

Transport Quebec Standard 5.1:

Reinforcing Steel for Concrete

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1- Subject

This standard establishes the Ministry's requirements regarding properties and evaluation criteria for reinforcing steel bars, their coating and their connections.

2- References

This standard refers to the latest issue of the following documents:

Standards:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 370 – Methods and Definitions for Mechanical Testing of Steel Products

A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

A 775M – Standard Specification for Epoxy-Coated Reinforcing Steel Bars

A 780 – Standard Practice for repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

Canadian Standards Association

G30.3M - Cold-drawn steel wire for concrete reinforcement

G30.5M - Steel welded wire-mesh for concrete reinforcement

G30.14M - Deformed steel wire-mesh for concrete reinforcement

G30.15M: - Steel welded wire-mesh for concrete reinforcement

CAN/SCA G30.18M: Steel-billet bars for reinforcement concrete

CAN/SCA G164M: hot dip galvanized of irregular-shaped objects.

CAN/CGSB-1.181 "Zn-rich coating, organic & prepared"

3- Definitions

Following definitions are applicable to the present standard:

Reinforcing steel: steel in the form of bars, wire or wire-mesh used in reinforcement of concrete structures.

Deformed bar: bar whose lateral surface has been deformed to improve adherence to concrete

Steel wire: cold-drawn wire whose diameter is equal or greater than 1.96mm

Deformed steel wire: cold-drawn wire whose section surface is comprised between 6mm^2 and 200mm^2 and which has deformations to improve adherence to concrete.

4- Required specifications

4.1. Reinforcing steel

4.1.1. Deformed bar:

The deformed bar must be grade 400W and conform to the requirements of standard CAN/CSA-G30.18M “ Billet-Steel bars for concrete reinforcement.

The minimal bending-diameter must be 6 times the diameter for bars designation 10, 15 or 20, and of 8 times for bars designation 25, 30 or 35 and of 10 times for bars designation 45 or 55.

4.1.2 Steel wire and deformed steel wire

The steel wire must conform to the requirements of standard CSA G30.3M: Cold-drawn steel wire for concrete reinforcement.

The deformed steel wire must conform to the requirements of standard CSA G30.14M: Deformed steel wire for concrete reinforcement.

4.1.3 Steel welded wire-mesh

Steel welded wire-mesh fabricated from non-deformed steel wire must conform to the requirements of standard CSA G30.5M: Steel welded wire-mesh for concrete reinforcement.

Steel welded wire-mesh, fabricated from deformed steel wire or a combination of steel wire and deformed steel wire, must conform to the requirements of standard CSA G30.14M: Steel welded wire-mesh for concrete reinforcement.

4.2 Galvanizing Steel reinforcement

When required; steel reinforcement must be galvanized.

4.2.1 Deformed bar

Bar bending must be done before galvanizing and conform to standard CAN/CSA-G164M “hot-dip galvanizing of irregular-shaped objects” and of its appendices A, B & C. The galvanizing process must include a chromate treatment described under section 4.2.3

The zinc coating thickness must be $87\mu\text{m}$, equivalent to a minimal coating mass of 610g/m^2 per surface.

4.2.2. Steel wire and welded wire-mesh

Steel wire and welded wire-mesh must be galvanized according to the requirements stated in the ASTM A.641, class 3 “Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire. The wire-mesh used must be of straight sections of minimal size of 1,2m X 2,4m.

4.2.3. Chromate treatment

After galvanizing, the reinforcing steel must receive a chromate treatment.

If the chromate-treatment is done immediately after galvanizing, the steel will be immersed in an aqueous solution with a minimum of 0.2% by weight sodium dichromate or 0.2% chromic acid. The temperature of the

solution must be equal or greater than 32°C and the reinforcing steel must be immersed in the solution for a minimum of 20 seconds.

If the reinforcing steel is at ambient temperature, sulphuric acid at a concentration between 0,5 and 1%, must be added as an activator in the chromate solution. No requirements are then set for the solution temperature.

A commercialized chromate solution can replace the previously described solution, providing it is equally efficient.

4.2.4. Repairs after Galvanizing

The repair of damaged coatings as well as protection of cut ends after galvanizing must be done according to standard ASTM A 780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coating". If a Zn-rich paint is used, it must comply with the requirements of standard CAN/CGSB-1.181 "Zn-rich coating, organic and prepared".

4.3 Mechanical joining of bars

Deformed bars must be mechanically joined using one of the following coupling types:

- Cold-pressed couple applied by segment with a hydraulic press.
- Conic threaded couples for joining bars of the same gauge.
- Threaded couples whose thread patterns match the deformity on the bars.

Mechanical joints must undergo the following tests for every grade and size of reinforcing bar:

- Tensile test: must be done according to requirements of standard ASTM A 370 "Methods and Definitions for Mechanical Testing of Steel Products" on at least 6 samples of mechanical joints. Tensile resistance of the mechanical joints must be a minimum 125% of elasticity limit of the reinforcing bar.
- Cyclic tensile test must be done by submitting the mechanical joints to 100 cycles of tensile/relaxation, whose limits go from the lower to the upper limits, from 5% to 90% respectively, of the minimal elasticity limit specified for the reinforcing bar. The "testing-tube" that underwent the cyclic tensile test has to be submitted again to the tensile test previously described and has to satisfy the mentioned tensile criteria. The cyclic tensile test and the following tensile test must be done on a minimum of 3 samples of mechanical joints.

4.4 Surface condition of the reinforcing steel

The reinforcing steel must be free of mud, oil, coating or any other substance that could reduce adherence to the concrete.

The presence of rust or scale on the uncoated reinforcing steel is not be considered a defect if, once cleaned with a wire brush, the steel is in conformity with the applicable standard.

4.5 Marking

Steel reinforcing bars must be marked according to the requirements of standard CAN/CSA-G30.18M "Billet-Steel bars for concrete reinforcement"