YOUNG SHIRE COUNCIL

ENGINEERING GUIDELINES FOR SUBDIVISIONS & DEVELOPMENTS

PART 7

Guidelines for Testing

Prepared by Engineering & Technical
Services Department
Young Shire Council

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PART 7

CONTENTS

1. INTRODUCTION

This document outlines Young Shire Council's recommended practice for testing roads, water reticulation and sewer reticulation.

It is in no way a comprehensive "Testing Manual" and it is intended to be read in conjunction with relevant Australian Standards, Roads and Traffic Authority and New South Wales Public Works Department publications.

All references to the Director should be interpreted as referring to the Engineering and Technical Services Director or his nominated representative.

The developer is required to pay for all tests and forty-eight (48) hours notice is required.

2. ROADS

Each layer of pavement material should be tested in accordance with Clauses 2.1 to 2.7 inclusive. Approval is required to be obtained for each layer from the Director prior to placing of subsequent pavement layers.

2.1 Subgrade

1. The subgrade profile should be tested by template to ensure accuracy, and any irregularities should be made good by the addition or removal of material, followed by further rolling.

2. Subgrade should be compacted to 100% standard maximum dry density. Every 500mm lift should be tested at a maximum spacing of 100m. All fill material should comply with the requirements of AS 3798-1190.

3. Every 500mm lift of subgrade should be proof rolled. The subgrade should be checked by proof-rolling with a roller having an intensity loading of seven (7) tonnes per meter width of roller. Any movement of the subgrade under the roller should be deemed a failure.

4. Upon completion of final boxing of subgrade, the geotechnical testing authority should inspect the exposed subgrade to ensure that the samples taken accurately represent the subgrade condition and should certify in writing, to Council that this is so prior to the placement of the first pavement layer.

2.2 Sub-base and Base

(a) The sub-base and base should be density tested at 100 metre intervals along the road as directed by the Director. A minimum of two (2) samples per road should be tested.

The sub-base and base courses should be compacted to 100% standard dry density;

(b) Sub-base and base courses also should be Benkelman Beam tested at 20 metre intervals in alternate wheel paths in each lane.

2.3 Density Testing

All tests should be undertaken and certified by an authorised representative of a laboratory registered by the National Association of Testing Authorities. The developer should pay for all density and beam testing. Copies of all density test results should be supplied to the Director for approval.

2.4 Benkelman Beam Testing

The characteristic deflection for each segment of road should be computed as follows:-

$d = x + 1.65 \times S$
where d - characteristic deflection (mm)
x - mean deflection (mm)
s - standard deviation of deflection (mm)

The allowable maximum deflection and characteristic deflection are given below:-

Road Type	Depth below FSL	Maximum Deflection (mm)	Characteristic Deflection (mm)
1. Minor Cul-de-Sac and short hrough roads (AADT<500) (less than 15 dwellings)	0	1.2	1.0
	-150	1.4	1.2
2. Local Access Roads (AADT<1000) (15-100 dwellings)	0	1.2	1.0
	-150	1.4	1.2
3. Collector (AADT<4000) (100-300 dwellings)	0	1.0	0.85
	-150	1.15	1.0
4. Distributor (AADT<10000)	0	0.8	0.65
	-150	0.9	0.8
5. Industrial	0	0.8	0.65
	-150	0.9	0.8

2.5 Pavement Materials

Sub-base and base course material must be initially tested for suitability unless advised otherwise by the Director.

The minimum thickness for base course is 100mm.

All sub-base and base course gravel must comply with the requirements of R.T.A. Specifications 1051 and 1052, with the following requirements:-

(a) Sub-base Gravel
Max P.I. = 12
Min CBR = 30

(b) Base Gravel
Max P.I. = 6
Min CBR = 80

No pavement material should be placed without the prior approval of the Director.

2.6 Asphaltic Concrete

The supplying and laying of asphaltic concrete must comply with M.R. Form No. 612.

2.6.1 Stability of Mixes

The stability of the job mix should be between 16KN and 36KN, as determined by the modified "Hubbard - Field Method"; i.e. RTA Test Methods T601 and T603.

Mixes with actual stability of less than 8KN below the lower limit or more than 12KN above the upper limit should be removed from the site. For mixes having stability outside the specified ranges, but within the above mentioned limit for rejection, consideration will be given to acceptance of the mix subject to a deduction in accordance with M.R. Form No. 612.

2.6.2 Voids in Compacted Mixes

The air voids in the total mix, when compaction is as specified in the modified Hubbard-Field method should be generally between 4% and 7% of the volume of the mix.

Mixes with actual voids of more than 2% below the lower limit or more than 5% above the upper limit should be removed from the site. For mixes having voids outside the specified ranges, but within the abovementioned limits for rejection, consideration will be given to acceptance of the mix subject to a deduction in accordance with M.R. Form No. 612.

2.6.3 Voids Filled By Binder

The designed or job mixes should be such that between 65% and 85% of the air voids in the total mineral aggregate will be filled by the binder when determined in accordance with R.T.A. Test Methods T601, T605 and T606.

2.7 Sprayed Bituminous Surfacing

Spray seals should be in one or two applications as specified on the drawings and should conform with the new R.T.A., specification for supplying and spraying of bituminous material (M.R. Form 898).

2.7.1 Aggregate

Aggregates should confirm to R.T.A., N.S.W. specification for cover aggregates (M.R. Form 351).

A sample of cover aggregate should be submitted and approved by the Director prior to their use.

2.7.2 Application Rates

The designed application rates of binder and aggregates, and average least dimension of aggregates should be submitted for approval by the Director, 48 hours prior to the start of works.

2.7.3 Work Records

The details of bitumen and aggregate applied should be recorded immediately after each "run"and submitted to the Director.

2.7.4 Defective Work or Materials

The Developer should remove from the work and should bear the cost of replacing any binder which has been overheated, or has deteriorated, or become contaminated in any way, prior to its application to the road.

The Developer should make good at his expense any work, which, in the opinion of the Director, is not in accordance with the specification, whether caused by bad workmanship or defective materials supplied by the Developer, or by materials made defective by his operations. Alternatively, the defective work may be accepted at a reduced price.

2.8 Final Road Profile

2.8.1 Pavement Crossfalls

The final road profile should satisfy the following requirements (if not otherwise stated in the drawings):-

Mean Crossfall	=	$3 \pm 0.25\%$
Maximum Crossfall	<	3.5%
Minimum Crossfall	>	2.5%
Standard Deviation of Crossfalls	<	0.35%

2.8.2 Vertical Alignment

The vertical alignment should not deviate more than ± 0.25% from the value shown on the drawings.

3. WATER RETICULATION

3.1 Field Pressure Testing of Pipelines

All pipelines including services should be pressure tested in accordance with this clause in order to detect and repair leakage and defects in the pipeline including joints, thrust and anchor blocks, if any.

Pipelines should be tested in sections approved by the Director as soon as practicable after each section has been laid, jointed and backfilled, provided that:

(a) if so specified or if the Developer so desires, some or all of the pipe joints should be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Director;

(b) the pressure testing should not be commenced earlier than seven days after last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section should be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Unless otherwise approved by the Director, pressure testing should not be carried out during wet weather.

During pressure testing all field joints which have not been backfilled should be clean, dry and accessible for inspection.

During pressure testing of a pipeline each stop valve should sustain at least once the full test pressure on one side of the valve with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, it should be cleaned to the satisfaction of the Developer and filled slowly with water, taking care that all air is expelled. Purging of air from reticulation should be prompted by opening hydrants. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section should be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which should be applied to each section of the pipeline should be 1.2 MPa, if not otherwise directed by the Director.

The specified hydrostatic test pressure should be maintained as long as required by the Director, while he examines the whole of the section. For the purpose of determining the actual leakage losses, the quantity of water added in order to maintain the pressure during the period of testing should be carefully measured and recorded.

The pressure testing of a section should be considered to be satisfactory if:-

(a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) there is no visible leakage; and

(c) the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:-

$$Q1 = (0.000532 + \frac{c}{l_p}) D.L. (H^{1/2})$$

Where:

Q_1 = permissible leakage rate (litres per hour)

C = a coefficient as specified for the particular pipe material and type of joint
(0.0548 for ductile iron)
(0.0568 for uPVC)

D = nominal diameter or pipe (mm)

L = length of section tested (km)

H = average test head (m)

l_p = average pipe length (m)

The following simplified formulae may be used.

$$Q_1 = 0.0105 D.L. (H^{1/2}) \text{ ..... Ductile Iron}$$
$$Q_1 = 0.01 D.L. (H^{1/2}) \text{ ..... uPVC}$$

For 100mm diameter pipes with 1.2 MPa hydrostatic test pressure, the following simplified formulae should be used:-

Q1 = 11.5 x L(km) Lit/hr ..... Ductile Iron
Q2 = 10.95 x L(km) Lit/hr ..... uPVC

Any failure defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the Maintenance Period, including any failure of thrust blocks or anchor blocks should be made good by the Developer at his expense.

The developer should provide all material, labour and equipment required for the pressure testing, including approved pumps and pressure gauges. Water for testing will be supplied free of charge to the Developer through the pipeline when it is in operation. Should, however, the various works not be sufficiently completed to enable the supply to be thus provided when the pipeline is ready for testing, the time for testing should be postponed until such is the case. Alternatively, the Developer may adopt other measures for supplying the water, but should have no right to claim for any expenses that may be incurred thereby.

All expenses in connection with testing should be borne by the Developer. The Developer should have no claim for compensation or damages in respect of any postponement of the testing.

4. WASTEWATER RETICULATION

4.1 General

All sewers and manholes should be subject to an test after construction. The tests should be carried out before release of the "Linen Plan". Should sewers or manholes fail any test, defects should be detected and repaired and the test repeated. The process of testing, defection and repair of defects and retesting should continue until a satisfactory test is obtained.

All lines are to be clear and free from soil, slurry, liquids and other foreign substances at the notification of complete.

4.2 Test of Gravitation Sewers

(a) The testing of gravitation sewers should be made in accordance with the relevant requirements and method of testing specified in Sections 4.4 or 4.5.

Before the test is performed, all pipelaying on the section should be completed and backfill should be compacted to the level of the centre of the pipe barrel, and the Developer should have requested the Director to check the pipeline for line and grade.

The test may be carried out after risers and/or sidelines are constructed.

Any fault detected should be rectified and a satisfactory test obtained before the remainder of backfill is placed.

4.3 Testing of Manholes

Each completed manhole must be tested for leakage. The test should be carried out with the manhole cover surround fitted with rendering of the channels and benches completed.

The test should be made by plugging all pipe openings in the walls and by filling the manhole with water to the lowest point on the top of the manhole cover surround. The plugs should be positioned in the pipes as near as practicable to the internal face of the manhole.

After allowing 30 minutes for absorption, if not otherwise determined by the Director, the manhole should be refilled and the loss of water during the following thirty minutes measured. The test on the manhole will be considered satisfactory provided the water lost is less than 3mm depth in the top section of the manhole for each 1 metre depth of the manhole. The depth of manhole is to be taken from the bottom of the manhole cover recess in the cover surround to the invert of the outlet from the manhole. The plug of the outlet should be fitted with a suitable release for emptying the manhole on satisfactory completion of the test.

4.4 Testing with Compressed Air

(a) Equipment

All necessary equipment is to be supplied by the Developer and kept in a condition acceptable to the Director.

Pressure gauges are to be tested daily by static water column. At least one spare gauge per test rig is to be kept on the job at all times.

Compressed air is to be supplied by a compressor of the capable of supplying at least $1m^3$/minute at 35 kPa. The air is to be fed through a pressure reducing valve capable of reducing pressure from that supply to 28kPa $\pm$4 kPa. The air is then to pass through an airtight line fitted with a 150mm Bourdon type pressure gauge reading from 0 to 50 kPa, a pressure relief valve that may be set to blow off at 28 kPa $\pm$4 kPa and a gate valve to the pipeline to be tested.

(b) Method of Carrying Out Test

The method of setting up and carrying out the test should be as follows:-

1. Insert a blank plug at one end and a disc with air-hose connection at the other end of the line. Care must be taken to ensure that the force due to pressure on the disc is not taken by pipe joints, but is taken by struts bearing on the disc or on the end pipe in the line.

2. Couple test equipment to line under test and compressor or air line.

3. Slowly increase the air pressure in the line from 0 to 28 kPa (over one minute approximately).

4. Hold air pressure at 28 kPa for three minutes for stabilising temperature.

5. Close gate valve to shut off air supply to test equipment.

6. Measure the time it takes for the pressure to drop from 25 kPa to 18 kPa. If this time is less than that permitted in 4.4 (c) or if the line cannot be pressurised to 28 kPa, then the test is unsatisfactory and the pipeline should be checked for leaks.

7. To check pipeline for leaks:-

   (i) Open the gate valve from the air supply sufficiently to maintain a pressure of 14 to 23 kPa in the pipeline;

   (ii) Move along the pipeline coating it with detergent solution. Bubbles will indicate a point of leakage. Special attention should be paid to joints, discs and horns of junctions.

8. If leaks are detected, they should be repaired as directed or approved.

9. Retest as abovementioned until time taken for the pressure to drop is greater than that shown in Clause 4.4(c).

(c) Allowable Pressure Drop Times

The time taken for the pressure to drop from 25 kPa and 18 kPa should be greater than:-

100mm pipe - 1 minute
150mm pipe - 2 minutes
225mm pipe - 4 minutes
300mm pipe - 6 minutes
375mm pipe - 8 minutes
400mm pipe - 9 minutes
450mm pipe - 11 minutes
525mm pipe - 14 minutes
600mm pipe - 17 minutes

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes must be thoroughly saturated with water before testing or a hydrostatic test applied.

In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, a hydrostatic test is to be applied in accordance with Clause 4.5.

4.5 Hydrostatic Testing

The hydrostatic test should be carried out by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline should be plugged.

The pipeline under test, and the pipe or hose with container, should be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements as set out below.

The test container should be suspended at a level such that the test head applied to the pipeline is as follows:-

(a) A minimum head of 2 metres above the highest invert in the line under test, including its risers and sidelines, or above the free standing level of groundwater in the vicinity whichever is the higher.

(b) Such other lesser head as the Director, at his discretion may direct.

The free standing level of groundwater should be determined by the Developer at his own expense by a method acceptable to the Director.

After allowing an interval for absorption, to be determined by the Director any fall of the free water surface is to be made good by adding extra water to the container. The fall in water level during ten minutes thereafter should be measured.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test including sidelines and/or risers.

A standard test length in metres is defined as 1370 metres divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter should be the nominal size of that pipeline. Where the pipeline under test has sidelines and/or risers of smaller nominal size than the main sewer line, then the effective diameter should be calculated as follows:-

The product of the length and the nominal size of the larger pipe should be added to the product of the length and the nominal size of the smaller pipe; this sum should be divided by the total length of the pipeline under test; the result should be the effective diameter.

4.6 Visual Inspection and Measurement of Infiltration

Whenever the pipeline is subjected to a significant head of groundwater (ie. 1500mm or more above the obvert of the sewer main provided that groundwater is at least 150mm above any sideline included in the test) the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration.

In such circumstances, the Developer should propose full details of the method by which the infiltration is to be measured.

If the Director at his discretion approves of an inspection and infiltration test being performed for the purposes of acceptance, the Director should determine, at his discretion, the duration over which infiltration is to be measured. The rate of infiltration should not exceed that determined hereafter.

$$Q.I. = 0.65 (l_1 d_1 h_1 + l_2 d_2 h_2 + ... l_n d_n h_n) + Ha$$

Where Q.I. = the rate of infiltration in litres/hour
l = the length of pipe in metres
d = the nominal size of pipe in metres
h = the average head of the groundwater over the invert level of the pipe in the section under test

Ha = the head of the groundwater above the invert level of the outlet pipe of the manhole when the manhole is included in the infiltration test

The head of groundwater should be determined by the Developer at his own expense by a method acceptable to the Director.

4.7 Testing of Rising Main

Rising mains should be pressure tested in accordance with this subclause in order to detect excessive leakage and defects in the pipeline including joints, thrust and anchor blocks, if any.

Pipelines should be tested in sections approved by the Director as soon as practicable after each section has been laid, jointed and backfilled, provided that:-

(a) If so specified or if the Developer so desires, some or all of the pipe joints should be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Director; and

(b) The pressure testing should not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this subclause, a section should be defined as a length of pipeline which can be effectively isolated for testing, eg. by means of main stop valves.

Unless otherwise approved by the Director, pressure testing should not be carried out during wet weather.

During pressure testing, all field joints which have not been backfilled should be clean, dry and accessible for inspection.

During the pressure testing of a pipeline each stop valve should sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, it should be cleaned to the satisfaction of the Director and filled slowly with water, taking care that all air is expelled. Purging of air from rising mains should be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section should be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which should be applied to each section of the pipeline should be such that at each point of the section, the test head should be equal to or greater than the design head specified or shown on the Drawings, but should not exceed same by more than 20 per cent.

The specified test pressure should be maintained as long as required by the Director, while he examines the whole of the section, and in any case not less than 8 hours. For the purpose of determining the actual leakage losses, the quantity of water added in order to maintain the pressure during the period of testing should be carefully measured and recorded.
The pressure testing of a section should be considered to be satisfactory if:-

(a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) there is no visible leakage; and

(c) the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:-

$$Q_1 = (0.000532 + \frac{C}{l_p}) D.L. (H^{1/2})$$

where:

Q_1 = permissible leakage rate (litres per hour)

C = a co-efficient as specified hereunder for the particular pipe material and type of joint

D = nominal diameter of pipe (mm)

L = length of section tested (km)

H = average test head (m)

l_p = average pipe length$_n$ (m)

If the measured leakage rate does not exceed that rate calculated by the simplified formula for the type of pipe tabulated hereunder, the determination of the permissible leakage rate on the basis of the formula specified in (c) above will not be necessary. The following simplified formulae are based on the co-efficient "C" and average pipe lengths contained in that tabulation.

PIPE TYPE	SIMPLIFIED FORMULAE	CO-EFFICIENT "C"	NOMINAL PIPE LENGTH (M)
C.I. & D.I.	$Q_1 = 0.0105$ D.L. $(H)^{1/2}$	0.0548	5.5
uPVC	$Q_1 = 0.01$ D.L. $(H)^{1/2}$	0.0568	6.0

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the Maintenance Period should be made good by the Developer at his expense.

4.8 Inspection Prior to Backfilling

All sewerage lines should be inspected and approved by the Director after laying and jointing and prior to the placing of any backfilling.

5. SUBDIVISION EARTHWORKS

All earthworks associated with commercial and residential developments must comply with the requirements of AS3798-1990.

Plans and specification for all earthworks are to be included with the Engineering Drawings and Construction Specification, for the Director's consideration.

Any material deemed to be unsuitable as described in the Australian Standard should not be used. All such unsuitable material should be disposed of from the site.

Any documentation for earthworks, including Works-As-Executed details and testing should comply with Sections 3 and 7 of AS 3798-1990. A copy of the documentation and test results should be supplied to the Director. The Linen Plan of Subdivision will not be released prior to the receipt and approval of all earthworks documentation.