NATIONAL TRANSPORT RESEARCH ORGANISATION

Best Practice Reference

On-site Assessment of Sprayed Seal Binder Oxidation

Version History

Version	Release Date	Release Notes
1.0	December 2025	Initial release of NTRO Best Practice document

Foreword

NTRO Best Practice References exist to articulate how a transport network owner or operator should require a specific, contemporary issue/challenge to be solved/resolved to ensure that it is delivering positive outcomes and meeting its statutory safety-, serviceability- and sustainability-related obligations effectively and efficiently. Rather than being totally prescriptive, NTRO Best Practice References identify the key building blocks to be followed to arrive at a desired outcome or solution and how they interrelate and combine. They are supported by NTRO and other specifications and/or test methods that set out which things must be done and specifically how they are to be done.

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1. Introduction

1.1 Scope

This Best Practice Reference specifies a procedure for the on-site assessment of bituminous binder condition in sprayed seals. It includes the use of Fourier-transform infrared spectroscopy (FTIR) and provides guidelines for evaluating the extent of binder oxidation.

1.2 Intended Use of Best Practice Reference

This document provides a consistent methodology for assessing the oxidation condition of bituminous binders in sprayed seals, which can be undertaken on-site from samples that have been removed from the sprayed seal. It is intended to support asset condition monitoring, maintenance planning and other pavement management activities where binder condition is a relevant factor.

This Best Practice Reference is applicable to the assessment of bituminous binder oxidation in sprayed seals where surface access and representative sampling are feasible. The method assumes that the binder sample is representative of the in-service condition and has not been contaminated or altered during sampling. External factors such as recent rainfall or surface contamination may influence results and should be considered when interpreting data.

1.3 Limitations of this Best Practice Reference

The scope of this document does not include in situ testing of sprayed seal binders using handheld FTIR devices or laboratory-based FTIR testing of binders that have been collected as cores and/or slabs of sprayed seals and have been subjected to secondary extraction.

This Best Practice Reference is only applicable to sprayed seals and not to other bituminous surfacing types.

This Best Practice Reference does not provide guidance on the root cause of binder distress or the selection of specific treatment types. Where oxidation is identified as a potential concern, further investigation may be required to confirm the contributing factors and to determine appropriate maintenance actions.

1.4 Role of Oxidation in Sprayed Seals

Oxidation is a chemical process where the bituminous binder reacts with oxygen under the influence of air and heat. This reaction increases the binder's stiffness and reduces its flexibility. As oxidation progresses, the binder becomes brittle and prone to distress, such as surface cracking and loss of aggregate (stripping), which can result in reduced seal life. Monitoring oxidation enables timely identification of when resealing or other treatments may be required to maintain pavement performance.

1.5 Role of FTIR in Binder Assessment

FTIR is a non-destructive analytical technique used to assess the chemical composition of bituminous binders. In the context of sprayed seals, FTIR enables the quantification of oxidation by detecting changes in specific functional groups that are associated with binder ageing.

A key indicator derived from an FTIR analysis is the carbonyl peak area, which corresponds to the presence of oxidised carbon within the binder. The calculated carbonyl peak area provides a measurable and repeatable parameter for assessing the degree of oxidation.

1.6 Referenced Documents

The following test method is referenced in this specification:

NT-TM01.04-01:2025 *On-site assessment of sprayed seal binder oxidation procedure*

1.7 Definitions

Table 1.1: Abbreviations and definitions

Term	Definition
Bituminous binder	A hydrocarbon-based material derived from refined crude oil which is used in sprayed seals to bind aggregate particles to the pavement surface.
Carbonyl peak area	A quantitative measure, derived from an FTIR analysis, representing the presence of oxidised carbon compounds in the binder. Used as an indicator of binder ageing.
FTIR (Fourier-transform infrared spectroscopy)	A non-destructive analytical technique used to identify chemical compounds in a material by measuring its infrared absorption spectrum.
Oxidation	A chemical process in which the bituminous binder reacts with oxygen, resulting in increased stiffness and reduced flexibility.
Oxidation category	A classification assigned to a binder sample based on its calculated carbonyl peak area, indicating the degree of oxidation (e.g. good, moderate, high).
Sprayed seal	A type of surface treatment applied to roads, consisting of a layer of bituminous binder sprayed onto the pavement followed by the application of aggregate.

2. Procedure

2.1 Operating Procedure

The procedure for conducting the on-site assessment shall follow the steps outlined in the NT-TM01.04-01:2025 *On-site Assessment of Sprayed Seal Binder Oxidation Procedure*, which provides a detailed methodology for measuring binder oxidation in the field.

2.2 Data Management

All data collected during the on-site assessment shall be recorded in accordance with the procedures defined in NT-TM01.04-01:2025 *On-site Assessment of Sprayed Seal Binder Oxidation Procedure*. This includes documenting test results, location details, environmental conditions and any supplementary observations.

Data should be stored in a secure and accessible format to support traceability, future analysis and reporting. Where applicable, digital records should be maintained in standardised templates to ensure consistency across assessments.

Collected data shall be used solely for the purposes of evaluating binder oxidation and informing maintenance planning. Any interpretation beyond this scope, such as determining the cause of distress or selecting treatment types, will require additional investigation.

3. Analysis and Interpretation

3.1 Analysis Techniques and Procedures

The calculated carbonyl peak area derived from NT-TM01.04-01:2025 *On-site Assessment of Sprayed Seal Binder Oxidation Procedure* shall be evaluated against the classification criteria outlined in Table 3.1 to determine the corresponding oxidation category.

Table 3.1: Oxidation category

Calculated carbonyl peak area	Oxidation category	Considered to be	Description
< 0.4	1	Good	Binder is in good condition, with maximum flexibility and good adhesion. Binder is soft, with less exposure to air and heat.
0.4 to 0.6	2	Moderate	Binder is considered slightly aged, with minor hardening and increased binder viscosity and stiffness, but still functional and resilient.
> 0.6	3	High	Binder is considered highly aged. Binder is significantly hardened, brittle, prone to defects such as cracking and stripping.

3.2 Findings

The oxidation category of the sample shall be recorded.

Determining the oxidation category is intended to inform the assessment of the potential need for treatment of the investigated sprayed seal, in conjunction with other relevant performance criteria.

4. Reporting

The results of the on-site binder oxidation assessment shall be presented in terms of the calculated carbonyl peak area and the corresponding oxidation category, as defined in Table 3.1. Each result shall be linked to its specific site location and include relevant contextual information.

Where applicable, results may be visualised using summary tables, charts or annotated site photographs to support interpretation and communication.

Any anomalies, outliers or uncertainties identified during analysis should be clearly noted, along with potential sources of error or limitations affecting the result.

5. Required Outcomes

5.1 Key Outputs

The primary output of the assessment shall be the categorisation of the sprayed seal binder into an oxidation category. This categorisation shall be documented alongside relevant site information and performance observations to support maintenance planning and asset management decisions.

Any uncertainties or anomalies encountered during the assessment shall be documented, including potential sources of error and limitations of the data.

5.2 Commentary

The oxidation category determined through the assessment may inform a range of maintenance planning options, including prioritisation of treatment needs and alignment with broader pavement management strategies.

It is recommended that the results be considered in conjunction with other condition indicators and network-level priorities to ensure a balanced and cost-effective approach to asset preservation.

The findings may also influence the scheduling and scope of related programs, such as resurfacing, rehabilitation or further diagnostic investigations, particularly where oxidation is identified as a contributing factor to surface distress.

6. Quality Assurance and Calibration

To ensure the reliability and consistency of results, all equipment used in the on-site assessment, including the FTIR spectrometer, shall be maintained and calibrated in accordance with the manufacturer's specifications and relevant quality assurance protocols.

Personnel conducting the assessments shall be trained in the use of the FTIR equipment and software and the use of the NT-TM01.04-01:2025 *On-site Assessment of Sprayed Seal Binder Oxidation Procedure* test method.