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Technical Specification**

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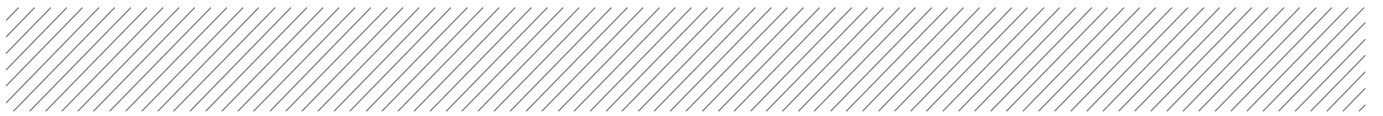
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Appendices

Appendix A

Procedure for the Location and Identification of Services

Appendix B

Draft Method of Working Plan

1. Execution of the Works

1.1 Scope

This Section of the Specification describes the work to be undertaken and outlines the restrictions that will apply, together with general arrangements.

1.2 Works Under the Contract

1.2.1 Scope of Works

The works involve the construction of a new 17/35 Runway, taxiway and RPT Apron extension and upgrading an existing taxiway and the apron for Code 3C aircraft.

Using new pavement materials, the high strength pavement structure comprises:

Prime and Two Coat Bituminous Seal, on
160 mm Class 1 Fine Crushed Rock, on
160 mm Class 2 Fine Crushed Rock; on
200 mm Cement Treated Class 2 Crushed Rock, on
Proof rolled subgrade

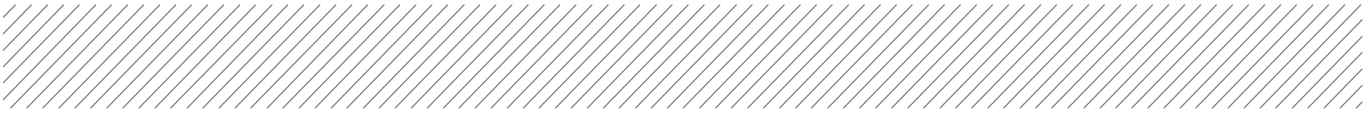
In instances where the existing pavement materials form the sub-base course, the pavement structure comprises:

Prime and Two Coat Bituminous Seal, on
150 to 160 mm Class 1 Fine Crushed Rock, on
Proof rolled existing unbound pavement

Without limiting the requirements set out elsewhere in the Contract, the works shown on the Drawings comprise:

17/35 Runway

- a) Clearing the site, carrying out any other preparatory work, stripping off grass and topsoil where necessary, removing any debris and lawfully disposing of it off the airport;
- b) Removal of unsuitable subgrade material and replacement with suitable fill material;
- c) Construction of sub grade course using select fill material;
- d) Construction of sub-base course using imported cement treated crushed rock;
- e) Construction of fine crushed rock sub-base course;
- f) Construction of fine crushed rock base course;
- g) Application of prime coat and two coat bituminous seal;
- h) Construction of new airside perimeter road network;
- i) Construction of sub-surface stormwater drainage system;
- j) Protection and relocation of underground infrastructure services;

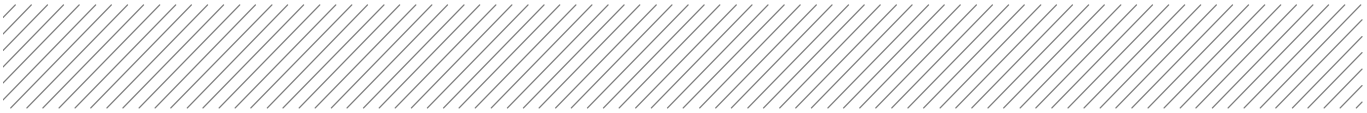
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- k) Installation of new runway edge lighting system (including new runway edge lights, Series Isolating Transformers (SITs), electrical pits and ducts);
 - l) Installation of new Precision Approach Path Indicator (PAPI) system (including new PAPI lights, SITs, electrical pits and ducts);
 - m) Installation of new Movement Area Guidance Signs (MAGs) (including new signs, SITs, electrical pits and ducts);
 - n) Installation of new Illuminated Wind Direction Indicators (IWDI) (including new lights, mast and electrical pits);
 - o) Installation of a new Airport Lighting Electrical Control Cubicle and Shelter;
 - p) Line marking; and
 - q) Regrading, topsoiling, hydromulching and spraying with bitumen emulsion beyond the edges of the runway pavements where necessary to remove changes in level only as directed by the Superintendent with reclaimed or imported material or as indicated on the Drawings.

Existing 17/35 Runway

- a) Removal of existing sections of seal and pavement material and stripping off grass and topsoil where necessary (as indicated on the Drawings);
- b) Removal of unsuitable subgrade material and replacement with suitable fill material;
- c) Construction of sub grade course using select fill material;
- d) Construction of sub-base course using imported cement treated crushed rock;
- e) Construction of fine crushed rock sub-base course;
- f) Construction of fine crushed rock base course;
- g) Application of prime coat and two coat bituminous seal;
- h) Line marking; and
- i) Regrading, topsoiling, hydromulching and spraying with bitumen emulsion beyond the edges of the taxiway pavements where necessary to remove changes in level only as directed by the Superintendent with reclaimed or imported material or as indicated on the Drawings.

Taxiways and RPT Apron

- a) Clearing the site, carrying out any other preparatory work, stripping off grass and topsoil where necessary, removing any debris and lawfully disposing of it off the airport;
- b) Removal of existing seal and pavement material and stripping off grass and topsoil where necessary;
- c) Removal of unsuitable subgrade material and replacement with suitable fill material;
- d) Construction of sub grade course using select fill material;
- e) Construction of sub-base course using imported cement treated crushed rock;
- f) Construction of fine crushed rock sub-base course;
- g) Construction of fine crushed rock base course;

- 
- h) Application of prime coat and two coat bituminous seal;
 - i) Construction of sub-surface stormwater drainage system;
 - j) Protection and relocation of underground infrastructure services;
 - k) Installation of new taxiway and apron edge lighting system (including new taxiway and apron edge lights, SITs, electrical pits and ducts);
 - l) Installation of new MAGs (including new signs, SITs, electrical pits and ducts)
 - m) Removal of an existing IWDI (including mast, lights and electrical pits) and Signal Circle;
 - n) Removal and relocation of existing apron flood light mast (including mast, lights and electrical pits);
 - o) Line marking; and
 - p) Regrading, topsoiling, hydromulching and spraying with bitumen emulsion beyond the edges of the taxiway and apron pavements where necessary to remove changes in level only as directed by the Superintendent with reclaimed or imported material or as indicated on the Drawings.

The various elements of the Works are particularised in the Drawings and the requirements concerning the Works are set out in the Specification. Where elements of the Works are not fully particularised or specified, the Contractor shall provide elements that are fit for the purposes for which they are required to the approval of the Superintendent.

1.2.2 Works To Be Undertaken By The Contractor

Without limiting requirements set out elsewhere in the Contract, the Contractor shall:

- a) Establish a Contractor's compound, by clearing the site, carrying out any other preparatory work, stripping off grass and topsoil where necessary, removing any debris and lawfully disposing of it off the airport;
- b) Do the setting out necessary to perform the work, including all associated survey work;
- c) Identify and protect existing services to the satisfaction of the Principal and all other relevant Authorities;
- d) Carry out and construct the Works in accordance with the Contract, removing all waste and lawfully disposing of it;
- e) Provide "as-built" records of the Works;
- f) On completion of the Works, remove all temporary facilities erected by the Contractor, and clear the site in general;
- g) Coordinate, supervise and manage all persons engaged in the execution of the Work under the Contract;
- h) Carry out all work incidental to the provision of the Works, being work that is not explicitly described in this Specification or shown on the Drawings but is necessary for the proper completion, or is a necessary prerequisite for the commencement, of work which is so described or shown; and
- i) Carry out all other work and do all that which the Contractor is or may be obliged by the terms of the Contract to undertake and to do.

1.2.3 As-Built Records

The Contractor shall establish and implement procedures to progressively record and document the as-built construction details of the Works.

Such procedures shall include identification and traceability of all drawing amendments during the source of the Works including changes to drawings issued for construction, cross referenced to relevant survey and records.

The Contractor shall carry out an accurate survey of each element of the Works that is not built in the location, or to the configuration shown in the Drawings authorised for construction (which include the Drawings, or drawings issued by the Principal replacing all or some of such Drawings, and include all drawings produced by the Contractor which have been duly reviewed as required by the Contract), and shall include in the as-built records drawings or sketches that fully document the results of such surveys.

Each lot or groups of lots of the Works shall be subject to assessment for compilation onto as-built records.

No part of any security held under the Contract shall be released until the Contractor has complied with its obligation to supply information in accordance with this Clause. If the Contractor fails to provide any of the required as-built records, the portion of the Contract Sum corresponding to the missing information shall not be paid to the Contractor. The Principal may engage others to obtain the missing information and, if the resulting cost to the Principal of engaging others to obtain the missing information exceeds the portion of the Contract Sum corresponding to the missing information, the cost in excess of that portion shall be a debt due from the Contractor to the Principal.

As-built records are to be supplied in a suitable electronic format as agreed with the Principal.

1.3 Work Arrangements

1.3.1 Staging of the Work

The Contract involves works on aircraft movement areas. Under Civil Aviation Safety Authority (CASA) requirements, such works are subject to restrictions as detailed in a Method of Working Plan (MOWP).

A draft MOWP for the work under the Contract is included in the Specification as **Appendix B**. The Works shall be completed in accordance with the stages detailed in the MOWP.

The MOWP forms part of the Contract and the Contractor shall comply with all requirements at all times. The Contractor agrees that the costs of such compliance have been allowed for in the Contract Sum.

The stages may be subject to adjustment to reflect actual starting dates, and progress achieved. The dates shown in the MOWP for each stage are notional. However, the extent of each stage and the sequence in which the stages are undertaken are fixed and are not subject to change.

Notwithstanding any date shown in the MOWP, works planned by the Contractor for a particular work period are subject to approval by the Superintendent. Approval or otherwise shall be based on operational considerations, including current NOTAMs on issue, and shall be communicated to the Contractor by the Superintendent.

Before completion of a stage detailed in the MOWP, the Contractor shall give the Superintendent a minimum of 48 hours notice for changing stages in accordance with the program. The Contractor shall also give at least 48 hours notice of any proposed changes to the agreed working hours and scheduled work periods, other than for cancellations due to weather or plant breakdown.

1.3.2 Movement of Plant and Equipment

The general requirements for the movement of plant and equipment are specified below, and the Contract Sum shall be deemed to include provision for these requirements:

- a) All vehicles, plant and personnel shall move via access routes designated by the Works Safety Officer for each stage of work;
- b) Vehicles and plant are prohibited from entering any part of the movement area available for aircraft use;
- c) Only vehicles and plant actually in use or required for the work in progress shall be permitted on the movement areas available to the Contractor for each stage of work;
- d) All instructions issued by the Works Safety Officer with regard to the safety of aircraft shall be complied with immediately; and
- e) All vehicles shall be fitted with flashing amber lights.

1.3.3 Maintenance

If any maintenance is required to be completed within the areas affected by the MOWP that forms part of this Contract, then the Contractor shall advise the Superintendent and obtain permission to commence such work. Should maintenance be required during the Defects Liability Period, operational restrictions will be applied to the Contractor's work to minimise disruption to aircraft operations. The conditions and restrictions that shall apply to such work will not necessarily be in accordance with the MOWP for this Contract. However, the additional cost from such conditions and restrictions imposed due to rectification of defects shall be borne by the Contractor.

1.3.4 Working Hours

In all stages, the works shall be carried out on the days of the week, and during the working hours as determined and mutually agreed between the Principal and the Contractor.

Unless otherwise agreed in writing by the Superintendent, there shall be no work carried out on site on Sundays, or Public Holidays.

1.3.5 Completion of Work

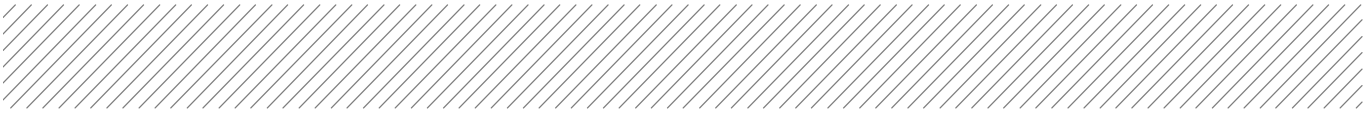
All portions of the movement area which have been affected by construction and/or trafficked by construction vehicles shall be cleaned and swept so that they are free from loose stones and debris to the satisfaction of the Works Safety Officer. The Contractor shall retain the necessary plant and personnel at the work site (including vacuum sweepers and bobcats), until the required cleanliness is achieved.

1.3.6 Airport Safety Provisions

The Contractor shall provide a full time Works Manager acceptable to the Principal, who shall be responsible for liaison with the Superintendent and the Works Safety Officers.

The Works Manager shall be responsible for ensuring that safety requirements relating to operation of aircraft at the aerodrome are complied with, and that any instructions issued by the Superintendent or Works Safety Officers are acted upon immediately.

Any member of the Contractor's workforce who disregards any instruction by the Works Safety Officers relating to safety of aircraft, may be refused further access to the work site.



Prior to commencement of work on site, all of the Contractor's personnel shall attend a briefing regarding security and safety arrangements and airside vehicle operations. The Superintendent shall conduct this briefing on site immediately prior to the first scheduled work shift. Further details of security/safety requirements shall be discussed with the Contractor's nominated Works Manager at the pre-start meeting.

1.3.7 Airport Security and Access

The work areas are located within the secure area of the aerodrome, and site security shall be maintained at all times.

Access to the site shall only be as determined and mutually agreed between the Principal and the Contractor, unless authorised by the Superintendent in writing. Only personnel with valid security passes shall be granted entry.

All of the Contractor's personnel (including truck drivers) entering the aerodrome shall be in possession of a valid security pass, and the pass shall be visible at all times. If any pass becomes lost, it shall be reported to the security provider immediately.

Any personnel without a valid security pass shall be denied entry to the site.

The costs associated with providing these access and security requirements shall be borne by the Contractor.

1.3.8 Existing Airport Light Fittings and Cabling

All electrical parts of the Works shall be of a high standard as required for safe operation of the equipment at the airport. The electrical work shall be carried out in a tradesman like manner, and (without limiting any other terms of the Contract) shall be in accordance with the requirements of this Specification, the SAA Wiring Rules AS 3000, and the requirements of MOS Part 139. Suitably qualified electrical tradesmen shall undertake all electrical work.

The execution of airport lighting work shall be under the immediate and constant supervision of the Contractor's supervising staff for airport lighting work, each of whom shall:

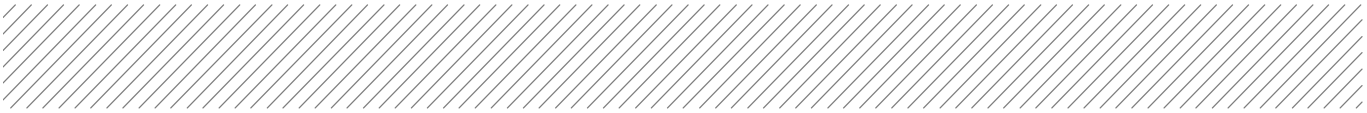
- a) Be a suitably qualified electrical engineer, electrical technician or electrical tradesman;
- b) Have completed an accredited airport lighting course or hold current qualifications acceptable to the Principal ; and
- c) Have experience in the installation of operational airport lighting acceptable to the Principal.

The Basic (5 day) Airport Lighting Course as run by Airways Training Services Pty Ltd (or equivalent) is the minimum accredited airport lighting training course acceptable to the Principal.

Existing airport light fittings within the works area may need to be removed and replaced by the Contractor during each work period, and shall be operational by the end of each work period or replaced by approved temporary lights. At least ½ hour prior to the end of the work period, the Contractor shall test that all lights are operational and shall notify the Works Safety Officer prior to the testing. This shall be a nominated **Witness Point** in the Project Quality Plan.

1.3.9 Marking of Unserviceable and Work Areas

The unserviceable and work areas shall be marked in every work period in accordance with MOS Part 139 Section 8.9.



The Contractor shall be responsible for the supply of all markers, cones, lights, unserviceability markings and any other markings required. These shall remain the property of the Principal, and at the completion of the project, all of the markers that have been supplied as part of the project shall be returned to the Works Safety Officer for retention.

The markers to be supplied by the Contractor shall comprise:

- a) A minimum 8 No. Unserviceability Markers (Closed Runway) – in accordance with MOS Part 139 Figure 8.9-1;
- b) A minimum 4 No. Vee bar markers for displaced threshold – in accordance with MOS Part 139 Figure 8.3-10;
- c) A suitable No. of Orange Works Limit Markers (Witches Hats) for marking access tracks from the Security Gate to the Contractor's compound and from the Contractor's compound to the works area – in accordance with MOS Part 139 Figure 8.2-1; and
- d) A suitable No. of Red and White (horizontal strip) Unserviceability Markers for marking closed taxiways or apron areas that are unfit for the movement of aircraft, however it is still possible for aircraft to bypass the area safely – in accordance with MOS Part 139 Figure 8.2-1.

The Contractor shall also supply appropriate lights in accordance with the requirements of MOS Part 139 Clause 9.19.2, together with portable battery operated lights to mark closed taxiways as directed by the Works Safety Officer.

The Contractor shall place all required markers, cones, lights, unserviceability markings, etc., at the commencement of the works, and remove them at the completion of the works, as directed by the Works Safety Officer

1.4 Site Arrangements

1.4.1 Contractor's Site Establishment, Compound, Plant and Equipment

The Contractor's compound and any other site establishment required for this Contract shall be in the location shown on the MOWP. All plant, equipment and materials shall be located within this area, or in any other areas that are approved by the Superintendent. Relocation of plant, equipment and materials during execution of the works shall be the Contractor's responsibility and at the Contractor's expense.

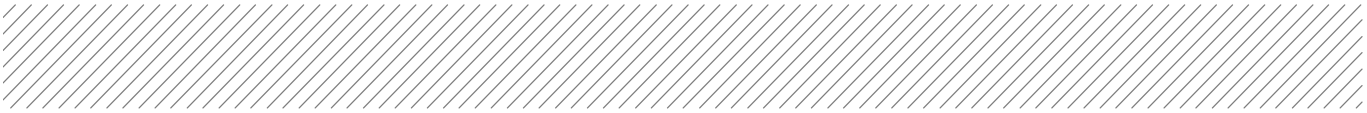
All fuels, oils and chemicals shall be stored in appropriate bunded compounds within the site compound.

When no longer required for the works of the Contract, unless otherwise permitted by the Superintendent, the Contractor shall remove from the compound area all buildings, plant, equipment, materials and rubbish. Unless otherwise approved, the Contractor shall return the area to a condition at least equivalent to that existing before occupation.

Cleaning up of the site shall be a condition precedent to the issue of the Certificate of Practical Completion.

1.4.2 Site Control

Except as otherwise provided in the Contract, delivery of materials to the site, space for storage of such materials and for building sheds, offices, workshops and other temporary structures shall be



allowed only in accordance with arrangements entered into between the Contractor and the Superintendent.

No new roads or tracks shall be formed, existing roads and tracks altered, fences, water, sewerage or power lines cut or any other thing done that may effect the environment to a significant extent without the prior approval of the Superintendent.

No fires shall be lit on the site without the prior approval of the Superintendent.

1.4.3 Access

The points of entry and routes of travel to each work site area are as described in the MOWP and as agreed to prior to commencement of the works. All airside access routes shall be marked with high visibility reflective cones supplied by the Contractor.

Only vehicles, plant, equipment, materials and personnel actually engaged on the Works shall be permitted on the movement area. Such vehicles, plant and equipment shall be clearly marked with the name of the Contractor or Sub-contractor. Vehicles owned by the Contractor or Sub-contractors that are not required to undertake the physical works on site shall be parked in locations directed by the Superintendent.

Personnel associated with the Works are not to enter the movement area, whether on foot or while operating vehicles or plant, unless authorised by the Works Safety Officer.

When authorised to enter the movement area, all personnel shall:

- a) Follow access routes designated by the Works Safety Officer;
- b) Comply with any further instructions issued by the Works Safety Officer;
- c) Give way to and not impede the movement of aircraft;
- d) Not cross the path of a moving aircraft; and
- e) Not operate a vehicle within 15 m of an aircraft unless specifically authorised by the Works Safety Officer to do so.

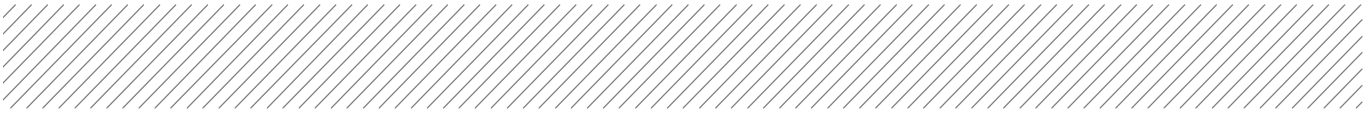
Vehicles, plant, equipment and personnel shall not move beyond the limits of each defined work area unless directed to do so by the Works Safety Officer.

1.4.4 Haul Roads and Access Tracks

Access is required for fire drill, aerodrome emergency procedures, aerodrome operational staff and other Contractors at all times. The Contractor shall protect haul roads, access tracks and adjacent areas from damage. Prior to commencement of physical works on site, the Contractor and Superintendent shall conduct a joint inspection of existing haul roads and access tracks and record their condition. Any damage occurring shall be repaired at the Contractor's expense. Fair wear and tear shall be exempt.

The Contractor shall be responsible for routine maintenance of the haul roads and access tracks.

All care shall be taken to keep all aircraft movement areas, roads and tracks free from loose material and rubbish during the Contract as directed by the Superintendent. The Contractor shall provide appropriate equipment to respond to any request by the Superintendent or a Works Safety Officer to clean an area of pavement. The Contractor shall provide a vacuum sweeper to clean all areas of pavement at the completion of a work stage. Washing shall also be employed as necessary to achieve a standard of cleanliness to the reasonable satisfaction of the Superintendent or Works Safety Officer,



as the case may be. The cost of complying with this Clause shall be deemed to be included in the Contract Sum.

A maximum speed limit of 15 km/h shall apply on the aerodrome.

1.4.5 Maintenance of Pavements

Prior to commencement on Site, the Contractor shall prepare a Dilapidation Report, including survey and photographic evidence of the existing condition of all existing roads within the movement area boundary and site access roads which are to proposed to be used by the Contractor for the duration of the Works. The Contractor shall submit three copies of the Dilapidation Report to the Superintendent and shall maintain a copy of the Dilapidation Report on Site. Submission of the Dilapidation Report shall constitute a **Hold Point**.

All active aircraft pavements affected by work under the Contract shall be kept clean at all times. All non-active aircraft pavements shall be cleaned at the end of each shift or work period.

All aircraft pavements used by the Contractor shall be cleaned of any material deposited on the surface by hosing, sweeping or any other method. Non-soluble materials shall not be washed into any drainage system. Any spilt hazardous material shall be removed immediately. The Contractor shall clean pavements progressively if instructed to do so by the Superintendent or Works Safety Officers.

The surface of all construction haul roads shall be maintained by the Contractor in such a manner to prevent carrying of foreign materials onto aircraft pavements.

All existing roads within the aerodrome and site access roads which are used by the Contractor shall be maintained in good repair and a clean condition, free from dust and debris by sweeping and watering as required.

Any damage to existing pavements caused by the Contractor's use of such pavements shall be reported immediately to the Superintendent and shall be repaired to original condition by the Contractor. All repair work to active aircraft pavements and roads shall be completed expeditiously by the Contractor to the satisfaction of the Superintendent.

1.4.6 Dust Control

The aerodrome stakeholders, adjoining owners, residents and the public shall be protected against dust, dirt and water nuisance. Dust screens and/or watering shall be used where necessary to control dust as directed by the Superintendent.

1.4.7 Trucking

No motor vehicle shall travel to or leave the site laden with any material unless it is loaded in a manner that shall prevent the discharge or dropping of any of the materials. No motor vehicle shall not be loaded above the maximum legal mass limit appropriate for the type of vehicle.

The Contractor shall ensure that the wheels, tracks and body of all construction plant entering or leaving the site and entering any aircraft movement areas are free of mud and debris.

1.4.8 Foreign Object Debris (FOD)

All personnel on site are to monitor the area for Foreign Object Debris (FOD). FOD is any loose item that could be ingested into a jet engine or blown in such a manner which would potentially cause damage to aircraft. Any FOD items should be removed immediately from aprons, taxiways and runways.



1.4.9 Work by Others

It may be necessary for aerodrome operations staff, Council staff and/or their Contractors, and others to enter the site periodically during the currency of this Contract to carry out other works which are not part of this Contract

The Contractor shall afford all reasonable facilities during progress of the works to Council and aerodrome personnel, stakeholders and other Contractors carrying out other works in the area. The Contractor shall allow them all reasonable access required to carry out their work and shall confer with them regarding connections between their work and that of this Contract and where necessary attend meetings for co-ordination of work.

1.4.10 Existing Structures and Services

The Contractor shall notify the Superintendent of any connection, disconnection or interference with existing structures and services other than those shown on the Drawings, including electrical cables and survey marks.

1.4.11 Damage to Services

The Contractor shall contact the Superintendent before commencing work on the site and shall inspect the location of all services in the presence of the Superintendent. The Contractor shall immediately notify the Superintendent in the event of damage to any water, electric, drainage, sewerage, telephone, fire alarm, control cable or other services in the area.

Where a service is identified in the Contract or is evident on the site or has been pointed out by the Superintendent, the Contractor shall be responsible for the cost of any necessary protection and repairs to that service. Refer to **Section 4** and **Clause 5.5.3** for further details regarding demolition of existing infrastructure.

1.4.12 Joining Up

Where the method of joining up of old and new is not otherwise specified, the cutting away and joining up shall be carried out in a manner approved by the Superintendent and made good in all trades to match existing adjacent work.

1.4.13 Survey Marks

The Contractor shall protect all survey marks from damage.

1.4.14 Approvals and Fees

The Contractor shall be responsible for obtaining all necessary approvals from Local Government, State Government and Statutory Authorities and for paying all fees in relation to all aspects of the works, except as otherwise specified in the Contract.

1.4.15 Light and Power

The Contractor shall install at the Contractor's expense any temporary electric light and power installations required and shall pay all fees and charges in connection therewith.



1.4.16 Water

The Contractor may be permitted to obtain water from a Council supply point as determined and mutually agreed between the Principal and the Contractor.

The Contractor will be required to obtain relevant approval from the water supply authority to use the supply point, subject to such conditions and costs as determined by the water supply authority. The Contractor may store water on site at the Contractor's expense.

1.4.17 Sanitary Facilities

Access to public toilets is not available from the work site. The Contractor shall provide portable facilities, which are to be located at the Contractor's compound or other approved locations. Portable sanitary facilities shall be serviced and cleaned at regular intervals and at least once a week.

1.4.18 Safety Precautions

As well as safety precautions related to the operation of aircraft, the Contractor shall observe all statutory requirements relating to storage, transport, use of materials, explosives, fire precautions in arc or flame cutting, flame heating and arc or gas welding operations, plant and equipment, work processes and safety precautions.

The Contractor shall ensure that all oxyacetylene cutting equipment is fitted with spark arrester components and shall comply with all the relevant safety standards. Electric welding is not to take place until all areas are protected from sparks and all fire prevention measures have been undertaken.

The Contractor shall not at any time use or cause to be used any explosives, arc or flame cutting, flame heating, or arc or gas welding equipment at the work site or in the Contractor's compound without the approval of the Superintendent. If approval is granted, the Contractor shall ensure that proper precautions and proper care are taken in respect of such explosives or equipment.

1.4.19 Access for Visitors

The Superintendent may, after consultation with the Contractor and subject to any arrangements made between the Principal and the Contractor in that behalf, take any visitor on the site.

1.5 Project Management

1.5.1 Site Meetings

The Contractor shall be required to attend regular site meetings which could be convened on a daily basis or at any other time set down by the Superintendent.

The purpose of such meetings is to discuss progress of the Works, matters pertaining to quality, cost and any other items relevant to the orderly progress of the Works. During construction of the Works, brief informal meetings shall be held just prior to and at the completion of each work period to discuss scheduling of aircraft movements and their likely impact on the Works, and any other operational or technical matters.



1.6 OHS Arrangements

1.6.1 General

The Contractor must comply with and ensure that its employees, subcontractors and agents comply with any Acts, regulations, local laws and by-laws, Codes of Practice, Australian Standards and the Principal's OHS policy and procedures which are in any way applicable to this Work or the performance of the services under the contract.

The Contractor is obligated to provide and maintain, so far as is practicable, a working environment for its employees and members of the public, that is safe and without risk to health. Any Subcontractors that may be engaged to perform a service on the Contractor's behalf will at all times identify and exercise all necessary precautions for the OHS of all persons including Contractor employees, the Principals employees and members of the public who may be affected by the services.

The Contractor must inform itself of all OHS policies, procedures or measures implemented or adopted by the Principal. The Contractor must comply with all such policies, procedures or measures; and in the event of any inconsistency, must comply with such procedures or measures as will produce the highest level of OHS.

1.6.2 OHS Management System

The Contractor's OHS management system must as a minimum requirement demonstrate compliance with all duties of an employer specified in the OHS Act. The Contractor must when requested by the Principal submit a complete copy of their OHS management system documentation which must include as a minimum requirement:

- a) OHS Policy and objectives;
- b) The organisational structure and responsibilities;
- c) Safe work practices and procedures;
- d) OHS training and induction;
- e) OHS auditing and inspection procedures;
- f) OHS consultation procedures; and
- g) OHS performance monitoring.

1.7 Witness Points and Hold Points

The following **Hold Point** (refer to **Section 2.1.3**) shall be incorporated in the Project Quality Plan:

- a) Provision of Dilapidation Report (**Clause 1.4.5**).

2. Quality Assurance

2.1 General

2.1.1 Scope

This Section of the Specification covers the Quality Assurance requirements for the Works.

The purpose of Quality Assurance in the context of this project is to:

- a) Provide the Principal with assurance that the quality of the product will be in accordance with the Contractual requirements.
- b) Place on the Contractor the responsibility for achieving the required quality and then demonstrating that it has been provided.

2.1.2 Referenced Documents

The following documents which are referenced in this Section, form part of this Specification only to the extent that they are referred to herein:

Standards Association of Australia

- AS/NZS ISO 9001:2000 Quality Management Systems - Requirements.

2.1.3 Definitions

The following definitions must be used for this project.

Lot - For the purpose of this Contract, a lot is an essentially homogeneous section of the Works, the limits of which will be chosen by the Contractor, but subject to the approval of the Superintendent (see also **Clause 2.2.9** in this Section of the specification).

Hold Point - For the purpose of this Contract, a Hold Point is a point defined in an appropriate Section of the Specification, beyond which an activity must not proceed without the approval of a designated organisation or authority. The approval to proceed beyond a Hold Point is given usually in written form, but it may be given by any other agreed system of authorisation.

For the purposes of this Contract, Hold Points will apply at the points defined in the approved Project Quality Plan, and also at any point at which a non-conformance is detected.

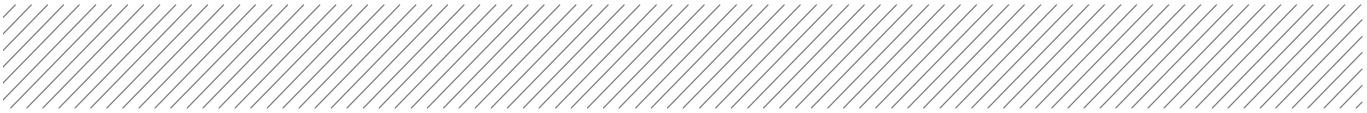
Witness Point - A Witness Point is a point at which the Superintendent may review, inspect or test the works.

2.2 Quality System

2.2.1 General

The Contractor must plan, establish, implement and maintain a Quality Management System for the works to meet the requirements of AS/NZS ISO 9001, and in accordance with the requirements of this Section of the Specification.

The Contractor must undertake and bear all costs of all independent and internal inspections and testing, surveillance of all manufacturing, construction and commissioning processes, and quality system audits.



The Principal may, at the Principal's discretion, carry out audits and surveillance as deemed necessary.

2.2.2 Project Quality Plan

The Contractor must prepare a Project Quality Plan for the Works and submit it to the Superintendent for approval within seven calendar days from the date of award of the Contract. The Project Quality Plan must cover all of the works under the Contract (both on-site and off-site) and must include:

- a) Contractor's organisation and management responsibilities;
- b) Inspection and Test Plans (ITPs);
- c) Hold Points and Witness Points;
- d) Planned audits; and
- e) A schedule and program of all quality documentation to be prepared during the progress of the Works.

Within three days of approval of any part of the Project Quality Plan by the Superintendent, the Contractor must submit three controlled copies to the Superintendent for retention.

2.2.3 Changes to the Project Quality Plan

The Contractor may make changes to the Project Quality Plan at any time. However, where the changes affect the Work either directly or indirectly, the proposed changes must be subject to the prior written approval of the Superintendent.

The Contractor must immediately implement changes to the Quality System upon receipt or issue of a Nonconformance Report or Corrective Action Request against any aspect of the work, or if the Contractor determines that the existing Project Quality Plan:

- a) Is causing non-conformance;
- b) Has to be changed as a result of an audit;
- c) No longer represents the Contractor's current or appropriate practice; or
- d) Does not address the needs of the Contract.

Any change to the Project Quality Plan must be subject to the change complying with the following requirements:

- a) The change does not cause the Works to be constructed to a lower standard than specified in the Contract;
- b) The change does not include any increase in payment by the Principal to the Contractor or others;
- c) Approval of the change does not incur any liability for the Superintendent or the Principal for any consequences of the change; and
- d) The change can be implemented without any disruption to the Work under the Contract.

The Contractor must remove all superseded documents and modify all relevant procedures and the ITPs and must replace them with the new documents and procedures.



2.2.4 Sub-Contractors' and Supplier's Quality Plans

The Contractor must specify on all purchasing documents, subcontracts or contract-related documents the relevant Quality System standard and audit provisions for all subcontract works. Such works include the supply of materials, material testing, off-site works, off-site material production or manufacture/construction involving output from established factories.

Subcontractors undertaking construction works or material fabrication must prepare ITPs for the work concerned. Should the Subcontractors not be able to provide satisfactory ITPs and the appropriate procedures, the Contractor must ensure that the Contractor's ITPs incorporate the necessary **Hold Points** to ensure that the specified requirements are met.

The Contractor must establish and maintain a register of subcontracts and all significant material suppliers describing details of the subcontract including the scope of works of each subcontract or supply agreement, the quality system specified and the Subcontractor's Quality Representative.

A copy of the Subcontract Register is to be submitted to the Superintendent as updates occur.

The Contractor must establish and maintain a procurement program for Subcontractors and significant material suppliers to include at least dates for award, commencement, submission of quality system documents, samples and delivery.

2.2.5 Quality Records

(a) General

Quality records must include the results of any system and product audits, tests, observations or measurements, including any relevant calculations or analyses

The Contractor must keep on site copies or originals of all project documentation. Such documentation must include all relevant Codes of Practice and Standards referred to in the Specification or required to construct, or to test any part of the Works

(b) Forms

All compliance tests/measurements/observations, test results, calculations and analyses must be reported on forms prepared by the Contractor as part of the Project Quality Plan to include at least the following:

- a) Unique identification number;
- b) The date (including the date of sampling);
- c) The lot number;
- d) The lot description;
- e) The type of test;
- f) The three dimensional location of the test;
- g) A clear and logical tabulation of results, calculations and analyses;
- h) A comparison of actual test results with the specified values;
- i) An indication of compliance or non-compliance; and
- j) The signature of an authorised representative of the Contractor.



(c) Retention of Records

The Contractor must retain all primary records in accordance with the Contractor's Project Quality Plan, statutory requirements, and the Contract. These documents must be handed over to the Superintendent in an agreed format at the completion of the Works. The records must be retained and made available to the Contractor for updating as necessary as a result of any work performed by the Contractor during the Defects Liability Period.

The handing over of these documents must be a condition precedent to the issue of a certificate of practical completion. For the purpose of the Contract, primary records must include at least:

- a) All conformance and nonconformance reports;
- b) All monitoring and testing results, analyses, reports, measurements and observations; and
- c) The original Project Quality Plan and any changes made to it.

(d) Conformance Reports

Conformance data must be entered in the record system daily as soon as possible after compliance testing has been completed.

Conformance reports must be prepared and recorded prior to any Progress Claim. Each conformance report must be signed by the Contractor's Quality Representative and must include a statement in the following form:

"On behalf of (Contractor) it is hereby certified that the Works represented by the items of work listed have been tested in accordance with the Project Quality Plan and conform in all respects with the requirements of the Contract."

Where work is to be covered up after conformance has been actioned, preparation of the conformance report prior to covering up must constitute a **Hold Point**.

(e) Nonconformance Reports

All nonconformance reports and records must be submitted to the Superintendent as soon as practicable and within one working day of the nonconformance being recognised.

2.2.6 Quality Audits

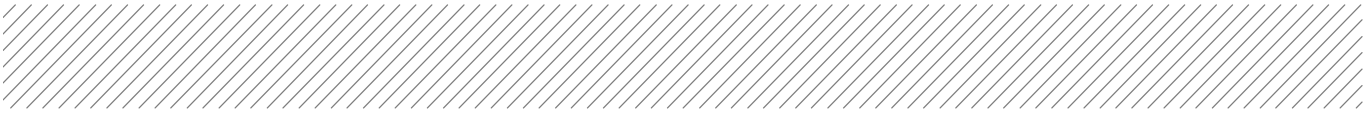
(a) Contractors Quality Audits

The Contractor (and Sub-Contractors and Suppliers) must undertake quality audits in accordance with the approved Project Quality Plan.

(b) Principal's Quality Audits

The Superintendent and/or any other authorised representative of the Principal may at any time, and from time to time, be entitled to conduct such audits of the Contractor's Works and Quality System including the works and quality systems of Subcontractors as are considered necessary. The Contractor must provide assistance to the Principal's Representative in the conduct of such audits, including access to all documentation and test records.

The cost of additional testing associated with audits conducted by the Principal's Representative must be borne by the Principal.



Auditing may take one or a combination of the following forms:

- a) A check on whether the Contractor is complying with the requirements of the Quality System;
- b) A check on the Contractor's individual procedures, records and/or calculations;
- c) A continuous check on the Contractor's processes; and/or
- d) A program of independent compliance inspections of any number of lots in accordance with the procedures in the Specification.

If the Superintendent or Principal's Representative detects any deficiency or deviation in the Contractor's Quality System, the Contractor must immediately rectify the Quality System in compliance with the requirements of **Clause 2.2.3**.

If the deficiency or deviation has caused a nonconformance, the Contractor must immediately submit a nonconformance report and comply with the requirements of **Clause 2.2.7**.

Where an audit detects any errors, deficiencies or deviations in any procedure, record, test, calculation, analysis or report, the procedure, record, test calculation, analysis or report must be immediately corrected. If the correction of an error, deficiency or deviation generates a nonconformance, the Contractor must immediately submit a nonconformance report and comply with the requirements of **Clause 2.2.7**.

If, in the opinion of the Superintendent, any process, procedure, test method, calculation, analysis or report has resulted or will result in a serious nonconformance, then the Superintendent may direct the Contractor in writing to stop the work or operation concerned. The Contractor must immediately carry out any corrective or remedial action.

2.2.7 Conforming and Nonconforming Materials and Work

(a) Nonconforming Materials and Work

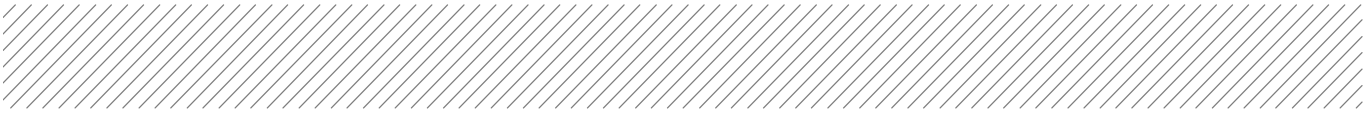
Any nonconforming Works detected by personnel of either the Contractor or the Superintendent must be reported to the Contractors Quality Representative, through a Nonconformance Report or a Corrective Action Request. The Contractor must also immediately submit a Nonconformance Report if the Superintendent advises the Contractor, in writing, of nonconformance with a process or a specification requirement.

All nonconforming Works detected by the Contractor's Quality System must be reported to the Superintendent as soon as practicable and within one working day of the nonconformance being recognised using a Nonconformance Report. Nonconformance Reports and Corrective Action Requests must be submitted with all records that indicate a departure from the requirements of the Contract.

The submission of a Nonconformance Report must constitute a **Hold Point**, and a **Witness Point** must apply prior to covering up rectification work.

The Contractor must advise the Superintendent in each Nonconformance Report the proposed disposition of the nonconformity and the corrective action to prevent the recurrence of the nonconformance. The proposed disposition must include one of the following:

- a) Proposed additional works to bring the lot up to the specified standard;
- b) Replacement of all and/or part of the lot to bring it up to the specified standard; or

- 
- c) Request for the utilisation of the nonconforming work when it is demonstrated to the satisfaction of the Superintendent that the work is satisfactory for its intended use.

All of the above options must be subject to approval by the Superintendent. In Options (a) and (b) after approval by the Superintendent of the proposed disposition, the reworked/replaced lot must be subject to verification in the Project Quality Plan.

Unless the Superintendent has granted approval otherwise, nonconforming materials or work must be repaired, or must be removed and replaced with conforming materials or work.

The Contractor must provide and keep updated a Nonconformance Register containing copies of all Nonconformance Reports and the current disposition status. The Contractor must each week review the Nonconformance Register and submit an updated copy to the Superintendent.

(b) Progress Payment for Conforming Work

Progress payments under the provision of the General Conditions of Contract will only be made for those lots of the Works for which a Conformance Report has been prepared and recorded under the provisions of **Clause 2.2.5**.

2.2.8 Design

The Contractor must provide design and development verification for the following:

- a) Temporary works for construction purposes; and
- b) Any alternative designs proposed by the Contractor and accepted by the Superintendent for the permanent works

2.2.9 Identification and Traceability

(a) Identification by Lot

Earthworks and pavement construction works must be identified by lots. All other items of work must be identified by the most appropriate method. Unless specified otherwise, a "Lot" also includes any "item of work" not divided into lots.

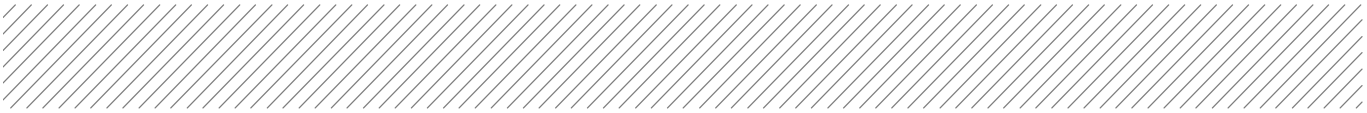
The Contractor must identify all samples and test results with accurate field locations and lots to which they relate.

If, prior to commencement or during construction of a lot, discrete portions of the lot are identified which are visually non-homogeneous and/or non-representative of the lot, the portions concerned must be excluded by the Contractor from the lot and each excluded portion treated as a separate lot.

The Superintendent must have the right at any time to determine if any lot is essentially homogeneous, non-homogeneous or non-representative and/or direct that discrete portions of a lot be treated as a separate lot, without additional cost to the Principal.

For the purposes of this Contract, essentially homogeneous must be taken to mean a lot or a section of the work where there is no variation due to assignable causes.

Where the term "homogeneous lot" or "homogeneous section of the work" appears elsewhere in the Contract it must be taken to mean "essentially homogeneous lot" or "an essentially homogeneous section of work".



Unless otherwise approved in writing by the Superintendent, the depth of lots for pavement works must be limited to the depth of a single layer placed for compaction purposes.

(b) Lot Numbering

Each lot must be given a lot number. The allocation of lot numbers must be carried out by the Contractor to suit the circumstances of construction. The lot number must be entered into a register that provides at least the following information:

- a) The three dimensional surveyed location of the lot (chainage of the start and finish points, lateral location and layer location) and/or the particular facility (e.g. Runway name);
- b) An indication of conformance or non-conformance;
- c) The replacement lot numbers for nonconforming lots;
- d) A summary of test results (e.g. characteristic value); and
- e) The location of detailed test results (form number, file number).

A nonconforming lot which is reworked and resubmitted for compliance testing or which has been subject to a fresh compliance testing program or which has been subdivided into smaller lots for rework and/or a fresh compliance testing program must retain its original lot identification number. A new number, or numbers, must be allocated to the reworked/resubmitted/subdivided lot(s).

Details of the lot numbering system must be included in the Contractor's Inspection and Test Plans.

Similar records must be maintained for all items of work not divided into lots.

(c) Field Identification

To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor must implement a field identification system that must clearly identify the bounds of each lot and the lot number.

2.2.10 Inspection and Testing

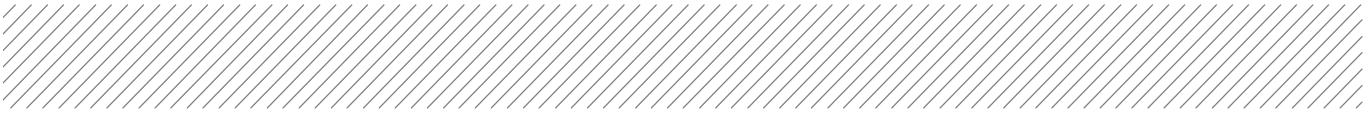
(a) Inspection and Test Plans

The Contractor must set up an appropriate regime of inspection and testing of the Works as well as the works of Subcontractors.

The Contractor must develop ITPs to cover all activities and components that are necessary to complete the Works. ITPs must include for the documentation and recording of sufficient test and inspections to ensure that the Works comply with the Contract.

ITPs must include the following information:

- a) Who carries out the inspection or test;
- b) The method of inspection or test;
- c) The specified acceptance criteria;
- d) The form of record of results;
- e) The frequency and timing of the tests;
- f) Details of what is to be inspected;

- 
- g) Details of Witness Points;
 - h) Details of Hold Points; and
 - i) Details of audits to be carried out by the Contractor's quality assurance team.

(b) Sampling

Inspection and Test Procedures must detail sampling methods and/or plans. Unless specified otherwise random sampling procedures must be used.

(c) Testing

All conformance testing must be based on lots at the frequency detailed in the relevant sections of the Specification.

2.2.11 Witness Points and Hold Points

The Contractor's Project Quality Plan must nominate Witness Points and Hold Points. The Contractor must establish notification procedures acceptable to the Superintendent to allow inspection of the work at each Witness Point and each Hold Point.

The Contractor must not proceed beyond a Witness Point or a Hold Point without the written concurrence of the Superintendent or the Superintendent's Representative in the form of signature on a suitable form provided by the Contractor.

Further, the Contractor must not proceed beyond a Hold Point unless the Contractor, or the Contractor's Quality Representative, certifies compliance with the following conditions:

- a) All underlying lot(s) and any adjacent lot(s) affected by the lot in question are conforming;
- b) All conformance reports for any underlying lot(s) or any adjacent lot(s) affected by the lot in question have been submitted; and
- c) The proposed dispositions and corrective actions related to all nonconformances for any underlying lot(s) or any adjacent lot(s) affected by the lot in question have been approved by the Superintendent.

The signature of the Superintendent must not constitute verification, acceptance or approval of the works completed at the Witness Point or the Hold Point. The quality of the Works must remain the responsibility of the Contractor as provided elsewhere in the Contract.

Witness Points and Hold Points must include, but not be limited to those detailed in other Sections of the Specification.

The following **Witness Points** must be incorporated in the Project Quality Plan:

- a) Prior to covering up rectification work (**Clause 2.2.7(a)**).

The following **Hold Points** must be incorporated in the Project Quality Plan

- a) Preparation of the conformance report prior to covering up (**Clause 2.2.5(a)**); and
- b) Submission of a Nonconformance Report (**Clause 2.2.7(a)**).



2.2.12 Records of Contractor's Quality System

(a) General

All records must be stored and maintained such that they are retrievable in facilities that provide a suitable environment to prevent deterioration or damage, and to prevent loss.

The Contractor's records procedures must ensure that all contract records are duplicated and second copies are stored separately from the first copy for fire protection and loss prevention purposes. One set of records may be held by the Superintendent or a Subcontractor provided such records are notified and recorded as such.

All records must be properly and clearly indexed and filed. Updated copies of the Contractor's file index must be copied to the Superintendent.

The record system must contain at least the following:

- a) Records of ITPs;
- b) Records of nonconformances;
- c) Records of corrective and preventive actions;
- d) Records of audits;
- e) Original records of certification and approvals by statutory authorities;
- f) Certificates and warranties of manufacturers and suppliers;
- g) Material quality records and analyses; and
- h) Records of surveys.

The Contractor must make all records available to the Superintendent at all reasonable times. Where requested by the Superintendent, the Contractor must permit the Superintendent to copy all records.

3. Environmental Management

3.1 General

This Section of the Specification defines the environmental management requirements for the Works.

3.1.1 Reference Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein.

Acts of Parliament, Regulations and State Environmental Protection Policies

- Airport Act 1996
- Airport (Environmental Protection) Regulation 1997
- Environmental Protection Authority (EPA)
- Environment Protection Act 1970
- Catchment and Land Protection Act 1994
- Environmental Guidelines for Major Construction Sites
- Noise Control Guidelines
- Construction Techniques for Sediment Pollution Control
- Reducing Stormwater Pollution from Construction Sites
- Guidelines for Environmental Management – Spraying Bituminous Materials 2002

3.1.2 Definitions

The following definition shall be used for this project:

Contaminants are defined as inert wastes, putrescible wastes, prescribed wastes and heavy metals, hydrocarbons or other toxic chemicals.

3.2 Site Environmental Management Plan

The Contractor shall be responsible for the management of the environmental effects of the Work. Within 14 calendar days of the Date of Acceptance of Tender, the Contractor shall submit a Site Environmental Management Plan (SEMP) to the Superintendent for approval. The plan is to be a written report identifying environmental risks associated with the works and shall address possible environmental impacts and detail procedures to prevent or mitigate such impacts as far as possible.

The SEMP shall comply with the requirements of the Airports Act 1996, Airports (Environment Protection) Regulations 1997, Environmental Protection Authority's "Catchment and Land Protection Act 1994", the "Environmental Protection Act 1970", other Acts of Parliament, Regulations and State Environmental Protection Policies. In addition the Contractor shall abide by all Ordinances, By-laws and any specific requirements of the responsible authorities for the administration of these Acts, Regulations, Ordinances and By-Laws. All environmental measures must take into account affected surrounding infrastructure.

Submission of the SEMP shall constitute a **Hold Point**.

3.3 Scope of the Site Environmental Management Plan

The Site Environmental Management Plan (SEMP) must:

- a) State the objective of the SEMP;
- b) List personnel responsible for the SEMP and contact details;
- c) List all regulatory requirements;
- d) List activities to be performed during the project, evaluation of environmental risk and identification of activities that require environmental management; and
- e) Provide a detailed program within the SEMP listing all issues (as well as any other environmental matters identified by the Contractor) and the time frame in which all of the issues will be addressed.

3.3.1 Traffic Management

The Contractor shall ensure that all construction vehicles are well maintained. All loads shall be covered, and the Contractor shall minimise the number of deliveries at night. Vehicles using public roads at night shall be fitted with residential grade mufflers and be in good running order so as to minimise disturbance. Roads shall be dampened to minimise the generation of dust if directed by the Principal's Representative.

New roads or tracks on the airport shall only be constructed after written approval is provided by the Principal's Representative.

3.3.2 Storage on Site

The Contractor shall store materials and equipment on Site so as to prevent damage to the Site and minimise hazards to persons, materials and equipment. The Contractor must keep storage areas in a neat and tidy manner. All materials are to be stored only on the land of which the Contractor has possession for the execution of the Contract. Where required an appropriate bunded surface shall be provided.

At the completion of the Works, storage facilities shall be removed, or disposed of, and the area rehabilitated to not less than the pre-existing condition by the Contractor.

3.3.3 Noise and Vibration

The Contractor shall comply with the Schedule 4 of the Airport (Environment Protection) Regulations 1997 and the Environmental Protection Authority's noise control guidelines.

To comply with these guidelines, all plant and equipment supplied by the Contractor for use on the Works between the hours of 0700 and 1800 weekdays and 0900 and 1800 weekends and public holidays, may be required to effectively 'sound-reduced' by means of silencers, mufflers, acoustic linings, shields, acoustic sheds or screens.

The Contractor shall take all reasonable and necessary precautions to protect services, structures and other property susceptible to damage from vibration.



3.3.4 Suppression of Dust

The Contractor shall take measures necessary to keep airborne dust to a minimum and shall comply with the requirements of Schedule 1 to the Airports (Environmental Protection) Regulations 1997. No separate payment will be made for the suppression of dust.

If the Contractor fails to achieve adequate dust control, particularly where the safety and convenience of aircraft and the public are affected, the Superintendent may take any action necessary and deduct the cost of such action from moneys due or becoming due to the Contractor.

The Superintendent may direct the suspension of work at any time where that work creates a dust hazard or nuisance to aircraft, the public, personnel working on the site, or property in the vicinity of the Work. Where the Superintendent has directed a suspension of work and considers that the Contractor could not have been expected to have adequately controlled the dust, the Superintendent may consider an extension of time pursuant to the General Conditions of Contract. No claim for increased costs due to such suspension will be considered.

3.3.5 Site Cleanliness and Disposal of Refuse

The Contractor shall maintain a high standard of housekeeping and site cleanliness during the course of the Works. The Contractor shall, on a regular and frequent basis, remove from the Site all refuse resulting from work under the Contract. Materials lost overboard from the Contractor's transit vehicles shall be cleaned up to the satisfaction of the Superintendent and any local authorities.

3.3.6 Disposal of Contaminants

In the event that contaminated soil or other contaminants are encountered during the course of the Works, the Contractor shall properly dispose of contaminants from the Site in accordance with all statutory and contractual requirements to approved locations or as otherwise directed by the Superintendent.

3.3.7 Installed Equipment

The Contractor shall protect installed equipment against damage by dust, dirt, shock or other causes.

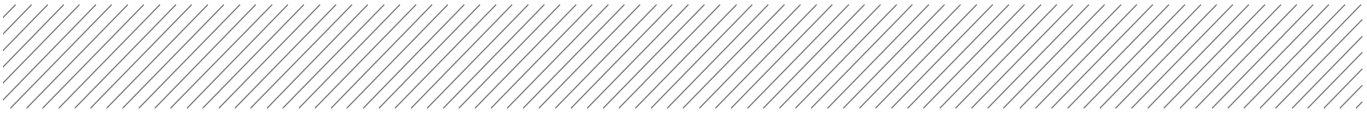
3.3.8 Construction Drainage and Stormwater Management

The Contractor shall provide and construct such drains and take such other precautions as are necessary to protect the Works from damage due to the flow or collection of water and to prevent the ponding of water on or in any of the Works to be done under the Contract.

The Contractor shall, at the Contractor's expense, make provision for the discharge and treatment of any water, whether foul or discoloured, or otherwise contaminated from the Works, including suitable settling ponds where appropriate, and shall exercise due care to prevent the fouling of watercourses. All such discharge and treatment shall be to the satisfaction of the Superintendent and to any persons having rights over the land and watercourses over or on which such water is discharged.

The Contractor shall not interrupt or interfere with the natural flow or open drains on the Site without the written approval of the Superintendent. The Contractor is to provide details in writing of any coffer dams or by-passes necessary to control water during construction for approval by the Superintendent prior to construction.

In locations where the disposal of water by gravity is not possible, the Contractor shall dispose of the water using adequate pumping equipment.



Such disposal of water shall take account of, and not adversely affect adjacent land and the Principal's existing operations on the Site.

3.3.9 Storage and Treatment of Hazardous Chemicals

Where chemicals or fuel are stored on Site, the storage area shall be protected by bunds of sufficient size to retain any potential spillage. A contingency plan shall also be included as part of the SEMP to contain, treat and dispose of any spill.

3.3.10 Fire Prevention

The Contractor shall provide and maintain adequate fire-fighting equipment and take adequate fire precaution measures during the construction of the Works and shall take action to prevent the damage to or destruction by fire of trees, shrubs or grasses in and surrounding the area of the Works. The Contractor shall comply with all statutory provisions that may be in force from time to time in relation to bush fire danger and to restrictions on the lighting of fires in the open.

3.3.11 Erosion Control

The Contractor must take such steps as are necessary to prevent the erosion of any lands used or occupied for the execution of the Works under the Contract, and must follow the relevant State and Commonwealth guidelines with respect to soil erosion and soil conservation.

Areas likely to be eroded such as exposed batters must be protected by temporary surface coverings as necessary, or by vegetation or other rehabilitation means as soon as practicable.

3.3.12 Sediment Control

The Contractor must take steps to ensure that stormwater drains in close proximity to the Works site are adequately protected from contamination with sediment suitable techniques include construction of sediment control fences and comply with any additional requirements of the Principal's Construction Environmental Management Plan (CEMP). The CEMP shall contain provisions greater than or equal to those outlined by NSW Government "The Blue Book - Managing Urban Stormwater (MUS): Soils and Construction" (July 2006).

3.3.13 Acid Sulphate Soils

The Contractor shall determine if management of Acid Sulphate Soils is required under the Contract.

All works shall be undertaken to minimise the exposure of air to potential or actual acid sulphate soils.

Where acid sulphate soils do or may potentially occur, the Contractor shall determine if an Acid Sulphate Soils Management Plan (or equivalent) is available. Where relevant, the Contractor shall prepare a work method statement demonstrating adherence to the Acid Sulphate Soils Management Plan.

3.4 Site Induction and Training Plan

The Contractor shall ensure that all site personnel, including Sub-contractors, are aware of how the SEMP is to be implemented in relation to the Works, including emergency response procedures. The plan shall include personnel to be trained, training objectives and induction procedures.



3.5 Compliance

The Superintendent will inspect the Works and/or conduct periodic audits to measure the Contractor's compliance with the approved SEMP. During the course of Works, the Superintendent may identify further environmental issues that need to be addressed by the Contractor for inclusion in the SEMP.

The Contractor shall record and advise the Superintendent of all environmental complaints received in regard to the Works.

3.6 Management of Documentation on Site

The Contractor must maintain copies of the approved SEMP on site at all times, together with copies of all relevant regulations.

Procedures shall be established to produce and maintain project records that provide objective evidence of the implementation and effectiveness of the SEMP.

3.7 Witness Points and Hold Points

The following Hold Point shall be incorporated in the Project Quality Plan:

- a) Submission of the SEMP (**Clause 3.2**).

4. Demolition of Existing Infrastructure

4.1 Scope

This section of the Specification defines the requirements in relation to demolition and/or safe removal of existing infrastructure including, pavements, pits, pipes, duct banks and all electrical infrastructure as shown on the Drawings.

4.2 Reference Documents

The following documents that are referenced in this section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 2601: The Demolition of Structures
- AS 2550: Cranes, Hoists and Winches

4.3 General Demolition Requirements

The Contractor shall carry out the works as detailed on the Drawings and Specification in a safe and satisfactory manner and in particular shall:

- (a) Perform the works in accordance with AS 2601-2001, excluding Clause 3.5;
- (b) Submit a Demolition Procedure to the Superintendent at least 14 days prior to commencing demolition work on site. This shall be a designated **Hold Point**;
- (c) Ensure that all plant, tackle, gear, stagings, scaffolding, ladders, winding arrangements and other equipment used in connection with the Works shall not only conform to the requirements of any Statutory regulation in relation thereto but also to prudent practice and to the requirements of the Superintendent. Cranes and their operation shall be fully in accordance with AS 2550;
- (d) Immediately discontinue any practice or remove any equipment considered likely to constitute a danger, notwithstanding that the Superintendent or other authorities may have previously approved such practice or equipment;
- (e) Remove from the works promptly any person, employed by the Contractor or sub-Contractor who shall create any danger on or about the Works, or misconduct themselves, or be incompetent or negligent; and
- (f) Bind Sub-contractors to accept and comply with all requirements of this Specification.

The use of explosives is forbidden in this Contract.

4.4 Preparation for Demolition Works

Some temporary works may be necessary to allow demolition equipment to use and access the site.

The Contractor shall be responsible for the design, installation and removal on completion of all such temporary works.



4.5 Installed Equipment

The Contractor shall protect installed equipment against damage by dust, dirt, shock or other causes.

4.6 Site Cleanliness and Disposal of Refuse

The Contractor shall maintain a high standard of housekeeping and site cleanliness during the course of the Works. The Contractor shall, on a regular and frequent basis, remove from the Site all refuse resulting from work under the Contract. Materials lost overboard from the Contractor's transit vehicles shall be cleaned up to the satisfaction of the Superintendent and any authorities.

On completion, the Contractor shall ensure that the works area is cleaned and surplus material, debris and the like have been removed, to the satisfaction of the Superintendent.

4.7 Disposal of Contaminants

In the event that contaminated soil or other contaminants are encountered during the course of the Works, the Contractor shall properly dispose of contaminants from the Site in accordance with all statutory and contractual requirements to approved locations or as otherwise directed by the Superintendent.

4.8 Protection of Services

The Contractor shall familiarise itself with all existing services prior to commencing work in accordance with **Clauses 1.4.11** and **5.5.3**. The Contractor shall immediately notify the Superintendent in the event of damage to any water, gas, electricity, drainage, sewerage, communications or other services in the area.

Where a service is identified in the Contract or is evident on the site or has been pointed out by the Superintendent, the Contractor shall be responsible for the cost of any necessary protection and repairs to that service.

4.9 Witness Points and Hold Points

The following **Hold Point** shall be incorporated in the Project Quality Plan:

- Submission of demolition work plan (**Clause 4.3**).

5. Earthworks and Subgrade Preparation

5.1 General

This Section of the Specification defines the requirements for excavation and removal of existing pavements, filling, and the preparation of the subgrade on which pavements are to be constructed.

5.1.1 Reference Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 1152: Specification for Test Sieves
- AS 1160: Bitumen Emulsion for Construction and Maintenance of Pavements

5.1.2 Definitions

The following definitions shall be used for this project:

Spoil comprises any surplus materials or any materials that cannot be used in the Works for any reason.

Subgrade is the prepared surface of the in-situ material after the completion of all stripping and excavation and prior to any filling.

Formation Level is the level obtained by subtracting the appropriate pavement thickness (not including Select Fill) as shown on the Drawings from the finished surface level at any point. It is the subgrade level in areas of cut, and the top of the filling in areas of fill.

Engineering Services include drains, power cables, control cables, sewers, water pipes, gas pipes, ducts or any other pipe, cable, associated structure or similar objects.

5.2 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

Specific equipment to be used in the Works shall comply with the following requirements:

5.2.1 Heavy Vibrating Rollers

Medium vibrating rollers shall be self-propelled or drawn by tractors and equipped such that the roller will not operate in the vibrating mode when the roller is stationary. They shall have:

- a) A smooth steel vibrating drum with a static mass of at least 15 tonnes on the drum;
- b) A minimum drum width of 2m;
- c) Static mass per metre width of vibrating drum of at least 7.5 tonnes;
- d) Minimum frequency of vibration of at least 20 Hz; and

- e) Amplitude of vibration within the range of 1 mm to 2 mm.

5.2.2 Pneumatic-Tyred Rollers

Pneumatic Rollers shall be designed and constructed such that:

- a) The rollers are self propelled or drawn by pneumatic tyred tractor;
- b) Each wheel is capable of being loaded to up to 5 tonnes with the load being evenly distributed over all wheels;
- c) Each tyre is capable of being inflated to 1000 kPa; and
- d) The wheel load/tyre pressure combinations specified are capable of being achieved.

5.3 Materials

5.3.1 Classified Fill

Classified fill comprises soils that are free from peats and other organic matter, free from cobbles and boulders, and such that all the material passes a 75 mm AS Sieve and has a Liquid Limit of not greater than 50%.

5.3.2 Topsoil

Topsoil comprises soils containing organic matter that are suitable for growing grass, and that are free from stones or other materials exceeding 25 mm in any dimension.

5.3.3 Select Fill

Select fill shall comprise material that complies with the requirements for VicRoads Type A Fill (as defined in VicRoads Standard Specification Section 204), and meeting the following requirements:

- a) Minimum CBR 10%
- b) Maximum Swell 2.5%
- c) Particle size distribution after compaction complying with the limits in **Table 5-1** when determined in accordance with the requirements of AS 1289.3.6.1

Table 5-1: Particle Size Distribution for Select Fill Material

Sieve Size (mm)	Percentage by Mass Passing Sieve
75.0	100
37.5	75-100
19.0	60-100
4.75	30-70
2.36	20-55
0.425	10-30
0.075	5-15

- d) Maximum Plasticity Index (PI) x % passing 0.425 mm sieve after compaction to be 1000; and
- e) Maximum PI after compaction not greater than 6%

5.4 Existing Pavement Details

Geotechnical Testing Services Pty Ltd was engaged by Aurecon to undertake a geotechnical investigation (comprising fieldwork and laboratory testing) to provide information on the existing pavement composition, layer thicknesses, material properties and subgrade strength.

A total of 22 boreholes were undertaken on the 17/35 Runway, 05/23 Runway, Taxiways A, B, C, Taxilanes 1 and 2 and the GA Apron. Based on the borehole investigation, the existing pavement generally comprised a spray seal overlying a base course layer and/or sub-base layer (medium dense to dense silty Sand with some gravel) over existing subgrade (soft to hard silty Clay/clayey Silt fill). Under this layer there was a layer of Siltstone which is considered to be the natural subgrade.

The pavement details contained within the Geotechnical Investigation Report are correct to the best of the Principal's knowledge, however the existing pavement thickness should be considered variable. A copy of the Geotechnical Investigation Report may be supplied by the Principal upon request for the purposes of Tender.

If during demolition and excavation any differences are noted, the Contractor shall notify the Superintendent immediately and the Superintendent will advise the Contractor of what modifications (if any) are to be made.

5.5 Construction

5.5.1 Clearing and Grubbing

(a) Clearing

Clearing shall be performed to a distance of 2 m outside the limit of the works, unless otherwise shown on the Drawings or instructed by Superintendent.

Clearing, of the areas shown on the Drawings shall include the removal of all trees, bushes, and other vegetation to within 150 mm above existing ground level. It shall also include the removal of dense growth of ground plants, matted dead vegetation, and rubbish resting on the existing ground.

Small tree branches, shrubs and leaves, excluding noxious weeds, shall be disposed of by chipping and mulching to form mulch. All mulch shall be disposed of at a legal disposal site.

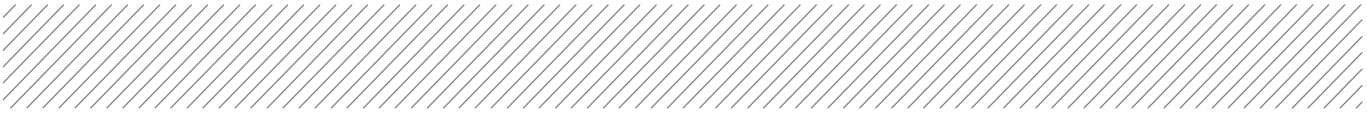
All other organic material, including trees, stumps, roots, and brush shall be removed from the Site as directed by Superintendent.

In areas to be cleared but to remain ungrubbed, trees and stumps shall be cut off to within 400 mm of the original ground surface unless otherwise noted.

(b) Grubbing

Grubbing shall include the excavation and complete removal of tree stumps. It shall also include the excavation and complete removal of all other plant life, including root structures, plus rubbish, to a depth of 200 mm below the existing ground level. Exceptions to the 200 mm depth for grubbing are as follows for the specific work areas shown below:

- a) Drainage excavations including open unlined earth drains and pipes and culverts shall be grubbed to a depth of not less than 500 mm beneath the finished sides and bottom;
- b) Pavement areas shall be grubbed to a depth not less than 300 mm below existing ground level; and
- c) Non-paved areas, embankment slopes and cut batters shall be grubbed to a depth not less than 300 mm beneath the finished surface levels.



Unless otherwise directed, grubbing shall be performed within the limits of and 2 m outside the limits in areas:

- a) to be covered with fill less than 1.5 m depth;
- b) to be covered with select fill to any depth; and
- c) to be occupied by permanent structures and pavements

Within areas to be filled, stump holes and depressions shall be backfilled with material approved by the Superintendent, and compacted to a density similar to the surrounding natural ground. All cleared and grubbed areas shall be sloped to drain. Drainage shall be sloped away from open holes.

Where clearing and grubbing will result in significant soil erosion, measures shall be taken to mitigate such erosion, when required by Superintendent.

5.5.2 Site Preparation

Earthworks shall not commence in any new area without the prior written approval of the Superintendent.

A new area is defined as an area in which earthworks and subgrade preparation have not previously been commenced, and/or a new stage of the works as defined in the Method of Working Plan or on the Drawings.

Within the limits of the Works, the Contractor shall remove all obstructions including abandoned engineering services, divert all drainage, relocate existing engineering services that are to be retained and, where appropriate, install new engineering services and drainage prior to the commencement of excavation or filling in any area.

All materials accumulated as a result of the clearing operations shall become the property of the Contractor and shall be removed from the airport property and disposed of at a legal disposal site.

Holes left as a result of clearing, demolition and the removal of abandoned engineering services shall be backfilled by the Contractor using Select Fill material in accordance with the requirements of **Clause 5.5.14**.

5.5.3 Protection of Engineering Services

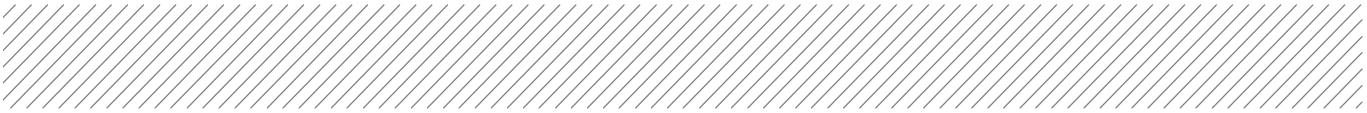
Existing engineering services that are shown on the Drawings, or the locations of which are made known to the Contractor prior to the commencement of earthworks, and that are to be retained, shall be protected by the Contractor from damage during earthworks and subsequent pavement construction, and, if damaged, shall be repaired by the Contractor at no cost to the Principal.

Before commencing any work on the site, the Contractor shall employ the services of a services location company approved by the Superintendent to ascertain and mark on the ground the position of all underground services and structures within the limits of the work and within 10 m beyond the limits of the work, in accordance with the 'Procedure for the Location and Identification of Services' contained in **Appendix A**. Actual service locations shall be checked by the Contractor in conjunction with the relevant service authority prior to any excavation proceeding.

The cost of employing a services location company shall be included in the Contract Sum.

The Superintendent will provide the names and telephone numbers of persons on the aerodrome who will assist the Contractor to locate the services and structures.

All excavations shall be carried out following the regulations set out by each individual service authority. It is the Contractor's responsibility to obtain these regulations and to comply with them. The Contractor shall make themselves aware of and comply with all service authority regulations and standards in relation to the use of machinery and equipment in the vicinity of services.



All services and structures that are located within the Works area shall be exposed using hand tools or other means of specialist sensitive excavation techniques (such as hydro-excavation) as approved by the Superintendent, only in the presence of the Superintendent. The Contractor shall give reasonable prior written notice to the Superintendent of the Contractor's intention to excavate in the vicinity of services and structures.

Unless otherwise stated in service authority regulations and standards, excavation shall be carried out using hand tools only within:

- a) 5 m of fuel or gas pipes;
- b) 3 m of electrical cables associated with airport power supply, aerodrome lighting and navigation aids;
- c) 2 m of other electrical cables (excluding 22 kV cables);
- d) 2 m of water pipes;
- e) 1 m of stormwater drains; and
- f) 1 m of structures.

Unless otherwise stated in service authority regulations and standards, excavation shall be carried out using specialist sensitive excavation techniques (such as hydro-excavation) as approved by the Superintendent, only within:

- a) 3 m of 22kV cables; and
- b) 3 m of Optical Fibre Communications Cables.

The Contractor shall consult with fuel and gas pipeline operators and obtain approval before commencing any work within five metres of any fuel or gas pipelines.

Particular care shall be taken where trenches cross existing underground services. The Contractor shall provide adequate support for any existing services both during the excavation and the backfilling of a trench.

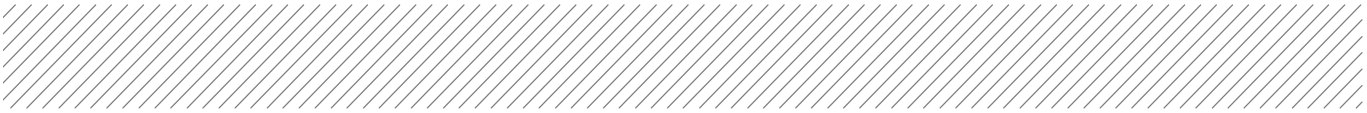
In the event that the Contractor damages any existing service lines that are not shown on the Drawings or the location of which have not been made known to the Contractor, the Contractor shall report the matter to the Superintendent as soon as practical after the event. If the Superintendent determines that repairs are to be made by the Contractor, such repairs will be ordered as provided for under the Contract.

5.5.4 Maintenance of Pavements

Prior to commencement on Site, the Contractor shall prepare a Dilapidation Report, including survey and photographic evidence of the existing condition of all existing roads on the aerodrome and site access roads which are to be proposed to be used by the Contractor during the Works. The Contractor shall submit three copies of the Dilapidation Report to the Superintendent and shall maintain a copy of the Dilapidation Report on Site. Submission of the Dilapidation Report shall constitute a **Hold Point**.

All active aircraft pavements affected by work under the Contract shall be kept clean at all times. All non-active aircraft pavements shall be cleaned at the end of each work stage.

All aircraft pavements used by the Contractor shall be cleaned of any material deposited on the surface by hosing, sweeping or any other method. Non-soluble materials shall not be washed into any drainage system. Any spilt hazardous material shall be removed immediately. The Contractor shall clean pavements progressively if instructed to do so by the Superintendent or Works Safety Officers.



The surface of all construction haul roads shall be maintained by the Contractor in such a manner to prevent carrying of foreign materials onto aircraft pavements.

All existing roads within the aerodrome boundary, site access and off site access roads which are used by the Contractor shall be maintained in good repair and a clean condition, free from dust and debris by sweeping and watering as required.

Any damage to existing pavements caused by the Contractor's use of such pavements shall be reported immediately to the Superintendent and shall be repaired to original condition by the Contractor. All repair work to active aircraft pavements and roads shall be completed expeditiously by the Contractor to the satisfaction of the Superintendent.

5.5.5 Drainage

During earthworks, the Contractor shall provide drainage such that all excavation and filling will be free draining to low points clear of the Works at all times. Water shall be drained or pumped from low points to prevent damage to the Works due to inundation, flooding, ponding or other causes. The Contractor shall do all things necessary to divert any water that interferes with progress of the Works, and to keep areas free from water during excavation and filling. The Contractor shall provide sufficient pumps, well-points or other equipment for keeping trenches and excavations dewatered during the Works at no additional cost to the Principal.

Existing drainage lines and structures may be utilised by the Contractor in draining the site. Before breaking into any lines or structures, the Contractor shall obtain prior approval from the Superintendent in writing. Should such approval be granted, restitution of the structure to a condition at least equivalent to that before the breaking occurred shall be undertaken by the Contractor at the Contractor's expense.

All drainage within the limits of earthworks shall be diverted as necessary by the Contractor to ensure that all run off from the surface of the earthworks and stockpile sites passes through environmental control facilities complying with the SEMP, before discharge into drainage outfalls.

The Contractor shall provide temporary pollution control devices or ponds, complying with the SEMP, to prevent siltation or the degradation of water quality in the existing drainage systems and receiving waters.

The Contractor shall lower the existing water table sufficiently to permit subgrade preparation in accordance with the requirements of **Clause 5.5.11**, and to allow trafficability.

Any drainage works that are required to control surface or subsurface flows so as to permit preparation of the subgrade and subsequent pavement construction, or for any other works, but which do not form part of the final design as documented on the Drawings, shall be provided by the Contractor at no additional cost to the Principal.

If required to control subsurface flows, the Contractor shall install subsurface drains comprising 90 mm diameter Class 1000 perforated plastic slotted pipe with filter sock within a minimum 400 mm deep by 300 mm wide trench in the subgrade. The bedding and backfilling of the trench shall be with 20 mm nominal size, 5% cement, no-fines concrete.

Subsurface drains constructed within the subgrade shall be enclosed on the bottom and sides with polyethylene sheet, overlapping the adjacent subgrade by 300 mm on each side.

If any lowering of the water table is carried out at the Site, the Contractor shall provide for the stability of all existing structures.

5.5.6 Control of Windblown Sand, Dust and Debris

The Contractor shall undertake the entire earthworks and subgrade preparation operation including stripping, carting, excavation, filling, compaction, proof rolling and stockpiling in such a manner as to totally prevent windblown particles and debris from leaving the surface of the site of the Works.

Prevention of wind blown material shall be based on a relocatable piped sprinkler installation or Superintendent approved equivalent (such as a mobile water spray truck) capable of reliable operation 24 hours per day, whether or not work is current on the Site.

In addition, for the duration of the Contract, the Contractor shall have on site bitumen emulsion spray equipment for emergency dust suppression as requested by the Superintendent. A slow setting anionic bituminous emulsion conforming to the requirements of AS 1160 shall be used.

The Contractor shall install, operate, maintain and manage the wind erosion control system, the cost of which shall be included in the Contract Sum.

Should the Contractor default in the responsibility to prevent windblown particles from leaving the surface of the site of the Works for whatever reason, the Superintendent will invoke whatever actions, plant, equipment and personnel are necessary to totally control windblown particles from the Site.

The cost of remedial actions shall become a debt due and payable by the Contractor to the Principal and may be deducted from any monies due or becoming due to the Contractor.

5.5.7 Stripping of Ground Surface

Areas beneath pavements and shoulders and as shown on the Drawings shall be stripped to a depth of at least 150 mm and any additional depth necessary such that all vegetation, grass roots, organic soil and humus is removed.

Such stripping shall extend for a distance of 1 m beyond the limits of the new or future pavements and shoulders as shown on the Drawings and, in each area, shall be completed prior to commencing earthworks.

The stripped material shall be stockpiled for re-use in accordance with **Clause 5.5.9**.

5.5.8 Excavation

The Contractor shall excavate every type of material encountered within the limit of demolition and earthworks below the depth of stripping, or below the existing surface level on paved areas, to the lines and levels and profiles shown or indicated on the Drawings. The excavated material shall be removed from the Site to a place of legal disposal unless otherwise directed by the Superintendent. All latent conditions such as the presence of rock shall be at the Contractor's own risk, the cost of which shall be included in the Contract Sum.

On areas on which it is proposed to construct the pavements, excavation shall not proceed closer than 100 mm to the proposed subgrade level if it is raining or if rain is imminent.

The final excavation and trimming of areas on which it is proposed to construct the pavements shall be undertaken as specified in **Clause 5.5.11**.

Where the Contractor over-excavates beyond the limits of areas on which it is proposed to construct pavements, such areas shall be restored to the required levels in accordance with **Clause 5.5.12**, at the Contractor's expense.

Where new pavements abut existing pavements, the existing pavement edge shall be cut back to provide a clean vertical face at the location shown on the Drawings. The existing surfacing shall be cut along the line of the junction and the underlying pavement shall be excavated carefully so as not to disturb the existing pavement beyond the junction.

5.5.9 Utilisation of Stripped and Excavated Material

The Contractor shall assess all materials recovered from stripping or excavations for re-use in the Works as topsoil, classified fill, or as spoil. The Contractor shall advise the Superintendent of this assessment prior to re-using any stripped or excavated materials in the Works. The Superintendent shall accept or reject this assessment based on visual inspection, or on the results of tests undertaken by the Contractor on samples obtained by the Superintendent, or on a combination of the above. The Superintendent may order the Contractor to re-assess the materials until an acceptable classification is obtained for all materials that are to be re-used in the Works.

Stripped or excavated materials in excess of that required in the Works, or which due to unsuitability for any other reason cannot be used in the Works, shall be classified as spoil and disposed of in accordance with the requirements of the **Clause 5.5.10**.

If the stripped or excavated materials that have been approved for re-use in the Works cannot be incorporated into the Works at the time of stripping or excavation, respectively, then the materials shall be stockpiled at locations outside the limits of the pavements, approved by the Superintendent. Stockpiled materials which have been approved for re-use in the Works shall be moved to their final position in the Works by the Contractor as and when appropriate for the correct and expeditious completion of the Works. All work associated with moving materials to and from stockpiles shall be at the Contractor's expense.

Stripped materials approved for re-use as topsoil shall be used to resurface areas which are disturbed in the course of the Works and which are not within the limits of the proposed pavements. Where stripped material is used in these areas however, it shall be free of stones in excess of 25 mm in any dimension.

Excavated materials approved for re-use as classified fill shall be used for reinstating earthwork surfaces in accordance with the requirements of **Clause 5.5.15**.

5.5.10 Spoil

Spoil, including material defined as topsoil, classified fill or material excavated for subgrade replacement, that is in excess of that required in the Works shall be disposed of by the Contractor in areas on the aerodrome site nominated by the Superintendent, or otherwise off site, at no additional cost to the Principal.

5.5.11 Subgrade Preparation

Subgrade preparation comprises rolling, final excavation to subgrade level and trimming, proof rolling of the finished subgrade surface, and subgrade replacement in areas that exhibit unsatisfactory behaviour under the proof rolling.

(a) Finishing Subgrade Surfaces

Finishing of subgrade surfaces includes final excavation to subgrade level and trimming to provide a planar surface.

Final excavation comprises the removal of material that is within a depth of 100 mm of the subgrade level which shall be undertaken so as to minimise disturbance of the subgrade surface.

The Contractor shall trim the subgrade to provide a reasonably smooth surface, free from all loose excavated material that conforms to the shape required at that section. The degree of finish shall be equivalent to that ordinarily obtainable with a grader blade. Cobbles and boulders that protrude above the surface shall be removed and the surface in such areas shall be restored to the required levels with Select Fill in accordance with **Clause 5.5.14**.

The surface of the subgrade in areas of cut shall not be above the Formation Level at any point.

(b) Subgrade Compaction

Rollers shall be of the types specified in **Clause 5.2**, and sufficient in number to complete the compaction of a layer whilst the layer is within the specified moisture content range.

Vibratory rollers shall not be operated at speeds greater than 4 km/h and pneumatic-tyred rollers shall not be operated at speeds greater than 6 km/h.

In small restricted areas not readily accessible to the rollers and when approved by Superintendent, compaction may be carried out using tamping vibrating equipment capable of achieving the specified minimum density requirements.

For cohesive materials, the moisture content during compaction and proof rolling shall be not less than 2% below, nor more than 1% above the modified optimum moisture content determined in accordance with AS 1289.5.2.1.

The Contractor shall compact the subgrade and select fill to achieve an average dry density ratio for each lot of not less than the values shown in **Table 5-2**.

For cohesive materials, the dry density ratio shall be determined in accordance with AS 1289.5.4.1 using modified compactive effort.

Table 5-2: Compaction Requirements

Depth Below Formation Level	Proof Rolling Requirement		Compaction Requirement
	Roller Type	No. of Coverages	Minimum Dry Density Ratio (Cohesive)
2 m or more	Pneumatic-tyred rolling with 3 tonnes per wheel and 600 kPa tyre pressure	8	90%
	PLUS Heavy vibratory (15 tonnes)	12	
1.5 m – 2 m	Pneumatic-tyred rolling with 4 tonnes per wheel and 700 kPa tyre pressure	8	90%
	PLUS Heavy vibratory (15 tonnes)	12	
1.0 m – 1.5 m	Pneumatic-tyred rolling with 4 tonnes per wheel and 700 kPa tyre pressure	8	93%
	PLUS Heavy vibratory roller (15 tonnes)	12	
0.6 m – 1.0 m	Pneumatic-tyred rolling with 5 tonnes per wheel and 1000 kPa tyre pressure	8	95%
	PLUS Heavy vibratory roller (15 tonnes)	12	
0.6 m – 1.0 m	Pneumatic-tyred rolling with 5 tonnes per wheel and 1000 kPa tyre pressure	8	98%
	PLUS Heavy vibratory roller (15 tonnes)	12	

(c) Proof Rolling Requirements

Proof rolling of the subgrade shall be undertaken where it is practical to do so.

If the Contractor considers that proof rolling is impractical in any area, the Contractor shall notify the Superintendent so that a visual assessment of the subgrade condition can be undertaken. This shall be a designated **Hold Point**.

If in the opinion of the Superintendent, the subgrade is not fit for subsequent pavement construction, the Superintendent may order subgrade replacement in accordance with **Clause 5.5.12**.

In areas where it is practical to undertake proof rolling, the Contractor shall proof roll the subgrade following trimming, and each select fill layer as specified herein. Alternatively, the Contractor may, if the Contractor so desires, incorporate the proof rolling into the compaction process. If the proof rolling is incorporated into the compaction process, it shall form the final compaction sequence. If the compaction and proof rolling are carried out as separate operations, then compaction shall precede proof rolling.

Proof rolling shall comprise a minimum of eight coverages of a pneumatic-tyred roller loaded to achieve 5 tonnes per tyre with a tyre pressure of 1000 kPa, and any additional rolling as necessary to achieve a minimum dry density ratio of 98% (based on standard compactive effect).

Commencement of proof rolling in any area shall be a designated **Hold Point**.

Proof rolling with each roller shall commence at one edge of the area being rolled and shall be executed in a systematic manner such that the entire area being rolled is uniformly subjected to the required proof rolling and such that not more than four passes of a roller are applied on any line before the roller is moved to the next line.

The Contractor shall guide the proof rollers along pre-determined parallel lines using markers, sighting poles or other suitable devices and shall control the rolling in accordance with an approved method to ensure that the entire surface receives the amount of proof rolling required by the Specification.

The rollers shall be operated as closely as practicable to any edges or pavement and there shall be at least a 5 m longitudinal and 0.5 m lateral overlap of the rolling between adjacent areas.

(d) Assessment of Proof Rolling

Instability of the subgrade is defined as the condition when:

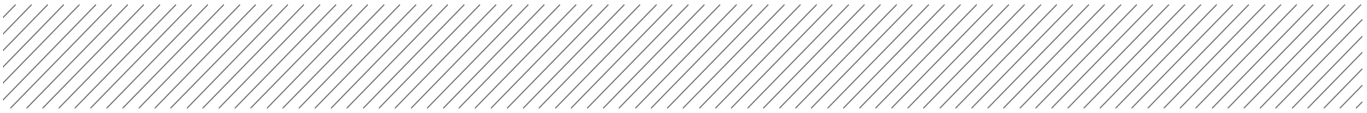
- a) The roller becomes bogged under normal rolling conditions; or
- b) The surface ruts, heaves and/or cracks under proof rolling.

Unstable areas shall be:

- a) Investigated by test boring to identify the nature of and the extent of the unstable material;
- b) Replaced in accordance with **Clause 5.5.12**, if subgrade replacement is required; and
- c) Proof rolled following subgrade replacement as specified herein.

5.5.12 Subgrade Replacement

Areas of subgrade that are assessed as being unstable shall be excavated and replaced with Select Fill. The excavated material shall be classified as spoil and handled in accordance with the requirements of **Clause 5.5.10**.



On completion of the subgrade replacement, the area shall be again proof rolled in accordance with the requirements of **Clause 5.5.11**.

A provisional quantity has been provided for subgrade replacement.

The Contract Sum will be varied according to the actual amount of replacement material ordered by the Superintendent in writing, excluding that to be replaced at the Contractor's expense, at the appropriate rate shown in the Schedule of Prices. The unit rate for replacement material given in the Schedule of Prices shall include costs for excavation, cartage and disposal of excavated material, supply, delivery, placing and compaction of replacement material, construction of any temporary haul roads over other parts of the subgrade, dewatering, over-excavation, ramps, shoring, delays, overheads and profits, and any other associated costs.

Measurement for payment of replacement material shall be the solid volume of replacement material directed or approved by the Superintendent. Measurement shall be made up to the level of the surrounding in-situ material where the work is being executed. At the completion of each day's work, the Contractor shall agree with the Superintendent the quantity of replacement material, other than that to be replaced at the Contractor's expense, executed during that day, and shall issue a docket, countersigned by the Superintendent, stating that quantity. One copy of the signed docket shall be retained by the Superintendent.

5.5.13 Protection of Prepared Subgrade

The finished surface of the prepared material in areas where it is proposed to construct pavements shall not be disturbed by traffic or other operations, and shall be protected and maintained by the Contractor until the select fill or pavement is placed thereon. The subgrade shall be kept drained and completely free of standing water at all times.

The Contractor shall, at the Contractor's expense, repair any prepared subgrade that is damaged by water, traffic or other means. Such repair, unless otherwise approved by the Superintendent, shall consist of the removal of any loose or wet material and its replacement in accordance with the requirements of **Clause 5.5.12**.

The prepared subgrade must be covered by the next subsequent pavement layer or fill (as shown on the Drawings) within 24 hours of completion of the subgrade preparation.

5.5.14 Fill

Fill shall be constructed within the limits of earthworks at the locations and to the lines and levels shown on the Drawings, using classified fill or select fill as specified.

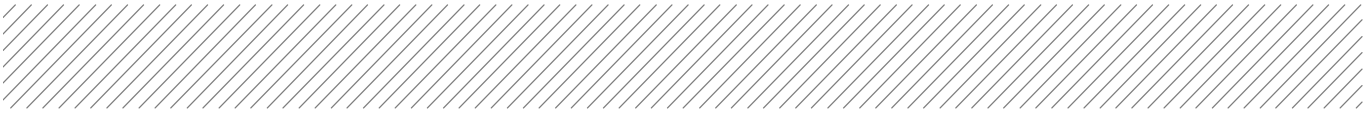
Filling in areas on which pavements are to be constructed shall not commence until the completion of proof rolling of the subgrade surface in accordance with **Clause 5.5.11**.

(a) Classified Fill

Classified fill shall be placed in layers essentially parallel to the finished surface with each layer not exceeding 200 mm in compacted thickness and compacted to a dry density determined in accordance with AS 1289.5.3.1 of not less than 95% Modified Maximum Dry Density as determined in accordance with AS 1289.5.2.1.

(b) Select Fill

Select fill shall be placed in layers approximately parallel to the finished surface with each layer not exceeding 150 mm in compacted thickness and compacted to a dry density ratio determined in accordance with AS 1289.5.3.1 of not less than 95% Modified Maximum Dry Density as determined in accordance with AS 1289.5.2.1.



Select Fill shall be spread, compacted, proof rolled, finished, protected and maintained in accordance with the requirements detailed herein.

5.5.15 Reinstatement of Earthwork Surfaces

The surfaces of all areas beyond the pavement limits, including those beyond the limit of earthworks which are disturbed during the course of the Works shall be reinstated by the Contractor to a condition at least equivalent to that which existed prior to the commencement of the Works. The reinstated surfaces shall be reasonably smooth as is ordinarily obtainable from a grader blade and shall be in accordance with the contour grading plan and cross-sections.

All areas beyond the pavement limits shall be topsoiled and grassed. In those areas that have been excavated to depths in excess of 75 mm, the excavation shall be backfilled with classified or select fill to within 75 mm of the finished surface level prior to placing topsoil as approved by the Superintendent.

In all reinstated areas, the finished surfaces shall be:

- a) Free of all stones or materials exceeding 25 mm in any dimension;
- b) Free from any abrupt changes in level;
- c) Within 30 mm of the design level;
- d) Graded so as to be self-draining; and
- e) Watered and compacted to the density of the adjacent undisturbed material.

5.5.16 Surface Stabilisation and Protection

The exposed surfaces of earthworks shall be protected during construction. Such protection works shall be carried out in stages following the earthworks so as to prevent erosion and wind generated dust at the Site or adjacent to the Site.

Initial surface protection shall be carried out as soon as practicable by means of watering to keep the surface fully wetted at all times. A bitumen emulsion spray shall be applied at an appropriate time at a minimum rate of 1 litre per square metre residual bitumen to all areas of exposed and unprotected earthworks. The bitumen emulsion shall comply with the requirements for ASS/170 in AS 1160 and shall not contain petroleum solvents or other components toxic to plant life. The emulsion shall be suitable for cold spray application.

5.6 Quality Assurance

5.6.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in **Section 2** of the Technical Specification.

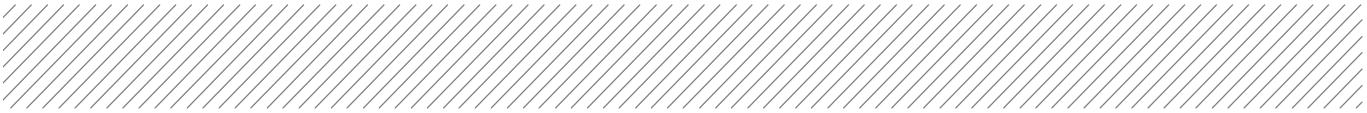
The program shall comprise three phases as defined below.

5.6.2 Phase A - Pre-commencement

(a) Supply of Information on Materials Sources – Select Fill

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) Location of source including the particular face of the quarry or pit from which the material will be obtained;

- 
- b) Whether an existing operating quarry or pit or a new quarry or pit;
 - c) Source rock type and petrographic description;
 - d) Historical test results on material previously obtained from the source indicating the variation in specified properties;
 - e) Proposed method of processing and transportation; and
 - f) Summary of the results of recent tests on samples of the material from the designated source indicating that the material complies with all the requirements herein and endorsed by a laboratory registered by NATA for the performance of such tests.

The submission of this report shall be a designated **Hold Point**.

(b) Reference Samples

Reference Samples shall be taken from the sources from whence the select fill material is to be obtained.

Such Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions of 50 kg each with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

The supply of reference samples shall be a designated **Hold Point**.

5.6.3 Phase B - Production and Process Control

(a) Program

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of the Production and Process Control Testing Program. The Contractor shall then undertake testing and supervision in accordance with the requirements of this clause and the approved Production and Process Control Testing Program.

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. All such testing of select fill shall be done in a NATA accredited laboratory which is adequately equipped and staffed for carrying out the tests required to be undertaken in the Contract. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the Works.

The Contractor shall keep a record upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract, then the Contractor shall record a nonconformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

All nonconformances shall be reported to the Superintendent immediately upon detection with advice as to what corrective action is proposed.

(b) Production Testing

At the commencement of production of select fill material, the Contractor shall take four representative bulk-samples from the first 500 tonnes of the materials produced. During subsequent production, the Contractor shall take at least one representative bulk-sample of the material manufactured during each workshift or from each successive 500 tonnes (whichever number of samples is the greater) of material from each source manufactured by the same process and intended for delivery to the stockpiles located at the site of the Works.

The bulk-samples shall be taken in accordance with the requirements of AS 1141.3 and shall consist of a set of five sample increments obtained randomly during manufacture or from within a stockpile.

For each bulk-sample of material obtained in accordance with the requirements specified in the preceding paragraphs of this clause, the Contractor shall determine:

- a) Particle size distribution in accordance with the requirements of AS 1289.3.6.1;
- b) Liquid limit of the material in accordance with the requirements of AS 1289.3.1.1 using the wet preparation method;
- c) Plastic limit of the material in accordance with the requirements of AS 1289.3.2.1 using the wet preparation method; and
- d) Plasticity index of the material in accordance with the requirements of AS 1289.3.3.1.

(c) Compaction

At the completion of compaction of each lot of subgrade and select fill, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the lot.

A lot of select fill is defined as a section in which all of the material has been obtained from the same source with uniform properties, using the same production techniques and which has all been subjected to the same handling, placing and compaction processes.

The rate of in-situ moisture content and field dry density testing shall be not less than one for each 500 m² of surface area of each layer, with a minimum of four tests where the area of each section is less than 800 m², and a minimum of six tests where the area of the section is greater than 800 m².

Each lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of AS 1289.5.3.1 or some other method accepted in writing by the Superintendent.

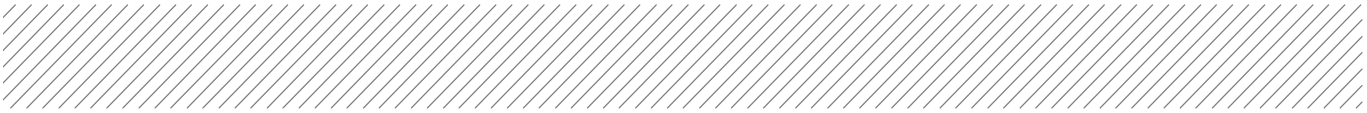
Modified maximum dry density determinations shall be made at a rate of not less than one for each sixteen field density determinations, in accordance with the requirements of AS 1289.5.2.1 or AS 1289.5.5.1

The dry density ratio shall be determined in accordance with the requirements of AS 1289.5.4.1 using the appropriate field dry density and modified maximum dry density determinations.

Conformance of the lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any lot:

- a) Equals or exceeds the specified minimum dry density ratio (SMDDR) less 1% (i.e. SMDDR - 1%) and no individual density result is less than SMDDR - 4%, then the lot shall be considered as complying with the dry density requirements;

- 
- b) Equals or exceeds the specified minimum dry density ratio less 1% (i.e. SMDDR - 1%) and any individual density result is less than SMDDR - 4%, then the lot shall be further tested and the results interpreted as in d) below;
 - c) Equals or is less than the specified minimum dry density ratio less 3% (i.e. SMDDR - 3%) then the lot shall be considered as not complying with the dry density requirements and shall be rejected; or
 - d) Is between the limits given in the preceding paragraphs (i.e. between 1% and 3% below the specified minimum dry density ratio) then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that lot
 - i) Equals or exceeds the limit given in the preceding paragraph (i), then the lot shall be considered as complying with the dry density requirements; or
 - ii) Is less than the limit given in the preceding paragraph (i), then the lot shall be considered as not complying with the dry density requirements and shall be rejected.

5.6.4 Phase C - Post-Construction

(a) Finished Surface Levels

The finished surface of the select fill in areas of fill and the finished surface level of subgrade in areas of cut, shall conform to the grades and levels specified and shall not be above the Formation Level at any point.

Any areas that are above Formation Level shall be corrected in accordance with the requirements of the Specification.

(b) Quality Assurance Records

Within one week of completion of the earthworks and subgrade preparation in each stage, the Contractor shall supply two copies of a report detailing the results of all quality control testing undertaken.

(c) Nonconforming Materials and Work

Areas of earthworks or subgrade or select fill that do not meet all the requirements of this Specification shall be rejected.

All nonconforming materials and work shall be repaired or replaced so that the Works meet all the requirements of this Specification.

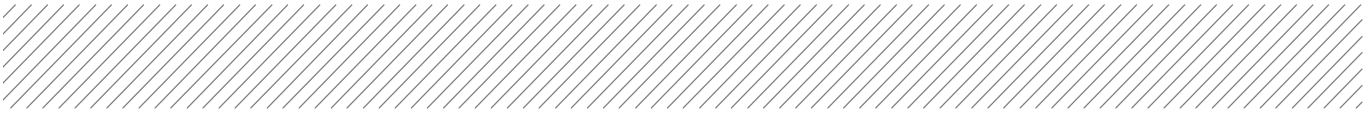
5.6.5 Correction of Nonconforming Work

Areas of earthworks or subgrade or fill that do not meet all the requirements of this Specification shall be subject to a non-conformance report.

Except as provided elsewhere in this clause, all rejected materials and materials from rejected areas shall be removed from the Works and replaced, repaired or rectified as necessary by the Contractor at the Contractor's expense so that the materials and work meet the requirements of the Specification.

In areas of rejected filling, the material shall be removed to the full depth of the layer and over an area of sufficient extent to permit replacement material to be placed in accordance with the requirements of the Specification.

Areas of subgrade or filling rejected for not complying with compaction requirements may be subjected to more compactive effort by the Contractor or may be removed for the full depth of the layer and over



an area of sufficient size to permit replacement material to be placed in accordance with the requirements of the Specification.

Any disturbance of underlying and/or adjacent pavement materials during the removal of materials from the pavement shall be rectified by the Contractor in accordance with the requirements of the Specification, at the Contractor's expense.

Rejected fill materials shall be removed from the site of the Works and placed in the surplus stockpile by the Contractor at his expense.

5.6.6 Witness Points and Hold Points

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Submission of the Dilapidation Report (**Clause 5.5.4**);
- b) Notification of impractical area for Proof Rolling of Subgrade (**Clause 5.5.11(c)**);
- c) Proof Rolling of Subgrade (**Clause 5.5.11(c)**);
- d) Information of Materials Sources (**Clause 5.6.2(a)**); and
- e) Provision of Reference Samples (**Clause 5.6.2(b)**).

6. Cement Treated Crushed Rock

6.1 General

This Section of the Specification covers the supply of materials for, and the construction of imported cement treated crushed rock pavement layers.

6.2 Referenced Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 1141 Methods of Sampling and Testing Aggregates
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 3972 Portland and Blended Cements
- AS 5101.3.3 Methods for Preparation and Testing of Stabilized Materials Cement content of cement stabilized materials

Vicroads

- Standard Specification Section 306 Construction of Cementitiously Treated Subbase Pavement
- Standard Specification Section 812 Crushed Rock for Base and Subbase Pavement
- Standard Specification Section 815 Cementitiously Treated Crushed Rock for Subbase Pavement

6.3 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

Specific equipment to be used in the works shall comply with the following requirements:

6.3.1 Medium Vibrating Rollers

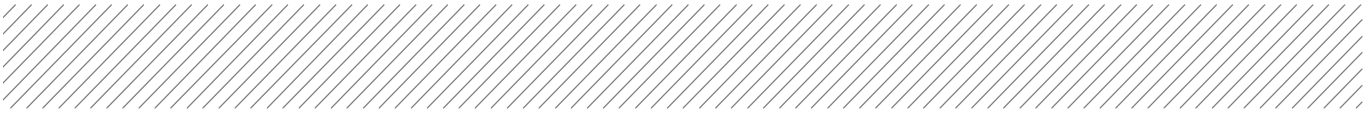
Vibrating Rollers shall be self propelled or drawn and equipped such that the roller will not operate in the vibrating mode when the roller is stationary, and shall comply with the following:

- a) Static mass per metre length of vibrating drum of at least 2.8 tonnes;
- b) Minimum frequency of vibration of 40Hz; and
- c) An amplitude of vibration within the range 0.5 mm to 1 mm.

6.3.2 Pneumatic Tyred Rollers

Pneumatic Tyred Rollers shall be designed and constructed such that

- a) The rollers are self propelled or drawn by pneumatic tyred tractor;

- 
- b) Each wheel is capable of being loaded to up to 5 tonnes with the load being evenly distributed over all wheels;
 - c) Each tyre is capable of being inflated to 1000 kPa; and
 - d) The wheel load/tyre pressure combinations specified are capable of being achieved.

6.3.3 Mixing Plant

Mixing shall be performed by a stationary mixing plant (or approved equivalent) which shall be designed and constructed as to thoroughly mix the aggregate, cement and water without degradation of the aggregate. Unless an alternative mixing plant is approved by the Superintendent, the mixer shall be of the twin shaft pugmill type, and may be either a batch or continuous mixer which will produce a uniform material. Each plant shall have a capacity of not less than 100 tonnes of mixed material per hour. The plant shall be equipped with feeding and metering devices which will add the various materials into the mixer in the specified or required quantities.

In particular, the metering systems for cement and water will only be approved by the Superintendent if it can be demonstrated that the calibration and metering performance of those additive systems is repeatable to the satisfaction of the Superintendent. Feeder calibrations are to be carried out for the establishment of plant calibration factors, which will form the basis of additive control.

The calibration of the plant shall be checked regularly during production to ensure the maintenance of accurate mix control within the project. A similar procedure and set of standards are to apply to water and other metering systems.

The effectiveness of mixing throughout the matrix of the blending material shall be evaluated by measurement of cement content in small collected samples randomly drawn from the mixed product and from various sections of pavement including separately upper and lower levels of mixed layers. The cement content of all such samples determined in accordance with AS 5101.3.3 shall be within +/- 0.5% of the specified cement content.

6.4 Materials

6.4.1 Cement Treated Crushed Rock

The cement treated crushed rock shall comprise 20 mm nominal size VicRoads Class 2 fine crushed rock complying with the requirements of VicRoads Standard Specification Section 812, mixed with 3% Portland Cement by weight of the dry unstabilized material.

6.4.2 Cement

Cement shall comprise Portland Cement Type GP complying with the requirements of AS 3972. Cement that fails to comply with AS 3972 shall be removed from the site. Cement that has been in storage for over four months shall not be used until proved satisfactory by retest.

6.4.3 Water

Water shall be clean, fresh, potable, and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.



6.4.4 Stockpiling and Mixing Material

(a) Stockpiling

Cement treated crushed rock shall not be stockpiled. Crushed rock for use in preparing cement treated crushed rock shall be stockpiled and removed from stockpiles in accordance with the requirements of this Specification.

(b) Mixing

The material shall be loaded from the stockpiles and mixed with water and Portland Cement in the required quantity (3% by weight of the dry unstabilized material). The mixing plant shall be designed and constructed so as to thoroughly mix the fine crushed rock, cement and water to provide a uniform product. The plant shall be equipped with feeding and metering devices which will add the materials in the specified or required proportions such that the mix is always within the specified limits.

The mixing operation shall produce a uniform material that is not segregated and has a moisture content and cement content within the specified limits when the material is placed into the Works.

6.5 Construction

6.5.1 Placing Cement Treated Crushed Rock Material

(a) Surface Preparation

The surface of the underlying layer shall be cleaned of all foreign matter before any new material is placed thereon.

(b) Placing

The commencement of construction of the cement treated crushed rock layer shall be a designated **Hold Point**.

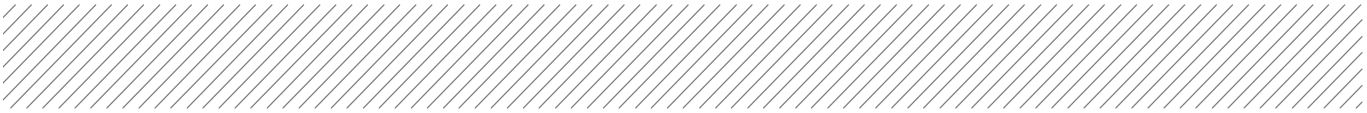
The surface of the underlying layer shall be cleaned of all foreign matter before any new material is placed thereon.

During construction, the lines and levels indicated for the cement treated crushed rock shall be maintained by means of line and level pegs, or other suitable control measures.

The cement treated crushed rock material shall be placed by power grader or other approved method. "Running out" direct from trucks is not acceptable.

The Contractor shall place the cement treated crushed rock in the Works such that:

- a) The moisture content of the materials throughout the full depth of the layer, maintained during placing, compaction and finishing is within 1% of the optimum moisture content for the material as determined in accordance with AS 1289.5.2.1, or such other moisture content as directed in writing by the Superintendent;
- b) The compacted thickness of each layer is not greater than 200 mm or less than 100 mm;
- c) Underlying layers are not disturbed during placing, compacting and trimming;
- d) The least possible surface disturbance is necessary to obtain the design shape, grade and levels within the tolerances specified;
- e) Placing commences at the crown or high side of the pavement with each lane spread adjacent to previously placed lanes;
- f) Segregation and contamination of the materials does not occur;

- 
- g) The layer is at the finished level or it can be trimmed to level, shaped and smoothed by cutting off excessive material;
 - h) The completed layer meets the specified density, thickness, surface level and surface shape requirements for that layer;
 - i) If more than one layer is required, each layer shall be fully compacted and the surface maintained in a damp condition (using a fine spray only) prior to placing the next layer;
 - j) Construction involving more than one layer shall be completed in the one day;
 - k) The surface of each compacted layer shall be kept moist for a period of 72 hours unless covered at an earlier stage with the succeeding layer or with an approved curing membrane;
 - l) Construction joints in each layer shall be displaced by a minimum of 500 mm to prevent continuity of the joint fully through the cement treated crushed rock; and
 - m) Construction or other traffic shall not use a compacted layer within 72 hours of placement without the approval of the Superintendent.

The Contractor shall make such adjustments in mixing and placing procedures or in equipment used, as are necessary to obtain finished surface levels within the allowable tolerance, to prevent segregation and degradation, to reduce or accelerate loss or gain of water, and to produce cement treated crushed rock conforming to the requirements of the Specification.

Before each section of cement treated layer is placed, any cement treated crushed rock material at the end of the preceding section or at the edge of an abutting lane which, is segregated or contaminated shall be rejected and removed and disposed of in accordance with the requirements of the Specification.

The edges of previously placed cement treated crushed rock layers shall be watered to maintain the moisture content specified herein for compaction prior to placement of adjoining material. The surface of the cement treated crushed rock layer shall be watered by the Contractor as necessary to maintain the required moisture content until completion of the compaction. Such watering shall not result in the removal of the fines from the surface of the layer.

The Contractor shall not tyne or rework the cement treated crushed rock material after it is placed in the pavement. If the moisture content of the material is more than 1% below the optimum moisture content or if it is necessary to tyne or rework it to change its moisture content or for any other reason, the material shall be removed from the pavement and replaced with material in accordance with the requirements of the Specification.

(c) Weather Limitations

Cement treated crushed rock layers shall not be constructed when the weather conditions are such that the moisture content cannot be maintained within the specified limits during spreading and compaction. Any areas of cement treated crushed rock layers that are damaged by rainfall or other weather conditions shall be reinstated to conform with the requirements of the Specification at the Contractor's expense.

6.5.2 Compaction

Immediately each pavement layer has been placed, it shall be compacted with the number of coverages of the roller(s) specified in **Table 6.1**, followed by as many additional coverages of the pneumatic tyred roller as necessary to achieve the average dry density ratio shown in **Table 6.1**. The dry density ratio and maximum dry density shall be determined in accordance with AS 1289.5.4.1 and AS 1289.5.2.1, respectively.

The maximum dry density shall be determined in accordance with the requirements of AS 1289.5.2.1, but with the 3% of cement by dry weight of unstabilized material added to the wetted and cured material portions and mixed for 10 minutes, and the portions compacted immediately.

Table 6.1 – Compaction Requirements

Roller Type	Roller Tyre Load (tonnes)	Tyre Pressure (kPa)	No. of Coverages	Modified Dry Density Ratio (%)
Vibratory	-	-	6 max	95 min
Pneumatic Tyred	5	1000	12 min	

All compaction shall be carried out expeditiously and completed while the material is within the moisture content range specified.

The Contractor shall ensure that full compaction of the cement treated crushed rock layer is achieved in all areas including the interfaces between successively placed lanes and sections of cement treated crushed rock layers.

Any costs incurred as a result of achieving a dry density in excess of the minimum specified, or as a result of the further compaction of the underlying layers during compaction of the cement treated crushed rock layers shall be at the Contractor's expense.

Care is required when using vibratory compaction equipment to avoid substantial mechanical breakdown in the surface of each layer, and should this occur the Contractor shall immediately adjust the compaction technique to minimise this effect.

Any powdered or caked surface on any layer shall be removed prior to placing the following layer.

6.5.3 Construction Joints

(a) Longitudinal Joints

Wherever practicable, adjoining runs shall be placed such that compaction of both runs is undertaken without the need for forming a longitudinal joint.

If compaction of adjoining runs cannot be effected within two hours of commencement of the mixing operations, then unless approved otherwise, a longitudinal joint shall be formed between the runs as follows:

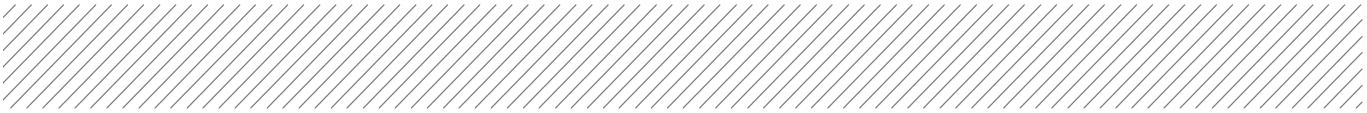
- a) Just prior to placing the next run, the edge of the previously placed and compacted run shall be cut back to the extent that the compacted mix at the cut face complies with the requirements of this specification;
- b) The cut material shall be removed from the site and the joint area left clean;
- c) The cut face of the previous run shall be maintained in a damp condition prior to placing the next run; and
- d) The roller shall be partly supported on the previously compacted run when compacting the fresh mix placed against the cut face.

(b) Transverse Joints

Transverse joints shall be formed as follows:

- a) Just prior to the commencement of the next days stabilizing operation; and
- b) Following any delay in excess of two hours in the continuity of the stabilizing operation.

The joint shall be formed just prior to the recommencement of placing by cutting back into the existing material to the extent that the compacted mix at the cut face complies with the requirements of the specification.



The cut material shall be removed from the site and the joint area left clean. The cut face of the existing material shall be maintained in a damp condition prior to recommencement of placing. The roller shall be partly supported on the existing material when compacting the fresh mix placed against the cut face.

6.5.4 Surface Finishing

Upon the completion of all compaction, the surface of the top layer of the cement treated crushed rock shall be finished by lightly watering and, where necessary, cutting down to the required level and rolling with a pneumatic-tyred roller ballasted such that the load is equally distributed to all wheels to achieve a wheel load of not less than 5 tonnes with the same tyre pressure in each tyre of not less than 1000 kPa.

Material cut from the surface of the cement treated crushed rock shall be collected by the Contractor and removed from the site of the works.

The surface shall not be raised to the required level by the addition of thin layers of cement treated crushed rock material, or any other material. Areas below the specified level shall be corrected prior to the subsequent layer being placed by reconstruction for the full depth of the layer. The reconstructed section shall be placed, spread, compacted and finished in accordance with the requirements of the Specification.

The finished surface of the cement treated crushed rock shall present a uniform tightly interlocked stone mosaic appearance and shall be fully compacted, free from loose stones, free from cement slurry and shall comply with all other requirements of the Specification.

The completion of construction of each layer shall be a designated **Hold Point**.

6.5.5 Tolerance on Finished Level and Surface Smoothness

The finished surface of the cement treated crushed rock shall conform to the grades and levels specified and shall not deviate at any point by more than 10 mm above nor 10 mm below the design surface level shown on the Drawings or defined elsewhere for that surface. Any deviations in excess of this amount shall be corrected by the Contractor in accordance with the requirements of the Specification.

The cement treated crushed rock shall have a surface smoothness such that, in any direction, the surface of the cement treated crushed rock does not deviate from a 3.5 m long straight edge, placed on the surface, by more than 7 mm except in directions where a change of grade occurs and the requirements of the grading design make it impossible to achieve the surface smoothness requirement.

The commencement of straight edge testing shall be a designated **Witness Point**.

6.5.6 Time of Processing

The maximum period of time which may elapse between the commencement of the mixing operation in the plant and the placing operation in the work shall be 30 minutes. The majority of the compaction shall be carried out within one hour of the commencement of the mixing operations.

The total time from the addition of cement and water into the fine crushed rock to the completion of compaction and finishing shall not exceed two hours.

Any material not placed, compacted and finished within their respective time limits shall be removed and replaced with new material, in accordance with this specification, and at the Contractor's expense.

6.5.7 Curing

On completion of the construction of the cement treated crushed rock, the surface of the cement treated crushed rock shall be maintained in a damp condition, using a fine mist spray to avoid leaching of the cement from the surface of the course, from the time of completion up to the time of construction of the next pavement layer.

6.5.8 Protection of Pavement

The surface of the cement treated crushed rock layers and any underlying layers shall be trafficked only by vehicles and equipment essential for the construction, repair and maintenance of the pavement and shall be kept to the minimum necessary. Any areas of cement treated crushed rock that are damaged in any way by traffic shall be reinstated to conform with the requirements of the Specification at the Contractor's expense.

Existing roads, construction roads and/or haul roads constructed by the Contractor shall be used, as required, for the haulage of materials.

6.5.9 Maintenance

The cement treated crushed rock layers shall be repaired and maintained by the Contractor in a condition meeting all requirements of the Specification at the Contractor's expense. Maintenance shall include the repair of any damaged areas.

The repair of cement treated crushed rock layers shall be a designated **Hold Point**.

6.6 Quality Assurance

6.6.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in Section 2 of the Technical Specification.

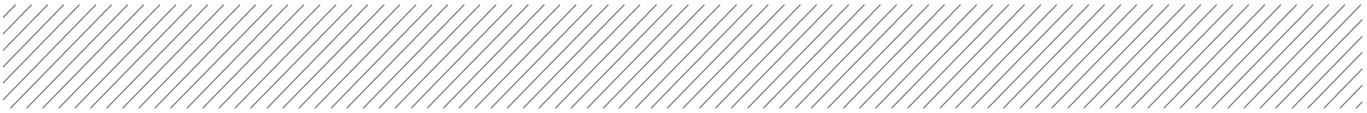
The program shall comprise three phases as defined below.

6.6.2 Phase A - Pre-commencement

(a) Supply of Information on Materials Sources

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) The source of supply of cement, brand, type, and test certificates demonstrating compliance with AS 3972.
- b) For the 20 mm nominal size VicRoads Class 2 crushed rock:
 - Location of source including the particular face of the quarry or pit from which the material will be obtained;
 - Whether an existing operating quarry or a new quarry;
 - Source rock type and petrographic description;
 - Historical test results on material previously obtained from the source indicating the variation in specified properties;
 - Proposed method of processing and transportation; and

- 
- A summary of the results of recent test on samples of the material from the designated source indicating that the material complies with all the requirements specified herein and endorsed by a laboratory registered by NATA for the performance of such tests.

The submission of this report shall be a designated **Hold Point**.

(b) Reference Samples

Aggregate reference samples shall be taken from the sources from where the crushed rock materials are to be obtained.

Such Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions of 50 kg each, with one being held by the Contractor and the second portion by the Principal until completion of the Works.

The reference samples shall be provided at least 5 days prior to the commencement of work, and this shall be a designated **Hold Point**.

6.6.3 Phase B - Process Control

(a) Program

The Contractor shall submit a report to the Superintendent at least 5 days prior to the commencement of the work that provides details of the Production and Process Control Testing Program. The Contractor shall then undertake testing and supervision in accordance with the requirements of this clause and the approved Production and Process Control Testing Program.

The Contractor's Production and Process Control Program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. All such testing of cement treated crushed rock material shall be done in a laboratory which is adequately equipped and staffed for carrying out the tests required to be undertaken in the Contract. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the Works.

The Contractor shall keep a record upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

All nonconformances shall be reported to the Superintendent immediately upon detection with advice as to what corrective action is proposed.

(b) Production Testing

At the commencement of production of fine crushed rock materials, the Contractor shall take four representative bulk-samples from the first 500 tonnes of the materials produced. During subsequent production the Contractor shall take at least one representative bulk-sample of the materials manufactured during each work shift or from each successive 500 tonnes (whichever number of samples is the greater) or materials from each source manufactured by the same process and intended for delivery to the stockpiles located at the site of the Works.

The bulk-samples shall be taken in accordance with the requirements of AS 1141.3 and shall consist of a set of five sample increments obtained randomly during manufacture or from within a stockpile.

For each bulk-sample of material obtained in accordance with the requirements specified in the preceding paragraphs of this clause the Contractor shall determine:

- a) Particle size distribution in accordance with the requirements of AS 1289.3.6.1; and
- b) Linear shrinkage of the material in accordance with the requirements of AS 1289.3.4.1 using wet preparation.

In any bulk-sample where the linear shrinkage exceeds 1.0%, or exceeds the linear shrinkage of the previous bulk-sample taken from the same material by more than 0.5%, then the Contractor also shall determine

- a) Liquid limit of the material in accordance with the requirements of AS 1289.3.1.1 using the wet preparation method;
- b) Plastic limit of the material in accordance with the requirements of AS 1289.3.2.1 using the wet preparation method; and
- c) Plasticity index of the material in accordance with the requirements of AS 1289.3.3.1.

For the material in the four bulk-samples obtained at commencement of production and from the first two half shift's production of the first two 500 tonnes lots of material manufactured from any source, and thereafter in at least one bulk-sample randomly selected from each successive 500 tonnes of each material, the Contractor shall determine:

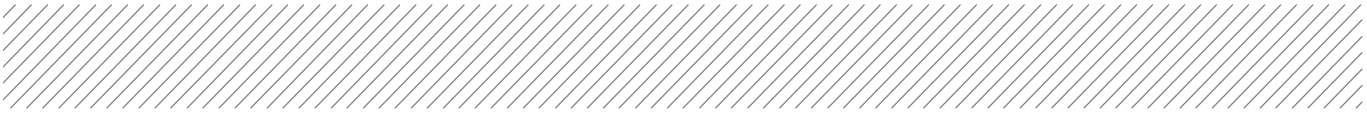
- a) Liquid limit of the material in accordance with the requirements of AS 1289.3.1.1 using the wet preparation method;
- b) Plastic limit of the material in accordance with the requirements of AS 1289.3.2.1 using the wet preparation method; and
- c) Plasticity index of the material in accordance with the requirements of AS 1289.3.3.1.

(c) Cement Content

Samples of the cement treated crushed rock shall be taken at regular intervals, from either the mixer or from material in place, to determine the cement content of the mix in accordance with AS 5101.3.3. The representative sample shall be obtained in accordance with AS 1289.1.2.1. The cement content shall be within the range of +/-0.5% of the specified cement content and no single result shall be less than 2.5% by weight of the dry unstabilized material, otherwise the mix shall be rejected and corrected in accordance with **Clause 7.6.5** at no additional cost to the Principal.

(d) Layer Thickness

The Contractor shall measure the thickness of each compacted cement treated crushed rock layer upon completion of compaction and surface finishing by direct measurement or some other method acceptable to the Superintendent. The frequency of thickness measurements shall be as for the dry density ratio determinations.



Field dry density and thickness determinations for the cement treated crushed rock may be performed at the same locations. The Contractor shall select the random locations for determining field dry density and the thickness of the cement treated crushed rock by a means accepted by the Superintendent in writing.

These measurements shall be recorded and included in the Quality Assurance records.

No part of the cement treated crushed rock at any location shall have a thickness of less than 80% of the specified thickness.

(e) Compaction

The specification requires a minimum number of passes of the pneumatic tyred roller to be applied during compaction. This requires that a rolling pattern which guarantees that all areas of surface receive the specified minimum number of passes with a minimum of excess passes in areas of overlap be established.

A system of recording and verifying the number of passes actually applied should be included in the construction monitoring.

(f) Dry Density

At the completion of compaction of each Lot of the cement treated crushed rock, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the Lot.

A Lot of cement treated crushed rock is defined as a section in which all of the material has been obtained from the same source with uniform properties, using the same production techniques and which has all been subjected to the same handling, placing and compaction processes.

The rate of in-situ moisture content and field dry density testing shall be not less than one test for each 500 m² of surface area of each layer, with a minimum of four tests where the area of each section is less than 800 m², and a minimum of six tests where the area of the section is greater than 800 m².

Each Lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of AS 1289.5.3.1 or some other method accepted in writing by the Superintendent.

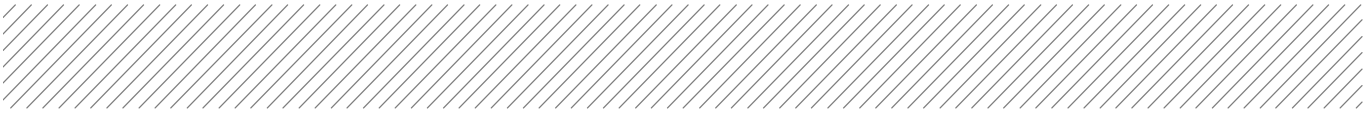
Modified maximum dry density determinations shall be made at a rate of not less than one for each 16 field density determinations, in accordance with the requirements of AS 1289.5.2.1.

The dry density ratio shall be determined in accordance with the requirements of AS 1289.5.4.1 using the appropriate field dry density and modified maximum dry density determinations.

Conformance of the Lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any Lot:

- a) Equals or exceeds the specified minimum dry density ratio (SMDDR) less 1% (i.e. SMDDR - 1%) and no individual density result is less than SMDDR - 4%, then the Lot shall be considered as complying with the dry density requirements;
- b) Equals or exceeds the specified minimum dry density ratio less 1% (i.e. SMDDR - 1%) and any individual density result is less than SMDDR - 4%, then the Lot shall be further tested and the results interpreted as in d) below;

- 
- c) Equals or is less than the specified minimum dry density ratio less 3% (i.e. SMDDR - 3%) then the Lot shall be considered as not complying with the dry density requirements and shall be rejected;
 - d) Is between the limits given in the preceding paragraphs (i.e. between 1 and 3% below the specified minimum dry density ratio) then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that lot:
 - i) Equals or exceeds the limit given in the preceding paragraph a), then the lot shall be considered as complying with the dry density requirements; or
 - ii) Is less than the limit given in the preceding paragraph a), then the lot shall be considered as not complying with the dry density requirements and shall be rejected.

(g) Finished Surface Levels

The finished surface of the cement treated crushed rock shall conform to the grades and levels specified and shall not deviate at any point by more than 10 mm above or 10 mm below the design surface level shown on the Drawings.

Any deviations in excess of this amount shall be corrected in accordance with the requirements of the Specification by the Contractor.

6.6.4 Quality Assurance Records

Within three weeks of completion of the Works, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

6.6.5 Nonconforming Work and Materials

Any cement treated crushed rock material or construction which does not meet all the requirements of the Specification shall be rejected by the Superintendent.

Except as provided elsewhere in this clause, all rejected materials and materials from rejected areas shall be removed from the Works and replaced, repaired or rectified as necessary by the Contractor at the Contractor's expense so that the materials and work meet the requirements of the Specification.

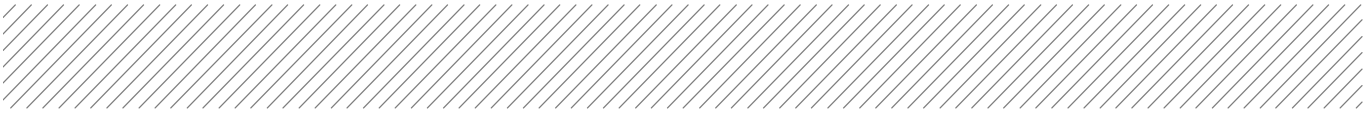
In areas of rejected cement treated crushed rock, the material shall be removed to the full depth of the layer and over an area of sufficient extent to permit replacement material to be placed in accordance with the requirements of the Specification.

The Contractor shall remove sufficient material from areas of cement treated crushed rock rejected for lack of adequate thickness, to permit a layer of material of at least 75 mm thickness to be placed, compacted and finished in accordance with the requirements of the Specification.

Areas of cement treated crushed rock rejected for excessive deviation from the required surface level or for lack of adequate surface smoothness shall be removed for the full depth of the layer and over an area of sufficient size to permit replacement material to be placed in accordance with the requirements of the Specification.

Cement treated crushed rock rejected for not complying with compaction requirements shall be removed for the full depth of the layer and over an area of sufficient size to permit replacement material to be placed in accordance with the requirements of the Specification. Cement treated crushed rock material shall not be tyned and/or reworked on the pavement. If it is necessary to disturb the cement treated crushed rock material it shall be removed from the pavement.

The completion of remedial works for nonconforming cement treated crushed rock shall be a designated **Hold Point**.



Any disturbance of underlying and/or adjacent pavement materials during the removal of materials from the pavement shall be rectified by the Contractor, in accordance with the requirements of the Specification, at the Contractor's expense.

Rejected cement treated crushed rock materials shall be removed from the site of the Works and placed in the surplus stockpile by the Contractor at his expense.

6.6.6 Witness Points and Hold Points

The following **Witness Point** shall be incorporated in the Project Quality Plan:

- a) Commencement of straight edge testing (**Clause 5.5.5**)

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Commencement of construction of each layer (**Clause 6.5.1(b)**);
- b) Completion of construction of each layer (**Clause 6.5.4**);
- c) Repair of layers (**Clause 6.5.9**);
- d) Information on Materials Sources (**Clause 6.6.2(a)**);
- e) Provision of Reference Samples (**Clause 6.6.2(b)**); and
- f) Completion of remedial works for nonconforming cement treated crushed rock (**Clause 6.6.5**).

7. Base and Sub-Base Course

7.1 General

This Section of the Specification defines the supply of materials for, and the construction of fine crushed rock base and sub-base course in flexible pavements.

7.2 Referenced Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 1141 Methods of Sampling and Testing Aggregates
- AS 1289 Methods of Testing Soils for Engineering Purposes

VicRoads

- Section 801 Source Road for the Production of Crushed Rock and Aggregates
- Section 812 Crushed Rock for Base and Subbase Pavement
- Section 304 Unbound Flexible Pavement Construction

7.3 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

Specific equipment to be used in the Works shall comply with the following requirements:

(a) Heavy Vibrating Rollers

Heavy vibrating rollers shall be self-propelled or drawn by tractors and equipped such that the roller will not operate in the vibrating mode when the roller is stationary. They shall have:

- At least one smooth steel vibrating drum;
- A static mass of at least 15 tonnes on each drum;
- Minimum width of vibrating drum of at least 2 m;
- Static mass per metre width of vibrating drum of at least 7.5 tonnes;
- Minimum frequency of vibration of 20 Hz; and
- Amplitude of vibration of at least 2 mm.

(b) Heavy Pneumatic-Tyred Rollers

Heavy Pneumatic Rollers shall be designed and constructed such that:

- Rollers are drawn by pneumatic tyred tractor;
- Each wheel is capable of being loaded to up to 8 tonnes with the load being evenly distributed over all wheels;
- Each tyre is capable of being inflated to 1000 kPa; and

- d) Wheel load/tyre pressure combinations specified are capable of being achieved.

7.4 Materials

7.4.1 Description

Base course materials for flexible pavements shall comprise fine crushed rock compliant with VicRoads Class 1 crushed rock (as defined in VicRoads Section 812) and meet the additional quality requirements detailed herein.

Sub-Base course materials for flexible pavements shall comprise fine crushed rock compliant with VicRoads Class 2 crushed rock (as defined in VicRoads Section 812) and meet the additional quality requirements detailed herein.

The fine crushed rock material shall consist of hard sound, durable particles of crushed rock of uniform particle density, and shall be free of lumps or balls of clay, organic matter, other deleterious materials and coatings.

The shape of the aggregate particles shall be generally angular and the material shall be crushed to provide at least one freshly fractured face to at least 75%, by mass, of particles retained on a 4.75 mm sieve.

In addition, 80% of the surface area of 75% of the particles shall be freshly fractured. The remainder shall have at least 50% of the surfaces freshly fractured.

7.4.2 Source

Prior to the commencement of work, the Contractor shall confirm the sources from which the crushed rock will be obtained. The Contractor shall select suitable sources and materials for the supply of quarry products to meet the requirements set out herein. The sources and materials shall be confirmed sufficiently in advance to permit the Superintendent to visit the quarry for confirmation and approval of the material source(s).

This shall be a designated **Hold Point** in the Quality Plan.

All sources are required to demonstrate sufficient reserves, capacity and quality of material to permit production of materials for use on this project. Confirmation shall be by way of existing test data, geological reports, nominated source areas from within the quarry and a definition of the extraction and stockpiling methods proposed to ensure all rock quarried is suitable for the production of the proposed materials.

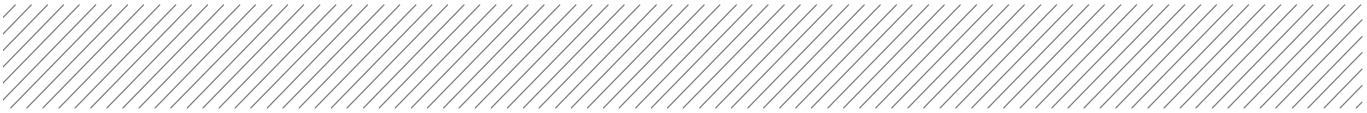
The Superintendent's approval shall be obtained prior to the use of a particular source, and prior to changing the source of any material. If at any time the Contractor proposes to obtain material from a source other than the approved source, the Superintendent shall be notified in sufficient time so that investigations, as may be required, can be carried out before approval is given.

7.4.3 Water Quality

Water shall be potable fresh or suitable groundwater that does not contain excessive quantities of dissolved salt, suspended matter or other contaminants and shall not be deleterious to the prime or bituminous surfacing or their adhesion.

7.4.4 Quality Requirements

The material for the construction of base course shall consist of crushed rock fragments meeting all the requirements of the Specification and shall be:

- 
- (a) Produced by crushing rock which is of a quality appreciably the same as the Reference Sample obtained from the source or sources proposed for use for the production of base course material and has:
- Wet strength greater than 150 kN and a wet/dry strength variation of less than 25% when tested in accordance with the requirements of AS 1141.22 using the material passing the 14.2mm AS sieve and retained on the 9.5mm AS sieve;
 - Water absorption value, when tested in accordance with AS 1141.5 and AS1141.6.1, not exceeding 2.5%;
 - Soil particle density in excess of 2.3 t/m³ when tested in accordance with AS 1289.3.5.1;
 - Secondary mineral content not exceeding 20% when tested in accordance with AS 1141.26 (basic igneous rocks only);
 - Los Angeles Abrasion loss for samples with gradings B and K of not more than 25% after 500 revolutions when tested in accordance with the requirements of AS1141.23; and
 - Combined weighted average loss of material of less than 5% when tested in accordance with the requirements of AS 1141.24.
- (b) Produced by crushing rock which is free from particles whose minimum dimension in any direction is less than 100mm, sand, disintegrated, friable or weathered material, lumps or balls of clay, organic matter or other deleterious materials or coatings;
- (c) Totally crushed product consisting of clean, sound, hard, dense, unweathered, durable particles of uniform quality free from sand, clay, organic matter or other deleterious materials or coatings and containing not more than a total of 1% of disintegrated, weathered, discoloured, soft, fractured, friable and poorly indurated fragments when tested in accordance with the requirements of AS1141.30;
- (d) Such that on all the particles at least 50% of the surface is freshly fractured and such that on at least three quarters of all the particles at least 80% of the surface is freshly fractured (a freshly fractured surface is a surface fractured in the crushing process used to produce the crushed rock);
- (e) Such that the particles retained on the 9.5mm sieve have a percentage of mis-shapen particles of less than 15 when tested in accordance with the requirements of AS1141.14 using a 3 to 1 calliper ratio; and
- (f) Such that the portion passing the 0.425mm sieve has a liquid limit of not greater than 25 per cent, a plasticity index of not greater than 5 per cent and a linear shrinkage not greater than 2 per cent when tested in accordance with the requirements of AS1289.3.1.1, AS1289.3.2.1, AS1289.3.3.1, and AS1289.3.4.1 as appropriate, using the wet preparation method for each test.

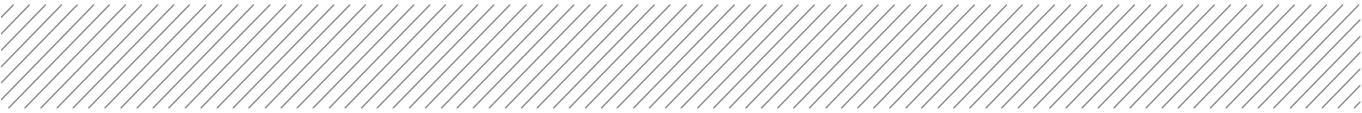
7.5 Construction

7.5.1 Delivery of Material

All base and sub-base course materials shall be transported from the point of manufacture or supply in vehicles that are so constructed that no loss of material occurs. The material shall be handled damp to avoid segregation during transit.

7.5.2 Stockpiling Materials for Use in the Works

All base and sub-base course materials for use in the Works shall be separately stockpiled on the Site at the location(s) directed by the Superintendent, or at the crushing plant site, prior to incorporation into the Works.



Existing unpaved stockpile sites shall be prepared by:

- a) Clearing the area of all vegetation and obstructions
- b) Levelling, grading and compacting the area to prevent ponding of water under the stockpiles and the bogging of delivery and extraction equipment; and
- c) Surfacing the area with a layer at least 100 mm thickness of material similar to that to be stockpiled.

Existing paved, graded gravel or sealed surface stockpile sites shall be prepared by:

- a) Removing all foreign material from the areas; and
- b) Providing adequate drainage in and around the area such that the area will be free of foreign material during the period that the stockpiles are in operation or while there is material stored in the stockpiles.

Material containing essentially different proportions of different types of aggregates or having an essentially different particle size distribution shall be stockpiled separately and in such a manner as to prevent mixing of the different materials and segregation or contamination by foreign materials.

7.5.3 Removal from Stockpiles

All material to be incorporated into the Works shall be taken from stockpiles of material that have been tested and that meet all the requirements of this Specification. Once the material in a stockpile to be used in the Works has been sampled for testing no further material shall be added to the stockpile. The material in a stockpile shall only be used in the Works if when so incorporated it is likely to meet all the requirements of the Specification.

Material recovered from storage stockpiles shall be loaded or recovered from the full height of the stockpile face working progressively along the stockpile using approved loading equipment.

Unused or surplus material shall not be returned to storage stockpiles under any circumstances. The surplus material shall be stockpiled separately away from the primary stockpiles and appropriately designated. Surplus material shall be spread evenly on top of the surplus stockpile in layers.

7.5.4 Mixing of Materials and Moisture Control

Materials of the same type from the same source but of significantly different maximum size, or from different sources, shall not be placed in the same layer except where they are blended together as a uniform material prior to placing.

The Contractor may use either of the methods specified hereinafter for blending of materials and/or addition and mixing of water into the materials. When required, water shall be added during mixing so that the moisture content of the material during spreading and compaction is within the range specified in **Clause 7.5.5 (a)**. Mixing operations shall produce a uniform blend such that when compacted, the specified particle size distribution, liquid limit and plasticity index requirements will be met.

(a) Stationary-Plant Method

The material shall be loaded from the stockpiles into a pugmill mixing plant and in which water is added to the material accurately and in controlled amounts. The mixing plant shall be designed and constructed so as to thoroughly mix the material and water to provide a uniform product. The plant shall be equipped with feeding and metering devices which will add the materials into the mixer in the specified or required proportions such that the mix is always within the specified limits. The mixing operation shall produce a uniform material that is not segregated and has a moisture content within the specified limits when the material is placed into the Works.

(b) Stockpile Method

The material shall be stockpiled in accordance with **Clause 7.5.2** in approximately horizontal layers of uniform thickness. The height of a stockpile shall be not less than 4 m. Water shall be added to the material in the stockpile by watering from the top so that the material is uniformly wetted for the full depth of the face being worked. The stockpile material shall be loaded from the full height of the stockpile face using approved loading equipment. The stockpiling and loading shall produce a uniform blend.

7.5.5 Placing Base and Sub-Base Course Material

The commencement of construction of each layer of the base and sub-base course shall be a designated **Hold Point**.

The surface of the underlying layer shall be cleaned of all foreign matter before any new material is placed thereon.

During construction, the lines and levels indicated for the base and sub-base course shall be maintained by means of line and level pegs, or other suitable control measures.

The base and sub-base course shall be placed by power grader or other approved method. "Running out" direct from trucks is not acceptable.

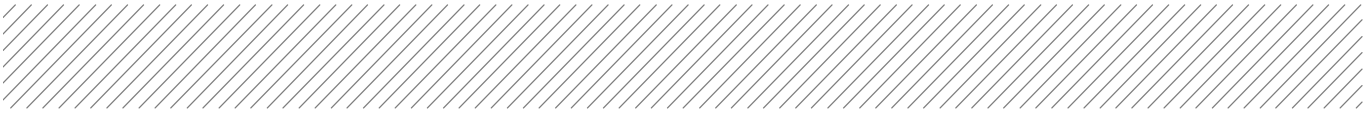
The base and sub-base course materials shall be placed in the Works in layers of uniform thickness such that:

- a) Moisture content of the materials throughout the full depth of the layer is maintained during placing, compaction and finishing within 1% of the moisture content at which maximum field compaction is attainable for the material and the equipment being used;
- b) Where a compacted course 200 mm or less in nominal thickness is required, the material shall be placed and compacted in a single layer. When a nominal compacted course thickness in excess of 200 mm is required, the material shall be placed and compacted in layers of approximately equal thickness, but no layer shall be in excess of 200 mm nominal thickness, or less than 75 mm nominal thickness;
- c) Underlying layers are not disturbed during placing, compacting and trimming;
- d) Least possible surface disturbance is necessary to obtain the design shape, grade and levels within the tolerances specified;
- e) Segregation and contamination of the materials does not occur;
- f) The layer is at the finished level or it can be trimmed to level, shaped and smoothed by cutting off excessive material; and
- g) The completed layer meets the specified density, thickness, surface level and surface shape requirements for that layer.

Mixing and placing procedures or associated equipment used shall be adjusted as necessary to obtain the finished surface levels within the allowable tolerances, to prevent segregation and degradation, to reduce or accelerate loss or gain of water, and to produce base and sub-base course conforming to the requirements of the Specification.

Before each section is placed, any material at the end of the preceding section or at the edge of an abutting lane which, is segregated or contaminated shall be rejected and removed and disposed of in accordance with the requirements of the Specification.

The edges of previously placed materials shall be watered to maintain the moisture content specified herein for compaction prior to placement of adjoining material. The surface of the base and sub-base course shall be watered as necessary to maintain the required moisture content until completion of the compaction. Such watering shall not result in the removal of the fines from the surface of the layer.



Underlying sub-base or base course layers shall be kept moist until the subsequent pavement layer is placed.

Base and sub-base course materials shall not be tyned or reworked after being placed in the pavement. If the moisture content of the material is more than 1% below the moisture content at which maximum field compaction is attainable, or if it is necessary to tyne or rework it to change its moisture content or for any other reason, the material shall be removed from the pavement and replaced with material in accordance with the requirements of the Specification.

Base and sub-base course shall not be constructed when the weather conditions are such that the moisture content cannot be maintained within the specified limits during spreading and compaction. Any areas of base and sub-base course that are damaged by rainfall or are adversely affected by excess moisture shall be reinstated to conform to the requirements of the Specification.

7.5.6 Compaction

Immediately after each base and sub-base course layer has been placed, it shall be compacted by rolling as specified herein to achieve the average dry density ratio shown in **Table 7-1**. The dry density ratio and Modified maximum dry density shall be determined in accordance with AS 1289.5.4.1 and AS 1289.5.2.1, respectively. A coverage is defined as one application of the pneumatic tyred roller tyre or vibratory roller drum to each point on the surface of the area being compacted.

Full compaction of each course shall be achieved in all areas including the interfaces between successively placed lanes and sections.

Care is required when using vibratory compaction equipment to avoid substantial mechanical breakdown in the surface of each layer, and should this occur, the compaction technique shall be immediately adjusted to minimise this effect.

Any powdered or caked surface on any layer shall be removed prior to placing the following layer.

All compaction shall be carried out expeditiously and completed while the material is within the moisture content range specified in **Clause 7.5.5 (a)**.

7.5.7 Proof Rolling

In addition to, or as part of the compaction rolling, each base and sub-base course layer shall be rolled with the number of coverages of the roller(s) specified herein before the moisture content of the course has dropped 2% or more from that at placing and within 24 hours of placement of the course.

If proof rolling is carried out as part of the compaction rolling, it shall be carried out as the final sequence of the compaction process. Otherwise the proof rolling shall be carried out after compaction rolling is completed.

Proof rolling with each roller shall commence at one edge of the area being rolled and shall be executed in a systematic manner such that the entire area of each layer being rolled is uniformly subjected to the required proof rolling and such that not more than four passes of a roller are applied on any line before the roller is moved to the next line.

The Contractor shall guide the proof rollers along predetermined parallel lines using markers, sighting poles or other suitable devices and shall control the rolling in accordance with an approved method to ensure that the entire surface receives the amount of proof rolling required by the Specification.

The rollers shall be operated as closely as practical to any unsupported edges of the layer and there shall be at least 5 m longitudinal and 0.5 m lateral overlap of proof rolling between adjacent areas of proof rolling.

During proof rolling, vibrating rollers shall not be operated at speeds in excess of 4 km/h and pneumatic tyred rollers shall not be operated at speeds in excess of 6 km/h.

Proof rolling shall be a **Witness Point** under the Project Quality Plan. The Contractor shall have available for inspection, records of the proof rolling in progress, and shall maintain these quality records in accordance with the requirements of the Contract.

If during rolling, the roller damages the pavement or disturbs the surface of the base and sub-base course or becomes bogged in the base and sub-base course or underlying layers, then the Contractor shall remove the roller from the pavement. Any areas of base and sub-base course or underlying layers that rut, yield or are unstable under the proof rolling shall be investigated by the Contractor to determine appropriate remedial works. The identification of unsuitable areas during proof-rolling shall be a designated **Hold Point**.

The Contractor shall carry out remedial works such that the entire area complies with the requirements of the Specification. Completion of the remedial works in the area shall be subject to a **Hold Point** under the Project Quality Plan. The Contractor shall not recommence proof rolling of the area until the remedial works have been completed.

The Contractor will not be entitled to any extension of time or additional payment for any delays resulting from such investigations or remedial works.

The Project Quality Plan shall include provisions for the control of the proof rolling process as follows:

- a) The number of coverages of any proof roller applied to any portion of any layer is known at all times;
- b) The correct number of coverages of each proof roller is applied to all portions of the Works; and
- c) A record is kept of the actual rolling applied to any portion of the Works at any time and the record is available at all times when the Contractor is undertaking the Works.

The proof rolling specified herein may result in the dry densities in the layer being proof-rolled and in underlying layers being increased beyond those specified and achieved during previous construction activities. It will be deemed that the Contractor will have made an assessment of the degree of any further compaction which may occur under proof rolling and the Contractor will have allowed in the Contract Sum for any additional material and processes necessary as a result of such further compaction.

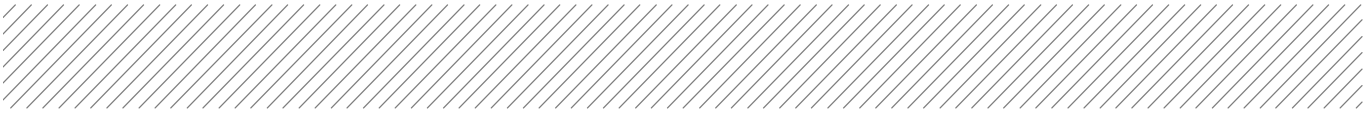
Table 7-1: Compaction and Proof Rolling Requirements

Roller Type	Roller Tyre Load (tonnes)	Tyre Pressure (kPa)	No. of Coverages	Modified Minimum Dry Density Ratio (%)
Heavy Vibrating			12 max	98
Pneumatic Tyred	8	1000	12 min	

7.5.8 Finishing

Upon the completion of all compaction, the surface of the base and sub-base course shall be finished by lightly watering, and where the surface is excessively high, by cutting down to the required level, and rolling with a pneumatic-tyred roller ballasted such that the load is equally distributed to all wheels to achieve a wheel load of not less than 8 tonnes with the same tyre pressure in each tyre of not less than 1000 kPa.

Material cut from the surface of the base and sub-base course shall be removed and stockpiled in a surplus stockpile.



The surface shall not be raised to the required level by the addition of thin layers of material. Areas below the specified level shall be corrected prior to the subsequent layer being placed by removing material from the surface where necessary and placing new material in layers having a compacted thickness of at least 100 mm. When additional material is added to the pavement it shall be placed, spread, compacted and finished in accordance with the requirements of the Specification.

The finished surface of the base and sub-base course shall present a uniform tightly interlocked stone mosaic appearance and shall be fully compacted, free from loose stones and shall comply with all other requirements of the Specification.

7.5.9 Protection of the Pavement

The surface of the base and sub-base course and any underlying layers shall only be trafficked by vehicles and equipment essential for the construction, repair and maintenance of the pavement, and any such trafficking shall be kept to the minimum necessary. Any area of base and sub-base course that is damaged in any way by traffic shall be reinstated to conform to the requirements of the Specification.

7.5.10 Maintenance

The base and sub-base course shall be repaired and maintained in a condition meeting all requirements of the Specification. Maintenance shall include the repair of any damaged areas.

7.6 Quality Assurance

7.6.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in Part 2 of the Technical Specification.

The program shall comprise three phases as defined below.

7.6.2 Phase A - Pre-commencement

(a) Supply of Information on Materials Sources

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) Location of source including the particular face of the quarry or pit from which the material will be obtained;
- b) Whether an existing operating quarry or a new quarry;
- c) Source rock type and petrographic description;
- d) Historical test results on material previously obtained from the source indicating the variation in specified properties;
- e) Proposed method of processing and transportation; and
- f) A summary of the results of recent tests on samples of the material from the designated source indicating that the material complies with all the requirements specified herein and endorsed by a laboratory registered by NATA for the performance of such tests.

The submission of this report shall be a designated **Hold Point**.



(b) Reference Samples

Reference Samples shall be taken from the sources from where the base and sub-base course materials are to be obtained.

Such Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions of 50 kg each, with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

The provision of reference samples at least five days prior to the commencement of the work shall be a designated **Hold Point**.

7.6.3 Phase B - Production and Process Control

(a) Program

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of the Production and Process Control Testing Program. The Contractor shall then undertake testing and supervision in accordance with the requirements of this clause and the approved Production and Process Control Testing Program.

The Contractor's production and process control program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the production control. All such testing of base and sub-base course material shall be done in a laboratory which is adequately equipped and staffed for carrying out the tests required to be undertaken in the Contract. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the Works, however the minimum amount of control testing that shall be undertaken is set out in this section of the Specification.

If at any time during the production of materials the control program being undertaken by the Contractor is inadequate, the Superintendent may order the Contractor to cease production and/or the delivery of materials to the Works.

The Contractor shall keep a record upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

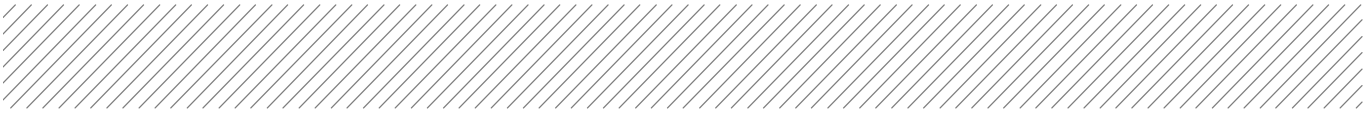
If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract then the Contractor shall record a nonconformance and shall not incorporate the materials represented by those test results into the Works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

All nonconformances shall be reported to the Superintendent immediately upon detection with advice as to what corrective action is proposed.

(b) Production Testing

At the commencement of production of base and sub-base course material, the Contractor shall take four representative bulk-samples from the first 500 tonnes of the materials produced. During subsequent production the Contractor shall take at least one representative bulk-sample of the material manufactured during each work shift or from each successive 500 tonnes (whichever number of samples is the greater) of material from each source manufactured by the same process and intended for delivery to the stockpiles located at the site of the Works.

The bulk-samples shall be taken in accordance with the requirements of AS 1141.3 and shall consist of a set of five sample increments obtained randomly during manufacture or from within a stockpile.



For each bulk-sample of material obtained in accordance with the requirements specified in the preceding paragraphs of this clause the Contractor shall determine the following:

- a) Particle size distribution in accordance with the requirements of AS 1289.3.6.1;
- b) Linear shrinkage of the material in accordance with the requirements of AS 1289.3.4.1 using wet preparation; and
- c) Percentage of particles in a sample of at least 200 particles with at least 50% and at least 80% of their surface area being freshly fractured surfaces.

In any bulk-sample where the linear shrinkage exceeds 1.0%, or exceeds the linear shrinkage of the previous bulk-sample taken from the same material by more than 0.5%, then the Contractor shall also determine the following:

- a) Liquid limit of the material in accordance with the requirements of AS 1289.3.1.1 using the wet preparation method;
- b) Plastic limit of the material in accordance with the requirements of AS 1289.3.2.1 using the wet preparation method; and
- c) Plasticity index of the material in accordance with the requirements of AS 1289.3.3.1.

For the material in the four bulk-samples obtained at commencement of production and from the first two half shift's production of the first two 500 tonnes lots of material manufactured from any source, and thereafter in at least one bulk-sample randomly selected from each successive 500 tonnes of each material, the Contractor shall determine the following:

- a) Liquid limit of the material in accordance with the requirements of AS 1289.3.1.1 using the wet preparation method;
- b) Plastic limit of the material in accordance with the requirements of AS 1289.3.2.1 using the wet preparation method;
- c) Plasticity index of the material in accordance with the requirements of AS 1289.3.3.1;
- d) For the material retained on the 9.5 mm sieve the percentage of mis-shapen particles in accordance with the requirements of AS 1141 Section 14 using a 3 to 1 calliper ratio;
- e) Bulk density and absorption of the material retained on the 4.75 mm sieve and the material passing the 4.75 mm sieve in accordance with the requirements of AS 1141 Section 5 and AS 1141.6.1; and
- f) For the material passing the 13.2 mm sieve and retained on the 9.50 mm sieve the wet strength, the dry strength and the wet/dry strength variation in accordance with the requirements of AS 1141.22.

(c) Layer Thickness

The Contractor shall measure the thickness of the compacted base and sub-base course upon completion of compaction and surface finishing by direct measurement or some other method acceptable to the Superintendent. The frequency of thickness measurements shall be as for the dry density ratio determinations.

Field dry density and thickness determinations may be performed at the same locations. The Contractor shall select the random locations for determining field dry density and the thickness by a means accepted by the Superintendent in writing.

These measurements shall be recorded and included in the Quality Assurance records.

No part of the base and sub-base course at any location shall have a thickness of less than 90% of the specified thickness.

(d) Compaction

The specification requires a minimum number of passes of each roller to be applied during compaction. This requires that a rolling pattern which guarantees that all areas of surface receive the specified minimum number of passes with a minimum of excess passes in areas of overlap be established.

A system of recording and verifying the number of passes actually applied should be included in the construction monitoring.

At the completion of compaction of each lot of the base and sub-base course, the Contractor shall determine the in-situ moisture content and the dry density ratio at random locations throughout the lot.

A lot of base and sub-base course is defined as a section in which all of the material has been obtained from the same source with uniform properties, using the same production techniques and which has all been subjected to the same handling, placing and compaction processes.

The rate of in-situ moisture content and field dry density testing shall be not less than one for each 500 m² of surface area of each layer, with a minimum of four tests where the area of each section is less than 800 m², and a minimum of six tests where the area of the section is greater than 800 m².

Each lot to be tested shall be divided into subsections of approximately equal area. The number of subsections shall be the same as the number of dry density determinations it is proposed to undertake. The location for each dry density determination shall be determined randomly within each subsection.

The in-situ dry density shall be determined in accordance with the requirements of AS 1289.5.3.1 or some other method accepted in writing by the Superintendent.

Modified maximum dry density determinations shall be made at a rate of not less than one for each sixteen field density determinations, in accordance with the requirements of AS 1289.5.2.1.

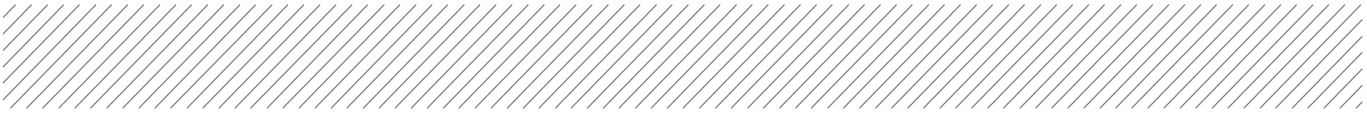
The dry density ratio shall be determined in accordance with the requirements of AS 1289.5.4.1 using the appropriate field dry density and modified maximum dry density determinations.

The Contractor shall determine the particle size distribution and linear shrinkage of a sample of the material made by combining an equal representative portion of the material obtained from each lot of each layer of base and sub-base course for the purpose of determining the field dry density in accordance with the requirements of AS 1289.3.6.1. and AS 1289.3.4.1 using the wet preparation method.

Conformance of the Lot with the specified compaction requirements shall be assessed as follows:

If the average of the dry density ratio determinations for any lot:

- a) Equals or exceeds the specified minimum dry density ratio (SMDDR) less 1% (i.e. SMDDR - 1%) and no individual density result is less than SMDDR - 4%, then the lot will be considered as complying with the dry density requirements;
- b) Equals or exceeds the specified minimum dry density ratio less 1% (i.e. SMDDR - 1%) and any individual density result is less than SMDDR - 4%, then the lot shall be further tested and the results interpreted as in d) below;
- c) Equals or is less than the specified minimum dry density ratio less 3% (i.e. SMDDR - 3%) then the lot shall be considered as not complying with the dry density requirements and will be rejected; or
- d) Is between the limits given in the preceding paragraphs (i.e. between 1 and 3% below the specified minimum dry density ratio) then an additional four randomly located dry density determinations shall be made in the lot in accordance with the requirements of the Specification. If the average of all the dry density ratio determinations for that lot:

- 
- i) Equals or exceeds the limit given in the preceding paragraph (a) then the lot will be considered as complying with the dry density requirements; or
 - ii) Is less than the limit given in the preceding paragraph a) then the lot will be considered as not complying with the dry density requirements and will be rejected.

The completion of construction of each layer shall be a designated **Hold Point**.

7.6.4 Phase C - Post-Construction

(a) Surface Smoothness Testing

The surface smoothness of the completed base course shall be checked using a 3 m mobile straight edge. The surface smoothness testing shall be undertaken as soon as possible after completion of the base course.

The straight edge shall be constructed of a material and in a manner that ensures rigidity and accuracy.

The straight edge shall be operated along a set of parallel lines not more than 10 m apart and covering the whole of the surface and on another set of parallel lines not more than 10 m apart which are perpendicular to the first set.

Surface irregularities that depart from the straight edge by more than 7 mm (except where design changes of grade make it impractical to achieve this tolerance) constitute a nonconformance and shall be clearly marked.

(b) Finished Surface Levels

The finished surface of the base and sub-base course shall conform to the grades and levels specified and shall not deviate at any point by more than 0 mm above or 10 mm below the design surface level shown on the Drawings.

Any deviations in excess of this amount shall be corrected in accordance with the requirements of the Specification.

(c) Quality Assurance Records

Within one week of completion of the base and sub-base course construction, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

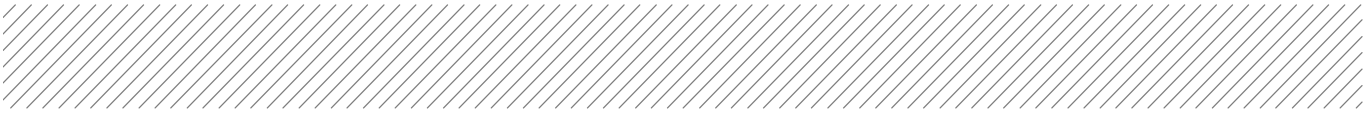
7.6.5 Nonconforming Work and Materials

Any base and sub-base course material, or any base and sub-base course construction that does not meet all the requirements of the Specification shall be subject to a nonconformance report.

Except as provided elsewhere in this clause, all rejected materials and materials from rejected areas shall be removed from the Works and replaced, repaired or rectified as necessary by the Contractor at the Contractor's expense so that the materials and work meet the requirements of the Specification.

In areas of rejected base and sub-base course, the material shall be removed to the full depth of the layer and over an area of sufficient extent to permit replacement material to be placed in accordance with the requirements of the Specification.

The Contractor shall remove sufficient material from areas of base and sub-base course rejected for lack of adequate thickness or excessive deviation from the required surface level or lack of adequate surface smoothness, to permit a layer of material of at least 75 mm thickness to be placed, compacted and finished in accordance with the requirements of the Specification.



Areas of base and sub-base course rejected for not complying with compaction requirements may be subjected to more compactive effort by the Contractor or may be removed for the full depth of the layer and over an area of sufficient size to permit replacement material to be placed in accordance with the requirements of the Specification. Base and sub-base course materials shall not be tyned and/or reworked on the pavement.

Any disturbance of underlying and/or adjacent pavement materials during the removal of materials from the pavement shall be rectified by the Contractor in accordance with the requirements of the Specification, at the Contractor's expense.

Rejected base and sub-base course materials shall be removed from the site of the Works and placed in the surplus stockpile by the Contractor at the Contractor's expense.

The satisfactory completion of remedial works in unsuitable areas shall be a designated **Hold Point**.

7.6.6 Witness Points and Hold Points

The following **Witness Points** shall be incorporated in the Project Quality Plan:

- a) Commencement of proof-rolling (**Clause 7.5.7**)

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Confirmation and approval of material source(s) (**Clause 7.4.2**);
- b) Commencement of construction of each layer (**Clause 7.5.5**);
- c) Identification of unsuitable areas during proof-rolling (**Clause 7.5.7**);
- d) Completion of remedial works (**Clause 7.5.7**);
- e) Information on Materials Sources (**Clause 7.6.2(a)**);
- f) Provision of Reference Samples (**Clause 7.6.2(b)**);
- g) Completion of construction of each layer (**Clause 7.6.3(d)**); and
- h) Completion of remedial works in unsuitable areas (**Clause 7.6.5**).

8. Prime Coat

8.1 Scope

This Section of the Specification defines the supply of materials for, and the application of a prime coat on the surface of the base course prior to the construction of the bituminous seal coat surfacing.

8.2 Referenced Documents

The following documents which are referenced in this Section of the Specification, form part of the Specification only to the extent that they are referred to herein:

Standards Association of Australia

- AS 1141 Methods of Sampling and Testing Aggregates
- AS 1152 Specification for Test Sieves
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 2008 Residual Bitumen for Pavements
- AS 2157 Cutback Bitumen
- AS 2341 Methods of Testing Bitumen and Related Road Making Products

AustRoads

- AG:PT/T530: Calibration of Bitumen Sprayers

RTA NSW

- Test Method T240 Road Surface Texture Depth

8.3 Plant and Equipment

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

Specific items of equipment to be used in the Works shall comply with the following requirements:

- a) **Bituminous Sprayers** shall comply with the requirements of the AustRoads specification for "Bitumen Sprayers". A current test certificate issued by a State Road Authority shall be made available for the Superintendent's inspection
- b) **Brooms and Blowers and Vacuum Sweepers** shall be of the power type and shall be suitable for cleaning the surfaces that are to receive the prime coat. Hand brooms and other tools that may be required shall also be provided

8.4 Materials

8.4.1 Composition

The prime coat shall be cutback bitumen comprising a mixture of residual bitumen and cutter.

8.4.2 Cutback Bitumen

Cutback bitumen shall comply with the requirements of AS 2157 for grade AMC0 cutback bitumen.

Cutback bitumen shall be manufactured at the refinery and shall not be prepared on site.

8.4.3 Cutter

Cutter shall either be power kerosene or aviation turbine fuel (AVTUR).

8.5 Construction

8.5.1 Time of Application

The prime coat shall be applied to the completed base course as soon as practicable after completion of the construction and testing of the base course.

The prime coat shall be applied only when the base course surface is dry and the surface (top 25 mm) has a moisture content at least 2% less than the modified optimum moisture content (determined in accordance with AS 1289.5.2.1).

8.5.2 Weather Limitations

Application of the prime coat shall not start until the pavement temperature is at least 15°C and is likely to remain at least at that temperature during the spraying operations. Spraying of the bituminous materials shall not proceed when rain is likely.

8.5.3 Preparation of Surface

Immediately prior to applying the prime coat to the surface of the base course, the surface shall be inspected to assess sweeping requirements. This shall be a designated **Witness Point**.

Sweeping may not be necessary if the surface of the base course is freshly placed and not damaged by rainfall, traffic or other activities. To be acceptable for receiving the prime coat, the surface shall:

- a) Be free of loose material;
- b) Be generally a smooth clean surface with an average surface texture depth not exceeding 1 mm when measured by the Sand Patch Test in accordance with RTA NSW Test Method T240; and
- c) Exhibit a tight mosaic of coarse aggregate particles in a matrix of compacted fine aggregate.

If sweeping is required, the equipment shall be adjusted and operated with care to only remove the loose material on the surface and/or improve surface cleanliness.

8.5.4 Rates of Application

The rate of application of prime coat shall be selected by the Contractor so that the prime coat will penetrate the surface of the base course and be free from any pools of bituminous material in not less than 6 hours and not more than 48 hours after the time of application, and so that the depth of penetration is not less than 6mm and not more than 10mm.

The prime coat shall be applied to the base course at a uniform rate of between 0.8 and 1.2 litres per square metre of surface area.

No adjustment will be made to the tendered price for variations of the rate of application within the range specified.

The rate of application shall be the quantity measured at 15°C. Volume adjustment for temperature shall be determined by multiplying the measured volume by the relevant multiplier in accordance with **Table 8.1**.

Table 8.1: Volume Correction Table
(Multipliers for reducing the volume of hot bituminous material to the equivalent volume at 15°C)

Observed Temp. (C°)	Multiplier
33	0.989
36	0.987
39	0.985
42	0.983
45	0.981
48	0.979
51	0.978
54	0.976
57	0.974

Note: Dividing the volume of bitumen at 15°C by these multipliers will give the equivalent volume of hot bitumen at the temperature shown.

8.5.5 Application

The prime coat shall be applied at a temperature of between 35°C and 55°C. Any bitumen heated to, or stored at a temperature in excess of 200°C shall not be used in the Works.

The prime coat shall be applied uniformly to all points of the surface to be treated.

All areas or spots missed by the sprayer shall be sprayed with prime coat by hand spraying.

Following the application of the prime coat, the surface shall be allowed to cure without being disturbed for a period of not less than 48 hours, or longer as may be necessary to attain full penetration into the base course and evaporation of volatiles from the prime material.

In areas where the prime does not penetrate adequately, a blinding coat of fine aggregate or sand shall be spread to effectively prevent subsequent pick up of the prime during the application of the surfacing material.

8.5.6 Maintenance

The Contractor shall maintain the prime coat until the construction of the overlying layer, by protecting the coat from any damage which will affect the continuity of the coat, and immediately repairing any breaks or defects in the coat if they appear.

Construction and/or other traffic, except equipment actually engaged in applying the prime coat, shall not be permitted onto the prime coat at any time, and barricades shall be erected if necessary to prevent such trafficking.



8.6 Quality Assurance

8.6.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in Part 2 of the Technical Specification.

The program shall comprise three phases as defined below.

8.6.2 Phase A - Pre-commencement

(a) Supply of Information on Materials Sources

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) Source and manufacturer of cutback bitumen.

The submission of this report shall be a designated **Hold Point**.

(b) Reference Samples

Reference samples of cutback bitumen shall be taken by the Contractor in accordance with the requirements of Appendix B of AS 2157.

All Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions, with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

Each portion of cutback bitumen shall not be less than one litre.

The supply of reference samples shall be a designated **Hold Point**.

(c) Test Certificates

A Test Certificate for the cutback bitumen proposed for use in the Works indicating compliance with the specified requirements shall be provided. This shall represent a designated **Hold Point**.

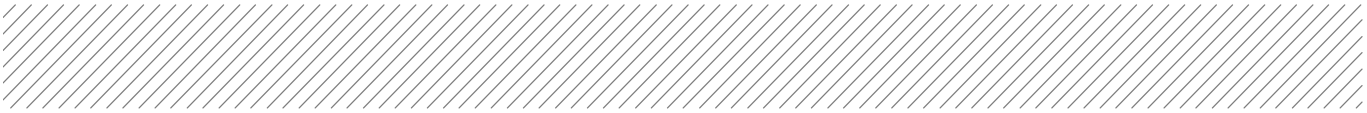
The Test Certificate may be supplied by the manufacturer or by a laboratory registered by NATA for the performance of such tests.

If at any time during the course of the Works, the source of the cutback bitumen is changed, the Contractor shall supply additional Test Certificates at least five days prior to the use of the new material.

8.6.3 Phase B – Production and Process Control

(a) Program

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of the Production and Process Control Testing Program. The Contractor shall then undertake testing and supervision in accordance with the requirements of this clause and the approved Production and Process Control Testing Program.



Submission of the process control program shall be a designated **Hold Point** in the Project Quality Plan.

The Contractor's Production and Process Control Program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the process control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the Works, however, the minimum amount of control testing that shall be undertaken as set out in this Section of the Specification.

The Contractor shall undertake testing and supervision in accordance with the approved Production and Process Control Testing Program.

The Contractor shall keep a record, upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract, then the Contractor shall record a nonconformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

All nonconformances shall be reported to the Superintendent immediately upon detection with advice as to what corrective action is proposed.

(b) Application Rates

The average rate of application of cutback bitumen on any area shall not deviate from the rate selected for the area by more than plus or minus 10%. The rate shall be determined from the measured area sprayed, and the quantity of cutback bitumen sprayed as determined by dipping the bituminous sprayer before and after spraying.

8.6.4 Phase C - Post-Construction

(a) Quality Assurance Records

At the completion of the Works, the Contractor shall supply copies of the results of all testing undertaken.

8.6.5 Correction of Nonconforming Work

Any prime coat that does not meet all the requirements of this Specification shall be resprayed or removed and replaced as specified herein.

In any area where the average rate of application is measured to be less than 90% of the selected rate, the area shall be resprayed so that the total average rate of application is within plus or minus 10% of the rate selected for the area.

Any application rate in excess of 110% of the selected rate shall be non-conforming and the prime coat shall be removed, the base course reinstated and the prime coat reapplied in accordance with the Specification.

8.6.6 Rejection of Work

Any materials or primed pavement layers that do not meet all the requirements of the Specification shall be deemed to be nonconforming.



8.6.7 Witness Points and Hold Points

The following **Witness Points** shall be incorporated in the Project Quality Plan:

- a) Following completion of surface preparation and prior to the application of the prime coat (**Clause 8.5.3**)

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Information on Materials Sources (**Clause 8.6.2(a)**);
- b) Provision of Reference Samples (**Clause 8.6.2(b)**);
- c) Supply of Test Certificate for the cutback bitumen (**Clause 8.6.2(c)**); and
- d) Supply of Test Certificate for the cutback bitumen (**Clause 8.6.3(a)**).

9. Bituminous Seal Coat

9.1 General

This Section of the Specification defines the supply of materials for, and the application of a bituminous seal coat comprising two applications of bitumen and cover aggregate.

9.2 Referenced Documents

The following documents which are referenced in this Section of the Specification, form part of the Specification only to the extent that they are referred to herein:

Standards Association of Australia

- AS 1141: Method for sampling and testing aggregates
- AS 1152: Test sieves
- AS 1289: Methods of testing soils for engineering purposes
- AS 2008: Residual bitumen for pavements
- AS 2157: Cut-back bitumen
- AS 2341: Methods of testing bitumen and related road making products
- AS 2758.2 Aggregates and rock for engineering purposes - Aggregate for sprayed bituminous surfacing
- AS 3568: Oils for reducing the viscosity of residual bitumen for pavements

AustRoads

- AGPT/T530 - 536: Calibration of Bitumen Sprayers, Parts 0 - 6.
- AP-T181/11 Performance Requirements of Bitumen Sprayers
- NTR-07: Bituminous Surfacing – Sprayed Work
- AP-41/96: Bitumen Sealing Safety Guide
- AP-T39/05: Sprayed Seal Cutting Practice

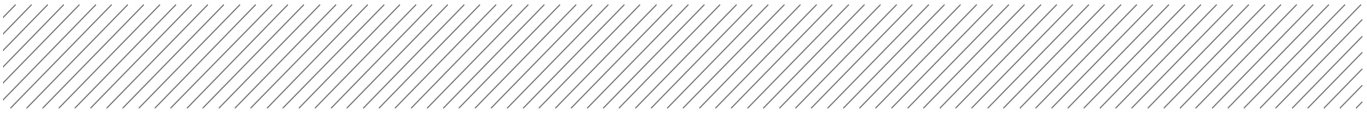
9.3 Plant and Equipment

9.3.1 General

The Contractor shall furnish to the Superintendent not less than seven working days prior to the commencement of work on site a detailed list of all plant items and equipment specified herein which are proposed for use in the performance of the Work covered by this Specification.

This shall be a designated **Hold Point**.

This information shall be used by the Superintendent in a preliminary assessment of the potential adequacy of specific items of plant in advance of the commencement of Works. There is no inference that plant and equipment so offered and assessed is totally suitable or adequate for all or any of the construction works until such is demonstrated by a field construction trial.



Acceptance of the plant and equipment for the trial does not imply final acceptance or approval of the plant and equipment for the Work nor does it relieve the Contractor of the responsibility to perform the Work in accordance with the requirements of the Specification.

The Contractor shall provide all plant, tools and equipment necessary to carry out and complete the Works in accordance with the Specification.

The plant and equipment used in the Works shall be appropriate for the execution of the tasks and shall be maintained in satisfactory working condition at all times while operating.

Specific items of equipment to be used in the Works shall comply with the following requirements:

(a) Bituminous Sprayers

Bitumen sprayers shall comply with the requirements of AGPT/T530 – 536, Calibration of Bitumen Sprayers, Parts 0 - 6.

The Contractor shall include in the Project Quality Plan a copy of the current certificate of compliance with AGPT/T530 – 536, Calibration of Bitumen Sprayers, Parts 0 – 6 for each bitumen sprayer proposed for use showing full compliance with these requirements.

A copy of the certificate shall also be mounted or retained on the sprayer, protected from damage, and shall be available for inspection at all times.

(b) Cover Aggregate Pre-coating Equipment

Cover aggregate pre-coating equipment shall be capable of applying the minimum quantity of pre-coating material that will uniformly coat all aggregate particles in accordance with the method described in **Clause 9.5.3 (d)**.

(c) Trucks

Trucks shall be suitable in number and performance for the transport, delivery and spreading of cover aggregate in accordance with the requirements of this Specification. Each truck shall be fitted with a suitable spreader box (lockable) which does not leak aggregate and is properly adjusted. A sufficient number of trucks shall be provided to enable the width of bitumen binder sprayed to be fully covered in a single operation.

Delays in covering the bitumen binder shall not occur.

(d) Brooms and Blowers and Vacuum Sweepers

Brooms and Blowers and Vacuum Sweepers shall be of the power type and shall be suitable for cleaning the surfaces that are to receive the seal coat. Brooms driven by the forward motion of the equipment shall not be acceptable. Hand brooms and other tools that may be required shall also be provided.

Drag brooms shall be mounted on a frame and designed to redistribute cover aggregate uniformly over the surface of the applied bituminous material without dislodging freshly embedded aggregate.

Hand brooms shall be stiff bass or similar types.

(e) Heating Equipment

Heating equipment for site storage tanks, if used, shall consist of steam coils, hot oil, electricity or other means that will not allow flames to come into direct contact with the heating tank. An armoured thermometer with a range from 10°C to 260°C shall be fixed to the tank so that the temperature of the bituminous material at the top, middle and bottom of the tank may be determined at all times.

(f) Aggregate Spreading Equipment

Aggregate spreading equipment shall be mounted on aggregate delivery trucks and shall be adjustable to uniformly spread aggregate at controlled quantities per square metre. Measurement shall be carried out prior to commencement of work to determine the volume capacity of each unit to a fixed mark on the unit.

(g) Steel Wheel Rollers

Steel-wheel rollers shall be self-propelled tandem types with a roll diameter of not less than 1.2 m and a loading intensity under operating conditions within the range 2 to 4 tonnes per linear metre of roll. The roller shall be capable of changing direction smoothly and reversing without backlash. The roller wheels shall have no flat and pitted areas, and no projections that will leave marks in the pavement.

(h) Pneumatic Tyred Rollers

Pneumatic tyred rollers shall be self-propelled and have an effective rolling width of not less than 1.5 m. Each pass of the roller shall result in at least one passage of a roller tyre on the pavement surface for the whole roller width.

The rollers shall be capable of ballasting to achieve a load in the range 1-2 tonnes per wheel. Rollers shall have a speed rating of up to 15 km/hr.

Tyres shall be heavy duty smooth tread types. Tyre pressures shall be between 700 to 850 kPa and each tyre shall be kept inflated to the specified pressure such that the pressure difference between any two tyres shall not exceed 35 kPa. Means shall be provided for checking and adjusting the tyre pressure on the job at all times.

9.3.2 Maintenance

The Contractor shall inspect each item of plant and equipment used on the Works daily to ensure it is free of fluid, oil, grease or water leaks and such inspections shall be a **Hold Point** and recorded in the Contractor's Quality Assurance System.

Plant and equipment permitted for use and used on the Work shall be maintained in a satisfactory working condition at all times. Plant and equipment used on the Work shall not drip fuel, oil, grease or water or other material onto the pavement and any plant or equipment that is found to drip fuel, oil, grease or water or other material shall be removed from the Works immediately until it is adequately repaired. Temporary repairs shall not be accepted.

Removal of critical items of plant or equipment from the Works due to breakdown or because they have contaminated the Works by leaking fluids shall require that the Contractor ceases work until the defective items of plant or equipment are repaired. Such events shall be **Hold Point**. The cost of delays caused as a result of the defective plant or equipment shall not form the basis for a claim against the Principal.

9.4 Materials

9.4.1 General

The source from which each bituminous material and aggregate is to be obtained shall be selected by the Tenderer before submitting the tender and shall be stated in the Tender.

9.4.2 Bitumen

Bitumen for hot bitumen sealing shall be a conventional Class C320 bitumen complying with the requirements of AS 2008 and when tested in accordance with AS 2341.13 shall have a time to reach the Specified Apparent Viscosity Level (SAVL) of not less than seven (7) days, unless a lower value is agreed with the Superintendent.

9.4.3 Cutter

The cutter for the seal binder, if required, shall comply with the requirements of AS 3568.

The amount of cutter to be used shall be determined in accordance with AustRoads AP-T39/05: Sprayed Seal Cutting Practice. **Table 9-1** has been provided as a guide.

Table 9-1: Cutting of Bitumen

Pavement Surface Temperature (°C)	10mm Aggregate nominal (parts or percentage of volume)	7mm Aggregate nominal (parts or percentage of volume)
20 to 25	8	10
26 to 32	6	8
33 to 38	4	6
39 to 45	2	4
>45	0	2

9.4.4 Bitumen Additives

The use of bitumen additives of any type shall not be permitted.

9.4.5 Pre-coating Material

The pre-coating material shall be either diesel fuel containing 1% of Megamine BA or a suitable proprietary pre-coating material that when applied to the cover aggregate at the specified rate will achieve the following stripping resistance. **Waste motor oil is not acceptable as a pre-coating material and shall not be used under any circumstances.**

When tested in accordance with AS 1141.50 "Resistance to Stripping of Cover Aggregates and Binders", the pre-coated aggregate shall show a percentage of stripping from the bitumen proposed for use in the work of not greater than 5%. However AS1141.50 Clause 7(d) shall be amended to read 'Remove the plate containing the binder and aggregate particles from the oven and immerse in the water bath at a temperature of between 47°C and 53°C for at least 4 days'.

The target rate of application for tendering purposes is 6-8 litres per cubic metre.

9.4.6 Cover Aggregate

The cover aggregate for application to the bituminous binder in the first seal coat shall be 10 mm nominal maximum size and in the second seal coat shall be 7 mm nominal maximum size and all cover aggregate shall consist only of crushed natural igneous rock complying with the following requirements:

Cover aggregate shall consist of clean, hard, dry, tough, sound particles of crushed rock of uniform quality, free from dust, clay, dirt or other deleterious matter and free from an excess of flat, elongated or laminated particles. The aggregate shall comply with the requirements of AS 2758.2 for Class B, and the particle size distribution shall be in accordance with **Table 9-2**.

The aggregate shall conform to the particle size distribution shown in **Table 9-2** when tested in accordance with AS 1289.3.6.1.

Table 9-2: Particle Size Distribution for Cover Aggregate

AS Sieve	Percentage by Mass Passing	
	10 mm	7 mm
13.2 mm	100	
9.5 mm	85-100	100
6.7 mm	0-30	85-100
4.75 mm	0-8	0-30
2.36 mm	0-2	0-10
1.18 mm		0-5

9.4.7 Adhesion Agents

The use of an adhesion agent in the binder to improve the adhesion of the binder to the cover aggregate shall only be permitted if adequate adhesion cannot be achieved using reasonable quantities of anti-stripping agent in the pre-coating material. Written evidence of the materials prior successful use shall be provided before use of any adhesion agent shall be permitted.

9.5 Construction

9.5.1 General

The Contractor shall be deemed to have based the Contract Price on the target rates of application for residual bitumen in bituminous binder and cover aggregates specified in **Table 9-3**.

The actual rates of application of the above materials to be used in the Work shall initially be determined following the construction of test areas as specified in **Clause 9.5.4**. These initially determined application rates of materials may be altered to suit field conditions during the progress of the Works. The Contractor shall allow for increases or decreases in the rates of application specified when ordering/supplying the bitumen binder, pre-coating material and cover aggregates.

9.5.2 Rates of Application

The rates of application of seal coat materials shall be as specified in **Table 9-3**.

Table 9-3: Rates of Application for Bituminous Sealing (For Tendering Purposes)

Seal Type	Coat	Nominal Aggregate Size	Binder Application Rate at 15°C (litres per m ² residual bitumen)	Aggregate Application Rate (m ² per m ³)
2 Coat	1st	10 mm	1.10-1.80	90-120
	2nd	7 mm	1.00-1.80	120-150

No adjustment will be made to the tendered price for variations of the rate of application above or within the range specified.

The rate of application shall be the quantity measured at 15°C. Volume adjustment for temperature shall be determined by multiplying the measured volume by the relevant multiplier in accordance with **Table 9-4**.

Table 9-4: Volume Correction Table
(Multipliers for reducing the volume of hot bituminous material to the equivalent volume at 15°C)

Observed Temp. (°C)	Multiplier	Observed Temp. (°C)	Multiplier	Observed Temp. (°C)	Multiplier
15	1.000	81	0.959	147	0.920
18	0.998	84	0.957	150	0.918
21	0.996	87	0.956	153	0.916
24	0.994	90	0.954	156	0.914
27	0.993	93	0.952	159	0.913
30	0.991	96	0.950	162	0.911
33	0.989	99	0.948	165	0.909
36	0.987	102	0.946	168	0.907
39	0.985	105	0.945	171	0.905
42	0.983	108	0.943	174	0.904
45	0.981	111	0.941	177	0.902
48	0.979	114	0.939	180	0.900
51	0.978	117	0.937	183	0.899
54	0.976	120	0.936	186	0.897
57	0.974	123	0.934	189	0.895
60	0.972	126	0.932	192	0.893
63	0.970	129	0.930	195	0.892
66	0.968	132	0.928	198	0.890
69	0.967	135	0.927	201	0.888
72	0.965	138	0.925	204	0.886
75	0.963	141	0.923		
78	0.961	144	0.921		

Note: Dividing the volume of bitumen at 15°C by these multipliers will give the equivalent volume of hot bitumen at the temperature shown.

9.5.3 Preparations for Sealing

(a) Safety Precautions

The safety precautions described in the AustRoads publications NTR-07 "Bituminous Surfacing-Sprayed Work" and AP – 41/96 "Bitumen Sealing Safety Guide" shall be followed during the execution of these Works.

At all times the bitumen and/or cut-back bitumen shall be measured into the tank first and then the required amount of cutter added. Mixing shall be continuous for a sufficient time to ensure a uniform mixture of the two components prior to spraying.

(b) Care of Bituminous Materials

All bituminous materials and cutter shall be kept completely free of all contaminants prior to application to the prepared surfaces. Any bitumen, binder or cutter contaminated with foreign matter, in any manner, shall be rejected and shall not be used in the Works.

Care shall be taken by the Contractor to avoid either local or total overheating of bituminous materials. In no case shall bitumen containing cutter be heated over 200°C or held at spraying temperatures for more than 6 hours. Bituminous materials that have been overheated shall be rejected and shall be removed from the site at no cost to the Principal.

(c) Stockpiling Cover Aggregate

The pre-coated cover aggregate shall be stockpiled on the site prior to commencement of any work. The stockpiles shall be located on prepared sites in areas designated by the Superintendent. Preparation of the site shall include:

- a) Clearing the site of all vegetation and obstructions,
- b) Constructing an area adequate for the stockpiling operations which will support the delivery vehicles during any periods of wet weather without bogging and which will not pond water; and,
- c) Surfacing the area with a sacrificial layer of at least 100 mm thickness of the material to be placed in the stockpile.

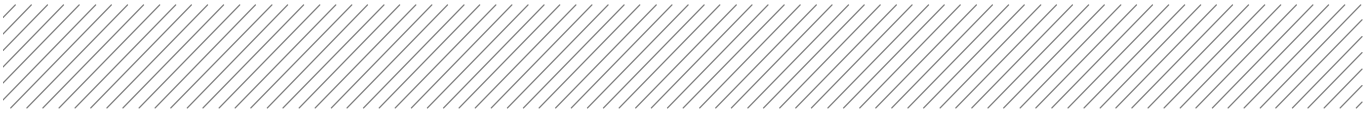
(d) Pre-coating of Cover Aggregate

The cover aggregate shall be pre-coated by the Contractor at an application rate within the specified range using the approved pre-coating material. The pre-coating material shall be thinly and evenly applied by means of a fine pressure spray to a moving stream of aggregate so that all particles are fully coated, but not excessively. The pre-coated aggregate shall be free flowing and the particles shall not adhere one to another.

When pre-coating material is being applied, the aggregate may be dry or damp, but shall not contain sufficient moisture to cause uneven distribution of the pre-coating material on the aggregate particles.

Pre-coating shall be carried out sufficiently in advance of the spreading of the cover aggregate on the binder to permit adequate curing of the pre-coating material and such that fluxing of the binder does not occur. The curing period shall be sufficient to ensure that the pre-coating material has adhered effectively to the aggregate.

Precoated aggregate shall be stockpiled in such a way that it is thoroughly protected from contamination by dust, water or other foreign matter until spread. If there is a visible coating of dust on the particles of aggregate, that portion of the stockpile shall be precoated again prior to use.



If the effectiveness of the pre-coating is lost, for any reason, the cover aggregate shall be pre-coated again as directed. The cost of the retreatment shall be borne by the Contractor.

No adjustment to the Contract Price shall be made for variations in the rate of pre-coating of cover aggregate that may be required or directed.

The precoated aggregate shall be dry or tacky at the time of application and shall flow evenly from the spreader.

(e) Surface Preparation

Immediately before applying any seal coat to the aircraft pavements, and only if required, all loose aggregate, dirt, clay, oil, or any other deleterious substance shall be removed and/or washed from the surface using a power operated broom and/or suction sweeper supplemented as necessary by hand brooms and shovels. Care shall be exercised by the Contractor when sweeping the surfaces of pavements to avoid damaging the surface during turning and braking. After completion of this cleaning operation and prior to any spraying, an inspection of the area to be sealed shall be made by the Contractor and the Superintendent to determine the suitability of the area to receive the bituminous material.

A **Hold Point** shall be included in the Contractor's Quality System at this point.

Any damage to the prepared surface resulting from the cleaning operation shall be repaired by the Contractor at no cost to the Principal.

(f) Weather Limitations

Application of the bituminous seal shall not commence until the pavement temperature is in excess of 15°C and is likely to remain in excess of 15°C during the entire sealing operation.

Bituminous seals shall not be applied to the pavement when the surface is moist or wet. Spraying of the bituminous materials shall not proceed when rain is likely, when the prepared surface is wet, or during high winds.

The quantity of cutter required to be added to the binder is dependent on the pavement temperatures during spraying and shall be adjusted as necessary in accordance with **Table 9-1** when variations in the pavement temperature occurs.

(g) Access

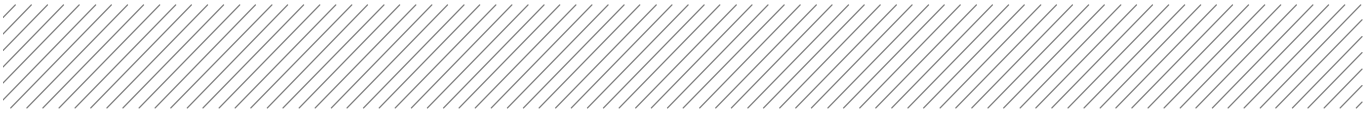
All construction plant and delivery vehicles shall enter onto the area of the Works by way of the aircraft pavements, or other routes designated by the Superintendent. No vehicles or construction plant shall travel over the unpaved flank areas.

(h) Protection against Overspray

The Contractor shall cover all adjacent structures and fixtures using paper or plastic sheet to protect the items from contamination. Upon completion of the sealing works the Contractor shall remove all protective coverings and lawfully dispose of them off the site of the Works.

The edges of adjacent asphalt surfaced pavements shall not be over-sprayed with bitumen and appropriate end jets shall be used to ensure a full and adequate application of binder at the edge of asphalt. To prevent spray drift and splatter, particularly in windy conditions, a shield shall be attached to the end of the spray bar, if required or directed.

The Contractor shall be responsible, at his expense, for removing any bituminous material which has adhered to any airport fixtures or structures as a result of his actions or, if it is not possible to remove



such bituminous material, the replacement and making good of the part splashed or sprayed with bituminous material.

9.5.4 Construction Trials

The Contractor shall conduct construction trials to demonstrate the capacity of his plant and personnel to carry out sprayed hot bitumen sealing in accordance with this Specification and to enable the Superintendent to check that the application rates proposed are adequate and sufficient to produce the required surface finish. This shall be a **Witness Point**.

The bitumen binder application rate of the first construction trial shall be agreed between the Contractor and Superintendent.

At least 2 hours prior to the intended commencement of the general application of the hot bitumen, the Contractor, in the presence of the Superintendent, shall construct, in accordance with the requirements of the Specification, test sections of the hot bitumen seal on an area designated by the Superintendent. The test sections shall be of a width equal to the proposed spray bar width for the general application and not less than 30 metres long.

Test areas that are not constructed as specified shall be considered non-conforming and shall be rectified in accordance with the Contractors Project Quality Plan. If required the Contractor shall re-spray and/or re-cover the hot bitumen seal in non-conforming test areas, or carry out other rectification of the pavement in accordance with the requirements of this Specification, and conduct another construction trial in accordance with this Clause all at the Contractor's expense.

The Contractor shall construct additional test areas on areas of the Works selected by the Superintendent using corrected rates of application of the hot bitumen seal and cover aggregate or amended procedures such as to comply with the requirements of this Specification.

The Contractor shall advise the Superintendent in writing of the rates of application of bitumen binder and cover aggregate to be applied in the execution of the Works. This submission shall be a **Hold Point**. Accepted test areas may be incorporated into the Works.

The Contractor shall not be entitled to any claims for delay or extensions of time resulting from the need to construct test areas or additional test areas.

9.5.5 Sealing Procedures

(a) General

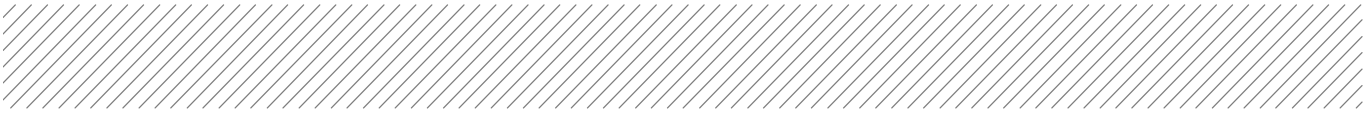
The commencement of sealing work shall be a **Witness Point**.

All bituminous materials shall be applied using a bitumen sprayer complying with this Specification.

The Contractor shall mark out the pavement before each spray run with paint marks if necessary to indicate the line along which the sprayer shall drive to ensure the bitumen binder is sprayed on the correct portion of the pavement.

The width and length of the area to be sprayed shall be limited to that which can be covered with aggregate at the specified rate within two minutes of spraying. All spray runs shall be of approximately equal length but the maximum length shall be 300m.

At the ends of each spray run of bitumen binder the Contractor shall commence and end each spray run on protective strips of building paper laid on the surface across the direction of spraying. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the sprayer's road speed is constant and correct to yield the specified application rate and the spray is fully developed at the commencement of spraying onto the pavement. Immediately after the



application of the bitumen binder, the building paper shall be removed from the site and not re-used in the Works.

After each and every spray run and before the commencement of any subsequent spray run the average application rate of the bitumen binder for that spray run shall be determined by dippings of the tank. Any necessary adjustments shall be made to ensure that the specified or ordered rate of application is maintained in subsequent runs.

If the average spraying rate on any spray run of bitumen binder is less than 95% or more than 105% of the ordered application rate or if the whole area being sprayed is not uniformly covered then that spray run shall be rejected.

(b) Hot Bitumen Binder for Sealing

The Contractor shall spray the bitumen binder at a temperature within the range 160°C – 180°C uniformly to all points on the prepared surface at the application rate established and agreed with the Superintendent from the results of the construction trials. The binder shall be circulated for at least 10 minutes prior to spraying and shall be applied as soon as possible after heating to the specified application temperature. If ordered, cutter shall be added in the proportions listed in **Clause 9.4.3** to suit the measured pavement temperature. Full records of the proportions of cutter added shall be maintained in the Contractor's Quality Assurance records.

Before any bitumen binder is sprayed, sufficient cover aggregate to cover all the bitumen binder to be sprayed in the spray run shall be ready in the trucks on site and the trucks shall be tipped ready for spreading. The pneumatic tyred rollers shall also be assembled on site ready to commence rolling the cover aggregate promptly and without any delay after the aggregate is spread on the bitumen binder.

Care shall be taken to ensure that no overlap occurs between successive spray runs and that no strips are left unsprayed. All areas or spots missed by the sprayer shall be sprayed with binder using hand spraying equipment.

The maximum amount of bitumen binder that shall be sprayed in any one working period shall be limited to that which can be rolled, in accordance with the requirements of this Specification, to not less than 80% completion within that working period.

No smoking, fires or flames, other than the heaters that are a part of the equipment, shall be permitted near heating, spraying or transferring operations of the binder.

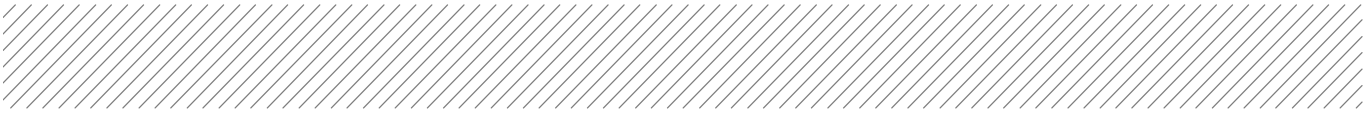
All necessary precautions shall be taken to prevent the binder from being sprayed on to existing structures such as kerbs, gutters, gratings, hydrants, lights, and any other aerodrome fixtures or furnishings. Any surfaces accidentally sprayed shall be cleaned to remove all contamination by bituminous material.

(c) Spreading Cover Aggregate

Immediately after the application of the binder, the precoated aggregate shall be uniformly distributed by means of approved aggregate spreading equipment, which shall follow the binder sprayer as closely as safety will permit, at the agreed spreading rate based on the test area results, to achieve a single uniform tightly interlocked mosaic of stone and such that the area is covered within 2 minutes of spraying. If any delay occurs in the application of the aggregate, further spraying shall be suspended immediately, including any spray run which may be in progress at the time.

The Contractor shall employ every effort to achieve the above requirement without excessive deviation from the directed rate of application of cover aggregate.

Any areas of the bitumen binder that are inadvertently missed by the spreading equipment shall be rapidly covered by hand application of additional aggregate.



Under-spreading of cover aggregate to the extent that a second cover of aggregate is required shall not be permitted. Overspreading of cover aggregate shall require additional brooming and sweeping during rolling at no additional cost to the Principal to remove the excess and ensure an even coverage.

The equipment used to spread the aggregate shall be operated in such a manner that the binder is covered by the aggregate in advance of the wheels passing over the area. The aggregate feeding rate and equipment speed shall be continually checked and adjusted throughout the spreading to ensure that the rate of application of aggregate is as specified.

(d) Rolling Cover Aggregate

i) General

Immediately following the application of the aggregate, the surface shall be subjected to rolling by the pneumatic tyred rollers. The pneumatic tyred rollers shall be operated at a uniform average speed in the range 10 to 15 km/h in such a manner that the aggregate is not displaced. Initial passes shall be slower if necessary to avoid any damage to the fresh seal.

The Contractor will be permitted to interrupt rolling of the cover aggregate at the end of any working period provided that during that period not less than 80% of the rolling specified below has been completed.

A coverage is defined as the application of the roller wheel to all parts of the surface.

ii) Pneumatic Tyred Rolling

The number of pneumatic tyred rollers shall be sufficient to apply one coverage to the full width of the lane being sealed in one pass, and shall follow the aggregate spreader/s as closely as safety will permit, immediately following application of the cover aggregate and operating at a uniform speed sufficient to keep up with the aggregate spreader/s.

Pneumatic tyred rolling shall continue until not less than one roller hour per 800 litres of residual bitumen sprayed has been applied uniformly to the full area of the seal coat in the area being rolled and any additional rolling that may be required until a suitable tight interlocked surface texture has been achieved.

Any additional pneumatic tyred rolling that may be directed shall be carried out at no additional cost to the Principal.

iii) Drag Brooming of Cover Aggregate

Drag brooming of the cover aggregate shall be carried out following application of at least one coverage of the rollers but under no circumstances shall drag brooming delay the rollers in any way. If drag brooming results in tearing of the surface or any dislodgement of the cover aggregate or delays to the rolling caused by drag brooming shall require such operations to be suspended and replaced by hand brooming or deferred until the surface has consolidated sufficiently to resist such damage or until delays to the rolling will not occur.

Drag brooming shall be supplemented by hand brooming as required to correct any areas where distribution is not uniform. Drag brooming shall not exceed that required to just distribute the aggregate uniformly.

Rolling and brooming shall continue over the area for as long as necessary to ensure uniform distribution of the aggregate and incorporation into the binder. Rolling shall be uniformly distributed over the area at a rate of one roller hour per 300 m² for each seal coat application or such lesser or greater amount of rolling to achieve the specified surface finish.



(e) Sweeping

Each finished seal coat shall be swept on completion of the specified amount of rolling to remove all loose aggregate. If overspreading of the cover aggregate has occurred, sweeping shall be undertaken on completion of approximately 50% of the specified amount of rolling and these areas shall be re-swept at completion of rolling or as directed until all excess aggregate has been removed, at no additional cost to the Principal.

Excess aggregate shall be windrowed and picked-up from the pavement surface, not swept off the pavement edges. Care shall be exercised during sweeping so as not to damage the freshly sealed surface. The excess aggregate shall not be returned to the stockpile. It shall be deposited in a location designated by the Superintendent or removed from the site.

At the completion of sweeping in any area the pavement shall be jointly inspected by the Contractor and the Superintendent and this shall be a **Hold Point**.

(f) Steel Wheel Rolling

Steel wheel rolling shall not commence until all excess aggregate is removed from the surface. Steel wheel rolling shall be carried out to apply not less than two (2) coverages uniformly to the full area of the seal coat or any additional rolling that may be directed. Steel wheel rolling shall cease if excessive crushing of aggregate occurs.

Steel wheel rolling shall be carried out in a longitudinal or transverse direction as appropriate. Care shall be exercised not to damage light bases within the sealed area during the steel wheel rolling.

The steel wheel roller shall only operate in the static mode.

(g) Second Seal

A period of at least 24 hours, or such longer period as the Superintendent may direct, shall elapse between the application of the first and second surfacing coats.

Prior to the second application of binder and the application of binder for the surface shall be thoroughly broomed to remove all loose aggregate.

The application of binder shall be undertaken in accordance with **Clause 9.5.5(b)**, but starting and finishing points for individual spray runs shall not occur coincidentally with those for the first seal coat.

Spreading and incorporation of aggregate in the second seal and shall be in accordance with **Clauses 9.5.5(c) and 9.5.5(d)**.

(h) Maintenance

From the completion of each section of the work until the end of the maintenance period, the surface shall be regularly inspected and any tendency to softening or bleeding shall be checked by the addition of small amounts of aggregate uniformly spread and rolled into the surface. All loose aggregate shall be removed from the surface by light sweeping.

Any breaks in the finished sealed surface shall be repaired and the seal shall be adequately maintained.

Construction and/or other traffic shall not be permitted onto the seal coat at any time, and barricades shall be erected if necessary to prevent such trafficking.



9.6 Quality Assurance

9.6.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in Part 2 of the Technical Specification.

The Contractor shall continually monitor the production and quality of the materials to be incorporated into the hot bitumen seal coat and the construction processes to ensure they comply with the requirements of this Specification. As part of the quality control system the Contractor shall sample and test the cover aggregate, obtain certificates of compliance for the bitumen and monitor the bitumen temperature and the application rates of all the materials.

All quality control tests to be undertaken by the Contractor shall be performed by laboratories registered with NATA for performing the tests and all test results shall be certified in accordance with NATA requirements.

The Contractor shall assess the implications of his process quality control tests and results. If these tests indicate that the materials or work are not in accordance with this Specification, then the Contractor shall take the necessary action to complete the Works in accordance with the requirements of the Contract.

The program shall comprise three phases as defined below.

9.6.2 Phase A - Pre-commencement

(a) Supply of Information on Materials Sources

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) Source and manufacturer of cutback bitumen (in accordance with the requirements of Clause A4 and A5 of Appendix A of AS 2008); and
- b) Source of cover aggregate (including all details included in Appendix B of AS 2758.2).

The submission of this report shall be a designated **Hold Point**.

(b) Reference Samples

Reference samples of cutback bitumen shall be taken by the Contractor in accordance with the requirements of Appendix B of AS 2157.

Reference samples of cover aggregate shall be taken by the Contractor in the presence of the Principal (or his representative) in accordance with the requirements of AS 1141.3.1.

All Reference Samples shall be truly representative of the materials and shall comply in all respect with all requirements of the Specification.

The Reference Samples shall be divided into two representative portions, with one being held by the Contractor and the second portion by the Principal until completion of the Defects Liability Period.

Each portion of cutback bitumen shall not be less than 1 L.

Each portion of cover aggregate shall not be less than 50 kg.

The supply of reference samples shall be a designated **Hold Point**.



(c) Test Certificates

Test Certificates for the bitumen proposed for use in the Works indicating compliance with the specified requirements shall be provided at least two weeks prior to the use of the material. This shall represent a designated **Hold Point**.

Test Certificates for the cover aggregate proposed for use in the Works indicating compliance with the specified requirements in accordance with AS 2758.2 shall be supplied at least two weeks prior to the use of the material, and this shall represent a designated **Hold Point**.

The Test Certificates may be supplied by the manufacturer or by a laboratory registered by NATA for the performance of such tests.

If at any time during the course of the Works, the source of the bitumen or cover aggregate is changed, the Contractor shall supply additional Test Certificates at least five days prior to the use of the new materials.

9.6.3 Phase B – Production and Process Control

(a) Program

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of the Production and Process Control Testing Program. The Contractor shall then undertake testing and supervision in accordance with the requirements of this clause and the approved Production and Process Control Testing Program.

The Contractor's Production and Process Control Program shall consist of sampling and testing the materials and product, and a continuous assessment of the adequacy of the process control. The Contractor is responsible for designing and implementing a control program which provides adequate and effective control over the Works, however, the minimum amount of control testing that shall be undertaken as set out in this Section of the Specification.

The Contractor shall undertake testing and supervision in accordance with the approved Production and Process Control Testing Program.

The Contractor shall keep a record, upon a plan of the Works, of where each work shift's production has been incorporated in the Works.

If the control results indicate that the materials being produced are not in accordance with the requirements of the Contract, then the Contractor shall record a non-conformance and shall not incorporate the materials represented by those test results into the works. The Contractor shall modify the manufacturing process so that conforming materials are produced.

All non-conformances shall be reported to the Superintendent immediately upon detection with advice as to what corrective action is proposed.

(b) Bitumen

The Contractor shall take a sample of binder from each delivery vehicle to the site and the samples shall be handed to the Superintendent immediately. Samples shall consist of two two litre sealed containers labelled appropriately such as to identify the location within the works (lots) that they represent, including traceability to the delivery dockets and supplier's manufacturing batch records and conformance reports. Within two weeks of the Date of Practical Completion, the samples shall be retrieved from the Superintendent and lodged with:

ARRB Transport Research
(Attention: Laboratory Manager)
500 Burwood Highway

VERMONT SOUTH, Victoria, 3133

The Contractor shall arrange delivery and pay all lodgement fees at the Contractor's expense.

All samples of binder shall be obtained in accordance with Appendix B of AS2008, and taking of the samples shall be a **Witness Point**. Sampling of materials may be observed by the Superintendent when deemed necessary. Samples shall be supplied by the Contractor at no additional expense to the Principal. Samples of bitumen shall be taken during construction at the rate of one sample per delivery vessel (tank) of bitumen delivered to the Works, from delivery vehicles, or from site storage tanks (i.e. approximately one sample per 20,000 litres).

Materials which do not comply with this Specification because of contamination or deterioration during handling shall be deemed non-complying and shall be rejected.

(c) Bitumen Test Certificates

The Contractor shall obtain test certificates covering all the bituminous material delivered to the site.

The test certificates shall contain the results of tests conducted on representative samples of the material taken from each batch of bitumen manufactured and delivered to the Works. The tests conducted shall be those required to permit an assessment to be made of the conformity of the material with the requirements of the Specification.

A copy of each test certificate shall be included in the Contractors Quality System. Material for which a test certificate is not obtained shall not be used in the Works.

(d) Temperatures

The Contractor shall measure and record the temperature of all bitumen delivered to the site in the delivery vehicle prior to the transfer of the bitumen to the storage tanks or the bitumen sprayer.

The temperature of the bitumen in all on-site storage tanks used to store bitumen for use under this Contract shall be measured and recorded by the Contractor at least once a day and at least once every hour when the bitumen is being heated.

The Contractor shall measure and record the temperature of the bitumen in the bitumen sprayer immediately prior to the commencement of spraying.

All temperature measurements shall be recorded in the Contractor's Quality Assurance System.

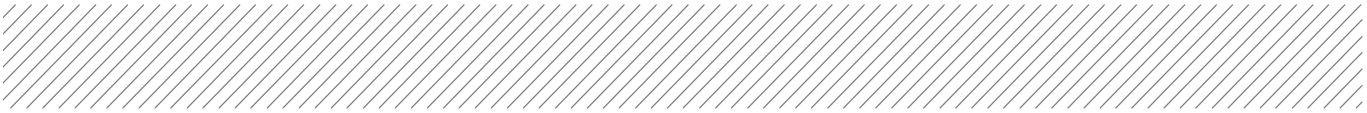
(e) Amount of Cutter Added

If cutter is to be added to the bitumen, the Contractor shall measure and record the quantities of cutter and bitumen mixed to produce the binder and determine the proportion of cutter to bitumen in the mixture. The quantities shall be determined from dippings of the mixing tank prior to and subsequent to the addition of cutter. Alternatively if the materials are mixed in the bitumen sprayer the vehicle may be weighed prior to and subsequent to the addition of cutter.

The measurements, calculations and results of the determination of the proportion of cutter in the binder for each spray load of binder shall be available for inspection by the Superintendent immediately prior to spraying on the Works and shall be recorded in the Contractor's Quality Assurance System.

(f) Residual Bitumen Spraying Rate

The Contractor shall determine and record the average rate of application of residual bitumen for each spray run. The average spraying rate shall be determined from the amount of bitumen binder sprayed,



calculated from dippings of the bitumen sprayer tank before and after the spray run, and the area sprayed.

The average rate of application of cutback bitumen on any area shall not deviate from the rate selected for the area by more than plus or minus 10%. The rate shall be determined from the measured area sprayed, and the quantity of cutback bitumen sprayed as determined by dipping the bituminous sprayer before and after spraying, corrected to 15°C from the temperature of application in accordance with **Table 9-3** and **Table 9-4**.

The temperature at which the binder was sprayed shall also be recorded.

(g) Cover Aggregate

The average application rate of cover aggregate in any lot of the work shall be within the range specified. The average rate of application shall be determined after spreading, from the measured area and the measured volume spread.

All aggregates supplied to the Works shall be sampled and tested on a routine basis to determine their compliance with the specified properties as required by the Contractor's Quality Assurance Program. The frequency of sampling and testing shall be such as to ensure that changes in quality of the materials are detected sufficiently in advance of the materials being incorporated in the Works to reject, verify or otherwise take action to avoid the inclusion of non-complying materials.

Production samples shall be obtained from the stockpiles as required and prior to the delivery of the materials to site.

The results of production testing shall be available at all times to the Superintendent for inspection.

All material that does not comply with the requirements of the Specification shall be rejected and shall not be incorporated in the Works.

The Contractor shall take at least one representative bulk sample of cover aggregate, in accordance with the requirements of AS 1141.3.1, from each 200 tonnes of the cover aggregate proposed to be used in the Work. Bulk samples shall consist of at least five random sample increments.

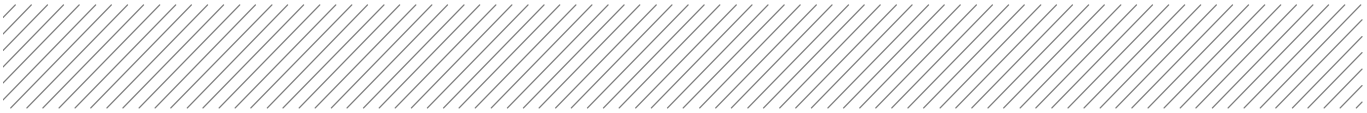
The Contractor shall determine the particle size distribution of each bulk sample in accordance with the requirements of AS 1289.3.6.1 'Determination of the particle size distribution of a soil - Standard method of analysis by sieving'.

(h) Testing

Testing shall be performed, in accordance with the test methods specified herein and/or detailed in the applicable standards listed in this Clause by a NATA registered laboratory. The cost of all the testing shall be borne by the Contractor.

The following is a list of the test methods relevant to this Section of the Specification together with the basic designation of the applicable publication:

- (i) AS 1141.2: Methods for sampling and testing aggregates – Basic testing equipment
- (ii) AS 1141.3.1: Methods for sampling and testing aggregates – Sampling – Aggregate
- (iii) AS 1141.14: Methods for sampling and testing aggregates – Particle shape, by proportional calliper
- (iv) AS 1141.23: Methods for sampling and testing aggregates – Los Angeles value
- (v) AS 1141.24: Methods for sampling and testing aggregates – Aggregate soundness – Evaluation by exposure to sodium sulphate solution

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- (vi) AS 1141.14: Methods for sampling and testing aggregates – Particle shape, by proportional calliper
 - (vii) AS 1289.3.6.1: Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving
 - (viii) AS 2341: Methods of testing bitumen and related roadmaking products - General introduction and list of standards

(i) Acceptance

The acceptance of bitumen and cover aggregate at any stage of production and construction shall be determined by the Contractor based on the results of routine tests on individual lots of material, in accordance with the approved Project Quality Plan. Each acceptance shall be a **Hold Point**.

9.6.4 Phase C - Post-Construction

(a) Quality Assurance Records

At the completion of the Works, the Contractor shall supply copies of the results of all testing undertaken.

9.6.5 Correction of Nonconforming Work

Any seal coat that does not meet all the requirements of this Specification shall be resprayed or removed and replaced as specified herein.

In any area where the average rate of application is measured to be less than 90% of the selected rate, the area shall be resprayed so that the total average rate of application is within plus or minus 10% of the rate selected for the area.

Any application rate in excess of 110% of the selected rate shall be non-conforming and the seal coat shall be removed, the base course reinstated and primed, and the seal coat re-applied in accordance with the Specification.

9.6.6 Rejection of Work

Any materials or areas of sealed pavement that do not meet all the requirements of the Specification shall be deemed to be nonconforming.

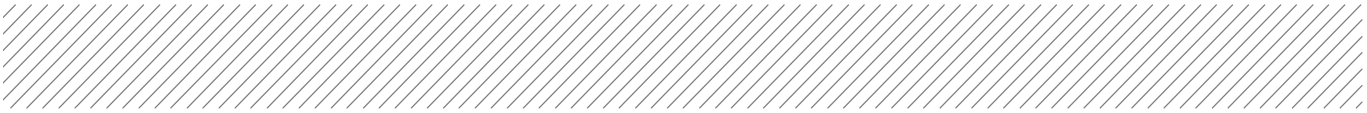
9.6.7 Witness Points and Hold Points

The following **Witness Points** shall be incorporated in the Project Quality Plan:

- a) Construction Trials (**Clause 9.5.4**);
- b) Commencement of sealing (**Clause 9.5.5(a)**); and
- c) Binder Samples (**Clause 9.6.3(b)**).

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Plant and equipment list (**Clause 9.3.1**);
- b) Maintenance of plant and equipment (**Clause 9.3.2**);
- c) Breakdown of plant and equipment (**Clause 9.3.2**);

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- d) Surface preparation (**Clause 9.5.3(e)**);
 - e) Construction trials (**Clause 9.5.4**)
 - f) Sweeping (**Clause 9.5.5(e)**);
 - g) Information on Materials Sources (**Clause 9.6.2(a)**)
 - h) Provision of Reference Samples (**Clause 9.6.2(b)**);
 - i) Supply of Test Certificate for the cutback bitumen (**Clause 9.6.2(c)**);
 - j) Supply of Test Certificate for the cover aggregate (**Clause 9.6.2(c)**); and
 - k) Acceptance of bitumen and cover aggregate (**Clause 9.6.3(i)**).

10. Grassing

10.1 General

This Section of the Specification defines the requirements for grassing of all areas disturbed during the course of the Works.

10.2 Referenced Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 1160 Bitumen Emulsions for Construction and Maintenance of Pavements
- AS 1289.5.3.1 Methods of Testing Soils for Engineering Purposes
- AS 2223 Garden Soils for Domestic Use
- AS 4419 Soils for landscaping and garden use

10.3 Materials

10.3.1 Topsoil

Where the topsoil at the site has been stripped and stockpiled, it shall be used and placed in locations where top soiling is required as shown on the Drawings.

Where necessary to supplement the stockpiled topsoil from the site, imported topsoil shall be supplied and placed.

The imported topsoil shall be won from the original surface layer of soil from grassland, bushland or cultivated land conforming to the requirements of AS 2223 except that the pH value of the imported topsoil, when determined in accordance with AS 1289.5.3.1, shall be within the range of 6.0 to 7.0. The texture of the imported topsoil shall be coarse to medium.

10.3.2 Grass Seed

Grass seed shall be a commercially prepared mix of fescue, couch, and rye with a high percentage of ryes.

The proposed mix composition (by mass) shall be submitted to the Superintendent for approval prior to undertaking the work. This shall be a designated **Hold Point**.

10.3.3 Fertiliser

Where specified, fertiliser shall be Shirley's No. 17 Fertiliser or equivalent.

10.3.4 Mulch

The vegetable mulch shall comprise chopped cereal straw and wood fibre, and shall be free of meadow hay, noxious weeds and seeds.

10.3.5 Bitumen Emulsion

Bitumen emulsion shall comply with AS 1160, and be of a grade suitable for the intended use.

10.4 Construction

10.4.1 Extent of Grassing

On completion of earthworks, all disturbed areas other than those to be built over with pavements or other permanent structures shall be prepared and grassed using the methods specified herein.

A uniform well bound grass cover shall be established as soon as practicable and maintained until the expiration of the Defects Liability Period.

10.4.2 Extent of Bitumen Emulsion Spraying

On completion of grassing, an area 2 m from the edge of paved surfaces along the full length of all newly grassed areas shall be sprayed with bitumen emulsion at 0.2 L per m².

10.4.3 Preparation

All rubbish and debris shall be removed from the surface and the area shall be cultivated. Topsoil shall be spread where necessary and graded and compacted.

The finished surface of the topsoil shall be smooth, free from lumps of soil, and left ready for grassing.

Topsoil for areas to be grassed by seeding shall be placed and lightly compacted to a thickness of 100 mm so that the finished surface of the topsoil is an even height above the prepared surface and conforms to the design levels shown on the Drawings. Where topsoil is placed adjacent to paved surfaces, the topsoil shall be finished flush with those surfaces.

This shall be a designated **Witness Point**.

10.4.4 Grassing

Grass shall be sown by hydromulching comprising the approved grass seed mix, vegetable mulch, fertiliser and bitumen emulsion at the following minimum rates:

- | | | | |
|----|-------------------|------|--------------------------|
| a) | Total grass blend | 100 | kg/ha |
| b) | Vegetable mulch | 4000 | kg/ha |
| c) | Fertiliser | 400 | kg/ha; and |
| d) | Bitumen emulsion | 2000 | L/ha of residual bitumen |

These application rates are the minimum acceptable rates. The proposed application rate shall be submitted to the Superintendent for approval prior to undertaking the work. This shall be a designated **Hold Point**.

Grassing shall be carried out in accordance with established horticultural practices and a uniform growth of a healthy and dense grass sward with no bare patches shall be produced.

If a suitably grassed surface is not established after the initial grassing, additional grass shall be sown and such additional fertilising and watering carried out as may be required at no additional cost to the Principal.



10.4.5 Maintenance of Grassed Surfaces

The care and maintenance of all grassed surfaces shall be carried out in accordance with established horticultural practices and the maintenance programme shall include, but shall not be limited to, the following items where and as required;

- a) Watering;
- b) Mowing;
- c) Fertilising;
- d) Reseeding or Returfing;
- e) Weeding;
- f) Pest and Disease Control; and
- g) Maintenance of Site in a neat and tidy condition.

The first cut and subsequent mowing of grass shall be carried out at intervals to maintain the grass at a height in the range of 50 mm to 100 mm.

10.5 Quality Assurance

10.5.1 Requirements

All grassing activities shall be monitored and recorded to ensure that the materials and application rates of materials are within the ranges specified, in accordance with the approved Quality Assurance program.

10.5.2 Tolerances on Application Rates

- a) Grass Seed - $\pm 5\%$ by mass; and
- b) Fertiliser - $\pm 10\%$ by mass.

10.5.3 Witness and Hold Points

The following **Witness Point** shall be incorporated in the Project Quality Plan:

- a) Upon completion of topsoil preparation and prior to hydromulching (**Clause 10.4.3**);

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Proposed mix composition (by mass) (**Clause 10.3.2**); and
- b) Proposed application rate (**Clause 10.4.4**).

11. Line Marking

11.1 General

This Section of the Specification covers the supply of materials for and the application of paint to indicate runway and taxiway markings as shown on the Drawings.

11.2 Referenced Documents

The following documents referenced in this Section form part of the Specification only to the extent that they are referred to herein.

American Society for Testing and Materials Standards

- ASTM D711-75 Test Method for No-Pick-Up-Time of Traffic Paint
- ASTM D821-47 Evaluating Degree of Abrasion, Erosion, or a Combination of Both in Road Service Tests of Traffic Paint
- ASTM D913-51 Standard Practice for Evaluating Degree of Traffic Paint Line Wear

Australian Standards

- AS 2700 Colour standards for general purposes
- AS/NZS 4049.3 Paints and related materials - Pavement marking materials - Waterborne paint - For use with surface applied glass beads

11.3 Plant and Equipment

Equipment shall be capable of producing a uniform rate of application of line marking material, with straight and essentially splatter-free edges and ends.

11.4 Materials

11.4.1 Paint

Paint shall comply with the requirements of AS/NZS 4049.3:1996 and shall be an Australian Paint Approval Scheme (APAS) approved product.

The paint shall be of a consistency suitable for application by brushing and/or spraying, and shall be capable of being used as supplied or when reduced with thinner as recommended by the manufacturer and specified on the container.

All runway markings shall be Watty white runway marking paint, "Airpave" or approved water-based equivalent. Submission of the proposed paint manufacturer details and material properties shall be a designated **Hold Point**.

All taxiway markings shall be yellow rapid drying road marking paint complying with the requirements of AS/NZS 4049.3 and AS 2700.



11.4.2 Colour

The colour of the paint shall be White (AS 2700 Colour Code N14) for runway markings, Golden Yellow (AS 2700 Colour Code Y14) and Signal Red (AS 2700 Colour Code R 13) for taxiway and apron markings.

The paint when applied to the pavement shall show a uniform colour with a high visibility against the pavement surfacing which will not dull appreciably for a minimum of six months.

11.4.3 Gloss

The dry film of the paint shall have a non-gloss finish, and preferably a matt finish.

11.4.4 Slipperiness

The surface of painted areas shall not adversely affect the directional control of aircraft under wet conditions.

11.4.5 No-Pick-Up Time

The no-pick-up time of the paint shall not exceed 20 minutes.

11.4.6 Durability

The paint when applied shall give a durable finish that will show resistance to weathering, chipping, abrasion and erosion. The paint shall also show resistance to jet blast and scuffing under normal aircraft operations.

11.4.7 Containers

Containers holding pavement marking paint shall be of durable construction without sharp edges and shall be clearly marked indicating the contents. Paint containers shall also be marked with the following details:

- a) Colour;
- b) Manufacturer's Name;
- c) Batch Number and Date;
- d) Thinning Instructions for Brushing and Spraying (including coverage rates); and
- e) Date of Manufacture.

Containers will be such that the paint can readily be mixed and poured or used direct from the container.

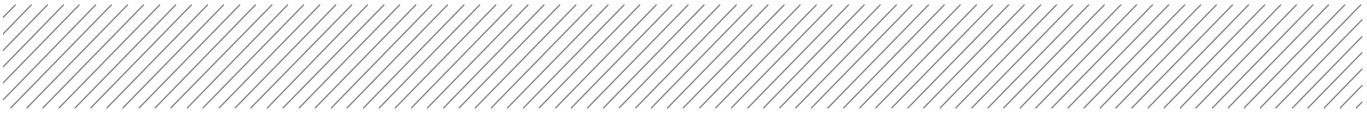
11.4.8 Supply

The paint supplied shall be of a similar quality and standard to the approved material and shall not differ in either composition or performance.

11.5 Construction

11.5.1 Line Marking

All runway, taxiway and apron pavement markings are to be painted as shown on the Drawings.



Setting out shall be undertaken by an approved surveyor.

Completion of the setting out (prior to undertaking the line marking) shall constitute a **Witness Point** in the Project Quality Plan.

Surfaces to be painted shall be cleaned free of dirt and grease and other contamination.

Runway, taxiway and apron pavement markings shall be applied in two equal coats.

The minimum total dry film thickness shall be 120 microns. The paint shall be applied to produce a crisp even line without any significant side splatter.

11.5.2 Application Rate and Uniformity of Application

Daily records of paint usage and area covered shall be maintained to ensure that the specified coverage is being obtained consistently. The application technique shall be consistently monitored to ensure that brush and/or spray marks are minimised.

11.6 Quality Assurance

11.6.1 Materials and Construction

All materials incorporated in the Works, the application techniques employed, daily average application rates, and the completed pavement markings shall be subject to the Quality System requirements for the Project to ensure that they comply with the requirements specified herein including such testing as is necessary to demonstrate such compliance.

11.6.2 Witness Points and Hold Points

The following **Witness Point** shall be incorporated in the Project Quality Plan:

- a) Upon completion of set-out of pavement marking and prior to pavement marking application (**Clause 11.5.1**).

The following **Hold Point** shall be incorporated in the Project Quality Plan:

- a) Submission of the proposed paint manufacturer details and material properties (**Clause 11.4.1**)



12. Stormwater Drainage

12.1 General

This Section of the Specification defines the supply of materials for, and the construction of stormwater drainage systems including culverts, pits, open drains and associated structures.

12.2 Referenced Documents

The following documents that are referenced in this Section form part of the Specification only to the extent that they are referred to herein:

Standards Association of Australia

- AS 1012 Methods of Testing Concrete
- AS 1141 Methods for Sampling and Testing Aggregates
- AS 1152 Test Sieves
- AS 1254 Unplasticised PVC pipes and fittings for Storm or Surface Water Applications
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 1326 Polyethylene (Polythene) Film for Packaging and Allied Purposes
- AS 1379 Specification and Supply of Concrete
- AS 3600 Concrete Structures
- AS 3610 Formwork for Concrete
- AS 3735 Concrete Structure Retaining Liquids
- AS 3799 Liquid Membrane-forming Curing Compounds for Concrete
- AS 3972 Portland and Blended Cement
- AS 3996 Access Covers and Grates
- AS 4058 Precast Concrete Drainage Pipes
- AS 5100 Bridge Design Set

Vicroads

- Road Design Guidelines Standard Drawings for Roadworks – Part 9



12.3 Materials

12.3.1 Alternative and Proposed Materials

If the Contractor desires to use any products or materials which are believed to be equal in quality, finish and durability and equally as suitable for the purpose for which they are intended, the Contractor shall indicate any such intentions as part of their tender documentation or at least 10 working days prior to construction and include suitable information (including type and manufacturer) and test data on such alternatives also as requested by the Superintendent. This shall be a designated **Hold Point**.

All proposed products and materials shall not be used without the written consent of the Superintendent, and the Contractor shall not contract, purchase, or cause to be delivered any products or materials prior to obtaining such consent from the Superintendent. Acceptance of a tender will not constitute written consent of the Principal.

12.3.2 Culverts

Culverts shall generally comprise Class 4 or 6 precast reinforced concrete pipes of the size shown on the Drawings and complying in all respects with the requirements of AS 4058. All drainage pipes shall have a minimum 25 mm of cover to all reinforcement. All pipe joints shall be rubber ring joints.

All pipes, pits, culverts and headwalls shall be handled and stored in strict accordance with the manufacturer's recommendations including use of the correct lifting accessories and/or temporary bracing, and shall be free of defects, damage, and distortion.

12.3.3 Subsurface Drains

Subsurface drains shall be constructed using 90mm diameter slotted uPVC pipes complying with AS1254.

12.3.4 Concrete

Concrete for drainage structures shall be 32 MPa/20 mm or 40MPa/20mm as detailed on the Drawings.

Concrete for bedding and backfill shall be 5 MPa/10 mm or 10 MPa/20 mm as detailed on the Drawings.

12.3.5 Cement

Cement shall be normal Portland Cement Type GP complying with AS 3972.

12.3.6 Mortar

Mortar for connecting culverts to structures shall be composed of one part by volume of Portland cement complying with AS 3972 and two parts of suitable clean sand.

The quantity of water in the mixture shall be sufficient to produce a stiff mortar of satisfactory workability for the work as specified hereinafter. Water shall be clean and free from injurious acids, alkalis and organic impurities. The mortar shall be used within 30 minutes of mixing the ingredients with water.

12.3.7 Bedding Materials

Under aircraft pavements bedding shall consist of 10MPa mass concrete. Elsewhere bedding materials shall be natural or crushed sand or gravel or crushed rock which can be compacted to provide a uniform firm bedding for the culverts and can be shaped as specified hereinafter. The materials shall comply with the requirements of **Table 12-1** when tested in accordance with AS 1289 using the wet preparation method.

Table 12-1: Bedding Material Particle Size Distribution

AS Sieve Size (mm)	Percentage of Total Sample Passing (by mass)
19	100
4.75	40-100
0.425	20-100
0.075	0-15

The portion of the material passing the 0.425 mm sieve shall be either non-plastic, or shall have a liquid limit not greater than 35% and a plasticity index not greater than 15%.

12.3.8 Backfilling Material

Under pavements backfill shall consist of a minimum 200mm layer of 10MPa mass concrete encasing the pipes. Elsewhere granular backfill shall consist of select fill or natural or crushed sand, gravelly sand or crushed rock complying with the particle size distribution requirements set out in **Table 12-2** compacted to 98% MMDD.

Table 12-2: Backfill Particle Size Distribution

AS 1152 Sieve Size (mm)	Percentage by Mass Passing Sieve
26.5	100
1.18	75-100
0.6	45-100
0.425	25-95
0.212	0-35
0.15	0-20
0.075	0-5

No length of drain shall be backfilled without being inspected and approved for backfilling by the Superintendent. Temporary uncompacted backfill may, however be placed over the pipe to prevent pipe flotation should water enter the trench. If such temporary fill is placed all of it shall be removed immediately after flotation is no longer a threat, and the drain made available for re-inspection and approval by the Superintendent.

Except under pavement crossings, backfilling above the sand bedding to 75 mm above the top of the pipe shall be carried out with approved granular or select fill. On no account shall high plasticity clay, rock, or material containing large stones be used. The fill shall be placed and compacted in layers not exceeding 150 mm (compacted thickness) in depth to not less than 95% Standard Relative Dry Density or 70% Density Index for cohesionless material.

12.3.9 Classified Fill

Classified fill material comprises soils that are free from peats and other organic matter, free from cobbles and boulders, and such that all the material passes the 75 mm AS sieve and has a liquid limit not greater than 35%.

12.3.10 Stockpiling

Prior to stockpiling the stockpile sites shall be cleared, drained, levelled and surfaced with at least 50 mm thickness of material of at least equal quality and type to that being stockpiled.

Essentially different materials shall be stockpiled separately.

12.3.11 Pits, Covers and Grates

All precast pits, pit covers, grates and frames shall be proprietary items designed for use under aircraft loading conditions and manufactured by an experienced supplier of such products, which have been utilised for this purpose.

All precast pits, pit covers, grates and frames shall be minimum Class D and must be approved by the Superintendent prior to installation. The Contractor shall supply all supporting manufacturer's documentation and information to the Superintendent as necessary. This shall be a designated **Hold Point**.

Covers and grates shall be non rocking and have metal to metal fit prior to bolting with a maximum tolerance of 0.25mm in vertical and horizontal movement.

Covers and grates shall be identified by permanent matching numbers clearly indicated on frames and grates/covers. Covers shall be greased using the sealing grease as recommended by the manufacturer. Lifting keys shall be supplied to suit the covers where required.

All cast units shall be free of distortion, cold shuts and chilling. Castings shall be neatly dressed and fettled. All castings shall be free of voids, whether due to shrinkage, gas intrusions or other causes. All load tests undertaken on pits/covers/grates and frames shall be performed by a NATA registered laboratory using competent operators on a machine complying with requirements of AS 2193.

The installation of all pits shall include the associated civil works including trenching, pipe laying and backfilling as required and shown on the Drawings.

12.4 Construction

12.4.1 Excavation

All excavation, regardless of the type of material, shall be undertaken to the depths and widths indicated on the Drawings.

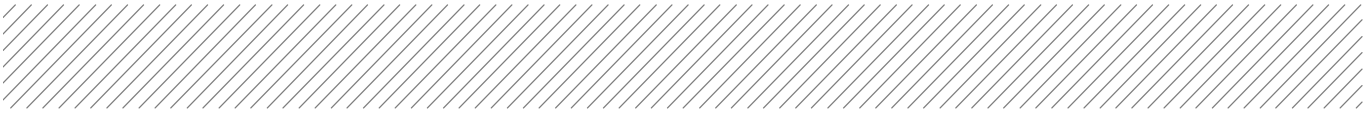
Trench excavation shall commence at the downstream end of the drainage line and proceed upstream and shall be to the depth required to provide for the thickness or bedding material below the culvert as detailed on the Drawings. The width of trench shall be not less than the exterior width of the culvert plus 300 mm, and not greater than that required for satisfactory backfilling of the culverts.

Trench sides shall be adequately shored.

Excavation for drainage structures shall be to the depth required for the structure. The shape of the excavation shall be as required and the size sufficient to enable construction of the structure. Excavation material from the trench, which is to be used as classified fill or backfill to culverts not under pavements, shall not be stockpiled adjacent to the trench. Excavated material not required for backfilling shall be spoiled.

Loose material in the bottom of the excavation shall be removed. Over excavation below required level shall be restored to level in the following manner:

Over excavation not under pavements shall be restored using bedding material as specified in **Clause 12.3.7**, and compacted with vibrating equipment; or



Over excavation under pavements shall be restored using 10MPa/20 mm concrete as specified for backfilling in **Clause 12.3.8**.

12.4.2 Diverting Water and Dewatering Excavations

As part of the Works it may be necessary to divert any water which interferes with progress of the work; to keep trenches or excavations free from water during construction of the drainage line or structure and backfilling; and to prevent any damage to the work due to flooding or other causes. Sufficient pumps, well points or other equipment for keeping trenches and excavations dewatered during the progress of the construction of the drainage line or structure shall be provided.

12.4.3 Shoring of Excavation

Trenches shall be shored or timbered where necessary to prevent collapse of sides or ends of excavations, for the protection of the work and safety of personnel. Voids behind sheeting shall be filled with suitable granular material and compacted. Shoring or timbering shall be adequately designed and constructed, and shall be maintained in position until backfilling has proceeded to the extent that no danger to the work, or personnel, will result from its removal. All shoring in trenches under pavements shall be removed. Shoring may remain in other trenches provided the top of the shoring is at least 600 mm below finished surface level.

12.4.4 Bedding of Culverts

All culverts not under aircraft pavements shall be bedded as shown on the Drawings.

Bedding material shall be as specified in **Clause 12.3.7**, and shall be placed and compacted whilst at an appropriate moisture content in layers not exceeding 150 mm compacted thickness. The material shall be compacted with vibrating plates or by other approved methods until the bedding is of uniform density and not less than 98% Modified Maximum Dry Density as determined in accordance with AS 1289.5.2.1 or 98% of the Maximum Vibrated Density in sand.

On completion, the bedding shall provide a uniform firm foundation for the culvert with the top surface of the bedding shaped to the details shown on the Drawings.

12.4.5 Laying and Jointing of Culverts

Each length of culvert shall be carefully examined before being laid and defective or damaged lengths shall not be used. Culverts shall be laid to the levels, alignment and grades indicated. Gaps between the installed individual culvert sections shall not be greater than the culvert manufacturer's recommendations or as shown on the drawings.

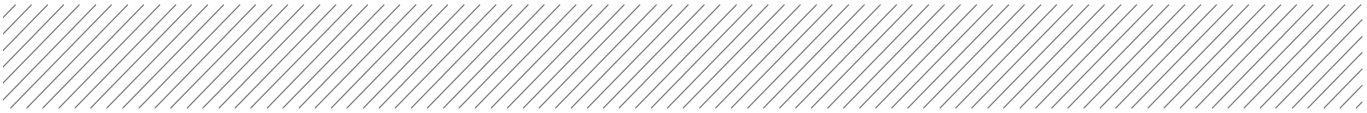
When laid, the clear distance between the outside of the culvert and the side of the trench shall be not less than 150 mm. Satisfactory facilities shall be provided for lowering culverts into trenches. Under no circumstances shall culverts be laid in water, and no culvert shall be laid when conditions are unsuitable for such work.

Culverts with rubber ring joints shall be laid and installed such that the rubber rings are in the fully seated position, in complete contact with the connecting culvert sections around the full diameter of the culverts and in accordance with manufacturer's recommendations.

If the rubber ring is not in complete contact with the connecting culvert sections, the culvert sections shall be removed and re-laid such that the rubber ring has been installed as specified herein.

Culverts shall be supported during laying, jointing, and backfilling on bedding material constructed as specified in **Clause 12.3.7**.

Laying shall commence at the outlet or discharge end of the line and proceed up-grade.



With multiple barrels the barrel spacing shall be 300mm between the exterior width of the culverts.

At the completion of laying and prior to bedding and encasement with concrete or any backfilling a **Hold Point** shall be designated in accordance with the Project Quality Plan.

12.4.6 Backfilling of Trenches

All culverts shall be inspected with regard to supporting, bedding, laying and jointing prior to backfilling. This shall be a nominated **Hold Point** in the Project Quality Plan.

(a) Culverts Under Aircraft Pavements

Culverts under aircraft pavements and shoulders shall be backfilled with concrete as specified in **Clause 12.3.8** to the level indicated on the Drawings. Adequate precautions shall be taken to prevent flotation of the pipes. Pipe culverts shall be bedded in concrete to a depth as indicated on the drawings and left until the initial set has taken place, but not more than 24 hours. The concrete shall be placed equally on both sides of the culvert and vibrated to completely fill any voids beneath the culvert and in the trench. Care shall be taken to avoid displacement of the culvert from correct alignment, level and grade. Concrete shall not be placed and vibrated in layers thicker than 600 mm, and for concrete backfill above the concrete bedding, layers shall be placed successively to complete the backfill before the initial set has taken place in the underlying layer.

12.4.7 Concrete Drainage Structures

Concrete drainage structures shall be constructed to the details shown on the Drawings, using 32 MPa/20 mm concrete.

Backfilling about drainage structures shall be in accordance with **Clause 12.4.6**.

12.4.8 Protection of Culverts

All measures necessary to protect the culvert from damage due to subsequent construction operations and construction traffic shall be taken. Any damaged sections shall be removed and replaced.

12.4.9 Subsurface Drains

Subsurface drains shall comprise 90mm Class 1000 slotted uPVC pipe. They shall be located within trenches to the dimensions shown on the Drawings. Bedding material shall comprise sand as specified in **Clause 12.3.7** "Bedding Materials", and backfilling shall comprise classified fill below topsoil as shown on the Drawings.

Both the subsurface drainage flushout risers and the subsurface drainage junction pits shall have securely fixed caps which shall not be dislodged by aircraft propeller wash.

12.4.10 SIT Pit Drains

Subsurface drains shall comprise 100mm Class 1000 uPVC pipe. They shall be located within trenches to the dimensions shown on the Drawings. Bedding material shall comprise sand as specified in **Clause 12.3.7** "Bedding Materials", and backfilling shall comprise classified fill below topsoil as shown on the Drawings.



12.5 Quality Assurance

12.5.1 Requirements

The Contractor shall implement a Quality Assurance program as defined in **Section 2** of the Technical Specification.

The program shall comprise three phases as defined below.

12.5.2 Phase A – Pre-commencement

(a) Supply of Information on Material Sources

The Contractor shall submit a report to the Superintendent at least five days prior to the commencement of the work that provides details of:

- a) Proposed material sources including quarry or pit from which the bedding and backfilling material will be obtained;
- b) Pit type, cover type and manufacturer;
- c) Concrete Drainage Structures type and manufacturer; and
- d) Culvert type and manufacturer.

The submission of information on material sources shall be a designated **Hold Point**.

12.5.3 Phase B – Production and Process Control

(a) Testing and Approval of Culverts

All culverts shall be inspected and checked at all stages of construction in accordance with the requirements of the Project Quality Plan, and prior to commencement of backfilling. The accuracy of alignment, level and grade will be checked by sighting through the culvert with mirrors if necessary, and by levelling on the top of the culvert. Joints shall be checked by visual inspection.

(b) Allowable Tolerance on Level and Alignment

Pipes shall be laid true to the alignments and grades shown within the following tolerances:

- a) Pipes 300 mm to 900 mm in diameter: +/- 5 mm in level and +/- 10 mm in line.

(c) Approval of Backfilling

Following completion of backfilling the culvert shall be inspected for any displacement of, or damage to, the culvert as a result of backfilling. Any such displacement or damage shall be repaired.

12.5.4 Phase C – Post Construction

(a) Level and Alignment

Finished culvert and pipe levels and alignments shall be submitted within 5 working days of completion of the work. This shall be a designated **Hold Point**.



(b) Quality Assurance Records

Within three weeks of completion of the work, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken.

12.5.5 Correction of Nonconforming Work

Any defects in the culvert, discrepancies in levels of alignment in excess of the allowable tolerances, and defective joints detected during inspection, shall be corrected.

12.5.6 Witness Points and Hold Points

The following **Hold Points** shall be incorporated in the Project Quality Plan

- a) Type, manufacturer and technical information for proposed material alternatives (**Clause 12.3.1**);
- b) Manufacturer design and test data (**Clause 12.3.11**);
- c) Laying and jointing of culverts (**Clause 12.4.5**);
- d) Backfilling of trenches (**Clause 12.4.6**);
- e) Information on Material Sources (**Clause 12.5.2(a)**); and
- f) Level and alignment of finished culverts or pipes (**Clause 12.5.4(a)**).

13. Service Ducts

13.1 General

13.1.1 Scope

This section of the Specification defines the supply of materials for and the construction of multi-way duct banks, split ducts and duct pits for services beneath aircraft pavements.

13.2 Referenced Documents

The following documents that are referenced in this section form part of the Specification only to the extent that they are referred to herein.

Standards Association of Australia

- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 1379 The Specification and Manufacture of Concrete
- AS 2053 Conduits and Fittings for Electrical Installations
- AS 3972 Portland and Blended Cements
- AS/NZS 4671 Steel Reinforcing Materials

13.3 Materials

13.3.1 uPVC Pipes and Fitting

Pipes and fittings shall be approved Heavy Duty uPVC in accordance with AS 2053.

The pipes shall be joined by painting approved solvent weld solutions on the inside of the sockets and the outside of the plain ends of the mating pipes for a length equal to the depth of the socket. The two parts shall be fitted together while the solution is wet with the plain end being pushed in the full depth of the socket. Only solvent weld solutions recommended by the pipe manufacturer shall be used.

13.3.2 Cement

Cement for use in concrete encasement, lean mix (10 MPa) concrete backfill, and cement stabilized sand backfill shall be Portland Cement Type GP complying with AS 3972.

13.3.3 Reinforcement

Reinforcing fabric, reinforcing bars and wire shall comply with AS/NZS 4671.

13.3.4 Cement Stabilized Sand

Cement stabilised sand shall contain 4% by mass of Portland Cement Type GP homogeneously mixed with the sand prior to placing.

13.3.5 Lean Mix Concrete

Lean mix concrete shall be 10 MPa/10 mm or 10 MPa/20 mm.

13.4 Construction

13.4.1 Timing

Duct banks in new aircraft pavements shall be constructed after all subgrade preparation works and pavement construction to top of sub-base level in the vicinity of the ducts.

13.4.2 Excavation

All excavation shall comply with **Section 4** and **Clause 5.5.3**. Trenches for installation of duct banks shall be excavated to the widths as specified and to the minimum depths required to achieve the levels for the duct banks shown on the Drawings. Excavation techniques and procedures shall be such that the state of compaction of the subgrade and sub-base course which exists immediately prior to excavation is not degraded at any time.

A **Hold Point** shall be incorporated into the Project Quality Plan prior to the commencement of excavation for the extension of existing duct banks.

13.4.3 Laying

Ducts shall be thoroughly cleaned before laying and particular care shall be taken to keep the inside of conduits clean of backfill and other materials during construction.

Any conduit cut on the site shall have all internal burrs removed, and the field cut end shall be placed at the end of the duct bank.

All conduits shall be rigidly supported and positioned by tying securely to the reinforcing cage and wired together so that no displacement occurs during concrete placing and compaction.

Where duct ends are not open to a pit, UPVC end plugs or caps shall be fitted to each end of each duct bank way.

All conduits shall be laid horizontally or at grade (following the natural surface), without sags (low points) that may result in the accumulation of water in the conduit.

13.4.4 Checking of Duct Banks

After stripping of end forms following installation, the duct bank shall be checked by passing a mandrel (not less than 300 mm long and having a diameter of not more than 6 mm less than the diameter of the conduit) through each way. This shall be a designated **Hold Point**.

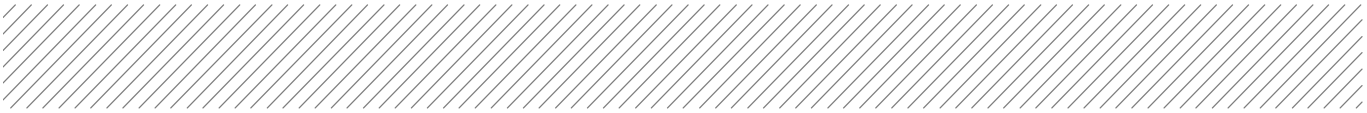
13.4.5 Draw Cords

Each duct way in each duct bank shall be fitted with a single unjointed length of draw cord of a length equal to the length of the duct plus 4 m. The draw cord shall be nylon rope 10 mm in diameter, blue in colour. The draw cord shall be extended 2 m past the end of each duct.

End plugs or caps shall be inserted in the duct way ends with the draw cord protruding through a small predrilled hole. The ends of the draw cord shall be laid down into the soil or coiled in junction pits.

13.4.6 Concrete Encasement

The ducts shall be encased using 20 MPa/20 mm concrete, reinforced as and where shown on the Drawings. Duct banks shall be of monolithic construction. A **Hold Point** shall be incorporated into the



Project Quality Plan following excavation, placing of ducts and reinforcement, but prior to concrete encasement of ducts.

13.4.7 Backfilling

Backfilling shall not commence until 48 hours after completion of the concrete encasement unless otherwise agreed by the Superintendent.

Cement stabilised granitic sand backfill shall be placed in layers not exceeding 300 mm and compacted with internal vibration. Care shall be taken not to damage the duct bank during compaction operations. Backfilling under aircraft pavements and shoulders shall consist of lean mix (10 MPa) concrete to the bottom of the sub-base course.

All trench backfill material other than concrete shall be compacted to a minimum of 98% MMDD.

13.4.8 Duct Markers

Duct Markers as detailed on the Drawings shall be supplied and installed to indicate the position, depth and duct number where relevant of conduit ends and at changes of direction.

Markers to indicate ends of ducts under aircraft taxiways, runways, aprons or roadways shall be set in the sealed shoulder and be flush with the surface as shown on the Drawings.

13.4.9 Cable Markers (Electronic)

For the ducts containing High Voltage cables, electronically detectable duct markers shall be laid horizontally in trenches approximately 300 mm above the top of the upper most duct in the duct bank and with a minimum of 150 mm clear cover at 1 m from ends of ducts.

13.4.10 Protection of Service Ducts

Service ducts shall be protected from damage due to subsequent construction operations as required using whatever measures are necessary. Any damaged ducts shall be removed and replaced.

13.4.11 Extension of Existing Ducts

Where existing ducts are to be extended, the location and direction shall be as shown on the Drawings. Where existing duct to be extended are of the type 'AC', the proposed method of extension shall be approved by a Hygienist and provided to the Superintendent prior to the commencement of works. This shall be a designated **Hold Point**.

The line and level of the duct extensions shall match the existing ducts and, as much as practicable, run at a constant depth underneath the pavements as shown on the Drawings. A designated **Witness Point** for the extension of existing ducts shall be incorporated into the Quality Plan.

13.4.12 Construction of New Ducts

New ducts shall be constructed at the location and in the direction as shown on the Drawings. New ducts shall run at a constant depth below the pavement and natural surface as much as practicable. Backfilling of new duct trenches beneath both existing and new pavements shall be as detailed on the Drawings.

13.4.13 Ducting of Existing Services – Split Ducts

Where existing services are shown on the Drawings, as being required to be placed in split ducts, the location of the services in specific ducts will be as directed by the Superintendent. Cables shall not be cut or disconnected during the placement of ducts except on the written instructions of and under the supervision of the Superintendent.

Where ducts are required to be constructed to incorporate existing Fibre Optic Communication services or other services, the existing services shall be accurately located prior to commencement of excavation. Excavation around existing services shall be in accordance with **Clause 5.5.3**.

The Contractor is to submit a Works Method Statement outlining the proposed procedure to expose and encase Fibre Optical Communications cables in a split duct for approval by the Superintendent at least 14 days prior to commencement of works associated with ducting of existing services. This shall be a designated **Hold Point**.

The existing cables are to be encased in a split duct, made by cutting lengths of uPVC pipe in half. The two halves of the duct shall be securely bound together using appropriate adhesive tape. The tape shall be so arranged to prevent ingress of concrete into the duct. The duct shall then be incorporated in the duct bank as detailed previously.

A designated **Witness Point** for the extension of existing ducts via split ducting shall be incorporated into the Quality Plan.

13.4.14 Duct Pits

Duct pits shall be constructed as specified in the details shown on the Drawings, either using precast pits or constructed in-situ using 32 MPa/20mm concrete.

13.4.15 Quality Assurance

The Contractor shall implement a Quality Assurance programme as defined in **Section 2** of this Technical Specification.

13.4.16 Materials and Construction Compliance

All materials incorporated in the Works, the construction techniques employed, and the completed service ducts shall be subject to the Quality Assurance requirements for the project to ensure that they comply with the requirements specified herein including such testing as is necessary to demonstrate such compliance.

13.4.17 Correction of Nonconforming Work

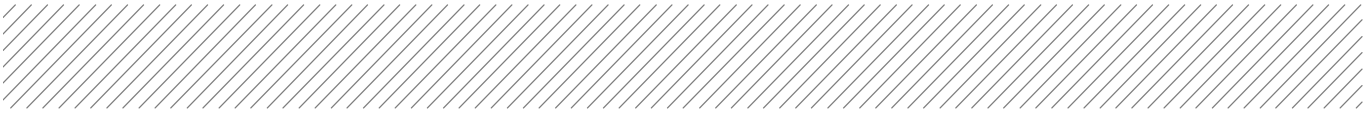
Any defects in the ducts, discrepancies in levels of alignment, and defective joints detected during inspection, shall be corrected at no additional cost to the Principal.

13.4.18 Witness Points and Hold Points

The following **Witness Points** shall be incorporated in the Project Quality Plan:

- a) Prior to construction of extensions to existing duct banks (**Clause 13.4.11**); and
- b) Prior to the split ducting of existing services (**Clause 13.4.13**).

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- 
- a) Prior to excavation for the ducting of existing services (**Clause 13.4.2**);
 - b) Checking of duct banks (**Clause 13.4.4**);
 - c) Following excavation, placing of ducts and reinforcement, but prior to concrete encasement or backfilling (**Clause 13.4.6**);
 - d) Provision of a Hygienist approved Works Method Statement for the extension of existing 'AC' duct banks (**Clause 13.4.11**); and
 - e) Provision of a Works Method Statement for ducting of existing Fibre Optical Communications cables (**Clause 13.4.13**).



14. Concrete for Miscellaneous Structures

14.1 General

14.1.1 Scope

This section of the Specification covers the supply of materials for and the construction of miscellaneous concrete structures including pits, headwalls, and footings for MAGS.

14.1.2 Reference Documents

The following documents referenced in this section form part of the Specification only to the extent that they are referred to herein.

Australian Standards

- AS 3600 Concrete Structures
- AS 3610 Formwork for Concrete
- AS 3799 Liquid Membrane-forming Curing Compounds for Concrete
- AS 3972 Portland and Blended Cement

14.2 Materials

14.2.1 Concrete

Concrete for miscellaneous structures shall be 32 MPa/20 mm unless shown otherwise on the Drawings.

14.2.2 Reinforcement

All reinforcement steel shall comply with the requirements of AS 3600.

14.2.3 Cement

Cement shall be normal Portland cement Type GP complying with AS 3972.

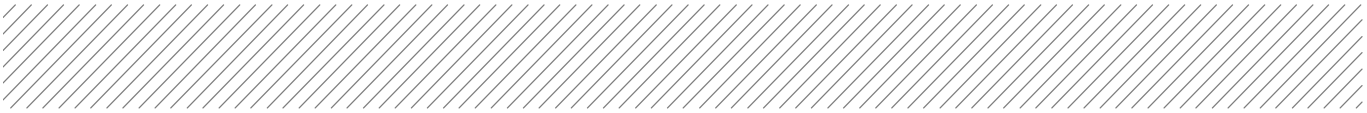
14.3 Construction

All concrete work and materials shall conform to the requirements of AS 3600 except where varied by the Specification and/or the Drawings.

14.3.1 Supervision and Inspection

All concrete work shall be supervised by a Supervisor experienced in all aspects of concrete construction. The Supervisor shall be in attendance when the Superintendent inspects the work prior to concreting.

The Superintendent shall inspect all formwork and reinforcement for each concrete placement before any concrete is placed in that section of the work and this shall constitute a **Hold Point**.



All formwork, reinforcement supports, cores, holding down bolts, conduits and the like shall be in position and the Superintendent notified at least one clear working day before concrete is placed in any section of the work.

14.3.2 Supply of Ready Mixed Concrete

Unless otherwise approved by the Superintendent, all concrete used in the Works shall be obtained from an approved ready mixed concrete supplier.

Notwithstanding the provisions of AS 1379 all concrete shall be completely discharged, placed and compacted in its final position within 90 minutes of the introduction of the cement to either the aggregates or the mixer.

No additional water or admixtures will be permitted to the batched load once it has left the batching plant. If it is determined that water and or admixtures have been added then the load shall be disposed off site at the Contractor's expense.

14.3.3 Site Mixing of Concrete

If site mixing of concrete is approved by the Superintendent, all concrete mixing on site shall be done in mechanically driven rotating batch mixers of approved type.

The concrete shall be mixed in the quantities required for immediate use and shall be placed in position rapidly.

Mixing by hand will not be permitted except in an emergency and then only with the approval of and to the satisfaction of the Superintendent.

14.3.4 Formwork

Formwork and falsework shall be designed and constructed in accordance with the requirements of AS 3610.

The standard of surface finish and colour uniformity to be achieved shall be in accordance with AS 3610 and as specified and/or shown.

14.3.5 Reinforcement

All reinforcement and the placing and fixing of all reinforcement shall comply with the requirements of AS 3600.

All reinforcement shall be furnished in the full lengths shown and laps and splices shall be made only in the positions and to the dimensions shown or otherwise approved by the Superintendent

Reinforcement shall not be bent except as shown in the bending lists without the approval of the Superintendent.

Hard drawn steel wire fabric shall be delivered to the Site in flat sheets, except that the fabric for slabs supported permanently on the ground may be supplied in rolls.

Reinforcement shall only be supported on approved spacers or chairs.

The clear cover to reinforcement shall be as shown, or where not shown, shall be in accordance with the requirements of AS 3600 for the condition of exposure nominated by the Superintendent.



14.3.6 Placing of Concrete

All concrete shall be placed in position as soon as possible after mixing and in no case shall more than 90 minutes elapse before this is done. In no case shall concrete be allowed to remain in the work if it has begun to set before final compaction has been completed.

Concrete shall be compacted by means of approved high frequency mechanical vibrators of the immersion type.

Concrete for walls shall be placed in continuous horizontal layers, the thickness of which shall generally not exceed 300 mm. No layers shall be tapered off but shall be stopped against forms to produce square ends.

Unless otherwise shown and/or specified the full thickness of all slabs, beams, footings, pile caps and column capitals shall be concreted in the one operation.

If a cessation of work becomes unavoidable a construction joint shall be formed as specified elsewhere herein, at the point of stopping.

When work is resumed the treatment of the concrete at the cold joints shall be as specified elsewhere herein.

Unless approved in writing by the Superintendent no concrete shall be placed under water and permission to do so will only be given in the most exceptional circumstances. Foundation excavations shall be thoroughly clear of ponding water before placing any structural concrete.

14.3.7 Pumping of Concrete

Approval to use concrete pumps to place concrete may be given by the Superintendent subject to the Contractor submitting full details of the type and capacity of the pumps, pipe work and procedures to be adopted, and satisfactory evidence that any modifications to the concrete proportions and consistency to suit pumping procedures shall comply with the provisions and intent of this Specification.

14.3.8 Construction Joints

A construction joint is the junction between two successive concreting operations in an element intended to act monolithically.

Construction joints shall be formed and constructed to the details and in the locations shown and they shall not be varied without the approval of the Superintendent.

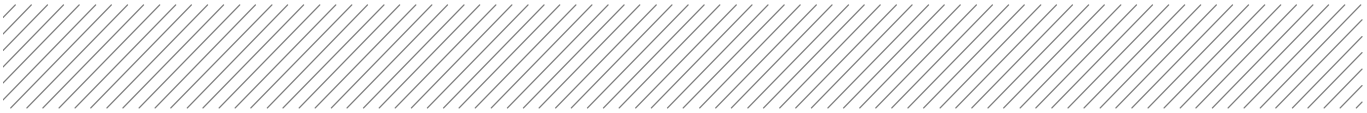
Whenever the work of placing concrete is delayed so that the initial set has taken place as determined by the Superintendent, the point of stopping shall be deemed a construction joint and formed accordingly.

All construction joints shall be truly vertical or horizontal. Unless otherwise shown inclined or feathered joints will not be permitted.

When placing concrete against a construction joint, appropriate measures shall be taken to ensure that aggregate segregation does not produce honeycombing at the joint.

14.3.9 Finish of Concrete Surfaces

All formed concrete surfaces which are to remain exposed and/or painted shall finish clean and even when the forms are stripped.



The surface finish shall meet the requirements of AS 3610 for the formwork category shown or specified elsewhere herein.

14.3.10 Curing of Concrete

Concrete shall be moist cured or coated by an approved curing compound for a period not less than seven days unless approved by the Superintendent.

Any concrete adversely affected by the omission of or by inadequate curing shall be liable to rejection. The Contractor shall modify or change the curing procedures as directed by the Superintendent at any time during the work of the Contract if the Superintendent is not satisfied that the concrete is being properly cured.

The Superintendent may consider approving the use of liquid membrane curing compounds which conform to the requirements of AS 3799 provided that the Contractor establishes to the satisfaction of the Superintendent that the proposed curing compounds can be applied and maintained effectively and that they are compatible with any subsequent surface finished.

14.3.11 Removal of Formwork

The responsibility for the safe removal of any part of the formwork and falsework shall rest with the Contractor.

Forms shall not be disturbed until the concrete in contact with them has hardened sufficiently to withstand such action without damage.

Formwork shall not be removed until the recommended minimum stripping times tabulated in AS 3610 have elapsed, unless approved by the Superintendent.

14.3.12 Concrete Control Testing

All concrete supplied for miscellaneous structures shall be subject to project control testing in accordance with AS 3600.

14.3.13 Rejection of Concrete

Where concrete already placed is classed as defective and liable to rejection, the criteria for rejection shall be as set out in AS 3600 and/or specified herein.

Concrete classed defective and rejected by the Superintendent shall be removed from the work and, together with any other work subsequently erected thereon, shall be replaced at the Contractor's expense with concrete complying with the Specification.

14.4 Quality Assurance

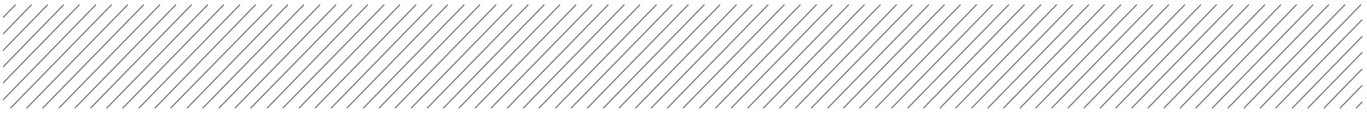
The Contractor shall implement a Quality Assurance programme as defined in **Section 2** of this Specification.

The programme shall comprise three phases as defined below.

14.4.1 Phase A – Pre-commencement

(a) Supply of Information on Materials

The following information shall be supplied:

- 
- (i) Ready mixed concrete supplier; and
 - (ii) Test Certificates demonstrating compliance of the reinforcement with the requirements of AS 3600.

The supply of information on materials shall be a designated **Hold Point**.

14.4.2 Phase B – Production and Process Control

(a) Concrete Strength

All concrete supplied for the Contract shall be subject to project control testing in accordance with AS 3600.

14.4.3 Phase C – Post Construction

(a) Quality Assurance Records

Within 3 weeks of completion of the work, the Contractor shall supply two copies of a report detailing the results of all quality control and testing undertaken. This shall be a designated **Hold Point** in the Project Quality Plan.

14.4.4 Correction of Nonconforming Work

Any nonconforming materials or construction shall be corrected at no additional cost to the Principal.

14.4.5 Witness Points and Hold Points

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Inspection of formwork and reinforcement by the Superintendent prior to placing concrete (**Clause 14.3.1**);
- b) Supply of details on ready mixed concrete supplier and Test Certificates demonstrating compliance of the reinforcement with the requirements of AS 3600 (**Clause 14.4.1(a)**); and
- c) Submission of report on quality control and testing (**Clause 14.4.3(a)**).

15. Aeronautical Ground Lighting

15.1 General

This part of the Specification covers all Works associated with the installation of Aeronautical Ground Lighting (AGL) including associated supply and control system. It also covers the removal of existing electrical infrastructure that will be made redundant upon completion of new AGL Works.

The AGL system shall comprise the following elements, all of which are to be supplied and installed by the Contractor to the relevant standards:

- a) Medium Intensity Runway Edge, Threshold and End Lights;
- b) Medium Intensity Taxiway Lighting (including Turning Nodes);
- c) Hold Point Lights;
- d) Runway Guard Lights;
- e) Movement Area Guidance Signs (MAGS);
- f) Precision Approach Path Indicators (PAPIs) for approaches to Runway 17 and Runway 35; and
- g) Illuminated Wind Director Indicators (IWDIs).

With the exception of the IWDI's which shall be supplied by 230V supply, the AGL field circuits shall be powered by high voltage series loops from Mains Isolation Transformers (MIT's) which are to be housed in the new Airport Lighting Cubicle.

The AGL system shall be fed via a pit and duct system. All AGL light fittings shall be isolated from the high voltage series loops by Series Isolating Transformers (SITs).

The Airport Lighting Works covered by the Specification consists of the following major activities:

- a) All survey and set out for AGL Works;
- b) Supply and installation of new primary and secondary conduits associated with the installation of the new primary AGL circuits;
- c) Supply and installation of new AGL primary circuit cables;
- d) Supply and installation of new ducts and high strength structural pits and SIT pits;
- e) Supply and installation of all secondary conduits from SIT pit to pavement edge;
- f) Installation of new AGL secondary cables (including conduits under pavement);
- g) Undertake all trenching, backfilling and making good all duct bank, conduit and pit work;
- h) Supply and installation of new SITs;
- i) Supply and installation of new Runway Edge Lights, Runway Turning Node Lights, Runway Threshold Lights and Runway End Lights (including bases);
- j) Supply and installation of new Taxiway Edge Lights and Holding Point Lights (including bases);
- k) Supply and install of new Runway Guard Lights (including bases);

- l) Supply and installation of new MAGS (including footings);
- m) Supply and installation of three new IWDIs (including footings);
- n) Design, supply and installation of new PAPI lights (including footings);
- o) Design, supply and installation of new Airport Lighting Cubicle and shelter complete with all new accessories and relocation and installation of existing AGL accessories;
- p) Supply and installation of new back-up power generator;
- q) Relocation or removal of existing apron flood lighting;
- r) Removal of redundant AGL lights, bases, SITs, pits, cables and conduits;
- s) Rerouting of existing power supply and reconnect to miscellaneous facilities impacted by the AGL Works;
- t) Testing and commissioning of all AGL systems and equipment; and
- u) Provision of all quality assurance and 'as built' records.

15.2 Applicable Standards

All equipment and the electrical installation shall comply with the latest issue of the appropriate Standards relevant to those components, in particular the following:

15.2.1 Material and Equipment Standards

- YSVE 4005: Specification for Airport Lighting Cables
- YSVE 4009: Specification for Series Isolation Transformers

15.2.2 Implementation Standards

Civil Aviation Safety Authority

- MOS Part 139: Manual of Standards Part 139 – Aerodromes
- Advisory Circular AX 139-04(0) – Commissioning of Aerodrome Lighting Systems

Australian Standards

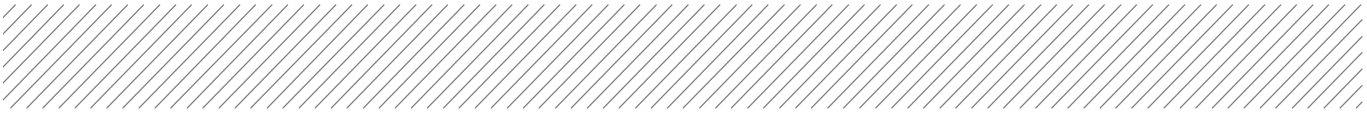
- AS/NZS 3000-2000: Electrical Installations – SAA Wiring Rules (including Amendments and Supplements)

International Standards

- ICAO Annex 14, Aerodromes – Aerodrome Design Manual, Parts 1, 3, 4 and 5

15.3 Workmanship

All electrical parts of the Works shall be of a high standard as required for safe operation of the equipment at the airport. The electrical work shall be carried out in a tradesman like manner, and (without limiting any other terms of the Contract) shall be in accordance with the requirements of this



Specification, the SAA Wiring Rules AS 3000, and the requirements of MOS Part 139. Suitably qualified electrical tradesmen shall undertake all electrical work.

The execution of airport lighting work shall be under the immediate and constant supervision of the Contractor's supervising staff for airport lighting work, each of which shall:

- a) Be a suitably qualified electrical engineer, electrical technician or electrical tradesman;
- b) Have completed an accredited airport lighting course; and
- c) Have experience in the installation of operational airport lighting acceptable to the Principal.

The Basic (5 day) Airport Lighting Course as run by Airways Training Services Pty Ltd (or equivalent) is the minimum accredited Airport lighting training course acceptable to the Principal.

15.4 Materials

15.4.1 Alternative and Proposed Materials

If the Contractor desires to use any products or materials which are believed to be equal in quality, finish and durability and equally as suitable for the purpose for which they are intended, the Contractor shall indicate any such intentions as part of their tender documentation or at least 14 working days prior to construction and include suitable information (including type and manufacturer) and test data on such alternatives also as requested by the Superintendent. This shall be a designated **Hold Point**.

All proposed products and materials shall not be used without the written consent of the Superintendent, and the Contractor shall not contract, purchase, or cause to be delivered any products or materials prior to obtaining such consent from the Superintendent. Acceptance of a tender will not constitute written consent of the Principal. This shall be a designated **Hold Point**.

15.4.2 Design Life

All equipment to be supplied by the Contractor, other than consumables such as lamps and filters, must have a minimum design life of 20 years under the ambient environmental conditions of the airport.

15.4.3 Environmental Conditions

(a) Temperature

External equipment shall be capable of operation without degradation over an ambient temperature range of -10°C to 60°C.

Internal equipment shall be capable of operation without degradation over an ambient temperature range of 0°C to 50°C.

(b) Relative Humidity

At temperatures up to 40°C, all equipment shall be capable of operation without degradation under conditions of relative humidity up to 95%. At temperatures above 40°C, all equipment shall be capable of operation without degradation under conditions of relative humidity up to 50%.

(c) Impact Resistance

The external surfaces of all outdoor equipment shall be capable of supporting, without deformation or fracture, the impact forces of hailstones or other particulate matter, equivalent to the impact resulting from a steel ball of mass 66g being dropped from a height of 2.9m above the relevant surface.

(d) Solar Radiation

All external equipment shall be capable of withstanding, without any physical degradation, solar radiation to the extent defined in AS1099.2Sa.

(e) Corrosion Resistance

All external equipment shall be corrosion resistant to the extent defined in AS1099.2Kd.

All metallic surfaces of internal equipment shall be suitably treated to inhibit corrosion.

Equipment shall be designed so as to minimise as far as practicable contact between dissimilar metals having different galvanic potential. In this regard, reliance shall not be placed solely on the painting of surfaces in order to prevent dissimilar metals from coming into contact with one another.

(f) Dust and Moisture Protection

The housings of all other external equipment shall permit a degree of protection against the ingress of dust and moisture no less than that corresponding to equipment IP54 of AS1939.

All electrical distribution and control cubicles shall provide a degree of protection against the ingress of moisture and foreign matter no less than that corresponding to requirement IP52 of AS1339.

(g) Hazardous Materials

Hazardous materials shall not be incorporated in any item of equipment.

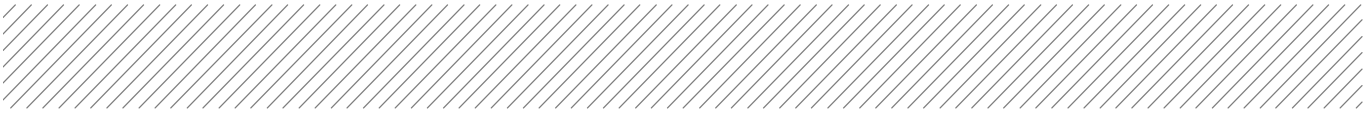
Toxic materials shall be adequately sealed to avoid contamination to other components or danger to personnel.

15.5 AGL – Light Fittings

15.5.1 General

In general, all AGL light fittings supplied and installed shall meet the following requirements:

- a) All light fittings shall be of the totally enclosed dry type and be suitable for continuous use and comply with the requirements of IP55 unless otherwise stated in this specification;
- b) All light fittings shall be supplied as a single completely assembled fitting from the manufacturer;
- c) Commonality of components between fitting types shall be maximised to reduce spares and maintenance cost;
- d) All light fittings located within the confines of high strength pavement of the runway shall be of the inset type as shown on the Drawings;
- e) All other light fittings outside the edge of the high strength pavement areas shall be of the elevated type;

- 
- f) All fittings shall be designed to enable quick and easy replacement of lamps, lenses, sealing rings etc. so that 'down time' is kept to a minimum;
 - g) The optical systems shall be simple, employing pre-focus lamps such that no adjustments need to be made when replacing lamps;
 - h) All lamps shall be long life halogen type; and
 - i) All light fittings shall have photometric performance and beam pattern that satisfies the MOS Part 139 requirements for Medium Intensity Lights.

15.5.2 Inset Lights

In general, all inset light fittings supplied and installed shall meet the following requirements:

- a) All inset light fittings shall be produced by the same manufacturer;
- b) All inset light fittings and all components shall be supplied as a single completely assembled fitting from the manufacturer;
- c) All inset lights shall be suitable for shallow base installation with facility for entry and replacement of the secondary cable through the bottom of the shallow base;
- d) The inset light fitting shall withstand all stresses of impact, rollover, static and dynamic loads of a landing, taxiing, parking and manoeuvring aircraft and of service vehicles without damage to the light fitting or to the aircraft and vehicle tyres;
- e) The lights shall present a smooth outer surface;
- f) No optical adjustment shall be required after replacement of lamp(s) or prism(s);
- g) All light fittings shall be of the totally enclosed dry type and be suitable for continuous use in a harsh, high traffic environment;
- h) The lenses and prisms shall be fixed in such a way to assure complete watertightness while resisting all applied in-service static and dynamic loads;
- i) The lenses and prisms shall be fixed in such a way as to assure complete resistance to salt water, kerosene, oil, de-icing fluids and all other chemical products that may be present on the runway, taxiways and parking aprons;
- j) The optical system shall be simple, employing prefocus long life lamps such that no adjustments will need to be made when re-lamping;
- k) Lamps shall be of the quartz halogen (or tungsten halogen) type, rated 6.6A, with an expected life of not less than 1,500 hours at full intensity;
- l) Lamps shall be precisely pre-focalised in order to guarantee constant photometric performances;
- m) All filters for inset lights shall be of the dichroic type with light output colour compliance with the requirements of MOS Part 139; and
- n) Each inset light shall be fitted with secondary cable leads terminated with a factory moulded FAA type bi-polar plug for termination to the secondary cable in the shallow base.

15.5.3 Inset Light Fitting Shallow Bases

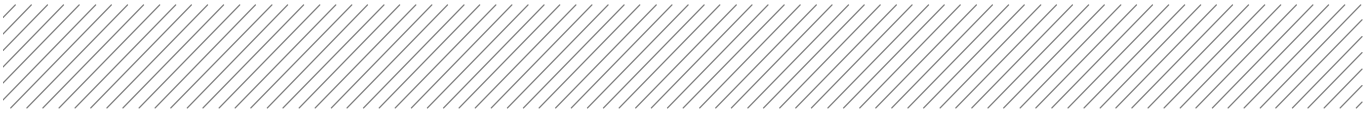
In general, all inset light fitting shallow bases supplied and installed shall meet the following requirements:

- a) The shallow base shall be of the same manufacture as the inset light;
- b) The manufacture of the shallow bases and cover plates shall comply with FAA AC150/5345-42F;
- c) Inset lights shall be mounted directly on the shallow base can without the use of adapter rings;
- d) Shallow bases shall have notches or other permanent markings on the top edge to facilitate alignment during can installation;
- e) The notches shall be 180 degrees apart and shall align parallel with the respective runway centre line; and
- f) The Contractor shall supply sufficient number of installation jigs and aiming and levelling instruments for the proper alignment and level of the mounting bases within the tolerance of $\pm 0.5^\circ$ in accordance with the requirements of MOS Part 139.

15.5.4 Elevated Lights

In general, all elevated lights supplied and installed shall meet the following requirements:

- a) All elevated light fittings shall be manufactured by the same manufacturer;
- b) All elevated light fitting components shall be supplied as a single completely assembled fitting from the manufacturer;
- c) The elevated light fittings shall be manufactured out of aluminium alloy or synthetic materials, or a combination of these materials with a heat resistant glass optical dome, or glass lens;
- d) The light fittings shall have a frangible coupling and arrangement that shall allow for easy elevation and azimuth setting;
- e) The elevated fittings shall include drainage holes to evacuate condensation water;
- f) The drainage holes shall be sized (or screened) so as to prevent the ingress of insects;
- g) The elevated fittings shall be totally watertight;
- h) The elevated fittings shall employ pre-focused long life lamps;
- i) The aluminium reflectors in the optical systems shall have a purity of 99.99%;
- j) Lamps shall be of the quartz halogen (or tungsten halogen) type, rated 6.6A, with an expected life of not less than 1000 hours at full intensity;
- k) Lamps shall be precisely pre-focalised in order to guarantee constant photometric performances;
- l) The body of all elevated fittings shall be coloured 'Aviation Yellow';
- m) Colour filters mounted outside the fitting are not permitted;
- n) The fitting hardware shall be plain stainless steel throughout;
- o) Each elevated light shall be fitted with secondary cable leads terminated in a FAA style bi-polar plug for termination to the secondary cable at the base of the fitting;

- 
- p) Elevated fittings, mounting couplings and masts shall satisfy the frangibility requirements of MOS Part 139; and
 - q) Elevated fittings, mounting couplings and masts shall be able to withstand without damage the jet blast from larger wide-bodied aircraft, including the Q400.

15.5.5 Inset and Elevated Light Optical Components

In general, all elevated light optical components supplied and installed shall meet the following requirements:

- a) All transparent optical components such as lenses, coloured filters, prisms, etc. shall be manufactured out of glassware of genuine optical quality;
- b) All transparent optical components such as lenses, coloured filters, prisms, etc shall be resistant to thermal shocks that may happen during operation; and
- c) To limit the number of spare parts and to simplify the maintenance procedures, preference shall be given to equipment with a high number of components that are common to the same family of elevated or inset lighting fittings.

15.5.6 Medium Intensity Runway Threshold and End Lighting System

In general, all medium intensity runway threshold and end lights supplied and installed shall meet the following requirements:

- a) The runway threshold and end lights shall be bidirectional elevated fittings showing Green Light in one direction (Threshold) and Red light in the other (End);
- b) The lights shall be compliant with MOS Part 139; and
- c) All threshold and end lights to have photometric performance as per MOS Part 139 for Medium Intensity.

15.5.7 Medium Intensity Runway Edge Lighting System

In general, all medium intensity runway edge lights supplied and installed shall meet the following requirements:

- a) Medium Intensity runway edge lights shall be fixed omnidirectional lights showing variable white;
- b) The light fitting total height above the surrounding pavement level shall not exceed 300 mm;
- c) The light fitting shall consist of the following components and/or sub-assemblies:
 - a. A pre-focused, tungsten halogen lamp, rated 6.6A, with a maximum power of 45W;
 - b. A pre-focused, tungsten halogen lamp with an expected life that shall exceed 1000 hours at rated current;
 - c. Prismatic, clear or coloured, glass inner lenses, thermal shock resistant;
 - d. A thermal shock resistant glass outer dome, externally smooth, with a heat resistant "O"-ring gasket;
 - e. A heat resistant supply cable, moulded on a 2-pole plug to FAA (AC 150/5345-26C); and
 - f. A levelling device.
- d) Re-lamping shall be possible without the use of any tool; and

- e) All runway edge lights shall have photometric performance as per MOS Part 139 for Medium Intensity Lights.

15.5.8 Medium Intensity Taxiway Edge Lighting

In general, all medium intensity taxiway edge lights supplied and installed shall meet the following requirements:

- a) Taxiway and Apron Edge light fittings shall be blue elevated omni-directional medium intensity. Hold point lights shall be yellow elevated omni-directional medium intensity photometrically matched to the blue fittings;
- b) Taxiway and Apron Edge light fittings shall comply fully with the requirements of MOS Part 139;
- c) Indicative mounting and secondary cable routing arrangements are provided in the drawings;
- d) All components shall be made out of temperature and UV-resistant material, suitably protected against corrosion;
- e) The protection degree of the fitting shall be IP43 or better.
- f) The light fitting shall be compact and of rigid, yet frangible construction, featuring an aerodynamic shape to resist jet engine exhaust blast.
- g) The total height of the light fitting above the surrounding pavement level shall not exceed 300 mm.
- h) The light fitting shall consist of the following components and/or subassemblies:
 - a. One prefocus tungsten halogen long life lamp, each with a rating not exceeding 45 watt 6.6 Amp;
 - b. The lamp shall have an expected life in excess of 1,000 hours;
 - c. A full coloured thermal shock resistant optical glass dome without additional filter;
 - d. A heat resistant "O"-ring gasket;
 - e. A heat resistant supply cable, moulded on a 2-pole plug to FAA (AC 150/5345-26D); and
 - f. A levelling device;
- i) Re-lamping shall be possible without the use of any tool.

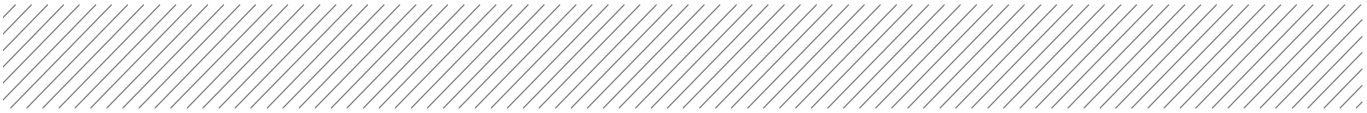
15.6 Movement Area Guidance Signs (MAGS)

Two mandatory MAGs are required to indicate the 17/35 Runway hold position. Two MAGs are required to indicate the exit from the 17/35 Runway on to the Taxiway.

The MAGS are required to provide guidance for aircraft as required by MOS Part 139 for the function of providing mandatory and information signs.

Supply shall include all equipment required for the normal installation and operation of the signs. This shall include frames, panels, mounts, transformers, lamps, switches, wiring and secondary cable plug.

MAGS shall be MOS compliant and shall be suitable for installation on a concrete pad and incorporate a holding device to retain the secondary cable socket in the event of the light being dislodged from its mounting.



The MAGS inscription and quantity of each type of sign required are shown and scheduled in the drawings. Information signs will be used to direct taxiing aircraft to various locations; runways, taxiways, dispersal areas etc. and shall comply with the colour schemes as per MOS Part 139

15.6.1 Character Form and Dimensions:

The sign dimensions shall be in accordance with the requirements for the particular sign type and inscription as approved by the Superintendent prior to manufacture and as detailed on the drawings.

All mandatory signs shall have a nominal inscription panel height of 800 mm and a legend size of 400 mm.

All information signs shall have a nominal inscription panel height of 600 mm and a legend size of 300 mm.

The body of all signs shall have a minimum ground clearance of 150 mm.

Where not detailed on the Drawings, the Contractor shall submit the proposed sign details including size, text, character and form for each MAGS to the Superintendent prior to manufacture. This shall be a designated **Hold Point**.

15.6.2 Lighting Methods

The signs shall be internally illuminated. The sign illumination shall be by means of fluorescent or other suitable lamps. The MAGS shall operate on a series circuit common with taxiway lights and shall operate over the entire range of currents required for the taxiway lights. The typical current range is between 2.8 and 6.6 Amperes. All signs shall be capable of operating over this range and shall comply with all requirements of this Specification when powered at any current within this range.

All signs shall be designed to be energy efficient and shall impose the minimum possible electrical load on the series current circuit. Details of the electrical load for each sign type and size shall be submitted for assessment; this shall include true power load, power factor and starting characteristics for all signs.

15.6.3 Sign Construction

The signs shall be constructed to provide long-term maintenance free service.

The signs shall be capable of withstanding long term exposure to dust and salt laden winds, heavy rain fall, high and low humidity, high and low temperatures, high ultra violet content sunlight without deterioration of the body of the sign, inscription panel face, external and internal finishes, or internal components (such as wiring, lamps, etc).

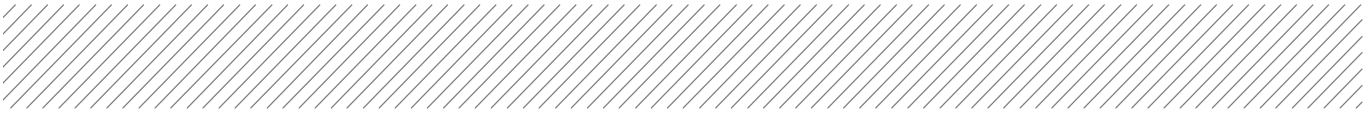
The sign body and inscription panel shall be capable of withstanding a vibrating wind force in the form of a jet blast of 250 km/hour.

The signs shall be designed to prevent foreign material build up that may damage internal sign components or degrade the signs visual performance, in particular when internally illuminated. Where drainage holes are provided, they shall be so designed to inhibit the entry of insects.

The sign shall be constructed to prevent collection or build-up of any material, either within the sign or on any external surface of the sign that may degrade the life and/or visual performance of the sign.

This shall include:

- a) Insects;
- b) Dust or any type;

- 
- c) Solid build-up due to rain splash;
 - d) Grass particles or blown grass cuttings; and
 - e) Bird soiling.

15.6.4 Sign Mechanical Construction and Finishes

Signs shall be constructed to provide long life low maintenance services. The signs shall be capable of providing a minimum of 10 years service under the environmental conditions detailed in this specification. The signs shall be constructed of lightweight, non-ferrous UV stabilised materials and shall be designed for installation on a concrete pad.

Dissimilar metals used in the construction and assembly (including fixing devices, screws, bolts, etc. shall be installed in a manner to prevent electrolytic corrosion of the materials. Use of directly compatible materials will be preferred.

All materials used in the manufacture of the signs shall be adequately protected against corrosion and shall be resistant to the effects of the corrosive and salt laden atmosphere in which the signs will be installed.

15.6.5 Frangible Mounting

Sign mounting legs/supports shall be frangible at no more than 50 mm above the ground level.

The couplings/feet shall be capable of withstanding wind loadings on the signs of 250 km/hour. These couplings shall withstand, without breaking, an applied pressure of 6 kPa, but shall break when a pressure of 9 kPa is applied to the face of the sign. The coupling shall be designed to provide rigidity of the sign and to minimise movement of the sign under normal installed service conditions.

The frangible coupling shall incorporate retention of the secondary circuit socket such that in the event of the MAGS being dislodged from its position the secondary circuit is disconnected and no bare electrical connections are accessible.

15.6.6 Safety Chains

To prevent the signs creating a hazard in case of detachment from it's mounting, each sign shall be provided with two safety retaining chains/wires permanently fixed to the body of the sign.

The safety chain/wire shall restrict the travel of the sign body to no more than 2000 mm from its base, after detachment of the sign from its mounting. The safety chain/wire shall be long term corrosion resistant. The safety chain/wire shall not restrict normal maintenance and easy installation of the signs.

15.6.7 Name Plate

Each sign shall have a name plate giving complete details indicating manufacturer's name, address and contact telephone number, equipment type number, serial number, input rating, total volt-amp load, weight, etc. These details shall be permanently inscribed on the nameplate. The nameplate shall be on the outside of the body of the sign and shall be readily visible when the sign is installed in normal service on the designed mounting.

15.6.8 Bird Soiling

The sign shall be provided with facilities on the top of the sign body, to prevent birds soiling the sign face and sides. This facility shall not obstruct or in any way reduce the readability of the sign inscription panel or photometric performance of the sign. Complete details of the operation of this facility, in preventing birds roosting on the sign and soiling the sign face, shall be included in the offer.



15.6.9 Electrical Fabrication

All wiring and components of the signs shall be adequately rated and shall not operate in excess of the manufacturers recommended ratings. All components shall be suitable for the environmental conditions of service in which the signs will be used. All cabling and components shall be adequately rated or protected against damage by ultra violet radiation and any high temperatures that may be experienced by or within the sign. All cabling shall be run into the sign and throughout the sign in a manner to prevent damage to or chaffing of any cable insulation. All cable entry holes shall be bushed.

All cables and equipment shall be suitably retained.

The internal electronic components shall be located at the top of the interior of the MAGS so that in the event of local flooding of the adjacent areas the electronic components would be above the water level.

All cables shall be run direct without joints. All terminations shall be carried out such that the cable conductors are adequately protected. This may be achieved by the use of ferrules or crimp lugs.

Where screw type terminations are used, the screw shall not act directly on the conductor.

An external IP56 rated isolating switch shall be provided to isolate the sign from the SIT and short the SIT secondary circuit.

15.6.10 Earthing

The Contractor shall Install an earthing stud so that the sign can be earthed to an external earthing stake.

15.6.11 Construction

The Contractor is responsible for the survey and setting out of the MAGS. Prior to commencement of construction of any sign, its position shall be set out on Site, and that position shall be inspected and approved by the Superintendent. The Contractor shall adjust any position if directed to do so by the Superintendent at no additional cost to the Principal.

Unless otherwise indicated, single sided MAGS shall be orientated 75 degrees to the centreline of the relevant taxiway or runway.

Unless otherwise indicated, the signs shall be located in accordance with ICAO Annex 14, Chapter 5.4. Perpendicular distances from defined taxiway and runway pavement edges to near side of signs shall be 20 m and 30 m, respectively.

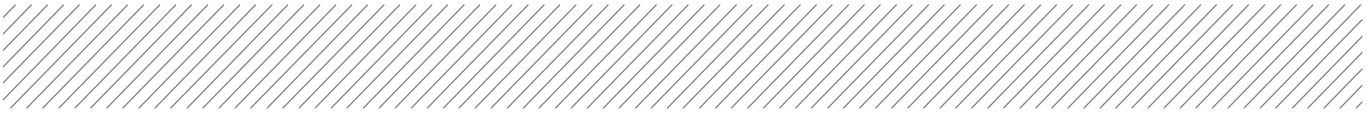
The Contractor is responsible for the setting out of the cable route for each sign.

The Contractor shall mark on the ground the precise cable route to be followed. Prior to commencement of trenching the marked cable route shall be inspected and approved by the Superintendent. The location of existing underground services will be identified by the Superintendent at that time. The Contractor shall adjust the cable route if directed by the Superintendent at no additional cost to the Principal.

15.6.12 Design and Construction of Concrete Bases

The Contractor shall design and construct the base slabs for the MAGS, to match existing MAGS base slabs where applicable.

For precast concrete bases, where the base for a sign consists of more than one slab, the two slabs shall interlock along the full length of the joint.



No heavy vehicles will be allowed to travel on grassed areas without protective matting. The top of each base shall be horizontal and at the same level as the natural surface level so that the base does not form an obstruction to grass cutting operations.

The dimensions of each base slab shall be such that the edge of the base slab extends 500 mm beyond the sign structure in each direction.

If lifting lugs are cast into the base slab, the lugs shall be recessed such that no part of the lug protrudes above the surface of the base slab.

15.6.13 Erection of MAGS

Each sign shall be tied to the base slab by not less than two safety retaining wires. The top of each sign shall be horizontal.

Where a MAGS is comprised of two units abutting, the tops of both units shall be in line and horizontal and the faces of both units shall be parallel with an offset of 30 mm, to allow removal of the inscription panels, and each of the two units shall be tied to the base slab by two safety retaining wires.

15.7 PAPI System

This part of the specification covers the technical requirements for PAPI systems, and associated alignment, special tools and special equipment to be supplied by the Contractor for installation.

Unless otherwise directed by this specification, PAPI equipment shall be manufactured to fully comply with all of the requirements of MOS Part 139. Approximate PAPI locations are indicated on the Drawings, however the exact location shall be determined by the Contractor based on aircraft advised by the Principal including the Q400.

Each PAPI system shall comprise a four (4) unit (box) wing bar system. All PAPI units forming each wing bar systems shall be identical. All PAPI units in all PAPI systems shall be identical. Each PAPI wing bar unit shall be adjustable within the range of at least 0 degrees to the horizontal to 8 degrees above the horizontal.

Each PAPI wing bar unit shall be a two-lamp sharp transition device. Each lamp in each PAPI unit shall be wired such that it is supplied by a dedicated SIT.

The equipment photometric performance of each PAPI wing bar system and each PAPI unit forming part of each wing bar system shall, at least, comply with the requirements of MOS Part 139. This shall include compliance of all equipment with MOS Part 139 colour, light intensity distribution and uniformity requirements for PAPI units. In particular, the colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3 degrees of arc as required by MOS Part 139

The PAPI units shall be provided with a precision adjustment system that shall allow the accurate adjustment and alignment of the units. This adjustment system shall be provided with a locking arrangement that shall ensure the long-term stability and retention of the required alignment setting.

Lamps provided with and for normal operational use in the PAPI units shall be suitable for operation using a standard airport type 6.6 A series current system. Rated life of the lamps provided for the PAPI units shall be a minimum of 1000 hours when operated continuously at maximum rated output.

Each PAPI unit shall be supplied complete with mounting legs, frangible couplings and all other equipment necessary for the proper assembly and installation of the equipment.

15.7.1 Alignment Tools, Special Tools and Special Equipment

The PAPI systems shall be supplied with at least one complete set of PAPI special tools (including alignment tools) and special equipment.

This set of special tools and equipment shall include all aiming, alignment and any other special set-up and installation tools that are required to allow the normal installation, set-up and maintenance of the particular PAPI systems. In addition, this set of special tools and equipment shall include any special equipment particularly required for the proper installation of the PAPI units.

The vertical alignment tools supplied for alignment of the alignment of the PAPI units shall allow the alignment of the PAPI units to be made to an accuracy of at least 1 degrees of arc.

15.8 Runway Guard Lights

The Runway Guard Lights (RGLs) layout will be configured in accordance with Configuration A as detailed in MOS Part 139 with the following parameters:

- a) Two pairs of elevated lights showing yellow, one pair on each side of the taxiway and equidistant from the taxiway centreline between 3 and 5 metres from the outside edge of the taxiway;
- b) The lights in each pair will be illuminated alternately between 30 and 60 cycles per minute;
- c) The light beams will be uni-directional with beam centres aimed across the taxiway centreline at a point 60 m prior to the runway holding position;
- d) Light performance criteria in accordance with ICAO Annex 14 Appendix 2 Figure A2-24 for night time operation and Figure A2-25 for day time operation; and
- e) The RGLs will operate continuously (24 hours a day).

15.8.1 Photometric Performance

The photometric performance of the lights shall conform to the requirements of MOS Part 139 Section 9.13

15.8.2 Construction Form

The standard installed height for the elevated RGLs shall be a minimum of 356 mm and not more than 660 mm from the bottom of the light emitting surface to ground level.

The RGL must be designed to reduce the amount of incident sunlight on the light emitting surface to maximise the contrast between the lamp-on and lamp-off states. This must be accomplished by providing one visor per light source. Each visor must comply with the requirements detailed in FAA Advisory Circular No. 150/5345-46D.

All bolts, studs, nuts, washers and other similar fasteners and fittings shall be fabricated from stainless steel of an appropriate alloy and finish. Provision shall be made in the light mounting to allow adjustment to obtain true vertical and azimuth alignment (eg Wells coupling). Details of this mounting arrangement shall be submitted with the Tender.

All components shall be suitable for the intended purpose and adequately protected against corrosion. A corrosion inhibiting paste (Never-Seez or similar) shall be applied to the threads of all external fixing and adjusting screws and clamps.

The components shall have adequate capacity and shall not be operated in excess of the component manufacturers recommended rating.

15.8.3 Frangibility

The light body and light mounting shall have an approved frangible coupling where the light attaches to the base and where the mounting attaches to the light respectively. The frangible coupling shall comply with the requirements of ICAO Aerodrome Design Manual Part 4 – Visual Aids Chapter 15.

15.8.4 Instruction Manual

An instruction manual must be included with each order and must contain at least the following information:

- a) Diagram showing layout of parts and wiring;
- b) Complete parts list with the names and addresses of the component suppliers and their part numbers;
- c) Assembly and installation instructions, including dimensions of any pavement cuts, recommended; torques, and special mounting requirements; and
- d) Maintenance instructions, including durability information on “pop-out” frangibility devices for elevated lights.

15.8.5 Specialist Tools

Provide details of any specialist tools that may be required for maintaining the runway guard lights.

15.9 Illuminated Wind Direction Indicator System

The Contractor shall supply and install 3 IWDIs as indicated on the drawings. The IWDI shall consist of a rag bolt assembly mounted hot dipped galvanised tilt-able steel column with white wind sleeve and be fully compliant with the requirements of MOS Part 139.

15.9.1 Construction Form

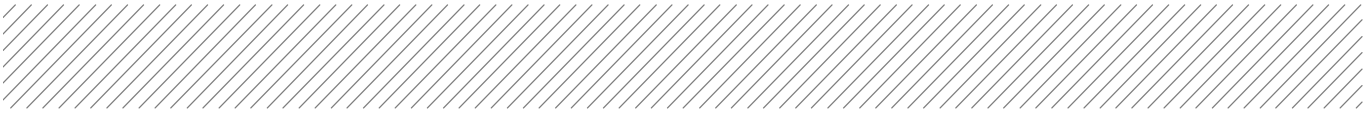
In general, the IWDI shall comply with the following requirements:

- a) The IWDI shall be approximately 8 metres tall;
- b) The IWDI sock shall be illuminated from above;
- c) The IWDI shall be mid-hinged for maintenance access;
- d) The IWDI shall have twin-bodied obstacle lights mounted on top;
- e) The design and construction of the IWDI shall comply with the frangibility requirements of MOS Part 139 Section 8.7;
- f) The IWDI shall include durable and tapering fabric sleeve attached to a mast at its wide end; and
- g) The light supporting structure/brackets shall be treated against corrosion.

15.9.2 Lighting Design

In general, the IWDI lights shall comply with the following requirements:

- a) Floodlight and obstruction light lamp holders shall be of the porcelain type;

- 
- b) The IWDI shall be fitted with adequate number of top mounted lights to produce an luminance level as per MOS Part 139;
 - c) The IWDI lights shall be energized whenever the runway lighting is selected;
 - d) The IWDI lights shall be weatherproof;
 - e) The lights shall be installed so as to prevent any glare to aircraft pilots;
 - f) Power supply to each IWDI shall be via a MIT located in the Airport Lighting Cubicle. A step up transformer 230V/900V shall be located in the MIT. A pole mounted step down transformer (900V/230V) shall be located on the IWDI pole. The IWDI shall be powered by 230V;
 - g) Each section of the pole shall be provided with a 12 mm earth stud on the inside of the pole located such that it does not interfere with the operation of the pole and is accessible when the pole is lowered;
 - h) Between these earth studs shall be connected a 35 mm² flexible cable complete with cable lugs. The cable shall be as short as possible but shall be sufficiently long to avoid any strain on the lugs or studs when the pole is in the upright or lowered position or during the raising/lowering operation.
 - i) A 12 mm diameter earth stud shall be welded to the outside of the pole near the base prior to galvanising for connection to a separate external lightning earth stake.

15.10 Primary Conduit System

The Contractor shall supply and install all primary conduit associated with the Works. Conduits shall run in a straight line using 63mm/100mm diameter orange uPVC conduit (minimum) from the new pits, as shown on the drawings. The primary conduit shall be installed at a minimum depth of 750mm from the finished surface level.

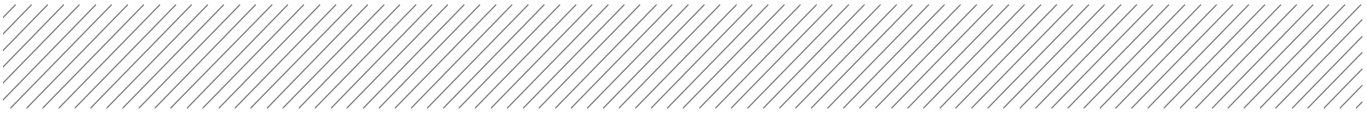
The Contractor shall carry out the following, but not limited to:

- a) Provide trenching for all primary cable conduits, ducts, structural pits, SIT pits and backfill;
- b) The primary conduits shall be laid into a bed of granitic sand;
- c) The trench shall be backfilled with approved classified fill, placed in layers not exceeding 200mm and compacted adequately to avoid future settlement;
- d) Install primary conduit, including a draw cable, SIT pits and structural pits;
- e) Conduit system shall link SIT pits, structural pits and ducts as per Drawings; and
- f) New conduit system to have a plastic conduit and warning tape.
- g) Install all conduits and pits in a manner that limits movement and settlement of the pit with time and minimises the ingress of water into the pit and conduit system.

The installation of the primary conduit shall include all the associated civil works including trenching, backfilling, conduits laying, ducting, making good and supplying all materials and labour, including all cabling works, as required and shown on the Drawings.

The Contractor shall install all conduits and pits in a manner that limits movement and settlement of the pit with time and minimises the ingress of water into the pit and conduit system.

Completion of the trenching and bedding and prior to conduit laying shall constitute a **Hold Point**.



All conduits to be installed between SIT pits shall be 63mm diameter orange uPVC conduits. Refer to the Drawings for details

The Contractor shall be aware of existing cables and services crossing in the area of works. The Contractor shall undertake all preventive actions to identify and protect these services. As a minimum the Contractor shall hand excavate all crossing areas to expose services and protect the existing cables. The Contractor shall be responsible for any damage and repair caused to the existing services.

Excavation around existing services shall be in accordance with **Section 4** and **Clause 5.5.3**.

15.11 Secondary Conduit System

The Contractor shall install all secondary conduits associated with the new and existing light positions. The new secondary conduits shall run from the pavement edge to the SIT pit in a straight-line using 32mm diameter orange uPVC conduits, as shown on Drawings. The secondary conduit to be installed at a minimum depth of 450mm below finished ground level.

The installation of the secondary conduit shall include all the associated civil works including trenching, backfilling, conduits laying, ducting, making good and supplying all materials and labour, including all cabling works, as required and shown on the Drawings.

The Contractor shall install all conduits and pits in a manner that limits movement and settlement of the pit with time and minimises the ingress of water into the pit and conduit system.

Completion of the trenching and bedding and prior to conduit laying shall constitute a **Hold Point**.

The Contractor shall be aware of existing cables and services crossing in the area of works. The Contractor shall undertake all preventive actions to identify and protect these services. As a minimum the Contractor shall hand excavate all crossing areas to expose services and protect the existing cables. The Contractor shall be responsible for any damage and repair caused to the existing services.

Excavation around existing services shall be in accordance with **Section 4** and **Clause 5.5.3**.

15.12 Field Circuit Layout

Every primary field circuit is connected by way of separate feeder cables to a new MIT located at a position as indicated on the Drawings. All elements of the AGL system are fed from this new MIT.

Where multiple primary field circuits and associated feeder cables are specified for any element of the AGL system, the underground cabling may be run in the same conduit system.

All cables, as far as practicable, must be laid in straight lines with the minimal number of changes in direction.

Where primary cables are to run through structural pits a 2 metre coil of cable must be left in the structural pit. The coils must be neatly tied to the supports on the insides of the pits. Cables must not be laid on the floor of the pits.

Where primary cables are to run through SIT pits and are nominated to be connected in the SIT pit, a 2 metre excess coil of cable must be left at the designated point of connection. Individual secondary cables must be provided for each light unit. Cables must not be laid on the floor of the pits.

Once installed, all new primary circuits shall be fully tested. Refer to cable Installation and testing requirements in **Clauses 15.18** and **15.22**. The Contractor shall ensure co-ordination with the Principal prior to carrying out any jointing or testing of any airport lighting circuit.

All redundant primary cables in the existing Airport Lighting Equipment Room (ALER) are to be disconnected and removed from site as directed by the Principal.

15.13 Airport Primary Circuits

As part of the Works, new primary circuits are required for the AGL system which cover the following as described in **Table 15-1**:

- a) Runway Edge, Turning Node and Threshold Lighting circuits;
- b) Runway Guard Light circuit;
- c) Taxiway Edge, Hold Point Lighting and MAGS circuits;
- d) Runway PAPI circuit; and
- e) IWDI circuits.

Table 15-1: New Airport Primary Circuits

Circuit	Function
05	Runway Edge, Runway Turning Node and Threshold Light Circuit
10	Runway Guard Light Circuit
15	Taxiway Edge, Holding Point Light and MAGS Circuit
20	Runway PAPI 17 Circuit
25	Runway PAPI 35 Circuit
30	IWDI 1 Circuit
35	IWDI 2 Circuit
40	IWDI 3 Circuit

All circuits shall be tested. Refer to the Testing requirements of **Clause 15.22**. Ensure that co-ordination with the Principal is carried out prior to carrying out any joint or test function to any lighting circuit.

15.14 Runway and Taxiway Secondary Circuits

New secondary circuits are to be installed within the new conduit system and cable jointing shall be made into the existing circuits to ensure complete circuit configuration. Refer to Drawings for relevant circuits.

All circuits shall be tested. Refer to the Testing requirements of **Clause 15.22**. Ensure that co-ordination with the Principal is carried out prior to carrying out any joint or test function to any lighting circuit.

15.15 Lighting Pits

The Contractor shall supply and install the following types of pits as per the Drawings and schedules.

SIT pit (Electrical) - are used for SIT and primary connection for AGL. Structural pit (Electrical) – installed at both the runway ends, at both ends of a duct bank



Element	Function	Material/Brand
SIT pit (Electrical) Located in grassed flanks, connected into the pit and conduit system	Primary and secondary cable connections, 750mm deep primary cable installation. Minimum 400 diameter, 900 mm deep with Class C lid	Plastic – BVCI or equivalent
Structural pit (Electrical) Located in grassed flanks, connected into the pit and conduit system	Duct bank ends, Primary and secondary cable connections (where required) Minimum 900 mm deep with Class D lid	Precast – BVCI or equivalent

The installation of all pits shall include all the associated civil works including trenching, ducting, conduits laying, backfilling, and all cabling works, as recommended by the pit manufacturer and as shown on the Drawings. The Contractor shall install all pits in a manner that limits movement and settlement of the pit with time and limits the ingress of water to a minimum as recommended by the manufacturer (including conduit connections).

15.15.1 SIT Pits

The Contractor shall install new SIT pits at the locations indicated on the Drawings.

The Contractor shall ensure that SIT pits are suitable for the later installation of transformers and the required cable conduit /connections.

The installation of the SIT pits shall include all the associated civil works including trenching, ducting, conduits laying, backfilling, and all cabling works, as required and shown on the Drawings.

The Contractor shall be able to install up to 3 transformers in a SIT pit or as per the Drawings.

The Contractor shall ensure that all SIT pit lids are clearly identified and labelled as “ELECTRICAL HV” to the approval of the Principal.

Refer to **Clause 15.15** for further details.

15.15.2 Structural Pits

Structural pits / cable pits shall be installed at nominated locations on the Drawings.

The Contractor shall ensure that structural pits are suitable for the later installation of transformers and the required cable conduit /connections.

The installation of the structural pits shall include all the associated civil works including trenching, ducting, conduits laying, installation of internal cable tray, backfilling, and all cabling works, as required and shown on the Drawings.

Refer to **Clause 15.15** for further details.

15.15.3 Pit Drainage

Selected SIT pits shall be drained at the locations shown on the Drawings. All SIT pit drainage shall be undertaken with 100mm diameter uPVC pipes.

The Contractor shall install all drainage pipes in a manner that limits movement and settlement of the pipe with time and minimises the ingress of water into the SIT pit and conduit system.

15.16 Series Isolating Transformers

A separate Series Isolating Transformer (SIT) and associated secondary circuit must be provided for each lamp unit of the runway/taxiway lighting systems.

The SITs shall be of a type encapsulated, complete with primary and secondary cable flying leads. The SIT ratings are provided below in **Table 15-2**.

Table 15-2: SIT Rating

Circuit	Function
Medium Intensity Runway Edge, Elevated, Omni-Directional	1 X 45W
Medium Intensity Runway Edge Flush – Omni-Directional	1 X 45W
Runway Threshold/ End : Elevated Bi-directional, Green/Red	1 X 100W
MAGS	2 X 100W
Medium Intensity Taxiway Edge: Elevated Omni-directional, Blue	1 X 45W
Medium Intensity Runway Holding Point Lights: Elevated Omni-directional, Yellow	1 X 45W

Primary plug/socket connections are to be used. All connections made in the field must be made with a cable joint kit.

Secondary cable joints shall be made using a FAA style plug and socket.

Details of the type, size, connection and technique of the cable joint shall be approved by the Principal. Note the correct size and type of crimping tool shall be used for crimp links.

15.17 Cable Ratings

Cable ratings must generally conform to the requirements of AS3000. In particular, the field cables supplied must be:

- Primary cable: 7/1.04, 6mm² single core cooper conductor, polythene insulated, 5kV, nylon 12 sheathed, generally to specification YSVE 4005, or Principal, airport lighting approved 5kV, unshielded, airport lighting type cable with a maximum overall diameter of 11mm
- Secondary cable: 50/0.25, 6/2.5mm² 2 two-core cooper, black/white PVC insulated, 50V, nylon 12 sheathed, to specification YSVE 4005 as indicated on the drawing

15.18 Installation

15.18.1 General

All elements of the lighting system shall be installed generally in accordance with the relevant requirements of the ICAO Aerodrome Design Manual, Part 5, Chapters 4 and 5, and of MOS Part 139.



15.18.2 Elevated Light Fittings

For new elevated light fittings, the work involves:

- a) Surveying the new installation points after completion of the pavement works;
- b) Supply and install new light bases;
- c) Supply and install new elevated lights,
- d) Supply and install new SITs;
- e) Supply and install new primary cable and conduit;
- f) Supply and install new secondary cable and conduit;
- g) Supply and install new duct/electrical pits;
- h) Retrieving leads and couplings from the light bases and installing new secondary cables and conduits;
- i) Connecting the leads and couplings to the light fittings;
- j) Installing the light fittings by drilling holes through the new concrete light bases and chemically setting new bolts;
- k) Commissioning the lights;
- l) Disconnecting and removing existing elevated edge lights and SITs in the work area that are decommissioned; and
- m) Demolishing and removal of existing elevated light bases in the work area that are decommissioned.

15.18.3 Inset Light Fittings

For new inset light fittings, the work involves:

- a) Surveying new light installation points and aiming points after completion of the pavement works;
- b) Installing new secondary primary cable and conduit;
- c) Installing new secondary cable and connecting to new secondary circuit;
- d) Coring and installing new light bases;
- e) Installing new SITs;
- f) Installing new duct/electrical pits;
- g) Installing new inset light fittings;
- h) Connecting leads and couplings to the light fittings;
- i) Commissioning light fittings; and
- j) Recording as-constructed details and verifying correct location and aiming of each light.

15.18.4 Cabling

(a) General

All cabling, except where otherwise indicated in this Specification, shall comply with the relevant requirements of Clause 5.3.2 of AS3000 and all applicable regulations of the power supply authority.

(b) Cable Marking

The cable shall be identified by indelibly printed (contrasting colour) identification along its length. The markings shall be printed on the outer sheath of the cable.

(c) Primary Cables

Primary cable shall be installed in conduits in ground at a minimum depth of 750mm with fine soil or sand providing at least 50mm all round cover. Bedding and backfill material shall be silty sand free of rubble, rocks or shells as described in **Section 12**

Where primary cables are to run through structural pits, SIT pits or manholes, a minimum two-metre coil of cable shall be left in each primary cable in each pit or manhole. The coils shall be neatly tied to the supports on the insides of the manholes. Cables shall not be laid on the floor of the manholes.

Manhole access rungs shall not be used as cable support and shall be clear and free of cables. Cable changes of direction in the manholes shall be by large radius sweep bends.

A two metre excess coil of cable shall be left at the end of each cable run or designated point of connection, for connection by the Principal or for future termination or connection.

Typically, the primary cable shall be installed in straight and single unjointed lengths. Joints shall only be made where cabling is jointed to a SIT, at test points or where cabling is required to be jointed into an existing primary cabling. Cable markers shall identify cable route changes of direction.

Where primary cable circuits are connected into the SITs the Contractor shall provide and use FAA type unscreened primary cable plugs and socket kits

Preformed, pre-terminated plugs and sockets compliant with FAA specifications shall be used for the connection of the primary cable to the SIT. The connection lead between the SIT and the airport lighting primary cable shall have a minimum length of 600mm and it shall have a factory moulded FAA style primary plug or socket. The insulation materials on the lead shall be compatible with the airport lighting primary cable and the in line cable joint

(d) Secondary Cables

Secondary cable shall be installed in conduits between the pit and the base of the lights at a minimum depth of 450mm with sand providing at least 50mm all round cover. Bedding and backfill material shall be silty sand free of rubble, rocks or shells as described in **Section 12**.

Where secondary cables run through SIT pits, a minimum two-metre coil of cable shall be left in each secondary cable in each pit. The coils shall be neatly tied to the supports on the insides of the pits.

Individual secondary cables shall be provided for each light unit.

Secondary cabling shall be installed in straight and single length unjointed runs, from the SIT pit to the light unit. Joints shall only be made where cabling is to be jointed to the secondary cable tails of the SIT and to the tails of the lamp unit.



(e) Cable Extensions and Joints

The Contractor shall install all new cables required for any cable extensions, associated tools and all materials required to provide the appropriate jointing of the cables.

All cable joints are to be located in sit pits and accessible. There are to be no joints in conduits/ducts or where they are directly buried.

Cable extensions and joints shall constitute a **Witness Point**.

There shall not be any joints within the primary cable system except at the SITs. If joints are required in the primary cable network then the Contractor shall provide and use FAA type unscreened primary cable plug and socket kits. Joints in the primary cables shall only be made in either the SIT pits or duct pits.

Where new primary cables are required to be joined into an existing primary cable circuit, the joints shall be located inside a SIT pit.

Once installed, all new primary circuits shall be fully tested. Refer to the Installation and Testing requirements of this specification. The Contractor shall ensure that co-ordination with the Principal is carried out prior to carrying out any jointing or test function to any airport lighting circuit.

The primary cable connection kits shall be compatible with primary connectors on the SITs.

The primary cable connection kits shall be sized to suit the outer diameter of the primary cable.

(f) Cable Markers and Cable Tags

Appropriate cable markers shall be installed above all underground primary cable runs to indicate all changes of direction, entrances to ducts, primary cable joints and, in the case of long straight cable runs, the cable route. In the lattermost case, the markers are to be installed at the maximum spacing of 60m. Where SIT pits are installed on a primary circuit they may be used in lieu of cable markers.

Cable markers shall be:

- a) Made of concrete and incorporate a "P" indication and directional arrows for power and AGL cables; and
- b) Contractor shall use a Tag Critchley Slide on cable number for individual cable identification.

Each transformer shall be clearly and indelibly marked to indicate the primary circuit feeder to which the transformer is connected.

(g) Underground Cabling for Airport Lighting Systems

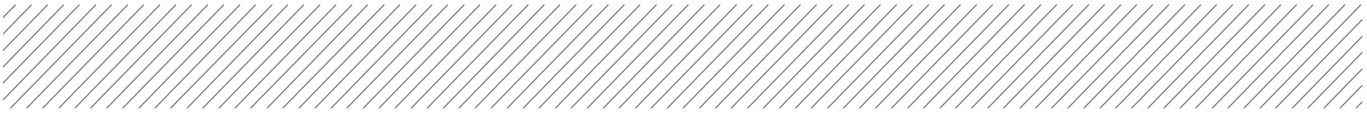
All SITs shall be installed inside a SIT pit.

To allow for future cutting and re-terminating of SITs, each SIT shall be installed with a 600mm loop of both primary (both legs) and secondary cable. The cable loop shall be installed in the hole with the transformer. The Contractor shall mark all cables in all SIT pits using a Critchley Slide on cable number to indicate the circuit number of individual cables

(h) Slotting (if applicable)

The slots shall meet the core as close as practicable to the cable entry point of the inset light unit base

All slots and cores shall be cut vertically. The minimum depths of slots to be 30mm with a maximum depth of 60mm. Refer to the Drawings for details.



Conduits shall then be run under from the pavement edge to the SIT pit in a straight line using 32mm conduit.

All cable slots in concrete shall be sealed with a joint sealant such as Dow Corning 888 or approved equivalent with backer rod as shown on the Drawings.

All cable slots in asphalt shall be filled with a flexible sealant as approved by the Principal with backer rod as shown on the Drawings.

All sealants shall be placed in accordance with the manufacturer's recommendations. All sealants shall be allowed to cure and shall not be trafficked immediately proceeding placement in accordance with the manufacturer's recommendations.

Where multiple light units are located in close proximity, multiple sets of secondary cables may be installed in a single slot. Refer to the Drawings for details.

Expansion joints in the concrete are to be utilised wherever possible with the number of cable slots kept to a minimum

Slot routes shall be planned and coordinated to ensure those existing operational secondary cables are not crossed and cut during the slotting process. If the position of a new light is such that it is not possible to avoid existing secondary cables then the direction of the Principal shall be sought prior to proceeding.

Planning and marking intended cable slot routes shall constitute a **Witness Point**.

All existing secondary cable locations shall be identified and determined on site by the Contractor.

(i) Backfilling/Restoration

All backfilling and restoration shall be able to withstand the effects of jet blast without displacement of the earthworks surface material. The Contractor shall be responsible for backfilling and rectifying areas damaged by construction activities so as to achieve this objective.

15.18.5 Cable "In-line" Jointing Kit

Cable jointing equipment and procedures shall have prior approval from the Superintendent before use.

Secondary cable joints shall be made using pre-insulated in-line crimp links of the appropriate size to suit the cable, and the correct crimping tool is to be used for the crimp links.

The in-line compression joints on each conductor shall be staggered so as to reduce the overall diameter of the joint. The joint shall be sealed to prevent the ingress of moisture and the entire joint covered and protected with a heat shrink cover.

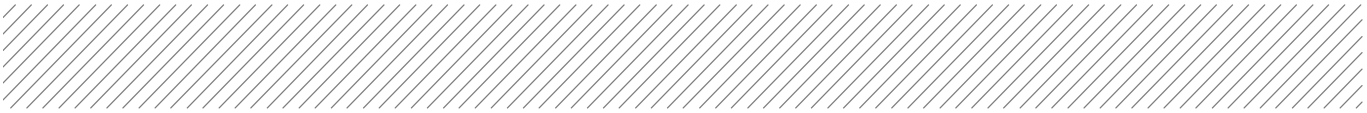
15.18.6 Epoxy Resin

Epoxy resin shall be used to bond the base of the inset light fitting to the pavement.

Epoxy resin shall be Megapoxy CT, a two part epoxy compound or equivalent approved by the Superintendent.

Epoxy resin is formed from two liquids (resin and hardener) and shall not be mixed until immediately prior to use.

Epoxy resin shall be mixed according to the manufacturer's recommendations.



The Contractor is responsible to ensure that employees are familiar with all hazardous material information relevant to epoxy resins, which are employed for the installation of inset light fittings.

15.19 Construction

15.19.1 Excavation

All excavation, regardless of the type of material, shall be undertaken to the depths and widths indicated on the Drawings in accordance with the requirements outlined in **Section 12**.

15.19.2 Bedding and Backfill

All bedding and backfill material shall be free of rubble, rocks or shells as indicated on the Drawings in accordance with the requirements outlined in **Section 12**.

15.19.3 Isolation

The Contractor shall establish suitable isolation procedures which shall be observed and adhered to during the isolation of the existing airport lighting circuits.

The Contractor shall liaise with the Principal in order to isolate all circuits which are impacted by the new airport lighting circuits while maintaining the operational capability of the existing airport lighting system until such time as the new airport lighting system is fully operational.

15.19.4 Survey

Identification points for the location of the base and the respective orientation (deviation angle) of the light shall be marked on the pavement at each light position prior to installation.

The survey shall capture all required coordinates required to undertake the set out of the visual aids, including all required tangent points, existing light locations and referenced line markings. Any discrepancy in the survey data with the design set out information shall be brought to the attention of the Superintendent for resolution.

The light position shall be accurately surveyed and marked by drilling a 5 mm diameter holes in the pavement. Drilled holes for surveyed markers shall be not less than 10 mm or more than 15 mm deep.

Nails or pins shall not be used to mark the surveyed locations.

The following methods of marking shall be applied:

- Identify the location of the centre of the light with red paint;
- Alignment markings should be identified by yellow paint as follows:
 - Two orientation points shall be drilled and painted each 1500 mm from the light centre and on opposite sides of the light base along the line coinciding with the centre line of the light. A string line shall be placed between these orientation points to ensure the correct orientation of the light base; and
 - A radial mark perpendicular to the above orientation at an approximate radius of 500 mm from the centre of the light location to indicate the orientation of the jig with respect to the pavement centreline.

All paint markings used for survey and set out purposes shall be removed from pavements prior to completion of the works.



15.19.5 Orientation and Level

To conform to the directional characteristics of the lights, it is essential that the fittings be oriented and level with respect to the centre-line of the pavement, so that the light distribution is secured in the required areas.

The final installed orientation of the centre line of the output beam of the inset light unit shall be within plus or minus 0.5 degree of the designed orientation.

Light bases shall be installed such that the light is installed within 0.25 degrees of level.

15.19.6 Elevated Runway Edge Light Fittings

After the completion of the pavement construction, the light fittings shall be connected to the secondary cables and installed into the new concrete mounting blocks at the location indicated on the Drawings, using stainless steel chemical anchors extending at least 100 mm into the concrete mounting block. This shall be a designated **Hold Point**.

Elevated light fittings shall be fitted, levelled and aimed by the Contractor using the correct instruments and tools.

15.19.7 Elevated Runway End/Threshold Light Fittings

After the completion of the pavement construction, the light fittings shall be connected to the secondary cables and installed into the new concrete mounting blocks at the location indicated on the Drawings, using stainless steel chemical anchors extending at least 100 mm into the concrete mounting block. This shall be a designated **Hold Point**.

Elevated light fittings shall be fitted, levelled and aimed by the Contractor using the correct instruments and tools.

15.19.8 Elevated Taxiway Edge/Runway Guard Light Fittings

After the completion of the pavement construction, the light fittings shall be connected to the secondary cables and installed into the new concrete mounting blocks at the location indicated on the Drawings, using stainless steel chemical anchors extending at least 100 mm into the concrete mounting block. This shall be a designated **Hold Point**.

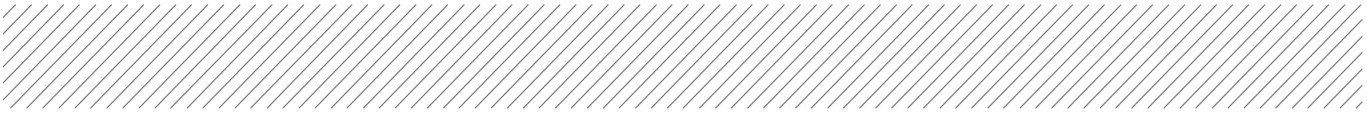
New elevated light fittings shall be fitted, levelled and aimed by the Contractor using the correct instruments and tools.

15.19.9 Inset Runway Edge Light Fittings

After the completion of the pavement construction, the light fittings shall be connected to the secondary cables and installed into the new concrete mounting blocks at the location indicated on the Drawings. This shall be a designated **Hold Point**.

Inset light fittings are normally constructed from two major component parts - a light top assembly which fits into a base that is permanently installed into the pavement with epoxy resin. No water, grease or dust shall be present in the cored light fitting hole prior to the placement of the epoxy resin.

Light bases are to be fixed in position with epoxy resin, in cored holes or concrete bases and the secondary cables are to be installed in conduits. Inset light fitting bases (if not factory treated on all surfaces) shall be properly prepared on Site.



Aluminium oxidises rapidly on exposure to the air, and shall be treated just before installation to remove the contaminated outside surface so that the epoxy resin can form a strong bond with the clean aluminium. If necessary, aluminium can be buffed with a power-driven wire buff until a clean shiny surface is obtained. The surface shall be kept clean (i.e. not to be touched with fingers) and the base shall be installed within 30 minutes.

Holes shall be cut and gravel filled to ensure the light base will be installed flush with the pavement surface in the correct orientation. Bases shall be held in position during installation by purpose specific jigs as referred to in **Clause 15.19.10**.

There is a possibility that, during installation, epoxy resin may overflow, or be spilt on to the jig, making it difficult to remove. To prevent this, parts of the jig may be smeared with grease (ordinary bearing grease). If this is done, great care shall be taken to ensure that the grease does not contaminate the buffed aluminium surface of the base. The jig should be fitted to the base casting.

There will often be a fall in the pavement of 3 mm over the diameter of the casting. This means one side of the rim may be depressed 1.5 mm while the other side is elevated 1.5 mm above the pavement.

The assembled jig and base shall be placed in position and lined up with the survey marks. At a radius of 500 mm from the hole, the allowable tolerance on accuracy of line up is 1.5 mm.

A suitable quantity of epoxy resin shall be mixed in accordance with the manufacturer's instructions. Epoxy shall be mixed using an electric drill with clean paint stirring attachment.

Mixed epoxy resin shall be poured into the space around the base, pausing at intervals to allow the epoxy resin to penetrate the gravel fill, until flush with the top of the pavement surface.

Suitable markers shall be placed around the jig so that the installation will not be disturbed until the epoxy resin has had time to set.

Jigs shall be maintained in position until epoxy has set.

15.19.10 Installation Jig

The Contractor shall provide all installation jigs required to complete the installation. A minimum of one new installation jig shall be handed over for retention by the Principal at the time of commissioning. All jigs shall be suitably cleaned and packaged for long term storage.

Installation jigs shall be suitable for retaining the inset light unit base during its installation. The jigs shall be dimensioned such that the base can be aligned, and will then remain in the aligned position, during installation of the base to meet the specified tolerances. Consideration shall be made for the location of jacking screws such that they clear the cored hole and will bear against the firm pavement surface.

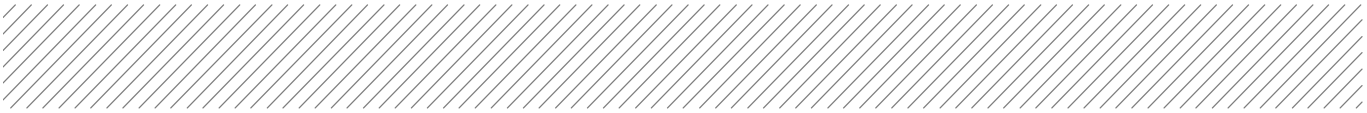
The installation jig shall include a bubble level with accuracy suitable to set the level of the light base within 0.25 degrees of level.

15.19.11 Coring

The cutting of the pavement for light bases and small cable slots shall be by means of hand tools.

All cores shall be cut as vertically as possible to provide a clean face.

The core position shall be accurately surveyed and marked before commencement of the core excavation process. The core shall be cut such that the final position of the light unit base is within 20 mm of the specified location.



The orientation marks shall be accurately surveyed and located outside the core area to allow proper orientation of the inset light fitting base when installed in the core hole.

The final installed orientation of the centre line of the output beam of the inset light unit shall be within ± 1 degree of the specified orientation.

A copy of the as-constructed light locations and fitting directions is to be provided to the Superintendent within one working day of the survey being completed, and this shall be a **Hold Point** in the Project Quality Plan.

The core shall not be cut or removed until immediately prior to installation of the light unit base. The core centre shall be removed avoiding damage to the surrounding pavement.

The core centre shall be removed such that the bottom surface of the hole will not prevent the inset unit base from being installed level and flush with the pavement surface.

All existing secondary cable locations shall be identified and determined on site by the Contractor.

15.20 Airport Lighting Control Cubicle and Shelter

15.20.1 Design

The design of the airport lighting control cubicle and shelter for the functionality of the airport lighting system is the responsibility of the Contractor and shall as a minimum meet the requirements and performance criteria as detailed herein.

The Contractor shall submit its design plans and schematics of the airport lighting control cubicle (including shelter and mounting slab) to the Superintendent a minimum of 15 working days prior to the commencement of manufacture. This shall be a designated **Hold Point**.

15.20.2 Cubicle

The Contractor must supply a new electrical distribution cubicle to be located landside to contain all necessary airport lighting equipment and provide control for the following facilities:

- a) The existing PAALC;
- b) 2 transformers for the power supply to the PAPIs (new);
- c) 2 x 5 kW multi tap MIT to power the runway and taxiway lights to be supplied by the Contractor;
- d) 1 x 2.5 kW multi tap MIT to power the Runway Guard Lights;
- e) 6 stage intensity control of the PAPI;
- f) 3 stage intensity control of the runway lighting;
- g) Selection of Illuminated Wind Direction Indicator;
- h) A distribution panel with circuit breakers for the equipment listed below:
 - (i) PAPI 17 MIT;
 - (ii) PAPI 35 MIT;
 - (iii) Runway Edge MIT;
 - (iv) Taxiway Edge and Runway Guard MIT;

- (v) Runway 17 IWDI;
- (vi) Runway 35 IWDI;
- (vii) Apron IWDI;
- (viii) PAALC?AFRU control panel; and

a) An Auto Transfer Switch (ATS) to connect to a Generator Set in case of mains power failure.

The panel must have an external override switch which when activated will select all facilities at the intensity determined by ambient light detector.

The panel must also have provision for a future apron lighting bypass switch which will select the apron flood lights during daylight for testing purposes

Provision for the external override switch and the apron lighting bypass switches must be made to be located in a lockable weatherproof enclosure mounted on the cubicle at a height of at least 1.2 meters above the ground.

The panel is to be controlled by the PAALC and will select the facilities at the intensity depending on the ambient light as displayed in the facility matrix.

15.20.3 Facility Matrix

The panel shall be controlled by the PAL and when activated by a pilot will select the facilities at the intensity depending on the ambient light as displayed in **Table 15-3**.

Table 15-3: Airport Ground Lighting Facility Matrix

Facility	Day	Twilight	Night
PAPI 17 and 35	Stage 6	Stage 4	Stage 2
Runway and Taxiway	Stage 3	Stage 2	Stage 1
IWDI (3 circuits)	Off	On	On
Runway Guard Lights	On	On	On

15.20.4 Cubicle Details

The electrical distribution cubicle must be built to comply with the standards contained in AS/NZS 3000 Electrical Installations.

The free standing cubicles must be manufactured from Grade 316 stainless steel and provided with either stainless steel or hot dipped galvanized steel mountings. All fasteners bolts and screws are to be metric and manufactured from Grade 316 stainless steel.

The cubicles must be provided with battery supported emergency internal lighting sufficient to allow emergency repairs and operation of the cubicle controls at night.

The control cubicles are to be mounted on a metal plinth 400mm high which is to be accessible from the front and rear by removable panels. All conduits are to finish 100 mm above the concrete slab and be contained inside the plinth.

All conduit and cable entries are to be through the bottom of the cubicle and are to be made using cable glands or flexible conduit terminators fixed into a removable gland plate. All entries must be sealed to prevent water or sand ingress and rodents.

15.20.5 Surge protection

The control cubicle must be provided with surge protection for the incoming mains and the runway lighting, windsock and apron lighting circuits. The surge protection devices are to be mounted in a separate compartment within the cubicle and must be accessible through an external door and provided with a separate earth stake as required.

The individual surge protection devices must be provided with an indication to show that they are still capable of providing the correct level of protection.

The surge protection must be capable of protecting the control cubicle from lightning strikes on the lighting equipment field.

15.20.6 Mounting Slab

The Contractor is to design, supply and install a concrete mounting foundation slab for the new control cubicle. The slab must be a minimum 150mm thick. The slab is to extend for a minimum distance of 1.2m around the cubicle to provide a hardstand clear area for operation and maintenance purposes.

The Contractor shall provide his proposed mounting slab design for approval by the Superintendent prior to manufacture.

15.20.7 Shelter

The Contractor is to design, manufacture and install a shelter to cover the cubicles and to provide protection for maintenance staff working on the cubicle. The shelter structure shall be open-sided with a solid roof which shall extend a minimum of 1200mm all around the cubicles.

The Contractor shall provide his proposed shelter design and layout for approval by the Superintendent prior to manufacture.

15.21 Diesel Generator

15.21.1 General

A back-up diesel generator shall be supplied, installed, tested and commissioned in accordance with the following Standards:

- a) Diesel Engine: AS 4594, Parts 0 to 6 inclusive. (ISO 3046 Parts 0-6 inclusive);
- b) Alternator: AS 1359;
- c) Installation: AS 3010 and AS 3000;
- d) Engine start batteries: AS 2149;
- e) Battery chargers: AS 4044;
- f) Control and alarm batteries: AS 3731.1, AS 3731.2, AS 4029.2 and AS 4029.3;
- g) Winding Thermistors AS 60947.8; and
- h) Fuel piping and associated auxiliary equipment: AS 1940.

15.21.2 Design

The Contractor shall ensure that the back-up diesel generator selected, supplied and installed will maintain the functionality of the airport lighting system (i.e. interface with the airport lighting cubicle) in all respects. It is the responsibility of the Contractor to ensure that the minimum requirements and ratings are met as detailed herein.

The Contractor shall submit its design plans and schematics for the back-up generator and proposed generator location (including mounting slab and housing) to the Superintendent a minimum of 15 working days prior to the commencement of manufacture. This shall be a designated **Hold Point**.

All conduit and cable entries are to be sealed to prevent water or sand ingress and rodents.

Rating

The back-up diesel generator shall meet the following requirements:

- a) 100 kVA prime rated for variable load continuous operation with 10% overload capacity;
- b) 400 Volt;
- c) 50Hz;
- d) De-rated for 1,600 m above sea level, 40 °C external ambient and 100% relative humidity (RH); and
- e) Capable of accepting a 60% initial load application with not more than a 10% voltage and 5% frequency drop.

15.21.3 Equipment Loads

The site load comprises 50 kVA AGL load.

Each generator shall be suitably de-rated to accept 50 kVA to the Airport Lighting Cubicle.

15.21.4 Mounting Slab

The Contractor is to design, supply and install a concrete mounting foundation slab for the generator if required. The slab must be a minimum 100mm thick and extend to a suitable distance around the generator to provide a hardstand clear area for operation and maintenance purposes.

The Contractor shall provide his proposed mounting slab design for approval by the Superintendent prior to manufacture.

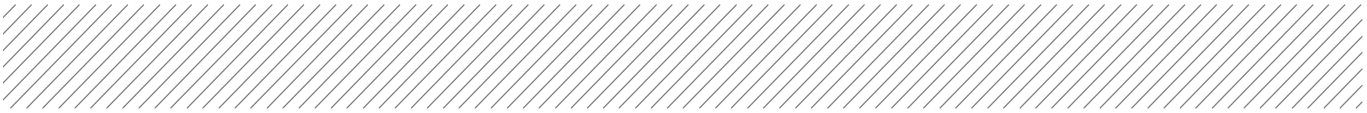
15.22 Quality Assurance

15.22.1 Requirements

All equipment used in the work, operating techniques employed and the completed lighting shall be subject to the Quality Management System requirements in **Section 2** of this Specification to ensure that they comply with the requirements specified herein.

15.22.2 Insulation Testing

To facilitate fault location and rectification, keep a progressive record of test results relating to each installation.



Lighting installation work shall maintain electrically safe and operable circuits by ensuring as high as possible an electrical resistance between individual circuit components and consequently between the total circuit and earth.

Test of the circuit shall be carried out at the completion of the installation of the circuits. Test readings shall be carried out using a suitable 1000-Volt Megger. The minimum acceptable reading is 1000Mega Ohm.

These test readings shall be taken during installation, both before and after:

- a) Each section of cable is laid;
- b) Each section of cable is jointed;
- c) Each new SIT is jointed into the circuit and buried; and
- d) Prior to connection into supply feeders.

On the completion of each lighting circuit shall conduct a final and certified check. Where a lighting circuit is completed prior to connection to the feed cables from the Airport Lighting Cubicle,, the Contractor shall maintain a regular check on its performance. All test results shall be identified as to day, date, and time of day.

For new cable insulation readings shall be recorded and documented by the Contractor at the end of each day's cable laying work. In addition, at the end of each day, a check shall be conducted by the Contractor on all installed primary circuits and equipment to monitor any progressive degradation of circuit resistance. A final and certified check shall be conducted by the Contractor on the completion of each lighting circuit. Where a lighting circuit is completed prior to connection to the feed cables from the Airport Lighting Cubicle, a regular check on its performance shall be maintained by the Contractor. All test results shall be identified as to day, date, and time of day.

Where work is carried out to existing primary circuit cabling, test and record, in the presence of the Superintendent, the primary circuit resistance prior to commencement of work. On completion of work on the lighting circuit the Contractor shall again test the circuit. Ensure that the insulation resistance value achieved on completion the work is not less than that measured prior to commencement of that work.

Insulation testing shall constitute a **Witness Point**.

Copies of all test reports shall be forwarded to the Superintendent within 2 working days of completion of the tests.

To facilitate fault location and rectification, keep a progressive record of test results relating to each installation.

Lighting installation work shall maintain electrically safe and operable circuits by ensuring as high as possible an electrical resistance between individual circuit components and consequently between the total circuit and earth.

Test of the circuit shall be carried out prior to and at the completion of the modification of the circuits. Test readings shall be carried out using a suitable 1000-volt Megger and the results conducted at the completion of the project be greater than or equal to those obtained prior to the commencement of work.

All test results shall be identified as to the day, date, and time of day.

Copies of all test reports shall be forwarded to the Superintendent within 1 day of completion of the tests. This shall be a designated **Hold Point**.

15.22.3 System Performance Testing and Commissioning

Final testing and commissioning of the new airport lighting will be carried out after completion of all work.

Part commissioning may occur as sections of the airport lighting systems are placed in operational service.

The Contractor, in the presence of the Superintendent and Principal shall carry out commissioning.

Commissioning shall involve a general inspection of all the primary cable, transformer and secondary cable installation and all fittings. It shall include critical inspection of randomly selected cable areas, transformers and light fittings as nominated by the Principal.

The primary field cabling shall be tested for compliance with the required insulation resistance.

The Contractor shall, where required by the Principal, expose ducts, cabling, transformer and other components and remove light top assembly units to allow inspection by the Principal.

15.22.4 Defects Liability Period

During the Defects Liability the Contractor shall maintain the insulation resistance of the primary cable at a minimum value of 500 Meg Ohms. If the insulation resistance of the primary cable falls below this value the Contractor will repair or replace, at no cost to the Principal, the damaged section of the installation.

System testing during the defects liability period shall constitute a **Witness Point**.

15.22.5 Final Inspection

The Superintendent and the Principal will carry out a final inspection, before the end of the Defects Liability Period.

The final inspection shall include testing and inspection of all work detailed herein, including (without limitation) the testing of primary cable insulation resistance.

If it is found that any of the installation has fallen below the standard required herein, the Contractor shall repair the installation to that standard before completion of the Defects Liability Period. This shall include maintaining the primary cable insulation resistance up to a specified minimum of 500 Meg Ohms.

System final inspection and testing shall constitute a **Witness Point**.

15.22.6 "As-Built" Drawings

The Contractor shall provide plans to the Principal and Superintendent prior to Practical Completion showing:

- a) Cable routes, where additional cables have been provided or existing cables relocated;
- b) SIT pits, structural pits and markers, where existing pits or markers have been relocated or additional items installed; and
- c) Underground conduit sizes and routes.

The Contractor shall mark up the drawings supplied by Aurecon to As-Built drawings showing any details that differ from the original installation drawings. The Contractor shall supply to the Principal a complete set of as built drawings. This shall constitute a **Hold Point**.

15.22.7 Witness Points and Hold Points

The following **Witness Points** shall be incorporated in the Project Quality Plan:

- a) Cable extensions and joints (**Clause 15.18.4(e)**);
- b) Planning and marking cable slots (**Clause 15.18.4 (h)**);
- c) Insulation testing (**Clause 15.22.2**);
- d) System testing during the Defects Liability Period (**Clause 15.22.4**); and
- e) System final inspection and testing (**Clause 15.22.5**).

The following **Hold Points** shall be incorporated in the Project Quality Plan:

- a) Type, manufacturer and technical information for proposed material alternatives (**Clause 15.4.1**);
- b) Manufacturer design and test data (**Clause 15.4.1**);
- c) MAGS text, character and form (**Clause 15.6.1**);
- d) Trenching and bedding prior to conduit laying (**Clauses 15.10** and **Clause 15.11**);
- e) Coring prior to installation of light base and secondary cable to light fitting (**Clause 15.19.11**);
- f) Insulation testing reports (**Clause 15.22.2**);
- g) Installation of elevated Runway Edge light fittings (**Clause 15.19.6**);
- h) Installation of elevated Runway End/Threshold light fittings (**Clause 15.19.7**);
- i) Installation of Taxiway Edge/Runway Guard light fittings (**Clause 15.19.8**);
- j) Installation of inset Runway Edge light fittings (**Clause 15.19.9**);
- k) Proposed design plans and schematics of the airport lighting control cubicle (**Clause 15.20.1**);
- l) Proposed design plans and schematics of the back-up diesel generator (**Clause 15.21.2**);
and
- m) Provision of 'As-Constructed' Drawings (**Clause 15.22.6**).

Appendix A

Procedure for the Location and Identification of Services





Appendix A

Procedure for the Location and Identification of Services

Purpose

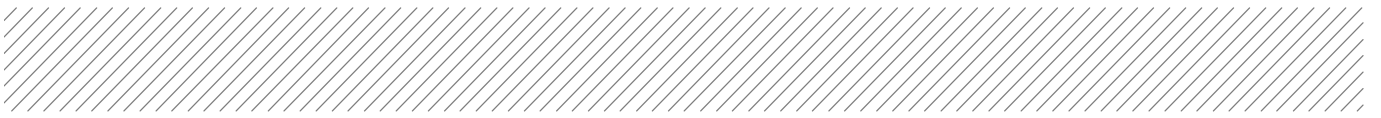
The purpose of this procedure is to assist in the communication and understanding in setting out the process, actions by relevant parties and their responsibilities for the identification of “known and unknown” services that exist within a work site area.

Procedure

- 1) The Contractor in the company of a Council representative shall locate and mark all cables with paint lines and shall install “buried cable” flags along cable routes.
- 2) The Contractor shall excavate and identify cables and duct systems at the following locations using hand tools and or approved specialist sensitive excavation techniques only (as outlined in **Section 5.5.3**, ‘Protection of Engineering Services’):
 - (a) Conduit crossings
 - (b) Stormwater/Drainage line crossings
 - (c) Existing duct ends where appropriate
 - (d) Proposed manhole locations (where appropriate)
 - (e) Aerodrome lighting feeder diversions joint positions (see 5 below)
 - (f) 22kV cables
 - (g) Optical Fibre Communications cables; and
 - (h) Any other as determined
- 3) The Contractor’s Surveyor shall record all relevant services at each location including the depth of cover to each service.
- 4) Excavated locations shall be reinstated using filled sandbags back to natural surface, marked with a numbered dumpy peg and recorded.
- 5) The identification of aerodrome lighting circuits shall be undertaken concurrently with the excavation of feeder diversion joints in conjunction with a representative from Council.
 - (a) The Contractor shall liaise with Council to arrange for staff allocation. A minimum of 24 hours notice will be required to determine staff availability. (NOTE: Unforeseen operational failures will take priority and override any prior arrangements)
 - (b) Council staff will normally only be provided for the times necessary to identify, isolate, test and reconnect the aerodrome lighting circuits. These attendance times may not necessarily be continuous
 - (c) Council staff will not provide site escort/operations functions at any time

Appendix B
**Draft Method of Working
Plan**







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