Laboratory testing of pavement crack sealants

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Canada

Presentation

- ❑ Problem Statement
- ❑ Objectives
- ❑ Testing Equipment
- ❑ Testing Program
- ❑ Test Results
- ❑ Conclusion

Problem Statement

- ❑ Demand for crack sealants improvement
- ❑ Field simulation
- ❑ Current techniques are not satisfactory

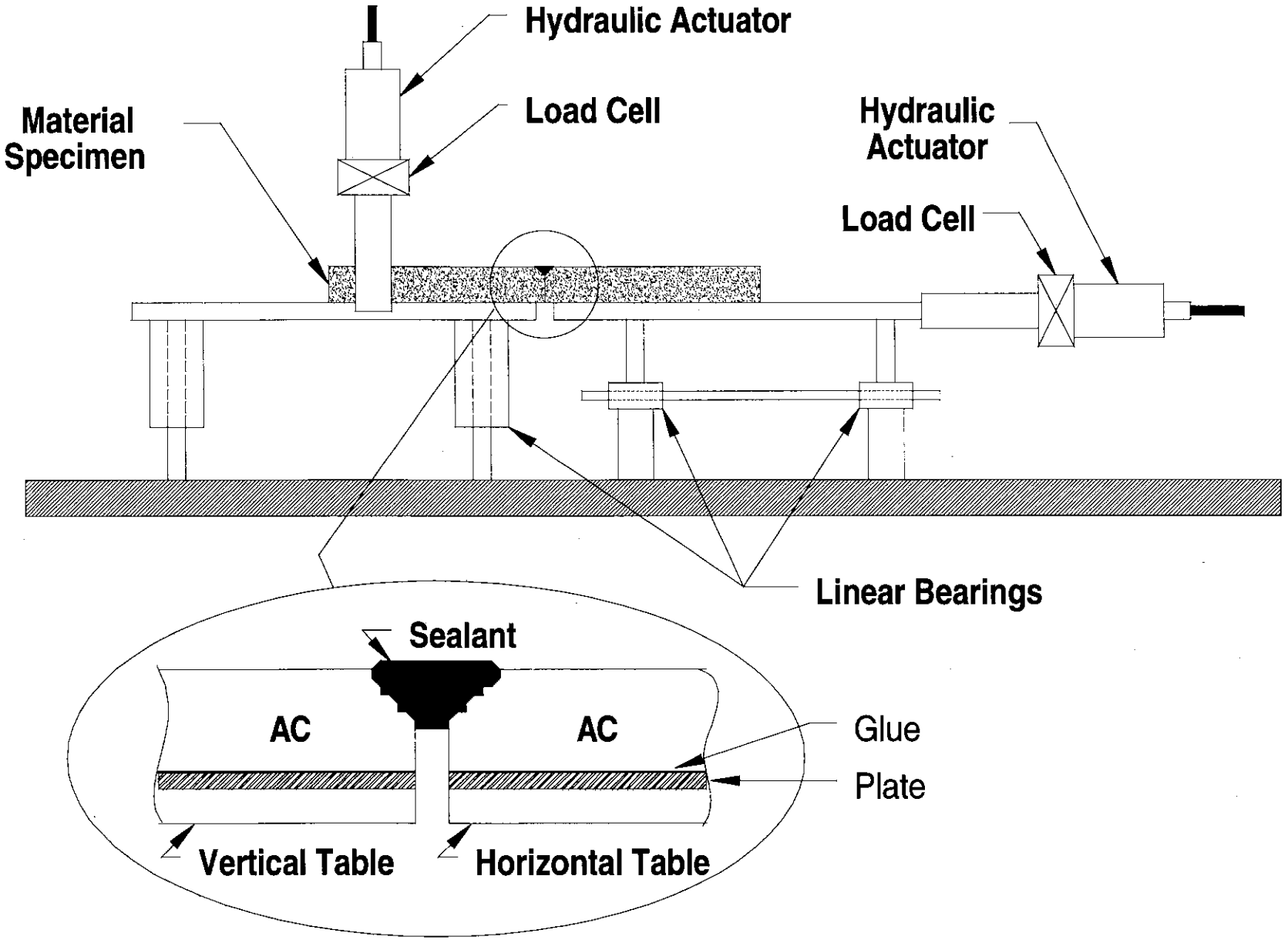
Objectives

- ❑ Develop testing procedure for evaluation of crack routing and sealing rehabilitation techniques in laboratory
- ❑ Determine the best combination of sealant and crack repair technique

Laboratory Testing Equipment

- ❑ Construction Material Testing System (Loading Table)
  - Vertical - shear stress (dynamic - ±0.127 mm/sec)
  - Horizontal - tensile stress (static - 0.1 mm/min)
- ❑ Environmental Chamber
  - -40°C to +40°C

Samples Preparation


Hydraulic Actuator
Load Cell
Material Specimen
Hydraulic Actuator
Load Cell
Linear Bearings
Sealant
AC
AC
Glue
Plate
Vertical Table
Horizontal Table

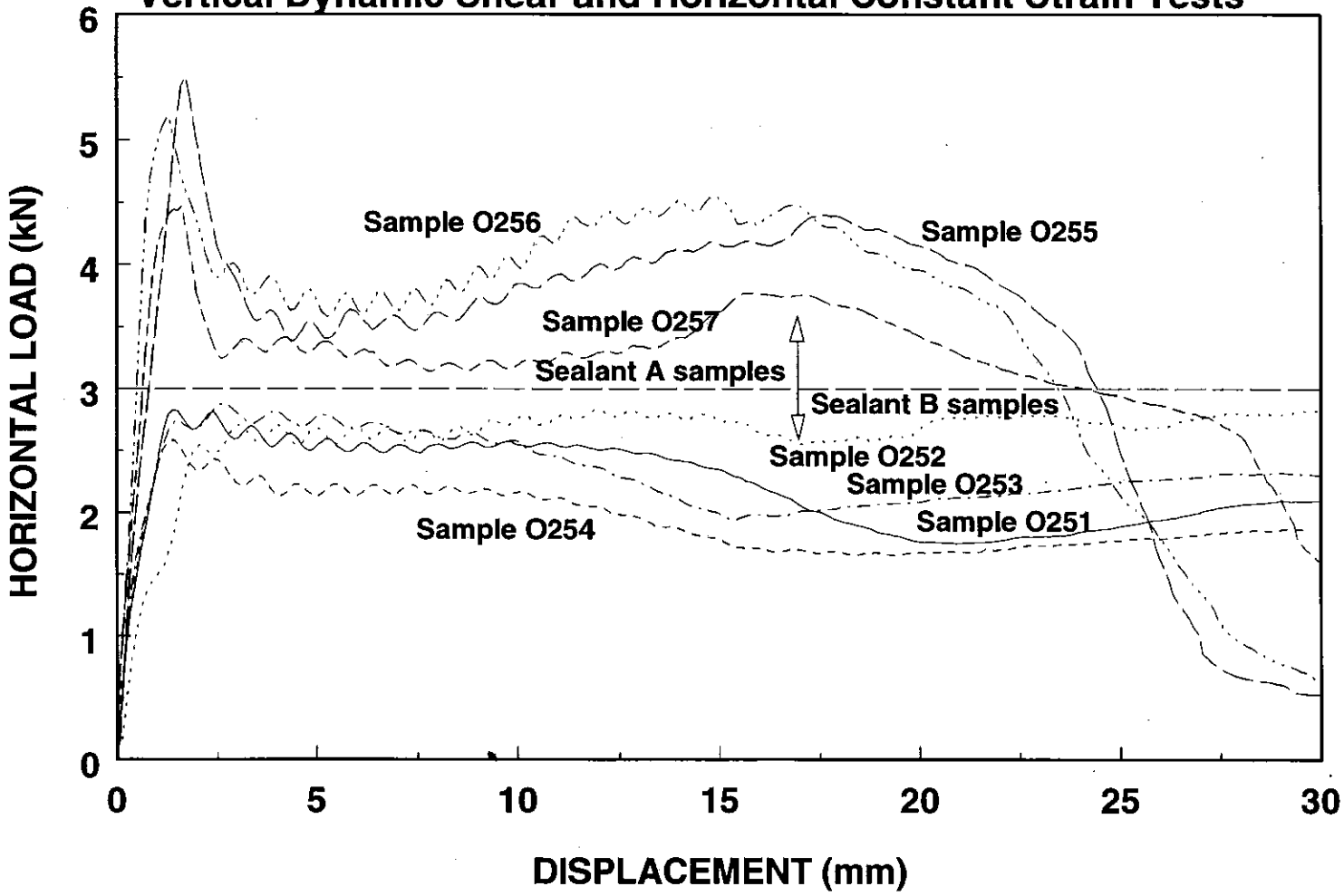
Test Results

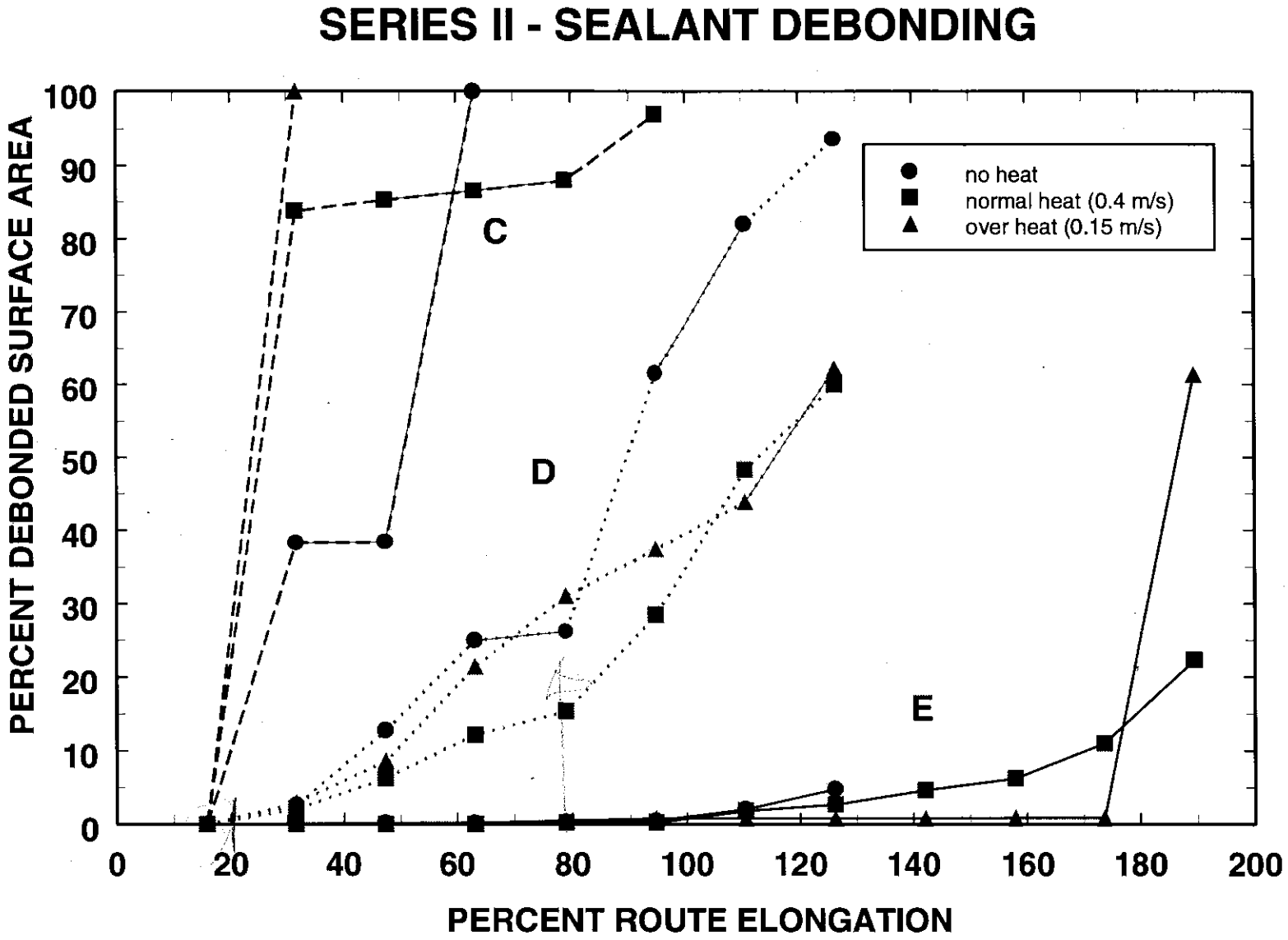
- ❑ Series I
- ❑ Series II

new

SERIES I - CHANGING TEMPERATURE TESTS (-30 to -40°C)

Vertical Dynamic Shear and Horizontal Constant Strain Tests



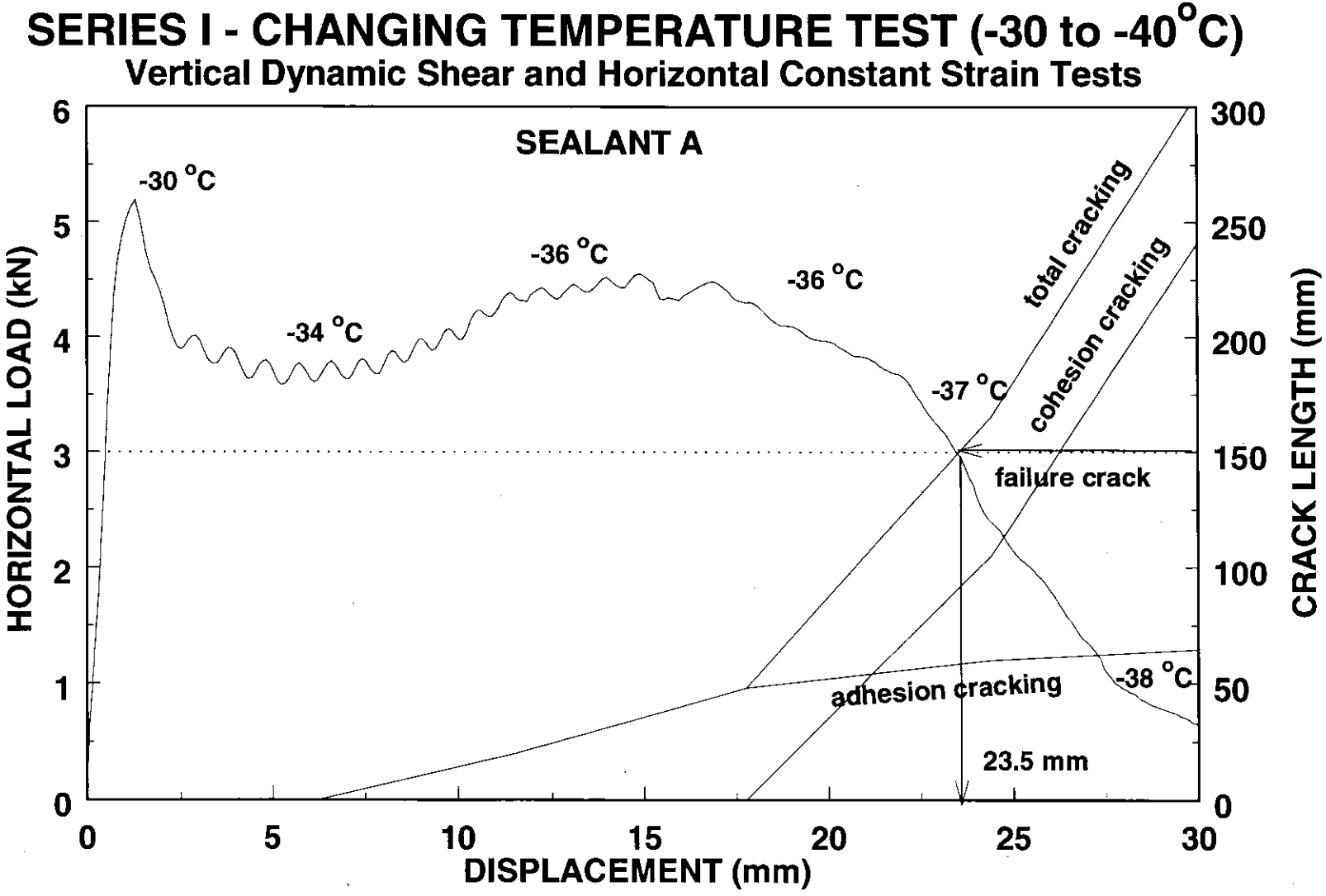

SERIES II - SEALANT DEBONDING
PERCENT DEBONDED SURFACE AREA
PERCENT ROUTE ELONGATION
no heat
normal heat (0.4 m/s)
over heat (0.15 m/s)
C
D
E
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200

Elastic Modulus Estimation

Sealant "E"		Sealant "C"		Sealant "D"	
sample number	modulus (kPa)	sample number	modulus (kPa)	sample number	modulus (kPa)
bb1-5	194.3	**cr1-5**	205.5	**hs1-5**	176.3
bb6-10	141.3	**cr6-10**	170.2	**hs6-10**	211.1
bb11-15	144.6	**cr11-15**	161.8	**hs11-15**	185.9
mean	160.1	mean	179.2	mean	191.1

Conclusions

- Results affected by temperature of sealant during pouring
- Rout heating does not significantly influence results
- Flexible material behaves better than stiffer material
- CMTS closely simulates field conditions


SERIES I - CHANGING TEMPERATURE TEST (-30 to -40°C)
Vertical Dynamic Shear and Horizontal Constant Strain Tests
SEALANT A
-30 °C
-34 °C
-36 °C
-36 °C
-37 °C
total cracking
cohesion cracking
failure crack
adhesion cracking
-38 °C
23.5 mm
HORIZONTAL LOAD (kN)
CRACK LENGTH (mm)
DISPLACEMENT (mm)
0
1
2
3
4
5
6
0
50
100
150
200
250
300
0
5
10
15
20
25
30

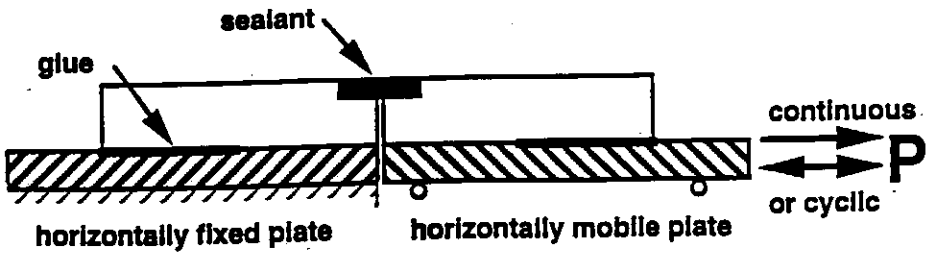
Series I: Changing Temperature Tests (-30°C to -40°C)
Vertical Dynamic Shear and Horizontal Constant Strain

Sealant/ Test Number	Readings at peak load			Readings at end of test			Readings at failure point [1]		
	load (N)	disp. (mm)	energy (N-mm)	energy (N-mm)	cycles	disp. (mm)	load (N)	disp. (mm)	cycles
Sealant A	5,054	1.54	4,946	100,356	17,600	29.97	2,999	25.5	15,033
Sealant B	2,751	2.39	4,820	67,858	17,220	29.94	No cracking / failure		

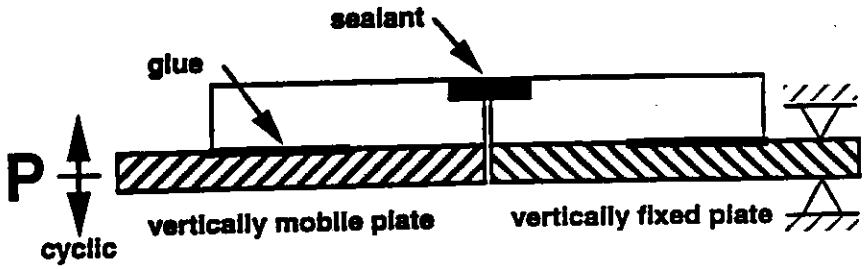
Loading Conditions:

Horizontal: 0.10 mm/min
Vertical: ±0.127 mm (±0.005in.) 1 Hz sine wave
Temperature change: -30°C to -40°C (achieved -30°C to -38°C)

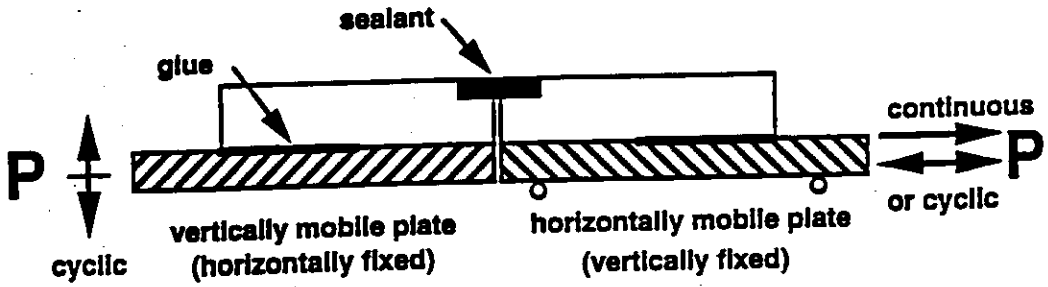
[1] Failure point defined as cracking ≥50% of rout length (300 mm)



a) Horizontal Continuous or Cyclic Loading

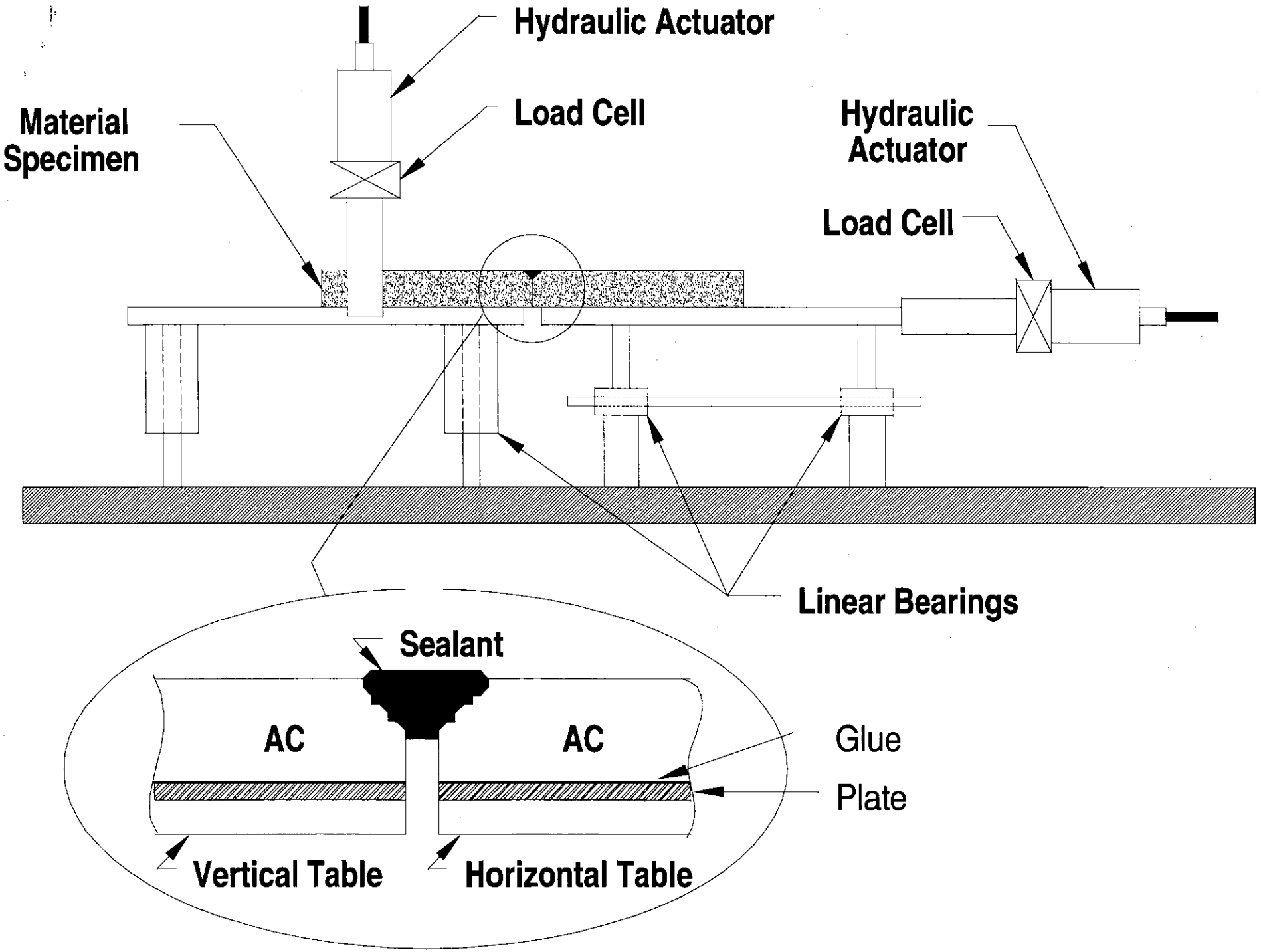


b) Vertical Cyclic Loading



c) Combined Horizontal and Vertical Loading

Figure A3: Types of test methods for evaluating pavement crack routing and sealing techniques.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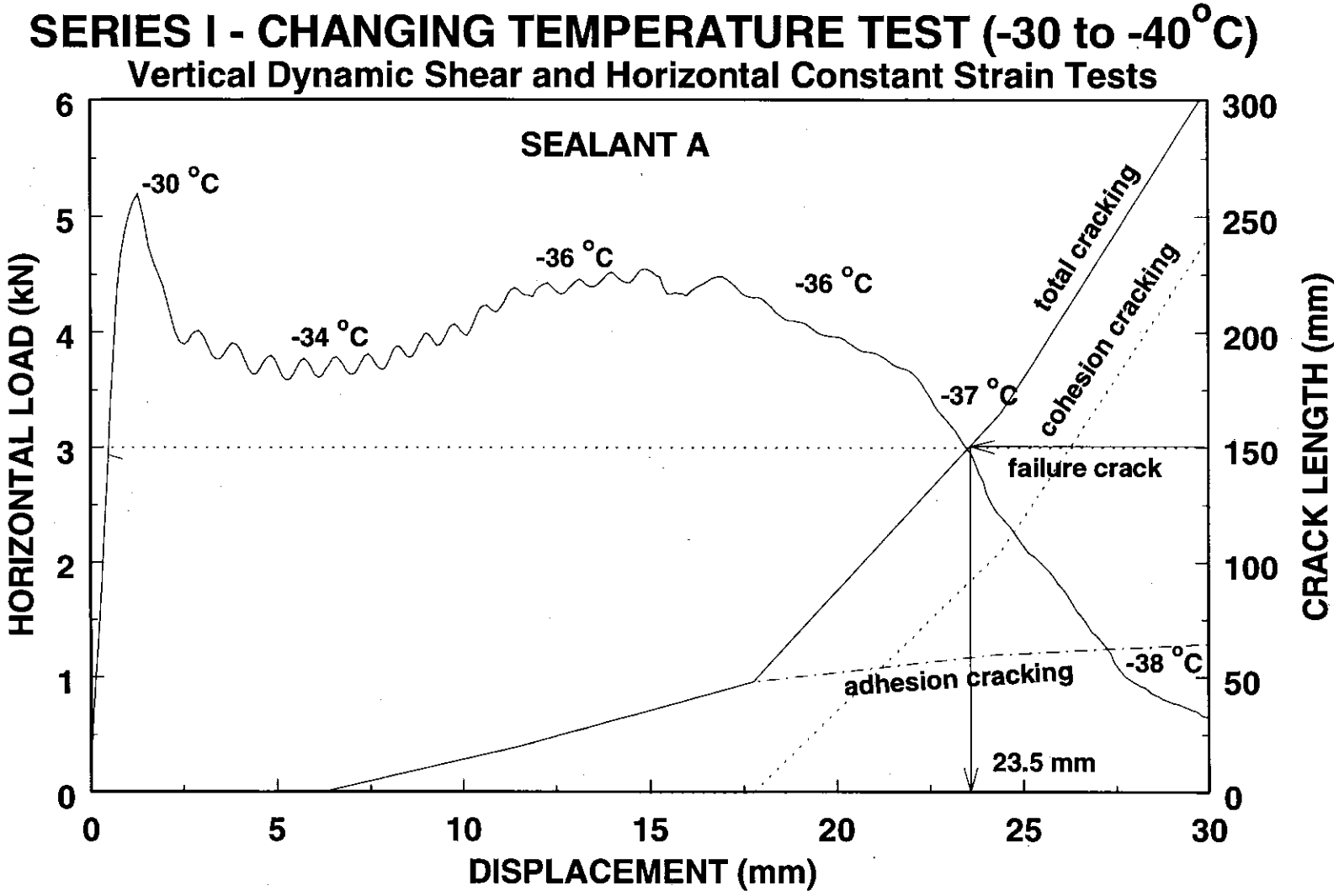
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150
200
250
300
0
5
10
15
20
25
30

Sealant Debonding

All Sealants

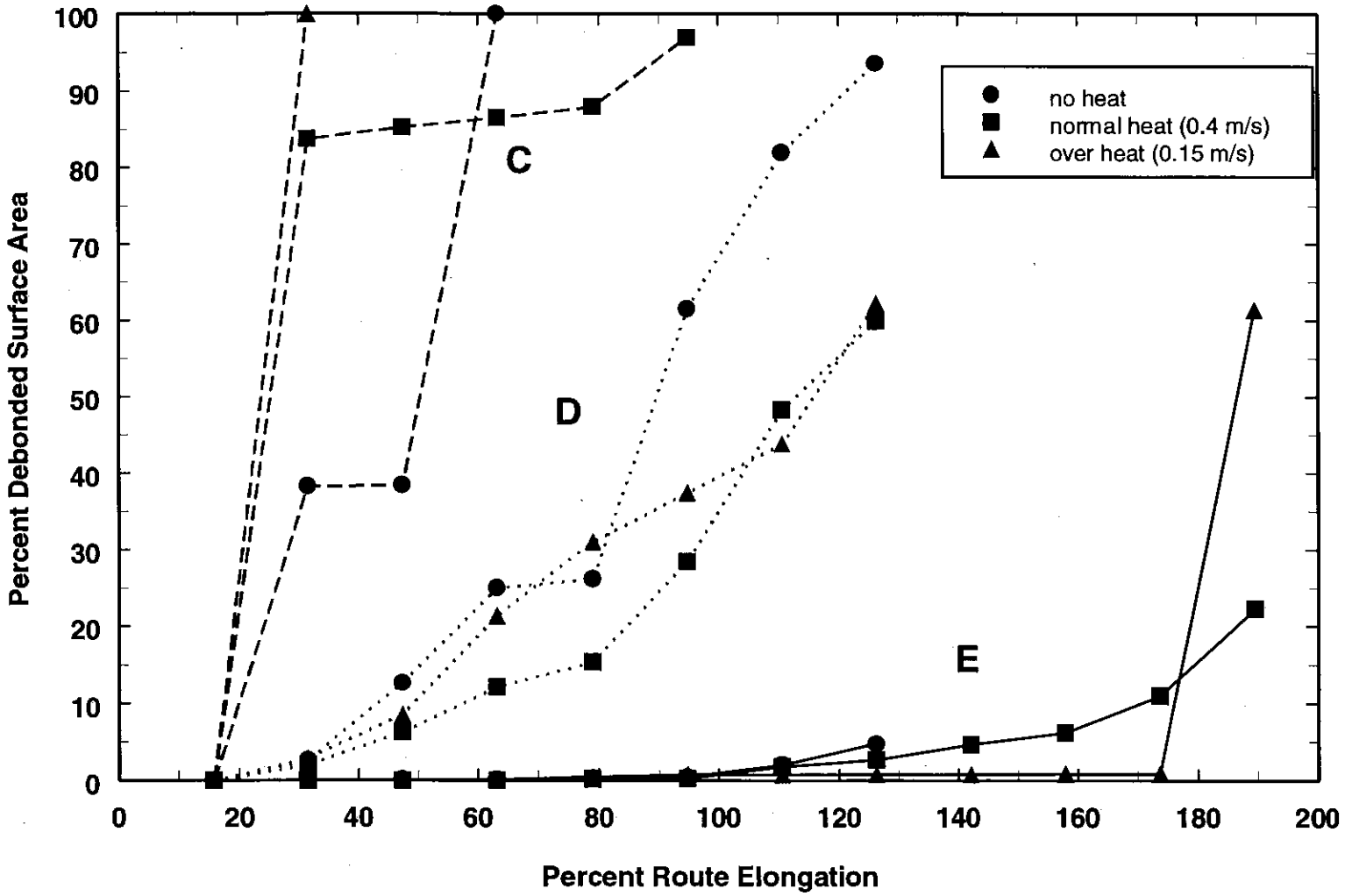

Table 1:

Series I: Changing Temperature Tests (-30°C to -40°C) Vertical Dynamic Shear and Horizontal Constant Strain

Sealant/ Test Number	Readings at peak load			Readings at end of test			Readings at failure point [1]		
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