

## **SECTION 423**

### **SUPPLY AND INSTALLATION OF STURUCTURAL PLATE PIPE**

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This specification covers the requirements for the supply and installation of structural plate round pipe and structural plate pipe-arch as new construction, or, where specified, to extend an existing structural plate pipe.

The structural plate round pipe or structural plate pipe-arch shall be of the size, thickness, and type specified in the contract documents.

The Contractor shall be responsible for quality control for the supply and installation of the Structural Plate Pipe.

Should headwalls be required, then they shall be covered separately under Section 451.

**423.02 COORDINATION AND PLANNING**

The Contractor shall be fully responsible for the comprehensive planning, coordination, and scheduling of all aspects related to the supply and installation of the Structural Plate Pipe, including but not limited to: submissions, mandatory inspections, quality control reporting and materials testing. The Contractor shall collaborate closely with the designated Owner's Representative throughout the entire process of the structure's installation, ensuring that all requirements outlined in the contract and specifications are met in a timely and efficient manner.

Failure to establish or maintain regular and clear communication with the Owner's Representative will not be considered an acceptable justification for non-compliance with this specification. The Contractor is expected to proactively manage all project activities and to give ample and reasonable notification to the Owner's Representative throughout all aspects of the structural plate pipe installation.

## **423.03 SUBMITTALS**

### **423.03.01 General Requirements**

The Contractor shall submit in a timely fashion all shop drawings for the Structural Plate Pipe. Drawings shall clearly show the dimensions of all components, materials, thicknesses, and special details. Drawings shall also detail the recommended backfill specifications, gradation, extents and backfilling procedures.

Shop drawings for the structure shall be received, reviewed and accepted by the Department prior to fabrication of the structure. All issued for construction submittals shall be received 2 weeks prior to the start of construction. The Contractor shall allow a minimum of 2 weeks for shop drawing review.

The Contractor is reminded of General Condition 41.3 and their responsibility to review, stamp, date and sign all submittals. Prior to the submission of shop drawings, all documents must be reviewed by the Contractor to ensure that the Department receives a compliant submission. The Department will not review a submittal which does not comply with the above requirement.

Any changes, deletions, omissions etc. to the Department's specifications shall be highlighted with each submission, with each instance specifically stated and explained for consideration by the Owner's Representative.

The above submittals for the structure shall be received, reviewed and accepted by the Department prior to fabrication of the structure.

Once submittals are accepted by the Department then no changes can be made by the Contractor or the Contractor's Engineer without the submission of such changes and written approval from the Owner's Representative acknowledging acceptance of such changes.

All drawings and technical specifications shall be in accordance with PEGNL's "Guideline for preparation of Engineering and Geoscience Drawings and Technical Specifications".

The manufacturer shall provide a copy of the plant certificate of conformance for Corrugated Steel Structures. The manufacturer's plant certificate of conformance shall be issued by an independent 3rd party certification agency who are accredited by the Standards Council of Canada, confirming that the manufacturer produces certified corrugated steel pipe products in accordance with CSA G401. The structure shall have two identifier plates attached to the upper ends of the structure or individual plates

containing the Certifying Agency's logo, manufacturer name, serial / project number and supply year.

Mill certificates for the material, as well as other Quality Assurance documentation related to the design and fabrication of the structure shall be available upon request.

#### **423.03.02 Quality Control Plan**

The Contractor shall submit to the Department a Quality Control Plan which ensures conformance with the requirements stipulated by the manufacturer, designer, CAN/CSA S6, CSA G401 and the Contract Documents.

The Department requires a minimum of 2 weeks to review the Quality Control Plan. The Contractor's finalized Quality Control Plan must be submitted minimum of 2 weeks prior to construction.

No work shall commence until the Contractor's Quality Control Plan has been reviewed and accepted by the Department.

The Contractor's Quality Control Plan shall bear the stamp of a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

At a minimum the Contractor's Quality Control Plan shall include the following:

##### **423.03.02.01 Bolt Torque Testing**

The Contractor shall include in their Quality Control Plan a procedure that ensures that assembly and erection is in accordance with latest version of CAN/CSA S6, with the following exception:

##### **423.03.02.01.01 Initial Assembly**

The torque on all bolts prior to backfilling shall be in accordance with ASTM A807/807M for steel structures and ASTM B789/789M for aluminum structures. A minimum of 10% of all bolts shall be tested after assembly. The tested bolts shall be randomly selected and the bolted assembly shall only be accepted if at least 90% of bolts test above the torque requirement.

Should the tested bolts not meet the 90% threshold stated above, then the Contractor shall randomly select 50% of the remaining untested bolts for additional testing. The bolted assembly shall only be accepted if at least 90% of the additional bolts tested satisfy the torque requirement. Otherwise, the Contractor shall re-torque all bolts.

Failure to obtain written acceptance of the initial assembly bolt torque testing results, prior to commencing backfill operations, shall result in the immediate rejection of the entire plate assembly.

#### **423.03.02.01.02 During Backfill Operations**

Upon acceptance of the initial assembly bolt torque testing results by the Department, backfilling operations may commence in accordance with Section 423.03.02.03.

During the backfilling operation a minimum of 5% of the bolts shall be randomly selected for testing. Testing shall be carried out as backfilling progresses and shall include the bolts which are exposed (above the current level of backfill at the time of testing). Bolts shall be randomly selected and the bolted assembly shall only be accepted when at least 90% of the bolts tested satisfy the torque requirement.

Should the tested bolts not meet the 90% threshold stated above, then the Contractor shall randomly select 25% of the remaining bolts for additional testing. The bolted assembly shall be accepted if at least 90% of the additional bolts tested satisfy the torque requirement. Otherwise, the Contractor shall re-torque all bolts, or as directed by the Owner's Representative.

#### **423.03.02.01.03 Bolt Testing Results**

All bolt testing results shall be provided to the Owner's Representative as they become available. Bolt testing from initial assembly must be submitted and accepted by the Owner's Representative prior to commencing backfilling operations.

Bolt torque results must be signed by the Contractor's Representative and include: date, time, location, equipment used and height of backfill.

#### **423.03.02.02 Shape Monitoring**

The Contractor must detail in their Quality Control Plan a procedure for monitoring shape throughout construction. Deflections from the specified dimensions shall be within the tolerances permitted by the soil-metal structure designer. Acceptable shape monitoring tolerances for the specific structure must be clearly shown in the Quality Control Plan and Shop Drawings.

All surveying shall be non-destructive in nature. No permanent alterations shall be made to the structure as part of this quality control activity.

All shape monitoring results shall be provided to the Owner's Representative as they become available. Shape monitoring results must be signed by the Contractor's Representative and include: date, time, location and equipment used.

#### **423.03.02.03 Backfill Testing and Compaction**

The Contractor's material testing, backfilling and inspection plan must be detailed in their Quality Control Plan. Select Backfill quality control procedures shall be compliant with Section 411.

All material testing requirements, testing methods, and frequency of testing for the select backfill material shall be clearly identified.

All equipment being used in backfilling operations must be listed. Maximum backfill lift thickness must be identified.

All details are to be provided on construction loading; including minimum heights of cover during construction and the use of any specific equipment and weights being utilized.

The backfilling and inspection plan shall indicate which third party geotechnical engineering consultant has been engaged to certify select backfill compaction. The plan shall also include the method and frequency by which the compaction is being tested.

All backfill material testing shall be promptly provided to the Owner's Representative as they become available. Backfill operations shall not commence until all material testing is complete and is accepted by the Department.

Compaction testing must be promptly provided to the Owner's Representative as the backfilling operations progress.

A comprehensive summary testing package, including all relevant material, electrochemical, and compaction testing results shall be submitted to the Department for its records. This package must be stamped and certified by the Contractor's Geotechnical Engineer of Record.

#### **423.03.02.04 Manufacturer's Installation and Best Practices Manual**

The manufacturer's installation and best practices guide shall form part of the Contractor's Quality Control Plan.

#### **423.03.02.05 Handling, Shipping and Storage**

As part of the Quality Control Plan the Contractor must detail the transportation, handling and storage methods for the structure. The methodology must be shown to be in conformance with the manufacturer's recommendations.

#### **423.03.02.06 Letters of Conformance**

The Contractor's Quality Control Plan shall list all letters of conformance which are required to be submitted to the Department. These include, but are not limited to:

- Manufacturer's Plant Certificate of Conformance
- Contractor's Geotechnical Engineer's Letter of Conformance (Materials Testing)
- Contractor's Geotechnical Engineer's Letter of Conformance (Compaction)

#### **423.03.02.07 Material on Site**

The Contractor's Quality Control Plan must include details to demonstrate compliance with Section 423.05 of this Specification.

As part of this procedure the Contractor must ensure that structure materials are made available and fully visible to the Owner's Representative for inspection and initial acceptance. The Contractor is advised that final acceptance of the structure material will only be given once the structure is completely installed and backfilled.

#### **423.03.03 Quality Control Reporting**

All quality control documentation shall be provided to the Department as the project progresses. Documentation shall include, but is not limited to: structure alignment/shape monitoring, bolt torque testing, material testing, and compaction testing. Failure to provide this information shall result in the issuance of a stop work order. Delays resulting from the failure to submit quality control documentation shall not form the basis of any claim.

Quality control reporting shall be promptly provided as the installation progresses.

As a minimum, the Contractor is required to submit a daily work report for each day that work is performed on-site. The report must summarize the following: a description of the work completed, the equipment utilized and present on-site, any significant issues or challenges encountered, and any quality control test results conducted during the day. The report must also include photographic documentation of the ongoing work activities, with the images clearly illustrating the progress made and specific tasks completed on that day. Additionally, the daily report must be dated and signed by the Contractor's Representative, verifying the accuracy of the information provided. Reports must be

submitted to the Owner's Representative no later than the following morning to ensure timely review and record-keeping.

Failure to submit quality control reporting in a timely manner shall result in a 10% holdback on the Structural Plate Pipe, until such time that the required reports have been submitted to, and accepted by, the Owner's Representative.

#### **423.03.04 List of Required Submittals**

To ensure proper documentation and conformance, the following items must be submitted by the Contractor at the specified stages of the installation. At a minimum the required submittals include, but are not limited to the following:

- Structure Shop Drawings
- Quality Control Plan
- Manufacturer's Plant Certificate of Conformance
- Bolt Torque Testing Results
  - Initial Assembly
  - During Backfill
- Structure Alignment/Shape Monitoring Testing Results
- Daily Quality Control Reporting
- Backfill Material Testing Results (Gradation and Electrochemical)
  - Backfill Sample Provided to Owner's Representative
- Contractor's Geotechnical Engineer's Letter of Conformance (Materials Testing)
- Backfill Material Testing Results (Compaction)
- Contractor's Geotechnical Engineer's Letter of Conformance (Compaction)
- Comprehensive Summary Testing Package

#### **423.04 ENVIRONMENTAL PERMITS AND AUTHORIZATIONS**

Authorization from the Department of Fisheries and Oceans Canada's Fish and Fish Habitat Protection Program is required for work in or near any watercourse or water body deemed to be viable fish habitat.

Where required by Fisheries and Oceans, a downstream pool shall be provided at the pipe outlet.

Structural plate pipes are to be installed such that the bottom of the pipe is at least 300 millimetres below the natural streambed. This will allow the deposition of stream gravels in the pipe providing a natural appearing streambed and will assist fish passage during minimum flow periods.



For stream crossings requiring multiple pipe installations, only the pipe designed to carry minimum flows shall be installed to maintain fish passage (i.e. countersunk a minimum of 300 millimetres). The other pipes shall normally be installed along the streambed or at an elevation determined by the Owner's Representative.

Work is to be carried out in accordance with all requirements stipulated by regulatory agencies whose approval is required. This includes, but is not limited to, the Department of Fisheries and Oceans Canada, Transport Canada's Navigation Protection Program and the Water Resources Division of the Department of Environment, Climate Change and Municipalities.

Where unwatering is required, the contractor shall carry out this work in accordance with Section 180.

The Contractor shall be aware of the requirements of Division 8.

## **423.05 MATERIALS**

### **423.05.01 Fabrication**

Structural components shall be carefully formed to the corrugation profile and curved to the required radius along the inner crest, in the manufacturer's plant.

Fabrication of all components must meet the requirements of CAN/CSA G401 or ASTM A761, as applicable.

### **423.05.02 Materials for Steel Structures**

Steel plate to conform to the latest version of CSA G401.

Corrugated steel structural plate shall meet the general requirements as specified in CSA G401.

For galvanized structures, a zinc coating shall be applied after fabrication. The coating must provide a minimum coating weight of 915 grams per square metre total on both sides of the corrugated steel plates in accordance with CSA G401.

For structures that are specified by the Department to have a thermoplastic copolymer coating; a thermoplastic copolymer coating shall be applied to both sides of the corrugated steel plates in accordance with CSA G401.

Bolts and nuts for the structural plate connections shall be heavy hex, meeting the requirements of CSA G401. Anchor bolts shall meet CSA G401. All fasteners and anchor bolts shall be zinc coated in accordance with CSA G401.

For thermoplastic copolymer coated structures all fasteners shall be in accordance with the latest version of CSPI Technical Bulletin Issue Twenty-Three.

Steel for base channels, if required, to conform to CSA G401.

### **423.05.03 Materials for Aluminum Structures**

Aluminum plates to conform to the latest version of ASTM B746.

The aluminum structural plate shall meet the general requirements as specified in ASTM B746. Bolt holes shall be 25 millimetres in diameter using 19 millimetre diameter (3/4" diameter) bolts.

Bolts and nuts for the structural plate connections shall be heavy hex.

Steel bolts shall meet the requirements of CSA G401. Anchor bolts shall meet CSA G401.

All fasteners and anchor bolts shall be coated in accordance with CSA G401.

Aluminum bolts shall meet the requirements of ASTM F468, made from Alloy 6061-T6.

Aluminum nuts shall meet the requirements of ASTM F467, made from Alloy 6061-T6.

### **423.06 HANDLING, SHIPPING AND STORAGE**

The Contractor shall be responsible for the acceptance, unloading, handling, and storage of all material delivered to the project site. All components shall be handled, stored and shipped in such a manner as to eliminate the potential for damage as detailed in the manufacturer's installation guide. All damaged components shall be rejected by the Department and replaced at the Contractor's expense. Any loss or damage to material after acceptance shall be replaced by the Contractor at their own expense. Damaged components shall include, but is not limited to, any structural plates which exhibit permanent deformation or strain.

Stockpile lay down areas shall be specified by the Contractor prior to the start of construction, and will be subject to the approval of the Owner's Representative. Stockpile locations shall be at or near the project site.

The stockpile lay down areas shall not impact the operation and/or access to utilities, including but not limited to power lines, waterlines, and underground utilities. The Contractor shall acquire any required approvals, clearances, or permits for stockpile lay down areas prior to the start of construction. Work is to be carried out in accordance with all requirements stipulated by regulatory or utility agencies whose approval is required. This includes, but is not limited to, the Department of Fisheries and Oceans Canada and the Water Resources Division of the Department of Environment and Climate Change. The Contractor shall be aware of the requirements of Division 8.

Stockpile lay down areas shall be cleaned of any debris and objectionable material by the Contractor prior to placing the material. This cleaning shall be considered incidental to the work. Stockpile lay down areas shall have a uniform smooth surface and be graded to ensure positive drainage away from the stockpile materials.

For any stockpile lay down areas on private property, the Contractor shall obtain a signed agreement with the property owner prior to the start of construction. This agreement shall be submitted to the Owner's Representative for review and approval at minimum ten (10) working days prior to the start of construction.

Structural plate and any other fabricated material shall be stored at least 150 mm above ground level, in an organized fashion, and be supported to prevent any permanent deformation, in a manner acceptable to the Owner's Representative. Structural plates and fasteners shall be stored in accordance with CSPI Technical Bulletin 28. For the purposes of this specification, long term storage is defined as a period exceeding 3 months or for material stored over the Winter Season (December to May). Stockpiled material must be protected from environmental damage and corrosion, in a manner acceptable to the Owner's Representative. For long term storage, the Contractor shall provide a detailed storage plan to the Owner's Representative for their review and acceptance. The Contractor shall adhere to any additional storage requirements specified by the manufacturer or as directed by the Owner's Representative.

The Contractor shall be responsible for providing any and all required security to prevent loss or damage to stockpiled materials. Any lost or damaged stockpiled material shall be replaced by the Contractor at their own expense.

#### **423.07 EXCAVATION**

The Contractor shall excavate a foundation within the limits and to the grade as staked by the Owner's Representative. This excavation shall be carried out and paid for in accordance with Section 403.

The foundation shall be excavated to a depth of 300 millimetres below the proposed grade of the invert and to a width equal to the width of the proposed structural plate pipe or pipe-arch plus half the span on each side, or as directed by the Owner's Representative.

The Contractor shall assemble the structure on a suitable foundation as approved by the Owner's Geotechnical Engineer.

#### **423.08        EXTENSIONS TO EXISTING STRUCTURAL PLATE**

When specified, the work will involve extending an existing structural plate pipe. Where the pipe has a beveled end on the end to be extended, then the Contractor shall remove the plates comprising the beveled end before adding the extension. The plates comprising the dismantled beveled end shall be disposed of by the Contractor at their own expense.

Where in order to secure the extension to the existing pipe, cuts need to be made, or bolt holes need to be drilled in the existing pipe, then the Contractor shall make such cuts or holes as are necessary. Cuts and holes shall be made in such a manner so as to leave neat edges.

In the case of extensions or modifications to existing pipe all cutting and drilling shall be reviewed and accepted by the supplier and the Owner's Representative. Cuts (if essential) shall be made with saws and holes (if essential) shall be drilled. Following such alteration, the Contractor shall clean, pre-treat if necessary and coat all damaged sections with cold-galvanizing compound as outlined. The cold-galvanizing compound shall be allowed to thoroughly dry before adding the extension.

Where corrugated steel pipe is cut, drilled, or welded the pipe shall be thoroughly cleaned with a wire brush to remove scale, rust, slag residue, weld splatter, and wiped clean. The clean surface shall receive at least one application of metal conditioner to de-oxidize, de-grease, and phosphatize the metal surface to be treated if the surface is oily. Pre-mixed, ready-to-apply, liquid-zinc compound should be applied to the prepared clean dry metal surface. The cold-galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound should have a minimum 50 millimetre overlap of the surrounding undamaged galvanized metal.

When applying a metal conditioner and a cold galvanizing compound near a watercourse or water body, the Contractor shall ensure that the application is carried out carefully as to prevent leakage or spillage.

All cut edges and any damage to galvanized or polymer coatings shall be repaired in accordance with the latest version of CSA G401

All materials must be applied in accordance with the manufacturer's instructions.

#### **423.09 BEDDING**

The Contractor shall prepare a bed to the alignment, shape of underside of the structural plate and grade, as required by the Owner's Representative.

See Form 1231 and Form 1232 for typical details.

Select bedding material shall be used to prepare the bed. Select bedding material shall satisfy the following soil classification requirements:

1. ASTM D2487 - Group GW, SW, GP, GW-GM, or SW-SM
2. ASTM D6913 - Maximum 25mm particles size  
Minimum Gravel Content 35% (particle size > 4.75mm)  
Less than 50% passing the 0.150mm sieve  
Less than 10% passing the 0.075mm sieve
3. ASTM D4318 - Plasticity index less than 6%
4. Uniformity Coefficient (Cu):  $Cu \geq 4$
5. Coefficient of Curvature (Cc):  $1 \leq Cc \leq 3$
6. Angularity of non-crushed Materials, ASTM D2488: > 35% Angular/Sub-angular
7. Flat/Elongates, ASTM D2488 or ASTM D4791: <25%
8. Los Angeles Abrasion Loss, ASTM C131: < 40%
9. Magnesium sulphate Soundness Loss, AASHTO T104: < 30% after four cycles

**No material testing requirements shall be waved.**

The bedding directly below structural plate pipe shall be lightly compacted to the required grade and shaped with a thin layer of loose select bedding in direct contact with the invert plates. All remaining bedding shall be compacted to at least 95% of Standard Proctor Dry Density (ASTM D698).

#### **423.10 ASSEMBLY**

The Contractor shall load the plates, nuts, bolts, washers, ribs if required, and all necessary hardware at the point of supply and transport them to the installation site.

Plates shall be bolted at longitudinal and circumferential seams such that no more than 3 plates overlap at any bolt hole on the main barrel.

The cutting or drilling of holes in new structural plates in the field is not permitted without the Owner's written approval. On a case-by-case basis the Contractor shall submit to the Department a detailed request to modify structural plate, which includes but is not limited to: drilling, cutting etc. Requests of this nature must also be accompanied by a manufacturer approved repair procedure.

Any defective plate(s) must be reported to the supplier and corrective action taken by the supplier or the manufacturer.

The Contractor shall assemble the structure using procedures as recommended by the supplier and in accordance with the instructions of the Owner's Representative.

The Contractor shall brush off all soil sticking to the outside of those parts of plates that are to be lapped when joined.

Structural plate pipes may be assembled at the proposed location or at the side of the location. If the assembled structure has to be moved to its final position it shall be moved in such a manner that no damage or distortion is caused to the structure or the bedding.

The structural plate pipe shall be placed to the required alignment, and grade and be within the required limits, as specified by the Owner's Representative.

After complete assembly all bolts shall be re-tightened with a torque wrench to comply with the manufacturer's specified torque requirements.

Any damage to metallic coatings shall be repaired in accordance with the latest version of CSA G401, with the following exception; an individual structural plate shall be rejected by the Department for either of the following:

- If an individual uncoated/damaged area exceeds 300mm in any one dimension.
- If an individual uncoated/damaged area exceeds 50mm in both dimensions.
- If the total combined uncoated/damaged surface area measures more than 1% of the total surface area.

In any of the above cases the Contractor may propose an engineered repair plan for consideration by the Department. If the Department elects not to accept the engineered repair plan, the structural plate shall be replaced with new material, or be re-dipped in

accordance with CSA G401. The acceptance of the repair procedure shall be at the sole discretion of the Department.

Any damage to polymer coatings shall be promptly repaired in accordance with CSA G401 and CSPI Technical Bulletin Number Two, with the following exception; an individual structural plate shall be rejected by the Department for either of the following:

- If an individual uncoated/damaged area exceeds 300mm in any one dimension.
- If an individual uncoated/damaged area exceeds 50mm in both dimensions.
- If the total combined uncoated/damaged surface area measures more than 1% of the total surface area.

In any of the above cases the Contractor may propose an engineered repair plan for consideration by the Department. If the Department elects not to accept the engineered repair plan, the structural plate shall be replaced with new material, or be re-coated in accordance with CSA G401. The acceptance of the repair procedure shall be at the sole discretion of the Department.

All costs associated with preparation of repair procedures and repairing or replacing the damaged structural plate components shall be borne entirely by the Contractor.

## **423.11 BACKFILLING**

### **423.11.01 Select Backfill and Material Testing**

Backfill material in the engineered backfill zone shall be clean, well graded, granular material meeting the strength, gradation, compressibility and electrochemical requirements specified herein.

Unless otherwise specified the select backfill envelope shall be as shown in Form 1231 and Form 1232, as appropriate. The engineered backfill envelope shall meet the requirements of the latest CAN/CSA-S6 design code.

All select backfill shall be provided from a single source.

When the air temperature is below 0°C, no backfilling is allowed. Frozen granular backfill materials will not be permitted. No backfill material will be permitted to be placed directly on frozen substrate.

It shall be the Contractor's responsibility to carry-out all required testing. The Contractor shall use professional geotechnical engineering services and a qualified testing firm licensed in Newfoundland and Labrador for all sampling and testing of the select backfill.

All material testing shall be carried-out on a project specific basis. Material testing results obtained from an alternate project will not be accepted by the Department.

At least two weeks prior to start of construction the Contractor shall identify the source of materials to be used for the select backfill and provide initial testing for the select backfill. This testing shall include both gradation and electrochemical testing as a minimum. A copy of these test results shall be provided to the Owner's Representative. The Contractor shall provide a letter of conformance from their third party geotechnical consultant stating that the material testing results are in compliance with this specification. Letters of conformance shall bear the stamp of a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

Select backfill material shall satisfy the following soil classification requirements:

1. ASTM D2487 - Group GW, SW, GP, GW-GM, or SW-SM
2. ASTM D6913 - Maximum 75mm particles size
  - Minimum Gravel Content 35% (particle size > 4.75mm)
  - Less than 50% passing the 0.150mm sieve
  - Less than 10% passing the 0.075mm sieve
3. ASTM D4318 - Plasticity index less than 6%
4. Uniformity Coefficient ( $C_u$ ):  $C_u \geq 4$
5. Coefficient of Curvature ( $C_c$ ):  $1 \leq C_c \leq 3$
6. Angularity of non-crushed Materials, ASTM D2488: > 35% Angular/Sub-angular
7. Flat/Elongates, ASTM D2488 or ASTM D4791: < 25%
8. Los Angeles Abrasion Loss, ASTM C131: < 40%
9. Magnesium sulphate Soundness Loss, AASHTO T104: < 30% after four cycles

**No material testing requirements shall be waved.**

All select backfill material must conform to the following electro-chemical limits per AASHTO LRFD specifications as detailed in Table 4 of Corrugated Steel Pipe Institute's (CSPI) Technical Bulletin Thirteen.

As a minimum requirement, the select backfill material shall be tested in accordance with AASHTO or ASTM standard methods and meet the following criteria:



ELECTRO-CHEMICAL PARAMETER	ELECTRO-CHEMICAL REQUIREMENT	TEST METHOD	
		AASHTO	ASTM
Chlorides (Cl <sup>-</sup> )	< 100 ppm	T291	D512
Sulphates (SO <sub>4</sub> <sup>2-</sup> )	< 200 ppm	T290	D516
Resistivity	> 3000 ohm-cm	T288	G57
pH	5 – 10	T289	G51
Max Organic Content	< 1%	T267	-

In addition to the initial gradation and electrochemical testing, the Contractor shall sample and test the backfill for conformance with the gradation requirements at least once for every 250 cubic metres of material placed.

The Contractor shall also provide a 20 kilogram representative sample of the backfill proposed for construction to the Owner's Representative for testing and approval two weeks prior to start of construction. The sample provided shall meet the geotechnical parameters as specified.

All sampling shall be carried out in the presence of the Owner's Representative.

Additional gradation testing at the Contractor's expense may be required if based upon visual inspection in the field it is evident to the Owner's Representative that the gradation of the select backfill material has changed.

Gradation requirements will be strictly enforced and variances to coarser or less well graded material will not be accepted.

The Contractor shall also be responsible for testing to establish the Standard Proctor Maximum Dry Density (ASTM 698) of the approved backfill and will be responsible for having the compaction of each lift of backfill tested for conformance with the compaction requirements specified in Section 423.11.02.

All results shall be provided to the Owner's Representative as the work progresses.

Where conventional material testing is not possible, the Contractor shall use professional engineering services licensed to practice in Newfoundland and Labrador to provide a visual inspection of each lift, ensuring proper compaction. The Contractor shall provide a letter of conformance from the third party engineering firm stating that the select backfill meets the compaction requirements of this specification

There will be no payment for installation until all initial testing results have been submitted to the Owner's Representative and deemed acceptable.

Timely submission of all required gradation and compaction testing results shall be provided to the Owner's Representative as the work progresses. The Contractor is advised that failure to provide testing results, or failure to meet the specified requirements, may result in the rejection of the select backfill material. Select backfill rejected by the Department as a result of not meeting the material requirements of this specification, shall be carefully excavated and replaced in accordance with this specification, at the Contractor's expense.

The Contractor is advised that the Department may elect to carryout quality assurance work in relation to any aspect of this structure. No delay claims will be accepted as a result of this activity.

Where there are discrepancies between the Department's and manufacturer's specifications then the more stringent requirement shall govern.

Upon request by the Department, where the Contractor is procuring select backfill material from a third party, the Contractor shall provide proof of delivery for all select backfill material.

#### **423.11.02 Backfilling Operations**

The Contractor shall notify the Owner's Representative a minimum of 7 days prior to the commencement of backfilling operations.

Backfilling shall not commence until concrete headwalls have achieved at least 70% of the specified design strength at 28 days or cured for seven days, whichever comes first. This requirement may be increased by the Owner's Representative.

The backfill material shall be uniformly placed in compacted lifts on both sides of the structure. The backfill lifts shall not exceed 250 millimetres in depth (before compaction) and shall be compacted to a minimum of 98% Standard Proctor Dry Density (ASTM D698).

The difference in levels of the backfill on the two sides at any transverse section shall not exceed two compacted lift thickness and the maximum particle size of 75 millimetres within 300 millimetres of the structure.

The select backfill shall extend along the sides of the structure at least a half span width away from the steel surfaces, or as indicated in the contract documents.

Backfilling with select backfill material shall be continued until all parts of the pipe have not less than 1 metre of backfill cover, or not less than the manufacturer's recommended minimum cover, whichever is less.

Heavy equipment cannot be operated within 1000 millimetres of the structure. Fill within 1000 millimetres of the structure must be placed and compacted using light equipment or by hand.

Loads that exceed design loading are not permitted on the structure. Live Load traffic is not permitted until the structure has been backfilled to the minimum design height of cover without prior approval from the Owner's Representative.

Backfill shall be carefully placed and compacted so that the correct shape of the structure is maintained. The Contractor shall monitor the shape of the structure during backfilling operations. Any deflection from the specified dimensions shall be within the tolerances noted on the manufacturer's shop drawings. If deflections exceed the permitted tolerances, then backfilling operations shall be ceased until a suitable procedure is developed by the Contractor and accepted by the Department. The Manufacturer and Owner's Representative shall be notified of any deflections in writing immediately.

All structural plates which exhibit permanent deformation or strain for any reason shall be rejected by the Department and replaced at the Contractor's expense.

#### **423.12 PROTECTION FROM TRAFFIC**

Prior to allowing the movement of construction equipment or any vehicular traffic over the structure, the depth of cover over the structure shall not be less than the manufacturer's recommended minimum cover for the particular loading. Any construction equipment exceeding CL-625 loading conditions shall not be permitted over the structure.

#### **423.13 MEASUREMENT FOR PAYMENT**

Measurement for payment for a structural plate pipe shall be the actual length of the new pipe measured in metres, rounded to one decimal place, along the bottom of the pipe.

#### **423.14 BASIS FOR PAYMENT**

Payment at the contract price for the size, thickness, and type of structural plate pipe specified shall be full compensation for all labour, materials, and equipment-use required

to: supply all plates, nuts, bolts, washers, ribs if required, together with all necessary hardware, load and haul the same from the supply point to the installation site, provide for temporary storage and all rehandling necessary, assemble the structure, locate to alignment, grade, and tolerance specified by the Owner's Representative, place, compact and test select bedding and select backfill as specified herein, together with all labour, materials and equipment-use necessary to provide any required unwatering and quality control.

Where the work involves extending an existing structural plate pipe, then the basis of payment shall, in addition to the aforesaid, also include all labour, materials and equipment-use for: removing and disposing of the existing beveled end or ends (if any), cutting plates (if needed), drilling holes (if needed), cleaning, and treating, supplying and applying cold-galvanizing compound to any cuts or drilled holes.

Select bedding material and select backfill material shall be paid for in accordance with Section 206 or Section 207 or Section 310 as the case may be, but the additional requirements for bedding and backfilling as stipulated in this specification shall be considered compensated for in the contract price for the supply and installation of the structural plate pipe.

All excavation required for a new pipe or to expose the end of an existing pipe where an extension is required shall be paid for in accordance with Section 403 for (a) Solid Rock or (b) Other Material, as the case may be.

Payment for the long span structural plate structure, including materials, will only be made once the structure is installed, backfilled and all letters of conformance have been received and accepted by the Department. No interim payments will be considered.

Contractors are advised that any failure to fully comply with all specified requirements, including but not limited to the timely submission of documentation, completion of necessary material testing, and adherence to all quality control protocols as outlined in this specification, shall result in the unconditional rejection of the structural plate installation. This decision will be made at the sole discretion of the Department, and no further consideration for acceptance or approval of the installation will be given unless all requirements are met in accordance with the established specification.