

# Sprayed seals - determining sprayer forward speed

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## INTRODUCTION

The design of sprayed seals is based on the volume of residual binder at a standard temperature of 15°C. Bituminous binders expand in volume when heated. When determining the quantity of binder to be sprayed, allowance must be made for expansion in volume at spraying temperature and the proportion of cutter oil or other additives (or the water content of bitumen emulsions) that do not form part of the residual binder.

## BASICS

Bitumen sprayers in Australia generally use slotted spray jets that are designed to operate at a constant output of 18 L/min. When placed at 100 mm centres, the spray bar output is therefore 180 L/min per metre width of bar.

By maintaining a constant spray jet output, the rate of application of binder is directly proportional to the forward speed of the sprayer.

Some bitumen sprayers provide an interlock between forward speed and spray pump output to vary output in proportion to variations in forward speed.

That facility is intended to compensate for small variations while operating and does not change target settings for calibration of spray bar output or setting of sprayer forward speed.

## COMPENSATION FOR TEMPERATURE

Standard tables are available in specifications, manuals and/or work procedures for calculation of change in volume with temperature.

Table 1 provides a guide to multiplier factors for converting volume from 15°C for some typical spraying temperatures of cutback bitumen primer, primerbinder and bitumen materials.

Binder Type	Temp. (°C)	Multiplier
Primer	60	1.0288
Primerbinder	120	1.0688
Class 170 Bitumen	180	1.1109

Table 1. Typical spraying temperatures and multiplier factors for cutback bitumen binders

## ALLOWANCE FOR CUTTER OIL

### Primers and Primerbinders

No allowance for cutter oil is made for cutback bitumen primers and primerbinders as design application rates for those

materials are based on the total volume, including cutter oil.

### Hot cutback bitumen sealing binders

In addition to adjustments for temperature, binder volume is increased, or sprayer forward speed reduced, in direct proportion to the amount of cutter oil in the mixture – see worked examples.

## CALCULATIONS

There are two different procedures for deriving sprayer forward speed for a given design application rate of residual binder:

- Determining the net volume of liquid to be applied (“hot litres”) by adjusting the binder application rate for temperature and addition of cutter or other allowances.
- Applying the adjustments directly to the calculated forward speed of the sprayer.

In either case the factors are the same and, apart from minor differences due to rounding, the calculated sprayer forward speed should be the same.

Consider the following example:

*Design binder application rate, 1.2 L/m<sup>2</sup>*

*Cutter oil, 4 parts per 100 parts of bitumen.*

*Spraying temperature, 180°C*

### a) Adjustment based on correction to total volume sprayed

1. Adjust application rate for temperature – see Table 1.
2. Determine corrected binder application rate using the following formula (see page 2):

*continued on reverse*

### Key Summary

*This issue of 'pavement work tips' provides a guide to the calculation of sprayer forward speed for correct binder application rates in sprayed seals.*



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$$B_c = B_D \times \frac{\text{Parts of residual binder + cutter}}{\text{Parts of residual binder}}$$

Where:

$B_c$  = Corrected binder application rate (L/m<sup>2</sup>)

$B_D$  = Design binder application rate (L/m<sup>2</sup>) (adjusted for temperature)

Residual binder includes bitumen, flux oil and any other materials such as crumb rubber added to the binder mixture and remaining as residual binder. Adhesion agents are often ignored in volume calculations due to the small quantities involved.

3. Read sprayer forward speed for total binder application rate from Table 2. Intermediate values may be interpolated.

For above example, correction for volume:

$$1.2 \times 1.1109 \text{ (Table 1)} = 1.333 \text{ L/m}^2$$

Correction for cutter oil:

$$1.33 \times (100 + 4) / 100 = 1.385 \text{ L/m}^2$$

Forward speed for total volume of 1.385 L/m<sup>2</sup> (Table 2, by interpolation) = 130 m/min.

App. Rate L/m <sup>2</sup> (hot)	Forward Speed metres/minute
0.5	360
0.6	300
0.7	257
0.8	225
0.9	200
1.0	180
1.1	164
1.2	150
1.3	138
1.4	129
1.5	120
1.6	113
1.7	106
1.8	100
1.9	95
2.0	90
2.2	82
2.4	75

Table 2. Sprayer Forward Speed (uncorrected)

### b) Adjustment based on correction to forward speed

1. Determine forward speed corrected for temperature. Table 3 shows speeds adjusted for the typical application temperatures shown in Table 1.
2. Calculate sprayer forward speed, corrected for cutter and other additives using the formula:

$$F_c = F_s \times \frac{\text{Parts of residual binder}}{\text{Parts of residual binder + cutter}}$$

Where:

$F_c$  = Corrected forward speed (metres/minute)

$F_s$  = Scale reading (Table 3)

Residual binder is the same as defined above.

Using the same example as above:

Forward speed for hot binder (Table 3, Column 4) = 135L/m<sup>2</sup>.

Correction to forward speed for cutter:

$$135 \times 100 / (100 + 4) = 130 \text{ m/min.}$$

App. Rate L/m <sup>2</sup> @15°C	Forward Speed (metres/minute)		
	Primer	Primer binder	Binder
0.5	354		328
0.6	296		275
0.7	253		234
0.8	222		205
0.9	197		182
1.0	175	168	161
1.1	161	154	148
1.2	146	139	135
1.3	135	129	125
1.4	125	120	116
1.5	116	111	107
1.6	109	104	101
1.7	102	98	95
1.8	97	93	90
1.9	93	89	86
2.0		83	81
2.2			74
2.4			67

Table 3. Sprayer Forward Speed Scale Reading (Corrected for temperature)

## MONITORING APPLICATION RATES

Application rates should be monitored in the field by:

- Recording temperatures and volume of all deliveries to site and converting to mass at 15°C;
- Accurate calculation of quantities to be loaded to sprayer using volume correction tables and monitoring quantities in sprayer, including any adjustment for part loads due to materials remaining in sprayer (if relevant);
- Recording the quantities sprayed;
- Measuring and recording area sprayed;
- Measuring and recording quantity of aggregate spread;
- Checking and adjusting of actual application rates of binder and aggregate against design rates.

For more information on any of the construction practices discussed in "pavement work tips", please contact either your local AUSTROADS Pavement Reference Group representative or AAPA — tel (03) 9853 3595; fax (03) 9853 3484; e-mail: info@aapa.asn.au A complete list of "pavement work tips" issues is available on AAPA's web site: www.aapa.asn.au Issues may be downloaded using Adobe Acrobat Reader. Copies may also be obtained from AAPA. Material may be freely reproduced providing the source is acknowledged. This edition was prepared by John Rebbechi and Walter Holtrop in consultation with members of the National Bituminous Surfacing Research Group.

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