

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R101

COLD MILLING OF ROAD PAVEMENT MATERIALS

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issued.	GM, CEC	Sep 94
Ed 1/Rev 1	3, 4.3, 4.5 4.3, 4.5	Hold Points redefined Timing of Notices to the Principal changed.	GM, CEC J Woodward	02.05.95
Ed 2/Rev 0	4.5 NOTICE	Specification Number changed from R41 to R101. Converted to MS Word 6.0c. References to RTA Specifications changed. Paragraph 2 deleted, details included in Hold Point NOTICE based on ECN No.8 added after this Register.	GM, RNIC J Woodward	29.01.97
Ed 2/Rev 1	4.5	Reference to “General Conditions of Contract” changed to “C1 RTA Conditions of Contract”.	GM, RNIC	17.07.01
Ed 3/Rev 0	Spec title Guide Notes 1.1 1.2 1.2.1, 1.2.2, 1.24	Title changed to “Cold Milling of Road Pavement Materials”. “Notice” changed to “Guide Notes” and rewritten. 1 st paragraph - cold milling materials reworded. 2 nd paragraph transferred to Clause 4.6.5. New clause New subclauses	GM, IC	27.04.09

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 0 (cont'd)	1.2.4	Previously Clause 1.2. Retitled and amended to clarify applicable issue of referenced documents. References transferred to Annexure R101/M.		
	1.3	Previously Clause 2. Retitled and rewritten. Planning documents transferred to Annexure R101/D.		
	3	Retitled. "buried objects" changed to "hidden objects". 1 st and 2 nd paragraph – "sketch plans or" added before "drawings". 4 th paragraph – 2 nd sentence added. Hold Point – "Pay Item R101P5" deleted.		
	4.1	New clause.		
	4.2	Previously Clause 4.1. Retitled and reworded.		
	4.3	New clause.		
	4.4	Previously Clause 4.2. Retitled. "texture" changed to "retextured". "off the" changed to "without fully removing the existing".		
	4.5	New clause.		
	4.6	New clause.		
	4.7	Previously Clause 4.4. Rewording to improve clarity. "Pay Item R101P5" deleted.		
	4.8	Previously clause 4.5. 1 st paragraph – location of unsuitable material clarified. Last paragraph – reworded to make it applicable to all types of contracts.		
	4.9	Previously Clause 4.6. Retitled and reworded to improve clarity.		
	4.10	Previously Clause 4.7. Requirement for inclusion of method of disposal of milled material in PROJECT QUALITY PLAN added.		
	Annex A	Previously Annex R101/1 and R101/2. Type of Work, requirement for survey of milled area and responsibility for investigation of existing pavement added.		
	Annex B	Previously Clause 5. Pay items revised. New items added.		
	Annex C	New Annexure.		
	Annex D	New Annexure.		
Annex E	New Annexure.			
Annex L	New Annexure.			
Annex M	New Annexure.			

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3/Rev 1	Guide Notes Annex E2	Guide Notes edited. Clarifying statement and guidance notes added.	MCQ	01.02.18
Ed 3/Rev 2	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

Using Specification R101

TfNSW R101 is a QA specification. The use of QA specifications requires the implementation of a quality management system by the Contractor that meets the quality management system requirements specified in TfNSW Q. To comply with the intention of government policy as well as TfNSW R101, cold milling works carried out using TfNSW R101 require adequate surveillance and audit by the Principal.

No cold milling over bridges or similar structures is permitted unless this is agreed in advance by the Regional Bridge Maintenance Planner (RBMP) and have complied with any additional requirements for cold milling over these structures.

Introduction

Cold milling machines come in a range of sizes to suit different size jobs. Selection of a suitable machine for a particular job is usually based on productivity potential considering the total amount of material to be milled and the time available to do it. Milling machines are equipped with a rotating drum with teeth capable of removing asphalt and other road pavement materials. Well maintained cold milling machines are expected to produce a uniform surface finish and are capable of tilting to allow feathering of edges to a zero cut.

Increased productivity on large jobs is obtained by running two machines (or more) in echelon. Fast-Change Systems are now available allowing standard 2-metre milling machines to cut from 0.6 m to 1.5 m wide by changing the cutter shell in about three hours. The system permits operators to change drums for different working widths on site. The precision of the cutting depth depends on the spacing of the cutting teeth. Milling drums are categorised as standard (coarse), fine and micro.

Cold milling machines may be fitted with automatic grade control. They can be manually or automatically controlled by using travelling or fixed grade references on either or both sides of the machine. The travelling reference can have either contact or non-contact sensors. An averaging beam can also be attached to optimise ride quality.

Edition 2

Edition 2 was re-numbered to “R101” based on the new RTA document numbering system and reference to “General Conditions of Contract” was changed to “C1 RTA Conditions of Contract”.

Edition 3

Edition 3 introduces more cold milling operation options, including milling to optimise final ride quality, and specifies additional requirements for milling over Concrete Structures. This edition also rationalises inspection frequencies, clarifies inspection requirements and provides an opportunity for the Contractor to propose alternative means of verifying certain aspects of quality.

Technical Notes

The following notes are intended to assist in the interpretation and application of Specification TfNSW R101.

Clause 3 Survey of Hidden Objects

It is important that all users have a clear understanding of the risk allocation under this specification in relation to Hidden Objects.

It is envisaged that:

- (i) the Principal will provide in Annexure R101/A the information based on enquiries to Public Utility Authorities, examination of work-as-executed drawings and any other reasonable enquiries which the Principal has undertaken before tenders are invited;
- (ii) the Contractor has undertaken a metal detector survey, or equivalent, to locate the positions of the items nominated in Annexure R101/A as well as any other items which have not been nominated in Annexure R101/A (e.g. old tram tracks) but which should have been detected by a well executed survey;
- (iii) if Hidden Objects which have not been disclosed by reasonable enquiries and detection surveys are nevertheless encountered, the Contractor is entitled to submit a claim for time and costs.

Clause 4.5 Milling to Optimise Final Ride Quality

This clause specifies the milling process requirements to optimise final ride quality (in a similar way that multiple layers of asphalt would).

For this type of work, there can be a risk of a slight difference in level between the cut surfaces of adjacent runs due to the averaging effect that takes place in each run. Provided that the Contractor implements adequate control over the milling process, the level difference is expected to comply with the straightedge tolerance over the cut length, but there may still be instances along the cut where it does not.

Rectification would generally not be required provided that there is no adverse impact on the quality of subsequently placed layers (e.g. differential compaction) and the ride quality of the wearing surface.

Clause 4.6 Milling of Asphalt over Concrete Structures

Concrete Structures include concrete bridge elements, concrete pavements and other concrete features (see definitions in Annexure R101/M).

The Project Manager must determine the thickness of asphalt to be removed above Concrete Structures, having regard to the thickness and condition of the existing asphalt and specify the thickness of asphalt to be removed above Concrete Structures in Annexure R101/A. Preliminary information on asphalt depths over Concrete Structures may be obtained from work-as-executed drawings. Advice on the thickness and condition of the existing asphalt may be sought from Regional Geotechnical Scientist or Pavement Surfacing Section. If investigation of thickness of existing asphalt over Concrete Structures as specified in Clause 4.6.1 is necessary, the Project Manager must determine and specify in Annexure R101/A whether the investigation will be carried out by the Principal or the Contractor (refer to notes under Clause 4.6.1).

The operation of large cold milling machines and associated heavy road maintenance equipment on bridge decks and culverts may result in high static and dynamic loadings and vibrations which can adversely affect the structure, especially structural components such as bearings and deck joints.

Where cold milling of asphalt over any concrete bridge element is proposed under the Contract, the Project Manager must notify RBMP at least 4 weeks before the calling of tenders. This is to enable the RBMP to make a preliminary assessment of the risks to the bridge structures and to specify additional requirements and precautions as follows:

- (i) additional requirements such as requirement for levels on finished asphalt and/or base of cut for cold milling over Concrete Structures;
- (ii) exclusion of milling work over certain concrete bridge elements from the Contract;
- (iii) more detailed investigation of existing asphalt thickness above certain concrete bridge elements.

The Project Manager must take into account RBMP's comments in the preparation of Tender Documents.

Clause 4.6.1 Investigation of Thickness of Existing Asphalt over Concrete Structures

Thickness of the existing asphalt above the Concrete Structures must be determined for:

- (i) Milling to a specified depth (refer Clause 4.2);
- (ii) Milling to variable depth to correct surface shape and/or ride quality and possibly to minimise dead load on structures (refer Clauses 4.3 and 4.5);
- (iii) Milling to remove all asphalt.

For milling to variable depth, control of milling equipment must include use of automated level control (such as Paveset®). However, the depth of cut will generally be manually controlled for milling to remove all asphalt on the Concrete Structures.

This specification specifies a regular pattern of coring but there may be instances where a suitable risk assessment identifies that a selective coring pattern would be more cost effective in minimising the risk of damage to the Concrete Structure. The Project Manager is required to consult the Asset Manager before specifying an alternative coring pattern. The Project Manager must consider whether further investigation is required and whether the Principal or the Contractor will be responsible for the investigation of the existing pavement thickness.

Clause 4.6.2 Revised Scope of Work Based on Investigation

If the Contractor is responsible for the investigation of the existing pavement thickness, and the investigation identifies that a revised scope of works is required, the Contractor must submit proposal for revised scope of works to the Principal for approval prior to the commencement of work.

Clause 4.6.4 Equipment Requirements

A milling machine with fine milling drum must be used on concrete bridge decks.

For milling over other Concrete Structures, a milling machine with a fine milling drum for thin single lift is recommended. This is due to the possibility of the milling machine reaching the concrete and delays caused by the Hold Point in Clause 4.6.5.

However, due to lower productivity rates, the use of fine milling drum on a concrete pavement may not always be warranted. The Principal must decide the most appropriate option based on the pavement material (i.e. sprayed seal or asphalt).

For deep cuts, where the use of the fine cut mill alone is not necessarily cost effective or efficient, the use of two cuts involving a initial cut and a final trim using a fine milling drum is recommended.

Clause 4.6.5 Milling Procedures

The **HOLD POINT** in Clause 4.6.5 applies to the commencement of milling of asphalt, including trials, over Concrete Bridge Elements. At least 4 weeks prior to the commencement of milling, the Contractor must notify the Principal of its intention to commence milling and submit its proposal for the milling, providing details on the type, mass and number of milling machine(s) and other heavy equipment to be used concurrently on the concrete bridge elements and the proposed measures to control dynamic effects. The proposal must be appropriate for the type of concrete bridge elements, especially for the Nominated Bridges listed in Annexure R101/E.

On receipt of the submission, the Project Manager must send the information to the RBMP for assessment of the following:

- (i) the adequacy of the structure to carry the heavy equipment loads and concurrent traffic loading and the risks of overloading;
- (ii) the dynamic effects on the concrete bridge elements and the possibility of damage caused to the concrete bridge elements due to dynamic effects.

The RBMP may require additional precautionary measures for milling work on certain bridge structures, such as a controlled trial with vibration monitoring measurements, temporary traffic and load restrictions, vibration monitoring or continuous surveillance by TfNSW bridge personnel.

Clause 4.6.6 Operation of Cold Milling Machine

There are no pre-determined dispositions for rectification of damage to Concrete Structures and each case must be considered on its merit by the Asset Manager based on the advice from RBMP.

Annexure R101/C

It is envisaged that the Principal will take all reasonable measures to ensure that the **HOLD POINTS** in Annexure R101/C are released promptly to avoid delay and disruption.

Annexure R101/D

To ensure that damage caused by cold milling machines to Concrete Structures is minimised, Annexure R101/D requires the Contractor to submit details of the milling processes in its PROJECT QUALITY PLAN.

Annexure R101/E

Annexure R101/E identifies bridges that require special precautions, such as fine milling, during the milling process, to avoid damage to the concrete structures. The bridges listed in Annexure R101/E1 must not be deleted.

The RBMP may nominate other bridges where the deck and/or structure are considered to be highly sensitive to the cold milling operation. The Project Manager must list these bridges under Annexure R101/E2.

It is important to note that there is **zero tolerance** to specified milling depth at bridges with lightweight concrete decks (refer Table R101.1).

Lightweight concrete has been used in some bridge decks as wind bracing. Any interference to this component of the bridge must be approved by the RBMP on the advice of TfNSW Engineering Technology Branch.

In situations where lightweight concrete is exposed by milling operations and where the lightweight concrete is found to have been broken and/or have become friable, advice must be obtained from TfNSW Engineering Technology Branch regarding the appropriate rectification measures.

The Project Manager must advise the RBMP before the commencement of cold milling work at bridges with lightweight concrete decks. It is advisable to have a bridge inspector on site when milling is being undertaken at identified bridge decks and approach spans.



COLD MILLING OF ROAD PAVEMENT MATERIALS

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VERSION FOR: DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R101 Edition 3 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R101

COLD MILLING OF ROAD PAVEMENT MATERIALS

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the removal of pavement materials from road pavements and Concrete Structures by cold milling, including the treatment of the milled vertical faces and the cleaning up and removal and disposal of the milled materials.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Project Specific Requirements

Project specific details of work are shown in Annexure R101/A.

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure R101/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure R101/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure R101/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R101/D and must be implemented.

In all cases where this Specification refers to the manufacturer's recommendations, these must be included in the PROJECT QUALITY PLAN.

1.2.5 Referenced Documents

Unless specified otherwise, the applicable issue of a referenced document, other than a TfNSW Specification, must be the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R101/M.

1.3 DEFINITIONS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

Object	Can be metal objects, utilities, old tram tracks, etc.
Hidden Objects	Any objects not visible to the naked eye and requiring identification by means of a location device or metal detector.
Location device	Device capable of identifying Hidden Objects using a non-destructive technique, specifically a metal detector (or equivalent) for metal objects.
Concrete Structure	Can be a concrete bridge element, concrete pavement or other concrete feature (see definitions below) that underlies an existing pavement.
Concrete bridge element	A concrete bridge deck, bridge approach slab, joint nosing or crown of a concrete box culvert.
Other concrete feature	A concrete footing, encasement, drainage or utility pit or other similar concrete feature.

2 (NOT USED)

3 SURVEY OF HIDDEN OBJECTS

The approximate locations of known Hidden Objects are listed in Annexure R101/A, and may be shown on the sketch plans and/or drawings provided by the Principal.

Make enquiries with the relevant Authorities to confirm the exact locations of all objects listed in Annexure R101/A, as shown on the sketches and/or drawings or otherwise brought to your attention.

Survey the area to be milled for Hidden Objects using a locating device or metal detector. The locations and extent of any objects (metal objects, public utilities, etc) detected must be clearly marked on site. Determine whether the Hidden Object is within the depth to be milled.

Unless otherwise directed by the Principal, set out the cold milling work area as specified in Annexure R101/A and/or as shown in the sketches and/or drawings. This work must include the marking of milling depths and locations of Hidden Objects.

Submit documented verification that the work has been set out in accordance with Annexure R101/A, the sketches and/or drawings or as directed by the Principal.

HOLD POINT

Process Held: Cold milling of work area.

Submission Details: Submission of verification documentation, the marking of milling depths and locations of all Hidden Objects on site, records and calculations of the areas to be measured under Pay Item R101P6.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

4 COLD MILLING OPERATIONS**4.1 WORKING TOLERANCES**

Depth of cut and other dimensions must comply with the tolerances specified in Table R101.1.

Table R101.1 – Tolerances

Nature of Milling Work	Tolerance, Depth of Cut (mm)		Groove Spacing (mm)	Surface Texture Depth (mm)
	Greater than specified	Less than specified		
Cutting to depth \leq 40 mm	0	8 max	15 max	2.5 max
Cutting to depth > 40 mm where the floor of the cut is asphalt or bound material	10 max	5 max	15 max	Not specified
Cutting to depth > 40 mm where the floor of the cut is unbound material	15 max	5 max	15 max	Not specified
Cutting to depth within nominal 40 mm of the surface of a Concrete Structure and/or waterproofing membrane that is to be retained.	0	8 max	10 max	2.5 max
Producing a surface suitable for spray sealing without prior correction	Not specified	Not specified	10 max	1.5 max
Milling to achieve specified level (Clause 4.3)	10 max	0	Not specified	Not specified
Re-texturing the surface of asphalt pavement (Clause 4.4)	As specified in Clause 4.4	As specified in Clause 4.4	10 max	Not specified
Producing a surface to optimise ride quality (Clause 4.5)	5 max	5 max	Not specified	Not specified
On Concrete Bridge Element with extra fine milling requirements ("Nominated Bridges" as listed in Annexure R101/E)	0	8 max	10 max	1.5 max

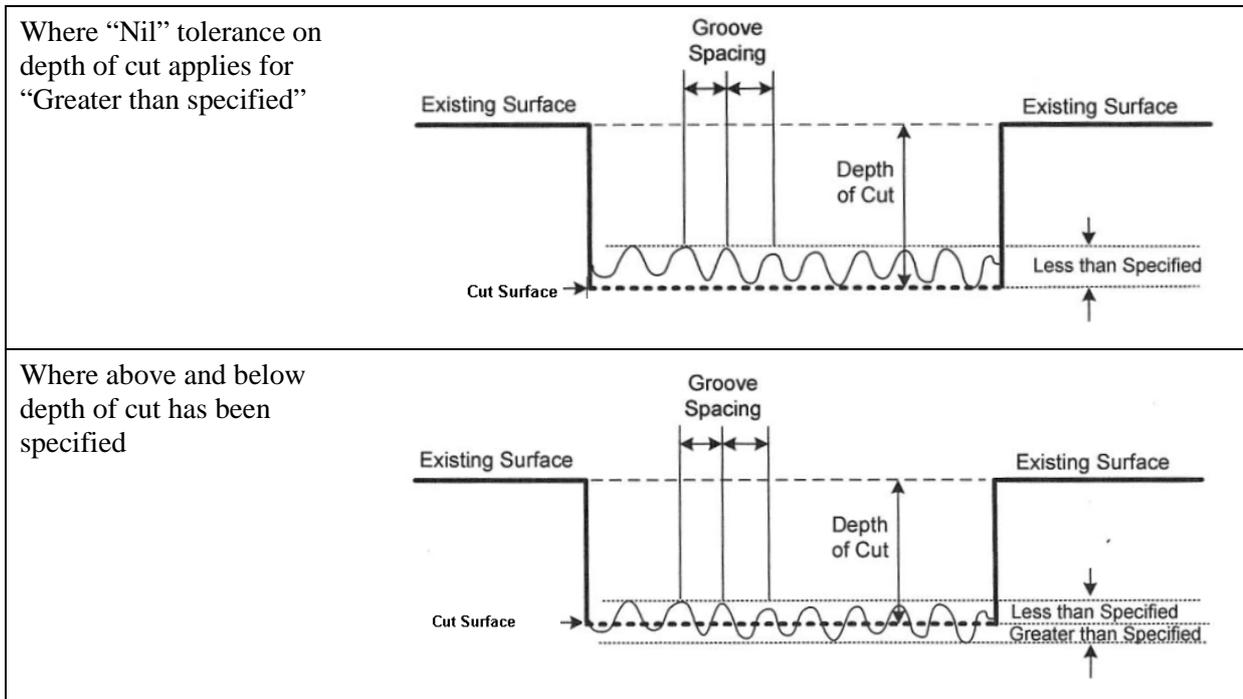
Note: Where the nature of milling work satisfies more than one of the descriptions above, the least tolerance applies.

The difference in surface position between adjacent cuts measured vertically by depth below straightedge must not exceed 5 mm.

Measurement of surface texture depth must be in accordance with Test Method TfNSW T240 and measurement of depth and groove spacing must be carried out using a metal rule or callipers graduated in millimetres.

4.2 MILLING TO ACHIEVE SPECIFIED DEPTH OF CUT

Depth of cut and other associated terminology is shown in Figure R101.1.



Note: Existing surface is the uncut surface immediately adjacent to the cut.

Figure R101.1—Cold Milling Terminology

HOLD POINT

Process Held:	Covering of milled work area and the removal of the cold milling machine and cleaning plant from the site (after milling to specified depth of cut).
Submission Details:	Written notice to the Principal at least 24 hours in advance of the time when the floor of the milled area will be available for inspection.
Release of Hold Point:	The Principal will inspect the completed work prior to authorising the release of the Hold Point.

4.3 MILLING TO ACHIEVE SPECIFIED LEVEL

Mill to the specified level as shown in Annexure R101/A, and remove any unsuitable material in accordance with Clause 4.8.

If specified in Annexure R101/A, survey the floor of the milled area prior to covering the work area.

Survey requirements are as follows:

- Carry out the survey in accordance with Specification TfNSW G71 using a flat-based staff placed on the high point of the milled profile.
- Report levels to the nearest 5 mm.

- (c) Submit a survey report in accordance with TfNSW G71.

Where the cut surface does not comply with the level tolerances, re-mill the high areas to bring the high areas to levels within tolerances. Fill the low areas with asphalt in accordance with Specification TfNSW R116 to bring the low areas to levels within tolerance.

You must bear the costs of re-milling high areas and filling of low areas with asphalt to achieve levels within tolerances.

HOLD POINT

Process Held:	Covering of milled area and the removal of the cold milling machine and cleaning plant from the site (after milling to specified level).
Submission Details:	Survey Report of the milled floor (if specified in Annexure R101/A) and written notice to the Principal of the time that the floor of the milled surface will be available for inspection.
Release of Hold Point:	The Principal will inspect the completed work and view the Survey Report (if required by Annexure R101/A) prior to authorising the release of the Hold Point.

4.4 MILLING TO RETEXTURE A SURFACE

When milling is required to retexture the surface, achieve the outcome by producing groove depths in the existing surface of between 5 mm to 10 mm in depth without fully removing the existing surface.

4.5 MILLING TO OPTIMISE FINAL RIDE QUALITY

When milling is required to optimise final ride quality, the outcome must be achieved by cutting to an average depth predetermined by survey. The nominal cutting width must be 2 m.

The milling machine must be equipped and operated using a minimum 6 m averaging beam or an equivalent non-contact system. Set milling operations to a constant speed and the cutting sequence must start from the crown towards the kerb.

You may propose, and implement subject to the Principal's prior approval, an alternative method for achieving effective averaging control on the profiler.

Verify the shape and profile of the milled surface by the use of a 3 m straightedge after each cut. Carry out testing transversely and longitudinally at intervals not exceeding 10 m using Test Method TfNSW T183. The milled surface must not deviate from any point on the bottom of the straightedge by more than 5 mm.

4.6 MILLING OF ASPHALT OVER CONCRETE STRUCTURES

Refer to Clause 1.3 for the definition of Concrete Structures.

4.6.1 Investigation of Thickness of Existing Asphalt over Concrete Structures

Where the Principal is responsible for the investigation of thickness of existing asphalt over Concrete Structures, the information on thickness of existing asphalt will be clearly marked on existing pavement prior to the commencement of the Contract.

Where specified in Annexure R101/A, carry out a comprehensive investigation to determine the thickness of the existing asphalt over each Concrete Structure. The Principal will provide you with any available preliminary information, including relevant work-as-executed drawings.

Carry out the investigation as follows:

- (a) Determine the proposed pattern of milling works and mark on the pavement the lines of movement of the depth sensing foot on each side of the milling machine.
- (b) Investigate the thickness of asphalt by taking small diameter cores (e.g. 25 mm), at 3 m intervals (over concrete bridge elements) or 20 m intervals (over other concrete structures) along each line of movement of a depth sensing foot, at least 24 hours prior to the commencement of milling.

Submit the findings of the investigation to the Principal at least 24 hours before commencement of milling.

4.6.2 Revised Scope of Works Based on Investigation

If you are responsible for the investigation and the investigation identifies that a revised scope of work is required, submit a proposal for revised scope of work to the Principal for approval prior to the commencement of work.

Clearly mark on the surface of the existing asphalt:

- (i) The proposed depths of cut (in millimetres) at each core location;
- (ii) The limits of milling (minimum 150 mm clearance) around all joints, kerbs and similar items which must not be contacted by the cutting teeth.

Record the locations of the cores and proposed depths of cut on a sketch plan. Submit the sketch plan to the Principal prior to the commencement of work.

WITNESS POINT

Process Witnessed: Milling of asphalt, including trials, over each Concrete Structure or where the planned base of cut is within 40 mm of the top surface of a Concrete Structure and/or waterproof membrane that is to be retained.

Submission Details: Notify the Principal not less than 24 hours prior to milling of the time and date of commencement of milling and the time and date the proposed depths of cut will be marked on the surface.

4.6.3 Milling Operators

Milling operators must have adequate training and experience in the operation of the cold milling machine (including automatic sensing equipment).

Submit to the Principal the experience and training records of each operator prior to the commencement of work on site.

During milling operations over Concrete Structures, provide three suitably trained and skilled milling machine operators at the cold milling machine at all times as follows:

- (i) one on the driving platform;

- (ii) one on each side of the machine generally in the vicinity of the sensor/cutting mandrel.

4.6.4 Equipment Requirements

For milling work over Concrete Structures, the cold milling machine must be well maintained, equipped and adjusted for the purpose of precision work.

Comply with the following:

- (a) Maintain the milling machine in “as new” condition and, unless approved otherwise by the Principal, fit the milling machine with a “fine” cutting drum which provides for tooth cut spacing not exceeding 10 mm;
- (b) Conduct a cutting trial using the same machine at the commencement of each working shift and after any repair or adjustment to the machine during the works. The trial must include the operation of depth sensing feet and depth adjustment equipment;
- (c) Equip each operator with a gauge to measure the depth of cut in millimetres.

4.6.5 Milling Procedures

Submit proposed procedures for the milling work at least 7 days (except for the work carried out according to Clauses 4.6.1 and 4.6.2 which requires 24 hours notification) prior to the commencement of cold milling of asphalt over a concrete bridge element or at locations where the planned base of cut is within 40 mm of the top surface of a concrete pavement or other concrete structure.

The proposal must be appropriate for the type of concrete bridge elements, especially for the Nominated Bridges listed in Annexure R101/E. The submission must include the type, mass and number of milling machine(s) and other heavy equipment to be used concurrently on the bridge structure; the expected dynamic effects on the structure; and measures to control these effects.

Submission of milling procedures is not required where milling is directed by the Principal. In this case, the Principal will provide project specific requirements for the milling work.

HOLD POINT

Process Held:	Milling of asphalt, including trials, over a concrete bridge element or other concrete structures.
Submission Details:	Written notice to the Principal together with proposed procedures for the work at least 7 days (except for Clauses 4.6.1 and 4.6.2 where it is 24 hours) prior to the commencement of milling work.
Release of Hold Point:	The Principal will assess the submission, and may require submission of further details on the effects of milling on the bridge structure, prior to authorising the release of the Hold Point.

4.6.6 Operation of Cold Milling Machine

Do not use cold milling machines to correct the shape, level or ride quality of the surface of Concrete Structures unless specified or specifically directed by the Principal.

During the operation of cold milling over Concrete Structures, take all necessary precautions to prevent the cutting teeth from contacting the concrete. Measure the actual depth of cut on both sides

of the cold milling machine at intervals not exceeding 3 m (over concrete bridge elements) or 10 m (over other Concrete Structures).

In the event that the cutting teeth contact the cement concrete, immediately comply with the following:

- (i) Halt forward progress of the cold milling machine;
- (ii) Notify the Principal of the incident, providing details of the cause and the proposed course of action;
- (iii) Repair any fault in the machine and readjust settings and controls;
- (iv) Notwithstanding the provisions of Clause 4.6.2, replace or retrain, as appropriate, any machine operator from the milling work who does not demonstrate the required competency;
- (v) Notify a “Nonconformity” under the Contract.

HOLD POINT

Process Held:	Further milling of pavement.
Submission Details:	After the cutting teeth have contacted the concrete, notify the Principal immediately of the incident and submit details of the cause and the proposed course of action.
Release of Hold Point:	The Principal will assess the submission prior to authorising the release of the Hold Point.

In the event that the pattern of the cut surface changes at any time during milling due to broken or worn cutting teeth, etc, immediately comply with the following:

- (i) Halt forward progress of the cold milling machine;
- (ii) Notify the Principal of the incident, providing details of the cause and the proposed course of action;
- (iii) Repair any wear and tear or fault in the machine and readjust settings and controls.

Remove asphalt that remains within the 150 mm clearance zone (refer to Clause 4.6.2), by hand operated equipment.

HOLD POINT

Process Held:	Further milling of pavement.
Submission Details:	After any change to the pattern of the cut surface due to broken or worn cutting teeth, notify the Principal immediately of the incident and submit details of the cause and the proposed course of action.
Release of Hold Point:	The Principal will assess the submission prior to authorising the release of the Hold Point.

4.7 WORK IN VICINITY OF OBJECTS WITHIN MILLING AREA

Where objects are located within the proposed milled area, remove the surrounding material for at least 0.5 m from the extremities of the object by means other than cold milling. Payment for this work will be made under Pay Item R101P6.

The Principal will not be liable for any costs arising from delay or from repairs to equipment caused by impacts with Hidden Objects or public utilities which could have been reasonably expected to be located by carrying out enquiries and surveys in accordance with Clause 3.

4.8 UNSUITABLE MATERIAL

Remove any planes of weakness within the asphalt, cement concrete and/or pavement materials, or any unsuitable material existing at the base of the cut, which is not removed by the milling operation to the extent directed by the Principal.

HOLD POINT

Process Held:	Backfilling with replacement material.
Submission Details:	Written notice to the Principal of the time that the removal of the unsuitable material will be completed and be available for inspection.
Release of Hold Point:	The Principal will inspect and consider the depth of excavation of unsuitable material, to determine whether a sufficient depth of unsuitable material has been removed, prior to authorising the release of the Hold Point.

This work will be dealt with as a variation.

4.9 TEMPORARY TREATMENT AT EDGES OF MILLING

Prior to opening of the work to traffic, ramp the edges of the milled surface to tie into the existing road levels. The dimensions of ramps must be as follows:

(i) Transverse Joints

A minimum taper length of 2.5 m for each 50 mm variation in levels or part thereof for areas where the speed limit exceeds 60 km/h and a minimum taper length of 1.5 m for each 50 mm variation in levels or part thereof for areas where the speed limit is less than or equal to 60 km/h

(ii) Longitudinal Joints

Where traffic is required to travel on a longitudinal edge, provide a ramp of minimum 1.0 m length for each 50 mm variation in levels (or part thereof)

(iii) Interface with Structures

Form and compact asphalt ramps around manholes, gully grates, utility covers or other similar structures unless otherwise directed by the Principal. The ramps must have a minimum taper length of 1.5 m for each 50 mm depth of cut (or part thereof).

Form the ramp by either bevelling with the cold milling machine or by placing asphalt. When bevelling, any lip remaining at the toe or head of the bevel must not exceed 10 mm in height.

Where hotmix asphalt or proprietary patching products are not available, temporary ramps may be formed with coldmix asphalt, provided that:

- (a) an emulsion tack coat is applied to the milled surface prior to the placement of coldmix asphalt;

- (b) the maximum thickness of coldmix asphalt does not exceed 40 mm. Where site conditions require greater thickness, the coldmix asphalt is placed and compacted in layers between 25 mm and 30 mm thick;
- (c) the coldmix asphalt ramp is not left in place longer than one week;
- (d) the ramp is maintained in good condition.

Do not cause damage to concrete medians or kerbs, manholes, gully grates, utility covers or other similar structures. Repair any damage caused due to the milling works at your own expense.

Exclude any vertical edges or surfaces which are not ramped from traffic in accordance with Specification TfNSW G10.

Where work under the Contract includes the replacement of the milled material with new materials, remove any ramps before the new material is placed. Dispose of the ramp material in accordance with Clause 4.10.

4.10 CLEAN UP AND DISPOSAL OF MILLED MATERIAL AND TEMPORARY RAMP MATERIAL

After the completion of cold milling, remove all loose milled material. The material removed will become your property unless otherwise specified in Annexure R101/A.

If the milled material remains the property of the Principal, deliver the milled material to the stockpile site(s) nominated in Annexure R101/A. Shape the milled material in uniform stockpiles with regular sides and, where appropriate, slope the top to promote water runoff. Clearly identify the milled material by signposting.

If the milled material becomes your property, remove it from the site in accordance with the Waste Management Plan (may form a part of PROJECT QUALITY PLAN).

Include in the PROJECT QUALITY PLAN how and where the milled material will be reused, recycled, stockpiled or disposed of.

ANNEXURE R101/A – PROJECT SPECIFIC REQUIREMENTS

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure R101/A)

Complete the tables below by filling in the required details. Where “Yes/No” or other options is shown below, delete whichever is not applicable.

Specify in the table below the party responsible for investigation of the existing pavement and the party owning the milled materials (whether Principal or Contractor) by deleting whichever is not applicable.

A1 DETAILS OF WORK

Details	Description		
	1	2	3
Type of Work (e.g. milling to specified depth, milling to specified level, milling to retexture, milling to optimise ride quality or milling over Concrete Structures)			
Road No.			
Name			
Section Between			
and			
Distances (km) From			
To			
Length (m)			
Nominal pavement width (m)			
Total area including widening (m²)			
Nominal Milling Depth of Cut (mm) (specified depth, average depth to specified level, or average depth to remove all asphalt from the surface)			
Stockpile Location and Approx. Haulage Length (km) (If the milled material remains the property of the Principal, refer to Clause 4.10.)			
Minimum Daily Available Working Area (m²/day)			

Clause	Description	Requirement
4.3	Survey of the milled area required	Yes / No
4.6.1	Investigation to determine thickness of existing pavement by	Principal / Contractor
4.10	Milled materials is property of	Principal / Contractor

A2 SCHEDULE OF HIDDEN OBJECTS

Description/Name of Object	Owner of Object	Contact Person & Phone Number	Phone Confirmation Required	Approximate Location ⁽¹⁾

Note:

⁽¹⁾ Sketch plans, or drawings where appropriate, will be provided by the Principal.

ANNEXURE R101/B – MEASUREMENT AND PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless specified otherwise, a lump sum price for any of these items will not be accepted.

If a survey report of the milled area is specified in Annexure R101/A, the costs of depth survey are deemed to be included in the rates and prices generally for the Work Under the Contract.

Pay Item R101P1 - Milling to Specified Depth of Cut

The unit of measurement must be the square metre. The width and length must be taken as specified on the Drawings or listed in Annexure R101/A.

A separate unit rate must be provided in the Schedule of Rates for each nominal depth specified in Annexure R101/A. Each unit rate applies for the full depth specified regardless of the number of passes carried out.

Pay Item R101P2 - Milling to Specified Level

The unit of measurement must be the square metre. The width and length must be taken as specified on the Drawings or listed in Annexure R101/A.

Pay Item R101P3 - Milling to Retexture a Surface

The unit of measurement must be the square metre.

The width and length must be taken as specified on the Drawings or specified in Annexure R101/A.

Pay Item R101P4 - Milling to Optimise Final Ride Quality

The unit of measurement must be the square metre.

The width and length must be taken as specified on the Drawings or specified in Annexure R101/A.

Pay Item R101P5 - Milling Over Concrete Structures

The unit of measurement must be the square metre. The width and length must be taken as specified on the Drawings or specified in Annexure R101/A.

A separate unit rate must be provided in the Schedule of Rates for each nominal depth specified in Annexure R101/A. Each unit rate applies for the full depth specified regardless of the number of passes carried out.

Pay Item R101P6 - Surcharge for Work in Vicinity of Objects

R101P6.1 Affected area up to 10 square metres

R101P6.2 Affected area over 10 and up to 25 square metres

R101P6.3 Affected area over 25 and up to 50 square metres

R101P6.4 Affected area over 50 square metres

This pay item covers any extra costs involved for work in the vicinity of objects.

A separate unit rate must be provided in the Schedule of Rates for each affected area range specified in the Schedule. Pay Items R101P6.1 to R101P6.4 are not cumulative but are additional to Pay Items R101P1, R101P2, R101P4 and R101P5 for the nominal milling depth specified in Annexure R101/A.

The unit of measurement must be the square metre.

Each affected area must be measured for payment, after completion of the milling operation as follows (see Figure R101.2):

- (a) The transverse width shall be measured between the extremities of the object plus an offset of 1 m at each end, except that where an extremity is within 2.5 m of a longitudinal edge, that edge must be the limit for the width
- (b) The longitudinal length must be measured between the extremities of the object plus an offset of 1 m at each end
- (c) If the extremities of two or more objects are within 2 m of each other, the objects must be grouped together and regarded as one object.

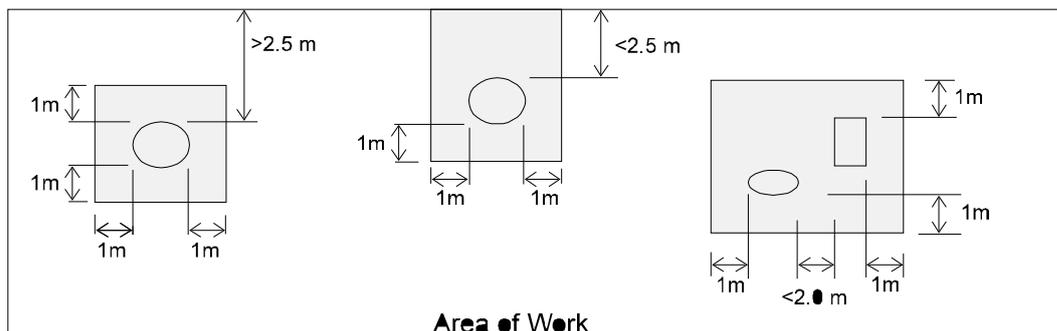


Figure R101.2 - Measurement Diagram for Objects

Pay Item R101P7 - Surcharge for Milling Base Concrete

This pay item covers any extra costs involved for milling base concrete in lieu of milling asphalt, granular base and subbase concrete as directed by the Principal.

The unit of measurement must be the square metre.

This Pay Item is extra over Pay Items R101P1, R101P2, R101P3, R101P4 and R101P5.

Pay Item R101P8 - Investigation of Thickness of Asphalt over Concrete Structures

This item must include all costs associated with investigation of thickness of asphalt over Concrete Structures. The frequency of investigations must be as specified on the Drawings or specified in Annexure R101/A.

The units of measurement and payment must be:

- (i) per investigation visit undertaken; and
- (ii) number of cores taken.

ANNEXURE R101/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3	Hold	Submission of verification documentation, the marking of milling depths and location of all Hidden Objects on site, records and calculations of the areas to be measured under Pay Item R101P6.
4.2	Hold	Written notice to the Principal at least 24 hours in advance of the time when the floor of the milled area will be available for inspection.
4.3	Hold	Survey Report of the milled floor (if specified in Annexure R101/A) and written notice to the Principal of the time that the floor of the milled surface will be available for inspection.
4.6.2	Witness	Notify the Principal not less than 24 hours prior to milling of the time and date of commencement of milling and the time and date the proposed depth of cut will be marked on the surface.
4.6.5	Hold	Written notice to the Principal together with proposed procedures for the work at least 7 days (except for Clause 4.6.1 and 4.6.2 where it is 24 hours) prior to the milling work.
4.6.6	Hold	After the cutting teeth have contacted the cement concrete, notify the Principal immediately of the incident and submit details of the cause and the proposed course of action.
4.6.6	Hold	After any change to the pattern of the cut surface due to broken or worn cutting teeth, notify the Principal immediately of the incident and submit details of the cause and the proposed course of action.
4.8	Hold	Written notice to the Principal of the time that the removal of the unsuitable material will be completed and be available for inspection.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
4	Submission of verification documentation, the marking of the location of all objects on site, records and calculations of the areas to be measured for cold milling.
4.3	Survey Report (if directed by Annexure R101/A).
4.6.2	Plan showing core locations, the thickness of existing asphalt and proposed depths of cut over a Concrete Structure.

ANNEXURE R101/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The information to be submitted as part of the PROJECT QUALITY PLAN must include the following:

Clause	Description
3	Methods and equipment to be used to identify hidden metal objects (tramlines, gratings, candybar brackets, loop detectors etc) and hidden public utilities.
4	<p>Cold milling equipment to be used for the work.</p> <p>Proposed method of carrying out the work, including sequencing of milling runs and planned daily outputs.</p> <p>Haulage fleet required to optimise the milling output and minimise public inconvenience.</p> <p>Procedures to minimise dust nuisance, excessive noise, excessive windrows, loose material or excessive roughness of the cold milled surface.</p> <p>Position of the loading conveyor.</p> <p>Factors affecting performance of the work, public safety and public convenience.</p>
4.1	<p>Width of single run cut.</p> <p>Method of level control proposed.</p>
4.6	<p>Methods and equipment to be used to ascertain the thickness of existing asphalt over Concrete Structures and measures to avoid contacting such structures.</p> <p>Methods and equipment for milling over each concrete bridge element, including details of milling machine(s) and other heavy equipment to be used concurrently on the bridge structure and measures to control dynamic effects on the structure.</p>
4.7	Procedure to work in the vicinity of Hidden Objects and/or public utilities.
4.10	Waste Management Plan (may form part of PROJECT QUALITY PLAN) including proposed method of handling, transportation and disposal of milled material.

ANNEXURE R101/E – NOMINATED BRIDGES REQUIRING EXTRA FINE MILLING

Refer Table R101.1.

E1 BRIDGES WITH LIGHTWEIGHT CONCRETE DECKS

Bridge No. 29	Tom Uglys Bridge	All approach spans and all truss spans
Bridge No. 65	Iron Cove Bridge	All approach spans and all truss spans
Bridge No. 222	Unwins Bridge	All spans
Bridge No. 226	Sydney Harbour Bridge	All approach spans and main deck

E2 OTHER BRIDGES

The following bridges have decks and/or structures which are considered to be highly sensitive to the cold milling operation.

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure R101/E2)

Insert here the Bridge No. and Name of any bridges within the contract area, other than those listed in Annexure E1, which may be affected, as advised by the RBMP.

If not applicable, then delete the entire clause and change the heading of E2 to “NOT USED”.

ANNEXURES R101/F TO R101/K – (NOT USED)

ANNEXURE R101/L – MINIMUM FREQUENCY OF INSPECTION

Nature of Milling Work	Depth of Cut (mm)	Groove Spacing	Surface Texture Depth
All milling work	Continuous observation for variability or change in cut surface appearance		
All cutting to depth ≤ 40 mm	One measurement on each side of cut per 3 m of lineal progress	At start of shift	At start of shift
All cutting to depth > 40 mm	One measurement on each side of cut per 3 m of lineal progress	At start of shift	
All cutting to depth within nominal 40 mm of the surface of a Concrete Structure and/or waterproofing membrane that is to be retained	Clause 4.6.6	At start of shift	
Producing a surface suitable for spray sealing without prior correction		At start of shift	At start and mid-point of shift
Milling to achieve specified level	Clause 4.3		
Re-texturing the surface of asphalt pavement	One measurement per 5 m of lineal progress.	At start of shift	
Producing a surface to optimise final ride quality	Clause 4.5	At start of shift	
On concrete bridge element requiring extra fine milling ("Nominated Bridges" as listed in Annexure R101/E)	Clause 4.6.6	At start of shift	At start and mid-point of shift

ANNEXURE R101/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.5.

TfNSW Specifications

TfNSW G10	Traffic Management
TfNSW Q	Quality Management System
TfNSW R116	Heavy Duty Dense Graded Asphalt

TfNSW Test Methods

TfNSW T183	Surface Deviation Using a Straightedge
TfNSW T240	Texture Depth of Coarse Textured Road Surfaces