

Material Testing Specification for Concrete Sealers

Government of Alberta

Transportation and Economic Corridors – Technical Standards Branch

B388 – August 29, 2023

Scope: This specification contains approval procedures and requirements necessary for qualifying products for use as concrete sealers for bridge structures.

1. General

1.1. Introduction

The specification covers the approval requirements for certification of all concrete sealer products that consist of one or two components. The test requirements are designed to represent the service conditions the concrete sealer will encounter in the field. The current edition at the time of testing shall apply for codes and standards referred to within this specification and attached appendices.

The concrete surfaces to be sealed are subject to freeze-thaw cycles, exposure to de-icing salt, extreme temperatures, rapid temperature changes and abrasion from traffic. The concrete surfaces are also periodically re-sealed to restore performance levels.

Products containing methyltrimethoxysilane have been identified as a health hazard which attacks the retina of the eyes and shall not be used in sealer products.

1.1.1. Related Documents

The following documents are to be used in conjunction with B388, Specification for the Supply of Concrete Sealers.

BT001	Test Procedure for Measuring the Vapour Transmission and Waterproofing Performance of Concrete Sealers
BT002	Test Procedure for Alkaline Resistance of Penetrating Sealers for Bridge Concrete
BT008	Test Procedure for Finger Printing Sealers Using Infrared Spectroscopy and Gas Chromatographic Separation
BT010	Test Procedure for Casting and Storing of Concrete Test Specimens for Use in Approval Testing of Sealers

The following published procedure is available from The American Society for Testing and Materials (ASTM):

ASTM D5095	Standard Test Method for Determination of Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments.
ASTM D523	Standard Test Method for Specular Gloss
ASTM D344	Standard Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts
ASTM D2805	Standard Test Method for Hiding Power of Paints by Reflectometry

1.2. Classification of Concrete Sealers

All proposed sealers shall be categorized into one of the types shown below:

Type 1 Penetrating sealers for use on traffic bearing surfaces exposed to abrasion. These sealers must not reduce the skid resistance of the wearing surface. These are divided into 3 categories depending on substrate exposure conditions:

Type 1a - penetrating sealers for application in sheltered conditions such as parkades where the deck is relatively dry (relative moisture content is a maximum of 55%). Relative moisture content is defined in BT001, "Test Procedure for Evaluation of Measuring the Vapour Transmission, Waterproofing and Hiding Power of Concrete Sealers."

Type 1b - penetrating sealers for application in outdoor conditions such as bridge decks where the deck relative moisture content is a maximum of 70%, representing 2 days drying in good drying conditions.

Type 1c - high performance penetrating sealers for application in outdoor conditions to new bridges and overlays cast with low water cement ratio (0.30-0.45) concrete, where the relative moisture content is a maximum of 80%.

All water-based sealers shall be tested to determine their ability to seal concrete surfaces that have been previously sealed with an alcohol or waterborne based sealer. This is in addition to the requirements of this specification, and applies to all three categories of the Type 1 sealer. The performance requirements shall be in accordance with Section 4.2.

Type 2 Clear, film forming sealers for use on non-traffic bearing elements such as portions of parapets, and curbs. These are divided into 2 categories depending on the number of components:

Type 2a - one component, clear coatings suitable for use by less experienced personnel on non-traffic bearing surfaces where the concrete relative moisture content is a maximum of 70%.

Type 2b - two or more component coatings for use by approved contractors where higher degrees of waterproofing performance are required and where the concrete relative moisture content is a maximum of 70%.

Type 3 Colored film forming sealers for use on elements highly exposed to public view where aesthetics is a primary consideration. These products are for use on concrete surfaces where the relative moisture content is a maximum of 70%.

2. Approval Procedure

2.1. Arrangements for Testing

The Supplier/Manufacturer shall have his product tested for approval according to the requirements of this specification. Once reviewed and approved, the product will be included on the Department's Product List. The test procedures allow for up to three immersions for Type 1a, 1b and 1c penetrating sealers, and two brushings for all other sealers.

The tests shall be carried out by an independent laboratory certified to CSA A283 or AASHTO R18 with accompanying accreditation from the Cement and Concrete Reference Laboratory (CCRL) at the supplier's or manufacturer's expense.

2.2. Submission Requirements

At minimum, submissions to the Department and testing laboratory shall contain the following:

- Product and manufacturer name
- Type of sealer
- Date of manufacturing and product batch/lot number
- Shelf life
- Product bulletins (if available)
- Technical product data sheet (including product description, recommended applications, installation and working temperatures, advantages, limitations, etc.)
- Comprehensive usage instructions (including requirements for surface preparation and minimum surface moisture content prior to application, mixing, application, finishing, curing, clean-up, limitations, etc.)
 - Instructions shall also include number of immersions or brushings and drying time between each, coverage rates, pot life if applicable, time of cube immersion in Type 1 sealer if applicable
- Material safety data sheet (including the Volatile Organic Compound concentration)
- Quality control test reports
- Laboratory data acquisition form (from Section 2.2.2 below)
- Updated list of Alberta based suppliers/distributors

In the event the Supplier's/Manufacturer's instructions conflict with the provisions of these specifications, these specifications shall govern.

The test results shall be submitted by the Supplier/Manufacturer to:

Alberta Transportation
Technical Standards Branch
2nd Floor, Twin Atria Building

Attention: Landon Keep, P.Eng.
Bridge Materials Engineer
landon.keep@gov.ab.ca

Test results will become the property of the Department. The Department reserves the right to publish the test information for public use. Results of testing may be submitted at any time provided all the requirements are met. The Department will update the approval list if all requirements of this testing standard have been met.

2.2.1. Laboratory Test Report

The test results shall be submitted on the report form "Concrete Sealer Test Report" attached.

Original graphs of the spectrographic and chromatographic analysis showing absorbance versus frequency and abundance versus time shall be included in the report. Two component sealers, such as epoxies, will require separate graphs for each component. Original hiding power test cards for Type 3 Sealers shall also be submitted. Xerox or fax copies are not acceptable.

2.2.2. Laboratory Data Acquisition Form

The laboratory shall record all observations, weights, and calculations on the attached "Laboratory Data Acquisition Form for Concrete Sealer Tests". The laboratory shall maintain these records for all products tested and shall submit this data if requested by Alberta Transportation.

2.3. Evaluation

The Department will base the acceptance of a product according to the results of the performance requirements in Section 4.0, Qualifying Tests.

The Type 3 sealer evaluation includes a field trial application assessment on a portion of a bridge no greater than 25 m² (approved by the Department) prior to final acceptance. Surface preparation, concrete finishing, application rates will be reviewed. Application shall be completed using the same equipment intended for the remainder of the work.

3. Identification of Sealers

3.1. Solids Content

For future purposes of quality control and verification that the sealers are identical to the sealers that have previously been tested and approved, all proposed sealers shall be tested for the amount of active solids content.

Non-volatile content for Type 1 sealers such as silanes, siloxanes, and silane/siloxane blends shall be measured using Test Procedure ASTM D5095 "Standard Test Method for Determination of Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments."

Non-volatile and solids content for Type 2 and Type 3 sealers shall be measured using the method described in Test Procedure BT001 "Test Procedure for Measuring the Vapour Transmission, Waterproofing and Hiding Power of Concrete Sealers".

3.2. Spectrographic and Chromatographic Analysis

Each sealer shall be subjected to an infrared spectrographic and gas chromatographic analysis. The test shall be done in accordance with BT008 "Test Procedure for Sealers using Infrared Spectroscopy and Gas Chromatographic Separation". A graph of absorbance versus frequency and abundance versus time shall be plotted for all sealers and submitted to the Department for review. Two component sealers, such as epoxies, will require separate graphs for each component.

4. Testing Requirements

4.1. Casting and Storing of Concrete Test Specimens

Test specimen cubes for all sealer types except Type 1c represent typical, mature, 30 MPa concrete with a relatively high water to cement ratio to simulate field cast bridge concrete. The test cubes for Type 1c represent newer, less mature 0.35 water to cement ratio concretes. For the purpose of evaluating sealers, it is important that test specimens be uniform with respect to permeability, void space, surface texture and both the amount and distribution of interior moisture.

The specimens shall be made in accordance with BT010, "Test Procedure for the Casting and Storing of Concrete Test Specimens for Use in Approval Testing of Sealers."

The qualifying test results shall be the average of three test specimens.

4.2. Performance Requirements

Test procedures for waterproofing and vapour transmission performance shall be according to BT001, "Test Procedure for Measuring the Vapour Transmission, Waterproofing and Hiding Power of Concrete Sealers."

Test procedures for alkaline resistance shall be according to BT002, "Test Procedure for Alkaline Resistance of Penetrating Sealers for Bridge Concrete."

4.2.1. Vapor Transmission Performance

The table below shows the minimum requirements for Vapor Transmission (VT) performance for each type of sealer.

TABLE 2: VAPOR TRANSMISSION PERFORMANCE

Sealer Type	Minimum Vapor Transmission
Type 1a	---
Type 1b	70%
Type 1c	85%
Type 2a	35%
Type 2b	20%
Type 3	35%

4.2.2. Waterproofing Performance

The table below shows the minimum waterproofing performance requirements for each type of sealer.

TABLE 1: WATERPROOFING PERFORMANCE

Sealer Type	Before Abrasion	After Abrasion
Type 1a	82.5%	75.0%
Type 1b	---	86.0%
Type 1c	---	*85.0%
Type 2a	82.5%	N/A
Type 2b	90.0%	N/A
Type 3	75.0%	N/A

* 144 gram abrasion instead of usual 72 gram

4.2.3. Alkaline Resistance Performance for Type 1 Sealers

Alkaline resistance tests shall be performed on the same test cubes as used for the waterproofing performance test. After 21 days of exposure to potassium hydroxide, waterproofing performance shall be within 3% of the actual measured after abrasion waterproofing performance.

4.2.4. Hiding Power and Gloss for Type 3 Sealers

Type 3 Sealers must also meet the following:

- a) Hiding Power – Hiding Power shall be measured in accordance with ASTM D344 and performed using the rate of coverage established at the time the sealer is applied to the test cubes in test procedure BT001.
- b) Hiding power shall also be measured by ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
- c) Gloss – Gloss for type 3 sealers shall be measured in accordance with ASTM D523.

As defined by The Masters Painters Institute, type 3 sealer shall produce a 'traditional matte finish-flat' (MPI Gloss Level 1) and gloss measured at 60° shall be less than or equal to '5' units.

The color tested shall be US Government 35630 AMS-STD595A unless otherwise approved.

4.2.5. User-Friendliness

This specification recognizes that most sealers are applied by brush or spray equipment in the field to meet the specified application rate. In addition to the above requirements for waterproofing, breathability, etc. all sealers shall meet conventional standards for brushing and/or spraying, whichever the manufacturer recommends.

Products that are not user friendly will not be approved.

4.2.6. Volatile Organic Compounds

The maximum Volatile Organic Compound (VOC) concentrations for the applicable concrete sealer type/category shall be in accordance with current concentration limits set by Environment Canada. Environmental regulation revisions/changes shall trigger requalification testing if any reformulation of the product is required to meet the updated limits.

5. Packaging

5.1. Quality and Size

Containers shall be of adequate strength with an airtight lid. The size of the containers shall not exceed 204 liters.

5.2. Marking

The following information shall be marked on the outside of each bag:

- (a) Dangerous goods warning where applicable should be found on the label
- (b) Product name
- (c) Manufacturer's name
- (d) Batch number
- (e) Volume of material
- (f) Date material was manufactured
- (g) Shelf life and pot life
- (h) For 2 component sealers, each component shall be clearly designated (A or B, for example) and the ratio of component mixtures and mixing instructions shall be indicated

6. Approval and Quality Control

6.1. Approved Product

Only products meeting this specification will be considered for approval. The approved products will be included on the approved products list and will include the following information: sealer type, product name, manufacturer, application rate, and a list of Alberta based suppliers/distributors (to be submitted to the Department as part of the product submission package). The Department will not notify the Supplier/Manufacturer of the expiry date. It will be the responsibility of the Supplier/Manufacturer to retest his product, at his own expense, prior to the end of the 5-year period.

The approval is valid for 5 years from the date of approval.

Any subsequent change in the product or this specification will require re-qualification at the Supplier's/Manufacturer's expense.

6.2. Quality Control

The Supplier/Manufacturer shall be responsible for quality control of the product. He shall sample and test the material as necessary during production to ensure that all material conforms to these specifications, and is consistent with the sample of material that was tested and approved. When requested by the Department, the Manufacturer will submit the quality control data within 30 days. Any subsequent change in the product will require a requalification at the Supplier's/Manufacturer's expense.

6.3. Right to Reject

The Department reserves the right to run laboratory tests, reject material and withdraw the product from the approval list should it not meet the requirements of the specifications.

In addition to the tests listed in BT001, the Department may perform tests such as spectrographic and chromatographic analysis (see Section 2.2), solids content and other identification tests to establish that the material delivered to the construction site is identical to the laboratory test sample on which approval was based.

Only materials that are identical to the original approval test sample within reasonable limits will be accepted by the Department. The sealer Supplier/Manufacturer shall maintain sufficient quality control to ensure material uniformity. The quality control data shall be submitted to the Department when requested within 30 days. Failure to pass identity tests will result in withdrawal of the Department's approval.

Unsatisfactory performance, whether short term or long term shall also be grounds for withdrawal of the approval.

LAB DATA ACQUISITION FORMS FOR CONCRETE SEALER TESTS

Lab: _____ Lab Project # _____

Client: _____

Lab Series # _____ Date Sealer Received: _____

Sealer Manufacturer & Address: _____

Alberta Distributor & Address: _____

Sealer Type: _____ Name: _____

Generic Description: _____

Classification: _____

Viscosity: _____ Texture: _____

Specific Gravity, Component "A": _____ "B": _____

Combined or single: _____ = Gs

Requested Application Rate, 1st Appl: _____ mL/m²

2nd Appl: _____ mL/m² Comb: _____ mL/m²

3rd Appl: _____ mL/m² (Type 1c only)

Comb: _____ mL/m²

Requested Time Allowed between Applications: _____ min. (maximum of 4 hours)

Legend

CC	Control Cubes
CD ₁	Weight of Control Cubes after initial 5 days of Drying
CD ₂	Weight of Control Cubes after initial 5 days of Drying
CG	Weight Gain of Control Cubes, 1st Water Immersion
CM	Weight of Control Cubes after moist conditioning
G _s	Specific Gravity
L1, L2 ...	Line number
L1av, L2av ...	Average of that line
N _s	Nonvolatile Content
RH	Relative Humidity
RM	Relative Moisture Content
SC	Solids content of sealers, accelerated method
SD	Weight of dried sealer adhering to treated cubes
SF	Weight of Fresh Sealer applied to treated cubes
SL	Weight of sealer portion that evaporated during drying period
SSD	Saturated surface-dry
SW	Weight of Fresh Sealer
TC	Test Cubes
TD ₁	Weight of Test Cubes after initial 5 days of Drying
TD ₂	Weight of Test Cubes after 10 days of Drying
TG ₁	Weight Gain of Test Cubes, 1st Water Immersion
TG ₂	Weight Gain of Test Cubes, 2nd Water Immersion
TM	Weight of Test Cubes after moist conditioning
TS ₁	Weight of Sealed Cubes, 1st application
TS ₂	Weight of Sealed Cubes, before 2nd application
TS ₃	Weight of Sealed Cubes, after 2nd application
TS ₄	Weight of Sealed Cubes, before 3rd application
TS ₅	Weight of Sealed Cubes, after 3rd application
VLC	Water Loss due to Vapour Transmission in Control Cubes
VLT	Water Loss due to Vapour Transmission in Test Cubes
VT	Vapour Transmission, %, of Test Cubes
W/C	Water-Cement Ratio

CONCRETE SEALER TEST REPORT - B388

LABORATORY _____ PROJECT/FILE No.: _____

PART 1 - PRODUCT DETAILS

Name of Product: _____ Manufacturer: _____
 Product Batch & Lot Number: _____ Expiration Date: _____
 General Description of Product: _____

Classification:
 Penetrating Sealer: Type 1a Type 1b Type 1c
 Film Forming Sealer: Type 2a Type 2b
 Pigmented Sealer: Type 3
 Viscosity: Low Medium
 High

Gloss: High Gloss Semi Gloss Flat
 Measured Specific Gravity: Component A: _____ Component B: _____ Combined: _____

Manufactured By: _____ Distributed By: _____

Phone No.: _____

PART 2 - CONCRETE TEST CUBES

CONCRETE MIX PROPORTIONS

Batch Size _____ m³
 Cement _____ kg Type: _____
 Coarse Agg. SSD _____ kg Size: _____ M.C. _____ %
 Fine Agg. SSD _____ kg F.M. _____ M.C. _____ %
 Water, Net _____ L Net W/C Ratio: _____
 Type and Amount of Air Entraining Agent: _____
 Type and Amount of Water Reducing Agent: _____

CONCRETE TEST DATA

Date Cast _____
 Age at Discharge _____ minutes Concrete Temp: _____ °C
 Slump (at discharge) _____ mm Slump (+30 min) _____ mm
 Air Content (at discharge) _____ % 28-Day Strength _____ MPa
 Curing Time _____ days
 Surface Voids _____ cm² _____ %
 Total Cube Moisture Content _____ g (100% RH less 7-day oven dry)
 Relative Moisture Content After Air Drying _____ % (see Table 1 BT001)
 _____ days of drying

PART 3 - APPLICATION OF SEALER

Date of Sealer Application: _____
 Type of Application: Immersion Coating Other _____
 Number of Applications _____ applications
 Duration of Each Application _____ minutes
 Average Time Between Applications _____ minutes (< 4 hrs)
 Average Weight of Fresh Sealer Gained _____ g (all applications)
 Total Coverage Rate of All Applications _____ mL / m²
 (convert weight to volume by using specific gravity _____ mil (DFT)
 and divide by total surface area for mL/m²)

PART 9 - NOTES:

(see BT001 for detailed testing specifications and requirements)

PART 4 - VAPOUR TRANSMISSION

	<u>Test Cubes</u>	<u>Control Cubes</u>
Average Initial Weight of Cubes	_____ g	_____ g
Average Weight after 5 days Drying	_____ g	_____ g
Average Weight after 15 days Drying	_____ g	_____ g
Average Weight Loss (15 day - 5 day)	_____ g	_____ g
Vapour Transmission (VT) Percentage	_____ %	

PART 5 - WATERPROOFING

Weight Loss in Test Cubes after 5 days Drying (initial less 5 day weight) _____ g
 Water Loss in Test Cubes after 5 days Drying (water loss in control x VT) _____ g
 Sealer Loss in Test Cubes after 5 Days Drying (the balance) _____ g
 Weight of Dry Sealer on Test Cubes (fresh sealer gained less sealer loss above) _____ g
(this value is used to equalize the relative moisture content of the cubes based on weight and before immersion)

	<u>Test Cubes</u>	<u>Control Cubes</u>
	<i>before abrasion / after abrasion</i>	
Weight of Cubes before Water Immersion	_____ / _____ g	_____ g
RM Content before Water Immersion	_____ / _____ %	_____ %
Weight Gain after 120-hr Immersion	_____ / _____ g	_____ g

Waterproofing Performance _____ % (before abrasion)
 Waterproofing Performance _____ % (after abrasion)

PART 6 - ALKALINE RESISTANCE (Type 1 sealers only)

	<u>Test Cubes</u>	<u>Control Cubes</u>
Weight Gained after 21 Days in Potassium Hydroxide (KOH)	_____ g	_____ g
Waterproofing Performance		_____ % (within 3% of post-abrasion?)

PART 7 - PRODUCT IDENTIFICATION TESTS

Non-Volatile Content (Ns) _____ % (Type 1, 2, and 3 sealers)
 Solids Content (SC) _____ % (Type 2 and 3 sealers)
 Infrared Spectrogram (Report Attached) (absorbance vs. frequency)
 Gas Chromatograph (Report Attached) (abundance vs. time)

PART 8 - Hiding Power & Gloss (Type 3 only)

Color Tested (AMS-STD595A): _____
 Gloss @ 60°_{D523}: (≤ 5) _____ units M.P.I Gloss Level: _____
 Gloss @ 60°_{D523}: Pass Fail
 Hiding_{D344}: Pass Fail Coverage Rate*: _____ ml/m²
 Hiding_{D2805 (H. 0.98)}: _____ ml/m² *same as Part 3 - Application of Sealer

Tested By: _____ Date: _____ Signature: _____