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| **Section Cover Page** |
|  **Section 03 05 05****2012-04-01 Testing of Concrete and Reinforcement** |
| Refer to “LEED Notes and Credits” page for additional guidance for LEED projects.Delete LEED items if project:.1 is excluded by the Department’s policy on LEED, or.2 the Department has determined that the work of this Contract is not to attain a LEED rating. |

This Master Specification Section contains:

.1 This Cover Sheet

.2 LEED Notes and Credits

.3 Specification Section Text:

**1. General**

1.1 Reference Documents

1.2 Appointment of Testing Agency

**2. Duties**

2.1 Responsibility of the Contractor

2.2 Responsibility and Duties of the Testing Agency

**3. Testing – Concrete and Reinforcement**

3.1 General

3.2 Regular Testing - Concrete

3.3 Full-time Testing - Concrete

3.4 Field-cured Cylinders

3.5 Testing Reinforcement

**LEED Notes:**

.1 Formwork for concrete is largely constructed from wood products. Sustainable practices would dictate that the wood products be harvested from sustainable managed forests.

.2 Should the project not be attaining LEED Certification it would still be prudent to leave in the requirements for FSC Certification products as an effort towards sustainability.

**LEED Credits:**

.1 This sections contains LEED requirements for MR Credit 7 which requires a minimum of 50% of wood-based materials and products be certified in accordance with Forest Stewardship Council’s Principles and Criteria. Rented forms, salvaged and refurbished wood products are not included in the calculation for this credit.

.2 Delete LEED requirements for Credit MR 7 if this credit is not part of the points being sought.

1. **General**
	1. **REFERENCE DOCUMENTS**

***SPEC NOTE: Edit this article to include only standards required to suit the project.***

* + 1. Canadian Standards Association:
			1. CSA-A23.1-09 Concrete Materials and Methods of Concrete Construction.
			2. CSA-A23.2-09 Methods of Test for Concrete.
	1. **APPOINTMENT OF TESTING AGENCY**
		1. The Minister may hire a CSA-approved Testing Agency who shall test concrete, reinforcement, and grout as per this specification.
		2. Testing paid for by the Minister:
			1. Review of initial mix designs.
			2. Testing as outlined in Section 3.0, except for testing required by the Contractor for stripping of formwork.
		3. Testing paid for by the Contractor:
			1. Review of Contractor requested mix design changes.
			2. Any waiting time incurred by the Testing Agency in excess of 1/2 an hour.
			3. Any additional costs due to overtime, shift work, holiday or weekend work, except that the Minister will pay for holiday or weekend pickup when the concrete was placed on a regular workday.
			4. Costs for testing required by the Contractor for stripping of formwork, such as field cure cylinders etc.
			5. Cost for retesting or additional testing of concrete or reinforcement where tests have failed to meet the specified requirements.
1. **Duties**
	1. **RESPONSIBILITY OF THE CONTRACTOR**
		1. The Contractor shall cooperate fully with the Testing Agency.
		2. The Contractor shall give the Testing Agency at least four (4) hours prior notice of a concrete placement.
		3. Contractor shall provide a finished product that meets the specification. If initial tests indicate that the concrete failed to meet the specification, additional testing is necessary. This testing shall be done by a CSA-approved Testing Agency, but need not be the Minister’s agency.
		4. Core strengths must equal the specified strength if tested dry or 85% of specified if tested wet, with wet or dry tests as per the Standard.
	2. **RESPONSIBILITY AND DUTIES OF THE TESTING AGENCY**
		1. The Testing Agency is responsible to the Minister and has the authority to, and is expected to, reject any concrete not meeting the specifications.
		2. If the Testing Agency becomes aware that concrete is being placed without their notification, or if insufficient notice is received, then the Testing Agency shall notify the Minister immediately.
		3. Low 7-day, 28-day and 56-day strength tests shall be brought immediately to the attention of the Minister.
2. **Testing - Concrete And Reinforcement**
	1. **GENERAL**
		1. All strength tests shall be numbered consecutively and the cylinders marked as follows:
			1. 7-Day Test: Marked “A”.
			2. 28-Day Test: Two (2) cylinders marked “B” and “C”.
			3. 56-Day Test: Where these are required by the drawings and specifications, two (2) cylinders marked “D” and “E”.
		2. Test reports shall record:
			1. Name of Project
			2. Date and time of sampling
			3. Name of supplier
			4. Delivery truck number
			5. Batch time and discharge time
			6. Identification of sampling and testing technicians
			7. Exact location in the structure of the concrete sampled
			8. Design strength of concrete sampled
			9. Admixtures, cement type, maximum aggregate size
			10. Air and concrete temperature
			11. Slump, and air content
		3. Field cured cylinders shall be marked “F”.
		4. Slump tests shall be performed prior to the addition of super-plasticizers.
		5. Tests for slump and air content shall be taken with each strength test and as required by the specifications and drawings.
		6. Analysis of Concrete Production
			1. A summary table and associated strip charts shall be submitted to the Minister for all classes of structural concrete placed on projects with 25 or more compressive strength tests.
			2. Summary tables are to indicate at least the following information:
				1. Classification of Concrete.
				2. Project name.
				3. Test number.
				4. Compressive strength of concrete.
				5. Supplier’s ticket number.
				6. Date concrete placed.
				7. Time batched.
				8. Time tested.
				9. Slump.
				10. Air entrainment.
				11. 1-7 day and 2–28 day compressive strength test results for each test.
				12. Average strength and within test variation for the two (2) 28-day concrete test results for each test
				13. Moving average of 3 consecutive 28 day concrete test results.
				14. Average and standard deviation of 28 day concrete test results and an evaluation of conformance to CSA production guidelines.
			3. Charts shall plot concrete slump, air content, individual compressive strength tests, and the moving average of 3 consecutive compressive strength tests.
			4. Tables and charts for each type or class of concrete are to be provided on a monthly basis for concrete supplied for the structure until completion of the concrete work.
			5. When 56 day concrete testing is permitted by the Minister, summary charts and tables shall be provided for concrete tested at 56 days.

***SPEC NOTE: Concrete statistical standard deviation charting is recommended for large concrete projects. See CSA A23.1-04, Section 4.4.6.7).***

* + 1. Chloride ion tests shall be performed on the first set of compressive test cylinders taken from the first [parking slab] pour and the first [post-tensioned slab] pour, to show that the chloride ion content of these mixes satisfies the limits set out in CAN/CSA A23.1.

***SPEC NOTE: chloride ion tests typically only required for Parking Structures, confirm if this article is required.***

* 1. **REGULAR TESTING - CONCRETE**
		1. Conform to the standard, except each test shall consist of three (3) cylinders - one (1) for 7-day strength and two (2) for 28-day strength[. and 2 for 56 day strength where 56 day concrete is permitted by the Minister].
		2. Testing for concrete with SCM’s to reduce the cement content [greater than 30% cement reduction as defined in Section 03 30 00 Cast-in-Place Concrete] to conform to the standard, except each test shall consist of four (4) cylinders – one (1) for 7-day strength, one (1) for 28-day strength[, and two (2) for 56-day strength].
		3. Regular testing applied to all elements not listed in Clause 3.3 - Full Time Testing.
	2. **FULL-TIME TESTING - CONCRETE**

***SPEC NOTE: This is not a CSA A23.1 requirement. Confirm the use of any and all of these articles.***

* + 1. Full time testing shall apply to:
			1. Concrete above 40 MPa specified strength.
			2. Parking slab concrete in suspended slabs.
		2. Conform to the Standard and regular testing except:
			1. The Testing Agency shall have a representative on the job site at all times that the concrete requiring full time testing is being placed.
			2. Test the slump and air content from every truck and reject any concrete not within specification.
	1. **FIELD CURED CYLINDERS**
		1. Field cure cylinders shall be stored on the floor right below the slab they represent and be protected against wind unless the floor below is heated, in which case they shall be stored on top of the slab but covered with a plywood box. The cylinders are to be undisturbed at this location until picked up by the Testing Agency.
	2. **[TESTING REINFORCEMENT]**

**SPEC NOTE: delete entire section if not required**

* + 1. [The Testing Agency shall, at start of the project, perform at least one (1) tensile and bend test for each bar size used on the project. Such testing shall comply with the applicable CSA documents. Further testing may be requested at the Minister’s discretion.]
		2. [The Testing Agency will select the bars to be tested from the reinforcing supplied to the construction site, not from the suppliers’ yard. The Contractor shall cut the bars to the required length and replace the shortened bars without cost to the Minister.]
		3. [The Contractor shall supply mill certificates of chemical analysis in accordance with CAN/CSA G30.18R and G30.18W when requested.]
		4. [For epoxy coated reinforcing steel, the Testing Agency will visit the epoxy coating fabrication site, as required, to satisfy themselves that the fabrications and quality control process is in accordance with ASTM A775M. They shall report their findings to the Minister.]
		5. [When bar fabrication occurs at temperatures less than 16 degrees Celsius, submit copies of bend tests indicating acceptability at the fabrication temperature.]

***SPEC NOTE: Delete article referring to epoxy-coated steel if not required.***

end of section