# GENERAL

## Scope of Work

### This Section covers the requirements for the installation of sanitary and storm sewer pipe and concrete appurtenances from the first pipe joint outside of the foundation to the limits of construction. All sewers are to be supplied and installed in accordance with OPSS.MUNI 410 [Nov 2018] as amended by this specification.

## Related Sections

### Section 01300 – Submittals

### Section 01550 – Traffic Control

### Section 02230 – Site Preparation for Pipelines, Utilities and Associated Structures

### Section 02240 – Dewatering General

### Section 02260 – Excavation Support Systems

### Section 02315 – Trenching, Backfilling and Compacting

### Section 02555 – Cathodic Protection

### Section 02631 – Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers

### Section 02701 – Aggregates – General

### Section 02959 – Gravity Sewer CCTV Inspection Requirements

### Section 03200 – Concrete Reinforcement

### Section 03300 – Cast in Place Concrete

## References

All standards mentioned in this specification Section are based on the dates below.

### Ontario Provincial Standard Specifications (OPSS)

#### OPSS.MUNI 410 [November 2018], Construction Specification for Pipe Sewer Installation In Open Cut.

### ASTM International ***(Also note ASTM References contained within OPSS.MUNI 410)***

#### ASTM C76-20, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

#### ASTM C117-17, Standard Test Method for Material Finer Than 75 um (No. 200) Sieve in Mineral Aggregates by Washing.

#### ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

#### ASTM C443-20, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

#### ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12,400 ft-lbf/ft3 (600 kN-m/m3)).

#### ASTM D3034-16, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and fittings.

#### ASTM F477-14(2021), Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

### CSA ***(Also note ASTM References contained within OPSS.MUNI 410)***

#### CAN/CSA A3000-18, Cementitious Materials Compendium.

#### CAN/CSA A257 Series-2019, Standards for Concrete Pipe and Manhole Sections.

#### CAN/CSA B1800:21, Thermoplastic Non-pressure Piping Compendium.

### ANSI/AWWA ***(Also note ASTM References contained within OPSS.MUNI 410)***

#### ANSI/AWWA C301-14(R19), Pre-stressed Concrete Pressure Pipe, Steel Cylinder Type.

#### ANSI/AWWA C302-16, Reinforced Concrete Pressure Pipe Non-Cylinder Type

#### ANSI/AWWA C655-18, Field Dechlorination

### OPSS 410, Construction Specification for Pipe Sewer Installation In Open Cut.

### Ontario Underground Infrastructure Notification System Act, 2012.

## Definitions

### OPSS.MUNI 410.03 shall be followed.

## Pre-Ordered Materials

### N/A

## Material Certification

### Submit the manufacturers’ test data and certification that all pipe materials meet the requirements of this Section at least ten (10) Working Days prior to commencing the Work. Include the manufacturer's drawings, information and shop drawings, where pertinent. Provide Affidavit of Compliance as per:

#### Section 6.3 – Verification, ANSI/AWWA C301 (Concrete pipe).

#### Section 6.3 – Verification, ANSI/AWWA C302 (Noncylinder Concrete pipe).

### Certification is to be marked on the pipe.

## Locates

### The Contractor shall comply with the Ontario Underground Infrastructure Notification System Act, 2012 and ensure Ontario One Call is contacted for locates of underground infrastructure for any such work. For underground work the Contractor shall be deemed “Excavator” under the Act. No excavation work is allowed to proceed until all underground locate work has been completed in accordance with the Ontario Underground Infrastructure Notification System Act, 2012.

## Shop Drawings

### Submit Shop Drawings in accordance with Section 01300 – Submittals.

### Submit shop drawings for all pipe, fittings, bends, saddles, sleeves, and other appurtenances.

### Submit shop drawings for maintenance holes in accordance with Section 02631 – Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers.

## Scheduling of Work

### Schedule the Work to minimize any interruptions to existing services.

### Submit a schedule of expected interruptions to the Consultant for approval and adhere to the approved interruption schedule. Note: during high flow periods, inclement weather or significant thaw events approvals may be delayed (at no cost to the Region) to maintain overall system capacity for service to the community.

### The Contractor shall provide a minimum of 10 Working Days advance notice to the Region for scheduling operation of any flow diversions or system modifications.

### Notify the Consultant and Region a minimum of 48 hours in advance of any interruptions in service.

### Ensure scheduling of Work accounts for required measures as defined in Section 01550 – Traffic Control and in accordance with the conditions on the local municipal or Regional Road Occupancy Permit. Road crossings shall be staged to minimize impacts to traveled lanes and may require installation outside of normal working hours after 19:00 hours or on weekends. The Contractor shall immediately notify the Region and contact Transportation Roads Operations Dispatch at (877) 464-9675 extension 75200 for any emergency lane restrictions or interference with the movement of traffic outside of the conditions of the Road Occupancy Permit for notification to emergency services, transit authorities and commuter traffic advisories.

### The Contractor will be responsible for providing traffic control and safe access to all maintenance holes for all inspections including but not limited to preliminary inspections prior to testing, deficiencies, investigative and warranty inspections.

## Measurement and Payment

### Sanitary sewers shall be measured for payment horizontally in meters from the first pipe joint outside of the maintenance hole. No allowance in measurement shall be made for sloped or vertical sections. Measurement will be based on shop drawing calculations or field measurements.

### Include the following in the unit price bid per meter of sanitary sewer under Items [ ]:

#### Excavation to grade and disposal of excess material off Site.

#### Unloading, storage and handling of sewer pipes and materials.

#### Supply and installation of all pipes, fittings, bends, adaptors, specials, sleeves, concrete appurtenances, restrainers, concrete pipe support or encasement, joints, bedding, supporting and protecting existing services, supply and installation of tracer wire and cathodic protection (refer to Section 02555 – Cathodic Protection).

### Payment for maintenance holes including piping to the first joint outside of the maintenance hole and appurtenances shall be according to Section 02631 – Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers.

### For pipe installed within shafts, the unit price per meter of pipe shall be included in the price for the shaft.

### Payment for connections to existing sewers shall be a lump sum item included in the price for Item No. [ ] Connections to Existing Sewers in the Bid Form.

### Payment for Trench Plugs shall be by the Each included in the price for Item No. [ ] Trench Plugs in the Bid Form for the full supply and installation of each trench plug.

### Payment for CCTV inspection shall be according to Section 02959 – CCTV Inspection Requirements.

## Basis of Payment

### Payment shall include full compensation for all labour, materials and equipment required to complete the Work as specified in the Contract Documents.

### Payment at the Contract unit prices shall be compensation in full for the supply of all materials and the performance of all Work to completely install the sewer to the satisfaction of the Consultant.

Item [ ] [size], [type], [class] Pipe Sewers from MHXX to MHXX

Item [ ] Trench Plugs

Item [ ] Continuity Testing of Tracer Wire

Item [ ] Connections to Existing Sewers

# PRODUCTS

For sanitary sewers, **OPSS.MUNI 410** shall be followed with the following amendments:

## **410.05.01 Pipe Materials**

### **410.05.01.02 Concrete Pipe** is amended by the addition of the following:

#### Pipe material, size and class shall be as specified on the Contract Drawings. Pipe class may be increased as required based on the manufacturers design calculations and layout, or the Contractors shoring and trench design.

#### Reinforced circular concrete pipe and fittings: in accordance with CAN/CSA A257 Series as indicated on the Contract Drawings, designed for flexible rubber gasket joints in accordance with CSA A257 Series.

#### Unless otherwise shown on the Contract Drawings, provide additional requirements as follows:

##### Lifting Holes and Anchors:

###### Pipe 900 mm and less in diameter - no lifting holes.

###### Pipe greater than 900 mm in diameter - lifting holes are not to exceed two in a piece of pipe.

###### Lift holes are to be grouted with non-shrink grout after installation.

#### Pre-stressed Concrete Pressure Pipe and Fittings: in accordance with AWWA C301 (class as noted on the Contract Drawings).

##### Approved Suppliers:

###### DECAST Ltd.

###### Forterra Pipe and Precast.

###### Or Equivalent.

#### Reinforced Concrete Pressure Pipe – Non Cylinder Type: in accordance with AWWA C302 (class as noted on the Contract Drawings).

#### The concrete pressure pipe manufacturer shall provide a comprehensive set of final shop drawings for all materials provided through the completion of the Work. The set shall be marked “Final” in the version table. The set shall include final closures and connections to existing sewers.

### **410.05.01.04 Polyethylene Pipe Products** is amended by the addition of the following:

#### The pipe diameter, stiffness, material, and type of all polyethylene pipe products shall be as specified in the Contract Drawings.

### **410.05.01.05 Polyvinyl Chloride Pipe** is amended by the addition of the following:

#### The pipe diameter, stiffness, material, and type of all polyvinyl chloride pipe products shall be as specified in the Contract Drawings.

#### Standard Dimensional Ratio (SDR): 18 unless otherwise shown on the Contract Drawings

### **410.05.01.06 Polypropylene Plastic Pipe Products** is amended by the addition of the following:

#### The pipe diameter, stiffness, material, and type of all polypropylene plastic pipe products shall be as specified in the Contract Drawings.

## **410.05.02 Mortar** is amended by the addition of the following:

### Portland cement: in accordance with CAN/CSA A3000].

### Mix mortar one part by volume of cement to two parts of clean, sharp, sand mixed dry. Add only a sufficient amount of water after mixing to give optimum consistency for placement. Do not use additives.

## **410.05.04 Concrete** is deleted and replaced with the following:

### Concrete mixes and materials for cradles, encasement and supports in accordance with Section 03300 – Cast in Place Concrete.

### Position pipe on concrete blocks to facilitate the placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

### Do not backfill over concrete within 24 hours after placing.

## **410.05.05 Steel Reinforcement** is deleted and replaced with the following:

### Steel reinforcement shall be of the size and grade specified in the Contract Drawings and shall be according to Section 03200 – Concrete Reinforcement.

## **410.05.07 Tracer Wire** is added:

### Tracer wire is to be stranded copper (8 gauge), plastic coated, on all radius gravity sanitary sewer pipe, any pipe material. Tracer wire on straight runs of sanitary sewer pipe is not required.

### Tracer wire shall be secured to the pipe using suitable tape or ties. At maintenance holes, tracer wire shall be clipped securely to the maintenance hole walls with plastic clips and tapcons, and a lead from each direction shall extend to the underside of the frame and cover. Provide 600 mm free ends and brass tags on each lead.

### All splices or connection of tracer wire ends shall be protected with a dielectric putty and waterproof cover.

## **410.05.08 Warning Mesh** is added:

### Continuous green Plyage Hz warning mesh 500mm wide shall be installed above all sewers, 1500mm above the crown of the pipe.

# EXECUTION

## **410.07.01 Site Preparation** is deleted and replaced with the following:

### Site preparation shall be according to Section 02230 – Site Preparation for Pipelines, Utilities and Associated Structures.

## **410.07.06 Transporting, Unloading, Storing, and Handling Pipe** is amended by the addition of the following:

### Delivery and unloading of pipes and fittings at the Site shall cause the least possible delay to traffic.

### All pipes, fittings and gaskets that are unsound or damaged shall be removed from the Site and replaced. Faded and discoloured PVC pipe are unacceptable and shall be removed from Site and replaced.

### Mechanical equipment shall be used to unload the pipe.

### Materials shall be placed in a safe storage location and the manufacturer's handling and storage recommendations shall be followed.

## **410.07.07 Excavation** is deleted and replaced with the following:

### Excavation for the placement of pipe sewers shall be according to Section 02315 - Trenching, Backfilling and Compacting.

### Trench alignment and depth require the approval of the Consultant prior to placing bedding material and pipe.

### Do not allow the contents of any sewer or sewer connection to flow into the trench.

## **410.07.08 Support Systems** is deleted and replaced with the following:

### Support systems shall be according to Section 02260 – Excavation Support Systems.

## **410.07.09 Dewatering** is deleted and replaced with the following:

### Dewatering shall be according to Section 02240 – Dewatering General.

## **410.07.11 Backfilling and Compacting** is deleted and replaced with the following:

### Backfilling and Compacting shall be according to Section 02315 – Trenching, Backfilling and Compacting.

### Refer to York Region Standard Drawings 02.74.

### Pipe Bedding

#### Place bedding in unfrozen conditions.

#### Place granular bedding materials in uniform layer(s) not exceeding 150 mm of compacted thickness.

#### Shape the bed true to grade and to provide a continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipe.

#### Shape transverse depressions as required to suit the joints.

#### Compact each layer the full width of bed to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

#### Fill the excavation below the bottom of the specified bedding or concrete pipe support adjacent to maintenance holes or structures with compacted bedding material.

### Pipe Surround

#### Place surround material in unfrozen conditions.

#### Upon completion of pipe laying, and after the Consultant has inspected the pipe joints, surround and cover pipes as indicated on the Contract Drawings.

#### Hand place surround material in uniform layers not exceeding 150 mm of compacted thickness as indicated on the Contract Drawings.

#### Place layers uniformly and simultaneously on each side of the pipe.

#### Compact each layer from the pipe invert to the underside of backfill to at least 98% of SPMDD.

### Backfill

#### Place backfill material in unfrozen conditions.

#### Place backfill material, above the pipe surround, in uniform layers not exceeding 150 mm of compacted thickness up to the grades as indicated on the Contract Drawings.

#### Under asphalt paving, gravel shoulders and sidewalks, compact backfill to at least 98% SPMDD. In other areas, compact to at least 90% SPMDD in accordance with ASTM D698, unless indicated otherwise on the Contract Drawings.

## **410.07.12 Pipe Installation** is amended by the addition of the following:

### Lay and join pipes in accordance with the manufacturer's recommendations and to approval of the Consultant.

### Handle pipe using methods in accordance with the manufacturer’s recommendations. Do not use chains or cables passed through rigid pipe bore so that the weight of pipe bears upon pipe-ends.

### Lay pipes on a prepared bed, true to line and grade, with the pipe invert smooth and free of sags or high points. Ensure that the barrel of each pipe is in contact with the shaped bed throughout its full length.

### Commence laying at the outlet and proceed in an upstream direction with the socket ends of the pipe facing upgrade.

### Do not exceed the maximum joint deflection recommended by the pipe manufacturer.

### Do not allow water to flow through the pipe during construction, except as may be permitted by the Consultant.

### Whenever the Work is suspended, install a removable watertight bulkhead at the open end of the last pipe laid to prevent entry of foreign materials.

### Pipe jointing:

#### Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

#### Manufacturer's instructions for jointing pipes shall be followed. Pipes shall be aligned to previously laid pipe.

#### Pipe shall be pulled or pushed only by hand or power operated winch. An excavator shall not be used for pushing pipe.

#### Joints shall be prevented from opening after the pipe has been laid.

#### Install gaskets in accordance with the manufacturer's recommendations.

#### Support pipes with hand slings or a crane as required to minimize lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned.

#### Align pipes before joining.

#### Maintain pipe joints free from mud, silt, gravel and other foreign material.

#### Avoid displacing gaskets or contaminating them with dirt or other foreign material. Gaskets so disturbed shall be removed and replaced before joining is attempted.

#### Complete each joint before laying the next length of pipe.

#### Minimize joint deflection after the joint has been made to avoid joint damage.

#### Apply sufficient pressure in making joints to ensure that the joint is complete as outlined in the manufacturer's recommendations.

### When any stoppage of Work occurs, block pipes as directed by the Consultant to prevent creep during down time.

### Cut pipes as required for special inserts, fittings or closure pieces as recommended by the pipe manufacturer, without damaging the pipe or its coating and to leave the smooth end at right angles to axis of the pipe. Any exposed reinforcement shall be protected with non-shrink grout.

### Make watertight connections to maintenance holes in accordance with York Region Standard Drawings 02.38. Use non-shrink grout when suitable gaskets are not available.

### Use prefabricated saddles or field connections approved by the Consultant for connecting pipes to existing sewer pipes. Joints are to be structurally sound and watertight.

## **410.07.15 Breaking into Maintenance Holes, Catch Basins, Ditch Inlets, Pipe Culverts, and Pipe Sewers** is deleted and replaced with the following:

### Openings shall be made as necessary in an existing maintenance hole, catch basin, ditch inlet, pipe culvert, or pipe sewer to install the new pipe sewer and connect it to the structure according to Section 02631 – Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers. Benching in existing maintenance holes shall be altered to accommodate the flow in the new pipe sewer system.

### Connections to existing maintenance holes shall be paid for under Item [ ] Connections to Existing Sewers.

## **410.07.16 Field Testing**

### **410.07.16.01 General** is deleted and replaced with the following:

#### The Contractor shall submit a comprehensive Site-specific plan for the field testing of the sewer a minimum of twenty (20) Working Days in advance of undertaking any field testing. The Region and Consultant shall be provided a minimum of 2 Working Days advance notice to witness the field testing. The plan must be approved prior to commencement of testing.

#### Leakage tests shall be carried out on all completed pipe sewers. There shall be no visible leakage for pipe sewers. Any visible leakage must be sealed.

#### Pipe sewers shall be repaired and retested, as required, until the test results are within the limits specified in this specification. Visible leaks shall be repaired regardless of the test results.

#### No part of the work shall be accepted until the pipe sewers are satisfactorily tested following completion of installation of service connections and backfilling.

#### Repair or replace pipe, pipe joint or bedding found to be defective.

#### Remove foreign material from sewers and related appurtenances by flushing with water.

#### Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete.

#### Carry out the tests on each section of sewer between successive maintenance holes.

#### Install watertight bulkheads in a suitable manner to isolate the test section from the rest of the pipeline.

#### No allowance for leakage in excess of the calculated limits is allowed in any test section.

### **410.07.16.03 Infiltration Test** is deleted and replaced with the following:

#### Discontinue dewatering operations before test measurements are to commence. Do not perform the infiltration test until the groundwater table has recovered to 75% of the pre-construction level.

#### Conduct an infiltration test in lieu of an exfiltration test where the static ground water level is 600 mm or more above the top of the pipe measured at the highest point in the line to be used.

#### Do not interpolate a head greater than 600 mm to obtain an increase in the allowable infiltration rate.

#### Install a watertight plug at the upstream end of the pipeline test section.

#### Prevent damage to the pipe and bedding material due to flotation and erosion.

#### Place a 90 degree V-notch weir, or other measuring device approved by the Consultant, at the invert of the sewer at the downstream end of the test section.

#### Infiltrating water shall be allowed to build up behind the weir until the flow through the V-notch has stabilized.

#### Measure the rate of flow over a minimum of 1 hour, with recorded flows for each 15 minute interval.

#### Allowable infiltration shall be calculated as 0.0375 litres/millimetre diameter/100 metres of pipe sewer/hour.

### **410.07.16.04.02 Testing With Water** is amended by replacing the fourth paragraph with the following:

#### The Contractor shall make all arrangements to obtain water for the purpose of filling, hydrostatic testing, flushing, and de-chlorination for all portions of newly installed sewers. If water will be sourced from a local municipal fire hydrant, the Contractor shall be responsible for obtaining the required hydrant permit and paying for the water. If the Contractor will source water from a Regional watermain, they shall submit a work plan for any related alterations, modifications, installation of a meter and a CSA certified reduced pressure principle (RP) backflow preventer in accordance with CSA Standards B64.10 and B64.10.1. The Contractor shall arrange for field testing of the backflow preventer on the Site in accordance with CSA Standard B64.10 and B64.10.1 by a tester with an Ontario Water Works Association (OWWA) Certified Cross Connection Control Specialist Certificate or Ministry approved equivalent. Alternatively, a Certified Operator or a Water Quality Analyst with a backflow prevention tester’s license can be authorized to test, install, relocate, repair or replace backflow preventers.

#### The initial water meter values shall be reported to the Region upon installation of the backflow preventor and the final water meter values prior to removal.

#### The Contractor shall ensure that the backflow preventer certification is provided to the Region. The Contractor will be responsible for supplying all necessary equipment and plumbing including measures for temperature control and security to prevent tampering.

#### Prior to filling the sewer and starting testing, the Contractor shall request the Consultant to coordinate a preliminary inspection of the maintenance holes with the Region. The inspection will be conducted to confirm that the sewer, maintenance holes, benching, required cover and all appurtenances are installed correctly and in accordance with the Contract Drawings. Any deficiencies identified by the Region shall be corrected immediately. Filling and testing shall not commence until written approval is provided by the Region.

#### The leakage at the end of the test period shall not exceed the maximum allowable calculated for the test section. Allowable leakage shall be calculated as 0.0375 litres/millimetre diameter/100 meters of pipe sewer/hour.

### **410.07.16.04.03 Low Pressure Air Testing** is amended by the addition of the following:

#### For sewers 250mm and less, low pressure air testing is permitted. Low pressure air testing for sewers greater than 250mm is not permitted.

### **410.07.16.06 Closed-Circuit Television (CCTV) Inspection** is deleted and replaced with the following:

#### Pipe sewers shall be inspected using CCTV equipment. CCTV inspection of pipe sewers shall be according to Section 02935 – CCTV Inspection Requirements.

## **410.07.17 Cleaning and Flushing of Pipe Sewers** is amended by the addition of the following:

### All pipe sewers shall be cleaned and flushed immediately prior to inspection and acceptance.

## **410.07.18 Clay Seals** is deleted and replaced with the following:

### Height and spacing of trench plugs as per geotechnical recommendations, and in accordance with York Region Standard Drawing 02.75 as indicated on the Contract Drawings.

## **410.07.19 Concrete Appurtenances** is deleted and replaced with the following:

### Concrete appurtenances shall be constructed as specified in the Contract Drawings. Concrete in concrete appurtenances shall be placed according to Section 03300 – Cast in Place Concrete. Steel reinforcement shall be placed according to Section 03200 – Concrete Reinforcement. Steel grating shall be installed when specified in the Contract Documents.

## **410.07.21 Management of Excess Material** is deleted and replaced with the following:

### Dispose of safely, all chlorinated water from draining operations or used for testing and flushing.

### Neutralization shall be in conformance with AWWA C655.

### Do not discharge untreated chlorinated water into any storm sewer, drainage ditch, water course or sanitary sewer.

### Provide acceptable equipment and additives to neutralize any chlorinated water which is to be wasted. Residual chlorine in the discharge water must not exceed 0.02 mg/L. The Contractor shall monitor the chlorine residual of the discharged water in the presence of the Consultant. Contractor to ensure no excess de-chlorinating agent is added such that there is any impairment of the environment.

### Approved de-chlorinating agents are as follows:

#### Hydrogen Peroxide

#### Sulphur Dioxide

#### Sodium Sulphite

#### Sodium Metabisulphite

## **410.07.22 Confirm Continuity of Tracer Wire** is added:

### The Contractor shall retain the services of a Subterranean Utility Engineering (SUE) Subcontractor, or approved alternative, to confirm the continuity of all installed tracer wire from maintenance hole to maintenance hole or node point. This shall be done using electronic instruments made for this purpose. The Subcontractor shall follow the entire length of all radius gravity sanitary sewer pipe installed to ensure that tracer wire is intact and effective. The Subcontractor shall prepare a signed report stating its findings and conclusions, a copy of which shall be delivered to the Consultant prior to commissioning.

### Should the Subcontractor find breaks or faults in the continuity of the tracer wire, the Contractor shall do whatever is required to repair the breaks or faults, and to deliver a properly functioning system of tracer wire to the Region. After the repairs have been completed, the testing shall be repeated at no additional cost to the Region.

## **410.09 Measurement for Payment**

### This OPSS section is not used, refer to section 1.10 of this specification Section.

## **410.10 Basis of Payment**

### This OPSS section is not used, refer to section 1.11 of this specification Section.

**END OF SECTION**