



CONSTRUCTION SPECIFICATION FOR
DEVELOPMENTS AND SUBDIVISIONS

C241 – Stabilisation

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This Specification includes a series of Annexures that detail Project Specific Requirements

GENERAL

C241.01 SCOPE

This specification defines the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

This Specification is for the:

Scope

- Supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade layer (including materials for the Select Material Zone (SMZ) and selected backfill), at specified locations; and
- Spreading, compaction, trimming and curing of such materials.

This Specification provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table C241.1.

Zone / Layer	Stabilising Binder
Pavement Course	
Base and Subbase	<ul style="list-style-type: none"> • Cement • Blended Stabilising Agent • Hydrated Lime • Quicklime (in-situ)
Subgrade Zone / Layer	
Selected Material Zone (SMZ)	<ul style="list-style-type: none"> • Cement • Blended Stabilising Agent • Quicklime (in-situ) • Hydrated Lime
Other Subgrade Layers	<ul style="list-style-type: none"> • Cement • Blended Stabilising Agent • Quicklime (in-situ) • Hydrated Lime
Selected Backfill Zone	<ul style="list-style-type: none"> • Cement • Hydrated Lime

Table C241.1 - Types of Pavement Courses, Subgrade Zones or Layers and Stabilising Binder

The pavement course or subgrade zone or layer to be stabilised shall be as specified in *C242 - Flexible Pavements*, or as indicated on the approved design drawings.

Associated Specifications

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B4*.

Quality

C241.02 REFERENCE DOCUMENTS

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents
Standards Test
Methods**

Where not otherwise specified in the relevant Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the Specifications at the time of the Project approval.

Currency

(a) Tamworth Regional Council (TRC) Specifications

C201 - Control of Traffic.

C213 - Earthworks.

C220 - Stormwater Drainage.

C242 - Flexible Pavements.

CQC - Quality Control Requirements.

(b) Australian Standards

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

- AS 1141.11 - Particle size distribution by dry sieving.
- AS 1289.5.7.1 - Compaction control test (Rapid method).
- AS 1289.5.8.1 - Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode.
- AS 1289.4.2.1 - Determination of the sulphate content of a natural soil and the sulphate content of the ground water - Normal Method.
- AS 1289.6.1.1 - Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen.
- AS 2350.4 - Setting time of Portland and blended cements.
- AS 2350.9 - Fineness of Portland fly ash cement.
- AS 3582.1 - Fly ash.
- AS 3582.2 - Slag - Ground granulated iron blast furnace.
- AS 3583.3 - Determination of loss on ignition.
- AS 3583.6 - Determination of relative water requirement and relative strength.
- AS 3583.12 - Determination of available alkali.
- AS 3583.13 - Determination of chloride ion content.
- AS 3583.14 - Determination of insoluble residue content.
- AS 3972 - Portland and blended cements.

(c) RMS Test Methods

- T432 - Rate of Slaking of Quicklime.
- T117 - California bearing ratio of remoulded specimens of road construction material.
- T109 - Plastic Limit and Plasticity Index of Road Construction Materials.

INSPECTION, SAMPLING AND TESTING

C241.03 MATERIALS PROPOSED FOR USE IN THE WORK

The Constructor shall provide a certificate from a laboratory with appropriate NATA registration stating that the stabilisation mix(s) submitted and the mix constituents comply with the mix nominated in **Annexure C241A** and that the stabilised material meets the requirements of the Specification for *C242 - Flexible Pavements*, if incorporated into the work as a pavement layer or alternatively, the specifications *C213 - Earthworks* or *C220 - Stormwater Drainage*.

**Constructor's
Responsibility**

C241.04 MATERIALS USED IN THE WORK

Regular inspection, sampling and testing of pavement and subgrade materials shall be undertaken by the Constructor while stabilisation is in progress in accordance with this Specification.

**Sampling and
Testing**

MATERIALS

C241.05 CEMENT

The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS 3972.

Type

Cement shall be from a source included in the New South Wales Government Quality Assurance Scheme at time of production.

**NSW QA
Scheme**

The Constructor shall nominate the brand and source of all cementitious materials.

Documentary evidence of the quality and source of the cement shall be furnished by the Constructor to the TRC Representative upon request at any time.

Proof of Quality

If the Constructor proposes to use cement which has been stored for a period in excess of three (3) months from the time of manufacture, the Constructor shall arrange a re-test, to ensure the cement still complies with AS 3972, before the cement is used in the work. The cost of retesting cement, which has been stored for a period in excess of three (3) months, shall be borne by the Constructor. Test results shall be forwarded to the TRC Representative for approval at least two (2) working days in advance of usage of the material.

**Storage in
Excess of 3
months**

C241.06 QUICKLIME

Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

Properties

- (a) Available Lime: The content of calcium oxide, determined by AS 3583.12, shall not be less than 85%.
- (b) Slaking Rate: The active slaking time shall not be greater than twenty (20) minutes and the temperature rise on slaking, determined from the average of four (4) samples tested in accordance with Test Method T432, shall not be less than 40°C in six (6) minutes.

The particle size distribution of the quick lime determined by AS 1141.11 shall comply with the following requirements in Table C241.2.

Particle Size

A. S. Sieve	Percent (%) Passing
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

Table C241.2 - Particle Size Distribution of Quicklime

C241.07 HYDRATED LIME

Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties: **Properties**

- (a) Available Lime: The content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80%.
- (b) Form: The material shall be in powder form.
- (c) Residue on Sieving (Particle Size): The residue on a 300 micron sieve, determined by AS 3583.14, shall not exceed 2%.

The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

- (a) Percentage (%) of calcium hydroxide.
- (b) Fineness - percentage (%) by mass passing the 45 micron sieve (AS 2350.9).
- (c) Source.

C241.08 GROUND GRANULATED BLAST FURNACE SLAG

The ground granulated blast furnace slag shall conform to AS 3582.2.

The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness - percentage (5) by mass passing the 45 micron sieve (AS 2350.9).
- (b) Relative strength - 28 days (AS 3583.6).
- (c) Source.

C241.09 FLYASH

Flyash shall conform to AS 3582.1.

The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are: **Properties**

- (a) Fineness – percentage (%) by mass passing the 45 micron sieve (AS 2350.9).
- (b) Loss on ignition (AS 3583.3).
- (c) Source.

C241.10 BLENDED STABILISING AGENTS

The Constructor may utilise a blended stabilising agent. The Constructor shall obtain mill and batch information which will make the blended stabilising agent traceable to the supplier's test results. Handling and storage requirements of the supplier shall be complied with by the Constructor who shall also arrange for sampling of the agent as required by the TRC Representative. **Requirements**

The mass of components of the nominated blended stabilising agent shall not vary by more than $\pm 3\%$ from the blend percentages nominated in the mix design described in **Annexure C241A**.

When a blended stabilising agent is produced from a combined grinding of components, the following properties will characterise the particular stabilising agent blend: **Properties**

- (a) Source of each component.
- (b) Fineness - percentage (%) by mass passing the 45 micron sieve (AS 2350.9).
- (c) Setting time (AS 2350.4).

C241.11 WATER

Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than: **Quality**

- (a) 600 parts per million of chloride ion, determined by AS 3583.13.
- (b) 400 parts per million of sulphate ion, determined by AS 1289.4.2.1.
- (c) 1% by mass of undissolved solids.

Water accepted as potable and fit for human consumption will not require testing to confirm suitability. **Potable**

C241.12 RETARDERS

Where the use of retarders is proposed, the retarder shall be submitted as part of the nominated mix design accompanied by a Certificate of Compliance. **Retarders**

NOMINATED MIX DESIGN

C241.13 MIX DESIGN REQUIREMENTS

Nominated mix designs must have a Nominated Working Time (determined in accordance with Test Method RMS T147) in excess of 6 hours or as stated in **Annexure C241A**, using a slow setting binder. **Nominated Working Time**

If a suitable mix design has not been nominated, the proposed material to be bound shall be sampled, tested and analysed to determine the preferred binder type and associated application rate to achieve the desired outcome whilst not exceeding specified limits resulting in undesirable material characteristics. Sampling and testing shall be undertaken by an approved NATA Laboratory.

Where the layer being stabilised is between subgrade level and the SMZ, the desired CBR and PI results, as determined by RMS Test Methods T117 and T109 respectively, shall be used to determine the preferred binder type and associated application rate. The assumed CBR and PI of the material shall be obtained from the approved pavement design. **Mix Design Requirements**

Where the layer being stabilised is either the Base or Subbase, the following characteristics are required:

- (a) An unconfined compressive strength (UCS) within the range of 1 to 1.5MPa.
- (b) Other characteristic values as nominated (i.e. PI) where a correction to the unstabilised material is required.

The material to be bound shall be tested to determine its optimum moisture content and the target moisture content as part of the mix design process.

In the absence of a mix design, the Constructor shall nominate a mix design for the consideration of the TRC Representative. The submission of the nominated mix design shall be supported by adequate technical justification for the proposed binder type and

associated application rate to achieve the desired objective. Where relevant subgrade sampling and testing, including CBR and PI, shall be incorporated into the selection of the treatment, testing of the constituent materials and the stabilisation process shall be submitted at least ten (10) working days prior to the proposed date for commencement.

TRC HOLD POINT

The nominated mix design, appropriate technical justification, stabilisation processes and test results for all constituent materials shall be submitted to the TRC Representative at least ten (10) working days prior to the proposed stabilisation work.

Annexure C241A shall accompany the submission summarising the requirements of the nominated mix design.

PROCESS HELD: Stabilisation

TRC Hold Point

STABILISATION PROCESSES

C241.14 GENERAL

The Constructor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work at least ten (10) working days prior to commencement of the work. This submission will nominate the sequence of operations, widths of stabilisation passes and provision for traffic if appropriate.

**Proposed
Equipment and
Procedures**

The stabiliser shall be centrally mounted unless approved otherwise by the TRC Representative.

Notwithstanding submission to the TRC Representative of the Constructor's equipment and stabilisation procedures, the work shall meet all the specification requirements and the Constructor shall perform such tests as specified as the work proceeds to ensure compliance. The costs of such tests shall be borne by the Constructor.

**Compliance
Constructor's
Cost**

Stabilisation of pavement materials shall not proceed during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix. Likewise, extreme temperature variations should be avoided. If the ambient temperature is below 5°C or exceeds 40°C, the stabilisation work is not to proceed.

**Weather
Conditions**

The suitability of the mixing equipment and the level of compactive effort shall be considered for stabilised layers exceeding 200mm in depth. The stabilisation process shall demonstrate the mixing equipment and the compaction equipment has sufficient capability to achieve the desired result.

When an existing pavement is being stabilised, wearing courses in excess of 80mm thick shall be removed (i.e. not incorporated into the stabilised layer).

C241.15 APPLICATION OF STABILISING AGENT

(a) Stationary Mixing Plant

The application rate of the stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the TRC Representative. The rate of application shall be monitored and recorded for every 100 tonnes of production.

Application Rate

The achieved accuracy of application rate shall be $\pm 10\%$ of the nominated rate nominated in **Annexure C241A**.

The application rate shall not be allowed to exceed the nominated rate by more than 10%.

Over Spread

(b) In-Situ

The incorporation of stabilising agent is to follow a process where stabilising agent is spread on the pavement in advance of the specialist mixing equipment. Where special processes are proposed by the Constructor involving supply of stabilising agent within the mixing bowl, the approval of the TRC Representative is required and a demonstration of the process at Constructor's expense may be requested.

**Application
Process**

Spreading shall be carried out using the mechanical spreader nominated and subsequently approved by the TRC Representative.

Spreading Rate

The actual spread rate shall be within $\pm 10\%$ of the nominated rate shown in **Annexure C241A**. The Constructor shall verify this by testing the spread rate for each lot or 500m² of pavement treated (whichever is less) in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable four sided tray placed on the pavement and between the wheels of the mechanical spreader. The rate of stabilising agent spread shall be calculated by dividing the mass collected (kg) by the area of the tray (m²).

Tolerances

Where spreading vehicles are fitted with load cells, the Constructor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Constructor shall record this data for each run and make it available to the TRC Representative by the end of daily operations. Such action will not cancel the Constructor's obligation to undertake manual testing of the spread rate.

Load Cells

The actual spread rate shall not exceed the nominated rate by more than 10%.

Over Spread

Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property.

Wind

Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised.

Construction Traffic

Any spillage of the stabilising agent on the Works site or at any loading location related to the Works site shall be removed as soon as possible and within the same work shift of such spillage.

Spillage

C241.16 INSITU MIXING

Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. A minimum of 2 passes of the mixing equipment is required. As mixing blades or tynes wear, they shall be replaced so as to maintain mixing efficiency. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in such a manner as to provide a uniformly moist mix to a target moisture content.

Equipment

The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.

Uniform Mixture

The procedure nominated shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.

Disturbance

The Constructor shall carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Inspection results shall be recorded as cited in *CQC - Quality Control Requirements Sub-Annexure B4*.

Additional Mixing

The TRC Representative may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content.

C241.17 FIELD WORKING PERIOD

The time period from addition of water during the mixing process until the completion of compaction is nominated as the Field Working Period. This period will vary significantly with variations in the type of stabilising agent.

Definition

The Nominated Working Time shall be provided in **Annexure C241A** for the stabilising agent approved for the work. The Nominated Working Time is defined as the lesser of the Working Times determined with respect to maximum dry density and with respect to unconfined compressive strength, in accordance with Test Method RMS T147. This testing shall be undertaken utilising samples of the materials representative of those to be utilised in the work.

Based on Laboratory Tests

The Constructor will complete the compaction process within the Nominated Working Time unless specific approval is provided by the TRC Representative to an adjustment for site and seasonal conditions.

Compaction within Field Working Period

C241.18 TRIMMING AND COMPACTION

After mixing the layer shall be trimmed and compacted in accordance with C242 – *Flexible Pavements* to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the approved design levels beyond the tolerance for primary trimming specified in Clause C241.20(a).

Level Tolerance

Subsequent secondary trimming may be undertaken on one (1) or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurring will not be accepted. The Constructor's survey control methods are to be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in Clause C241.20(b). When required by the TRC Representative, survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary trimming.

Secondary Trimming

All trimmed material having been cut to waste shall be used as fill or spoiled.

Trimmed Material

Measurements with a 3m straight edge shall be taken at a minimum of ten (10) randomly selected stations so as to represent a 200m lane length or part thereof. Deviation of the surface from the bottom of a 3m straight edge placed in any direction will meet the tolerance shown in Clause C241.20(a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

Straight Edge Test

The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.4.1 is not less than as detailed in C242 - *Flexible Pavements*, C213 - *Earthworks* or C220 - *Stormwater Drainage* as appropriate.

Compaction

The maximum wet density (modified compaction) will be determined by sampling immediately after the addition of stabilising agent and water and two passes of the mixing equipment then the field density will be determined within the allowable working time.

Wet Density

The field density may be determined by in-situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS 1289.5.8.1.

In-Situ Dry Density

C241.19 JOINTS

Joints are defined in this specification to comprise interfaces between work episodes that are separated in time by more than the nominal Field Working Period for the nominated stabilisation mix design. A longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the Nominated Working Time.

Joint Type

All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. A minimum longitudinal overlap of mixing runs shall be 75mm. Transverse joints shall be overlapped by a minimum of 2m. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work. No longitudinal joints shall be allowed within 0.5m of the centreline of a typical wheel path. Care is required to ensure there is no unbound material located between the joints.

Cutting Back

The level and shape of the joints shall be within the limits specified in Clause C241.20.

Finish

C241.20 TOLERANCES

(a) Surface Level

The surface level after secondary trimming shall be within a tolerance of $\pm 15\text{mm}$ of the levels shown on the approved design drawings.

Secondary Trimming

The pavement surface after secondary trimming and immediately prior to sealing shall be of a quality such that deviation under a 3m straight edge does not exceed 12mm.

Surface Uniformity

It is recognised that tolerances may not always be applicable where stabilisation of existing road pavements is undertaken. Where applicable, tie ins will need to be flush with the adjacent pavements. Amendments to the design levels shall be submitted to the TRC Representative for approval.

(b) Layer Thickness

The final thickness of the stabilised layer at any point shall be within a tolerance of -0mm and +30mm of the nominated layer thickness.

Minimum Thickness

The average thickness of the layer in a lot shall be determined from measurements of six (6) randomly selected locations over any 200m length of a lot. The average thickness shall not be less than that required to meet the specified final thickness tolerances after trimming.

Average Thickness

(c) Width

The width measured at any point of the stabilised layer shall be not less than the specified width as shown in the approved design drawings by more than 50mm.

Minimum Width

The average width of the layer determined from measurements at three (3) sites selected at random by the TRC Representative over any 200m length of a lot and shall be not less than the specified width.

Average Width

C241.21 CURING

The Constructor shall submit to the TRC Representative details of the proposed method of curing.

Notice

The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.

Water Curing

Water curing shall consist of frequent light uniform spraying that will not produce significant run off or flooding on sections of the area. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

Caution

Under this specification, provision for curing up to the period indicated in **Annexure C241A** shall be the responsibility of the Constructor.

Curing Period

LIMITS AND TOLERANCES

C241.22 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses of this Specification are summarised in Table C241.3 below:

Item	Activity	Limits/Tolerances	Spec Clause
1	Quicklime		
	a) Available Lime	> 85% Calcium Oxide content.	C241.06
	b) Slaking Rate	Active Slaking time < 20 minutes and temperature rise on slaking not less than 40°C in 6 minutes (for an average of 4 samples).	C241.06
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve. 96-100% for 9.5mm Sieve. 70-100% for 4.75mm Sieve. 0-90% for 2.36mm Sieve.	C241.06
2	Hydrated Lime		
	a) Available Lime	> 80% Calcium Hydroxide.	C241.07
	b) Particle Size	< 2% residue on a 300 micron Sieve.	C241.07
3	Blended Stabilising Agents		
	Blended Percentages	Shall not vary by more than $\pm 3\%$ from those nominated in Annexure C241A .	C241.10
4	Water		
	a) Chloride ion content	< 600 PPM Chloride ion.	C241.11
	b) Sulphate ion content	< 400 PPM Sulphate ion.	C241.11
	c) Undissolved solids	< 1% by mass of undissolved solids.	C241.11
5	Application of Stabilising Agent		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within $\pm 10\%$ of the nominated rate.	C241.15
6	Trimming and Compaction		
	a) Surface Level	After primary trimming, be within +30mm and -10mm of levels shown on approved design drawings. After secondary trimming, be within ± 15 mm of levels shown on approved design drawings.	C241.20(a)
	b) Layer Thickness	Final thickness of layers shall not vary more than +30mm and -0mm of required thickness.	C241.20(b)
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing.	C241.20(a)

Item	Activity	Limits/Tolerances	Spec Clause
7	Compaction Acceptance		
	Minimum Characteristic Value: Q	Base: 102% Subbase: 100%	C241.18 & C242.16
8	Joints		
	a) Longitudinal Overlap	> 75mm overlap of mixing runs.	C241.19
	b) Transverse Overlap	> 2m overlap of transverse joints.	C241.19
	c) Longitudinal Joints	Shall not be allowed within 0.5m of the centreline of a typical wheel path.	C241.19
9	Width		
	Width of Stabilised Layer	At any point, the width shall be not less than 50mm short of the width shown on the approved design drawings with an average width always greater than that shown on the approved design drawings.	C241.20(c)

Table C241.3 - Summary of Limits and Tolerances

**ANNEXURE C241A
STABILISATION MIX DESIGN**

(Refer C242 – Flexible Pavements C242.06)

To be completed by the Constructor for approval at least five (5) days prior to the commencement of stabilisation works

Type of Stabilising Agent:	
Nominal Percentage of Stabilising Agent by Mass:	(%)
Spread Rate of Stabilising Agent:	(kg/m ²)
Depth of Compacted Layer to be Stabilised:	(mm)
Nominated Working Time:	(hrs)
Nominated Target UCS: (7 day accelerated curing)	(MPa)
Nominated Target CBR Value: (4 day soaked) for stabilised modified subgrade)	(%)
Period for Constructor's Curing:	(days)
Nominated Granular Material(s):	(type)
Source of Nominated Granular Material:	