
SECTION SP43 CEMENTITIOUS MATERIALS FOR CONCRETE**1 GENERAL**

1.1 CONTENTS

OUTLINE: This Section sets out the technical requirements for the manufacture and supply of cementitious materials (ie: cement or hydraulic cement), consisting of general purpose cement, or of mixtures of general purpose cement and one or more of fly ash, ground granulated iron blast-furnace slag (slag) and amorphous silica (silica fume), for use in special class concrete, grouts and mortars for all types of durable infrastructure, including risk limitation from both salinity and alkali-silica reactive (ASR) aggregates. This Section may also be used for normal class concretes.

[Note: Not applicable for bagged special mortars, grouts and repair products.]

1.2 STANDARDS

MANUFACTURE: General purpose and blended cements to AS 3972, and where in combination with one or more supplementary cementitious materials (SCM), that is fly ash, slag and amorphous silica (silica fume), to AS/NZS 3582 Part 1, AS 3582 Part 2, and AS/NZS 3582 Part 3, respectively.

Consistent with international Standards, as the scope of AS/NZS 3582 covers many products, this Section specifically addresses 'Silica Fume', which is to be read wherever 'Amorphous Silica' may be specified.

[Note: See CCAA Technical Note 79.]

1.3 PACKAGING, STORAGE AND TRANSPORT

REQUIREMENT: At all times, all cementitious materials to be protected from moisture ingress, free from contamination and be accessible for inspection, sampling and identification purposes. Prior to use, all materials manufactured three months or more before, to be retested at the supplier's expense. Use in chronological order and reject any materials containing lumps or signs of moisture absorption.

1.4 DEFINITION

DESIGN & DEVELOPMENT: Application of AS/NZS 3582 Part 1, AS 3582 Part 2, AS/NZS 3582 Part 3, and/or AS 3972 for determining cement performance parameters, the criteria required to yield the desired performance, their interpretation and the test methods determining compliance with these criteria.

AUSTRALIAN DISTRIBUTOR: An entity (corporation or otherwise) based in Australia, including but not limited to an Australian manufacturer, overseas manufacturer's local representative, importer or contractor, which has the responsibility for verifying that the products comply with Section SP43.

ACCREDITED LABORATORY (AL): Accredited by an accreditation body (AB) that is a signatory to a mutual recognition arrangement (MRA) established by the International Laboratory Accreditation Cooperation (ILAC) or the Asia Pacific Accreditation Cooperation (APAC). If a laboratory holds accreditation from an AB, that is signatory to APAC MRA, then it is accepted as equivalent to ILAC MRA.

Note: For information about ILAC MRA, see: <https://ilac.org/ilac-mra-and-signatories/> and for information about APAC see: <https://www.apac-accreditation.org/apac-mra/>.

1.5 TERMINOLOGY

BLENDED CEMENTS: Hydraulic cement containing general purpose cement and one or more of the SCMs of fly ash, slag and/or amorphous silica, to the proportions prescribed herein.

SULFATE RESISTING CEMENTS: A blended cement as prescribed in Clause 4.7. Clause 4.7 replaces the requirements and test methods for special purpose cement Type SR of AS 3972, Table 1.

CONFORMITY: General headings adopted from ISO/IEC Directives, Part 2.

2 CONFORMITY

2.1 QUALITY MANAGEMENT SYSTEM (QMS)

STANDARD: To ISO 9001 and the following with the certifier accredited by JAS-ANZ or recognized by JAS-ANZ through the International Accreditation Forum (IAF) multilateral recognition arrangement:

- Verification or validation at the external providers' premises is required. (Clause 8.4.3f).
- The scope of certification to include 'delivery'. (Clause 8.5.1h).
- Traceability is required. (Clause 8.5.2).
- Scope of certification to include the provision of products relevant to the procurement objectives.

2.2 PRODUCT CONFORMITY

REQUIREMENT: In order for the manufacturer or supplier to claim that a product is manufactured to Section SP43, the products must meet the Product Conformity evaluation requirements.

EVALUATION: Further requirements for Product Conformity are detailed in Appendix A. If the Product Conformity evaluation is not completed, or the product does not conform to the criteria detailed in Section SP43, the manufacturer cannot claim that products meet the requirements of Section SP43.

SAMPLING: General purpose and blended cements, fly ash, slag and amorphous silica (silica fume) to AS/NZS 2350.1. Test samples to Appendix A. Also access required for independent sampling by customers, and for verification testing of registered products nominated in the Project Specifics.

CEMENT TESTING: To Appendix A and AS 3972.

SCM TESTING: To Appendix A and AS/NZS 3582 Parts 1 & 3, and AS 3582 Part 2.

2.3 CONFORMITY ASSESSMENT

REQUIREMENT: To AS 3972, AS/NZS 3582 Parts 1 & 3, AS 3582 Part 2, and Section SP43, with the 3rd party CB (independent), accredited by JAS-ANZ or recognized by JAS-ANZ through the IAF multilateral recognition arrangement:

OR

Registered cementitious materials for concrete, to the requirements of Appendix A. The ATIC government agencies manage the Cementitious Materials Registration Scheme (CMRS), currently administered by the Roads and Maritime Services, Materials Technology Laboratory (RMS Materials Technology). CMRS includes a Registered Products List posted on the ATIC website at www.ATIC.net.au and a detailed description of the product types is shown in Clause 4.8.

DESIGN, DEVELOPMENT & NEW PRODUCTS: QMS certification to ISO 9001, and product evaluation from a cementitious materials product specialist or a Chartered Professional Engineer (CPEng) or other person providing equivalent evidence of the necessary qualifications and experience.

AUDITOR COMPETENCE: Further to ISO/IEC 17065 and ISO/IEC 17021-3, the minimum criteria for competence of auditor teams engaged by the product and QMS CBs, to include the following:

- Tertiary qualifications in a relevant field or prior learning or at least ten years in the specific production environment, with demonstrated competence as an auditor in that particular product area, or particular product / referenced Standard.
- Demonstrated knowledge of the application of ISO/IEC 17020 and ISO/IEC 17025, including experience in manufacturing process control, laboratories and interpreting test results.
- At least one year actively involved in product evaluation of this or similar product, either in a laboratory or in production inspection
- Also, auditors to have demonstrated experience in auditing QMS to ISO 9001, or quality plans to ISO 10005, and their continuous improvement; and technical experts to have demonstrated experience in the assessment of the technical evaluation of product conformity, in the relevant field.

3 CONSTITUENT MATERIALS

3.1 GENERAL

CHLORIDE ION: For all individual cementitious materials, including blends, the mass of chlorides not to exceed 0.05%, except amorphous silica not to exceed 0.20%.

3.2 GENERAL PURPOSE CEMENT

REQUIREMENT: General purpose cement and portland cement clinker to AS 3972, plus additional acceptance criteria herein, including the total alkali content (Na_2O equivalent {equiv}) not to exceed 0.6%. Also general purpose cement may contain a combination of mineral additions alone or in combination with minor additional constituents (max 5%) up to 7.5% by mass of the total cement.

3.3 FLY ASH

REQUIREMENT: Special Grade or Grade 1 to AS/NZS 3582.1 and the following acceptance criteria. 'Significant oxides', defined as silicon oxide (SiO_2), aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3), to be greater than 70%, plus the total and available alkali (Na_2O equiv) to meet either of the following criteria:

- Total alkali content to be less than 3.0%, OR
- For total alkali content greater than 3.0%, but less than 4.5%, the available alkali not to exceed 2.0% for any single determination.

3.4 SLAG

REQUIREMENT: To AS 3582.2 plus additional acceptance criteria herein, including the available alkali content (Na_2O equiv) not to exceed 0.5%.

3.5 AMORPHOUS SILICA (SILICA FUME)

REQUIREMENT: To AS/NZS 3582.3 plus additional acceptance criteria herein, including the available alkali content (Na_2O equiv) not to exceed 0.5%. For slurried and densified (ie: condensed or microsilica) amorphous silica (silica fume), sample and test from the raw silica used to make these products.

3.6 OTHER POZZOLANS

REQUIREMENT: Not accepted.

3.7 LIMESTONE

REQUIREMENT: To AS 3972.

3.8 CALCIUM SULFATE

REQUIREMENT: To AS 3972.

3.9 ADDITIONS

DEFINITION: Any material used and not included above.

REQUIREMENT: Full chemical analysis of additions and their proportions to be available from the manufacturer on request. Processing additions not to exceed 1%, and the properties of the cement, or concrete made from the cement, to be unimpaired by the additions (eg: reduced durability).

4 MANUFACTURE AND/OR PROCESSING

4.1 GENERAL

MATERIAL SELECTION: Appendix B tabulates specific cement blends for a variety of applications. Also some deemed-to-comply solutions are given for a range of environments.

Mixing: Blend cement either at the manufacturer's facilities and/or at the concrete batching plant. Powdered amorphous silica accepted only for concrete use in other than flat work.

Analysis: Full chemical analysis of each component material where supplied separately, and of the blended product where the components are supplied as a blend. For the latter case, the type, proportion and place of manufacture of each component, including sources of cement clinker, is also required. Testing of other properties and characteristics to AS 3972, Clauses 5.4 and 5.5.

4.2 BLENDED CEMENTS WITH ONE SCM (BINARY)

REQUIREMENT: To Table 1 by % of total combined weight (general purpose cement portion not shown).

TABLE 1: RANGE OF SCM %

SCM	GENERAL (MIN TO MAX)
Fly Ash	20 to 40
Slag	30 to 70
Silica Fume	4 to 10

4.3 BLENDED CEMENTS WITH TWO SCM (TERNARY)

REQUIREMENT: To Table 2 by % of total combined weight (general purpose cement portion not shown). The proportion of SCMs between Combination A and B, to be linearly interpolated.

TABLE 2: RANGE OF SCM COMBINATIONS % *

SCM I	SCM II	Combination A		Combination B	
		Max % of SCM I	Min % of SCM II	Min % of SCM I	Max % of SCM II
Fly Ash	Silica Fume	30	4	20	8
Slag	Silica Fume	50	4	30	8
Slag	Fly Ash	50	20	30	30

* Sourced from BRC 27131

4.4 BLENDED CEMENTS WITH THREE SCM (QUATERNARY)

REQUIREMENT: To the following:

- General purpose cement content to be not less than 40% of the total cementitious material
- Creditable reference or test data for specific corrosive ions, showing proof of performance against concrete penetration, and
- A comparison with published data for binary, ternary and quaternary blends of similar materials.

4.5 LOW HEAT CEMENTS

REQUIREMENT: Type LH, to AS 3972.

4.6 SHRINKAGE LIMITED CEMENTS

REQUIREMENT: Type SL to AS 3972, and tested to AS 2350.13, with a maximum shrinkage limit of 750 microstrain at 28 days, and a maximum allowable mean (not more than 180 days or 30 samples) of 600 microstrain at 28 days.

4.7 SULFATE RESISTING CEMENTS

REQUIREMENT: Use a blended cement with designation SRC to SP43, containing either: one SCM (ie: binary) conforming with Table 1 OR Two SCM (ternary) conforming with Table 2.

References & Solutions: Refer to BRC 27131, CSIRO/UTS CCC, ACI 201R-01, 232.2R-03, 233R-03, 234R-96 and AS 5100 Part 5, Section 4, or equivalent papers for data and proof of performance. Also refer to deemed-to-comply solutions included in Appendix B.

4.8 REGISTERED PRODUCTS LIST

DESIGNATIONS: The following cementitious material designations may appear in the CMRS Registered Products List:

- AS 3972 Types: GP, SL, LH, HE
- AS 3582 Series Types: Fly Ash (FA) Special Grade or Grade 1, Slag, Amorphous Silica (silica fume)
- SP43 Designations: SRC (sulfate resisting cement), High Slag (> 55%), High FA (> 30%), Off-white, GB2 (binary general blend), GB3 (ternary general blend), GB4 (quaternary general blend).
- Combined Examples: (i) GB2, LH (ii) GB3, SRC (iii) GB2, LH, SRC (iv) GB2, High FA
- Amorphous silica (silica fume)

All materials must be supplied to the above designations or types, as registered with CMRS.

5 SCHEDULES

5.1 REFERENCED DOCUMENTS

STANDARDS:

- SG-006 - Standardisation Guide 006: Rules for the Structure and Drafting of Australian Standards [Based on, but not equivalent to, ISO/IEC Directives, Part 2]
- AS 1199 (ISO 2859) - Sampling procedures for inspection by attributes
- AS/NZS 2350.0 - Methods of testing portland and blended cements – General introduction and list of methods
- AS/NZS 2350 - Methods of testing portland, blended and masonry cements
 - .1 - Sampling
 - (AS) .2 - Chemical composition
 - .4 - Setting time
 - .5 - Determination of soundness
 - (AS) .7 - Determination of temperature rise during hydration of portland and blended cements
 - .8 - Fineness index by air permeability method
 - (AS) .9 - Determination of residue on the 45 micrometre sieve
 - .11 - Compressive strength of portland and blended cement
 - (AS) .12 - Preparation of a standard mortar and moulding of specimens
 - (AS) .13 - Determination of drying shrinkage of portland and blended cement mortars
 - .17 - Determination of soundness of masonry cements
- AS/NZS 3582 - Supplementary cementitious materials
 - .1 - Fly ash
 - (AS) .2 - Slag – Ground granulated iron blast-furnace
 - .3 - Amorphous silica (Note: includes silica fume)
- AS 3583 - Methods of test for supplementary cementitious materials for use with portland and blended cement
 - .1 - Determination of fineness by the 45 micrometre sieve
 - .2 - Determination of moisture content
- AS 3583 - Methods of test for supplementary cementitious materials for use with portland cement
 - .3 - Determination of loss on ignition
 - .4 - Determination of autoclave expansion
 - .5 - Determination of relative density
 - .6 - Determination of relative water requirement and strength index
 - .7 - Determination of sulfide sulfur content
 - .8 - Determination of sulfuric anhydride content
 - .9 - Determination of magnesia content
 - .10 - Determination of alumina and total iron content
 - .11 - Determination of manganese content

-
- .12 - Determination of available alkali
 - .13 - Determination of chloride content
 - .14 - Determination of insoluble residue content
 - AS 4489.10.1 - Test methods for limes and limestones – Bulk density – Quicklime and hydrated lime
 - AS 3600 - Concrete structures
 - AS 3735 - Concrete structures retaining liquids
 - AS 3942 - Quality control - Variables charts – Guide
 - AS 3972 - General purpose and blended cements
 - AS 4489.10.1 - Test methods for limes and limestones – Bulk density – Quicklime and hydrated lime
 - AS 5100.5 - Bridge design – Concrete
 - ASTM C 151 - Test method for autoclave expansion of portland cement
 - ASTM C 1069 - Determination of specific surface area by nitrogen adsorption
 - CSA A3000 Series - Cementitious materials for use in concrete
 - EN 197-1 - Cement – Composition, specifications and conformity criteria for common cements
 - EN 933-9 - Test for geometrical properties of aggregates – Part 9: Assessment of fines – Methylene blue test
 - EN 13639 - Determination of total organic carbon content in limestone
 - ISO DOCUMENTS:
 - ISO/IEC Directives - Part 2, Rules for the structure and drafting of International Standards (6th Ed, 2011)
 - ISO 7870-1 - Control charts – Part 1: General guidelines
 - 2 Part 2: Shewhart control charts
 - ISO 9001 (AS/NZS) - Quality management systems – Requirements
 - ISO/IEC 10005 (AS/NZS) - Quality management systems – Guidelines for quality plans
 - ISO/IEC TR 17028 - Conformity assessment – Guidelines and examples of a certification scheme for services
 - ISO/IEC 17020 (AS/NZS) - Conformity assessment - Requirement for the operation of various types of bodies performing inspection
 - ISO/IEC 17021-3 (AS/NZS) - Conformity assessment - Requirement for bodies providing audit and certification of management systems - Part 3: Competence requirements for auditing and certification of quality management systems
 - ISO/IEC 17025 (AS) - General requirements for the competence of testing and calibration laboratories
 - ISO/IEC 17065 (AS/NZS) - Conformity assessment – Requirements for bodies certifying products, processes, and services
 - ISO/IEC 17067 - Conformity assessment - Fundamentals of product certification and guidelines for product certification schemes
 - OTHER DOCUMENTS:
 - ACI 201.2R-01 - Guide to Durable Concrete
 - ACI 232.2R-03 - Use of Fly Ash in Concrete
 - ACI 233R-03 - Slag Cement in Concrete and Mortar
 - ACI 234R-96 - Guide for the Use of Silica Fume in Concrete
 - CCAA - Amorphous Silica, Properties, Characteristics and Uses, Jan 2018, Technical Note 79

- BRC 27131 - Properties of Fresh and Hardened Concrete with Ternary Binder System Containing Two Supplementary Cementitious Materials, 1998
- CSIRO/UTS CCC - Cao, H.T., Bucea, L., Ray, A. and Yozghatlian, S., 'The Effect of Cement Composition and pH of Environment on Sulfate Resistance of Portland Cements and Blended Cements', Cement and Concrete Composite 19 (1997), 161-171

5.2 PROJECT SPECIFICS

[Note: To nominate the type of cementitious materials required for the various grades of concrete used in the project, select from or add to the following table, then insert in the project spec.]

CEMENTITIOUS MATERIALS TYPES: Use the nominated cementitious materials and proportions in the concrete grades, grouts, mortars as shown:

APPLICATION DETAILS	REQUIRED CEMENTITIOUS MATERIALS
To WS-SPEC, Section SP45 (or nominated other)	To Section SP43
Concrete mix type, grouts, mortars: (A) - Application: (eg: pre-stressed, reinforced or mass concrete) - Environment: (eg: see Appendix B) - Concrete type & grade: (eg: Sx, SFx, Nx or project code)	
Concrete mix type, grouts, mortars: (B) - Application: - Environment: - Concrete type & grade:	
Etc	

[Note: To specify the requirements for each of the cementitious materials above, select each heading in turn, with a copy of the table below, then select from or add to it, before inserting in the project spec.]

GENERAL PURPOSE & BLENDED CEMENTS REQUIREMENTS: To Section SP43 and the following:

FLY ASH REQUIREMENTS: To Section SP43 and the following:

SLAG REQUIREMENTS: To Section SP43 and the following:

AMORPHOUS SILICA (SILICA FUME) REQUIREMENTS: To Section SP43 and the following:

ITEM	SP43	PROJECT REQUIREMENTS #
Government registration details & contacts of manufacturer's nominated key liaison staff	-	Manufacturers without Product Certification to supply
Certificate for Design & Development	2.3	
Full chemical analysis of additions & proportion	3.9	
Chemical analysis results	4.1	
Agency requirements, both standard & additional	5.3	
Other properties & characteristics	App A	
Additional tests	App A	
Customer & nominated agency contacts	A3.9 & 10	
Low volume special blends for critical projects, required frequency for verification test	A3.15	
Certificate of Compliance to SP43	-	

For premixed concrete, concrete manufacturer to arrange and supply certification as above.
For direct purchase, cementitious material manufacturer to certify as above.

5.3 AGENCY PRACTICES

Agency	Requirement or Cement Types	Applications
All	Specialist advice required	Severe exposure environments
RMS & TforNSW (minor works)	Type SL (to ASTM C151, less than 0.8%) OR Type GB OR Type GB with all SCM(s) of Clauses 4.3 & 4.4	Concrete work for bridges and Shotcrete work (Specs B80 and B82)
	Type GP OR Type SL OR Type GB OR Type GB with all SCM(s) of Clauses 4.3 & 4.4	Lean concrete sub-base (Spec R82)
	Type SL OR Type GB OR Type GB with all SCM(s) of Clauses 4.3 & 4.4	Plain and continuously reinforced concrete base (Specs R83)
	Type SL OR Type SL plus SCM	Refer to RMS 3211, for Spec R82 mixes see Annexure C & for Spec R83 mixes see Annexure D
	Blended cement with 30% min FA or 65% min slag	For use in low heat concrete 30% min FA or 65% min slag
	AAR suppression – requirement for binders	Refer to RMS T363 & RMS 3211
VicRoads	Type GP Cement min 60% (refer to VicRoads Standard Specification, Section 610 “Structural Concrete”)	For all types of work at moderate replacement levels refer to Clause 610.07(f)
	<ul style="list-style-type: none"> ▪ 90% GP/ 10% SF; OR ▪ Higher replacement levels of: <ul style="list-style-type: none"> - at least 30% FA; OR - 30%GP / 60% Slag / 10% SF; OR - 65% Slag / 35% GP 	<ul style="list-style-type: none"> ▪ Concrete structures in marine and other saline environments ▪ Concrete structures subject to sulfate and chemical attack
	90% GP / 10% SF; OR 80% GP / 20% FA (For precast members, eg: beams and crown units) [Note: SF = silica fume = amorphous silica]	<ul style="list-style-type: none"> ▪ Depending on concrete member and exposure classification, refer to Table 610.072.
	AAR suppression – refer to VicRoads Standard Specification, Clause 610.11, and VicRoads Test Methods, RC 376.03 (Accelerated mortar bar) and RC 376.04 (Prism test)	
Qld DTMR	All Special Class Concrete to use blended cement as specified by MRTS 70	To control alkali silica reaction & provide the specified durability
	Slag & silica fume not to exceed 1.0% total alkali (refer MRTS 70)	As specified
HWC	Fly ash blends OR Type GP (under review)	Water supply & sewerage
	Fly ash blends	Marine & saline areas
	Fly ash blends	Acid sulfate soils
NSW PWA & SCA *	Fly ash blends OR high slag cement (refer SP45, under review)	Combined low heat & sulfate resistance
	Specialist advice required (refer SP45)	Chloride and other chemicals
SPA	Case by case basis	Major works

Includes all concrete and precast concrete strategic products

APPENDIX A

PRODUCT CONFORMITY & CONFORMITY ASSESSMENT

A1 SCOPE

This Appendix sets out the means by which Product Conformity and Conformity Assessment can be demonstrated by the manufacturer or supplier.

- The use of a third party product certification scheme OR
- Other means of assessment, involving government registration and the use of a minimum sampling and testing frequency plan, combined with random verification testing from projects.

A2 CONFORMITY ASSESSMENT

A2.1 REQUIREMENT: To be based on ISO/IEC TR 17028, corresponding to a System 5 Product Certification System as described in ISO/IEC 17067 and to be operated by product certification bodies that fulfil the requirements of ISO/IEC 17065. This aligns with that of Clause 6.7, SG-006, as taken from the ISO/IEC Directives, Part 2, requiring ‘Conformity Assessment’ to be separately specified from ‘Product Conformity’.

The purpose of product certification (conformity assessment) is to provide independent assurance of the claim by the manufacturer that products comply with the Standard(s). The certification scheme shall meet the criteria described in ISO/IEC TR 17028 in that, as well as full type testing from independently sampled production and subsequent verification of conformity assessment, it requires the manufacturer to maintain effective planning to control production.

A2.2 APPLICATION: The frequency of the sampling and testing plan, as detailed in Tables A1 to A4, shall be used by the CB for conformity assessment. However, where the manufacturer can demonstrate adequate process control to the CB, the frequency of sampling and testing nominated in the manufacturer’s quality plan and/or documented procedures shall take precedence for the purpose of product certification.

A3 PRODUCT CONFORMITY

A3.1 GENERAL: Tables A1 to A4, set out the minimum sampling and testing frequency plans, for manufacturers to demonstrate product conformity to AS 3972, AS/NZS 3582 Parts 1 & 3, and AS 3582 Part 2 respectively. All tests conducted to these requirements shall be certified by an AL. The plans are also designed to complement factory production control or the permanent internal quality control measures, as used by manufacturers for the continuous mass production of cementitious materials.

Product registration confirmation to ATIC’s CMRS Scheme, can be obtained from the RMS Materials Technology, on tel: (02) 8837-0598 or at 99 Philip St., PARRAMATTA NSW 2150.

A3.2 PROVEN SOURCE: A source for which the manufacturer presents 6 months minimum, verifiable data, at unproven source frequency, to demonstrate that the production of the cementitious material remains in statistical control using control charts procedures such as included in AS 3942, or ISO 7870 and to criteria in this specification. Registered proven source manufacturers shall provide a monthly summary of results and other properties listed in Tables A1 to A4 to the RMS Materials Technology, and on-going results to other nominated government agencies. Also from time to time, second party surveillance tests, audits and reviews may be carried out.

A3.3 UNPROVEN SOURCE: A source from which the manufacturer presents less than 6 months, but more than 1 month, verifiable data. Also the following to apply:

- Unproven sources have the option of continuing with the higher testing frequencies or progressing to become a proven source.
- For one-off supply or spot sales on the open market, with limited source and production information, apply “unproven source” testing requirements with testing carried out at the point of dispatch.
- For new cementitious materials where the intention is to become a “proven source”, during the transition period the “unproven source” testing requirements may be progressively relaxed at the discretion of ATIC, as production records and other data becomes available.
- For testing not conducted at an AL, CMRS registration is not available.

- For testing conducted at an AL but not to Australian Standards, and the test data is consistent, 3 tests at an AL to Australian Standards are required to demonstrate compliance and consistency.

A3.4 CONFORMITY CRITERIA: All product to meet the mechanical, physical, chemical and durability requirements of Tables A1 to A4, to the Standards nominated therein (clauses shown), and also to the additional requirements of SP43 (clauses not shown).

A3.5 REGISTRATION: All cementitious materials to be registered, and each to be classified as being from either a “Proven” or “Unproven” Source. Products compliant with the requirements for the former, may initially be so registered, while all other product will be registered as “unproven source”.

TABLE A1: GENERAL PURPOSE & BLENDED CEMENTS TO AS 3972

Characteristic	Clause	Requirement	Test Method	Source & Frequency	
Type Tests					
Material Properties & Performance	--	For registering or re-registering materials, use “Unproven Source” & other testing from last 6 months, to establish control limits and other data	--	At change of material source or production operation or interruption of production for 6 months	
Process Control Monitoring or Lot Release Tests				Proven	Unproven⁽ⁱ⁾
Materials	3	Nature & proportion	--		
Specified Properties	5.4	Setting time	AS/NZS 2350.4	< 2,000 P 1/week OR > 2,000 P & < 5,000 P, 1/week OR > 5,000 P & <50,000 P, 2/week OR >50,000 P, daily	If in continuous production, daily OR If in shipments, either Lot or 1,000 tonne but not less than 1/week
		Soundness	AS/NZS 2350.5		
		SO ₃ content	AS 2350.2		
		Compressive strength	AS/NZS 2350.11		
	--	Peak temp rise (Type LH)	AS 2350.7		
	--	Shrinkage (Type SL)	AS 2350.13		
	--	Chloride content ⁽ⁱⁱ⁾	AS 2350.2		
Other Properties & Characteristics	5.5	Loss on ignition	AS 2350.2		
		Fineness or fineness index	AS 2350.9		
			AS/NZS 2350.8		
	--	Major oxide composition ⁽ⁱⁱⁱ⁾	AS 2350.2		
	5.5	Shrinkage data	AS 2350.13		
Additional Tests	--	Autoclave expansion to limits given in ASTM C 151 ⁽ⁱⁱⁱ⁾	AS/NZS 2350.17 or AS 3583.4		

- (i) Whichever is more frequent. P = factory production, tonne/week/product
- (ii) Certificate to specify whether by test or by calculation from the general purpose cement and SCM reports.
- (iii) Except for high slag blends, when magnesia (MgO) > 4.5% autoclave expansion test is required
- (iv) Reportable property for blended cements

A3.6 DE-REGISTRATION: Systemic failure OR a series of testing failures OR other evidence (eg: failure to advise of significant production changes, or loss of testing and traceability records or events that demonstrates the process is out of control), will result in de-registration of all affected registered product from that source and hence ineligibility for use on any works covered by Section SP43.

A3.7 RE-REGISTRATION: Following de-registration, for re-registration, the extent of data required to be negotiated, to suit the classification of the material and the specific circumstances of the incident, at the discretion of ATIC.

A3.8 RE-CLASSIFICATION: The following to apply:

- Requests for change from an “unproven source” to a “proven source”, will be accepted on the provision of at least six (6) months compliant test results for the former.
- The opposite situation of “proven source” to “unproven source” occurs when there is either, an interruption of production for more than six (6) months OR a significant change to raw materials or production operation, that could significantly impact on product properties. Early advice to RMS Materials Technology of these events, will avoid un-necessary de-classification.
- Following de-classification, for re-classification, the extent of data required to be negotiated to suit the classification of the material and the specific circumstances of the incident, at the discretion of ATIC.

TABLE A2: FLY ASH TO AS/NZS 3582.1

Characteristic	Clause	Requirement	Test Method	Source & Frequency	
Type Tests					
Material Properties & Performance	--	For registering or re-registering materials, use “Unproven Source” & other testing from last 6 months, to establish control limits and other data	--	At change of material source or production operation ⁽ⁱⁱ⁾ or interruption of production for 6 months	
Process Control Monitoring or Lot Release Tests				Proven ⁽ⁱ⁾	Unproven ⁽ⁱ⁾
Specified Properties	6.1	Fineness	AS 3583.1	500 tonne OR 6 hourly	⁽ⁱⁱⁱ⁾
		Loss on ignition	AS 3583.3		
		Moisture content	AS 3583.2		
	--	Chloride ion content	AS 3583.13 ^(iv)	Monthly	Lot ^(v) OR 3000 t OR weekly
	--	Available alkali content ^(vii)	AS 3583.12		
	--	Total alkali content	AS 2350.2		
	6.1	Sulfuric anhydride content SO ₃	AS 3583.8		
Other Properties & Characteristics	6.2	Relative density	AS 3583.5	Lot ^(v) OR 500 tonne OR daily	
		Relative water requirement	AS 3583.6		
		Strength index	AS 3583.6		
	--	Significant oxide composition	AS 2350.2		
Additional test	--	Magnesia content ^(vi)	AS 3583.9		

- (i) Whichever is more frequent t = tonne
- (ii) Includes change of power station or furnace operation, or method of ash collection and treatment.
- (iii) For a source having less than 3 months production record, for the first 4 weeks, increase to each lot or 100 tonne, then for the next 8 weeks, each 300 tonne
- (iv) Fly ash may be optionally tested to AS 2350.2
- (v) Lot is applicable where source furnace is operated intermittently.
- (vi) If unproven source magnesia testing, for a period not less than 6 months, shows content less than 3%, adopt proven source frequency.
- (vii) If **total** alkali content $\leq 3.0\%$, **available** alkali testing is not required, but if $> 3.0\%$ and $\leq 4.5\%$, use either of the following two options: Test annually, where 12 months of production data demonstrates that the **available** alkali content conforms with: $\mu + 3\sigma \leq 1.5\%$ OR Test to the frequencies give in Table A2. (Note: μ is the mean value and σ is the standard deviation of the last 12 months production data).

A3.9 SWAPPING OF PROVEN SOURCES: Swapping of proven source materials may be accepted provided that the new product data has been reviewed by the manufacturer’s nominated product specialist for consistent material properties, confirmed in writing with the data for technical justification attached, signed off and submitted to RMS Materials Technology, customers and other parties nominated in the project specifics.

A3.10 CHANGE OF RAW MATERIAL: Changes of constituent raw materials for “proven sources” may be accepted provided that:

- Production records have been reviewed by the manufacturer’s nominated product specialist and are sufficient to demonstrate the process is in control and final product properties are not significantly different from the registered product
- The above review must be technically justified, certified, signed off and a copy given to RMS Materials Technology, customers and other parties nominated in the project specifics.

A3.11 TEST SAMPLES: The test sample shall be the amount of product necessary to provide material for the tests required for Section SP43, “which is representative of the product manufactured or of the individual identifiable lots sold or offered for sale”. [CSA A3001-03] Test samples to be taken individually and chosen randomly. Where product has been imported, test samples for conformity shall be taken at the importing supplier’s point of dispatch.

Composite samples are not accepted, the single exception being general purpose and blended cements for factory productions of less than 2,000 tonne/week/product. For small quantities of product (eg: amorphous silica), negotiation on a project by project basis may be considered.

TABLE A3: SLAG TO AS 3582.2

Characteristic	Clause	Requirement	Test Method	Source & Frequency	
Type Tests					
Material Properties & Performance	--	For registering or re-registering materials, use “Unproven Source” & other testing from last 6 months, to establish control limits and other data	--	At change of material source or production operation or interruption of production for 6 months	
Process Control Monitoring or Lot Release Tests				Proven ⁽ⁱ⁾	Unproven ⁽ⁱ⁾
Specified Properties	7.1	Loss of ignition	AS 3583.3	3,000 t OR monthly	Lot OR 500 t OR daily
		Insoluble residue	AS 3583.14	25,000 tonne OR monthly	Lot OR 3,000 tonne OR weekly
	--	Chloride ion (Cl) content ⁽ⁱⁱ⁾	AS 3583.13		
		Available alkali content ^(v)	AS 3583.12		
	7.1	Sulfide sulfur (S) content	AS 3583.7		
		Magnesia (MgO) content	AS 3583.9		
		Alumina (Al ₂ O ₃) content	AS 3583.10		
		Total iron (FeO) content	AS 3583.10		
		Manganese (MnO) content	AS 3583.11		
Other Properties & Characteristics	7.2	Fineness ⁽ⁱⁱⁱ⁾	AS 3583.1	3,000 tonne OR weekly	Lot OR 500 t OR daily
		Sulfuric anhydride (SO ₃) content	AS 3583.8	25,000 tonne OR monthly	Lot OR 3,000 tonne OR weekly
		Relative water requirement ^(iv)	AS 3583.6		
	--	Strength index ^(iv)	AS 3583.6		
	--	Total alkali content ^(v)	AS 2350.2		
Other tests	--	Relative density	AS 3583.5		

t = tonne (i) Whichever is more frequent. (ii) Slag may be optionally tested to AS 2350.2
 (iii) Daily process control Blaine testing, to AS 2350.8, accepted in lieu
 (iv) QTM relative water and strength index proven source testing to be at 12,000 t or monthly
 (v) If **total** alkali content ≤ 0.6% (0.5% for QDTMR), **available** alkali testing is not required. But if **total** alkali content > 0.6% (0.5% for QDTMR), test both **total** and **available** alkali to the frequencies in Table A3.

A3.12 TESTING FAILURE: In the event of a test failure, the manufacturer shall notify the RMS Materials Technology, customers and other parties nominated in the project specifics.

- A3.13 LOT:** “An identifiable quantity of material, such as loads in trucks, rail cars, or boats, material in silo storage, or bagged material” [CSA A3001-13] from a single source. Maximum lot size to be less than that provided for unproven source frequencies given in Table A1 to A4.
- A3.14 ACCEPTANCE CRITERIA:** Production records from proven source manufacturers to demonstrate process is in-control and meets the criteria of AS 3972, AS/NZS 3582 Parts 1 & 3, AS 3582 Part 2, and the additional requirements of Section SP43.
- A3.15 BLEND VERIFICATION:** Adopt the following to $\pm 3\%$ of the specified proportions, for each of the nominated cementitious materials:
- Sampling and testing of blended SCM shall be as specified for its predominant SCM component. For a 50/50 blend, the sampling and testing shall be as specified for the component with the higher frequency of sampling and testing. [CSA A3004-03]
 - For periodic low volume blends of “proven source” materials (eg: ‘dial-a-blend’), verify the process, using as a minimum, a weekly chemical composition test from a grab sample.
 - For low volume special blends for critical projects, an increase in frequency of the verification test may be specified.

TABLE A4: AMORPHOUS SILICA (SILICA FUME) TO AS/NZS 3582.3

Characteristic	Clause	Requirement	Test Method	Source & Frequency	
Type Tests					
Material Properties & Performance	--	For registering or re-registering materials, use “Unproven Source” & other testing from last 6 months, to establish control limits and other data	--	At change of material source or production operation or interruption of production for 6 months	
Process Control Monitoring or Lot Release Tests ⁽ⁱⁱⁱ⁾				Proven ⁽ⁱ⁾	Unproven ⁽ⁱ⁾
Specified Properties	5.1	Moisture content (Not applicable to all types)	AS 3582.2	500 tonne OR monthly	Weekly
		Loss on ignition (Not applicable to all types)	AS 3583.3		Lot OR 100 tonne (manufact'd or mined)
		Sulfuric anhydride content SO ₃	AS 3583.8		
		Total silica content SiO ₂	AS 2350.2		
	5.2	Available alkali content	AS 3583.12		
--	Chloride ion content	AS 3583.13 ⁽ⁱⁱ⁾			
Other Properties & Characteristics	5.2	Surface area	ASTM C1069	500 tonne OR monthly	Weekly
	--	Total alkali content	AS 2350.2		
	5.2	Strength index	AS 3583.6		
		Bulk density, loose	AS 4489.10.1		
Additional Tests	--	Relative density	AS 3583.5	Method & frequencies to be determined	
	--	Fineness			

(i) Whichever is more frequent

(ii) Amorphous silica may be optionally tested to AS 2350.2

(iii) All tests are on undensified material or slurry, prior to processing.

A3.16 SAMPLING PLAN: A specific plan which indicates the number of units of product to be inspected.

A3.17 TYPE TESTING (TT): Testing performed to prove that the product is capable of conforming to the requirements given in the relevant standard.

APPENDIX B

APPLICATIONS & ENVIRONMENTS

B1 SPECIFIC CEMENT BLENDS WITH ONE SCM

Table B1 contains a range of solutions for some typical environments or applications using a single SCM. The table is by % of total combined weight (general purpose cement portion not shown).

TABLE B1: APPLICATIONS: SCM % (MIN TO MAX)

SCM	GENERAL	* ALKALI SILICA REACTION	ACID SULFATE SOILS	SALINE & MARINE	WATER SUPPLY	SGE #
Fly Ash	20 to 40	20 to 30	20 to 30	20 to 40	20 to 40	20 to 30
Slag	30 to 50	50 to 70	50 to 70	50 to 70	50 to 70	50 to 70
Silica Fume	4 to 6	8 to 10	7 to 10	7 to 10	4 to 10	7 to 10

* For ASR minimisation, if not using pre-blended cement, use 25% fly ash content

Sewerage, for combined low heat and sulphate resistance

B2 DEEMED-TO-COMPLY SOLUTIONS

Table B4 shows more specific options for cement selection related to the level of aggressive ions present in the water surround. The nominated cement types are accepted as deemed-to-comply solutions, in soils of medium to high permeability and in static water. The classifications are similar, but not equal to those given in AS 3600, AS 3735 and AS 5100, Part 5. Table B4 is for application with WS-SPEC, Section SP45 Concrete Supply Special Class [being revised to include durability] and AS 3600, as part of the total mix design for strength and durability.

TABLE B2: EXPOSURE TO SULFATE # (CHLORIDE < 2,000 PPM)

SULFATES (ppm) (IN WATER SURROUND)	4.5 < pH < 5.5	5.5 < pH < 6.5	pH > 6.5
< 400	3	2	1
400 to 1,500	4	3	2
1,500 to 3,000	4	3	3
3,000 to 6,000	X	4	4
> 6,000	X	X	4

If magnesium ions (Mg²⁺) exceed 1000 ppm, assume an aggressivity of one higher class.

TABLE B3: EXPOSURE TO SULFATES & CHLORIDES

Cl ⁻ & SO ₄ ²⁻ (ppm) (IN WATER SURROUND)	pH > 6.5		
	CHLORIDES (ppm)		
SULFATES (ppm)	< 2000	2,000 to 6,000	6,000 to 30,000
< 400	1	2	4
400 to 1,500	2	2	4
1,500 to 3,000	3	3	4
3,000 to 6,000	4	4	4

TABLE B4: DEEMED-TO-COMPLY SOLUTIONS

CLASSIFICATIONS	CEMENT TYPE	CEMENT BLEND #	
		GP/FA	GP/SLAG
1 (non-aggressive)	GP or GB	–	–
2 (mild)	GB	–	–
3 (moderate)	–	80/20 to 70/30	–
4A (severe) Cl⁻ < 2,000 ppm	–	75/25 to 60/40	50/50 to 30/70
4B (severe) Cl⁻ > 2,000 ppm	–	75/25 to 60/40	50/50 to 30/70
X	Expert advice required		

Blend proportions “general purpose cement / fly ash” and “general purpose cement / slag”.

Blends to have a known history of effective sulfate resistance.

Cl⁻ = chlorides SO₄²⁻ = sulphates