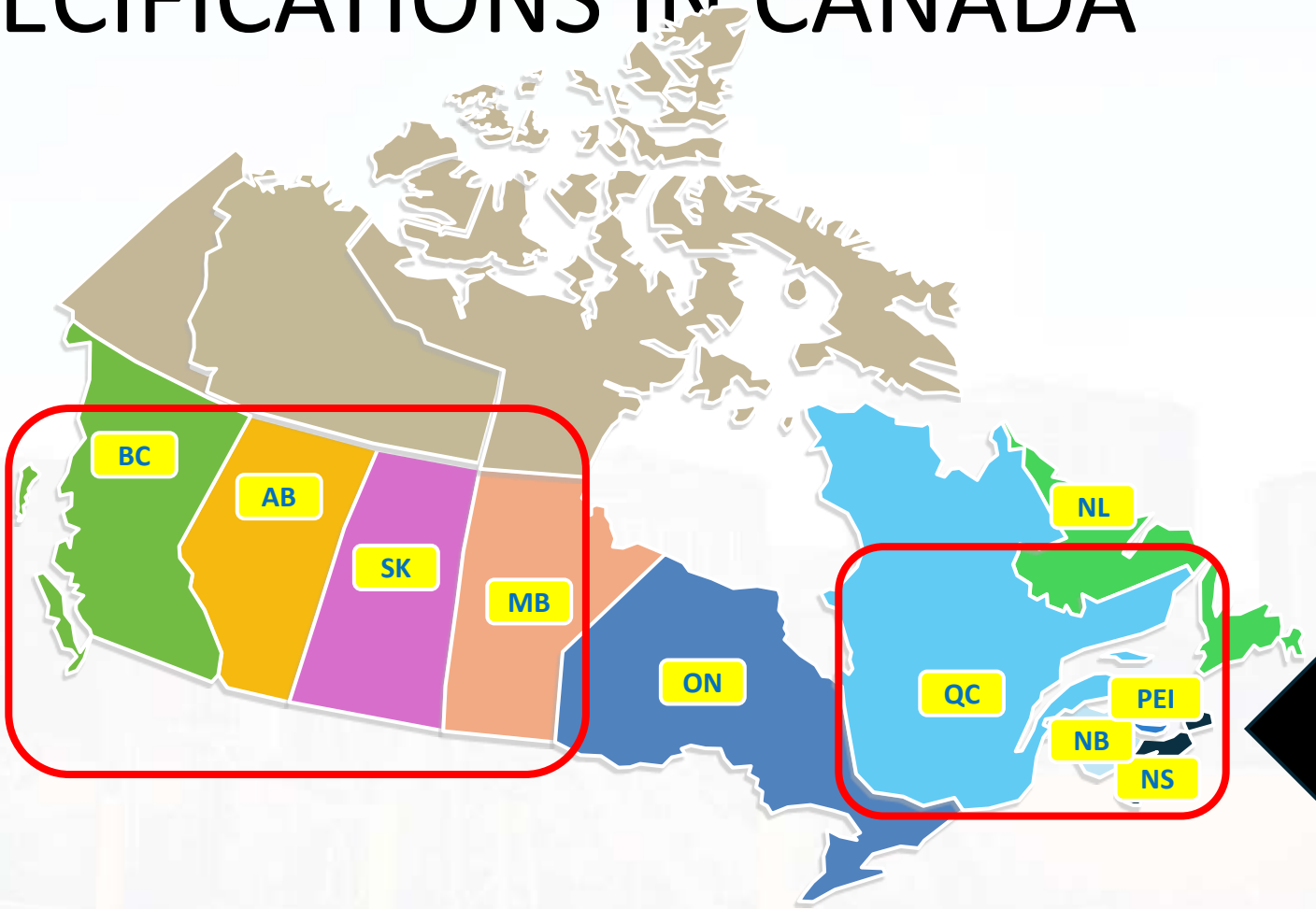
SPECIALTY

PGAC SPECIFICATIONS IN CANADA

52-34
58-28
58-31
58-34
58-37
58-40
64-22
64-28
64-34
64-37
70-22
70-28
70-31

TOTAL: 13 GRADES

PG SPEC + MSCR TEST



MSCR SPEC

52S-34
52V-40
58S-28
58H-28
58S-34
58H-34
58E-34
64H-28
64E-28
64U-28

TOTAL: 10 GRADES

PGAC GRADES IN ONTARIO TODAY

52-40
52-34
58-28
58-34
58-40
64-28
64-34
70-28

TOTAL: 8 GRADES

×

SUFFIXES
J
X
XJ

1101 APP B

MSCR Grades

=

52-40
52-34 52-34J 52-34X
58-28 58-28J 58-28 XJ
58-34 58-34J 58-34X 58-34XJ
58-40
64-28 64-28J 64-28X 64-28XJ
64-34 64-34J 64-34X 64-34XJ
70-28 70-28J 70-28X 70-28XJ
70-34 70-34J 70-34X 70-34XJ

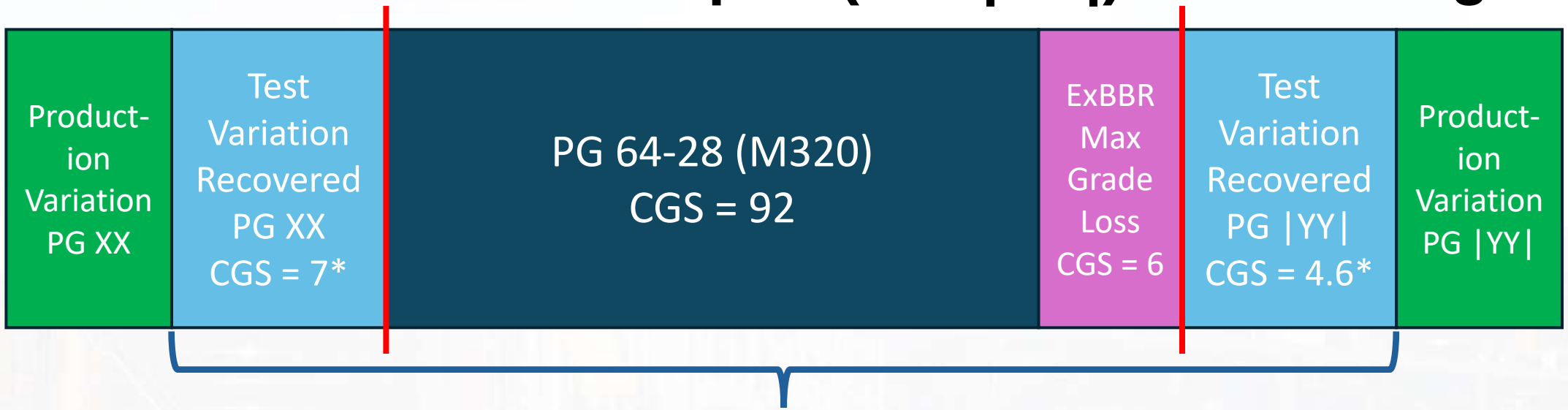
58H-28 J 58V-28 J 58V-28 X
58S-34 XJ

TOTAL: 32 GRADES

WHY?

HOW TO CREATE AN IMPOSSIBLE SPEC

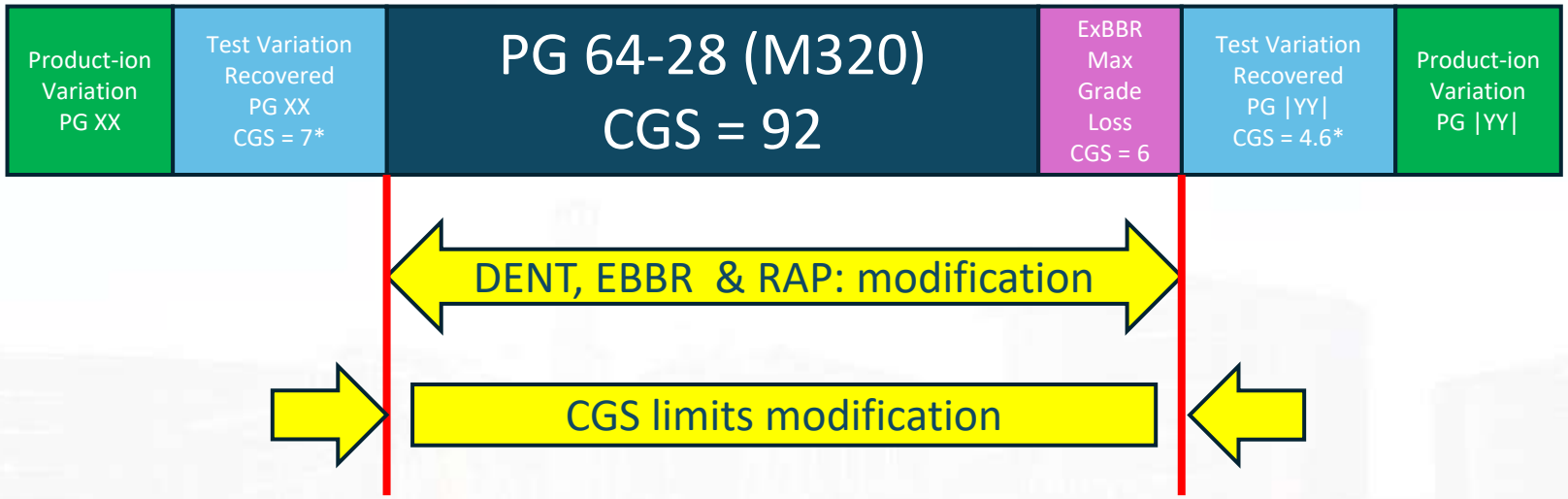
Continuous Grade Span (XX+|YY|) Accounting



*2023 MTO Recovered AC Correlation

Required Continuous Grade Span (CGS) = 109.6 - <u>Excluding</u> Production Variation & RAP usage

ACCEPTANCE ON RAC, PLUS EBBR, DENT, CGS



The likeliness for the RAC to fail this specification is almost guaranteed
The control of the AC supplier over the QA results is almost inexistent

HOW DO WE FIX OUR SPECIFICATIONS

- Adopt one specification across the province – MTO & municipalities
- Ensure it captures every desired aspect of the PGAC quality
- Set different acceptance limits between tank PGAC and RAC
- Use simple, less variable and less time-consuming tests
- Consider variability and precision of tests when establishing acceptance limits
- Stick to these standard specifications and resist modifying criteria
- Refrain from trying to police dishonest behaviour using specifications

THANK YOU

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