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| AUSTROADS TECHNICAL SPECIFICATION ATS5330    Supply of Geopolymer Concrete | A close up of a flag  Description automatically generated |

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# Scope

This Austroads Technical Specification covers the requirements for the supply and delivery of Geopolymer Concrete in strength grades up to 50 MPa for use in the following applications:

1. gutters, kerbing, drainage channels, footpaths, driveways, shared paths, post footings and safety barrier anchor blocks; and
2. minor cast-in-place works or the production of precast elements with a design life not exceeding 50 years, such as stormwater pits and headwalls.

# Definitions

The following definitions apply to this specification:

**Geopolymer Binder:** Polymeric binder formed by reacting alumina-silicate pre-cursors with alkaline activator(s).

**Geopolymer Concrete:** Geopolymer Binder with aggregates, water and additives.

# Referenced Documents

The following documents are referenced in this Specification or are relevant to this Specification:

**Australian /New Zealand Standards**

AS 1012.3.1 Methods of testing concrete, Method 3.1: Determination of properties related to the consistency of concrete—Slump test

AS/NZS 1379 The Specification and Supply of Concrete

AS 3582.1 Supplementary cementitious materials for use with portland and blended cement – Part 1: Fly ash

AS 3582.2 Supplementary cementitious materials for use with portland and blended cement – Part 2: Slag Ground granulated iron blast furnace

AS/NZS 3582.3 Supplementary cementitious materials for use with portland and blended cement – Part 3: Amorphous silica

ISO/AS/NZS 9001 Quality management systems – Requirements

# Quality System Requirements

The Geopolymer Concrete must be manufactured under a quality management system which has been independently certified by a JASANZ accredited organisation as fully complying with AS/NZS ISO 9001.

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| **For Works constructed in Queensland, the following additional requirement applies:**  Fly ash, slag and amorphous silica pre-cursors must be a Transport and Main Roads registered product and the manufacturer must be a Registered Supplier.  Further details are available from: <https://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers> |

# Manufacturer Competency

Geopolymer Concrete must be supplied by a manufacturer / licensed technology provider with at least 12 months experience in the commercial supply of Geopolymer Concrete.

The manufacturer / licensed technology provider must have submitted the following to the Principal within the 12 months preceding the supply of Geopolymer Concrete under this Specification:

1. details of the mix design (including strength grade, nominated slump, and types, proportion by mass, sources, and registration numbers of the various constituent materials), except that only a generic description of each chemical component of the activator is required; and
2. test results from a NATA accredited laboratory demonstrating that the proposed Geopolymer Concrete complies with the properties listed in this Specification.

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| HOLD POINT 1 | |
| Process Held | Supply of Geopolymer Concrete |
| Submission Details | Evidence that the manufacturer / licensed technology provider has complied with Clause 55.2 must be provided at least 7 days prior to the manufacture of the Geopolymer Concrete |

# Manufacture of Geopolymer Concrete

## General

The Geopolymer Concrete and its constituent materials must conform to this Specification.

The manufacturing plant and equipment, production, delivery, sampling and testing of Geopolymer Concrete must comply with the requirements specified for concrete in AS 1379.

The mix design for each Geopolymer Concrete strength grade must have a unique identification number.

Flyash, slag and silica fume must:

1. comply with the requirements of AS 3582.1 and ATIC‑SPEC SP43;
2. be registered under the Cementitious Material Registration Scheme (CMRS) in accordance with ATIC‑SPEC SP43; and
3. not be used in the manufacture of Geopolymer Concrete if it is more than 3 months old, unless it is re‑tested to demonstrate compliance with this Specification.

Super-workable Geopolymer Concrete is not permitted.

## Water

The quality of water to be used in the mix and for the curing of Geopolymer Concrete must comply with the requirements of Clause 2.4 of AS 1379. However, for sources other than water drawn from a stable reticulated drinking water supply, the amounts of chloride in the water must be not greater than 0.03% and the amount of sulphate (as SO4) in water must not be greater than 0.04% when tested in accordance with the test methods listed in Table 2.3 of AS1379.

## Addition of Water at the Slump Stand

Slump stand water meters must be initially zeroed and actual amounts of water added into the agitator drum must be accurately recorded. The following records must be made available for review by the Principal upon request:

1. actual amount of water added into the agitator drum at the slump stand,
2. time that the water is added; and
3. calculated maximum permissible amount of water that can be added.

# Delivery of Geopolymer Concrete

## General

Water may be added to the freshly mixed Geopolymer Concrete prior to commencement of discharge, subject to:

1. obtaining the manufacturer’s prior approval;
2. no more than 10 l/m3 is added;
3. the records generated under Clause 6.7 are available for inspection;
4. no more than 45 minutes has elapsed since batching;
5. the maximum water / Geopolymer Binder ratio is not exceeded; and
6. a means of accurately measuring the volume of water is utilised.

Water must not be added after commencement of discharge of Geopolymer Concrete.

Prior to the discharge of Geopolymer Concrete at the site, the mixer or agitator must be operated at mixing speed for not less than three minutes.

## Delivery Docket

In addition to the information required by Clause 1.7.3 of AS 1379, the following information must also be recorded on each delivery docket:

1. the total water in the batch, including:
2. the moisture content of both fine and coarse aggregates
3. batch water
4. water added at the slump stand
5. total amount of water permitted to be added on site
6. water added on site before commencement of discharge, including water used to wash down the mixing blades of the mixer or agitator
7. total specified mass of Geopolymer Binder
8. slumps, including:
9. nominated slump
10. measured slump
11. any other additions to a batch
12. the unique identification number allocated to the mix design.

Further to the above requirements, the following information must be traceable to the supplier’s batching plant(s) for each batch (truck load) of Geopolymer Binder used in the works and must be made available for review upon request by the Principal.

1. Geopolymer Binder brand and type, including:
2. proportions of components (by mass); and
3. total actual mass of Geopolymer Binder.
4. chemical admixtures, including:
5. types; and
6. amounts.

## Period for Completion of Discharge

Geopolymer Concrete must be placed and compacted within 60 minutes of the commencement of mixing.

The consistency of the Geopolymer Concrete must be determined by a slump test in accordance with AS 1012.3.1.

Geopolymer Concrete must not be incorporated into the works if its consistency is outside the tolerance specified in Table 7.8 for the corresponding specified slump.

Table 7.8: Slump Tolerance

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| **Specified slump, mm** | **Tolerance, mm** |
| < 60 | ±10 |
| ≥ 60 ≤ 80 | ±15 |
| > 80 ≤ 110 | ±20 |
| > 110 ≤ 150 | ±30 |
| > 150 <180 | ±40 |

## Water Left in the Mixer or Agitator

Water left in the mixer or agitator from the previous load must be discharged prior to reloading new Geopolymer Concrete in accordance with the requirements of *Clause 4.1.3(c)(ii) water in mixing chamber* of AS 1379.

# Geopolymer Concrete Properties

If the Geopolymer Concrete is cast in place with a strength grade not exceeding 40 MPa, the Contractor must ensure that production assessment reports are prepared in accordance with *Clause 6.4.2 Reports for Production Assessment* of AS 1379 and provided to the Principal. The reports must identify the mix as Geopolymer Concrete.

If the Geopolymer Concrete is used in the manufacture of precast elements or is placed cast in place with a strength grade of 50 MPa:

1. *Clause 6.5.2 Additional project assessment for plants subject to production assessment* of AS 1379 applies; and
2. the hardened Geopolymer Concrete must be tested to demonstrated conformance with the properties as listed in Table 8.2 and the test results are provided to the Principal.

Table 8.2: Hardened Geopolymer Concrete Properties

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| Property | Test Method | Criteria | Age |
| Compressive Strength | AS 1012.9 | As per design | 28 days |
| Flexural Strength | AS 1012.11 | ≥ 2.5 MPa | 28 days |
| Shrinkage | AS 1012.13 | ≤ 750 µε | 91 days |
| Modulus of Elasticity | AS 1012.17 | 30 GPa ± 20% | 28 days |
| Density | AS 1012.12 | 2.1 – 2.8 t/m³ | 28 days |
| Chloride Permeability | ASTM C1202 | < 1000 C | 56 days |
| AAR resistance | AS 1141.60.1 | < 0.1 % | to 21 days |
| Carbonation resistance | ISO 1920-12 | Reported only | to 91 days |
| Chloride ion content | AS 1012.20.1 | < 0.4 kg/m³ (Exposure classification C)  < 0.8 kg/m³ (Exposure classification B2) | 28 days |

# Additional Requirements for Placement of Geopolymer Concrete

Notwithstanding any requirements specified elsewhere in this Contract for formwork, placement, finishing and curing of concrete, Geopolymer Concrete must comply with the following:

1. curing must be by either: steam, membrane, polyethylene sheet or maintaining the formwork in place;
2. water curing is not permitted;
3. where steam curing is used, care must be taken to prevent condensation pooling on the surface of Geopolymer Concrete;
4. if temperature-matched curing tanks are used, the manufacturer must protect the sample cylinders from water infiltration; and
5. steamed precast units must be coated with a curing membrane within 1 hour of removal from the enclosure.

Annexure A: Summary of Hold Points, Witness Points and Records

The following is a summary of the Witness Points / Hold Points that apply to this specification and the Records that the Contractor must supply to the Principal to demonstrate compliance with this specification.

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| **Clause** | **Hold point** | **Witness point** | **Record** |
| 5.2 | Manufacture of the Geopolymer Concrete |  | Evidence that the manufacturer / licensed technology provider has complied with Clause 5.2. |
| 7.4 |  |  | Delivery docket with additional information. |
| 8.1 |  |  | Production assessment reports |
| 8.2 |  |  | Project assessment test results |

Amendment Record

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| Amendment no. | Clauses amended | Action | Date |
| - | New specification | New | January 2020 |
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| **Key** |  |
| Format | Change in format |
| Substitution | Old clause removed and replaced with new clause |
| New | Insertion of new clause |
| Removed | Old clauses removed |