

Determination of Rapid Chloride Permeability of Cast-in-Place Concrete

1350.02 REFERENCES

Section 1350.02 of OPSS 1350 is amended by the addition of the following:

Ontario Provincial Standard Specifications, Construction

OPSS 904 Concrete Structures

1350.05 MATERIALS

1350.05.01 Cementing Materials

Subsection 1350.05.01 of OPSS 1350 is amended by the addition of the following:

At the Contractor's option, silica fume in the form of a blended cement containing silica fume, may be added to the concrete mix to achieve reduced permeability. Where silica fume is used, the allowable limit for concrete permeability shall be reduced to 1,000 coulombs and the curing requirements of OPSS 904 for HPC shall apply.

1350.05.05 Concrete

Subsection 1350.05.05 of OPSS 1350 is amended by deleting point b) of the hardened concrete requirements and replacing it with the following:

- b) Rapid chloride permeability at 28 to 32 Days shall be less than or equal to:
 - i. 1,000 coulombs for HPC, silica fume overlays and any other concrete containing silica fume.
 - ii. 2,500 coulombs for all other concrete.

1350.07 PRODUCTION

1350.07.05.11 Rapid Chloride Permeability

Clause 1350.07.05.11 of OPSS 1350 is deleted in its entirety and replaced with the following:

Cores for evaluation of rapid chloride permeability shall be required for the categories of concrete shown in Table 4.

The lot sizes, core sizes, and number of cores shall be as identified in Table 4. If the total quantity of concrete in a category or quantity of concrete in a category during a construction stage is less than that shown in Table 4, two cores per stage shall be removed except for overlays, concrete patches and refacing for which four cores per stage shall be removed.

One core shall be removed at a random location specified by the Contract Administrator and the second core shall be removed at a location no more than 1 m from the location of the first core. When four cores are

required from a lot, the same procedure shall be followed with a second random location selected within the lot. Cores shall not contain steel or GFRP reinforcement, or other embedded material. The Contractor shall use a covermeter to establish reinforcement location, prior to coring.

All cores shall be removed when the concrete is between 7 to 10 Days of age and cores from bridge decks shall be removed prior to the application of any waterproofing membrane. Cores from footings shall be removed from the above ground portion of the footing.

The Contract number, lot number and exact location of each individual core shall be marked legibly on the core with durable ink. Cores shall be placed in a plastic bag sealed to prevent loss of moisture and given to the Contract Administrator along with Form A of the concrete mix design for the component, for testing by the Owner.

1350.08 QUALITY ASSURANCE

1350.08.03 Acceptance of Rapid Chloride Permeability

Subsection 1350.08.03 of OPSS 1350 is deleted in its entirety and replaced with the following:

1350.08.03.01 General

Cores shall be tested according to LS-433. Acceptance testing shall be carried out at 28 to 32 Days.

For cores that are a minimum of 125 mm long, one of the two cores representing a lot shall be cut to obtain 2 - 50 mm long samples and tested to determine the acceptance of the lot. The second core shall be retained for referee testing.

For overlays, patches and refacing represented by cores that are less than 125 mm long, two of the four cores representing a lot, both from the same location, shall be cut to obtain 2 - 50 mm samples, one sample from each core. The two cut samples shall be tested to determine the acceptance of the lot. The remaining two cores shall be retained for referee testing.

Individual test results shall be forwarded to the Contractor as they become available.

1350.08.03.02 Basis of Acceptance

Acceptance of rapid chloride permeability shall be based on the average of 2 results obtained on 2 - 50 mm long samples representing a lot.

For HPC, silica fume overlays and any other concrete containing silica fume, lots with an average value of rapid chloride permeability exceeding 1,000 coulombs and less than or equal to 2,000 coulombs shall be accepted with a payment reduction. Lots with rapid chloride permeability value exceeding 2,000 coulombs shall be considered unacceptable. Unacceptable lots shall be removed and replaced at no additional cost to the Owner.

For all other concrete, lots with an average value of rapid chloride permeability exceeding 2,500 coulombs and less than 3,500 coulombs shall be accepted with a payment reduction. Lots with rapid chloride permeability value exceeding 3,500 coulombs shall be considered unacceptable. Unacceptable lots shall be removed and replaced at no additional cost to the Owner.

For the purpose of calculating the payment reduction, the Contract Administrator shall determine the volume of concrete in the lots using the dimensions specified in the Contract Documents.

The payment reduction shall be calculated based on individual lots and applied as follows:

For silica fume overlays, HPC and any other concrete containing silica fume = lot quantity x (C-1000)/5

For all other concrete = TODRF x lot quantity x (C-2500)/5

Where:

- Payment reduction = payment reduction of a lot (\$)
- C = average rapid chloride permeability of a lot (coulombs)
- Lot quantity = volume of concrete in a lot (m³)
- TODRF = tender opening reduction factor as given below.

Year of Tender Opening	Tender Opening Date Reduction Factor (TODRF)
2019	0.50
2020	0.75
2021	1.00

1350.08.03.03 Referee Testing

Referee testing of rapid chloride permeability may only be invoked by the Contractor within 5 Business Days of receipt of the acceptance test result.

Referee testing shall be carried out on 2 - 50 mm long samples obtained from the reserved core representing the lot for which referee testing was invoked, and the results shall be averaged to obtain the test result for the lot. For overlays, patches and refacing, referee testing shall be carried out on 2 - 50 mm long samples cut from the two reserved cores representing the lot for which referee testing was invoked, and the results shall be averaged to obtain the test result for the lot.

The referee laboratory shall be designated by the Owner based on the applicable roster and cores shall be tested according to LS-433 by that laboratory.

Referee test results shall be forwarded to the Contractor as they become available.

For silica fume overlays, HPC and any other concrete containing silica fume:

- a) When the referee result is greater than the acceptance test result or no more than 300 coulombs below the acceptance test result, the acceptance test result is then confirmed and shall remain valid.
- b) When the referee test result for the lot is more than 300 coulombs below the acceptance test result, the acceptance test result is then not confirmed and the referee test result shall replace the acceptance test result in the acceptance requirements of this specification.

For all other concrete:

- a) When the referee result is greater than the acceptance test result or no more than 500 coulombs below the acceptance test result, the acceptance test result is then confirmed and shall remain valid.

- b) When the referee test result for the lot is more than 500 coulombs below the acceptance test result, the acceptance test results is then not confirmed and the referee test result shall replace the acceptance test result in the acceptance requirements of this specification.

1350.08.03.01 Referee Testing Cost

The cost of referee testing shall be as specified in the Contract Documents.

When the referee result confirms the acceptance test result, the Contractor shall be responsible for the cost of rapid chloride permeability referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

OPSS 1350 is amended by deleting Table 4 in its entirety and replacing it with the following:

**TABLE 4
Cores for Rapid Chloride Permeability Determination**

Category	Lot Size	Core Size	Number of Cores per Lot
Sidewalk on structure and curb on structure	500 lineal metres per stage	100 mm diameter and 200 mm long	2
Median on structure	500 lineal metres per stage		
Parapet or barrier wall on structure	500 lineal metres per structure per stage		
Toe wall	500 lineal metres per stage		
Bridge deck-thin slab deck	500 m ² per stage		
Bridge deck-post-tensioned deck	300 m ² per stage		
Abutment, wingwall, cast-in-place retaining wall	1 abutment, wingwall, cast-in-place retaining wall or a stage thereof		
Pier	1 pier (Note 1)		
Arches and spandrels	Between piers or between pier and abutment		
Culvert	For cast-in-place concrete culverts, 1,000 m ² of floor area of cast-in-place concrete culvert (Note 2) For precast culverts, all cast-in-place concrete elements associated with each culvert		
Approach slab	500 m ² per stage		
Concrete barrier	Slipformed: 1,000 lineal metres (Note 3) Cast-in- place, including transitions: 250 lineal metres (Note 3)	100 mm diameter and 200 mm long	2
Concrete footings (for high mast poles and sign supports which extend above ground)	40 m ³ (Note 4)	100 mm diameter and 200 mm long	2
Concrete patches and refacing	Approximately equal in size and not greater than 100 m ² , for each individual structure.	100 mm diameter and a minimum of 70 mm long	4
Overlays	300 m ² per placement per individual structure. (Note 5)	100 mm diameter and a minimum of 70 mm long	4

Table 4 Notes:

1. A pier consists of columns and a pier cap.
2. The total floor area of a component shall be added together and then divided into lots of specified size. Where a culvert has no floor, the area of the upper surface shall be used as the basis of determining lots.
3. The total length of a component shall be added together and then divided into lots of specified size.
4. The total volume of concrete in footings for high mast poles and sign supports per contract shall be added together and then divided into lots of specified size. Cores shall be taken from above ground portion of the footing.
5. If typical depth of overlay is less than 70 mm, the Contract Administrator shall identify areas for coring that provide the required core lengths.