



Ontario Provincial Standards Unit
301 St. Paul St., 2nd Floor North
St. Catharines, ON L2R 7R4

REVISION INFORMATION SHEET

ONTARIO PROVINCIAL STANDARDS FOR ROADS AND PUBLIC WORKS

VOLUME 5 PROVINCIAL-ORIENTED MTO GENERAL CONDITIONS OF CONTRACT AND GENERAL AND CONSTRUCTION SPECIFICATIONS

MANUAL REVISION #13

APRIL 2017

UPDATING ONTARIO PROVINCIAL STANDARDS FOR YOUR USE

Each roads and public works owner (Owner) is responsible for determining implementation dates and directions for use of Ontario Provincial Standards; therefore, manual holders are cautioned about immediately discarding superseded and cancelled standards.

ACCESSING AND OBTAINING ONTARIO PROVINCIAL STANDARDS

The Ontario Provincial Standards for Roads and Public Works (OPS) manuals and the latest published updates for each of the eight OPS manuals are available as follows:

- Available electronically on the OPS/MTO website. Online access to the current, updated, and archived standards; indexes; OPS User Notes; and publication Revision Information Sheets are available free of charge at the site.
(<http://www.raqs.mto.gov.on.ca/techpubs/ops/nsf/OPSHomepage>)
- The eight OPS manuals of standards are also available for free as well in a single PDF format on the website.

A link to the Ontario Provincial Standards on the MTO Library website is available on the OPS website (www.ops.on.ca). Also on this site under News and Activities are notices for updates and changes in OPS.

Questions should be directed by email to Ontario.Prov.Standards@ontario.ca

WAITING TO HEAR FROM YOU

If you have a suggestion to revise a standard or you have a standard that works in your ministry, municipality, or area, send it to the Head, OPS Administration, for review and possible inclusion into the Ontario Provincial Standards.

THIS MANUAL IS REVISED AS FOLLOWS:

Index Pages Volume 5

Remove the entire index and replace with the revised index.

Standard Specifications Volume 5

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.PROV	Dated	OPSS.PROV	Dated	
		106	Apr 2017	“GENERAL SPECIFICATION FOR ELECTRICAL WORK” See Summary of Revisions.
		127	Apr 2017	“SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT, INCLUDING MODEL AND SPECIFICATION REFERENCE” New PROV specification that replaces OPSS Common 127 April 2016. Rental rates and machinery details updated.
182	Nov 2015	182	Apr 2017	“GENERAL SPECIFICATION FOR ENVIRONMENTAL PROTECTION FOR CONSTRUCTION IN AND AROUND WATERBODIES AND ON WATERBODY BANKS” See Summary of Revisions.
185	Nov 2012			“GENERAL SPECIFICATION FOR TEMPORARY FLOW CONTROL FOR CONSTRUCTION IN WATERBODIES” This Specification is Cancelled, content added to OPSS.PROV 517, Nov 2016.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.PROV	Dated	OPSS.PROV	Dated	
		366	Apr 2017	“CONSTRUCTION SPECIFICATION FOR REPAIRING CONCRETE PAVEMENT AND CONCRETE BASE” New PROV Specification created from SSP399S43. Replaces OPSS Commons 360, 362 and 364.
402	Nov 2016	402	Apr 2017	“CONSTRUCTION SPECIFICATION FOR EXCAVATING, BACKFILING AND COMPACTING FOR MAINTENANCE HOLES, CATCH BASINS, DITCH INLETS AND VALVE CHAMBERS” Formatting update with no technical content changes.
403	Nov 2016	403	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ROCK EXCAVATION FOR PIPELINES, UTILITIES AND ASSOCIATED STRUCTURES IN OPEN CUT” Formatting update with no technical content changes.
441	Nov 2016	441	Apr 2017	“CONSTRUCTION SPECIFICATION FOR WATERMAIN INSTALLATION IN OPEN CUT” Formatting update with no technical content changes.
518	Nov 2016			“CONSTRUCTION SPECIFICATION FOR CONTROL FROM DEWATERING OPERATIONS” This Specification Cancelled. Content was added to OPSS.PROV 517, Nov 2016.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.PROV	Dated	OPSS.PROV	Dated	
		578	Apr 2017	“CONSTRUCTION SPECIFICATION FOR UNSHRINKABLE FILL” This is a New Specification.
		615	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ERECTION OF POLES” See Summary of Revisions.
		620	Apr 2017	“CONSTRUCTION SPECIFICATION FOR TRAFFIC SIGNAL EQUIPMENT” See Summary of Revisions.
		621	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ELECTRICAL TRAFFIC CONTROL DEVICES” This is a Reissued Specification based on September 1984 version of OPSS 621 updated with the contents of SSP621S01.
		622	Apr 2017	“CONSTRUCTION SPECIFICATION FOR INSTALLATION OF TRAFFIC SIGNAL CONTROLLERS” This is a Reissued Specification based on September 1993 version of OPSS 622 updated with the contents of SSP's 622F01 & 622F02.
		623	Apr 2017	“CONSTRUCTION SPECIFICATION FOR TRAFFIC ACTUATION EQUIPMENT” This is a Reissued Specification based on January 1990 version of OPSS 623 updated with the contents of SSP's 623S01 & 623S02.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.PROV	Dated	OPSS.PROV	Dated	
		810	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ROOTWAD STRUCTURES” See Summary of Revisions.
		811	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS” See Summary of Revisions.
		812	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LUNKERS” See Summary of Revisions.
		820	Apr 2017	“CONSTRUCTION SPECIFICATION FOR RIFFLES ON STREAMBEDS” See Summary of Revisions.
		821	Apr 2017	“CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS” Summary of Revisions.
		822	Apr 2017	“CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS” See Summary of Revisions.
		823	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LOW FLOW CHANNELS” See Summary of Revisions.
		824	Apr 2017	“CONSTRUCTION SPECIFICATION FOR BAFFLES IN A CULVERT” See Summary of Revisions.

Superseded/Cancelled (Remove)		Revised/New (Insert)		Remarks
OPSS.PROV	Dated	OPSS.PROV	Dated	
		830	Apr 2017	“CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK” See Summary of Revisions.
		918	Apr 2017	“CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS” See Summary of Revisions.

SUMMARY OF REVISIONS TO OPSS.PROV 106

GENERAL SPECIFICATION FOR ELECTRICAL WORK

- Section 106.02, References, updated.
- Subsection 106.07.03, Work to be Coordinated with Others, has been rewritten.
- Clause 106.07.04.05.01, General, first paragraph has been rewritten.
- Clause 106.07.10.01.02, Proof of Performance Testing and Inspection, updated.

SUMMARY OF REVISIONS TO OPSS.PROV 182

GENERAL SPECIFICATION FOR PROTECTION OF WATERBODIES AND WATERBODY BANKS

- Section 182.02, References, updated.
- Subsection 182.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsections 182.07.01, General; 182.07.04, Preservation of Riparian Vegetation; 182.07.06 Restoration of Disturbed Area and 182.07.08, Fish Protection revised.
- Subsections 182.07.03, Dewatering and Temporary Flow Control and 182.07.07 Contaminant and Spills Management added.
- Clause 182.07.08.01, Timing of In-Water Works added.
- Section 182.10, Basis of Payment, last paragraph removed.
- Table 1, revised.

SUMMARY OF REVISIONS TO OPSS.PROV 615

CONSTRUCTION SPECIFICATION FOR INSTALLATION OF POLES

- Title of specification changed
- Section 615.02, References, updated.
- Subsection 615.05.02, Steel Reinforcement, has been rewritten.
- Subsection 615.05.03, Poles, has been retitled and rewritten.
- Subsection 615.05.05, Pole Hardware and Accessories, has been rewritten.
- Subsection 615.07.07, Quality Control, has been rewritten.
- Table 1, Hardware and Accessories for Wood Pole Anchors in Rock, has been added.

SUMMARY OF REVISIONS TO OPSS.PROV 620

CONSTRUCTION SPECIFICATION FOR TRAFFIC SIGNAL EQUIPMENT

- Although OPSS.PROV is based on OPSS 620, a significant number of revisions have been made to the technical content. It is recommended that users read the entire specification to become familiar with the differences.

SUMMARY OF REVISIONS TO OPSS.PROV 810

CONSTRUCTION SPECIFICATION FOR ROOTWAD STRUCTURES

- Section 810.02, References, OPSS 517 added, Canadian and Provincial Statutes deleted.
- Subsection 810.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 810.07.04, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 811

CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS

- Section 811.02, References, OPSS 517 added, Canadian and Provincial Statutes deleted.
- Subsection 811.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 811.05.02, Backfill Stone revised.
- Subsection 811.07.04, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 812

CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS

- Section 812.02, References, OPSS 517 and OPSS 1005 added, Canadian and Provincial Statutes deleted.
- Subsection 812.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 812.05.03, retitled to Streambed Material and revised with addition of OPSS 1005.
- Clause 812.07.01.02, Stone Lunkers, base stabilizing stone and backfill stone replaced with streambed material.
- Subsection 812.07.03, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 820

CONSTRUCTION SPECIFICATION FOR RIFFLES ON STREAMBEDS

- Section 820.02, References, OPSS 517 added, Canadian and Provincial Statutes deleted.
- Subsection 820.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 820.07.02, retitled Streambed Excavation.
- Subsection 820.07.03, Streambed Materials, revised.
- Subsection 820.07.06, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 821

CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS

- Section 821.02, References, OPSS 517 added, Canadian and Provincial Statutes deleted.
- Subsection 821.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 821.07.02, retitled Pool Excavation.
- Subsection 821.07.03, Streambed Materials, revised.
- Subsection 821.07.05, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 822

CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS

- Section 822.02, References, OPSS 517 added, Canadian and Provincial Statutes deleted.
- Subsection 822.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 822.07.03, retitled Streambed Excavation.
- Subsection 822.07.06, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 823

CONSTRUCTION SPECIFICATION FOR LOW FLOW CHANNELS

- Section 823.02, References, OPSS 517 added, Canadian and Provincial Statues deleted.
- Subsection 823.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 823.07.04, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 824

CONSTRUCTION SPECIFICATION FOR BAFFLES IN A CULVERT

- Section 824.02, References, OPSS 517 added, Canadian and Provincial Statues deleted.
- Subsection 824.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsection 824.07.04, retitled to Dewatering and Temporary Flow Control and revised with the addition of the reference to OPSS 517.

SUMMARY OF REVISIONS TO OPSS.PROV 830

CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK

- Section 830.01, Scope, rewritten.
- Section 830.02, References, OPSS 804, OPSS 805 and Ontario Provincial Legislation added.
- Subsection 830.03, Definitions, has been rewritten for consistency with other MTO fishery related documentation.
- Subsections 830.07.01, 830.07.02 and 830.07.03 retitled and rewritten.

SUMMARY OF REVISIONS TO OPSS.PROV 918

CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS

- OPSS 918 has been revised extensively. It is recommended that users read the entire specification, as there are major differences between this version of the specification and previous versions.

MANUAL REVISION RECORD

Provincial-Oriented

Volume 5 – MTO General Conditions of Contract and General & Construction Specifications

This record should remain in the manual at all times. Revisions are numbered sequentially. This sheet should be filled in after each revision has been placed into the manual. It will quickly indicate to users whether the contents of the manual are up-to-date.

REVISION NUMBER	REVISION DATE	ENTERED BY	REVISION NUMBER	DATE	ENTERED BY
1	APRIL 2008	Included in new manuals	27		
2	NOV 2008	Included in new manuals	28		
3	APR 2010	Included in new manuals	29		
4	NOV 2010	Included in new manuals	30		
5	APR 2012	Included in new manuals	31		
6	NOV 2012	Included in new manuals	32		
7	NOV 2013	Included in new manuals	33		
8	NOV 2014	Included in new manuals	34		
9	APRIL 2015	Included in new manuals	35		
10	NOV 2015	Included in new manuals	36		
11	APRIL 2016	Included in new manuals	37		
12	NOV 2016	Included in new manuals	38		
13	APRIL 2017	Included in new manuals	39		
14			40		
15			41		
16			42		
17			43		
18			44		
19			45		
20			46		
21			47		
22			48		
23			49		
24			50		
25			51		
26			52		



DATE	SPEC. NO. OPSS.PROV	TITLE
MTO GENERAL CONDITIONS OF CONTRACT		
NOV 2016	100	MTO General Conditions of Contract
DIVISION 1 - GENERAL SPECIFICATIONS		
APR 2017	106	General Specification For Electrical Work
NOV 2014	120	The Use of Explosives
APR 2017	127	Schedule of Rental Rates for Construction Equipment, Including Model and Specification Reference
NOV 2016	180	General Specification for The Management of Excess Materials
APR 2017	182	General Specification For Environmental Protection for Construction in and Around Waterbodies and on Waterbody Banks
DIVISION 2 - GENERAL GRADING		
NOV 2013	202	Rock Removal by Manual Scaling, Machine Scaling, Trim Blasting, or Controlled Blasting
NOV 2014	203	Rock Stabilization
NOV 2014	206	Grading
NOV 2014	209	Embankments Over Swamps and Compressible Soils
NOV 2013	212	Earth Borrow
NOV 2014	220	Wick Drain Installation
DIVISION 3 - PAVEMENT (FLEXIBLE AND RIGID)		
NOV 2016	304	Single and Double Surface treatment
NOV 2016	305	Granular Sealing
APR 2012	308	Tack Coating and Joint Painting
NOV 2016	313	Hot Mix Asphalt - End Result
NOV 2015	314	Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling
APR 2016	320	Open Graded Drainage Layer



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

VOLUME 5 INDEX

**PROVINCIAL-ORIENTED
MTO GENERAL CONDITIONS OF CONTRACT AND
GENERAL & CONSTRUCTION SPECIFICATIONS**

DATE	SPEC. NO. OPSS.PROV	TITLE
NOV 2014	330	In-Place Full Depth Reclamation of Bituminous Pavement and Underlying Granular
NOV 2015	331	Full Depth Reclamation with Expanded Asphalt Stabilization
NOV 2016	332	Hot In-Place recycling and Hot In-Place recycling With Integral Overlay
NOV 2015	333	Cold In-Place Recycling
NOV 2015	335	Cold In-Place Recycling with Expanded Asphalt
NOV 2015	342	Grinding of Centreline and Shoulder Rumble Strips in Asphalt
NOV 2014	355	Installation of Interlocking Concrete Pavers
NOV 2014	363	Repairing Rigid Pavement with Precast Concrete Slabs
NOV 2014	365	Cross-Stitching Longitudinal Cracks in Concrete Pavement and Concrete Base
APR 2017	366	Repairing Concrete Pavement and Concrete Base

DIVISION 4 - DRAINAGE, WATERMAINS, AND UTILITY

NOV 2015	401	Trenching, Backfilling, and Compacting
APR 2017	402	Excavating, Backfilling and Compacting For Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
APR 2017	403	Rock Excavation For Pipelines, Utilities and Associated Structures in Open Cut
NOV 2015	410	Pipe Sewer Installation in Open Cut
NOV 2015	421	Pipe Culvert Installation in Open Cut
APR 2017	441	Watermain Installation In Open Cut



DATE	SPEC. NO. OPSS.PROV	TITLE
DIVISION 5 - MISCELLANEOUS		
NOV 2014	501	Compacting
NOV 2014	510	Removal
NOV 2014	512	Installation of Gabions
NOV 2016	517	Dewatering
NOV 2014	539	Temporary Protection Systems
APR 2017	578	Unshrinkable Fill
DIVISION 6 – ELECTRICAL		
NOV 2016	610	Removal of Electrical Equipment and Materials
APR 2017	615	Erection of Poles
APR 2017	620	Traffic Signal Equipment
APR 2017	621	Electrical Traffic Control Devices
APR 2017	622	Installation of traffic Signal Controllers
APR 2017	623	Traffic Actuation Equipment
NOV 2016	630	Installation of Sectional Steel High Mast lighting Poles
DIVISION 7 - TRAFFIC SAFETY		
NOV 2016	706	Temporary Traffic Control Devices
NOV 2016	708	Portable Temporary Traffic Signals
NOV 2015	721	Steel Beam Guide Rail and Cable Guide Rail
NOV 2015	723	Energy Attenuators
APR 2016	732	Guide Rail End Treatment - Steel Beam Energy Attenuating Terminal Systems
NOV 2014	771	Standard Highway Fence



DATE	SPEC. NO. OPSS.PROV	TITLE
DIVISION 8 - ENVIRONMENTAL AND LANDSCAPE		
NOV 2014	804	Seed and Cover
APR 2017	810	Rootwad Structures
APR 2017	811	Large Woody Debris
APR 2017	812	Lunkers
APR 2017	820	Riffles On Streambeds
APR 2017	821	Pools In Streambeds
APR 2017	822	Rocky Ramps On Streambeds
APR 2017	823	Low Flow Channels
APR 2017	824	Baffles In A Culvert
APR 2017	830	Local Seed Bank
DIVISION 9 – STRUCTURAL		
APR 2016	903	Deep Foundations
NOV 2014	905	Steel Reinforcement for Concrete
NOV 2014	908	Metal Traffic Barriers and Metal Railings for Structures
NOV 2016	909	Pre-stressed Concrete – Precast Girders
APR 2008	910	Stressing Systems for Post-Tensioning
NOV 2014	911	Coating Structural Steel Systems
NOV 2014	914	Waterproofing Bridge Decks with Applied Asphalt Membrane
NOV 2014	915	Sign Support Structures
APR 2017	918	Modular Bridge Structures For Temporary Installations
NOV 2016	920	Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops – Structures



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

VOLUME 5 INDEX

**PROVINCIAL-ORIENTED
MTO GENERAL CONDITIONS OF CONTRACT AND
GENERAL & CONSTRUCTION SPECIFICATIONS**

DATE	SPEC. NO. OPSS.PROV	TITLE
NOV 2016	922	Installation of Bearings
APR 2012	928	Structure Rehabilitation - Concrete Removal
NOV 2014	930	Structure Rehabilitation - Concrete Patches, Refacing, and Overlays
NOV 2014	935	Impressed Current Cathodic Protection System for Bridge Structures



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

VOLUME 5 INDEX

**PROVINCIAL-ORIENTED
MTO GENERAL CONDITIONS OF CONTRACT AND
GENERAL & CONSTRUCTION SPECIFICATIONS**



GENERAL SPECIFICATION FOR ELECTRICAL WORK

TABLE OF CONTENTS

106.01	SCOPE
106.02	REFERENCES
106.03	DEFINITIONS
106.04	DESIGN AND SUBMISSION REQUIREMENTS
106.05	MATERIALS
106.06	EQUIPMENT - Not Used
106.07	CONSTRUCTION
106.08	QUALITY ASSURANCE
106.09	MEASUREMENT FOR PAYMENT - Not Used
106.10	BASIS OF PAYMENT
APPENDICES	Not Used

106.01 SCOPE

This specification covers the general requirements for electrical work and is applicable to all electrical work in the Contract.

106.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

106.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

106.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 609	Grounding
OPSS 611	Installation of Underpass Luminaires
OPSS 614	Installation of Power Supply Equipment
OPSS 617	Installation of Roadway Luminaires
OPSS 620	Traffic Signal Equipment
OPSS 621	Electrical Traffic Control Devices
OPSS 622	Installation of Traffic Signal Controllers
OPSS 623	Traffic Actuation Equipment
OPSS 630	Installation of Sectional Steel High Mast Lighting Poles

Ontario Ministry of Transportation Publications

Electrical Engineering Manual, Volume 2, Electrical Maintenance

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

For the purpose of this specification, definitions in the Ontario Electrical Safety Code and the following definitions apply:

Cable means a solid or stranded, bare or insulated metal conductor (wire) or group of conductors enclosed in a common jacket or twisted to form a group.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

Down Time means the time during which an electrical system is de-energized or not under full operation.

Duct means a circular pipe or conduit for the mechanical protection of cables.

Electrical Chamber means a chamber for placing and maintaining conductors, cables, ducts, or electrical equipment. A general name for electrical maintenance holes and handholes.

Electrical Maintenance Hole means a subsurface chamber large enough for a person to enter that allows facilities for placing and maintaining underground conductors, cables, and associated apparatus.

Electrical Work means any work associated with the installation, modification, removal, inspection, or testing of electrical system components, including work required for all auxiliary concrete, mechanical, metallic, or non-electrical components required for the work.

Electrician means a person in possession of a certificate of qualification for the trade of Electrician, Construction and Maintenance, 309A or 309D, issued by the Ministry of Training, Colleges and Universities, Ontario.

Emergency Maintenance or Emergency Repairs means an activity required to repair unexpected failure of electrical equipment components that requires immediate action and takes precedence over routine maintenance activities for the duration of the emergency.

Energized means electrically live.

ESA means Electrical Safety Authority.

High Mast Lighting Equipment means high mast poles complete with luminaire raising and lowering devices consisting of ring assemblies complete with tenon arms, shrouds, external or internal drive mechanisms, and pole anchorage assemblies.

Highway Lighting System means a system of luminaires, poles, sign luminaires, underpass illumination, cables, power supply equipment, control system, and all associated materials required to provide illumination on a highway, roadway, or associated appurtenances.

IMSA means International Municipal Signal Association.

Luminaire means a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

Nighttime means the time during which the ambient natural horizontal illuminance at ground level is less than 15 lux.

Non-Routine Maintenance means any activity, other than routine maintenance activities, required to bring the electrical systems to full functionality according to standards.

Pad means a concrete footing with a level surface used to mount electrical equipment or for a temporary installation that could be made of wood.

Power Supply Equipment means electrical equipment installed to provide a source of power for electrical systems and includes transformation, switching, and control equipment.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Record Drawings means drawings illustrating constructed deviations from the original Contract Drawings in hard copy and scanned digital copy. Authorized deviations from the original Contract Drawings are marked up in red on one set of Contract Drawing prints in a neat legible manner.

Routine Maintenance means ongoing preventive maintenance activities according to the manufacturer's recommendations and the Owner's maintenance standards and includes the periodic adjustment of the electrical system components to correct deviations from the system specifications resulting from normal operation of the system.

Service Manuals means the full literature, drawings, directives, instructions, and procedures issued by the supplier or manufacturer of any system component for the purposes of assembly, installation, operation, preventive maintenance, or emergency maintenance of the system component.

Signalized Intersection means an intersection or junction of roadways or crosswalks or both where the vehicular and pedestrian traffic is controlled by a traffic signal system.

Switchover means the act of closing down an electrical system and bringing a new or modified electrical system into operation.

System Components means all hardware and software components, devices, parts, and materials included in the electrical work supplied and installed under a Contract, including all spare parts supplied by the Contractor.

Temporary means work that is done to serve a specific function and removed on the same Contract as it was placed.

Traffic Signal System means a system of traffic signal equipment, poles, traffic signal controllers, traffic signal actuation and interconnection equipment, and all associated materials required to regulate vehicular and pedestrian traffic.

Underpass Illumination means any work required for the installation of luminaires on the ceilings, walls, beams, abutments, or piers of a bridge or retaining walls.

106.04 DESIGN AND SUBMISSION REQUIREMENTS

106.04.01 Submission Requirements

106.04.01.01 Electrical Equipment Working Drawings

Working Drawings for the following electrical equipment are required:

- a) Luminaires
- b) High-voltage switches and fuses

- c) Transformers
- d) Distribution assemblies
- e) Supply control cabinet assemblies
- f) Traffic signal control cabinet assemblies
- g) Anchorage assemblies
- h) High mast lighting equipment (i.e., poles, and raising and lowering equipment)
- i) High mast luminaires
- j) Advanced traffic management systems (ATMS) equipment
- k) Traffic data collection systems equipment
- l) Roadway weather information systems equipment

Working Drawings for luminaires shall consist of manufacturer's catalogue information and photometric data. Working Drawings for all other items shall include all information required in the Contract Documents.

Working Drawings for all items shall include all information required in the applicable Owner's material specification.

Materials and dimensions shown on the final Working Drawings shall not be changed without approval of the Contract Administrator. Resubmission of Working Drawings showing any changes to the final Working Drawings is required.

106.05 MATERIALS

All similar electrical materials, equipment, components, or completed assemblies of components shall be approved according to the Ontario Electrical Safety Code.

106.07 CONSTRUCTION

106.07.01 Qualification of Workers

106.07.01.01 Contractor's Representative

A representative, who is experienced in the electrical work to be performed, shall be appointed to represent the Contractor.

The Contractor's representative shall attend such meetings required by the Owner to coordinate services affected by the Contract.

106.07.01.02 Contractor's Workers

The Contractor or electrical subcontractor shall be a licensed electrical contractor according to the Electricity Act and shall use workers qualified to do the electrical work according to the following:

- a) All electrical and advanced traffic management system work shall be performed by or under the direct personal supervision of an electrician.
- b) Traffic signal and traffic signal control equipment installation, inspection, and testing shall be performed by an electrician who has successfully completed one of the following:
 - i. Levels 1 and 2 of the IMSA Traffic Signal Technician Certification Program
 - ii. Ministry of Transportation's (MTO) 170 Training Course and 170 Advanced Training Course
 - iii. 170-332 IMSA/MTO Certification Program
- c) All high mast lighting installation, inspection, and testing shall be performed by an electrician who has successfully completed training from the manufacturer(s).
- d) All locates for electrical systems and advanced traffic management systems shall be performed by a licenced electrician who has successfully completed cable locate training.
- e) All electrical testing and inspection work shall be performed by an electrician.

The Contract Administrator may request at any time that the Contractor provide proof that the individual performing or supervising the electrical work is an electrician. If such a person is not present, the Contract Administrator may direct the Contractor to cease all electrical work until an electrician, with proof of such, is on site to perform or supervise the electrical work.

106.07.01.03 High-Voltage Work

High-voltage work shall be performed by qualified personnel.

106.07.02 Work to be Inspected by Electrical Safety Authority

All electrical work is subject to inspection by the ESA. The Contractor shall perform all work associated with inspection or re-inspection by the ESA. This work includes, but is not limited to the following:

- a) Arranging and coordinating all visits to the construction site by the ESA's inspectors.
- b) Correcting all defects identified by the ESA.
- c) Submitting all applications for inspection.
- d) Obtaining all permits.
- e) Obtaining all certificates.
- f) Obtaining all connection authorizations from the ESA.
- g) Payment of fees.
- h) Performing any other work that may be required under the Ontario Electrical Safety Code.

106.07.03 Work to be Coordinated with Others

MTO is not a member of Ontario One Call and Ontario One Call shall not be relied upon to provide any information regarding the ministry's electrical systems and advanced traffic management systems.

The Contractor shall coordinate for the following work:

- a) Electrical power supply connection and disconnection by the electrical power supply authority.

- b) Communication connection and disconnection by the communication provider(s).
- c) Mounting of any electrical equipment on a pole or any structure owned by or under the jurisdiction of a Utility authority.
- d) Mounting of any electrical equipment in close proximity to or requiring modification of any plant owned by a Utility authority, private person, or other company.

The Contractor shall notify the Contract Administrator in writing at least 15 Business Days prior to commencing the above work. A detailed breakdown of the required Utility work and the corresponding Utility cost to complete the work, along with a Utility authority contact name, address, and telephone number, shall be provided to the Contract Administrator.

Utility authority invoices for the above work shall be forwarded to the Contract Administrator.

Obtaining all connection authorizations and layouts shall be completed by the Contractor.

The Contractor shall provide 2 copies of all Utility service layouts to the Contract Administrator.

The Contract Administrator and the Owner's electrical coordinator shall be notified a minimum of 72 hours in advance of all service layout meetings with an electrical power supply authority. The Contractor shall obtain electrical power supply billing account details from the Contract Administrator and provide them to the electrical power supply authority.

The Contractor shall locate all of the electrical systems and advanced traffic management systems within the limits of the Contract. The Contractor shall complete all locates on the Owner's electrical systems and advanced traffic management systems required for the Contractor to do the Work. The Contractor shall not rely on the Owner to complete the locates.

106.07.04 Traffic Signal Systems

106.07.04.01 General

Testing of signal displays and switch on for operation of traffic signals shall be under police supervision. Switch on and switchover for operation is not permitted on Mondays, Fridays, Saturdays, Sundays, and statutory holidays.

106.07.04.02 Existing Traffic Signal Systems

Except when the Contract requires modifications to existing traffic signal systems, the Contractor shall perform the operations with the existing traffic signal systems undisturbed and fully operational. When traffic signal systems are to be installed and the existing traffic signal system is to be removed or modified, the new traffic signal system shall be installed independently of the existing system such that short duration switchover from one system to the other is effected without appreciable down time.

106.07.04.03 New Traffic Signal Systems Activation

A new traffic signal system at a location not previously signalized shall be initially switched on for operation according to the following requirements:

- a) For the testing of circuitry and components, operation of the system shall take place with signal head covers in place.

- b) The Contract Administrator shall be given a minimum of 5 Days notice of when the system shall be ready for operation and 24 hours notice prior to completion of the work. Confirmation is to be given that the work shall be done as scheduled.
- c) The Contractor shall complete all preliminary system testing as specified in the Contract Documents and all repairs or replacement of defective components prior to final energizing.

106.07.04.04 Traffic Signal Systems Switchover

A new traffic signal system installed to replace an existing traffic signal system shall be initially switched on for operation according to the following requirements:

- a) The Contract Administrator shall be given a minimum of 3 Days notice of when the system switchover shall be done and 24 hours notice prior to completion of the work. Confirmation is to be given that the work shall be done as scheduled.
- b) All preliminary system testing shall be completed as specified in the Contract Documents and all adjustments or replacement of defective electrical equipment in the new system completed prior to system switchover.
- c) For the testing of circuitry and components, operation of the new signal system shall take place with the covers for the new signal head in place and the existing signal system operational.
- d) Signal heads of the existing traffic signal system shall be covered and covers shall be removed from the new signal heads with both systems de-energized. Traffic shall be under police supervision during this operation.

106.07.04.05 Maintenance of Traffic Signal Systems

106.07.04.05.01 General

All routine, non-routine, and emergency maintenance work shall be performed as required on all traffic signal systems for public use within the limits of the Contract.

The initial traffic signal timing shall be programmed into the traffic signal controller as directed by the Contract Administrator up to a maximum of four times. The traffic signal controller shall be set up by performing all programming, setting all timing controls and switch settings, and setting any other controller operational parameters obtained from the Contract Administrator. The Contractor shall verify to his own satisfaction that the revised signal timing is consistent and complete.

At any time during the Contract, the Contract Administrator reserves the right to review the timing and operations of the traffic signal system and the Contractor shall implement any changes to the operation settings and timings requested by the Contract Administrator.

All traffic signal system components shall be maintained in good working condition according to the Contract Documents and all routine maintenance and emergency repairs shall be provided as required.

On call local emergency repair service shall be provided 24-7 for the duration of the Contract, including seasonal shutdown. Emergency repairs shall be required whenever there is a failure or cessation of the operation of any component or components of the traffic signal system.

Each time emergency repair work is performed on a traffic signal system, the Contractor shall notify the Contract Administrator within 72 hours of the completion of the emergency repair work.

Any traffic signal timing not included in the original Contract Documents shall be approved by the Owner before it is installed in a traffic signal controller.

Routine, non-routine, and emergency maintenance shall be according to the manufacturers' recommendations and the Electrical Engineering Manual, Volume 2.

106.07.04.05.02 Notification and Record Keeping - Traffic Signal Systems

The Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Contract Administrator. The Contract Administrator shall designate representatives and alternates as contact persons for the Owner.

A logbook shall be maintained and kept in the traffic signal field cabinet or at a location agreed upon with the Owner. The logbook shall record any fieldwork performed on the traffic signal system, including the replacement of any hardware, changes to the software, or changes to the configuration, phasing, or timing parameters. The time and date of each entry in the logbook shall be signed by the individual making the entry.

106.07.04.06 Traffic Signal Activation Meeting

A minimum of 48 hours prior to the planned activation of each set of traffic signals, the Contractor shall coordinate and attend an on-site quality control meeting with the Contract Administrator. As a minimum, the following individuals shall be in attendance at the meeting:

- a) Contractor's on-site representative
- b) Pavement marking sub-contractor representative
- c) Electrical sub-contractor representative
- d) Electrical Quality Verification Engineer
- e) Contract Administrator
- f) Contract Administrator's electrical inspection staff
- g) Contractor's person responsible for traffic control and highway work zone safety
- h) Owner's electrical coordinator, traffic representative, and electrical quality assurance representative

The purpose of this meeting is to ensure that the Contractor clarifies the roles and responsibilities of all parties involved in the traffic signal activation, that all advanced work is complete, and to confirm that all required arrangements have been made in order to ensure that the activation proceeds smoothly and expeditiously. The Contractor shall prepare the agenda for the meeting and record the minutes to be distributed to all attendees.

As a minimum agenda, the following shall be addressed:

- a) General
 - i. Confirm the name and position of the person responsible for coordinating traffic control during the signal activation.
 - ii. Confirm that arrangements have been made with the appropriate police authority to provide traffic control.
 - iii. Confirm that all the work has been constructed as specified in the Contract Documents and is in accordance with the signed legal drawing (PHM-125). Any deficiencies shall be brought to the attention of the Contract Administrator.
 - iv. Confirm the date and time of the traffic signal activation.

b) Pavement Marking

- i. Confirm the name and position of the person responsible on site for carrying out the pavement markings.
- ii. Confirm that the pavement markings have been pre-marked as specified in the Contract Documents and are according to the signed legal drawing (PHM-125).
- iii. Review the Contract Drawings for the pavement markings that shall be in place on the day of signal activation.

c) Electrical

- i. Confirm that the Contract Administrator shall be in receipt of all Quality Verification Engineer certificates of conformance immediately following the activation of the signals.
- ii. Confirm that all vehicle detection is positioned as required and functioning correctly.

106.07.05 Maintenance of Highway Lighting Systems

106.07.05.01 General

All routine, non-routine, and emergency maintenance work shall be performed on all highway lighting systems for public use within the limits of the Contract, until the issuance of the Contract Completion Certificate by the Contract Administrator.

The Contractor shall maintain all lighting systems located within the limits of the Contract in full nighttime operation. The Contractor shall perform all routine, non-routine, and emergency maintenance work required to maintain the lighting systems. Suitable combinations of existing, temporary, or new lighting systems may be used to achieve the required performance, safety, and reliability of the lighting system. The Contractor shall provide routine, non-routine, and emergency maintenance service during seasonal shutdown. Routine, non-routine, and emergency maintenance work shall be according to the Electrical Engineering Manual, Volume 2.

106.07.05.02 Notification and Record Keeping - Highway Lighting Systems

The Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Contract Administrator. The Contract Administrator shall designate representatives and alternates as contact persons for the Owner.

A logbook shall be maintained and kept in the highway lighting system field cabinet or at a location agreed upon with the Owner. The logbook shall record any fieldwork performed on the highway lighting system, including the replacement of any hardware, changes to the software, or changes to the configuration, phasing, or timing parameters. The time and date of each entry in the logbook shall be signed by the individual making the entry.

106.07.06 Temporary Electrical Work

All temporary electrical work specified in the Contract Documents shall be installed and made ready for operation prior to opening the associated traffic lanes or sidewalks that the work is intended to serve.

106.07.07 Layout of Electrical Equipment

All equipment shall be installed at locations detailed in the Contract Documents.

Layout for stations and offsets of concrete pads and footings, electrical chambers, and poles shall not exceed a tolerance of ± 100 mm.

The Contractor shall ensure there are no Utility conflicts, both overhead and underground, with any pole locations prior to starting any excavation or pole installation work. Underground ducts and cables shall not be located within 600 mm of guide rail.

106.07.08 Adjustment of Electrical Equipment

All luminaires, traffic signal heads, optical lens assemblies, photoelectric controllers, and other devices shall be adjusted according to the Contract Documents. Luminaires shall be adjusted under nighttime operational conditions and in the presence of the Contract Administrator.

106.07.09 Open Excavations

Excavations within 4.0 m of the edge of travelled roadway shall not be left open overnight.

106.07.10 Quality Control

106.07.10.01 General

Tests and inspections on electrical equipment shall be according to the appropriate specifications covering the work.

The Contractor is responsible for all pre-installation and proof of performance testing and inspections for electrical work. Each time the Contractor is to perform an inspection or test, the Contract Administrator shall be notified 48 hours prior to commencing the inspection or test.

106.07.10.01.01 Pre-Installation Testing and Inspection

Pre-installation testing and inspection of electrical work shall include all testing and inspection of system components, including testing of mock-ups, prototype testing, and normal factory production testing undertaken on behalf of the Contractor prior to the installation of such components.

106.07.10.01.02 Proof of Performance Testing and Inspection

Proof of performance testing and inspection of electrical work shall include all testing and inspection of system component installations into the work in order to verify the physical and operational features of each part of the system components and electrical subsystems.

The Quality Verification Engineer shall witness the inspection, testing, and test results for the following electrical work according to the appropriate specification prior to issuing a Certificate of Conformance:

- a) Installation of power supply equipment according to OPSS 614
- b) Traffic signal equipment according to OPSS 620
- c) Installation of high mast lighting poles according to OPSS 630

When issuing the Certificate of Conformance for the above work, the Quality Verification Engineer shall also certify that he or she has witnessed the inspection, testing, and test results for such electrical work.

106.07.10.02 High-Voltage System Testing

All high-voltage cable and electrical equipment shall be tested according to the Contract Documents.

One copy of test results and one copy of the cable and electrical equipment manufacturer's test report shall be submitted to the Contract Administrator.

106.07.11 Documentation

106.07.11.01 General

Documentation, including Working Drawings, catalogue sheets, calculations, drawings, diagrams, test print-outs, photographs, manufacturer's instructions, service manuals, and text shall be provided by the Contractor to a level of detail such that it assures the Contract Administrator that the system components that the Contractor is furnishing are according to the requirements of the Contract Documents. The documentation shall also be used to provide records for future operational and maintenance activities.

The Contractor shall submit, as part of the service manuals, a dated and signed form of inspection of each item of work.

106.07.11.02 Test Results and Inspection Reports

Test results and inspection reports, including any required verifications and certifications from the Quality Verification Engineer, shall be submitted to the Contract Administrator. Inspection reports shall include the completed checklist and any material observations made at the time of the inspection.

The documentation shall include the method of testing and inspecting of each item. The method of testing and inspecting shall ensure that the functional, physical, and environmental aspects of the contract specifications are demonstrated.

The documentation shall include all quantitative information generated as part of the testing and inspecting work, including meter readings, screen displays, charts, and any other numerical or graphical data.

The documentation shall include all applicable verifications and certifications from the Quality Verification Engineer. The documentation shall present the results of all tests and inspections in a format that is logical and easily understood.

Test results and inspection reports shall be submitted to the Contract Administrator within 48 hours of completion of the inspection or test detailing:

- a) The installation and operation of the system components on an item-by-item basis.
- b) Clear detailed illustrations, including control layouts, displays, schematic diagrams, and all other information, required to correctly operate a fully functional unit as well as the maintenance and service aspects of the system components.
- c) The model number, suggested and actual settings, and options as installed and configured for each piece of electrical equipment.
- d) Sections that completely describe the theory of operation using block diagrams and schematic drawings.
- e) Diagnostic and repair procedures for corrective maintenance of the unit, assembly and disassembly instructions and drawings, layout drawings showing location of all components, and complete components listing showing component type, ratings, cost, and acceptable manufacturers. Complete schematic diagrams to the component level.
- f) Fully described adjustments and alignment procedures and provide descriptions of expected signals at all test points and outputs.
- g) The specifications of system components performance.

106.07.11.03**Service Manuals**

Each service manual shall be assembled in 3-ring binders of 75 mm maximum thickness and shall be indexed item by item. Several items may be covered in a single binder. The manual shall document in detail the installation and operation of the system components on an item-by-item basis. It shall contain clear detailed illustrations, including layout of controls, displays, schematic diagrams, and all other information required to correctly operate a fully functional unit as well as the maintenance and service aspects of the system components. The model numbers, with installed options and installed settings shall be clearly shown.

The manual shall provide sections that completely describe the theory of operation using block diagrams and schematic drawings. The manual shall include diagnostic and repair procedures for corrective maintenance of the unit; assembly and disassembly instructions and drawings; layout drawings showing location of all components; and complete components listing showing component type, ratings, cost, and acceptable manufacturers. Complete schematic diagrams to the component level shall be provided. The manual shall fully describe all adjustments and alignment procedures and provide descriptions of expected signals at all test points and outputs. Detailed specifications of the performance of system components shall be provided.

The Contractor is responsible for generating the required documentation in the event that it is not available from the manufacturer.

The manual shall detail, at the system engineering level, the procedures for installation of software on a given computer system. The manual shall also address the operation of the software at three different levels: beginner (trainee), intermediate (operator), and advanced (systems engineer).

106.07.11.04**Submission of Documentation**

The Contractor shall provide the following:

- a) Three copies of all documentation required under the Documentation subsection.
- b) Three copies of the Working Drawings and service manuals for the items specified in Table 1.
- c) Three sets of record drawings to the Contract Administrator at the completion of the Contract. All deviations and design changes from the original design shall be marked accurately on the record drawings printed in red along with any required explanatory notes. The location of the underground facilities on the record drawings shall be drawn accurately and correctly with stations, offsets and tie down points.
- d) Three copies of any documents and drawings that are resubmitted.

106.07.11.05**Quality of Documentation**

The documentation shall be of professional quality, including machine- or hand-printed text, inked or CAD produced drawings, and photographic material, if applicable.

106.07.12**Restoration**

The site of all electrical works shall be restored to original or better condition than existed prior to the works or as specified in the Contract Documents.

106.07.13**Management of Excess Material**

Management of excess material shall be according to the Contract Documents.

106.08 QUALITY ASSURANCE

Electrical equipment requiring the submission of Working Drawings, as detailed in the Design and Submission Requirements section is subject to inspection by the Owner's representative prior to shipping of the electrical equipment. The inspection shall take place at the manufacturer's factory or at the supplier's place of business. The Owner's representative shall be informed when the electrical equipment fabrication is approximately 80% and 100% complete and suitable arrangements shall be made for any required inspection.

All electrical work is subject to random inspection by the Owner's representative. The Owner's representative may witness any testing performed by the Contractor.

Upon notification, any Owner's representative (e.g., electrical coordinator, quality assurance representative) shall have access to the working area for the purpose of inspection and testing of electrical installations.

106.10 BASIS OF PAYMENT

Payment at the Contract price for the tender items that require general electrical work shall be full compensation for all labour, Equipment, and Material to do the general electrical work.

When the Contract contains separate tender items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

106.10.01 Contractor's Workers

When the Contract Administrator directs the removal of staff or the cessation of electrical work, no extra payment shall be made by the Owner for any costs incurred by the Contractor as a result of such direction.

106.10.02 Work to be Inspected by Electrical Safety Authority

The work resulting from the inspection or re-inspection of electrical work by the ESA, except for correcting defects that are the direct result of compliance with the Owner's design of the work, shall be at no extra cost to the Owner.

106.10.03 Traffic Signal Systems

The activation of traffic signals, including police supervision, shall be at no extra cost to the Owner.

106.10.04 Maintenance Costs

When the Owner performs maintenance work resulting from inadequate workmanship on systems installed by the Contractor or defective materials supplied by the Contractor, the actual costs of the maintenance work shall be charged to the Contractor.

106.10.05 Temporary Work

Payment for temporary items shall be made at the rate of 80% of the Contract price upon acceptance of the installation, and the remaining 20% of the Contract price shall be paid upon acceptance of the removal work.

TABLE 1
Submission Requirements for Working Drawings and Service Manuals

Item	Submission Requirements	
	Working Drawings	Service Manuals
Luminaires	Y	Y
High-voltage switches and fuses	Y	-
Transformers	Y	-
Distribution assemblies	Y	Y
Supply control cabinet assemblies	Y	Y
Traffic signal control cabinet assembly	Y	Y
Anchorage assemblies	Y	-
High mast lighting equipment (i.e., poles, raising and lowering equipment)	Y	Y
High mast luminaires	Y	Y
Advanced traffic management systems equipment	Y	Y
Traffic data collection systems equipment	Y	Y
Roadway weather information systems equipment	Y	Y
Traffic signal controllers	-	Y
Flasher mechanisms	-	Y
Conflict monitors	-	Y
Load switches	-	Y
Loop detectors	-	Y
DC isolators	-	Y
AC isolators	-	Y
Thermostat panel	-	Y



**SCHEDULE OF RENTAL RATES FOR
CONSTRUCTION EQUIPMENT, INCLUDING
MODEL AND SPECIFICATION REFERENCE**

TABLE OF CONTENTS

127.01	SCOPE
127.02	SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT
127.02.01	Air Equipment
127.02.01.01	Air Compressor, Silenced
.02	Air Hammer, Including 15 m Hose, Excluding Points
.03	Sand Blaster, Including Nozzles and Hoses
127.02.02	Asphalt Equipment
127.02.02.01	Asphalt Paver
.02	Asphalt Paver Attachment
.03	Asphalt Distributor With Truck
.04	Asphalt Pavement Profiler
.05	Asphalt Pavement Repair Equipment
.06	Asphalt Material Transfer Vehicle
.07	Profilograph
.08	Linestripper
127.02.03	Compaction Equipment
127.02.03.01	Rammer
.02	Manually Guided, Vibratory Plate
.03	Hoe Mounted, Vibratory Plate, Hydraulic
.04	Manually Guided, Self-Propelled, Vibratory, Tandem Drum
.05	Self-Propelled, Vibratory, Single Pad Foot Drum
.06	Self-Propelled, Vibratory, Single Smooth Drum
.07	Self-Propelled, Vibratory, Tandem Drum
.08	Self-Propelled, Static, Tandem Drum
.09	Self-Propelled, Static, Segmented, Four-Wheeled, Two Axles, Including Blade
.10	Self-Propelled, Static, Pneumatic Tires
127.02.04	Concrete Equipment
127.02.04.01	Saw, Self-Propelled, Excluding Blades
.02	Saw, Manually Guided, Excluding Blades
.03	Slip Form Paver
.04	Concrete Vibrator, Including Flexible Shaft and Electric Motor
.05	Concrete Repair Equipment

.06	Concrete Placing Equipment
.07	Hydraulic Breaker, Boom Mounted, Excluding Points
127.02.05	Crushing Equipment
127.02.05.01	Jaw Crusher, Diesel
.02	Cone Crusher, Diesel
.03	Impact Crusher, Diesel
.04	Screening Plant, Double Deck, Diesel
.05	Screening Plant, Triple Deck, Diesel
.06	Surge Bins and Conveyor, Excluding Power Unit
.07	Stacker, Excluding Power Unit
.08	Telescoping Stackers, Excluding Power Unit
.09	Trommel Screening Plant, Diesel
127.02.06	Earth Moving, Grading Equipment
127.02.06.01	Scraper, Single Engine, Two-Wheel Drive
.02	Scraper, Twin Engine, Four-Wheel Drive
.03	Scraper, Single Engine, Self-Loading
.04	Scraper, Pull Type
.05	Tractor Bulldozer, Crawler Type
.06	Tractor Bulldozer Ripper Attachment, Hydraulic, Rear Mounted
.07	Wheeled Tractor, Farm, Industrial, Two-Wheel Drive
.08	Wheeled Tractor, Farm, Industrial, Four-Wheel Drive
.09	Motor Grader, Articulated Frame
.10	Motor Grader Ripper or Scarifier Attachment, Hydraulic Mounted
.11	Gravel or Chip Spreader, Self-Propelled
.12	Spreader Attachment
.13	Shoulder Spreader/Road Widener
.14	Reclaimer/Stabilizer
.15	Grade Trimmer
127.02.07	Excavation Equipment
127.02.07.01	Hydraulic Excavator, Crawler Mounted, Long Reach, 12 to 21 m Boom
.02	Hydraulic Excavator, Crawler Mounted
.03	Hydraulic Excavator, Rubber Tired
.04	Hydraulic Excavator, Bucket Attachment, Wrist Action
.05	Telescopic Boom, Carrier Mounted Excavator
.06	Telescopic Boom, Crawler Mounted Excavator
.07	Tractor With Loader/Backhoe Combination, Two-Wheel Drive
.08	Tractor With Loader/Backhoe Combination, Four-Wheel Drive
.09	Tractor With Loader/Backhoe Combination Attachments
.10	Front End Loader, Crawler Mounted
.11	Front End Loader, Rubber Tire, Four-Wheel Drive
.12	Skid Steer Loader, Rubber Tire
.13	Skid Steer Loader, Tracked
.14	Skid Steer Loader, Attachments
.15	Chain Type Trenching Equipment
127.02.08	Haulage Equipment
127.02.08.01	Tag Along Trailer
.02	Rigid Gooseneck Float With Tractor
.03	Detachable Gooseneck Float With Tractor

.04	Pickup, Two-Wheel Drive
.05	Pickup, Four-Wheel Drive
.06	Rear Dump, Single Rear Axle, Diesel or Gas
.07	Rear Dump, Tandem Rear Axle, Diesel or Gas
.08	Rear Dump, Triaxle, Diesel
.09	Tractor, On Highway, Diesel
.10	Trailers, Rear Dump
.11	Trailers, Live Bottom
.12	Water Truck, Single Rear Axle
.13	Water Truck, Tandem Rear Axle
.14	Dump Trucks, Off Highway, Rigid Frame
.15	Dump Trucks, Off Highway, Articulated Frame
127.02.09	Hoisting Equipment
127.02.09.01	Boom Truck
.02	Hydraulic Crane, Rough Terrain
.03	Hydraulic Crane, Carrier Mounted
.04	Lattice Boom Crane, Crawler Mounted
.05	Lattice Boom Crane, Carrier Mounted
.06	Aerial Bucket Lift, Truck Mounted, Including Truck
.07	Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating
.08	Scissor Lift, Self-Propelled
.09	Tool Carrier
.10	Telescopic Handlers
127.02.10	Pile Driving Equipment
127.02.10.01	Hammer, Open End, Diesel
.02	Driver/Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane
.03	Leads, Including Hydraulics and Kicker
.04	Hydraulic Post Driver
.05	Universal Piling Machine, Including Attachment
127.02.11	Drilling Equipment
127.02.11.01	Mechanical Drilling Equipment, Truck Mounted, Including Auger and Crowd and Power Pack
.02	Mechanical Drilling Equipment, Crawler Mounted, Including Auger
.03	Hydraulic Drill Rig
.04	Mechanical Drilling Equipment, Crane Mounted Attachment, Including Auger
.05	Horizontal Earth Boring Equipment
.06	Trenchless Directional Drill, Track Mounted
.07	Hydraulic Rock Drill, Including Power Pack, Excluding Drill Steel and Bits
.08	Tieback Drill Rig, Hydraulic, Dual Head
127.02.12	Broom and Sweeper Equipment
127.02.12.01	Front Mounted Attachment, Hydraulic
.02	Self-Propelled, Dual Control
127.02.13	Forestry Equipment
127.02.13.01	Brush Chipper, Tow Type
.02	Log Skidder, Cable/Grapple
.03	Chain Saw

127.02.14	Portable Generating Equipment
127.02.14.01	Generator, Gas or Diesel
127.02.15	Pumping Equipment
127.02.15.01	Centrifugal, Dewatering, Including 6 m Suction and 7.5 m Discharge
.02	Centrifugal, Trash, Including 6 m Suction and 7.5 m Discharge
.03	Diaphragm, Including 6 m Suction and 7.5 m Discharge
.04	Electric Submersible, Including 30 m Cable and 7.5 m Discharge, Excluding Generator
127.02.16	Welding Equipment
127.02.16.01	DC Arc Welder, Engine Driven, Including Rods
.02	Oxygen/Acetylene Torch, Including Gas, Excluding Rods
127.02.17	Traffic Control Devices
127.02.17.01	Portable Variable Message Signs
.02	Buffer Vehicles, Including Arrow Board and Attenuator
.03	Traffic Barrels
.04	Portable Light Towers
127.02.18	Miscellaneous Equipment
127.02.18.01	Hydro Excavation Equipment
127.03	MANUFACTURERS' MODEL, SPECIFICATION, AND CAPACITY REFERENCE GUIDE
127.03.01	Air Equipment
127.03.02	Asphalt Equipment
127.03.03	Compaction Equipment
127.03.04	Concrete Equipment
127.03.05	Crushing Equipment - Not Used
127.03.06	Earth Moving, Grading Equipment
127.03.07	Excavation Equipment
127.03.08	Haulage Equipment
127.03.09	Hoisting Equipment
127.03.10	Pile Driving Equipment
127.0.11	Drilling Equipment
127.0.12	Broom and Sweeper Equipment

127.0.13	Forestry Equipment
127.0.14	Portable Generating Equipment
127.0.15	Pumping Equipment
127.0.16	Welding Equipment
127.0.17	Traffic Control Devices - Not Used
127.04	NON-CURRENT EQUIPMENT, SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT
127.04.01	Air Equipment
127.04.01.01	Air Track, Crawler Mounted, Excluding Compressor, Excluding Drill Steel and Bits
127.04.02	Asphalt Equipment - Not Used
127.04.03	Compaction Equipment - Not Used
127.04.04	Concrete Equipment
127.04.04.01 .02	Air Breaker, Boom Mounted, Excluding Points Saw, Self-Propelled, Excluding Blades
127.04.05	Crushing Equipment
127.04.05.01	Roll Crusher
127.04.06	Earth Moving, Grading Equipment
127.04.06.01	Motor Grader, Rigid Frame
127.04.07	Excavation Equipment
127.04.07.01	Clams, Draglines, Shovels, Crawler Mounted, All Cable
127.04.08	Haulage Equipment
127.04.08.01	Rear Dump, Tandem Rear Axle, Diesel or Gas
127.04.09	Hoisting Equipment - Not Used
127.04.10	Pile Driving Equipment - Not Used
127.04.11	Drilling Equipment
127.04.11.01	Mechanical Drilling Equipment, Carrier Mounted, Including Auger
127.04.12	Broom and Sweeper Equipment - Not Used
127.04.13	Forestry Equipment - Not Used
127.04.14	Portable Generating Equipment - Not Used

127.04.15	Pumping Equipment - Not Used
127.04.16	Welding Equipment - Not Used
127.04.17	Traffic Control Devices - Not Used
127.05	NON-CURRENT EQUIPMENT, MANUFACTURERS' MODEL, SPECIFICATION, AND CAPACITY REFERENCE GUIDE
127.05.01	Air Equipment - Not Used
127.05.02	Asphalt Equipment - Not Used
127.05.03	Compaction Equipment - Not Used
127.05.04	Concrete Equipment - Not Used
127.05.05	Crushing Equipment - Not Used
127.05.06	Earth Moving, Grading Equipment
127.05.07	Excavation Equipment
127.05.08	Haulage Equipment - Not Used
127.05.09	Hoisting Equipment - Not Used
127.05.10	Pile Driving Equipment - Not Used
127.05.11	Drilling Equipment
127.05.12	Broom and Sweeper Equipment - Not Used
127.05.13	Forestry Equipment - Not Used
127.05.14	Portable Generating Equipment - Not Used
127.05.15	Pumping Equipment - Not Used
127.05.16	Welding Equipment - Not Used
127.05.17	Traffic Control Devices - Not Used
127.01	SCOPE

This specification covers equipment rental rate compensation for work on a Time and Material Basis. The calculated rate represents the cost of owning and operating the equipment and is made up of direct and indirect costs such as fuel, oil, lubrication, field repairs, overhaul, depreciation, financing, storage, insurance, overhead, and profit.

The rental rates in this schedule are hourly, unless otherwise stated, and do not include the cost of the operator.

The information was compiled from manufacturers, equipment dealers and distributors, and contractors and is based on equipment specifications for standard models, including all necessary attachments to perform the work. Adjustments shall not be made to the rental rate due to optional components that may increase the weight, capacity, or power of a piece of equipment.

Except for Subsection 127.02.09, Hoisting Equipment, the rates listed cover the range of all equipment up to the next highest increment. When a piece of equipment falls in between listed categories, with respect to weight or capacity, the lower rental rate shall apply. For Subsection 127.02.09, Hoisting Equipment, when the size of the equipment falls between the increments shown, the rental rate is to be determined by a straight-line interpolation and rounded to the nearest five cents.

The rental rates reflect the existing tax situations as they pertain to the purchase of equipment at the date of publication.

Section 127.03, Manufacturers' Model, Specification, and Capacity Reference Guide, covers a partial listing of manufacturers' equipment model or specification numbers, with appropriate capacity and power ratings. This guide is provided for reference purposes only to assist in determining the appropriate ratings listed in Section 127.02, Schedule of Rental Rates for Construction Equipment.

The rental rates are reviewed annually; therefore, any errors, omissions, or additional suggestions or amendments should be addressed in writing to:

Head, Estimating Section
Contract Management Office
Ontario Ministry of Transportation
Garden City Tower, 2nd Floor
301 St. Paul Street
St. Catharines, ON L2R 7R4

127.02 SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT

127.02.01 AIR EQUIPMENT

127.02.01.01 Air Compressor, Silenced

Flow Rate, m³/min

3	14.60
5	18.45
7	27.15
10	36.95
17	65.25
25	101.95
45	160.35

127.02.01.02 Air Hammer, Including 15 m Hose, Excluding Points

Weight, kg

3	1.10
14	1.90
28	2.10

127.02.01.03 Sand Blaster, Including Nozzles and Hoses

Sand Pot Capacity, Weight, kg	
135	5.70
270	6.35

127.02.02 ASPHALT EQUIPMENT**127.02.02.01 Asphalt Paver**

Weight, kg	
2,000	44.85
4,000	60.25
7,000	103.50
9,000	225.75
14,000	271.90
17,000	315.25
20,000	356.60

127.02.02.02 Asphalt Paver Attachment

Mechanical Floating Beam	7.30
Mechanical Grade and Slope Control	16.75
Screed Extension, Bolt On	4.70
Sonic Averaging Ski	8.15
Sonic Grade and Slope Control	16.25

127.02.02.03 Asphalt Distributor With Truck

Tank Volume, litre	
7,000	127.25
11,000	150.55

127.02.02.04 Asphalt Pavement Profiler

Power, kW	
32	107.85
90	176.30
135	295.50
340 *	486.50
590 *	520.30
700 *	660.35

* Excluding teeth

127.02.02.05 Asphalt Pavement Repair Equipment

Equipment Type	
4 kW Pavement Line Grinder	2.80
8 kW Pavement Line Grinder	7.25
Pavement Router	10.95
Hot Air Lance	9.85
Mastic Kettle	32.50

127.02.02.06	Asphalt Material Transfer Vehicle	
Without Surge Bin		269.30
With Surge Bin		343.05

127.02.02.07	Profilograph	
Equipment Type		
California Profilograph, including trailer		27.40
High Speed, including truck		66.30

127.02.02.08	Linestripper	
Equipment Type		
Walk Behind		4.25
Walk Behind Ride-On Attachment		3.60
Skid Mounted		13.85
Ride-On		14.80
400 litre Truck Mounted		98.50
1,000 litre Truck Mounted		115.50
2,000 litre Truck Mounted		138.55
2,000 litre Truck Mounted, including attenuator		148.75

127.02.03 COMPACTION EQUIPMENT

Note: Equipment weights include water ballast, where applicable.

127.02.03.01	Rammer	
Minimum Weight, kg		
45		4.05
65		4.95
85		5.65

127.02.03.02	Manually Guided, Vibratory Plate	
Minimum Weight, kg		
65		3.20
100		5.35
160		10.20
280		14.70
390		21.40
500		31.90

127.02.03.03	Hoe Mounted, Vibratory Plate, Hydraulic	
Minimum Weight, kg		
100		8.90
300		10.55
600		15.20
900		27.60

127.02.03.04 Manually Guided, Self-Propelled, Vibratory, Tandem Drum

Minimum Weight, kg

400	14.15
600	17.20
800	19.10
1,200	38.10

127.02.03.05 Self-Propelled, Vibratory, Single Pad Foot Drum

Minimum Weight, kg

1,000	39.10
4,000	53.80
6,000	72.50
9,200	95.55
13,000	108.35
18,000	118.25

127.02.03.06 Self-Propelled, Vibratory, Single Smooth Drum

Minimum Weight, kg

1,000	37.35
4,000	51.05
6,000	64.90
9,200	87.05
13,000	102.75
18,000	113.65

127.02.03.07 Self-Propelled, Vibratory, Tandem Drum

Minimum Weight, kg

1,000	29.35
3,000	41.90
6,000	78.95
8,000	95.85
10,000	100.25
12,000	107.65

127.02.03.08 Self-Propelled, Static, Tandem Drum

Minimum Weight, kg

1,200	21.35
4,000	34.20
7,000	50.40
10,000	52.85

127.02.03.09 Self-Propelled, Static, Segmented, Four-Wheeled, Two Axles, Including Blade

Minimum Weight, kg

19,000	209.40
30,000	287.70

127.02.03.10 Self-Propelled, Static, Pneumatic Tires

Minimum Weight, kg	
8,000	57.25
18,000	91.90

127.02.04 CONCRETE EQUIPMENT**127.02.04.01 Saw, Self-Propelled, Excluding Blades**

Power, kW	
5	5.15
10	6.10
15	16.35
40	37.40
Ride-On, Vertical Cut	42.40
Ride-On, Horizontal Cut	103.30

127.02.04.02 Saw, Manually Guided, Excluding Blades

Power, kW	
3	2.45
5	3.65
10	6.10

127.02.04.03 Slip Form Paver

Power, kW	
10	45.80
30	136.35
70	172.15
120	240.10
200	453.30

127.02.04.04 Concrete Vibrator, Including Flexible Shaft and Electric Motor

Vibrator Diameter, mm	
< 50	0.95
50	1.05

127.02.04.05 Concrete Repair Equipment

Equipment Type	
50 mm Hammer Drill, excluding bits	3.65
Predampener	40.35
Shotcrete Pump, Dry Process	8.50
Shotcrete Pump, Wet Process	69.10
Batch Mixer Pump	39.15

127.02.04.06 Concrete Placing Equipment

Equipment Type	
15 m ³ /hr Concrete Pump, Trailer Mount	33.80
25 m ³ /hr Concrete Pump, Trailer Mount	37.20
35 m ³ /hr Concrete Pump, Trailer Mount	46.95
54 m ³ /hr Concrete Pump, Trailer Mount	102.60

98 m ³ /hr	Concrete Pump, Trailer Mount	240.10
17 m	Vertical Height, Concrete Pump-Truck Mount	156.35
24 m	Vertical Height, Concrete Pump-Truck Mount	269.10
28 m	Vertical Height, Concrete Pump-Truck Mount	306.50
33 m	Vertical Height, Concrete Pump-Truck Mount	330.50
40 m	Vertical Height, Concrete Pump-Truck Mount	415.75
47 m	Vertical Height, Concrete Pump-Truck Mount	519.25
	Concrete Deck Finisher, Self-Propelled	56.40
	Concrete Placer	229.90
	Concrete Placer Spreader	392.80
	Concrete Texture Curing Machine	79.15
	Concrete Conveyor	68.25

127.02.04.07 Hydraulic Breaker, Boom Mounted, Excluding Points

Impact Energy, Joules		
200		10.95
400		11.25
900		15.30
1,400		24.70
2,200		36.70
3,300		58.90
4,500		62.75
6,000		67.70
12,000		117.70
20,000		207.65

127.02.05 CRUSHING EQUIPMENT

127.02.05.01 Jaw Crusher, Diesel

Jaw Opening, m		
< 1.00		170.70
1.00		198.55
1.15		335.65

127.02.05.02 Cone Crusher, Diesel

Cone Diameter, m		
0.90		252.15
1.00		332.10
1.30		399.10

127.02.05.03 Impact Crusher, Diesel

Crusher Size, m		
1.0		207.20
1.2		265.65
1.3		379.45

127.02.05.04 Screening Plant, Double Deck, Diesel

Screen Size, m		
3		96.30
4		104.30
5		156.25

127.02.05.05 Screening Plant, Triple Deck, Diesel

Screen Size, m

5	136.50
6	224.65

127.02.05.06 Surge Bins and Conveyor, Excluding Power Unit

Bin Volume, m³

7	42.55
10	60.90
20	73.10

127.02.05.07 Stacker, Excluding Power Unit

Conveyor Length, m

12	23.70
18	30.20
24	42.90
30	65.85

127.02.05.08 Telescoping Stackers, Excluding Power Unit

Conveyor Length, m

36	133.75
46	171.40
61	310.10
76	372.80

127.02.05.09 Trommel Screening Plant, Diesel

Drum Diameter, m

1.20	62.80
1.50	89.50
1.80	199.45

127.02.06 EARTH MOVING, GRADING EQUIPMENT

127.02.06.01 Scraper, Single Engine, Two-Wheel Drive

Minimum Struck Capacity, m³

10	223.45
16	290.30

127.02.06.02 Scraper, Twin Engine, Four-Wheel Drive

Minimum Struck Capacity, m³

10	312.40
16	394.15
22	513.55

127.02.06.03 Scraper, Single Engine, Self-LoadingMinimum Struck Capacity, m³

6	141.40
11	273.40

127.02.06.04 Scraper, Pull TypeVolume, m³

6	38.55
9	43.40
13	58.15

127.02.06.05 Tractor Bulldozer, Crawler Type

Minimum Net Flywheel Power, kW

25	41.40
50	54.35
60	63.60
80	95.20
120	123.75
160	175.00
210	238.85
280	327.55

127.02.06.06 Tractor Bulldozer Ripper Attachment, Hydraulic, Rear Mounted

Power, kW

50	9.10
120	12.45
160	21.45
210	23.20
280	34.85

127.02.06.07 Wheeled Tractor, Farm, Industrial, Two-Wheel Drive

Power, kW

10	12.00
25	19.30
40	25.05
50	37.20
70	51.90
90	60.50
120	81.80
160	101.35

127.02.06.08 Wheeled Tractor, Farm, Industrial, Four-Wheel Drive

Power, kW

10	13.45
25	20.15
40	25.90
50	40.00
70	50.30
90	60.70
110	81.75

135	93.40
150	103.65
180	118.60

127.02.06.09 Motor Grader, Articulated Frame

Minimum Operating Weight, kg

11,500	86.45
14,000	109.05
15,500	115.70
17,000	120.40
22,000	152.00

127.02.06.10 Motor Grader Ripper or Scarifier Attachment, Hydraulic Mounted

Grader Weight, kg

11,500 - Grader Ripper	6.30
14,000 - Grader Ripper	6.65
15,500 - Grader Ripper	7.55
17,000 - Grader Ripper	9.35
22,000 - Grader Ripper	13.40
Scarifier - any size grader	5.50

127.02.06.11 Gravel or Chip Spreader, Self-Propelled

Spreader Width, m

3 - 4	108.80
-------	--------

127.02.06.12 Spreader Attachment

Equipment Type

Grader/FEL - Shouldering	43.35
--------------------------	-------

127.02.06.13 Shoulder Spreader/Road Widener

Spreader Width, m

2	133.50
3	180.40

127.02.06.14 Reclaimer/Stabilizer, Excluding Teeth

Equipment Power, kW

250	240.05
325	296.35
440	338.00
500	460.25

127.02.06.15 Grade Trimmer

Minimum Width, m

3	458.85
---	--------

127.02.07 EXCAVATION EQUIPMENT

127.02.07.01 Hydraulic Excavator, Crawler Mounted, Long Reach, 12 to 21 m Boom

Minimum Operating Weight, kg

19,500	102.10
23,000	121.40
26,500	131.60
32,000	154.45
44,000	215.05

127.02.07.02 Hydraulic Excavator, Crawler Mounted

Minimum Operating Weight, kg

1,000	19.95
4,000	28.45
6,000	44.80
12,000	77.55
19,500	92.80
23,000	100.60
26,500	126.00
32,000	150.35
44,000	204.85
55,000	298.90
70,000	318.90
100,000	423.10

127.02.07.03 Hydraulic Excavator, Rubber Tired

Minimum Operating Weight, kg

11,000	97.35
18,000	113.65
21,000	129.30

127.02.07.04 Hydraulic Excavator, Bucket Attachment, Wrist Action

Minimum Carrier Weight, kg

4,000	5.15
9,000	6.30
13,000	9.60
18,000	12.60

127.02.07.05 Telescopic Boom, Carrier Mounted Excavator

Weight, kg

15,000	164.30
20,000	171.15
22,000	198.70

127.02.07.06 Telescopic Boom, Crawler Mounted Excavator

Weight, kg

17,000	110.65
20,000	116.35
23,000	136.05

127.02.07.07 Tractor with Loader/Backhoe Combination, Two-Wheel Drive

Minimum Power, kW

45	38.60
60	45.25
75	57.80
94	85.40

127.02.07.08 Tractor with Loader/Backhoe Combination, Four-Wheel Drive

Minimum Power, kW

30	29.35
45	44.10
65	47.95
80	59.80
94	83.25

127.02.07.09 Tractor with Loader/Backhoe Combination Attachments

Attachment Type

300 mm Auger	3.25
Jaw Bucket	6.30

For Hydraulic Ram Hoe Attachments, see 127.02.03.03

127.02.07.10 Front End Loader, Crawler Mounted

Power, kW

50	60.10
70	93.90
100	115.75
150	169.80

127.02.07.11 Front End Loader, Rubber Tire, Four-Wheel Drive

Power, kW

40	43.40
75	64.40
100	78.50
125	86.10
150	108.00
175	115.25
200	140.25
225	158.60
250	169.60
300	294.30
400	357.15

127.02.07.12 Skid Steer Loader, Rubber Tire

Lift Capacity, kg

300	25.60
700	28.80
850	31.25
1,000	36.00
1,200	38.00
2,500	41.60

127.02.07.13 Skid Steer Loader, Tracked

Lift Capacity, kg	
900	33.65
1,100	34.20
1,300	37.35
1,600	40.15
1,800	41.70

127.02.07.14 Skid Steer Loader, Attachments

Attachment Type	
Auger	2.80
Backhoe	4.20
Breaker	12.40
Cold Planer	9.60
Multi Bucket	4.50
Pick Up Broom	6.70
Power Rake	5.95
Scarifier	3.65
Steel Tracks	1.75
Sweeper, Angle Broom	6.25
Trencher	2.10

127.02.07.15 Chain Type Trenching Equipment

Power, kW	
13	16.25
20	29.60
35	41.55
50	74.15

127.02.08 HAULAGE EQUIPMENT

127.02.08.01 Tag Along Trailer

Load Capacity, kg	
2,000	2.90
3,000	4.80
9,000	9.20
16,000	12.90
19,000	15.25

127.02.08.02 Rigid Gooseneck Float With Tractor

Load Capacity, kg	
20,000	118.00
40,000	123.15

127.02.08.03 Detachable Gooseneck Float With Tractor

Load Capacity, kg	
30,000	120.60
45,000	124.90

127.02.08.04	Pickup, Two-Wheel Drive	
Pickup Type		
Mini Type		16.90
2,600 kg GVW		29.00
3,800 kg GVW		34.85
4,500 kg GVW		35.25
127.02.08.05	Pickup, Four-Wheel Drive	
Pickup Type		
Mini Type		20.75
2,600 kg GVW		30.30
3,800 kg GVW		35.40
4,500 kg GVW		37.70
127.02.08.06	Rear Dump, Single Rear Axle, Diesel or Gas	
AGW, kg		
5,000		61.80
12,000		70.20
127.02.08.07	Rear Dump, Tandem Rear Axle, Diesel or Gas	
AGW, kg		
24,000		93.80
127.02.08.08	Rear Dump, Tri-Axle, Diesel	
AGW, kg		
32,000		113.75
32,000 kg Stone Spreader		126.50
127.02.08.09	Tractor, On Highway, Diesel	
Tandem Axle		106.45
127.02.08.10	Trailers, Rear Dump	
Axle Configuration		
Pony/Pup		43.10
Tri		48.30
Quad		57.50
Quint		64.75
127.02.08.11	Trailers, Live Bottom	
Axle Configuration		
Tandem		49.25
Tri		56.35
Quad		59.75
Quint		64.25

127.02.08.12	Water Truck, Single Rear Axle	
Spray Bar Type		
Gravity / Pressure		80.35
127.02.08.13	Water Truck, Tandem Rear Axle	
Spray Bar Type		
Pressure		98.20
127.02.08.14	Dump Trucks, Off Highway, Rigid Frame	
Payload, kg		
35,000		251.00
38,000		277.70
50,000		353.00
75,000		483.45
127.02.08.15	Dump Trucks, Off Highway, Articulated Frame	
Payload, kg		
20,000		164.65
26,000		195.45
30,000		233.90
35,000		256.65
40,000		316.55
127.02.09	HOISTING EQUIPMENT	
127.02.09.01	Boom Truck	
Lift Capacity, kg		
7,000		145.40
11,000		204.55
19,000		228.00
25,000		252.35
127.02.09.02	Hydraulic Crane, Rough Terrain	
Lift Capacity, kg		
13,000		85.55
20,000		148.50
40,000		190.85
65,000		259.25
100,000		370.95
127.02.09.03	Hydraulic Crane, Carrier Mounted	
Lift Capacity, kg		
25,000		213.50
45,000		286.15
60,000		304.35
90,000		457.80
135,000		612.65
200,000		714.40
300,000		1,057.80

127.02.09.04 Lattice Boom Crane, Crawler Mounted

Lift Capacity, kg	
50,000	223.60
70,000	292.85
90,000	359.70
130,000	480.40
200,000	663.50
250,000	763.50

127.02.09.05 Lattice Boom Crane, Carrier Mounted

Lift Capacity, kg	
110,000	505.10
270,000	688.70

127.02.09.06 Aerial Bucket Lift, Truck Mounted, Including Truck

Platform Height, m	
7.0	85.20
10.0	102.90
15.0	127.30
20.0	154.85

127.02.09.07 Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating

Platform Height, m	
9.0	40.85
12.0	57.00
18.0	66.45
22.0	104.35
30.0	144.70
41.0	260.95

127.02.09.08 Scissor Lift, Self-Propelled

Platform Height, m	
4.0	10.65
7.0	27.10
9.0	40.95

127.02.09.09 Tool Carrier

Power Rating, kW	
40	50.85
75	64.20
100	80.20
125	102.30

127.02.09.10 Telescopic Handlers

Lifting Height, m	
5	53.95
10	78.85

127.02.10 PILE DRIVING EQUIPMENT**127.02.10.01 Hammer, Open End, Diesel**

Rated Energy, joules

50,000	47.15
80,000	67.10
120,000	89.15
220,000	150.00

127.02.10.02 Driver/Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane

Driving Force, kN

245	69.05
392	94.40
637	120.05
980	171.60
1,471	210.45

127.02.10.03 Leads, Including Hydraulics and Kicker

Length, m

20, Fixed/Vertical	69.90
20, Hanging	20.90
24, Fixed/Vertical	73.65
24, Hanging	25.50
30, Fixed/Vertical	77.85
30, Hanging	31.20

127.02.10.04 Hydraulic Post Driver

Track Mounted	59.95
Truck Mounted	150.55

127.02.10.05 Universal Piling Machine, Including Attachment

Power Rating, kW

< 450	358.10
450	613.60
570	828.10

127.02.11 DRILLING EQUIPMENT

Note: Use Manufacturer's Model, Specification, and Capacity tables to determine power rating for hydraulically driven rotary drilling equipment.

127.02.11.01 Mechanical Drilling Equipment, Truck Mounted, Including Auger and Crowd and Power Pack

Power, kW

80	184.80
120	353.15

127.02.11.02 Mechanical Drilling Equipment, Crawler Mounted, Including Auger

Power, kW	
95	179.55
113	254.20
130	314.60

127.02.11.03 Hydraulic Drill Rig

Power, kW	
185	452.90
250	645.55
350	710.60
430	873.65
570	1157.60

Note: Base rate includes initial casing up to 20 m, teeth, and auger. Replacement auger teeth not included.

127.02.11.04 Mechanical Drilling Equipment, Crane Mounted Attachment, Including Auger

Power, kW	
110	98.80
200	140.30

127.02.11.05 Horizontal Earth Boring Equipment

Power Rating, kW	
20	42.50
50	79.35
100	126.50
200	239.20

Note: Base rate includes 20 m auger and cutting head.

127.02.11.06 Trenchless Directional Drill, Track Mounted

Operating Weight, kg	
1,000	84.10
7,000	198.60
12,000	256.10
20,000	307.70

127.02.11.07 Hydraulic Rock Drill, Including Power Pack, Excluding Drill Steel and Bits

Diameter, mm	
< 75	69.25
75	201.90
125	228.40
150	293.90

127.02.11.08 Tieback Drill Rig, Hydraulic, Dual Head

Power, kW	
< 140	175.05
140	260.75

Note: Base rate includes initial casing, drilling, augering components up to 20 m.

127.02.12 BROOM AND SWEEPER EQUIPMENT

127.02.12.01 Front Mounted Attachment, Hydraulic

Broom Width, m	
1.2	7.90
1.8	9.45
2.4	14.70

127.02.12.02 Self-Propelled, Dual Control

Sweeper Type	
Bottom Dump	92.20
High Dump	109.30
Vacuum	112.95

127.02.13 FORESTRY EQUIPMENT

127.02.13.01 Brush Chipper, Tow Type

Minimum Net Flywheel Power, kW	
19	20.25
35	28.30
60	35.95
80	46.75
140	83.70

127.02.13.02 Log Skidder, Cable/Grapple

Minimum Net Flywheel Power, kW	
75	132.60
120	177.00
150	185.05

127.02.13.03 Chain Saw

Power, kW	
1	1.70
3	2.90
5	4.50

127.02.14 PORTABLE GENERATING EQUIPMENT

127.02.14.01 Generator, Gas or Diesel

Power, kW	
0.5, Air Cooled, Gasoline	1.65
3, Air Cooled, Gasoline	2.75

5, Air Cooled, Gasoline	3.65
10, Air Cooled, Diesel	14.75
40, Water Cooled, Diesel	26.55
80, Water Cooled, Diesel	50.60
150, Water Cooled, Diesel	79.20
250, Water Cooled, Diesel	107.70
300, Water Cooled, Diesel	135.50
400, Water Cooled, Diesel	173.10
600, Water Cooled, Diesel	262.30
910, Water Cooled, Diesel	331.20

127.02.15 PUMPING EQUIPMENT

127.02.15.01 Centrifugal, Dewatering, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

25, Air Cooled, gasoline	2.40
50, Air Cooled, gasoline	2.55
100, Air Cooled, gasoline	3.55

127.02.15.02 Centrifugal, Trash, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

50	2.90
75	3.85
100	9.90
150	26.10
200	52.35

127.02.15.03 Diaphragm, Including 6 m Suction and 7.5 m Discharge

Intake Size, mm

50, Air Cooled, gasoline	4.20
75, Air Cooled, gasoline	4.80
100, Air Cooled, gasoline	17.95

127.02.15.04 Electric Submersible, Including 30 m Cable and 7.5 m Discharge, Excluding Generator

Intake Diameter, mm

50	2.25
100	5.05
150	15.80
200	23.25

127.02.16 WELDING EQUIPMENT

127.02.16.01 DC Arc Welder, Engine Driven, Including Rods

Current, A

125	3.05
150	3.80
200	6.00
300	7.80
400	13.20

127.02.16.02 Oxygen/Acetylene Torch, Including Gas, Excluding Rods

Equipment Type	
Hand Mobile, Heavy Duty	24.25

127.02.17 TRAFFIC CONTROL DEVICES

127.02.17.01 Portable Variable Message Signs

Equipment Type	
Trailer Mounted, Solar	8.90
Truck Mounted	4.85

127.02.17.02 Buffer Vehicles, Including Arrow Board and Attenuator

Equipment Type	
Crash Truck	71.95

127.02.17.03 Traffic Barrels

Each Per Day	1.00
--------------	------

127.02.17.04 Portable Light Towers, Trailer Mounted

Extended Tower Height, m	
9	16.95

127.02.18 MISCELLANEOUS EQUIPMENT

127.02.18.01 Hydro Excavation Equipment

Hydro Excavating / Vacuum Truck	
Single Axle	192.60
Tandem Axle	212.00
Tri Axle	245.25

127.03**MANUFACTURERS' MODEL, SPECIFICATION, AND CAPACITY REFERENCE GUIDE**

Note: Each table has a number in parentheses as part of the table title that refers to the corresponding clause in Section 2 - Schedule of Rental Rates for Construction Equipment.

127.03.01**AIR EQUIPMENT****Air Compressor, Silenced (127.02.01.01)**

CLASSIFIER	MAKE AND MODEL						
Flow Rate m ³ /min	Atlas Copco	Chicago Pneumatics	Doosan and Ingersoll-Rand	Grimmer- Schmidt	Kaeser	Multiquip	Sullair
3	XA57 XASTS67 Hardhat XATS67 XAS67KD XATS67 Hardhat XAS77 XAS77 Hardhat	CPS 90	P-100WD P-130WD P-110WIR P-135WIR AIRSOURCE	125 150 H100G 125G OEM 125G			125
5	XAS97 XAHS106 XATS116 XAS185 XAST250KD7	CPS 185 CPS185KD	P-185WJD P-185WIR XP185WIR AIRSOURCE Plus IR AIRSOURCE Plus JD	175 185D 185E 185J 210D 210J H185D H210D H130E	M50 M57 M58	DIS185SSi4F	185
7	XAS126 XA(S)136 XAHS146 XATS300KD7		P-250WJD P-260WIR VHP300WIR	250 250D H300D			250 260
10	XATS156 XAHS186 XA(S)186 XATS400	CPS 375	P-375WCU P-600WCU XP375WIR HP375WIR VHP400WIR P425WIR HP450WIR	375 375D	M100 M114		375 375H 425
17	XAMS286 XAHS336 XAMS356 XRHS366 XATS750	CPS750 CPS750 CD3	P-750WJD P-600WIR XP675WCU XHP700WCAT XP750WCU HP750WCU VHP750WCAT MHP825WCAT XP825WCU MHP825WCU	800 800D			750
25	XAHS426 XRVS366 XAMS496 XRHS486 XAHS536 XAMS546 XATS1050		HP900WCAT HP915WCU HP1300WCU XP1200WCU	900			1050
45	XATS1800		P-1600WCU				

Sand Blaster, Including Nozzles and Hoses (127.02.01.03)

CLASSIFIER	MAKE AND MODEL					
Weight kg	Canablast	Clemco	Empire	Lindsay	Marco	Schmidt
135	340 P	4.0 6.0 1042 1642 1648	P-350 350 Super Blast 350 Super Blast 350 XL	300LAD	1.5 1.5 Portable 3.5 M Portable	4
270	640 P	21505 21545 2452	P-650 650 Super Blast 650 Super Blast 650 XL P-1050	600LAD	6.5 M Portable	7

127.03.02

ASPHALT EQUIPMENT

Asphalt Paver (127.02.02.01)

CLASSIFIER	MAKE AND MODEL											
Weight kg	ABG	Barber - Greene	Volvo (Blaw-Knox)	Caterpillar	Cedarapids/ Bomag	Gehl	Gilcrest	Ingersoll - Rand	Lee Boy	Mauldin	Roadtec	Vogele/ Wirtgen
2,000			M-450 PF-545			1448 1649				550E		
4,000			PF-150 PF-840 PF-855 PF-875 3120	AP255E		1648	813 814			690F 1500SP 1550-C		Super 700
7,000				P385 AP355F AP300F	BSF-330			650P 660W 580W		1750C		Super 1300-3 Super 1303-3
9,000		BG-210B	PF-120H PF-161 PF-171 PF-172 PF-400		CR351 CR352 CR361			780T 880TD 780W	8500			AP780WB AP880RTB
14,000			PF-2181 PF-3172 PF-3200 PF-4410	AP500E AP555E AP650B AP800C AP900 BG225C BG230	352 362S 362 CR 361R CR 451 CR 362							AP880WB Vision 5103-2 Vision 5100-2
17,000			PF-5500 PF-5510 PF-6160 PF-6170	AP655C AP900B AP1000B AP1050B BG240C BG245C BG260C BG2455C AP600D AP655D AP1000E	452 462S 462 552 562S CR 461R CR 461RX CR551 CR552 CR 561R CR 452 CR 462						RP-170 RP-175	AP1010WB AP1110WB Vision 5203-2 Vision 5200-2
20,000	325EPM 423		PF6110 PF6160 PF6170 PF7110 PF7170 P7170B P7110B	AP1055B AP1055D AP1055E	562 CR652RX CR562 CR662RM						RP-190e RP-195e RP-2505 SP-200e	AP1110RTB Super 2100-3

Asphalt Distributor With Truck (127.02.02.03)

CLASSIFIER	MAKE AND MODEL		
Tank Volume L	Bearcat	E. D. Etnyre	Rosco
7,000	BC-501/CRC * BC-501/CRC2	Shooter 1665 Centennial 2000	
11,000	BC-501/CRC * BC-501/CRC3	Centennial 2500 Centennial 3000 Centennial 3500	Maximizer 3 Maximizer 11

* Equipment available in 7,000+ and 11,000+ tank capacities.

Asphalt Pavement Profiler (127.02.02.04)

CLASSIFIER	MAKE AND MODEL					
Power kW	Bomag	Caterpillar	Roadtec	Terex	Volvo	Wirtgen Inc.
32						W35 W50 W35DC
90	BM 500/15 BM 600/15				MW500	W600DC W1000L W50DCi
135	BM 1000/30 BM 1200/30 BM 1300/30 BM 1000/35 BM 1200/35 BM 1300/35	PM102	RX-400e			1000F 1000 W100Fi W130Fi W150i W100i W60i
340	BM 2000/60 BM2200/75 BM2200/75	PM 200 PM 201 * PM 620 PM 622	RX500 RX700 RX-600e RX-700e	PR600	MT2000	W1900 W2000 W200i W210i W220
590		PM 201 *		PR800-7 PR860		W2200
700			RX-900e	PR950		W250i

* May be either capacity depending on equipment year of manufacture.

Asphalt Pavement Repair Equipment (127.02.02.05)

CLASSIFIER	MAKE AND MODEL		
Equipment Type	Bartell	Edco	Hoffman
4 kW Pavement Line Grinder	SP 8 SP8-G1	CPM-4	
8 kW Pavement Line Grinder	BGG10	TLR-7 CPM-10 CPU-10FC	H92

Asphalt Material Transfer Vehicle (127.02.02.06)

CLASSIFIER	MAKE AND MODEL			
Equipment Type	Ingersoll-Rand	Roadtec	Terex	Weiler
No Surge Bin		MTV-1000C MTV-1000D		E1250
Surge Bin	MC 330	SB 2500 SB-1500D SB-2500e	CR 662	E2850

127.03.03**COMPACTION EQUIPMENT****Rammer (127.02.03.01)**

CLASSIFIER	MAKE AND MODEL							
Min. Weight kg	Bomag	Chicago Pneumatics	Dynapac	Ingersoll- Rand	Multi-Quip / Mikasa	Vibromax	Wacker	Weber
45	BS 600 BT 50 BT 58 BT 60 BT 60/4	MS590 MS595		RX-55 RX-554	MT 55F MT 62HS MTR 40 MTR 40 SF MTR 50 MTR 60L MTX 60 MTX 60 HD MTX 60 SD	SL 1B VM1	BS 45 Y BS 50-2 BS 50-2i BS 50-4s BS 52 Y BS 60 Y BS 500 BS 600 ES 52 Y	SRV 590 HO SRV 600i
65	BS 720 BT 68 BT 65 BT 65-4	MS690 MS695 MS780	LC 50 LC 70	RX-65 RX-75 RX-654 RX-654H RX-754 RX-754H	MT 65H MT 70 MT 74F MT 75HS MT 76D MT 85HS MTX 70 MTX 70 HD MTX 70 SD MTX 80 MTX 80 SD	SL 2B VM2	BS 60-2i BS 60-4i BS 60-4s BS 62 Y BS 70-2i BS 700 DS 70 DS 72 Y	SRV 620 SRV 620 HO SRV 650 SRV 660 SRX 75 DH
85		MS840			MT 86D MTR 80L MTX 90		BS 100 Y BS 105 Y DS 70 H	

Manually Guided, Vibratory Plate (127.02.03.02)

CLASSIFIER	MAKE AND MODEL							
Min. Weight kg	Bomag	Chicago Pneumatics	Dynapac	Ingersoll- Rand	Multi-Quip / Mikasa	Vibromax	Wacker	Weber
65	BP 10/36 BP 10/36-2 BP 15/45 BP 18-45-2	KMR11 LF82 MV82 MV90 Asphalt MV100	LG 140	BX-6WH BX-8 BX-8WH BXR-7	MT-85HS MVC 64VH MVC 64VHW MVC 64XH MVC 77 MVC 82VH MVC 82VHW MVC-88GHW MVC 88VTH MVC-90H MVC 90L MXC 82VH	AT 8 AV 600 AV 601 AV 900 AV 901	VP 1135AW VP 1340 VP 1340A VP 1340W VP 1550 VP 1550A VP 1550AW VPA 1740 VPG 165A VPR 1330 VPY 1740 WP 1540 WP 1540A WP 1550 WP 1550A WP 1550V	CF1i CF1 PRO CF2 HO CF2i CF2 PRO CF2 PRO S CF3 PRO
100	BPR 25/32 BPR 25/40	MV100 Asphalt MV100 A MV115 Asphalt MV115 D MV135 MV140	LG 450	BX-12 BX-12WH	MVC 88VTHW MVC 110 MVC 135G MVH 120VGH MVH 150VGH MVH-R120GH MVH-R150GH	AV 1300B AV 22B 12	BPS 2550A BPS 2550R BPU 2440A BPU 2540A BPU2540AW DPU 2430 VP 2050 VP 2050A VP 2050Y VPA 1350W VPY 1770	CR1 HO CR2 HO
160	BPR 30/38 BPR 30/38D BPR 35/60D	MV165 MV170 MV220 MV245 MV305			MVH 150D MVH 200D MVH 200G MVH 200GH MVH 206GH	15 25	BPU 2950A BPU 3050A BPU 3750A DPU 2950 DPU 3050H DPU 3750A DPU 3750H	CR3 D CR3 E CR3 HO CR5 HO VPR 700
280	BPR 45/45	MV320			MVH-304DSB MVH-304GHB MHV306GH MVH308GH MVH308DZ MVH408GH	35	BPU 3345A BPU 4045A BPU 5045A BPU 5545A DPU 4045H DPU4545H DPU 5045H	CR5 E
390	BPR 55/52D	MV400 MV430			MVH-402DSB MVH-402GHB MVH 406GH MVH 408DZ		CPU 4545He DPU5545 DPU 5545He DPU 6055 DPU 6055H DPU 6555He	CR5 HO CR6 CR6 CCD CR6 CCD 2.0 CR6 MDM CR6 MSM CR7 CR7 CCD CR7 CCD 2.0 CR7 E CR7 HO CR7 MDM CR7 MSM
500	BPH 80/65S BPR 65/52D-3 BPR 100/80D	MV480 MV500			MVH-502DSB MVH 508DZ MVH-702DSRC	45	DPU 100-70 DPU 100-70Les DPU 130 DPU 7060 DPU 7060H DPU 7060RC	CR8 CR8 CCD CR8 CCD 2.0 CR8 E CR8 MDM CR8 MSM CR9 CCD CR9 CCD 2.0 CR9 E

Hoe Mounted, Vibratory Plate, Hydraulic (127.02.03.03)

CLASSIFIER	MAKE AND MODEL								
Min. Weight kg	Allied	Balderson	BTI (Formerly Teledyne)	Chicago Pneumatics	Kent	NPK	Rammer	Stanley	Tramac
100	300 500 4700 400B 700B			RC103	KHP 30 KHP 35	C-2 C2C C-2D	RP 10	HS 2500 HS 3000	TR-6 TR-7S TR-8
300	1000 1000B 8700C NT 8900	B4 B4S	TC-90S TC-91S TC-92V	CR308 RC409	KHP-12 KHP 65	C-4B C-4C C-3D	RP 20	HS 6000 HS 8000	TR-4S TR-9 TR-14
600	1600 9700C	B6 B6S	TC-151S TC-152V	RC920	KHP-25 KHP 135	C-6 C-6C		HS 11000	TR-21
900	9800 9801 2300	B8	TC-150S TC-301 TC-302V	RC2040 RC2041	KHP 210-11	C-8 C-8C C-10C C-12 C-12C	RP 40 RP 50	HS 20000 HS 22000	TR-40 TR-40M

Manually Guided, Self-Propelled, Vibratory, Tandem Drum (127.02.03.04)

CLASSIFIER	MAKE AND MODEL										
Min. Weight kg	Altrad Belle	APT	Bomag	Chicago Pneumatics	Dynapac	Ingersoll- Rand	Mikasa	Multi-Quip	Vibromax 2000	Weber MT	Wacker
400			BW 35 BW 65S BW 71E			DX-500E	V304 EH V304 EY	MRH601GS	W 50		RS 800A RS 800H RSS800A DPU5545
600	BWR650		BW 60HD BW 65S BW 65S-2 BW65 HD/E	MR7000	LP 650	DX-60 DX-70 DX-70E DX-600E	MR 8D MR 8G	MRH600GS MRH800DS2 MRH800GS	W 70		W 55T W 65T W 74A
800			BW 60S BW 65H BW 75S BW 75S-2		LP 750		MDR 9D MDR 9G MRH 800DS MRH 800GS				RD 7H RD7 RD 11 W 74T WH 74
1,200		WR85	BW 75AD-2 BW 90S BW 85T BMP 8500	TR630 TR850		FX-130	MRV 10G MRV 15 P 3324	RX1510C24 RX1510CI33 RX1575		TRC86 TRC88	RD 15H RT 560 RT 820

Self-Propelled, Vibratory, Single Pad Foot Drum (127.02.03.05)

CLASSIFIER	MAKE AND MODEL									
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Multi- Quip	Super Pac	Vibromax	Volvo / Ingersoll- Rand
1,000	BW 124PD BW 124PDH-3 BW 124PDH40			A36PD A40PD		C812C	P35K P48K P54K	540P 4010P		SD-25F
4,000	BW 142PD-2 BW 145PDH-3 BW 145PDH-5		CP-323C CP-34	CA121PD CA141PD CA121PD-PDB CA141PD-PDB	3205P	C822C		540P 600P 540PC	405-PD	SD-40F SD-45F SD-45
6,000	BW 172PD2 BW 177PDH-3 BW 177PDH-40 BW 177PDH-5	SV 210 SV 208	CP-433C CP-433E CP-44	CA151PD CA152PD	2322 DS 3307P	C832C		6620P	602B-PD 605-PD	SD-70F SD-75F SD-75 SD-77F
9,200	BW 211PDH-3 BW 213PDH-3 BW 213PDH-40 BW 213PDH-4i	SV 212	CP-56 CP-563C CP-563E CP54B CP56B	CA250PD CA252PD CA262PD CA301PD CA302PD	2422-D 3412P	C842C C852C		840P 8410P 8420P	1102-PD	SD-100F SD-105F SD-115F SD- 115D4 SD-116F
13,000	BW 218PD BW 213PDH-5	SV 216	CP-64 CP-76 CP-583 CP-68B CP-74B	CA302PD(2003) CA362PD CA512PD CA551PD CA602PD	2522-DS			8430P	1105-PD 1402-PD 1405-PD	SD-150F SD-160F SD-160
18,000	BW 219DH-5			CA602PD	3520P			8430P	1805-PD	SD-175F SD-180F SD-200F SD-200

Self-Propelled, Vibratory, Single Smooth Drum (127.02.03.06)

CLASSIFIER	MAKE AND MODEL									
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Multi- Quip	Super Pac	Vibromax	Volvo / Ingersoll- Rand
1,000	BW 122D BW 124D BW 124DH-S BW 124DH-40					C815C	S35K S48K	A300V 540 4010		SD-25D
4,000	BW 142D-2 BW 145D-3 BW145DH-5		CS-323 C CS-34	CA 121D CA 141D	2220 D	C820C C825C		540 (2003) 600	405-D	SD-40 SD-40D SD-45D SD-45
6,000	BW 172D-2 BW 177D-3 BW 177DH40 BW 177DH-5	SV208D SV280 SV210	CS-423 E CS-431 B CS 433 C CS 433 E CS-44	CA 150D CA 151D CA 152D	2320 D 3307	C830C C835C		6620	602B-D 605-D	SD-70 SD-70D SD- 75D SD-75 SD-77DX
9,200	BW 211D-3 BW 213D-3 BW 213DH-3 BW 213DH40 BW 213DH-4i	SV212	CS-54 CS-54B CS-56 CS-56B CS-563 C	CA 250D CA 251D CA 252D CA 262D CA 320D	2420 D 3412	C840C C850C C855C		8410 8420 840	1102-D 1105-D	SD-100 SD-100D SD-115 SD-115 D4 SD-105DX SD-116DX
13,000	BW 217D BW 213DH-5	SV216	CS-573 E CS-583 C CS-583 E CS-64 CS-68B CS-74 CS-74B CS-76	CA 302D CA 362D CA 511D CA 512D	2520-D			8430	1402-D 1405-D	SD-150 SD-150D SD-160 SD-160DX
18,000	BW 219DH-3 BW 219DK-4 BW 219DH-5		CS-78B	CA 620D	3520				1805-D	SD-175 SD-180 SD-200DX SD-200F SD-200

Self-Propelled, Vibratory, Tandem Drum (127.02.03.07)

CLASSIFIER		MAKE AND MODEL										
Drum Width m	Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Ingersoll-Rand	Multi-Quip	Vibromax 2000	Wacker	Volvo (Super Pac)
0.75	1,000	BW 80AD-2 BW 90AD BW 100SL-5 BW 120SL-5 BW120AD-5 BW 120AD-2 BW 120AD-3 BW 80D BW 120	DV201 DV201 DV23 DV26	CB-14 CB-14B CB-214B,C CB-214D CB-22 CB-24 CB-224B,C CB-224D CB-225D	CC 102 CC 122 LA 75 2100V	HD 10 HD 12		DD-22 DD-24 DD-28HF DD-30	AR13G AB13D	102 252 255 265	RD 11A RD 11V RD12A-90 RD16-90 RD 25 WHK 90L WHK4080 WHK5010	A421 A471 DD14S DD25
1.30	3,000	BW 130AD BW 135AD-5 BW 137AD BW 138AD-5 BW 138AD	DV36 DV45	CB-334D CB-335D CB-32 CB-34	CC 142	DV 3 * HD 13	C 754A C 754B C330B-3 ton C330B-5 ton	DD-32 DD-38HF		W 355 W 365 W 455 W 465 752C		DD38
1.40	6,000	BW 141AD-2 BW 141AD-5 BW 144AD-2 BW 151AD-2 BW 151AD-5	DV207	CB-434 CB-434C CB-434D	CC 211 CC 221 CC 222	DV 6 HD 70HV HD 75HV	C760C C340C-8 ton C340C-10 ton C350D-12 ton	DD-65 DD-70				DD70 DD70-HF
1.67	8,000	BW 161AD BW 161AD-2 BW 161ADS BW 164AD BW 161AD-5HF BW 174AP-4AM BW 174AP-4		CB-534B CB-44B	CC 232	DV 8 HD 85 HD 85-C HD 110HV	C766B C766C C350D-14 ton	DD-90		W 752B		DD90
1.67	10,000	BW 180AD BW 190AD-AM BW 202AD BW 202ADH-2	DV210 DV210C	CB-534D CB-634 CB-54 CB-54	CC 421 CC 422HF CC 522HF CC 722	DV 10 HD 110HV HD 130HV	C778B	DD-110 DD-130				
1.67	12,000	BW 184AD BW 284AD BW 205 BW 206AD-5	DV213	CB-64 CB-634D CB-63	CC 432 CC 622	HD 130HV	C784					DD118-HF DD112-HF DD132-HF DD138-HFA

* Hamm DV 3 Drum Width 1.10 m.

Self-Propelled, Static, Tandem Drum (127.02.03.08)

CLASSIFIER	MAKE AND MODEL					
Min. Weight kg	Bomag / Hypac	Dynapac	Lee Boy	Supercap	Volvo / Ingersoll-Rand	Weiler
1,200		2100	300	320		
4,000	BW 5AS BW 9AS BW 9ASW C 330B	CS 06T				
7,000	BW 11AS C 340C	CS 08T CS 10T			ST 60 ST 75	C307
10,000	C 350D	CS 12T CS 14T			ST 80 ST 105	C310

Self-Propelled, Static, Segmented, Four-Wheeled, Two Axles, Including Blade (127.02.03.09)

CLASSIFIER	MAKE AND MODEL	
Min. Weight kg	Bomag	Caterpillar
19,000	BC 462EB BC 572RB-2	815 F 815 F Series 2
30,000	BC 672RB-2 BC 772EB-4 BC 772RB-2	825 C 825 H 825 K

Self-Propelled, Static, Pneumatic Tires (127.02.03.10)

CLASSIFIER	MAKE AND MODEL						
Min. Weight kg	Bomag	Case	Caterpillar	Dynapac	Hamm	Hypac	Volvo/ Ingersoll-Rand
8,000	BW 11RH (4+5)		CW 14 PS 110 (5+6) PS 130 (5+4) PS 150B (5+6) PS 180 (5+4)	CP 141 CP 142 (5+4) CP 15 (4+5)	GRW 5 (5+4)	C 530A C 530AH C 560B (5+4)	PT 140A (5+4) PT 125R (4+5) PT 124R
18,000	BW 20R (4+4) BW 24R BH 24RH BW 27RH	PT 240R	CW 34 PF 300B PS 200B (5+4) PS 300B (3+4) PS 360C	CP 21 (3+4) CP 221 (3+4) CP 22 (4+3) CP 27 CP 271 (5+4) CP 301 (5+4)	GRW 10 (4+4) GRW 15 (4+4) GRW 18 (4+4) GRW 35 (4+4)		

127.03.04 CONCRETE EQUIPMENT**Slip Form Paver (127.02.04.03)**

CLASSIFIER	MAKE AND MODEL							
Power Kw	Curb Fox	Gomaco Corp.	Guntert and Zimmerman	Huron Mfg./ Overbuilt Paving and Mining	Miller Formless	Power Curbers	Rexcon	Terex Road Building
10	2000 3000 5000 5000-T	Curb Cadet		Easi-Pour 570		150 Extruder 440XL		
30		GT 3200 Commander II		Easi-Pour 650B				
70		GT 3400 GT 3600 GT 6000 GT 6300 4400 5700C		Easy Pour 880	M-1000 M-8100	5700C		
120		GP 2400 Commander III	S600	Easi-Pour 1000	M-8800	SF-2700 SF-3000 SF-1700		SF2204C
200		GP 2600 GP 4000 GHP 2800	S850 S1500				Town and Country	SF3502B SF3504B

Concrete Placing Equipment (127.02.04.06)

CLASSIFIER	MAKE AND MODEL						
Equipment Type	Gomaco Corp.	Guntert and Zimmerman	Heavy Equipment Mfg.	Power Pavers	Rexcon	Terex Bidwell	Terex Road Building
Concrete Deck Finisher	450 750 1750					2450 3600 4800	
Concrete Placer Spreader	RPT-500 PS 2600 PS 4000		MP 2500 PS 1230	PS-2700 PS-3000	Town and Country #1	PS3502	PS 3502 PS 6004
Concrete Texture Curing Machine	T/C-600 T/C-400B T/C-400	TC 850		TC-2700	2600	TC-360 TC3600M	
Concrete Conveyor	RC/Conveyor RC/Conveyor (wider)						

127.03.06**EARTH MOVING, GRADING EQUIPMENT****Scraper, Single Engine, Two-Wheel Drive (127.02.06.01)**

CLASSIFIER	MAKE AND MODEL		
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	Terex
10	611 621F 621G 621H 621K	260B	
16	631E 631G 651E		S-24C

Scraper, Twin Engine, Four-Wheel Drive (127.02.06.02)

CLASSIFIER	MAKE AND MODEL		
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	Terex
10	627F 627G 627H 627K	262-B	TS-14C TS-14D TS-14G
16	637E 637G 657E 671E		TS-24C
22	657G		

Scraper, Single Engine, Self-Loading (127.02.06.03)

CLASSIFIER	MAKE AND MODEL			
Min. Struck Capacity m ³	Caterpillar	Fiat-Allis	John Deere	Terex
6	613C 613C SII 613G		JD 762B	S17E
11	615C 615C SII 623F 623G 623H 623K	161	JD 862B	

Scraper, Pull Type (127.02.06.04)

CLASSIFIER	MAKE AND MODEL			
Volume m ³	Bron	Caterpillar	John Deere	Reynolds
6			1512C 1512E	12C10 14CS10 12E10 12.5E12 14E10.5 15.5E14 15CFB14
9	35 E 35 F	TS180 TS185	1510C 1612E 1810C 1810E 1814E 2112E	16CS10 17C12 17C12LGP 17CS12 17E10.5 17E10.5LGP 18CMX12.5 18CS14 20E12.5
13	63 E 63 F	TS220 TS225	1812C 1814C 2010E 2012C 2014E 2412E	

Tractor Bulldozer, Crawler Type (127.02.06.05)

CLASSIFIER	MAKE AND MODEL									
Minimum Net Flywheel Power kW	Case	Caterpillar	Dresser	Dressta	Fiat-Allis	Hanomag	John Deere	Komatsu	Liebherr	New Holland
50	550G 550H 650K 650L	D3C XL 111 D3CLGP111 D3C 111 D3G D3C, D4C D3K, D3K2	TD7G TD7H	TD-7H TD-7M			450E,G,H 450J 550G	D31 E and P D32 E and P D31EX-21 D31PX-21 D31EX-22 D31PX-22		D75
60	650G 750K 750L 750M 850D 850G 850K 850L	D4H,D5C D4C 111 D4C XL 111 D4CLGA111 D4G D4K D4K2 D5G D5K D5K2 D5XL 111	TD8G,H TD9H	TD-8H TD-8M TD-9H TD-9M	FD7 FD9	D500E	550G, H 550J 550K 650G, H 650J 650K	D32E-1 D41A D37 E and P D37EX-21 D37EX-22 D37PX-22 D38 E and P D38E-1 D38P-1 D39 E and P D39EX-22 D39PX-22 D39E-1 D39P-1 D41 E and P D41E-6 D41P-6	PR711 PR712B	D85 D95
80	850M 1150E,G 1150H 1150K 1150M 1450B 1550 1650K 1650L 1650M	D5H D5M LGP D5M XL D5NLGP D5N XL D5XL 111 D6K D6N LGP D6N XL D6K2	TD12 TD12G	TD-12C TD-15C TD-12C-XP	14C	D540E D600D	700H 700J 700K 750B, C 750BLT 750CII 750J 750K	D53A D65E D41E-6C D41P-6C D51EX-22 D61EX-15 D61PX-15	PR721 PR722B PR731	
120	1850K	D6RLGPD/S D6RLGP 11 D6RXL 11 D6RXW 11 D6T D7G, H	TD-20 TD15E	TD-15H	FD20	D700D	850B 850BLT 850C 850J 850K	D61EX-15EO D61PX-15EO D65 E and P D65EX-15 D65PX-15 D65EX-17 D65PX-17	PR732B PR741	
160	2050M	D7E D7R D/S D7RLGP 11	TD20G TD-25	TD-20H	FD30B		950J	D85E D85 E and P D85EX-15EO D85PX-15EO D155A D155AX-7	PR742B	
210		D8N, D9N D8R D/S D8R 11 D8T	TD25G	TD-25H			1050C 1050J	D155AX-3 D155AX-6	PR752	
280		D9R D/S D9T D10T2	TD40	TD-40C	FD40				PR751	
Note: The power rating should be obtained from equipment in use, as the models in the table above may span a number of years and categories/ratings.										

Tractor Bulldozer Ripper Attachment, Hydraulic, Rear Mounted (127.02.06.06)

CLASSIFIER	MAKE AND MODEL					
Power kW	Case	Caterpillar	Dresser/ Dressta	John Deere	Komatsu	New Holland
50	550H 650H 650K 650L 750H 750K 750L 750M 850H 850K 850L 850M 1150H 1150K 1150M 1650K 1650L 1650M	D3G D3K D3K2 D4G D4K D4K2 D5G D5K D5K2 D6K D6K2 D6NXL D6NLGP	TD7H TD8H TD9H TD12C-XP	450J 550J 550K 650J 650K 700J 700K 750J 750K	D37E-5 D41E-6 D31EX-21 D31EX-22 D37EX-21 D37EX-22 D37PX-21 D37PX-22 D39EX-21 D41E-6C D51EX-22 D61EX-12	D75 D85 D95
120	1850K	D6R D6T	TD15H TD15H/LGP	850J 850K	D61EX-15EO D65EX-12 D65EX-15 D65EX-17	
160	2050M	D7E D7R	TD20H	950J	D85E-21 D85EX-15 D85EX-15EO D85PX-15	
210		D8R D8T D8R LGP	TD25H	1050J	D155AX-5 D155AX-7	
280		D9R D9T D10T2	TD40C		D275A-2 D375A-3	

Wheeled Tractor, Farm, Industrial, Two-Wheel Drive (127.02.06.07)

CLASSIFIER	MAKE AND MODEL					
Power kW	AGCO	Case	John Deere	Kubota	Massey Ferguson	New Holland
10			790 990 1023E 3005 4210 4310	BX25 B26	GC1715 GC1750 MF 1215-2 MF 1225-2 MF 1230-2 1233-2 1240-2 1250-2 1726E	TC-18 TC-25 TC-29 TC-30 TC-33 TC-35
25			110 5045D 4005 5103 4044M 5105 4044R 5203 4052R 5205 4510 5220 4610 5225 5045	L39 M 4900 F	MF 451 1734E 1736 1739E 1749 1754 2615 2605	3010S 3415 Boomer 3040 TC-40 TC-45 TN-55 TN-65
40			5055 5320 5055D 5325 5065E 5403 5065M 5420 5210 5425 5303 6120 5310	M59	MF 471 240 240S 253 263 271 1758 1759	TN-70F TN-70 TN-75 TL-80 STD
50	LT 70 LT 85	570L 570 Mxt 570 Mxt Turbo	210LE 6210 5075E 6215 5075M 6220 5085M 6320 5410 6403 5510 6405 5520 6415 5525 6420 6110 6603		281 2635 4335 4345 4608 4609 5609 6255-2 M 6800 F MF 481	LT-90 TN-80F TN-95F T4.75 Powerstar STD U80B
70	RT 95 RT 115		5095M 6430 5100M 6603 6100D 6605 6105D 6615 6105M 6715 6115D 7210 6115M 7220 6230 7405 6310 7410 6330 7420 6410		4360 4370 5610 5611 5612 6265-2 6270-2 6280-2 6290-25	TM-120 TM-130 TM-140 TS6.110 TS6.120 TV-140
90	RT 130 RT 145		6125M 7330 6730 7520 7130 7610 7230 7710 7320 7810		5613 6290-2	TM-155 TM-175 TM-190 TS6.125 TS6.140
120			7210R 8120 7530 8130 7630 8220 7730			
160			7230R 7830 7930			

Wheeled Tractor, Farm, Industrial, Four-Wheel Drive (127.02.06.08)

CLASSIFIER	MAKE AND MODEL									
Power kW	AGCO	Case	Ditch Witch	Fendt	JCB	John Deere		Kubota	Massey Ferguson	New Holland
10						790 990 1025R 1026R 2025R 2032R 2210 2305 2320 2520 2720 3005	3032E 3033R 3120 3203 3320 4010 4110 4115 4210 4310 4410	L310 DT	MF 1205-4 MF 1215-4 MF 1225-4 MF 1230-4 MF 1233-4 MF 1235-4 MF 1240-4 MF 1250-4 MF 1260-4 1526 1532 1533	TC-18 TC-21 TC-25 TC-29 TC-30 TC-33 TC-35 Boomer20 Boomer24 Boomer25 Boomer30 Boomer33
25			3610 3700 3700CD 5110			110 990 3046R 3038E 3039R 3520 3720 4005 4105 4120 4320	4510 4610 4710 5045 5045E 5105 5202 5205 5220 5225	L3410 DT L3710 DT L4310 DT L4610 GST R4205 R5205 L39 L48	MF 451 1529 1540 2605 2615	TC-40 TC-45 TN-55 TN-65 2120 3010S Boomer35 Boomer37 Boomer40 Boomer41 Boomer47 Boomer50 Boomer3040 Boomer3045 Boomer3050
40					210SU	4520 4720 5055 5055E 5065 5065E	5210 5320 5325 5420 5425 6120	M6800 DT MX5700 DT	240 253 263 271 4325 MF 471	TN-70F TN-70 TN-75 TL-80
50		570L 570Mxt 570Mxt Turbo		409 410	212SU	210LE 5085E 5075E 5075M 5085M 5310 5410 5510 5520 5525	6110 6210 6215 6220 6320 6403 6405 6415 6603 7210	M6800 DT	281 MF 481 2630 4335 4345 4608 4609 5609 6255-4	TL-80F TL-90 TN-95F TS-90 TS-100 TS-100 TS-110 T4.75 T4.85F Powerstar STD U80B
70	RT 95 RT 115 DT 200 DT 225			411 412 712		5095M 5100E 5100M 5105M 5115M 6100D 6105D 6105M 6115D 6115M 6115R 6230	6310 6330 6410 6430 6605 6615 6715 7210 7220 7320 7420 7510	M100X M110X M126X M135X	4355 4360 4370 4610 4610LP 5610 5611 5612 6280-4 MF7614	TL-100 TM-120 TM-140 T4.95F T5.95 T4.105F T5.105 TS6.110 T5.115 TS6.120

CLASSIFIER	MAKE AND MODEL									
Power kW	AGCO	Case	Ditch Witch	Fendt	JCB	John Deere		Kubota	Massey Ferguson	New Holland
90	RT 130 RT 145			714 716		6105R 6125M 6125R 6130 6140 6730	7130 7230 7520 7610 7720		5613 6290-4 MF6614 MF6615 MF7615	TM-155 TM-175 TS6.125 TS6.140 T7.175
110	DT 160 DT 180			918		7330 7530 7810	8120 8130 8220		MF6616 MF7616 MF7618 MF7619	TM-190 T7.210
135	DT 200			920		7630 8220 8230			MF7620 MF7622	T7.190 T7.230 T7.245
150	DT 225			924		7210R 7230 7730 7830	8320 8330 8420 9120		MF7624 MF7626	
180				926		7250R 7270R 7290R 7310R	7930 8430 9320 9420			

Motor Grader, Articulated Frame (127.02.06.09)

CLASSIFIER	MAKE AND MODEL							
Min. Operating Wt. kg	Case	Caterpillar	Fiat-Allis	Galion/ Dresser	John Deere	Komatsu	New Holland	Volvo/ Champion
11,500	845	135 H 140 H		830 850	670B 670C Series II 670CH Series II	GD530A GD530AW-2C GD555-3 Laterra GD650A GD650AW	RG 140	C70A 710A 710A VHP
14,000	845B 865 865B	12H 143H	FG 70A-B FG 75A-B FG 85A-B	970	770B 672CH Series II 770CH Series II 772CH Series II	GD650A-2C GD650AW-2C GD670A GD670AW GD750AW GD555-3 GD655-3	RG 170	710A 720A 720A VHP G710B G720B
15,500	865B AWD	160H 163H			670G 672G 770G	GD670AW-2C GD670A-2C GD675-3 Laterra GD675-3	RG 200	730A 730A VHP 740A 740A VHP G730B E740B G930 G930B G940 G940B
17,000	885 885B	14H 12M 120M 12M3 140M3 160M3	FG 105A-B		670G 672G 770G 772G 870G 872G	GD750A-1		750A 750A VHP 780A 780A VHP G780B G946 G946B G960 G960B G970 G976
22,000		16H 14M 16M 140M 160M						G990

Spreader Attachment (127.02.06.12)

CLASSIFIER	MAKE AND MODEL
Equipment Type	Midland
Grader/FEL - Shouldering	SA-1 WA-1

Shoulder Spreader/Road Widener (127.02.06.13)

CLASSIFIER	MAKE AND MODEL		
Spreader Width m	Blaw-Knox	Midland	Weiler
2		SP-8 SPD-8	W430
3	RW-100A RW-195D	SP-10 SPD-10 SPD-12	W530 W730

Reclaimer/Stabilizer (127.02.06.14)

CLASSIFIER	MAKE AND MODEL					
Equipment Size kW	Bomag	Caterpillar	CMI	Hypac	Roadtec	Wirtgen
250	100R 100S 100S-DM MPH 362R MPH 362S MPH 362SDM MPH 364S MPH 364S-2 MPH 364R MPH 364R-2 MPH 364SDM PH 364SDM-2 RS446D	RM250C RM 300 RR250B SS250B	RS-350 RS-446	MPH 362 SDM	SX-2e	WR 200i WR 2000 WR 2000XL
325	MPH 122 MPH 122-2 MPH 454S	RM350B RM500	RS-425 RS-425B RS-500B RS-500C	MPH 364R MPH 364S MPH 454R MPH 454S	SX-4e	SS Raco 350 WR 2400
440	MPH 125		RS-600C RS-650 RS-650B RS-800 RS-950B		SX-6e	WR 240i WR 2500S WR 2500SK 2200CR
500	RS950B				SX-8e	WR 250

Grade Trimmer (127.02.06.15)

CLASSIFIER	MAKE AND MODEL	
Minimum Width m	CMI	Gomaco
2	TR 3503 TR 4503	
3	TR 6004	9000 9500

127.03.07

EXCAVATION EQUIPMENT

Hydraulic Excavator, Crawler Mounted (127.02.07.02)

CLASSIFIER		MAKE AND MODEL													
Min. Oper. Weight kg	Nominal Bucket Size m ³	Bob-cat	Case	Caterpillar	Daewoo	Fiat-Allis	Hitachi	John Deere	Kobelco	Komatsu	Kubota	Liebherr	Linkbelt	Samsung	Volvo
1,000		320 325 331		300.9D 301.6C			EX17U EX27U	17ZTS 28CZTS		PC12R-8 PC15R-8 PC27R-8	KX018 KX91				EC20C ECR28
3,000				304DCR	DH50		EX35U EX80-5	35CZTS 17D 27D	30SR-3 35SR-3	PC35MR-2 PC35MR-3					EC35C
4,000			CX36B CX50B				EX50	50CZTS	50R 50SR-3	PC45MR-3 PC50MR-2 PC58UU-3	KX040 KX121			SE50-3	EC20C EC55 EC55C ECR58
6,000			9007B CX75MSR	305E CR 305.5E CR 307B 307D 308E2 308CR/SB 311B			EX110	80 190E 50D 290D	55SRX SK75R SK70SR SK85SR	PC60-7 PC78-8 PC95	KX057		1600		EC55C ECR58D ECR88 ECR88D
12,000	0.3		9010B CX130 CX130B CX130C CX135SR CX160C	312BL 312D 312E 314D 314E 316E 318E 311F RR		FX130LC	EX120 EX150	110 120 490D	SK135SR SK140SR	PC120-6 PC130-8	KX080		2650 LS2650	SE130LC-3	EC140B EC145D EC160D
15,000	0.5		9020B CX160 CX160B	315BL 318BL	DH170		EX160 EX200	590D 160LC		PC150LC-6 PC170-6 PC138LC-8		R900	2700 LS2700		EC145 EC150 EC160
19,500	0.7		9030B CX210 CX210C	319DL 320DL 320L	DH220LC	FX210LC	EX220 EX200LC-5 Zaxis 200	690ELC 200LC 210G LC	SK200SR SK210LC	PC200LC-6 HB215LC-1		R317 R900C R902 R904 - LITRONIC R912 R914 - LITRONIC	2800 LS2800	SE210LC-3	EC210B EC220D
23,000	1.0		9040B CX240 CX250 CX300C	320EL 321D 321D LR 322L, BL 326FL	DH280	FX250LC	EX230-5 EX270	790ELC 230LC 245G LC	SK230SR SK235SR SK260LC SK260SR	PC220LC-6 PC228LC-8 PC240LC-10 PC250LC-6		R906 R922 R924 - LITRONIC R932	3400 LS3400	SE240LC-3	EC240B EC240C EC220D ECR235D
26,500	1.2		9045B CX290 CX300	325BL 326FLCR 329FL 336EH 336F	DH320	FX310LC	EX270-5 EX300	270LC 290G LC 892	SK290LC	PC270LC		R934 - LITRONIC R942	3900	SE280LC-3	EC290B EC290C EC300D
32,000	1.5		9050B CX330 CX350 CX350C	328D 328DLCR 330BL 330L 336DL			EX330LC-5 EX370-5 EX400 EX450	330LC 350G LC 370	SK330LC SK350 LC	PC300LC PC360LC-10		R944 - LITRONIC	4300	SE350LC-2	EC330B EC330C EC340D EC360B EC360C EC380C
44,000	1.7		9060B CX460 CX470 CX470C	345BL 345DL 349F 350L	DH450		EX450-5	450LC 470G LC	SK480LC SK500LC	PC400LC PC400HD		R945B - LITRONIC R954/C R964/C	5800 LS5800	SE450LC-2	EC460B EC460C EC480D
55,000			CX700B	365BL			EX550 EX550-LC Zaxis 600	600LC		PC600LC					

CLASSIFIER		MAKE AND MODEL													
Min. Oper. Weight kg	Nominal Bucket Size m ³	Bob-cat	Case	Caterpillar	Daewoo	Fiat-Allis	Hitachi	John Deere	Kobelco	Komatsu	Kubota	Liebherr	Linkbelt	Samsung	Volvo
70,000	2.0		CX800 CX800B	374DL 374FL 375L 375BL 385CL 390FL			EX700 EX750-LC Zaxis 800	670G LC 750 800C		PC750			8000		EC700 EC700C
100,000	5.0			5080 5090			EX1100	870G LC		PC1100-6					

Hydraulic Excavator, Rubber Tired (127.02.07.03)

CLASSIFIER	MAKE AND MODEL							
Min. Operating Weight kg	Badger	Caterpillar	Daewoo	John Deere	Komatsu	Liebherr	Samsung	Volvo
11,000		M312 M315 M318 M313D M315D	DH130W	595	PW170 PW170ES-6 PW160-7 PW140-7	A308 A900 A309 - LITRONIC A311 - LITRONIC A312 - LITRONIC A314 - LITRONIC A316 - LITRONIC	SE170W3	EW160C
18,000	1085C	M320 M316D M318D	DH200W	190D W	PW200-7 PW180-7	A900C - LITRONIC A904C - LITRONIC A904 - LITRONIC A914 - LITRONIC A924 - LITRONIC		EW180B EW180C
21,000		M322D		220D W	PW220-7	A914C - LITRONIC A924C - LITRONIC		EW210C EW230C

Telescopic Boom, Carrier Mounted Excavator (127.02.07.05)

CLASSIFIER	MAKE AND MODEL	
Weight kg	Badger	Gradall
15,000	450-4X2 450-4X4 460-6X4 460-6X6 470 TM 4x2 470 TM 4x2 A 470 TM 4x4 470 TM 4x4 A	65WD XL3100 XL3100IV XL3300
22,000	670-6X4 670-6X6 888-6X4 888-6X6	XL4100 XL4100-II XL4100IV XL4300-II XL5100 XL5100IV

Telescopic Boom, Crawler Mounted Excavator (127.02.07.06)

CLASSIFIER	MAKE AND MODEL
Weight kg	Gradall
17,000	XL3200 III XL3300 III
20,000	XL4200 XL4200 III XL4300 III
23,000	XL5200 XL5200 III XL5300 III

Tractor with Loader/Backhoe Combination, Two-Wheel Drive (127.02.07.07)

CLASSIFIER		MAKE AND MODEL						
Minimum Power kW	Nominal Bucket Size m ³	Case	Caterpillar	JCB	John Deere	Komatsu	Massey Ferguson	Volvo
45	0.7	580L 580M 580N	416B 416C 416D 416E 426B	214 E IV 214 III 3C 14FT 3C 15FT 3CX 14FT	310D 310E			
60	1.3	580SL 590SL 580M Turbo 580N 580 Super M 580 Super M+ 580 Super N 590 Super M	416F 420D 420E 420F 426C 430D 436B 436C 446B	214 214E 215 215 E III 217 217 III	310J 310K 310SE 310SK 310SJ 310SJTMC 410D 410E 410J 410JTMC 510D	WB150-2	50HX 60	BL60 BL60B
75	1.3	590 Super N	446B 446D		410K 710D			
94	1.3				710J 710K			

Tractor with Loader/Backhoe Combination, Four-Wheel Drive (127.02.07.08)

CLASSIFIER		MAKE AND MODEL						
Minimum Power kW	Nominal Bucket Size m ³	Case	Caterpillar	JCB	John Deere	Komatsu	Kubota	Volvo
30	0.5			208S Midi CX	110 TLB		L39 L45 M59	
45	0.7	580L 580M 580M Turbo 580N	416B 416C 416D 420D 426B 436	210S 212S 214 214 IV 215E 2CX 12FT	310D 310G 310J 310SG 315SG 410D	WB142-5		BL60
65	1.3	580SL 580 Super M 580 Super M+ 590 Super M 590 Super M+ 580 Super N 580 Super NWT	416E 416F 426C 430D 437C 446D 420E/IT 420F 430E/IT	214E 214 III, S, SM 215 215 III, S 217 217S 217 III 3C 14FT 3C 15FT 3CX 14FT 3CX 15FT 3CX 17FT 4CX 14FT 4CX 15FT 4CX 17FT	310K 310SJ 310SJ TMC 310SK 315SJ 315SK 410E 410G 410J 410J TMC 510D	WB146-5 WB146PS-5 WB156-5 WB156PS-5		BL60B BL70 BL70B
80	1.3	590 Super N	430F 446B 450E		410K 710D 710G			
94	1.3		450F		710J			

Front End Loader, Crawler Mounted (127.02.07.10)

CLASSIFIER		MAKE AND MODEL			
Power kW		Caterpillar	Fiat-Allis	John Deere	Liebherr
50	933 933C 939C			455G 555G	LR611
70	953B 955C 939		FL145	605C 605K 655C	LR614 LR621C LR622 - LITRONIC
100	755C 936B 939C 953C 953D 960C 963C 963D		FL175	655C-II 655K 755C 755K	LR614 LR624 LR631C LR632 - LITRONIC LR634
150	973 973B 973C/D 973D			755C-II	LR641C LR641 - LITRONIC

Front End Loader, Rubber Tire, Four-Wheel Drive (127.02.07.11)

CLASSIFIER	MAKE AND MODEL											
Power kW	Case	Cat	Dresser	Fiat-Allis	Hyundai	JCB	John Deere	Kawasaki	Komatsu	Liebherr	New Holland	Volvo
40	21E 221E 221F 321E 321F	914G	510C	FR70 FR90		210SL 406 407B ZX 409 409B ZX 411 411B HT 411 HT	244E 244H 244J 304H 304J 324H 344G 344H 344J	WA95-3 50Z IV	WA120-1 WA65-5 WA70-5 WA80-5 WA100-5 WA150-5	L512 L525		L20B L20F L25B L25F L30B L30G L35B L35G L40B L45B L50C L50D
75	521D 521F 621B 621C	924F 924G 924H 928F 928G	515C	FR100 FR120.2	HL 740-7	416 416B HT 416 HT 426 HT 426B HT 426B ZX	444G 444H TC 44H 544G 544H TC 54H	60Z IV 65Z V 70Z V-2	WA120-3 WA120L-3 WA180-1 WA180-3 WA250-3 WA250-5	L522	W110B	L45G L50G L70C
100	521E 621D 621F 721B 721C	928HZ 930G 930H 938F 938G	520C 532	FR130.2 FR140.2		426 ZX 436 HT 436B HT 436B ZX	544J 624G 624H TC 62H	65Z IV-2 65Z V 70Z IV-2	WA250-1 WA300-3 WA320-1 WA320-3 WA320-5	L531-B L541-B L542	W130B	L60E L60F L60G L70E L90C
125	621E 721D 721E 721F 821B 821C 821D	938-II 938H 939 950F 950G 950H 962G		FR160.2 FR180.2		456B ZX 456 HT 456 ZX 950G	624J 644E 644G 644H 644J 644H MH	70Z V 80Z V	WA380 WA380-5 WA400-5	L544 L550 L556	W170B W190B	L70F L70G L90E L90F L90G
150	821E 821F 921B 921F	950K 960F 962K 966F 962G-II	545	FR220.2	HL 760-7		724J 744E 744H 744H MH	80Z IV-2 85Z IV-2 85Z V-2	WA420 WA420-1 WA430-6	L551		L110E L120C L120E
175	921C	962H 966G 966H			HL 770-7		744J		WA450-5	L564 L566		L110G L120F
200	921D 1021F	921E 970F 972G 966G-II 966K 972K					824J	90Z IV-2 90Z V	WA450-1 WA450-3 WA480-5 WA500-1	L576 L580		L120G L150C L150E L180C
225	1121F	980G			HL 780-7		844J	95Z IV-2	WA500 WA500-3			L180E L220D
250		980H 980K						95Z V	WA500-6	L586		L220E
300		988F 988G 988H 990	560B					115Z IV-2 115Z V	WA600-1 WA600-3 WA700			L330C L330E L350F
400		988K 990H 990K 992G						135Z V	WA700-3			L350F

Skid Steer Loader, Rubber Tire (127.02.07.12)

CLASSIFIER	MAKE AND MODEL									
Lift Capacity kg	Bobcat	Case	Caterpillar	Gehl	JCB	John Deere	Mustang	New Holland	Thomas	Volvo
300	463 553 S100 S130 443B 543B 743B 753 753H	40 XT 1825B 1825 1838 410 SR130	216 226	3935 4635 SXT SL3410 SL3825 SL4625	160 170 165 Robot	240 313 315	2022 2032 2044	L213 LS120 LS125 LS140 LS150	85 105 135 T83 T103 T105 T133S	MC60 MC70
700	S160 S175 S185 S510 S530 S550 7753 853 853H	1845 1845C 420 SR160 SR175 SV185	232 236	4835 SXT SL5625		250 317	2054	L218 LS160 LS170	153 175 T173	MC60C MC70C MC80
850	A220 S205 S220 S570 S630 SR175 SR220	70 XT 75 XT 85 XT 430 435 440 SR210	242 246 248 252 260	5635 SXT 6635 SXT SL6625	190 185 Robot	260 320	2064 2074	L220	225 245HF T183 T203 T233HD	MC85C MC90 MC95C
1,000	A300 S250 SR250 SV250	90 XT 445 SR220	262 270		185 Robot	325		L223 L225 LS180	255	MC110 MC115C MC155
1,200	S300 S750 S770	95XT 465 SV300	280	7600 7800	1110	318D 318E 320D 320E 328 332	2095 2105	L230 LS190		MC135 MC135C
2,500	S650					328D 328E 332D 332E				

Skid Steer Loader, Tracked (127.02.07.13)

CLASSIFIER	MAKE AND MODEL						
Tipping Load * kg	Bobcat	Case	Caterpillar	John Deere	New Holland	Kubota	Volvo
900	T140					SVL75	MCT85C
1,100	T180 T550	420CT					MCT 125C
1,300	T590	440CT 445CT	279C	CT322	C175		MC 135C
1,600	T190 T250	450CT	289C		C185		
1,800	T300 T630 T650 T750 T870	TR270 TR320 TR380 TV380	299C	CT315 CT319D CT323D CT323E CT329D CT329E CT332 CT332D CT333D CT333E	C190	SLV90	
* SAE - Rated Operating Capacity @ 50% Tipping Load							

Skid Steer Loader, Attachments (127.02.07.14)

CLASSIFIER	MAKE AND MODEL																
Attachment Type	Bob-cat	Case	Caterpillar	Clean-sweep	Gehl	John Deere	New Holland	Tele-dyne	Thomas	Volvo	Bore Pig	ETerra	Bradco	Quick Attach	Arrow-head	FFC	Sweep-ster
300 mm Auger	AB	CA15			300 A		300 P		AU 19	NR 3-10	9PD 12PD 15PD 19PD	3500 4500					
Backhoe		D100 D125							XR 911				509 511	QA640 QA940			
Breaker	BR		H45/H45S		550 BK	HB 15			HB 102					210SX 310SX 360SX	S30 S40 S50 S60		
Scarifier														Quick Tiller 66 and 78			
Sweeper			BA18	AMH72	72 BR	BA72	560B	TB 125	AB 101	ABR10-2							
Multi-Bucket	MB411				36 MB	MP66	40B-ML			MBU-2-10							
Power Rake	PR				65 PR	PR72			MB 106					RSC72 RSC84 FSC72 FSC84			
Steel Tracks	STR	Grouser 120 GR10 GR12 GR14	ST18			ST32	45T-ST			STR8-10							
Trencher	TR				24TR	TR48	16TR			TRE14-10				Mini Trencher Standard Trencher			
Cold Planer	CP	Alitec 30	PC4		16 CP	CP12	16C		CP 110	PL4-10			SP300 HP450 HP750 HP1000			FFC16 FFC18 FFC20 FFC30 FFC36	
Pick Up Broom	PB		BP18		72PB	PB72											SB60 SB72 SB84 VRS5 VRS6 VRS7 VS5 VS6 VS7

Chain Type Trenching Equipment (127.02.07.15)

CLASSIFIER	MAKE AND MODEL				
Power kW	Astec	Case	Ditch Witch	Toro	Vermeer
13	RT 60 RT 130 RT 160 TF 300B	TF300B	1820 RT12 RT25 100SX	TRX20 TRX26	RTX150 RTX250
20	RT 360 RT 460	360 460	3610 3700 RT36 RT40 RT45		LM42 PTX44
35	RT 560 RT 560 Quad RT 660 RT 669 Quad	560 660	3700 CD 5110 5700 RT55 410SX 420SX	RT600	
50	RT 960		7610 8020 RT70 RT75 RT80Q RT90 RT100 RT95 RT120 RT115	RT1200	T455 T555 T655

127.03.08 HAULAGE EQUIPMENT**Dump Trucks, Off Highway, Rigid Frame (127.02.08.14)**

CLASSIFIER	MAKE AND MODEL			
Payload kg	Caterpillar	Euclid/Hitachi	Komatsu	Terex
30,000	770	R35		3305B TR35 TR40
35,000	769C 769D 770G	EH650	HD325-6	3340 3345
38,000	771D 772 772G	EH700 EH750-3	HD325-7 HD405-7	TR45
50,000	773D 773E 773F 775E 775F 773G	EH1000 EH1100 EH1100-3	HD465-7 HD605-7	3360B 3310E TR60 TR70
75,000	777D 777F 777G	EH1600 EH1700 EH1700-3		TR100

Dump Trucks, Off Highway, Articulated Frame (127.02.08.15)

CLASSIFIER	MAKE AND MODEL								
Payload kg	Caterpillar	Hitachi	John Deere	Komatsu	Link Belt	Moxy	Terex	Volvo	Bell
20,000	D25D D250E 725 725C 725C2	AH250-D	250D 250D Series II		D25		2566C 2766C TA25	A25B A25C A25D A325F A25G	
26,000	D30D D300D D350E 730 730C 730C Ejector 730C2 730C2EJ	AH300-D	300D 300D Series II	HM300-1 HM300-2	D300	MT30X	3066C TA30	A30C A30D A30F A30G	
30,000	735 735B	350D	350D	HM350-1		MT36	TA35	A35C A35D A35F A35FFS A35G A35GFS	B35D
35,000	D40D D400D D400E 740 740 Ejector 740B 740B Ejector	AH400-D	400D	HM400-1 HM400-2		MT40B	4066C TA40	A40 A40D A40F A40FFS A40G A40FFS	B40D
40,000								A60H	B45D B50D

127.03.09
HOISTING EQUIPMENT
Boom Truck (127.02.09.01)

CLASSIFIER	MAKE AND MODEL					
Lift Capacity kg	National Crane	Terex	Maintex	Manitowoc	Altec	Tadano
7,000	300C 400B	BT 2047				TM-1052
11,000	300 C * 400 B * 500D 500E 600D 600E	3063B 3470 3874	1703 C 1704 C	1770 C 1781 C	AC 18-70B AC 18-70B HL AC 18-70R HL	TM-1882 TM-20110
19,000	800D * 900A * 900H * 500 E2 NBT 14 NBT 15 NBT 16 600E 600D 600 E2 600 H	BT3870 4485 4792 BT 3870 S	2601 C 2801 C	26101 C 22101 S 2892 S	AC 23-95B AC 26-103B AC 23-95R AC 26-103R	
25,000	800 D * 800 H 900 A * 900 H * NBT 30 H 1100 1300 1400 1500 1800 NBT 36 NBT 45 NBT 55 1400 H	BT 4792 BT 28106 BT 70100 RS 70100 5092 60100	102 WL 3001 3001 C 3500	2892 C 2892 C-HYACS 38100 HL 38124 HL	AC 38-103S AC 30-103S AC 28-130B AC 38-127S AC 40-152S AC 45-127S	

* May be either capacity depending on equipment year of manufacture.

Hydraulic Crane, Rough Terrain (127.02.09.02)

CLASSIFIER	MAKE AND MODEL							
Lift Capacity kg	Broderson	Grove	Link Belt	Badger	Tadano	Zoomlion	Liebherr	Terex
13,000	IC 200-3G IC 250-3D IC 200-F IC 250-A IC 250-3C RT 200-E RT 300-B RT 300-C RT 300-2E			CD 4415	TX 150XL			208S
20,000		RT 530E2 RT 540E RT 525E RT 530E TR 540E	ATC 822 C 8030-SII RT 8030-II RTC 8030 RTC 8040	CD 4430	TR 300XL-4 TR 450XL-4			CD 200 RT 200 RT 300-1 RT 230-XL
40,000		GMK 2035 GMK 3050 GMK 3055 RT 600E RT 700E RT 765E2	C 8050-SII RTC 8050 RTC 8050-IV RTC 8060 RTC 8065		ATF 500XL TR 450XL-3 TRX 600XL-4 TRX 650XL-4			RT 500-1 RT 555-1 RT 345-XL RT 670-1
65,000		GMK 4090 GMK 5120B GMK 5240 GMK 6250 GMK 6250L GMK 7550 RT 770E RT 875BXL RT 875C RT 880E RT 890E RT 9100 RT 9130E	C 8065-SII C 8080-SII C 8090-SII ATC 3130 RTC 8075-II RTC 8080-II RTC 8170		ATF 650XL ATF 1300XL TR 800XXL-4	RT75	LRT 1090-2.1	600-1 RT 670 RT 700 RT 780 RT 780-1 RT 100
100,000		RT 9100 RT 9130E RT 9130E-2 RT 9150E	C 80110-SII C 80130-SII RTC 8090 RTC 80100 100 RT C 80150-SII			RT100	LRT 1100-2.1	RT 130 RT 1000 RT 1100 Quadstar 1100

Hydraulic Crane, Carrier Mounted (127.02.09.03)

CLASSIFIER	MAKE AND MODEL				
Lift Capacity kg	Grove	Liebherr	Link Belt	Tadano	Terex
12,000			ATC 822		
25,000	TMS 500E TMS 500E2	LTM 1030-2.1 LTM 1035-1 LTM 1040-2.1	HTC 8640 HTC 8640 Heavy Lift	TT 300XL	T 340-1 T 340-1-XL T 230 T 300 T 335 T 340 T 700
45,000	TMS 700E GMK 3050-1	LTM 1045-3.1 LTM 1050-3.1 LTM 1055-3.1 LTM 1045-1 LTM 1055-1 LTM 1055-3.2	HTC 8660 HTC 8650 HTC 11100	TT 600XL	T 490 T 500-1 T 560
60,000	TMS 800E TMS 900E * GMK 3060	LTM 1060-1 LTM 1070-4.1 LTM 1080-1 LTM 1070-4.2	HTTO 8675-SII HTC 8670LB HTT 8675 HTT 8690 HT 8675LB	TT 800XXL *	T 560-1 T 780-1 T 750 T 780 T 790
90,000	TMS 900E * TMS 9000E GMK 5465-2	LTM 1090-4.1 LTM 1100-4.1 LTM 1100-4.2 LTM 1100-5.2 LTM 1095-5.2 LTM 1100-5.1 LTM 1090-2 LTM 1095 LTM 1100-2 LTM 1130-5.1 LTM 1095-5.1	HTTO 86100	TT 800XXL *	Roadmaster 9000
135,000		LTM 1150-1 LTM 1160-2 LTM 1200-1 LTM 1160-5.1 LTM 1160-5.2			
200,000		LTM 1250-1 LTM 1300-1 LTM 1500 LTM 1800 LTM 1200-5.1 LTM 1220-5.2 LTM 1250-5.1			
250,000		LTM 1250-6.1	ATC 3275		
300,000		LTM 1300-6.1 LTM 1350-6.1 LTM 1300-6.2			

* May be either capacity depending on equipment year of manufacture.

Lattice Boom Crane, Crawler Mounted (127.02.09.04)

CLASSIFIER	MAKE AND MODEL					
Lift Capacity kg	American Crane	Kobelco	Liebherr	Link Belt	Manitowoc	Terex
32,000			HS 833			
50,000	5299A 5300		HS 835 HD	108 HYLAB 5 LS-108 H II LS-138 H II LS-208 II		
70,000	HC 80 7225A	CK 800 III CK 850 III CK 850 G		138 HYLAB 5	Model 111 8500-1 8000-1	HC 80
90,000	7260 HC 110 HC 125 9260	CK 1000 III CK 1100 G	HS 855 HD HS 860 HD HS 885 HD LR 1090 LR 1100	LS-218 H II LS-308 H II 218 HSL	Model 222 11000-01 12000-01 10000 10000 B1 10000 A1	HC 110
130,000	9299 HC 150 HC 210	CK 1600 II CK 2000 II CK 1600 G	LR 1130 LR 1160	238 HSL LS-238 H LS-248 H II 248 HYLAB 5	Model 555 Model 777 MLC 165	HC 165
200,000	9310A 9320		HS 895 HD LR 1200	248 HSL	Model 888	HC 230
250,000		LR 1200 SX LR 1250 LR 1300 SX LR 1280 LR 1300 CK 2500 II	LR 1250	348 HYLAB 5 * 298 HSL	Model 999	HC 275

* May be either capacity depending on equipment year of manufacture.

Lattice Boom Crane, Carrier Mounted (127.02.09.05)

CLASSIFIER	MAKE AND MODEL			
Lift Capacity kg	American Crane	Liebherr	Link Belt	Manitowoc
60,000	5530		HTT 8675 HT 8675 LB	
110,000	7150 8470 9460 9480		HC-238 HII HC-248 H	777T
270,000	9490	LG 1550 LG 1750	HC-278 HII	

Aerial Bucket Lift, Truck Mounted, Including Truck (127.02.09.06)

CLASSIFIER	MAKE AND MODEL				
Platform Height m	Altec	Elliot	Mobile Tool International	Terex	Versalift
7.0	AT200AV		P3	T292	TEL-29-N Vantel 29N/1
10.0	AO442 AT248F AT35G AT37G L42A TA36 TA37 TA40 TA41	M43R	83G-36 U3	HR37 HR46 L13i LT38 LT40 LTM40 SC40 T292 TL36P TL37 TL41 TL45	SST37E1H SST-37-EIH VO431 VST-40-I VST-47-I
15.0	AA55E AM50 AM55 AM650 AM855 AT37G CLASS A 50 LRV52 LRV55 TA50 TA55S TA60	G50F H60F H70R	83G-42 829-45 829-50 U5-50 805B-50 805B-55	HRX60 OM50 SCM55 TC55 TC65 TCX55 TL 45 TL50 TL55 TL60 XT PRO 56 XT PRO 60	LT56 VO255/260 VO-270E VO350/355 VST-47-MHI VST5000-6000
20.0	A77TE93 AN67-E100 CLASS A 70 CLASS A 77T	G85F G85R H70F I70F I85F		TCX65/100 TM100 TM125 XT PRO 60/70	VO-270-I VST7500 VXD 50

Aerial Bucket Lift, Self-Propelled, Telescopic/Articulating (127.02.09.07)

CLASSIFIER	MAKE AND MODEL					
Platform Height m	Genie	Grove	JLG	Skyjack	Snorkel	Terex
9.0	A-30/20 Z-30/20N Z33/18 Z34/22 DC Z-34/22N Z34/24 IC		340AJ E300AJ H340AJ	SJ30 AJE SJ30 ARJE	A38E TB 37	TA 33 TA 34
12.0	S40 S45 S60X Z34/22N Z40/23N Z40/23N RJ Z-45/25 Z-45/25DC Z45/25J DC Z45/25J RT		400S 400SJ 450A 450AJ 460SJ E400AJP E400AJP-N E400A-N E450A E450AJ M450A M450AJ	SJ40 T SJ45 T SJ46 AJ SJ61 T	400S 460SJ 660SJ A46JE A46JRT AB 50J T 46J TB 42 TB 42J TB 47J TB 50 UNO41	TA 40E TA 50E TA 50RT TB 42 TB 50
18.0	S60X S60 S65 Z-60/34 Z60/37 DC Z62/40	A60J Type I A60J Type II T60 T60 Type II T65T	600A 600AJ 600AJN 600AN 600S 600SC 660SJ 660SJC E600J E600JP M600J M600JP	SJ63 AJ SJ66 T	600S AB 60J TB 60 TB 66J	TB 60 TB 66
22.0	S80 S80X S85 Z80/60	A80J T80 T86J	740AJ 800A 800A 800AJ 800HX 800HX6 800S 860SJ	SJ82 T SJ85 AJ	AB80J AB85J TB 80 TB 85J TB86J	TB 85
30.0	S100 S105 S120 S125		1200SJP 1250AJP		TB100J TB120 TB126J	TB100 TB110
41.0	SX-135XC SX-150 SX-180 ZX-135/70		1350SJP 150 HAX 1500SJ 1850SJ			

Scissor Lift, Self-Propelled (127.02.09.08)

CLASSIFIER	MAKE AND MODEL				
Platform Height m	Genie	JLG	Skyjack	Snorkel	Terex
4.0	GS-1530 GS-1930 GS-2032 GS-2046	1532E3 1930ES 1932E2 1932R 2030ES 2032E2 2032ES 2033E3	SJIII 3015 SJIII 3215 SJIII 3219 SJIII 3220 SJIII 4620	S3219E	TSM 20
7.0	GS-2632 GS-2646 GS-2668 GS-2668 RT GS-2669 BE GS-2669 DC GS-2669 RT	260MRT 2630ES 2632E2 2632ES 2643E2 2646E3 2646ES 2658	2409 SJ 4626 SJ 6826RT SJ 7127 SJIII 3226 SJIII 4626 SJIII 6826	S3226E S4726E S2770RT	TSM 25RT TSM 26
9.0	GS-3232 GS-3246 GS-3268DC GS-3268RT GS-3369 GS-3369 BE GS-3369 DC GS-3369 RT GS-3384RT GS-3390RT GS-4047 GS-4069 BE GS-4069 DC GS-4069 RT GS-4390 GS-4390RT GS-5390 GS-5390 RT	3246E2 3246ES 3369LE 3394RT 339RT 3669ES 4069LE 4394RT 439RT 500RTS 530LRT	4832 6832 8831 8841E 9250RT SJ 6832 RTE SJ 6832RT SJ 7135 SJ 8243 SJ 8831 SJ 8831 RT SJ 8841 SJ 8841 RT SJ 9250 SJ 9250 RT SJIII 4632 SJIII 4740 SJIII 6832	S4732E S3370RT S3970RT	TSM 30 TSM 30RT TM54RT

Tool Carrier (127.02.09.09)

CLASSIFIER	MAKE AND MODEL				
Power Rating kW	Case	Caterpillar	JCB	John Deere	Komatsu
40	570 XT 570N EP 570 NXT	IT 14G * 907M 906M 908M 910K 914K 910M	411-HT*	310SJ TMC	
75		IT 14G 914M 918M	411-HT 416-HT 417-HT	410SJ TMC 410SK TMC 444K	WA200PT-5
100	521G XT T4	924 K 926M 930 K 930M	426-HT	544J 544K 544K-II 624J	
125	621G XT T4F 721G XT T4F	IT 38G 938K 938M	427-HT 436-HT 437-HT 456-HT 457-HT	624K 624K-II 644J 644K	WA250PT-5
* May be either capacity depending on equipment year of manufacture.					

Telescopic Handlers (127.02.09.10)

CLASSIFIER	MAKE AND MODEL						
Lifting Height m	Bobcat	Case	Caterpillar	Genie	JCB	JLG	Skyjack
5 - 10	V 518 V 723		TH210 TH215 TH220 TH255 TH330B TH406 TH407	GTH-5519	520 531-70 531-70T 541-70T	G5-18A	
> 10		TX742 TX842 TX945	TH350B TH460B TL1055 TL1055C TL1255 TL1255C TL1255D TL642 TL642C TL642D TL943 TL943C TL943D	GTH-636 GTH-844 GTH-1544 GTH-1256 GTH-1056	506-36 506-C 506-C HL 507-42 508-C 509-42 510-56 512-56 514-56 535-140 540 TURBO 550 550-140 550-170	642 943 1043 1055 1255	SJ883 TH SJ643 TH SJ1044 TH ZB2044 SJ1056 TH SJ1256 TH

127.03.10 PILE DRIVING EQUIPMENT
Hammer, Open End, Diesel (127.02.10.01)

CLASSIFIER	MAKE AND MODEL					
Rated Energy J	APE	Berminghammer	Delmag	ICE	MKT	Pileco
50,000	D16-42 D19-42 D25-32	B-21 B-3505 B-4005	D8-22 D12-42 D16-32 D19-32 D19-42 D112-32	42S I-19	DE-42 DE-50 DE-50C	D6-42 D19-42
80,000	D25-42 D30-32 D30-42 D36-32	B-32 B-4505 B-5005	D25-32 D30-32 D30-32/33	I-30 60S 80S	DE-70	D25-32 D36-32
120,000	D36-26 D36-42 D46-32 D46-42 D50-42 D62-42	B-64 B-5505 B-6505 B-6505HD G4	D36-32 D36-32/33 D46-32 D46-32/33 D62-22	D62-22 I-36 I-46 I-62 I-80 100S 120S 120S-15 205-S	DE-110 DE-150	D62-22 D80-23 D100-13

Driver Extractor, Vibratory Centrifugal, Including Power Pack, Excluding Crane (127.02.10.02)

CLASSIFIER	MAKE AND MODEL					
Driving Force kN	APE	Delmag	HPSI	ICE	J and M	MKT
245			MODEL 100	216	216	
392	50 Vibro Model 50	HPSI 65 HPSI 130 HPSI 150	MODEL 150 MODEL 150L	23 RF 7 RF	11-23	VC 5
637	100 Vibro 150 Vibro Model 100 Model 150	HPSI 200 HPSI 260	MODEL 200 MODEL 250 MODEL 260 MODEL 300	11-23 14-23 14 RF 40-30 44-30 416L 14C-230M	416 44-30 22-30 28-35	V-20B
980		HPSI 300 HPSI 400	MODEL 500	44-50 66-65 416L 28C-350E	44-50	150 Tandem Vibro
1,471	200 Vibro, 3 Model 200	HPSI 450		44-65 44B-595E 50B-595E 55B-595E 66C-800E	44-65 66-65 66-80	V-30 V-35

Universal Piling Machine (127.02.10.05)

CLASSIFIER	MAKE AND MODEL			
Power KW	A.B.I. (Mobilram)	Liebherr	Bauer	Casagrande
< 450	TM 11/14			
450	TM 13/16 TM 14/17	LRB 125 XL LRB 155	RG 16T RG 19T	PTC PR 16/19
570	TM 18/22	LRB 255	RG 21T RG 20S RG 25S	

127.03.11 DRILLING EQUIPMENT**Mechanical Drilling Equipment, Truck Mounted, Including Auger and Crowd and Power Pack (127.02.11.01)**

CLASSIFIER	MAKE AND MODEL		
Power KW	Reeddrill	Watson	CME
80	Texoma Model 650 Texoma Model 500 Texoma Model 330	1100 2100	CME-55 CME-75
120		2500 3110	

Mechanical Drilling Equipment, Crawler Mounted, Including Auger (127.02.11.02)

CLASSIFIER	MAKE AND MODEL		
Power KW	Reedrill	Watson	ICE
95	Texoma 600T Texoma 700T	1100	
113	Texoma 800T	2100 2500	
130	Texoma 900T Magnum XLT Taurus XLT	2500 3110 3000 3100 3400	EX-12 EX-25

Hydraulic Drill Rig (127.02.11.03)

CLASSIFIER	MAKE AND MODEL							
Power KW	APE	Bauer	IMT	Liebherr	Mait	Soilmec	Watson	Casagrande
185	SA-16 SA-20 SA-22	BG 18 H BT 50 BG 20 H BT 60	AF 160 AF 180		HR 180	SR-40 SR-50	4400CM	B125XP B175XP B200XP C7XP C9XP
250	SA-25	BG 24 H BS 70 BG 24 H BT 70C BG 24 H BT 75 BG 25 H BG 28 H BT 60	AF 220 AF 240	LB 20	HR 260	SR-60 SR-65 SR-70PDC SR-70PDW SR-80PDC SR-80PDW SR-80CAT SR-80CPDW3		B250 XP
350		BG 28 H BS 80 BG 36 BS 80 BG 36 H BS 80 BG 36V BS 95 BG 30V BS 95	AF 280	LB 24	HR 240-800 HR 300-570	SR-90 SR-100 SR-100PDC SR-90PDW		B300XP B360XP
430		BG 40 BS 100 BG 40 BS 115		LB 28 LB 36				
570		BG 50 BT 180						

Mechanical Drilling Equipment, Crane Mounted Attachment, Including Auger (127.02.11.04)

CLASSIFIER	MAKE AND MODEL				
Power kW	Berminghammer	Calweld	Reedrill	Steven M. Hain	Watson
110	Mark IV BDH-30/30 BDH 60/60 BHD-40	125 CH 155 CH	CM 100	165 K 8V71 450 K (2005)	5000 CA 200 K
200	BHD-80				

Horizontal Earth Boring Equipment (127.02.11.05)

CLASSIFIER	MAKE AND MODEL			
Power Rating kW	American Augers	Barbco Inc.	Bor-it Mfg.	McLaughlin Mfg.
20	24/30-150 30/225	24-150 30-200	24 Brute 30 Power Plus Model 24 Model 30 Model 36	MCL-24B MCL-30/36B
50	36/42-440G2 48/54-900G2 42-600G2 36-600NG 42-600NG	36-350 36-500 36-630	36 Workhorse 36/425 Workhorse Model 42 Model 48 48 Terminator	MCL 36/42C
100	16-1200 72-1200 48/54-900NG 60-1200NG 72-1200NG	48-750 48-950 48/60-1350 60/72-1000HD 60-1HD	Model 54 Model 60	MCL 54/60
200	84/96-1800NG			

Trenchless Directional Drill, Track Mounted (127.02.11.06)

CLASSIFIER	MAKE AND MODEL					
Operating Wt. kg	Astec/Toro	Case	Ditch Witch	Vermeer	McCloskey	American Augers
1,000	DD-65 DD-1416 DD-2024	6010	JT 520 JT 921 JT 922 JT 1220 Mach I JT 5	D7 X Series II D16 X 20A D9 X 13 D20 X 22 Series III	DD15	
7,000	DD-3238 DD-4045	6030	JT 2020 Mach I JT 2720 Mach I JT 3020 Mach I JT 30AT	D24 X 40A Series II D24 X 40 Series III D18 X 22 D36 X 50 Series II		
12,000	DD-6		JT 4020 Mach I JT 8020 Mach I JT 100AT	D60 X 90 Series II D75 X 100 D15 X 300 D80 X 100 Series II		
20,000						D110 D155T

Hydraulic Rock Drill, Including Power Pack, Excluding Drill Steel and Bits (127.02.11.07)

CLASSIFIER	MAKE AND MODEL					
Diameter mm	Caterpillar	Atlas-Copco	Ingersoll-Rand	Sandvik	Tamrock	Terex/Reeddrill
< 75		ROC D5		DC120 DC301R	Commando 110 Commando 120	
75	MD 5050 MD 5050T MD5075C	ROC 642 HP ROC D3 ROC D7 ROC F7 ECM-580 ECM-590 ROC D7 RRC ROC D7C-11	ECM-470 ECM-580 ECM-590 ECM-660	DX700	Ranger 500 Scout 500 CHA 560 Dino 560 Ranger 600 Ranger 700 Scout 700 CHA 700	R20 SD345C
125	MD 5090 MD 5075	ROC F9 ECM-660 II ECM-720 ROC L7	CM-692 ECM-680 ECM-690	DP900 DP1100 DX800	Ranger 800	SD345 R30C
150	MD 5125C MD5150C		CM-695D	DP1500 D1550		SCH5000C
Note: Ingersoll-Rand line sold to Atlas-Copco.						

Tieback Drill Rig, Hydraulic, Dual Head (127.02.11.08)

CLASSIFIER	MAKE AND MODEL			
Power Rating kW	Casagrande	Davey-Kent	Hutte	Klemm
< 140	M6	DK625		
140	C7 C8 M9 M9-1 Hutte HBR C6XP	DK720 DK725 DK820	HBR605	KR 600-1 806-3D 806-3F 806-4 KR807-7

127.03.12

BROOM AND SWEEPER EQUIPMENT

Front Mounted Attachment, Hydraulic (127.02.12.01)

CLASSIFIER	MAKE AND MODEL					
Broom Width m	Case	John Deere	York	M-B Companies	Multi Sweep	Sweepster
1.2	VRS Series, 1.5 m	BR60	SSAB, 1.5 m	LB Series, 1.2 m CL-HT, 1.5 m FLB, 1.5 m HL Series, 1.5 m HTS, 1.5 m LB Series, 1.5 m SHL Series, 1.5 m SHT, 1.5 m	270	QCTL Series, 1.5 m RLH, 1.68 m SB, 1.5 m SSL Series, 1.5 m VRS Series, 1.5 m VS5, 1.5 m
1.8	SB Series, 1.8 m VRS Series, 1.8 m CS Series, 2.1 m SB Series, 2.1 m VRS Series, 2.1 m	BA 72 BP 72 BR 72 BA 84 BP 84 BR 84	FLB, 1.8 m SSAB, 1.8 m SSAB, 2.1 m TFB, 2.1 m FLB, 2.3 m	FLB Series, 1.8 m HL Series, 1.8 m HT Series, 1.8 m LB Series, 1.8 m LLB Series, 1.8 m SHL Series, 1.8 m SHT Series, 1.8 m HL Series, 2.1 m HT Series, 2.1 m LB Series, 2.1 m LLB Series, 2.1 m SHL Series, 2.1 m TK-H Series, 2.1 m TKH-TR Series 2.1 m HL Series, 2.1 m HT Series, 2.1 m LB Series, 2.1 m LLB Series, 2.1 m SHL Series, 2.1 m TK-H Series, 2.1 m HTP Series, 2.1 m HLP Series, 2.1 m TKH-T Series, 2.1 m	425 C 725 C	CH, 1.8 m LCH, 1.8 m LH, 1.8 m MCH, 1.8 m MH, 1.8 m RHFA, 1.8 m TMRH, 1.8 m 2500, 1.8 m QCTL Series, 1.8 m SSL Series, 1.8 m VS Series, 1.8 m VCS Series, 1.8 m AD AD, 2.1 m CS Series, 2.1 m LH Series, 2.1 m QCS Series, 2.1 m SB Series, 2.1 m TKH, 2.1 m VRS Series, 2.1 m VS Series, 2.1 m QCTL Series, 2.1 m SSL Series, 2.1 m VCS Series, 2.1 m
2.4	CS Series, 2.4 m	CS Series, 2.4 m	FLB, 2.43 m SSAB, 2.7 m TFB, 2.4 m TFB, 2.7 m TFB, 3.0 m	HL Series, 2.4 m HT Series, 2.4 m LB Series, 2.4 m LLB Series, 2.4 m TK-H Series, 2.4 m HLP Series, 2.4 m TKHL Series, 2.4 m TKH-T Series, 2.4 m TKH-TR Series, 2.1 m LLB Series, 2.7 m TK-H Series, 2.7 m TKH-T Series, 2.7 m TKHL Series, 2.7 m TKH-TR Series, 2.7 m TK-H Series, 3.0 m TKH-TR Series, 3.0 m TKH-T Series, 3.0 m TKHL Series, 3.0 m TK-H Series, 3.4 m TKHL Series, 3.4 m TKH-TR Series, 3.4 m TKH-T Series, 3.4 m TK-H Series, 3.7 m TKH-T Series, 3.7 m TKHL Series, 3.7 m TKH-TR Series, 3.7 m	900	AD, 2.4 m LA, 2.4 m LCH, 2.4 m LA, 2.7 m LCH, 2.7 m LA, 3.0 m LCH, 3.0 m CS Series, 2.4 m QCS Series, 2.4 m SSL Series, 2.4 m QCTL Series, 2.4 m WLA Series, 3.0 m

Self-Propelled, Dual Control (127.02.12.02)

CLASSIFIER	MAKE AND MODEL				
Sweeper Type	Allianz	Elgin	Schwarze Industries	Global Environmental	Johnston
Bottom Dump	RT 655 VT 650-1	Air Cub LX, 3.3 m ³ Crosswind, 6 m ³ Crosswind Fury, 6 m ³ Crosswind J, 6 m ³	A4 Storm, 3 m ³ A7 Tornado, 6 m ³ A9 Monsoon, 7 m ³		RT 655, 6 m ³ VT 651, 6 m ³ VT 801, 8 m ³
High Dump	3000 450 4000 MS-350 MT-350	Air Bear FL52H, 4.2 m ³ Broom Badger, 3 m ³ Broom Bear, 3.4 m ³ Eagle-1, 3.5 m ³ Eagle, 3.5 m ³ Pelican, 2.7 m ³ Pelican P Waterless Road Wizard, 3.5 m ³	A8 Twister, 4.4 m ³ M6 Avalanche, 3.8 m ³	Python S2000, 3.0 m ³ Python S2500, 3.8 m ³ Python S3000, 4.5 m ³	J3000, 4.3 m ³ J4000, 4.3 m ³
Vacuum	VT-650 VT-800	Crosswind, 6.0 m ³ Geo Vac, 6.0 m ³ Megawind, 6.0 m ³ Whirlwind, 6.0 m ³			605, 6.0 m ³

127.03.13 FORESTRY EQUIPMENT

Brush Chipper, Tow Type (127.02.13.01)

CLASSIFIER	MAKE AND MODEL		
Minimum Net Flywheel Power kW	Bandit	Morbark	Vermeer
19	65 65XP 75 75XP	2050 2060-D	BC200XL BC600XL BC900XL
35	90 150		BC1000XL (Drum)
60	90XP 95XP 200 254 280	2012-D 2090-D 2070XL	BC1000XL BC1200XL
80	150 150XP 200 + 200XP 250 250XP 280 1390XP 1890 1990	2100-D 2400XL Storm 12	BC1200XL BC1500 BC1500XL BC1800XL
140	280XP 1890XP 1990XP		BC2100XL

Log Skidder, Cable/Grapple (127.02.13.02)

CLASSIFIER	MAKE AND MODEL					
Minimum Net Flywheel Power kW	Allied	Caterpillar	Franklin	John Deere	Tigercat	Timberjack
75	F65C	517 525B 525C		540G-II 540G III 548G II 548G-III		360DC 360DS 460D 460DC 460DS
120	H66DSC-II F68C	525C 527	170S2 185S2 Q70	640G III 640H 648G III 648H 648G III (2007) 748G III 784H 848G 848H	604 610	560DD 560DS 660DC 660DD
150		525D 535C 535D 545C 545D	Q80		625C 630C	

127.03.14

PORTABLE GENERATING EQUIPMENT

Generator, Gas or Diesel (127.02.14.01)

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker-Neuson	Multiquip	Subaru	Magnum	Pramac	Doosan
0.5			EM2500CC EM3000CC EU1000iC EU2000iC EU3000iSCA Et1800XK1C Et2500XK1C EZ1800C EZ2500C EU 1000i EU 2000i EP 2500		EF1000 EF1000A EF1000iS EF1600 EF1600X EF2400iS EF2600 EF2600A EF2600X EF2800i EF3000iSE EF3000iSEB EF1000iS EF 2000iS EF 2000iSH EF 2000iSHC	GP2500A	GDP5HA GA25H				
3			EB3800XC EB5000iC EB5000XK2C EM3500XK1C EM3800SXC EM5000isCT EM5000XK1C EM5000SX2C EX50CC9 EZ3500C EZ3500XL1C EZ5000C EZ5000XL1C EM 3000 EU 3000iS EU 3000iK EB 4000		EF4000DX EF4500iSE EF4600A EF4600DE EF5200DE EF5200DEC EF 3000iS EF 3000iSEB EF 4500iSE	GP3800A		RG3200iS RGD 3300H RG 4300iS RGX4800			
5	D8L1		EB6500XC EB7000iC EB11000C EM6500SXC EM6500SXKC ES6500K2CA EV6010 EX5500K2C EG 5000 EB 5000 EM 5000S EB 6500 EM 6500S EM 6500Si EG 6500 EU 6500iS EU 7000iS		EDL6500S EF6200PDEX EF6300iSDE EF6600A EF6600DE EF6600DEC EF12000DEX EF 5500DE EF 5500D EF 7200D EF 7200DE	GP5600A GP6600A GP9700V		RGX 6500 SGX 7500E RGX 7500E	MLG8	S6000 S7200 Whisper-watt GA97HEA	5
10	D12L1 D17L1 D20P1 D25P1 D30P3 D40P3 XQ35	20DSEJB 30DSEJB 40DSEJB	EX12DCC9	25JC6DT4 30JC6DT4 35JC6DT3 40JC6DT3		G14 G25 G50			MLG15 MLG25 MLG20 MMG25 MMG35		G25 G40
40	D50P3 D60P3 D75P3 XQ60	50DSEJB 60DSEJB 80DSEJB 80DSJB		50JC6DT3 60JC6DT3 75JC6DT3		G70			MMG45i MMG55 MMG75 MMG100		G70
80	D90P1 D100P1 D125P1 D150P1 XQ125	100DSEJB D125DSEJB 125DSEJB 150DSEJ		100JC6DT3 125JC6DT3 150JC6DT3		G100 G120 G150 G180			MMG130 MMG175		G85 G125 G185

CLASSIFIER	MAKE AND MODEL										
Power kW	Caterpillar	Detroit Diesel Spectrum	Honda	MTU Onsite Energy	Yamaha	Wacker-Neuson	Multiquip	Subaru	Magnum	Pramac	Doo-san
150	D200P4 3306 3406, 275 kW XQ200	180DSEJB 200DSEJB 230SEJB 275DSE		180JC6DT3 200JC6DT3 230JC6DT3 250JC6DT3 250XC6DT3		G240			MMG205		G240
250				275JC6DT3 275XC6DT3 300XC6DT3		G320			MMG330		G325
300	3406, 320 kW 3406, 365 kW XQ375	350DSE 400DSE		350XC6DT3 400XC6DT3					MMG480		G450
400	3412, 455 kW 3412, 545 kW	450DSE-4 500DS-4 600DS-4		450XC6DT3 550VC6DT2 600VC6DT2							G570
600	3412, 635 kW 3412, 725 kW XQ800	750DS-4 800DS-4 900DS-4		650XC6DT2 750XC6DT2 900XC6DT2							
910	3508B XQ1000	1000DS-4		1000XC6DT2							

127.03.15 PUMPING EQUIPMENT

Centrifugal, Dewatering, Including 6 m Suction and 7.5 m Discharge (127.02.15.01)

CLASSIFIER	MAKE AND MODEL						
Intake Size mm	AMT / Gorman-Rupp / IPT	Honda	Kodiak	Kosin America	Kubota	Multi-Quip	Wacker
25	1G4XAR 1G1XH	WX10C1 WX10K1C WX10TC WB15CA1 WH15XK1C1 WN15CX1 WX15CX1					
50	4222-95 4225-95	WB20XK2C WB20XT2C WB20XT3 WB30XKZC WB30XT2C WB30XT3 WD30XK2C WH20XK1JC1 WN20CX1 WN30CX1 WP20XCX6 WP30XCF6 WT20XK2C	PWP2HX PWP3HX	SEV50X SERH-80X	KVP20 KVP20S	QP204H QP205SH QP205SLT QP2H QP303H QP305SLT	PG2 PG2A PG3 PG3A
100			PWP4HX	SHE-100	KVP40	QP402H	

Centrifugal, Trash, Including 6 m Suction and 7.5 m Discharge (127.02.15.02)

CLASSIFIER	MAKE AND MODEL								
Intake Size mm	Atlas Pumps	AMT / Gorman- Rupp / IPT	Hatz Diesel	Honda	Kodiak	Kosin America	Multi-Quip	Vanguard	Wacker
38		11-1/2 A2-9 2S5XAR 3163-95 3930-95							
50		12D-GX160 2S5XHR 2S5XZR 3930-D5 3932-95	PT2H	WT20XK3C WT20XK4C	PWP2SWT	KTH-50X	QP202TH QP2TH QP2TZ QP3TH		PT2A PT2 PT2H
75		13D-GX270 3941-96 3943-96 3944-96 3S5XAR 3S5XHR 3S5XZR 3S9XAR 3S9XHR 3S9XZR	PT3H	WT30SXK4C WT30XK3C WT30XK4C	PWP3SWT	KTH-75X	QP301TH QP3TH QP3Ti QP3TZ		PT3A PT3 PT3H
100		14C2-F3L 14D-GX390 3993-96 3993-Z6 3994-96 4S13XAR 4S13XHR 4S13XZR		WT40XK1C WT40XK2C WT40XK3C	PWP4SWT	KTH-100	QP40TH QP4TH QP4TZ QP4TZT10P QP4TZTMP16F QP4TZTMPXF	PTS4V	APT4S APT4T PTS4V
150	CA6DP	16A2-F3L 5586-H6 5586-Y6 T6A60S4045T					MQ61DD MQ600H MQ600HTP HQ600HTB		APT6S APT6T PT6LS PT6LT
200	CA8DP								APT8S APT8T

Diaphragm, Including 6 m Suction and 7.5 m Discharge (127.02.15.03)

CLASSIFIER	MAKE AND MODEL					
Intake Size mm	AMT / Gorman- Rupp / IPT	Honda	Kodiak	Multi-Quip	Small Line	Wacker
50	2D-X75 336G-96	PDT2A		MQ206H MQD2H		PDT2A PDT2
75	3D-13 3D-GX160 335A-96 335G-96 335H-96 335Z-96	PDT3A WDP30XK2AT	Pwp35md	MQ306H MQD3H		PDI3A PDT3 PDT3A PDT3AA
100	4D-E3 4D-E3-3P 4D-X3-1P 4D-X3-3P				PL4DDP-K SL4DDPHE SL4DDPYE	

**Electric Submersible, Including 30 m Cable and 7.5 m Discharge, Excluding Generator
(127.02.15.04)**

CLASSIFIER	MAKE AND MODEL									
Intake Size mm	Flygt	Claeson	Grindex	AMT / Gorman- Rupp / IPT	Honda	Kodiak	Kosin America	Multi-Quip	Tsurumi	Wacker
50	2610 2620 3085	Mine He	MINEX MINOR H MASTER H MINETTE SALVADOR TUFF ONE	5771-95 5773-95 5777-95 577A-95 577B-95	WSP50AA WSP100AA	PSP200SSD	PB-65011 PB7-65011 PX-65011 PXL-65011	PX400 SS233 SS2038P ST2005CUL2 ST2010CUL ST2037 ST2037F ST2047 ST2040T ST3020BCUL ST3050D	LB480 LB800	ASP 400 PS2-1503 PS2-2203 PS2-400 PS2-500 PS2-501 PS2-750 PS2-800 PS2-801 PS3-1500 PS3-1501 PS3-2200 PS3-2203 PS3-3703 PS3-5503 PSA2-500 PSA-800 PSG2-500 PST2-400 PST2A-800 PST3-750 PST3-751 PSTF2-400 PSTF3-750 PSTF3-751 PSW3-1500 PSW3-1501 STP 400 STP 750
100	3102 2125		MAJOR H MAXI H MIDI H MAJOR N MASTER N MINOR N SANDY SEMI SENATOR SENIOR	577D-95 577E-95 S3A1				ST41230 ST41460		PS4-5503 PS4-7503HH PS4-11003HH
150	3152 2201		MATADOR H MASTER L MATADOR N MAXI N MIDI N	S6D1-E30				ST61230 ST61460		
200	3202 2250		MAXI L							

127.03.16
WELDING EQUIPMENT
DC Arc Welder, Engine Driven, Including Rods (127.02.16.01)

CLASSIFIER	MAKE AND MODEL			
Current A	Lincoln	Miller	Multi-Quip	Thermal Arc / Red-D-Arc
125	Bulldog 5500 K2707-2 Outback 125 Power Arc 5500 Power Arc 5501-1 Weldan Power Weldan Power 125-1	Blue Star 145 Blue Star 145-K Cat Pro 300		Scout TA-4/170H
150	K2706-2	Blue Star 145-1 Blue Star 185 Blue Star 185 DX Blue Star 185DX-K Blue Star 6000 Bobcat 225 NT		
200	Ranger GXT Ranger 8, Honda Engine Ranger 8, Kohler Engine Ranger 8, Onan Engine Ranger 9 Ranger 225 Ranger 250 GTX Ranger 250, Kohler Engine Ranger 250, Onan Engine	Bobcat 225 Bobcat 250CH Bobcat 250EFI Bobcat 250GFI Bobcat 250 NT, Diesel Bobcat 250 NT, Gas Bobcat 3-Phase Trailblazer 275	DW225SSAWR SDW225SS	GX200
300	Classic 300G Classic 300D Commander 300 K2409-3 Pipeliner 200G Ranger 305 D-1 Ranger 305G SA-250 SAE 300 Vantage 300	Legend 301G Legend 302 Trailblazer 301D Trailblazer 301G Trailblazer 302 Trailblazer 325 Trailblazer Pro 350D	DLW300ES DLW300ESA DLW300ESAWR	D300K3 GX300 Lincoln
400	Big Red 500 K2325-2 SAE-400 SAE-500 Vantage 300 Vantage 400 Vantage 500 Vantage 500 Deutz	Big Blue 40P Big Blue 251D Big Blue 300 Big Blue 300 Pro Big Blue 302 Big Blue 350 Pipe Pro Big Blue 400 Big Blue 400 Pro Big Blue D400 Big Blue 402 Big Blue 450 D CST Big Blue 500 Big Blue 500 Pro Big Blue 700 Duo Big Blue 800 Pro Big Blue 800 Airpak Big 40 Cat CC Miller Du-op Pro 300 Pipe Pro 304	DLW400ES DLW400ESA DLW400ESAWR DAW500SA DAW500SAWR	D302K DX450 D550KHO

Oxygen/Acetylene Torch, Including Gas, Excluding Rods (127.02.16.02)

CLASSIFIER	MAKE AND MODEL				
Equipment Type	Blueshield	Prostar	Purox	Smith	Victor
Hand Mobile, Heavy Duty	BLU 01300008 BLU 01300012 BLU DUOKIT 510	PRS21506 PRS21512	GT 350 Deluxe GT 510FG E Master Deluxe HD	LE 200 Kit LE 300 Kit LE 400HD	Cutskill 0384-2500 DLX G350-540/510 Journeyman II Journeyman 450 Journeyman 540/300 SuperRange II 0384 315FC ST2630FC Torch Vanguard XHD 510

127.04 NON-CURRENT EQUIPMENT, SCHEDULE OF RENTAL RATES FOR CONSTRUCTION EQUIPMENT
127.04.01 Air Equipment
127.04.01.01 Air Track, Crawler Mounted, Excluding Compressor, Excluding Drill Steel and Bits

Hole Diameter, mm

≤ 100

37.15

> 100

50.45

127.04.04 Concrete Equipment
127.04.04.01 Air Breaker, Boom Mounted, Excluding Points

Rated Energy, joules

600

5.30

900

10.10

2,200

21.50

127.04.04.02 Saw, Self-Propelled, Excluding Blades

45, Curb-Trailer, Self-Contained

51.75

157, Curb-Truck, Self-Contained

83.90

127.04.05 Crushing Equipment
127.04.05.01 Roll Crusher, Excluding Power Unit

Roller Size, m

1.00 x 0.75

161.30

1.05 x 1.00

185.80

127.04.06 Earth Moving, Grading Equipment
127.04.06.01 Motor Grader, Rigid Frame

Minimum Operating Weight, kg

11,500

44.40

14,500

52.15

17,000 72.30

127.04.07 Excavation Equipment

127.04.07.01 Clams, Draglines, Shovels, Crawler Mounted, All Cable

Minimum Operating Weight, kg

27,000	154.05
40,000	186.50
60,000	209.55
75,000	246.90

127.04.08 Haulage Equipment

127.04.08.01 Rear Dump, Tandem Rear Axle, Diesel or Gas

AGW, kg

20,000	65.30
22,000	76.60
22,000 kg Stone Spreader	80.40
24,000 kg Stone Spreader	83.20

127.04.11 Drilling Equipment

127.04.11.01 Mechanical Drilling Equipment, Carrier Mounter, Including Auger

Power, kW

95	111.70
113	200.70
130	289.90
150	417.30
185	498.15

127.05 NON-CURRENT EQUIPMENT, MANUFACTURERS' MODEL, SPECIFICATION, AND CAPACITY REFERENCE GUIDE

Note: Each table has a number in parentheses as part of the table title that refers to the corresponding clause in Section 4 - Non-Current Equipment, Schedule of Rental Rates for Construction Equipment.

127.05.06 Earth Moving, Grading Equipment

Motor Grader, Rigid Frame (127.04.06.01)

CLASSIFIER		MAKE AND MODEL		
Minimum Operating Wt. kg	Minimum Net Flywheel Power kW	Champion	Fiat-Allis	Galion
11,500	125		FG 85	
14,500	135	720 730	FG 95	T 500C
17,000	185	740 760 750-780		T 600C

127.05.07 Excavation Equipment

Clams, Draglines, Shovels, Crawler Mounted, All Cable (127.04.07.01)

CLASSIFIER		MAKE AND MODEL		
Min. Operating Weight kg	Size kW	American	Linkbelt	Manitowoc
27,000	1.1		LS-98D LS-108C	M50
40,000	1.3	5220	LS-138	
60,000	1.5	7225	LS-208H 11	M65 M80
75,000	1.9		LS-218H	

127.05.11 Drilling Equipment

Mechanical Drilling Equipment, Carrier Mounted, Including Auger (127.02.11.02)

CLASSIFIER	MAKE AND MODEL	
Power KW	Reeddrill	Watson
95	Texoma 330 Texoma 500	
113	Texoma 600 Texoma 700 Texoma 800	2500
130		2500 3110
150	Texoma 900	3000 3100
185	Magnum XL	



**GENERAL SPECIFICATION FOR
ENVIRONMENTAL PROTECTION FOR CONSTRUCTION IN AND AROUND
WATERBODIES AND ON WATERBODY BANKS**

TABLE OF CONTENTS

182.01	SCOPE
182.02	REFERENCES
182.03	DEFINITIONS
182.04	DESIGN AND SUBMISSION REQUIREMENTS
182.05	MATERIALS
182.06	EQUIPMENT
182.07	CONSTRUCTION
182.08	QUALITY ASSURANCE - Not Used
182.09	MEASUREMENT FOR PAYMENT - Not Used
182.10	BASIS OF PAYMENT
APPENDICES	Not Used

182.01 SCOPE

This specification covers the environmental protection requirements and mitigation measures that apply to construction involving work in and around waterbodies and on waterbody banks.

182.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

182.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

182.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specification, Construction

OPSS 517	Dewatering
OPSS 804	Seed and Cover
OPSS 805	Temporary Erosion and Sediment Control Measures

Ontario Ministry of Transportation Publications

MTO/DFO/MNRF Protocol for Protecting Fish and Fish Habitat on Provincial Transportation Undertakings
MTO Best Management Practices Manual for Fisheries

Canadian and Provincial Statutes

Endangered Species Act, S.O. 2007, c. 6
Fisheries Act, R.S.C., 1985, c. F-14
Fish and Wildlife Conservation Act, S.O. 1997, c. 41 - Ontario Regulation 664/98 - Fish Licensing
Species at Risk Act, S.C. 2002, c. 29

Canadian and Provincial Policy

Fisheries and Oceans Canada Freshwater Intake End-of-Pipe Fish Screen Guideline
Fisheries and Oceans Canada Protocol for the Detection of Fish Species at Risk in Ontario Great Lakes Area (OGLA)
Fisheries and Oceans Canada Protocol for the Detection and Relocation of Freshwater Mussel Species at Risk in Ontario Great Lakes Area (OGLA)

For the purpose of this specification, the following definitions apply:

Cofferdam means a temporary enclosure constructed within a waterbody to allow the enclosed area to be pumped out, creating a dry work environment.

Deleterious Substance means as defined by the Fisheries Act.

Entrainment means when a fish is drawn into a water intake and cannot escape.

Endangered Species Act Permit means as defined by the Endangered Species Act.

Fish means as defined by the Fisheries Act.

Fish Habitat means as defined by the Fisheries Act.

Fish Salvage means the physical relocation of fish from the work area.

Fish Screen means a device designed to prevent fish from swimming or being drawn into a water intake pipe.

Fisheries Act Authorization means as defined by the Fisheries Act.

Fisheries Protocol means MTO/DFO/MNRF Protocol for Protecting Fish and Fish Habitat on Provincial Transportation Undertakings.

High Water Level means the highest point on the bank of a waterbody that the water level commonly reaches during high flow events or periods.

Impingement means when an entrapped fish is held in contact with the intake screen and is unable to free itself.

In-Water Work Timing Window means a restriction to in-water work related to an activity during certain periods in order to protect fish from impacts of works or undertakings in and around water during spawning, migration and other critical life stages. They are established by the Ontario Ministry of Natural Resources and Forestry.

Licence to Collect Fish for Scientific Purposes means as defined in Part IV of Ontario Regulation 664/98, under the Fish and Wildlife Conservation Act.

Mitigation means a measure to reduce the spatial scale, duration, or intensity of serious harm to fish that cannot be completely avoided. The best available mitigation measures or standards should be implemented by proponents as much as is practicably feasible.

Offsetting means measures that are undertaken to counterbalance unavoidable serious harm to fish resulting from a project, with the goal of maintaining or improving the productivity of the commercial, recreational or Aboriginal fishery.

Overall Benefit means undertaking actions that contribute to improving the circumstances for the species specified in an ESA permit. Overall benefit is more than “no net loss” or an exchange of “like- for-like”.

Qualified Fisheries Assessment Specialist means an individual who meets the requirements of the Fisheries Assessment specialty and is registered on MTO’s Consultant Registry.

Qualified Fisheries Contracts Specialist means an individual who meets the requirements of the Fisheries Compliance During Contracts specialty and is registered on MTO's Consultant Registry.

Riparian Vegetation Areas means vegetation areas within 30 m of the waterbody bank.

Sediment means soils or other surface material transported by wind or water as a result of erosion. Sediment is a deleterious substance.

Species at Risk Act Permit means as defined in the Species at Risk Act.

Species at Risk means a provincially or federally aquatic species listed as endangered, threatened special concern or extirpated.

Streambed means the bottom and sides of the watercourse over which the water flows, up to the high water level.

Waterbody means any permanent or intermittent, natural or constructed body of water including lakes, ponds, wetlands and watercourses.

Waterbody Bank means the land adjacent to a waterbody from the high water level to the top of slope.

Watercourse means a stream, creek, river, or channel including ditches, in which the flow of water is permanent, intermittent, or temporary.

182.04 DESIGN AND SUBMISSION REQUIREMENTS

182.04.01 Submission Requirements

182.04.01.01 Fish Salvage Licencing

Unless otherwise specified in the Contract Documents, a Licence to Collect Fish for Scientific Purposes shall be obtained from the Ontario Ministry of Natural Resources and Forestry (MNR) prior to any in-water works.

Copies of the all permits and licences obtained from regulatory agencies shall be submitted to the Contract Administrator upon receipt.

182.04.01.02 Fisheries Specialists

When a fisheries specialist(s) is required, the name(s) of the Qualified Fisheries Contracts Specialist(s) and, if applicable, Qualified Fisheries Assessment Specialist(s), shall be provided to the Contract Administrator a minimum of 10 business days prior to the commencement of work at each location where specialist oversight is specified.

182.05 MATERIALS

All Materials used to provide environmental protection shall not contain any deleterious substances.

182.06 EQUIPMENT

All Equipment used for the work in and around waterbodies or on waterbody banks shall at all times be free of excess or leaking fuel, lubricants, coolant and any other deleterious substances that could enter the waterbody.

182.07 CONSTRUCTION

182.07.01 General Requirements

In addition to the environmental protection requirements specified elsewhere in the Contract Documents, all Work shall be controlled to provide effective waterbody and fish habitat protection. If fish are observed in the work area during construction the work shall cease and the fish salvaged.

The Work shall be according to the applicable MTO Best Management Practices Manual for Fisheries requirements, as specified in the Contract Documents.

Unless specified in the Contract Documents, waterbodies shall not be permanently diverted, relocated, blocked, or filled.

The removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or streambed shall be minimized.

When practicable, work shall be scheduled to avoid wet or windy periods that may increase erosion and sedimentation.

182.07.02 Operation of Equipment in and around Waterbodies or on Waterbody Banks

Equipment shall arrive on site in clean condition. It shall be operated on dry land in a manner that minimizes disturbance to waterbody banks and riparian vegetation areas.

Unless specified in the Contract Documents, Equipment shall not enter or be operated in and around waterbodies or on waterbody banks but shall be operated on land above the high water level, on ice, or from a floating barge in a manner that minimizes disturbance to the waterbody banks.

Equipment refueling and maintenance shall take place at locations as far away as practicable from a waterbody and in a manner that prevents sediment and other deleterious substances from entering into a waterbody.

182.07.03 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

182.07.04 Preservation of Riparian Vegetation

Removal of riparian vegetation shall be kept to a minimum to help maintain the stability of waterbody banks. The area over which vegetation in riparian vegetation areas is removed shall affect no more than one third (1/3) of the total woody vegetation in the right-of-way within 30 metres of the high water level of a waterbody. Vegetative root masses found within the waterbody banks shall remain undisturbed unless specified in the Contract Documents.

Existing trails, roads or cut lines shall be used wherever possible as access routes to avoid disturbance to waterbody banks and riparian vegetation areas. Equipment travel, stockpile areas and staging areas within the vicinity of the crossing, shall be established to minimize impacts to riparian vegetation.

When practicable, riparian vegetation in the right-of-way shall be altered by hand.

Vegetative root masses found within the waterbody banks shall remain undisturbed unless specified in the Contract Documents.

182.07.05 Erosion and Sediment Control

The installation, monitoring, maintenance, and removal of temporary erosion and sediment control measures shall be according to OPSS 805.

Erosion and sediment control measures shall be in place prior to any soil disturbance and shall remain effective at all times, including seasonal and other shut down periods.

Site isolation measures (i.e. cofferdams, turbidity curtains) shall be installed prior to any in-water work activities taking place and shall remain effective at all times to allow the Contractor to work in a manner that prevents sediment from entering into a waterbody.

Measures for managing water being pumped and/or diverted from the site shall be according to OPSS 517.

182.07.06 Restoration of Disturbed Areas

All disturbed areas shall be immediately restored after a disturbance or upon completion of the work in or around waterbodies, waterbody banks, and riparian vegetation areas. The disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

All disturbed areas on waterbody banks and riparian vegetation areas shall be stabilized with effective temporary erosion and sediment control measures as specified in the Contract Documents and maintained until vegetation is established.

All cover treatment shall be applied according to OPSS 804.

Materials for the restoration of streambeds shall not be obtained from below the high water level of any waterbody unless specified in the Contract Documents.

182.07.07 Contaminant and Spills Management

All stockpiled materials, including but not limited to excavated overburden and topsoil, excess materials, construction debris and containers shall be stored and stabilized in a manner that prevents them from entering any waterbody.

All materials such as paint, primers, blasting abrasives, concrete, rust, solvents, degreasers, grout, or other chemicals shall not enter a waterbody.

All building materials used in and around a waterbody or on waterbody banks shall be handled and treated in a manner to prevent the release or leaching of substances into a waterbody that may be deleterious to fish.

All waste materials (e.g., dredging spoils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) shall be contained and stabilized above the high water level of nearby waterbodies to prevent re-entry.

182.07.08 Fish Protection

182.07.08.01 Timing of In-Water Works

All in-water work construction activities shall comply with the timing windows specified in the Contract Documents.

182.07.08.02**Fish Salvage**

Fish stranded by the Work or found in the work area during construction shall be salvaged and relocated according to the Licence to Collect Fish for Scientific Purposes, unless specified in the Contract Documents. If fish cannot be safely relocated, the local MNRF office shall be consulted prior to fish collection commencing to determine a suitable relocation site.

Fish exclusion measures (i.e. block nets) shall be used to prevent fish from re-entering work areas. In the event that the fish exclusion measures fail, additional fish salvage activities shall be performed to relocate the fish from the work areas prior to recommencing construction.

All fish shall be handled as little as possible and in a manner that minimizes stress and prevents death to the fish.

All persons conducting electrofishing shall possess valid Ontario Electrofishing Certification.

182.07.08.03**Reporting Species at Risk**

When an aquatic species (i.e. fish and/or mussel) protected under the federal Species at Risk Act (SARA) or the Ontario Endangered Species Act (ESA) is incidentally captured during fish salvage activities, the individual that incidentally captured the aquatic species at risk (SAR) shall take a digital photograph according to DFO's Protocol for the Detection of Fish Species at Risk in Ontario Great Lakes Area (OGLA). Once the digital photograph has been taken, the species shall be released immediately. The digital photograph shall be reported and emailed to the Contract Administrator, the local MNRF District Office, and the Fisheries and Oceans Canada (DFO) Central and Arctic Region Fisheries Protection Program.

All mortalities of species protected under SARA or ESA associated with the fish salvage activities shall be reported to the Contract Administrator, the MNRF District Office, and DFO immediately upon being discovered. Mortalities shall be vouchered according to DFO's Protocol for the Detection of Fish Species at Risk in Ontario Great Lakes Area (OGLA) and/or Protocol for the Detection and Relocation of Freshwater Mussel Species at Risk in Ontario Great Lakes Area (OGLA).

182.07.08.04**Fish Screens**

Any water intakes or outlet pipes in fish bearing waters shall have screens to prevent entrainment or impingement of fish and shall follow the measures as outlined in Fisheries and Oceans Freshwater Intake End-of-Pipe Fish Screen Guideline.

182.07.08.05**Fisheries Specialist Services**

When oversight by a Fisheries Specialist is required for a location as specified in the Contract Documents, a Qualified Fisheries Contracts Specialist shall be retained to provide the following services:

- a) Work with construction personnel to protect fish and fish habitat;
- b) Work with construction personnel in the development of waterbody and fisheries protection strategies and plans, when specified in the Contract Documents;
- c) Liaise with the Owner, the Contract Administrator, and, as necessary, Regulatory Agency representatives regarding Fisheries Act Authorization requirements;
- d) Be on-site to inspect the installation, function and decommissioning (as appropriate) of all temporary and permanent mitigation measures as specified in the Contract Documents, including providing field fit advice and necessary corrective actions for issues of non-compliance;

- e) Complete and submit all monitoring documentation as specified in Table 1;
- f) Fish salvage as necessary under a Licence to Collect Fish for Scientific Purposes;
- g) Inspect erosion and sediment control measures within 24 hours after a rain event; and
- h) Review Change Proposals for compliance with the Fisheries Act. If the Fisheries Protocol requires the completion of a fisheries assessment, it shall be conducted by a Qualified Fisheries Assessment Specialist.

182.07.09 Contingency Measures

When an environmental protection measure is found to be ineffective, corrective actions shall be taken immediately including repair or replacement of the measure to ensure waterbody and fish habitat protection.

182.07.10 Management of Excess Materials

Management of excess material shall be according to the Contract Documents.

182.10 BASIS OF PAYMENT

Payment at the Contract price for the appropriate tender items that require fisheries protection and mitigation measures shall include full compensation for all labour, Equipment, and Material to do the work.

Table 1
Qualified Fisheries Contracts Specialist - Monitoring Documentation

Documentation Name	Warrant for Completion	Distribution
MTO Construction Inspection Checklist	Every day that a Fisheries Contracts Specialist is on site	Within 1 Business Day of inspection, submit one (1) electronic copy of the inspection checklist to Contract Administrator.
MTO Non - Compliance Summary	Friday of each week when the Contractor is not in compliance with mitigation/offsetting/overall benefit measures as specified in the Contract Documents	By the following Monday, submit one (1) electronic copy of the non-compliance summary to Contract Administrator.
MTO Construction Monitoring Report	Annually by December 31st on multi-year construction projects and prior to the completion of construction	By November 1 of the monitoring year, submit one (1) electronic copy of the draft report to Contract Administrator. By December 15 of the monitoring year, submit one (1) electronic copy and three (3) hard copies of the final report incorporating MTO comments on the draft to Contract Administrator.



**CONSTRUCTION SPECIFICATION FOR
REPAIRING CONCRETE PAVEMENT AND CONCRETE BASE**

TABLE OF CONTENTS

366.01	SCOPE
366.02	REFERENCES
366.03	DEFINITIONS
366.04	DESIGN AND SUBMISSION REQUIREMENTS
366.05	MATERIALS
366.06	EQUIPMENT
366.07	CONSTRUCTION
366.08	QUALITY ASSURANCE
366.09	MEASUREMENT FOR PAYMENT
366.10	BASIS OF PAYMENT
APPENDICES	Not Used

366.01 SCOPE

This specification covers the requirements for full depth and partial depth repairs using conventional concrete, and full-depth fast-track repairs, to concrete pavement and concrete base.

366.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

366.01.02 Appendices Significance and Use

Appendices are not for use in provincial Contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner.

Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their Contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

366.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 350	Concrete Pavement and Concrete Base
OPSS 369	Sealing or Resealing of Joints and Cracks in Concrete Pavement and Concrete Base
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Materials

OPSS 1002	Aggregates – Concrete
OPSS 1010	Aggregates – Base, Subbase, Select Subgrade and Backfill Material
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1308	Joint Filler in Concrete
OPSS 1315	White Pigmented Curing Compounds for Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1441	Load Transfer Assemblies

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-101	Procedures for Calculating Percent Within Limits
LS-410	Method of Test for Compressive Strength of Drilled Cores
LS-432	Method of Test for Microscopical Determination of Air Void System Parameters in Hardened Concrete
LS-435	Method of Test for Linear Shrinkage of Concrete
LS-447	Method of Test for Falling Weight Deflectometer

Designated Sources for Materials (DSM)

CSA Standards

A23.1/A23.2-014	Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens
A23.2-9C	Strength of Cylindrical Concrete Specimens
A23.2-14C	Obtaining and Testing Drilled Cores for Compressive Strength Testing

ASTM International

C 171-92	Sheet Materials for Curing Concrete
----------	-------------------------------------

American Association of State Highway and Transportation Officials (AASHTO)

M 182 –89	Standard Specification for Burlap Cloth made from Jute or Kenaf
-----------	---

366.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Autogenous Cylinders means cylinders used for estimating compressive strength of concrete in fast-track repair areas. These cylinders are stored in insulated curing containers at which the elevated curing temperature is obtained from heat of hydration of the cement.

Cold Weather means those conditions when the air temperature is at or below 5 °C, or when the air temperature is at or is likely to fall below 5 °C within 96 hours after completion of concrete placement. Temperature refers to shade temperature.

Diamond Grinding means altering the profile and texture of a concrete surface by utilizing grinding equipment that employs diamond tip blades.

Fast-track Repair means a process in which a section of concrete pavement or concrete base is closed to traffic, concrete is removed and repairs are completed and the section re-opened to traffic within a specified time period of 24 hours or less.

Hot Weather means those conditions when the air temperature is at or above 28 °C, or when the air temperature is at or is likely to rise above 28 °C within 24 hours after concrete placement. Temperature refers to shade temperature.

Partial Depth Repairs means repair areas in the concrete pavement or concrete base which have a minimum depth of 50 mm to a maximum depth of one-third the thickness of the existing concrete slab.

Staged Repair means a repair area which cannot be repaired in one complete operation due to traffic or construction sequence requirements, and must be completed in separate stages. Each stage shall be a minimum of one lane in width and 2 m in length.

Working Cracks means full depth cracks which are subject to horizontal or vertical movement under normal service conditions.

366.04 DESIGN AND SUBMISSION REQUIREMENTS

366.04.01 Design Requirements

366.04.01.01 Concrete Mix Design

The concrete mix shall be designed to provide adequate strength and durability for the intended use and to meet the requirements specified in the Contract Documents.

366.04.02 Submission Requirements

366.04.02.01 Concrete Mix Design

The concrete mix design(s) shall be submitted according to OPSS 1350 with the following addition:

- a) Test data for linear shrinkage tested according to LS-435, shall be submitted to the Contract Administrator within 40 days of the mix design submission, for information purposes only. Concrete specimens may be obtained from a laboratory batch or sampled in the field.

366.04.02.02 Calibration Charts and Autogenous Cylinder Method for Fast-track Repairs

The autogenous cylinder method shall be used for determination of strength prior to opening to traffic for all fast-track repairs. The minimum length of time for which calibration charts shall be developed shall be the period of lane closure specified in the Contract Documents.

The size, preparation and testing of cylinders shall be according to the Early Strength Determination of Fast-track Repairs section in the Construction section of this specification.

For the development of the calibration chart, testing of cylinders for compressive strength shall commence no later than 3 hours after the cylinders are cast, and testing shall continue at a minimum frequency of every 30 minutes for the length of time of the lane closure. One set of two cylinders shall be tested at each time interval. A thermocouple wire shall be installed in one of the cylinders in each set, and temperature shall be recorded at a minimum of every 30 minutes after casting until the time of testing.

The following information shall be submitted to the Contract Administrator at the time of submission of the concrete mix design:

- a) Calibration chart indicating compressive strength versus temperature.
- b) Calibration chart indicating temperature versus time.
- c) Ambient air temperature during development of the calibration charts.

The above data shall be accompanied by a covering letter, signed by an Engineer, identifying the curing method and test method, and detailing the development of the calibration chart.

If the ambient air temperature at time of placement differs from the ambient air temperature during the development of the calibration charts by more than 10 °C, new calibration charts shall be submitted.

In the event that field performance or conditions are no longer representative of the conditions under which the submitted calibration charts were developed, a new mix design and charts shall be resubmitted prior to proceeding with concrete repairs.

366.04.02.03 Method of Removal of Existing Concrete

A description of the method to be used to remove the existing concrete shall be submitted to the Contract Administrator at least two weeks prior to the start of the work. The description shall comply with the requirements in the Concrete Removal subsection and include the sawcutting and removal process, equipment, and disposal.

366.04.02.04 Chipping Hammers

The manufacturer's published specifications on the chipping hammers shall be submitted to the Contract Administrator one week prior to the commencement of the partial depth removal operation.

366.04.02.05 Temperature Control Plans

366.04.02.05.01 Cold Weather

Temperature control plans for all repairs except fast-track repairs, shall be submitted according to OPSS 904 in the event of cold weather conditions.

366.04.02.05.02 Hot Weather

For concrete subject to hot weather, a description of the methods to be used to control the temperature of the concrete shall be submitted to the Contract Administrator 7 Days prior to placement.

366.05 MATERIALS

366.05.01 Admixtures for Concrete

Use of admixtures shall be according to the Use of Admixtures clause of OPSS 1350 with the following exceptions and additions:

- a) For fast-track repairs, superplasticizer may be used and may be added at the plant or site. Testing of slump prior to addition of superplasticizer is not required.
- b) For fast-track repairs, calcium chloride based accelerator may be used. When used, it shall be measured accurately to ensure a consistent dosage for each load, and it shall be added and mixed in a manner to ensure consistent distribution throughout the load.

Type S admixtures listed on the DSM may be used and concrete containing Type S admixtures shall meet all requirements of this specification.

366.05.02 Bond Breaker for Dowel Bars and Load Transfer Devices

Dowel bars and load transfer devices shall be shop coated with RC-250, Tectyl 506, or an Owner-approved equivalent. Application of a shop applied bond breaker does not apply to dowels which are grouted into existing concrete.

366.05.03 Bonding Agent

Bonding agent shall consist of Portland cement and fine aggregate mixed with water to form a stiff mixture. Portland cement shall be according to OPSS 1301. Fine aggregate shall be according to OPSS 1002. The consistency of the mixture shall be such that it can be applied with a stiff brush to the concrete surface in a thin even coating that will not run or puddle.

366.05.04 Burlap

Burlap shall be according to AASHTO M182, Class 4, and shall be free from substances that are deleterious to concrete. The burlap shall have no tears or holes.

366.05.05 Concrete

Materials for concrete shall be according to the Materials section of OPSS 1350 with the following exceptions and additions:

- a) The nominal maximum size of coarse aggregate shall be as specified in Table 1.
- b) The minimum 28-Day concrete compressive strength shall be 30 MPa.
- c) The compressive strength of the concrete in the repair area shall be a minimum of 20 MPa prior to opening to traffic.
- d) For partial depth concrete repairs in areas where the greatest dimension (width or length) of the repair area is less than 300 mm, a proposal to use a proprietary patching material may be submitted to the Contract Administrator for approval.
- e) The requirements of OPSS 1350 for plastic air content and rapid chloride permeability do not apply.
- f) Fast-track concrete shall not be used for partial depth repairs.
- g) For fast-track repairs, Type HE Portland cement may be used.
- h) For fast-track repairs, the maximum allowable slump including tolerance shall be 230 mm.
- i) For fast-track repairs, the temperature of concrete at the time of placing shall be less than or equal to 35 °C.

366.05.06 Curing Compound

White pigmented curing compound for concrete shall be according to OPSS 1315.

366.05.07 Epoxy Adhesives

Epoxy adhesives shall be of the type approved for horizontal dowel applications and mixed in the nozzle (cartridge). Cementitious grouts shall not be permitted for this application.

366.05.08 Joint Materials

Expansion joint filler shall be according to OPSS 1308. Joint sealant material shall be according to OPSS 369.

366.05.09 Moisture Vapour Barrier

Moisture vapour barrier shall be white opaque polyethylene film according to ASTM C171 and shall not be less than 100 µm thick.

366.05.10 Proprietary Patching Materials

Proprietary patching materials shall be from the Owner's list of acceptable concrete patching materials. The list of proprietary patching materials may be obtained from the Contract Administrator.

366.05.11 Tie Bars, Dowel Bars and Load Transfer Devices

Tie bars shall be deformed bars, according to OPSS 1440. Dowel bars and load transfer devices shall be according to OPSS 1441.

366.05.12 Water

Water used for concrete production, curing, pre-soaking of burlap, and bonding agent shall be according to OPSS 1302.

366.06 EQUIPMENT

366.06.01 Batching Plant and Delivery Equipment

The batching plant shall be according to the Batching Plant subsection of OPSS 1350. Delivery equipment shall be according to the Delivery Equipment subsection of OPSS 1350.

366.06.02 Chipping Hammer

Chipping hammers shall be hand held and have a maximum weight of 9.0 kg prior to any handle modification, where applicable, and a maximum piston stroke of 102 mm. All hammers shall have the manufacturer's name and parts or model number engraved on them by the manufacturer. All information shall be clearly legible. The manufacturer's published specifications shall be the sole basis for determining air hammer weight and piston stroke.

366.06.03 Air Compressor

The compressor for air blasting shall have a minimum capacity of 3.5 m³/min. The compressed air shall be free from oil and other contaminants.

366.06.04 Diamond Grinder

When a diamond grinder is used, it shall be power-driven, self-propelled equipment specifically designed to grind and texture concrete surfaces. It shall be equipped with a grinding head with at least 50 diamond blades per 300 mm of shaft. The grinding head shall be at least 0.9 m wide. The grinder shall be equipped with the capability to adjust the depth, slope and cross-fall to ensure that concrete is removed to the desired dimensions and uniformly feathered and textured across the width and length of the required area. The equipment shall also include a slurry pick-up system.

366.06.05 Gang Drill

The gang drill shall consist of not less than three independently powered pneumatic drills. Drilling shall not damage adjacent concrete.

366.06.06 Hand Finishing Equipment

Floats used to finish concrete shall be made of magnesium or wood with the exception of bull floats which shall be magnesium.

366.06.07 Placing and Finishing Equipment

Equipment used for placing, consolidating and finishing concrete for full depth and fast-track repairs shall be a vibratory steel screed or steel cylinder screed with integral internal vibration including automatic shut-off, and shall operate on fixed forms.

For repair areas less than 3 m in length, measured in the direction of traffic, the concrete may be placed and consolidated using hand held vibrators and finished with a straightedge.

366.06.08 Thermocouples and Dataloggers

Thermocouples and associated instrumentation shall have an accuracy of $\pm 1.5^{\circ}\text{C}$, shall record temperatures at time intervals not exceeding 15 minutes, and shall display the temperature.

366.07 CONSTRUCTION

366.07.01 Autogenous Cylinder Method Calibration Charts

For fast-track repairs, prior to commencement of the trial area and construction of the repairs, calibration charts shall be developed for the purpose of determining the rate of early strength development of the fast-track mix. Development of the calibration charts shall be according to the Design and Submission section.

366.07.02 Operational Constraints

366.07.02.01 General

The Contract Administrator shall be notified in writing of the intent to repair the concrete pavement or concrete base one week prior to the commencement of concrete pavement repairs.

Concrete shall not be placed when the air temperature or existing pavement surface temperature is below 5°C , or is above 30°C .

Vehicles shall not be permitted to drive on areas where the concrete pavement or base has been removed, in whole or part.

The concrete pavement or concrete base shall be protected from damage to the surface at all times when steel-tracked equipment is used. Traffic, other than foot traffic and rubber-tired sawing equipment, shall not be permitted on the concrete until it has attained a compressive strength of 20 MPa.

366.07.02.02 Fast-track Repairs

Fast-track repairs shall not be placed between October 1 and May 1. Fast-track repairs shall not be performed in cold weather conditions. Fast-track repairs shall be full depth.

Each repair location shall be completed within the time frames specified in the Contract Documents. If the repair is not progressing at a rate that will permit the opening to traffic within the specified time period,

temporary measures acceptable to the Contract Administrator shall be undertaken to allow the opening of the road to traffic. These temporary measures shall be at the Contractor's expense. A fast-track concrete repair shall replace the above temporary work during the next scheduled closure.

366.07.03 Concrete Removal

366.07.03.01 Full Depth and Fast-track Repairs

Areas to be repaired with full depth removal or with fast-track repairs shall be as specified in the Contract Documents or as demarcated by the Contract Administrator. Repairs shall extend the full width of the lane. Partial lane-width repairs shall not be permitted.

The outer limits of the concrete removal area shall be sawcut full depth. Sawcuts shall extend no more than 100 mm into existing adjacent concrete that is to remain in place. Sawcuts in concrete that are to remain in place shall be filled with an epoxy resin acceptable to the Owner. Sawcutting shall not be carried out more than one week prior to the expected date of repair.

Concrete removal shall be by a lift-out method rather than breaking in place. Adjoining concrete and underlying base shall remain undisturbed. Heavy breaking equipment such as hoe rams shall not be used in the removal operation.

If during the removal, the material below the concrete pavement or base is disturbed or removed, any voids shall be filled with Granular O meeting the requirements of OPSS 1010. Compaction of the Granular O shall be by means of:

- a) A plate tamper with a minimum mass of 80 kg, or
- b) A self-propelled (walk-behind) single or tandem steel drum with a minimum static mass of 500 kg used in vibration mode.

If during the removal process the adjacent concrete in the lane is damaged or cracked due to the removal procedure, the damaged area shall be cut back full depth to sound concrete and replaced as directed by the Contract Administrator at no additional cost to the Owner. The full area shall be repaired as one continuous placement.

366.07.03.02 Partial Depth Repairs

Areas to be repaired with partial depth concrete removal shall be as demarcated by the Contract Administrator. The perimeter of the repair area shall be sawcut vertically to a depth of 25 mm. The concrete within the sawcut area shall be removed using a chipping hammer to a minimum depth of 50 mm, and to a maximum depth of one-third the thickness of the existing concrete slab, using equipment that will not damage the underlying sound concrete. Any wire mesh in the concrete shall be removed within the repair area.

In the event that the partial depth concrete removal operation reveals deterioration extending to a depth greater than one-third the thickness of the existing concrete slab, the repair shall be treated as a full depth repair or fast-track repair and concrete shall be removed according to Concrete Removals – Full Depth and Fast-track Repairs subsection. Full depth repair work shall not proceed without prior approval from the Contract Administrator.

366.07.04 Preparation Work

366.07.04.01 Full Depth and Fast-track Repairs

Before placing concrete on granular base, the granular immediately ahead of the concrete placing operation shall be wetted down thoroughly. The wetting down shall be carried out without leaving standing water.

366.07.04.02 Partial Depth Repairs

All concrete surfaces to receive new concrete shall be abrasive blast cleaned according to OPSS 929.

Immediately prior to wetting the concrete surface, all dust and loose material shall be removed from the prepared surface of the repair area by using compressed air.

The surface of the patch to receive new concrete shall be maintained in a wet condition for a period of one hour prior to placing any new concrete. Prior to placing concrete, excess water shall be removed from the surface using compressed air.

Immediately prior to filling the repair area with concrete, a thin even coat of bonding agent shall be brushed onto all vertical and horizontal prepared surfaces against which concrete will be placed. After application of the bonding agent, any fine aggregate separated from the mixture or any excess bonding agent shall be removed from the surface of the concrete.

The bonding agent shall be applied within 30 minutes after mixing and shall not be permitted to dry prior to placing any concrete on it. In the event that the bonding agent has dried, it shall be removed and reapplied prior to concrete placement. All bonding agent or concrete deposited in areas other than the intended point of discharge shall be removed immediately.

366.07.05 Joints

366.07.05.01 Full Depth and Fast-track Repairs

366.07.05.01.01 General

Joints for concrete pavement and concrete base shall be according to OPSS 350. Where the operation requires a staged repair, a construction joint shall be placed between stages.

366.07.05.01.02 Dowel Bars and Tie Bars

Dowel bars and tie bars shall be installed at locations specified in the Contract Documents. Where reinforcement is present, dowel bars may be adjusted 25 mm horizontally and raised or lowered 10 mm, to avoid drilling through the reinforcement.

Gang drills shall be used to drill holes in the existing concrete for insertion of the dowel bars. The diameter of the drill hole shall be no more than 5 mm larger than the diameter of the dowels or tie bars. Prior to filling the drill holes, the inside surfaces of each drill hole shall be wire brushed and then cleaned using compressed air. The dowel bars and tie bars shall be secured into the existing concrete with epoxy adhesive. The epoxy adhesive shall be injected into the back of the cleaned drill hole and the dowel or tie bar, with grout retention disks attached, shall be inserted to completely encase the bars with epoxy adhesive for the full depth of the hole.

The dowel bars shall be placed mid-depth of the slab thickness specified in the Contract Documents and parallel to the longitudinal axis and the horizontal plane of the pavement with the following tolerances:

- a) Vertical Alignment: ± 15 mm along the length of the dowel bar.
- b) Horizontal Alignment: ± 15 mm along the length of the dowel bar.
- c) Side Shift: The centre of the dowel bar shall lie within ± 50 mm from the transverse joint.
- d) Depth:
 - i. For a slab thickness of < 215 mm: ± 6 mm
 - ii. For a slab thickness from 215 to 229 mm: $+15$ /-12 mm
 - iii. For a slab thickness of 230 mm or greater: $+25$ /-15 mm

The tie bars shall be installed within a tolerance of ± 15 mm from mid-depth of the slab thickness.

Dowel bars and tie bars shall be installed and secured in a manner that will ensure they remain in the proper position and orientation during the concreting operation.

The epoxy adhesive shall be fully cured prior to placing concrete. The free end of the dowel bars shall be coated with bond breaker immediately prior to placing concrete.

366.07.05.01.03 Transverse Joints

Transverse contraction joints shall be cut or formed as specified in the Contract Documents and skewed if required. Joints shall have a minimum spacing of 2 m and a maximum spacing of 4 m.

Expansion joints shall be placed where specified in the Contract Documents and when replacing existing expansion joints.

366.07.05.01.04 Mid-Lane Longitudinal Joints for Fast-track Repairs

In repair areas where the transverse joint spacing is 3 m or less in length, a longitudinal joint shall be created in the middle of the lane and for the full length of the repair. Tie bars shall be placed at mid-depth of the slab along the full length of the longitudinal joint. The tie bars shall be 25M deformed bars and shall be 760 mm in length. These bars shall be spaced every 400 mm and shall not be placed within 400 mm of a transverse joint.

Tie bars shall be installed and secured so that they remain in the proper position and orientation during the concreting operation.

366.07.05.01.05 Sawcutting

Sawcutting of joints shall be carried out before uncontrolled cracking occurs and prior to opening to traffic. Sawcutting operations shall not result in ravelling or other damage to the concrete. The cut shall extend one-third the depth of the concrete slab.

For fast-track repairs, equipment specifically designed for dry-cut joint sawing shall be used and the sawing shall be carried out within 2 hours of final finishing. In lieu of sawcutting, the joint may be formed to a minimum depth of one third the pavement thickness when the concrete is in the plastic state.

366.07.06 Production of Concrete

Production of concrete shall be according to the General, Temperature Control, Mixing Time and Mixing Rate, and Delivery subsections in OPSS 1350.

366.07.07 Placing of Concrete

Prior to placing concrete, the Contract Administrator may request a demonstration that the equipment to be used provides for proper adjustment of screeds, floats, propulsion, and control equipment to achieve the required end product.

Delivery of concrete shall be according to OPSS 1350.

Placing of concrete in the repair areas shall be according to the Construction section of OPSS 350 with the following exceptions and additions:

- a) Concrete shall be placed in such a way as to avoid disturbing or displacing tie bars, dowel bars or load transfer devices.
- b) When there is an interruption in placing concrete greater than 20 minutes, the surface of the concrete shall be covered with wet burlap.
- c) When an interruption of more than 45 minutes occurs during placing of full depth concrete or 5 minutes for fast-track concrete, a transverse construction joint shall be formed. Notwithstanding the time limits, there shall be no delays which will result in a cold joint. Concrete placed in the areas between the newly formed joint and the previous joint is subject to removal and replacement at no additional cost to the Owner if the Contract Administrator deems it necessary.
- d) The use of insulation to retain heat is permitted.

366.07.08 Consolidating

Consolidation of concrete in the repair areas shall be according to OPSS 350.

366.07.09 Concrete Finishing

No water or other chemical agents shall be applied to the concrete surface to aid in the finishing.

For concrete pavements where fixed forms are being used or where concrete is being placed against an existing pavement the edge of the pavement shall be finished, before texturing of the pavement surface, with an edging tool having a radius of not more than 6 mm. The finished pavement edge shall be left smooth, true to line and grade.

366.07.10 Texturing of Pavement Surface

Texturing of pavement surface shall be according to OPSS 350, except that manual devices may be used to provide the required tined texture.

Texturing is not required on concrete base or when diamond grinding of the pavement surface is specified in the Contract Documents.

366.07.11 Surface Tolerance

The surface of the concrete repair shall join flush with the existing concrete pavement or concrete base.

The surface of the concrete shall be such that when tested with a 3 m long straightedge placed in any location and direction, including the edge of pavement and joints, except across the crown or drainage gutters, there

shall not be a gap greater than 3 mm between the bottom of the straightedge and the surface of the concrete pavement. For concrete base, the tolerance over a 3 m straightedge shall be 6 mm.

Use of diamond grinding to meet the above requirements shall require the prior approval of the Contract Administrator.

366.07.12 Curing

Curing shall be applied within 10 minutes of placing concrete and immediately following texturing.

The curing period shall be a minimum of 7 Days for concrete cured with curing compound and for concrete subject to cold weather. For all other types of curing, the curing period shall be a minimum of 4 Days.

For fast-track repairs, only curing compound shall be used for curing and may remain in place following the 7 Day curing requirement.

For non-fast-track repairs, concrete shall be cured using one of the following methods, according to the applicable clauses in OPSS 904:

- a) Curing with Curing Compound, or
- b) Curing with Burlap and Water, except during cold weather, when curing shall be according to Curing with Moisture Vapour Barrier.

When curing compound is used, it shall not be applied to joint faces against which sealant is to be placed or to concrete surfaces to which concrete or mortar is to be bonded.

If curing compound is used on repairs to concrete base in areas greater than 10 m in length, the curing compound shall be completely removed from the concrete surface prior to the application of tack coat and the overlaying with asphalt pavement. The method of removal shall be by shot blasting and it shall not result in any damage to the concrete surface.

366.07.13 Retaining Heat for Fast-Track Repairs

Insulating blankets or protection systems of any type may be used for retaining heat to accelerate the strength gain of fast-track repairs. Insulating blankets used for the purpose of accelerating strength gain for fast-track repairs are not required to meet the requirements for cold weather protection of other types of concrete.

366.07.14 Cold Weather Protection – Full Depth and Partial Depth Repairs

366.07.14.01 General

Except for fast-track repairs, the temperature of the concrete during cold weather shall be monitored and controlled for a period of 7 Days to ensure that the concrete temperature does not fall below 15°C for the first three days of curing and 10°C for the subsequent four days.

The protection system shall be designed for the worst conditions that can be reasonably anticipated from local weather records, forecasts, site conditions, and past experience for the time period during which the protection is required. Conditions shall be monitored and the protection system modified as required. For cold weather conditions, the minimum cold weather protective measures as specified in the Minimum Cold Weather Protective Measures table in OPSS 904 shall be provided.

366.07.14.02**Monitoring and Control of Temperature**

During cold weather, monitoring and control of the concrete and ambient air temperature shall be recorded and submitted to the Contract Administrator. The monitoring shall commence when the concrete is placed.

For each Day's placement of concrete, thermocouple wires shall be embedded within 5 mm of the concrete surface in a minimum of four locations distributed throughout the repair areas, as directed by the Contract Administrator. At least one additional thermocouple shall be installed to measure ambient air temperature above the surface of the concrete and outside of the specified cold weather protection.

The recording of concrete temperatures shall begin at the start of concrete placement. The temperature shall be recorded automatically at intervals no greater than 15 minutes. The thermocouples and instrumentation shall be left in place and temperatures recorded until the end of the monitoring period.

Concrete and ambient air temperature readings shall be monitored and verified on site every 6 hours or more frequently as required for the first 3 Days, and every 12 hours or more frequently as required for the remainder of the monitoring period. Temperature verification shall be carried out in person at each concrete repair location. All necessary action shall be taken to maintain the temperature within the specified limits.

A record of temperatures for each Day during the temperature monitoring period shall be prepared. At the end of the temperature monitoring period, a complete temperature record including graphical plot of temperature versus time shall be prepared.

366.07.14.03**Submission of Temperature Records**

Datalogger temperature records and a record of any actions taken to maintain control of temperature shall be submitted to the Contract Administrator at the end of each Business Day during the temperature monitoring period. At the end of the temperature monitoring period, the complete temperature record shall be submitted to the Contract Administrator.

366.07.15**Joint Sealing**

Joint sealing shall be according to OPSS 369.

366.07.16**Material Sampling and Testing****366.07.16.01****Slump, Air Content and Temperature**

Plastic concrete sampling, testing, acceptance and field adjustments, visual acceptance, and submission of plastic concrete test results shall be according to the "Material Sampling and Testing" subsection of OPSS 1350, with the following exceptions and additions:

- a) Testing of plastic air content is not required for fast-track repairs.
- b) The minimum frequency of testing slump and concrete temperature shall be once for each load of concrete.
- c) For fast-track concrete, if the slump exceeds the maximum allowable slump of 230 mm, the load of concrete shall be rejected. Re-testing of slump of fast-track concrete is not permitted.

366.07.16.02**Coring for Compressive Strength and Air Void System Parameter Testing**

For all concrete pavement repairs including fast-track, cores shall be removed from the hardened concrete for acceptance testing by the Owner. Coring shall be carried out when the concrete is 28 to 35 Days old.

Concrete shall be sampled on a lot basis according to the Quality Assurance section of this specification. For each lot, a total of 5 cores shall be obtained. Cores shall be taken at random locations specified by the Contract Administrator. Four cores shall be taken from one repair area in the lot within 1 m of one another; three for compressive strength testing, and one for air void system (AVS) testing. A single core shall be taken from another repair area within the lot for AVS testing. Cores shall be 100 mm diameter and full depth.

Coring shall be carried out according to CSA A23.2-14C. Cores shall not contain steel reinforcement or other embedded material. A covermeter shall be used to establish the location of reinforcement and other embedded material prior to coring. No core shall be taken within 500 mm of any joint or repair area edge.

The Contract number, lot number, and repair area identification information shall be marked legibly on each core with durable ink. Each core shall be placed in a plastic bag, sealed to prevent loss of moisture.

Core holes shall be filled according to OPSS 1350.

366.07.16.03 Early Strength Determination for Repairs Other than Fast-Track

For repairs other than fast-track, the Contractor may elect to take cores for early strength determination in addition to the cores required for determination of 28-Day compressive strength. In order to demonstrate that the pavement has achieved sufficient strength for loading of construction vehicles or traffic, one set of three cores shall be taken for each Day's placement, from the last repair placed during that day. Cores shall be 100 mm diameter and full depth. All cores of the same set shall be removed at a location no more than 1 m from the location of the first core for that set.

When the Contractor elects to take cores for early strength determination, core removal and handling shall be carried out according to the Coring for Compressive Strength and Air Void System Parameters clause.

The Contract Administrator shall be provided with 1 Business Day advance notice to arrange testing by the designated quality assurance laboratory.

Core holes shall be filled according to OPSS 1350.

366.07.17 Special Requirements of Fast-track Repairs

366.07.17.01 Trial Area for Fast-track Repairs

A typical fast-track full depth repair shall be demonstrated at the trial repair area specified in the Contract Documents a minimum of one week prior to any concreting operation. If a trial repair area is not specified in the Contract Documents, a location acceptable to the Contract Administrator shall be selected to demonstrate a repair. The selected repair area shall be a minimum of 2 m long by 3.75 m wide and 0.250 m deep.

The ability to fully complete the trial repair area within the time frame of the lane closure as specified in the Contract Documents shall be demonstrated. The trial repair shall simulate the Contract site conditions as if it were the last repair of the closure and shall include sampling and testing as specified in the Material Sampling and Testing subsection. The trial repair area shall not be overlaid and shall remain exposed for at least seven Days to permit inspection for deficiencies.

The Contractor shall verify the calibration chart for the mix design strength versus temperature and the calibration chart for the mix design temperature versus time using the autogenous cylinder method.

Five cores shall be obtained from the trial repair area according to the Coring for Compressive Strength and Air Void System Parameters clause. Three cores shall be tested for compressive strength and two cores shall

be tested for AVS according to the Quality Assurance section. The compressive strength and air void system shall meet the requirements of this specification.

Permission to proceed with repairs shall only be given when the Contract Administrator is satisfied that all of the above conditions have been met.

A trial repair area is not required if the Contractor has demonstrated successful placement of fast-track repairs, meeting all specification requirements, within the last five years on another ministry Contract.

366.07.17.02 Early Strength Determination for Fast-Track Repairs

The autogenous cylinder method shall be used to determine compressive strength for purposes of opening the lane to traffic. The Contractor is responsible for the timing and frequency of testing of the autogenous cylinders and shall determine when the concrete pavement or concrete base has attained a minimum compressive strength of 20 MPa.

The Contractor shall make a minimum of three sets of two autogenous test cylinders for the final repair area of each lane closure according to CSA A23.2-3C. The cylinders shall be 150 mm in diameter and 300 mm long.

Compressive strength testing of autogenous cylinders shall be carried out according to CSA A23.2-9C by the Contractor to verify that the concrete in the repair area has attained a minimum compressive strength of 20 MPa. The testing shall be performed at a laboratory certified as a concrete testing laboratory by the Canadian Council of Independent Laboratories (CCIL) that has successfully participated in the MTO correlation program.

The concrete compressive strength specimen shall be tested to complete failure. These test results shall be communicated immediately to the Contract Administrator, prior to re-opening the lane to traffic.

The compressive strength of the concrete in the repair area shall be based on the following procedure:

- a) Install thermocouple wires according to the Monitoring and Control of Temperature for Fast Track Repairs clause.
- b) Monitor and record the temperature of the repair slab and autogenous cylinders a minimum of once every 15 minutes.
- c) Autogenous test cylinders shall be tested in pairs for compressive strength at time intervals determined by the Contractor, until a compressive strength of 20 MPa or greater is obtained. The repaired slab shall not be opened to traffic until the slab temperature has reached at least the same temperature as the cylinders which attained a compressive strength of 20 MPa or greater.

The Contract Administrator shall be provided access to verify temperature readings. If the datalogger does not have a digital display for verifying the temperature, the Contract Administrator shall be provided with the necessary instruments to verify thermocouple function and readings.

A record of the temperatures of the repair slab and autogenous cylinders, and the compressive strength test results shall be submitted to the Contract Administrator for each lane closure.

366.07.17.03 Monitoring and Control of Temperature for Fast Track Repairs

Thermocouple wires shall be installed at a minimum of two test locations in the final full depth repair area for each lane closure. The thermocouple wires shall be embedded within 5 mm of the concrete surface and at the edge of the repair area.

Thermocouple wires shall also be embedded in each of the autogenous cylinders.

366.07.18 Unacceptable Repair Areas

Concrete found to be unacceptable shall be removed and replaced with new concrete meeting the Contract requirements.

The area to be removed shall extend to the nearest contraction joint and longitudinal joint or edge outside the deficient area so that there are no additional joints.

Concrete which does not meet the surface tolerance may be corrected by diamond grinding in lieu of removal and replacement, subject to approval by the Owner.

366.07.19 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

366.08 QUALITY ASSURANCE

366.08.01 Lot Size for 28-Day Compressive Strength and Air Void System Testing

Concrete shall be accepted on a lot basis. A lot shall consist of up to 400 m² of each type of repair. Partial depth and full depth repairs shall be separate lots. Conventional concrete repairs and fast-track concrete repairs shall be separate lots.

For each lot, one set of three cores shall be tested for 28-Day compressive strength and two cores shall be tested for AVS.

366.08.02 Acceptance of 28-Day Compressive Strength

One set of three core samples per lot shall be tested to determine the acceptability of compressive strength of the lot. Compressive strength shall be determined according to LS-410 on moisture conditioned cores. The compressive strength result of a lot shall be the average of the set of the three acceptance cores, rounded to one decimal place.

Compressive strength of a lot shall be considered acceptable when:

- a) The average compressive strength of the set of three cores is equal to or greater than 30 MPa, and
- b) No individual core result is more than 10% below the specified strength.

Unacceptable lots shall be rejected. Concrete from unacceptable lots shall be removed and replaced.

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

366.08.02.01 Referee Testing of Compressive Strength

Referee testing for compressive strength shall be according to OPSS 1350, except that referee testing shall be done on a new set of cores. A set of referee cores for compressive strength shall consist of three individual cores and shall be taken from the same repair area from which acceptance samples were obtained. The new set of cores shall be obtained within 5 Business Days of invoking referee testing.

All cores of the same set shall be removed at a location no more than 1m from the location of the first core for that set.

Coring shall be carried out according to CSA A23.2-14C. No core shall be taken within 500 mm of any joint or repair area edge. The Contractor shall use a covermeter to establish the location of reinforcement and other embedded material prior to coring. Cores shall not contain steel reinforcement or other embedded material.

The Contract number, lot number and repair area identification information shall be marked legibly on each core with durable ink. Each core shall be placed in a plastic bag, sealed to prevent loss of moisture.

The Contractor shall fill the core holes according to OPSS 1350.

366.08.02.01.01 Referee Testing Cost

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

When the referee results indicate that the refereed lot is acceptable, the Owner shall bear the cost. When the referee results indicate that the refereed lot is not acceptable, the Contractor shall be charged the cost of the air void system referee testing.

366.08.03 Acceptance of Air Void System in Hardened Concrete

One half of each core shall be tested according to LS-432 to determine the acceptability of concrete AVS of the lot. The other half of each core shall be retained by the Owner for audit purposes.

For a lot to be considered acceptable, each core shall have air content of 3.0% or more and spacing factor of 0.230 mm or less.

Unacceptable lots shall be rejected. Concrete from unacceptable lots shall be removed and replaced.

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

366.08.03.01 Referee Testing of Air Void System in Hardened Concrete

Referee testing of AVS parameters may only be invoked by the Contractor within 5 Business Days of receiving the test result.

When referee testing is invoked, both core samples representing a lot shall be referee tested and the acceptance test results discarded. The lot referee test results shall replace the acceptance test result in the acceptance requirements of this specification.

Referee testing shall be carried out on the same half of the core sample that was tested for acceptance.

Cores shall be tested according to LS-431. Referee test results shall be forwarded to the Contractor as they become available.

366.08.03.01.01 Referee Testing Cost

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

When the referee results indicate that the refereed lot is acceptable, the Owner shall bear the cost. When the referee results indicate that the refereed lot is not acceptable, the Contractor shall be charged the cost of the air void system referee testing.

366.08.04 Falling Weight Deflectometer Acceptance Testing

The Contractor shall make the work available for testing by the Owner. The Contract Administrator shall carry out falling weight deflectometer (FWD) testing on the approach and leave joints of each full depth conventional and fast-track repair area to determine the load transfer efficiency across the transverse joints. FWD testing, equipment calibration and reporting shall be according LS-447. Each repair shall be acceptable if the FWD test results indicate a load transfer efficiency of 70% or greater. Repair areas with a load transfer efficiency less than 70% shall be removed and replaced.

366.08.04.01 Falling Weight Deflectometer Referee Testing

FWD referee testing may only be invoked by the Contractor within 5 Business Days of receiving the test result. Referee testing shall be according to LS-447. The referee test result shall replace the acceptance test result in the acceptance requirements of this specification. Referee test results shall be forwarded to the Contractor, as they become available.

366.08.04.01.01 Referee Testing Cost

When the referee results indicate that the refereed repair is acceptable, the Owner shall bear the cost. When the referee results indicate that the refereed repair is not acceptable, the Contractor shall be charged the cost of the FWD referee testing.

366.08.05 Acceptance of Surface Tolerance

Each repair area shall meet the requirements of the Surface Tolerance section of this specification. Repair areas that do not meet the surface tolerance requirements of this specification shall be considered unacceptable and shall be removed and replaced.

366.08.06 Defects

Concrete repair areas are unacceptable if they contain any of the following defects:

- a) Concrete with any visible surface cracks in the repair, unless the Contractor demonstrates, at his expense, that the depth of the crack is less than 10 mm.
- b) Concrete with honeycombing or other deficiencies detected visually.
- c) Partial depth repairs with debonding identified by sounding.

Unacceptable concrete shall be removed and replaced.

366.08.07 Acceptance or Rejection

The lot shall be rejected if any of the following apply:

- a) Compressive strength not meeting the minimum strength requirements prior to opening to traffic.
- b) Average 28-Day compressive strength less than 30 MPa or individual results less than 10% of specified compressive strength.
- c) Air void system not meeting the requirements of this specification.
- d) FWD test results indicating a load transfer efficiency of less than 70%.

- e) Defects listed in the Defects section of this specification are present in the work.
- f) Any work that does not conform to the requirements of this specification.

366.09 MEASUREMENT FOR PAYMENT

366.09.01 Actual Measurement

**366.09.01.01 Fast-track Concrete Repair
Full Depth Concrete Repair
Partial Depth Concrete Repair**

Measurement of fast-track concrete repair, full depth concrete repair, and partial depth concrete repair shall be by the area of the repair in square metres. Each repair area shall be measured to the nearest 0.1 m².

366.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

366.10 BASIS OF PAYMENT

**366.10.01 Fast-track Concrete Repair - Item
Full Depth Concrete Repair - Item
Partial Depth Concrete Repair - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the Work.

Concrete and concrete repair areas that are unacceptable shall be removed and replaced at no additional cost to the Owner.

TABLE 1
Nominal Maximum Size of Coarse Aggregate

Repair Type	Nominal Maximum Size of Coarse Aggregate
Partial Depth	19.0 mm
Full Depth and Fast-Track	19.0 mm, 37.5 mm or combined gradation of nominal maximum aggregate size of 37.5 and 19.0 mm



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.PROV 402
APRIL 2017**

(Formerly, OPSS 402, NOVEMBER 2013)

Note: The PROV implemented in April 2017 replaces OPSS 402 COMMON, November 2013 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
EXCAVATING, BACKFILLING, AND COMPACTING
FOR MAINTENANCE HOLES, CATCH BASINS,
DITCH INLETS, AND VALVE CHAMBERS**

TABLE OF CONTENTS

402.01	SCOPE
402.02	REFERENCES
402.03	DEFINITIONS
402.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
402.05	MATERIALS
402.06	EQUIPMENT - Not Used
402.07	CONSTRUCTION
402.08	QUALITY ASSURANCE - Not Used
402.09	MEASUREMENT FOR PAYMENT
402.10	BASIS OF PAYMENT

APPENDICES **Not Used**

402.01 **SCOPE**

This specification covers the requirements for excavating, backfilling, and compacting for the installation of storm and sanitary pipe sewer maintenance holes, storm sewer catch basins and ditch inlets, and valve chambers for watermains and forcemains.

402.01.01 **Specification Significance and Use**

This specification has been developed for use in provincial oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

402.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

402.02 REFERENCES

When the Contract Documents indicate that provincial specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 403	Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1359	Unshrinkable Backfill

402.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Additional Excavation means all excavation ordered in writing by the Contract Administrator beyond excavation specified in the Contract Documents.

Backfilling means the operation of filling the excavation with bedding and backfill material.

Backfill Material means approved fill material used above the bedding and below the lower of the subgrade or finished grade or original ground.

Bedding Material means the material used to support the maintenance hole, catch basin, ditch inlet, or valve chamber.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Imported Material means material obtained from a source other than the Work Area.

Native Material means the material removed to form an excavation within the Work Area for return to the same or other excavation.

Over-Excavation means all excavation beyond that specified in the Contract Documents, performed without the written order of the Contract Administrator.

Structure means maintenance hole, catch basin, ditch inlet, or valve chamber.

Unshrinkable Fill means a controlled density cement treated aggregate material.

402.05 MATERIALS

402.05.01 Granular Material

Granular material shall be according to OPSS 1010.

402.05.02 Backfill Material

402.05.02.01 General

Backfill material shall be as specified in the Contract Documents.

402.05.02.02 Native and Imported Material

Native and imported material shall be material approved by the Contract Administrator. All material shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks, and boulders over 150 mm in any dimension, and other deleterious material.

402.05.03 Unshrinkable Fill

Unshrinkable fill shall be according to OPSS 1359.

402.07 CONSTRUCTION

402.07.01 General

Excavations shall be stable and dry, unless designated as subaqueous Work.

402.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

402.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

402.07.04 Removals

Removals shall be according to OPSS 510.

402.07.05 Dewatering

Dewatering shall be according to OPSS 517.

402.07.06 Support Systems

Support systems shall be according to OPSS 404.

402.07.07 Removal of Frozen Ground

Written permission shall be obtained from the Contract Administrator prior to starting an excavation in frozen ground. The method used for removal of frozen ground shall not cause damage to adjacent structures or Utilities.

402.07.08 Excavation

402.07.08.01 General

Excavation shall be performed to the lines, elevations, and dimensions specified in the Contract Documents plus an allowance for support systems, where required.

Rock excavation for maintenance holes, catch basins, ditch inlets, or valve chambers shall be according to OPSS 403.

402.07.08.02 Additional Excavation

Structures shall not be placed or constructed on an unsuitable foundation as may be determined by the Contract Administrator.

Unsuitable material shall be excavated and the resulting excavation shall be backfilled and compacted to obtain a suitable foundation.

402.07.08.03 Over-Excavation

Corrective measures ordered by the Contract Administrator to rectify deficiencies caused by over-excavation shall be performed. Soil that has become disturbed by construction methods or procedures shall be removed and replaced with granular material compacted to 95% maximum dry density where the excavated surface is below or beside the proposed structure.

402.07.09 Backfilling and Compacting

402.07.09.01 Bedding

A 150 mm layer of granular bedding material shall be placed on the bottom of the excavation and compacted according to OPSS 501, prior to the placing of a structure.

402.07.09.02 Backfill

Backfill material shall be placed simultaneously on all sides of the structure in layers not exceeding 300 mm in thickness, loose measurement, and compacted according to OPSS 501, prior to the placement of a subsequent layer.

Backfill material shall not commence around cast-in-place concrete structures until approval has been obtained from the Contract Administrator.

402.07.10 Additional Excavating, Backfilling, and Compacting

Additional excavating, backfilling, and compacting shall be as described in the Excavation and Backfilling and Compacting subsections.

The volume of the excavation that is in addition to the limits specified in the Contract Documents shall be determined.

402.07.11 Site Restoration

Site restoration shall be according to OPSS 492.

402.07.12 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

402.09 MEASUREMENT FOR PAYMENT

402.09.01 Actual Measurement

402.09.01.01 Additional Excavating, Backfilling, and Compacting

Additional excavating, backfilling, and compacting shall be based on the volume of the additional excavation measured in cubic metres prior to installation of a structure.

The volume of the additional excavation shall be determined beyond the limits specified in the Contract Documents.

402.10 BASIS OF PAYMENT

402.10.01 Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Payment at the Contract price for the appropriate tender items for the installation of maintenance holes, catch basins, ditch inlets, and valve chambers shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Any expenses for remedial work resulting from over-excavation shall be borne by the Contractor.

402.10.02 Additional Excavating, Backfilling, and Compacting - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

402.10.03 Rock Excavation for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Payment for rock excavation for maintenance holes, catch basins, ditch inlets, and valve chambers shall be according to OPSS 403.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.PROV 403
APRIL 2017**

(Formerly OPSS 403, November 2010
(Formerly OPSS 515, November 2005)

Note: The PROV implemented in April 2017 replaces OPSS 403 COMMON, November 2010 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
ROCK EXCAVATION FOR PIPELINES, UTILITIES,
AND ASSOCIATED STRUCTURES IN OPEN CUT**

TABLE OF CONTENTS

403.01	SCOPE
403.02	REFERENCES
403.03	DEFINITIONS
403.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
403.05	MATERIALS - Not Used
403.06	EQUIPMENT - Not Used
403.07	CONSTRUCTION
403.08	QUALITY ASSURANCE - Not Used
403.09	MEASUREMENT FOR PAYMENT
403.10	BASIS OF PAYMENT

APPENDICES **Not Used**

403.01 **SCOPE**

This specification covers the rock excavation requirements for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, and watermains and associated appurtenances; underground Utilities; and maintenance holes, catch basins, ditch inlets, and valve chambers in open cut.

403.01.01 **Specification Significance and Use**

This specification has been developed for use in provincial oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

403.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

403.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 412	Sewage Forcemain Installation in Open Cut
OPSS 441	Watermain Installation in Open Cut

403.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenances means as defined in OPSS 412 and OPSS 441.

Associated Structures means a maintenance hole, catch basin, ditch inlet, or valve chamber.

Rock means rock as defined in OPSS 206.

403.07 CONSTRUCTION

403.07.01 General

Rock excavation to install sanitary and storm pipe sewers, pipe culverts and end sections, forcemains and associated appurtenances, and watermain and associated appurtenances; underground Utilities; and maintenance holes, catch basins, ditch inlets, and valve chambers in open cut shall be performed to the lines and grades specified in the Contract Documents.

403.07.02 Use of Explosives

The requirements for the use of explosives shall be as specified in the Contract Documents.

403.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

403.09 MEASUREMENT FOR PAYMENT

403.09.01 Actual Measurement

403.09.01.01 Rock Excavation for Pipelines, Utilities and Associated Structures

Measurement shall be in cubic metres.

The volume of rock excavation for pipelines, Utilities, and associated structures shall be determined by the product of the relevant following dimensions measured in place:

a) Height

The height of rock excavation for pipelines, Utilities, and associated structures is the difference in elevation between the theoretical bottom of bedding and the lower of the top of the original rock or the top of shatter.

The top of the original rock shall be determined using one of the following methods:

- i. Elevations taken after the overburden has been removed but before rock excavation.
- ii. From rock surface elevations on both sides of the excavation after rock excavation has been completed.

b) Width

The width of rock excavation for pipelines and Utilities is the actual width of trench measured horizontally to a maximum of the specified trench width.

c) Length

The length of rock excavation for pipelines and Utilities is measured horizontally along the centreline of the trench to the outside limits of the backfill for the associated structures or to the outlet end of a pipe where it emerges from the rock.

d) Horizontal

The horizontal measurement for associated structures is the:

- i. diameter at the external surfaces of a circular structure plus 300 mm all around; or
- ii. the length and width to the external surfaces of a rectangular or square structure plus 300 mm on all sides.

Where the excavation for this item overlaps rock excavation for other items there shall be no deduction for the overlap.

The volume of boulders in an excavation shall be determined by the product of the three maximum rectilinear dimensions. Where boulders classified as rock are measured for payment, only the amount

actually removed shall be considered for payment, the total volume of rock considered for payment shall not exceed the volume of excavation within the theoretical lines.

403.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

403.10 BASIS OF PAYMENT

403.10.01 Rock Excavation for Trenches and Associated Structures - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS.PROV 441
APRIL 2017**

(Formerly OPSS 441, November 2014)

Note: The PROV implemented in April 2017 replaces OPSS 441 COMMON, November 2014 with no technical content changes.

**CONSTRUCTION SPECIFICATION FOR
WATERMAIN INSTALLATION IN OPEN CUT**

TABLE OF CONTENTS

441.01	SCOPE
441.02	REFERENCES
441.03	DEFINITIONS
441.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
441.05	MATERIALS
441.06	EQUIPMENT - Not Used
441.07	CONSTRUCTION
441.08	QUALITY ASSURANCE - Not Used
441.09	MEASUREMENT FOR PAYMENT
441.10	BASIS OF PAYMENT
APPENDICES	Not Used

441.01 SCOPE

This specification covers the requirements for the installation of watermains, service connections, and associated appurtenances in open cut.

441.01.01 Specification Significance and Use

This specification has been developed for use in provincial oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

441.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

441.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 490	Site Preparation for Pipeline, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 493	Temporary Potable Water Supply Services
OPSS 510	Removal
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1842	Pressure Polyethylene Pipe Products

CSA Standards

B64.5-11	Double Check Valve (DCVA) Backflow Preventers [Part of B64 Series-11, Backflow Preventers and Vacuum Breakers Compendium]
----------	--

B137.1-09	Polyethylene Pipe, Tubing and Fittings for Cold-Water Pressure Services [Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.2-09	Polyvinyl Chloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications [Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3-09	Rigid Polyvinyl Chloride (PVC) Pipe and Fittings for Pressure Applications [Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3.1-09	Molecularly Oriented Polyvinyl Chloride (PVCO) Pipe and Fittings for Pressure Applications [Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.10-09	Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure-Pipe Systems [Part of B137-09, Thermoplastic Pressure Piping Compendium]

ASTM International

A 153M-09	Zinc Coating (Hot Dip) on Iron and Steel Hardware
A 276-10	Stainless Steel Bars and Shapes
A 307-10	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
B 88-09	Seamless Copper Water Tube
B 633-11	Electrodeposited Coatings of Zinc on Iron and Steel
B 766-86 (2008)	Electrodeposited Coatings of Cadmium
C 361-11	Reinforced Concrete Low-Head Pressure Pipe
D 3139-98 (2011)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

C104/A21.4-08	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C110/A21.10-08	Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-07	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C151/A21.51-02	Ductile-Iron Pipe, Centrifugally Cast, for Water
C153/A21.53-06	Ductile-Iron Compact Fittings for Water Service
C200-05	Steel Water Pipe - 6 In. (150 mm) and Larger
C205-07	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger
C206-11	Field Welding of Steel Water Pipe
C208-07	Dimensions for Fabricated Steel Water Pipe Fittings
C301-07	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
C302-11	Reinforced Concrete Pressure Pipe, Non-Cylinder Type
C303-08	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
C502-05	Dry-Barrel Fire Hydrants
C504-10	Rubber-Seated Butterfly Valves
C509-09	Resilient-Seated Gate Valves for Water Supply Service
C510-07	Double Check Valve Backflow Prevention Assembly
C800-05	Underground Service Line Valves and Fittings
C900-07	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Transmission and Distribution
C905-10	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm Through 1,200 mm (14 in. Through 48 in.) for Water Transmission and Distribution
C907-12	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Distribution
C909-09	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 100 mm Through 600 mm (4 in. Through 24 in.), for Water Distribution

American Society of Mechanical Engineers (ASME)

B18.2.1-2010 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

NSF International

61-2008 Drinking Water System Components - Health Effects

441.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit, which are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, and thrust restraints.

Backfilling means the operation of filling a trench with bedding, cover, and backfill material, or embedment and backfill material.

End Covers means temporary cover installed at the factory over both ends of uninstalled watermain pipe to prevent the entry of contaminants during shipping and storage.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipe: for example, elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a main; plugs and caps to close an end; and bushings, diminishers, or reducers to couple two pipes of different diameters.

Service Connection means the system used to supply water from the watermain to the property line.

Service Connection Appurtenance Set means the main stop, curb stop, couplings, service box, service box support, and service saddle used in the installation of a service connection.

Watermain means an installation designed for the conveyance of water under pressure using circular pipe.

441.05 MATERIALS

441.05.01 General

The pipe size shall be according to the size specified in the Contract Documents. Pipe type and class shall be as specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

All material for watermains shall be NSF/ANSI 61 compliant.

441.05.02 Ductile Iron Pipe

Ductile iron pipe shall be according to AWWA C151/A21.51.

Fittings shall be gray iron according to AWWA C110/A21.10 or ductile iron according to AWWA C110/A21.10 or AWWA C153.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.4.

Rubber gaskets for push-on or mechanical joints shall be according to AWWA C111/A21.11.

441.05.03 Concrete Pressure Pipe

Concrete cylinder pipe including joints and fittings shall be according to AWWA C301 or AWWA C303.

Non-cylinder pipe and joints shall be according to AWWA C302 or ASTM C 361. Fittings shall be according to AWWA C302.

441.05.04 Polyvinyl Chloride Pipe

441.05.04.01 General

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings for polyvinyl chloride (PVC) and molecularly oriented polyvinyl chloride (PVCO) pipe shall be either:

- a) Gray iron according to AWWA C110/A21.10.
- b) Ductile iron according to C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.
- c) Injection moulded polyvinyl chloride, blue in colour and according to AWWA C907 and CSA B137.2.
- d) Prefabricated polyvinyl chloride, blue in colour and according to AWWA C905 and CSA B137.3.

441.05.04.02 Polyvinyl Chloride Pipe (PVC)

Polyvinyl chloride pipe shall be according to AWWA C900 or AWWA C905 and CSA B137.3, and shall be blue in colour and supplied complete with gaskets.

441.05.04.03 Molecularly Oriented Polyvinyl Chloride Pipe (PVCO)

Molecularly oriented polyvinyl chloride pipe shall be according to AWWA C909 and CSA B137.3.1, and shall be blue in colour and supplied complete with gaskets.

441.05.05 Polyethylene Pipe

Polyethylene pressure pipe shall be according to OPSS 1842.

Fittings shall be either:

- a) Flanged gray iron according to AWWA C110/A21.10.
- b) Flanged ductile iron according to AWWA C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.
- c) Polyethylene according to OPSS 1842.
- d) Heat fusion or insert or compression type fittings according to CSA 137.1.

441.05.06 Steel Pipe

Steel pipe shall be according to AWWA C200. Fittings shall be according to AWWA C208. Steel pipe shall have a cement-mortar protective lining and coating according to AWWA C205.

441.05.07 Copper Pipe

Copper pipe for service connections shall be according to ASTM B 88 and shall be type K soft copper.

441.05.08 Composite Pipe

Crosslink polyethylene/aluminum/crosslink polyethylene composite pressure pipe for service connections shall be according to CSA B137.10.

441.05.09 Valves

441.05.09.01 General

All valves shall open by operating in a counter clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valve types shall be one of the following:

- a) Valves less than 75 mm shall be brass or bronze gate valves.
- b) Valves greater than or equal to 75 mm, and less than or equal to 300 mm, shall be cast or ductile iron gate valves.
- c) Valves greater than 300 mm up to and including 500 mm shall be gate or butterfly valves.
- d) Valves greater than 500 mm shall be butterfly valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153 or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

441.05.09.02 Service Line Valves

Valves shall be according to AWWA C800. Type, pressure class, and end connections shall be as specified in the Contract Documents.

441.05.09.03 Gate Valves

Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall use O-ring type seals that do not require adjustment.

The gate valve end configuration shall be as specified in the Contract Documents.

441.05.09.04 Butterfly Valves

Butterfly valves shall be according to AWWA C504.

Valves shall be short body flanged or mechanical-joint, class 150B.

Valve shafts shall be stainless steel and, when they project through the body, shall have seals that do not require adjustment.

A vertical operating nut shall be provided. Valves shall be provided with an external indicator showing valve position by means of a pointer operating through a 90° arc from open to close.

441.05.09.05 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be single acting type.

441.05.10 Hydrants

Hydrants shall be according to AWWA C502. The type shall be as specified in the Contract Documents.

441.05.11 Double Check Valve Backflow Preventers

Double check valve backflow preventers shall be according to CSA B64.5 or AWWA C510.

441.05.12 Service Connection Fittings and Appurtenances

Main stops, curb stops, couplings, service boxes, and service saddles shall be as recommended by the manufacturer of the service connection pipe.

441.05.13 Concrete

Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

441.05.14 Mortar

Mortar for joints shall be composed of one part Portland cement and three parts mortar sand, wetted with sufficient water to make the mixture plastic.

The mortar sand shall be according to OPSS 1004, the Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

441.05.15 Straps, Tie-Rods, Angles, Nuts, and Bolts

Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.

441.07 CONSTRUCTION

441.07.01 General

The work for the installation of watermains shall include all watermain pipe, bends, tees, fittings, and thrust restraints and the testing of the watermain system.

The interior of all pipe, fittings, and other accessories shall be kept clean and free from undesirable material at all times.

441.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

441.07.03 Removals

Removals shall be according to OPSS 510.

441.07.04 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

441.07.05 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the works.

441.07.06 Cold Weather Work

All work shall be protected from freezing. Pipe and bedding material shall not be placed on frozen ground.

441.07.07 Transporting, Unloading, Storing, and Handling Pipe

All pipe, fittings, and gaskets that are unsound or damaged shall be rejected.

All pipe up to and including 600 mm diameter shall be delivered to the Work Area with end covers and a tamper evident seal on only the bell end. These components shall adhere sufficiently to withstand the stresses caused during shipment.

A waterproof seal is not required on the end covers.

Tamper evident seals shall display the manufacturers name or logo or both. Seals shall straddle the end cover and the pipe. Removal of the cover shall render the tamper evident seal unusable either by breaking the seal or by leaving a message such as "VOID" on the pipe. Tamper evident seals are not required for non-reusable heat shrink plastic covers or foam plugs with punch-out centres.

Pipe delivered to the construction site with damaged or missing end covers shall be field cleaned to remove all undesirable material along the entire length of the interior of the pipe and the end covers reinstalled.

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

441.07.08 Excavation

Excavation for the installation of watermain shall be according to OPSS 401.

441.07.09 Support Systems

Support systems shall be according to OPSS 404.

441.07.10 Dewatering

Dewatering shall be according to OPSS 517.

441.07.11 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

When the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling when necessary to prevent damage to such works or proposed works.

441.07.12 Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

441.07.13 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

441.07.14 Installation of Pipe

Pipe shall be laid in a dry trench.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

When the Owner raises or lowers the invert of a watermain by up to 150 mm, it shall not constitute a Change in the Work and no adjustment shall be made to the payment. When the invert of a watermain is raised or lowered by more than 150 mm, then this shall constitute a Change in the Work for the full extent of the change from the original grade.

Pipe shall be kept clean and dry as work progresses. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

441.07.15 Jointing

441.07.15.01 General

End covers shall be removed immediately prior to jointing. Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipe shall be followed.

Joints and all connections shall be made watertight.

All bolts, nuts, couplings, rubber rings, and connecting pieces shall be cleaned thoroughly before installation.

Pipe shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by a hand-operated winch. A backhoe shall not be used for pushing pipe.

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

441.07.15.02 Ductile Iron Pipe

Mechanical Joints:

The gland shall be positioned on the pipe with the lip extension toward the joint. The gasket shall be slipped on the pipe with the thick edge towards the gland. The spigot end shall be pushed to its seat in the bell. The gasket shall be pressed to seat it evenly around the joint.

The gland shall be positioned for bolting and the bolts shall be inserted. All nuts shall be hand tightened.

The nuts shall be tightened half a turn at a time with a calibrated torque wrench. All nuts shall be tightened uniformly to the torque specified in AWWA C111/A21.11.

Bell and Spigot Joints:

The gasket shall be placed in the groove of the bell making certain it is properly seated.

The gasket shall be lubricated.

Pipe to be joined shall be aligned and the spigot shall be carefully entered into the bell until the spigot end just makes contact with the gasket.

The entry of the spigot into the bell shall be completed by hand or by the use of a hand operated winch until the second reference mark is flush with the face of the bell.

441.07.15.03 Concrete Pressure Pipe

Bell and Spigot Joints:

A cotton or burlap diaper shall be placed around the bell end of the pipe already in place.

A rubber gasket shall be placed on the spigot end of the pipe to be laid ensuring that the stretch and volume of the gasket is equalized around the entire circumference of the pipe. The gasket and spigot shall be lubricated prior to the spigot end being inserted home into the bell end.

The pipe shall be aligned and the spigot end shall be inserted into the bell of the pipe already in place.

Steel inserts shall be placed in the joints to prevent the spigot from entering the full depth of the bell. The location of the rubber gasket shall be checked around the entire circumference of the joint. The steel insert shall be removed and the pipe pushed until the spigot enters the full depth of the socket and is retained in position.

Ensure that the diaper is carefully placed around the joint recess. Cement mortar shall be poured around the assembled joint.

441.07.15.04 Polyvinyl Chloride Pressure Pipe - PVC and PVCO

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell up to but not beyond the depth of the stop reference mark.

441.07.15.05 Polyethylene Pressure Pipe

Polyethylene pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Polyethylene pipe 75 mm diameter and smaller shall be joined with heat fusion or insert or compression type fittings that are recommended by the pipe manufacturer and that prevent pull-out and resist creep deformation at full test pressure.

Connections to non-polyethylene fittings and appurtenances 50 mm diameter and larger shall be made with flanged joints according to the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

441.07.15.06 Steel Pipe

Steel pipe shall be jointed according to AWWA C200. Field welding for joints shall be according to AWWA C206.

441.07.15.07 Service Connection Pipe

Service connection pipe shall be jointed as recommended by the manufacturer.

441.07.16 Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer. After cutting the pipe, the interior of the pipe shall be cleaned and the end cover replaced until the pipe is installed.

441.07.17 Change in Line and Grade

441.07.17.01 Ductile Iron Pipe

Fabricated bends shall be provided for changes in line and grade of 11.25° or more.

Deflections of less than 11.25° may be made using a series of pipe joint deflections. The manufacturer's recommendation in deflecting any single pipe joint shall not be exceeded.

441.07.17.02 Concrete Pressure Pipe

Fabricated bends, bevel adaptors, or elbows shall be used for changes in line or grade greater than 5°. Changes in line or grade less than 5° shall be made using a manufactured joint or bevel connection or may be made over several joints. The manufacturer's joint deflection recommendations shall not be exceeded.

441.07.17.03 Polyvinyl Chloride Pipe - PVC and PVCO

Polyvinyl chloride pipe joints may be deflected but shall not exceed the manufacturer's recommendations. Otherwise, fabricated bends shall be used.

441.07.17.04 Polyethylene Pipe

Use of pipe flexibility may be allowed but shall not exceed the manufacturer's recommendations.

441.07.17.05 Steel Pipe

Fabricated bends shall be used at all changes in line or grade, unless the change can be accomplished by deflections at pipe joints without exceeding the manufacturer's recommendation for deflection at pipe joints.

441.07.18 Installation of Valves and Fittings

441.07.18.01 General

The work for the installation of valves and fittings shall include the valves and couplings and valve boxes, when valve boxes are specified in the Contract Documents. Valves and fittings shall be installed in locations and be of the type specified in the Contract Documents. Valves and connecting pipe shall be aligned accurately and supported as specified in the Contract Documents. Valves and fittings do not require end covers but shall be field cleaned prior to installation.

441.07.18.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

441.07.19 Installation of Hydrant Sets

The work for the installation of hydrant sets shall include the placing of hydrants, hydrant isolating valves, hydrant leads, restraining devices, and support devices.

Hydrant sets shall be installed at locations specified in the Contract Documents.

The hydrant shall be plumb with the nozzles parallel to the edge of pavement or curb line and the pumper connection facing the roadway.

441.07.20 Installation of Service Connections

A service connection shall consist of a service connection pipe and a service connection appurtenance set and shall be installed at locations and be of the size specified in the Contract Documents.

Service connection pipe shall be installed by pressure tap connection or saddles. Service connections on plastic watermain shall be installed using service saddles or tapped couplings.

Curb stop valve boxes shall be installed vertically and flush with the final grade elevation.

441.07.21 Shutting Down or Charging Mains

At no time shall watermain be shut down or charged or valves operated without permission from the Contract Administrator.

441.07.22 Connections to Existing Watermain

The work of connecting to existing watermain shall include the removal of all plugs, caps, blow offs, and thrust blocks from an existing watermain or fitting, and the installation of the connection.

All connections to existing watermain shall be made under the supervision of the Contract Administrator.

441.07.23 Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking and/or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete. Only restrained joint products specifically designed for use with the pipe material shall be used.

441.07.24 Hydrostatic Testing

441.07.24.01 General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator upon completion of the watermain, including services and backfilling.

A test section shall be either a section between valves or the completed watermain.

Test pressure shall be 1,035 kPa.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for 2 hours.

441.07.24.02 Polyethylene Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure and sufficient make-up water added each hour for 3 hours to return to test pressure. The test phase begins after the initial expansion phase.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the value in Table 1, leakage is not indicated.

If the amount of make-up water exceeds the Table 1 value, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for at least 8 hours before bringing the test section up to pressure again.

441.07.24.03 Other Pipe

A period of 24 hours shall be allowed before starting the test.

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

441.07.25 Flushing and Disinfecting Watermains

Flushing and disinfecting operations shall be conducted under the supervision of the Contract Administrator. The watermain shall be flushed to achieve a minimum velocity of 0.76 m/sec otherwise the watermain shall be swabbed. The Contract Administrator shall be notified at least 2 Business Days in advance of the proposed date on which flushing and disinfecting operations are to commence.

Watermains shall be flushed in a sequence approved by the Contract Administrator. The Contract Administrator may permit or require the flushing to be carried out in stages as sections of the system are completed. Flushed sections shall be protected from contamination.

After flushing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new pipeline. Liquid chlorine solution shall be introduced so that the chlorine is distributed throughout the section being disinfected. The chlorine shall be applied so that the chlorine concentration is 50 mg/litre minimum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

Sampling and testing for chlorine residual shall be carried out by the Contract Administrator. The chlorine residual shall be tested in the section after 24 hours. If tests indicate a chlorine residual of 25 mg/litre minimum, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the chlorination procedure shall be repeated until satisfactory results are obtained.

Twenty-four hours after the system has been recharged, the Contract Administrator shall take samples for bacteriological tests. Samples shall be collected from every 350 m of the new watermain plus one sample from the end of each of the line and at least one sample from each branch. If there is indication of contamination, the disinfection procedure shall be repeated.

The system shall not be put into operation until approval has been given by the Contract Administrator.

441.07.26 Site Restoration

Site restoration shall be according to OPSS 492.

441.07.27 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

All chlorinated water used for testing, flushing, or disinfecting watermains shall be disposed of safely.

The method of disposal of chlorinated water is subject to the approval of the Contract Administrator.

441.09 MEASUREMENT FOR PAYMENT

441.09.01 Actual Measurement

441.09.01.01 Watermains

Measurement of watermains shall be by length in metres along the horizontal centreline of the pipe from the point of connection to a chamber, water treatment plant, or existing watermain to a point vertically above the end of the new watermain.

441.09.01.02 Valves

For measurement purposes, a count shall be made of the number of valves installed, regardless of the type and size.

441.09.01.03 Hydrant Sets

For measurement purposes, a count shall be made of the number of hydrant sets installed, regardless of the type.

441.09.01.04 Service Connection Pipe

Measurement of service connection pipe shall be by length in metres along the horizontal centreline of the pipe from the point of connection at the watermain to a point vertically above the end of the service connection.

441.09.01.05 Service Connection Appurtenance Sets

For measurement purposes, a count shall be made of the number of service connection appurtenance sets installed.

441.09.01.06 Connections to Existing Watermains

For measurement purposes, a count shall be made of the number of connections made to existing watermains.

441.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

441.10 BASIS OF PAYMENT

- 441.10.01 Watermains - Item**
Valves - Item
Hydrant Sets - Item
Service Connection Pipe - Item
Service Connection Appurtenance Sets - Item
Connections to Existing Watermains - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Test Phase Make-Up Amount for Pressure Polyethylene Pipe

Pipe Diameter mm	Make-Up Water litre/km
30	12.38
40	12.38
50	13.62
75	18.60
100	31.00
150	74.50
200	124.20
250	161.40
275	248.30
300	285.60
350	335.20
400	409.70
450	533.90
500	682.90
550	869.10
600	1,105.00
700	1,378.20
800	1,775.50
900	2,234.90
1,000	2,731.60
1,050	3,104.00
1,200	3,973.20
1,350	5,152.70
1,600	7,449.70



CONSTRUCTION SPECIFICATION FOR THE PLACEMENT OF UNSHRINKABLE FILL

TABLE OF CONTENTS

578.01	SCOPE
578.02	REFERENCES
578.03	DEFINITIONS
578.04	SUBMISSION AND DESIGN REQUIREMENTS
578.05	MATERIALS
578.06	EQUIPMENT
578.07	CONSTRUCTION
578.08	QUALITY ASSURANCE
578.09	MEASUREMENT FOR PAYMENT
578.10	BASIS OF PAYMENT
APPENDICES	Not Used

578.01 SCOPE

This specification covers the requirements for the placement of unshrinkable fill.

578.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

578.01.02 Appendices Significance and Use

Appendices are not for use in provincial Contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner.

Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their Contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

578.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 350	Concrete Pavement and Concrete Base
OPSS 517	Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:

LS-407	Method of Test for Compressive Strength of Moulded Cylinders
LS-610	Organic Impurities in Concrete Sands
LS-618	The Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	The Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

MTO Forms:

PH-CC-322	Concrete Construction Report
-----------	------------------------------

CSA Standards

A23.1	Table 3, Additional requirements for concrete subjected to sulphate attack*
A23.2-3B	Total or Water-Soluble Sulphate Ion Content of Soil*
A23.2-8B	Water-Soluble Sulphate Ion Content of Recycled Aggregates Containing Crushed Concrete*
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens*
A23.2-5C	Slump and Slump Flow of Concrete *
A3001	Cementitious Materials for Use in Concrete**
*	[Part of CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
**	[Part of CSA A3000-13 Cementitious Materials Compendium]

ASTM International

D 1411-09	Standard Test Methods for Water-Soluble Chlorides Present as Admixtures in Graded Aggregate Road Mixes
-----------	--

578.03 DEFINITIONS

For the purpose of this specification, the following definition applies:

Unshrinkable Fill means a self-compacting cement treated aggregate with flowable consistency and controlled low strength properties.

578.04 DESIGN AND SUBMISSION REQUIREMENTS

578.04.01 Design Requirements

Unshrinkable fill shall be according to the following:

- The mix shall be designed to provide appropriate strength and performance characteristics for the intended use, and to meet the requirements as specified in the contract documents.
- The unshrinkable fill shall contain 25 kg/m³ of Type GU or GUL cement according to CSA A3001 and may contain additional supplementary cementing materials to aid in placement.
- The mix may contain foaming agents to aid in placement.
- Slump at point of discharge shall be a minimum of 150 mm and the unshrinkable fill shall be uniformly mixed throughout.
- The material shall be designed such that it can flow into the excavation and fill the entire space without vibration, and without segregation.
- The 28-Day compressive strength shall be a maximum of 0.40 MPa.

578.04.02 Submission Requirements

The Contractor shall be responsible for designing the unshrinkable fill mix and shall submit the unshrinkable fill mix design according to OPSS 1350 except the use of reclaimed concrete material and the amount used expressed in percent by mass of the total aggregate shall be identified on Forms A and B.

578.05 MATERIALS

578.05.01 Cementing Materials

Cementing materials shall be according to OPSS 1301.

578.05.02 Water

Water shall be according to OPSS 1302.

578.05.03 Aggregates

Aggregates shall be according to OPSS 1001 and this specification.

Except as noted below or elsewhere in the Contract Documents, aggregates may be sands, gravel, quarried rock or reclaimed concrete material provided the source is of such a nature and extent as to ensure acceptable processed aggregates of a consistent grading and quality. When any change in the character of the aggregate occurs or when the performance of aggregate meeting the requirements of OPSS 1001 and this specification is found to be unsatisfactory, use of the aggregate shall be discontinued until a reappraisal by the Contractor, with the approval of the Contract Administrator, proves the source to be satisfactory or another source is selected.

Fine and coarse aggregates shall meet the grading requirements of Table 1 and the physical property requirements of Table 2.

578.05.03.01 Reclaimed Concrete Material

Reclaimed concrete material may be used up to a maximum of 25 % by mass of the total aggregate. Reclaimed concrete material shall not be used in unshrinkable fill to be placed in contact with sulphate-bearing soil or ground water with sulphate.

578.06 EQUIPMENT

578.06.01 Mixing Equipment

A central mixing, dry batch plant, capable of accurately proportioning aggregate, cement, and water shall be used. The plant shall be certified according to OPSS 1350.

578.06.02 Transport Equipment

Unshrinkable fill shall be transported to the site by means of ready mix trucks.

578.07 CONSTRUCTION

578.07.01 Operational Constraints

Where vehicular traffic, including construction equipment, is to be accommodated, the unshrinkable fill shall be protected by covering it with a steel plate suitable for the traffic loading for a minimum of 24 hours.

Hot mix asphalt or any other material shall not be placed on unshrinkable fill until a minimum of four hours after the placing of unshrinkable fill.

578.07.02**Unshrinkable Fill Placement Requirements**

Individual loads of unshrinkable fill shall be placed within 2 hours from the time of batching.

When placed into excavations, unshrinkable fill shall be placed so that it fills the entire excavation without voids beneath horizontal projections or in other locations within the excavation. When unshrinkable fill is to be placed in an excavation subject to the entry of flowing water, the excavation shall be dewatered according to OPSS 517 prior to placement of the unshrinkable fill.

When placed adjacent to culverts, arches, rigid frames, integral abutments and piers, the unshrinkable fill shall be placed in alternating layers on each side of the structure to balance the earth pressure forces. Unless specified in the Contract Documents, the unshrinkable fill layers shall not exceed 500 mm in thickness and the height of the layers shall be approximately the same. At no time shall the elevation difference between the sides be greater than 500 mm. Each layer shall set for a minimum of four hours before a new layer is placed.

When shoring, bracing, or sheeting is used to support the sides of the excavation or to prevent movements that could damage other services or adjacent pavements, and this support system is to be removed, it shall be removed as filling proceeds to ensure stability of the excavation.

The unshrinkable fill material shall be protected from cold weather according to OPSS 350 with the exception that unshrinkable fill shall be protected from freezing after placement but need not be monitored with thermocouples nor maintained above 15° C.

578.07.03**Field Sampling and Testing**

The Contractor shall be responsible for testing of slump, casting, initial storage and transportation of cylinders for compressive strength determination by the Owner.

Field sampling and testing of concrete shall be performed by a person holding either of the following certifications:

- a) CCIL Certified Concrete Testing Technician, or
- b) ACI Concrete Field Testing Technician, Grade 1.

Such persons shall have a valid original card issued by the certifying agency in their possession at all times.

Unshrinkable fill shall be tested for slump according to CSA A23.2-5C when directed by the Contract Administrator. Unshrinkable fill that does not meet the slump requirement shall be adjusted to meet the slump requirement or rejected and removed from the Working Area.

For the determination of compressive strength, a set of two cylinders, 150 mm diameter 300 mm long, shall be cast each Day of production and placement, when directed by the Contract Administrator. When there is more than one supplier of unshrinkable fill, a separate set of two cylinders for each supplier shall be cast each Day of production and placement.

Cylinders shall be cast and transported according to CSA A23.2-3C except that only cardboard moulds shall be used to cast the test cylinders. A disc of wax paper matching the inside diameter of the cylinder mould shall be placed at the base of the cylinder mould prior to casting. The interior sidewalls of the cardboard mould shall be treated with a light coating of release agent.

For the first 24 hours after casting, test cylinders shall be stored within the Working Area either covered or in a shaded area.

Test information shall be recorded on MTO form PH-CC-322, a copy of which shall be submitted with each set of compressive strength cylinders.

The Contractor shall transport the cylinders to the designated quality assurance laboratory specified in the Contract Documents, for testing.

578.08 QUALITY ASSURANCE

578.08.01 Testing Requirements

Compressive strength testing shall be according to LS-407. The results of the set of two cylinders cast each Day shall be averaged to provide the test result for the Day.

578.08.02 Acceptance

Unshrinkable fill shall be accepted when:

- a) The material does not deform under traffic loading.
- b) The compressive strength requirements are met.
- c) Materials used comply with the requirements of this specification.

578.09 MEASUREMENT FOR PAYMENT

578.09.01 Actual Measurement

Measurement of unshrinkable fill shall be by volume in cubic metres.

578.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

578.10.0 BASIS OF PAYMENT

578.10.01 Unshrinkable Fill – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Aggregate Gradation Requirements, LS-602 (Note 1)

Sieve Designation	Percent Passing
26.5 mm	100
75 µm	0-5
Notes: 1. Test samples shall be prepared by blending all aggregate components based on their individual percentages stated in the mix design.	

TABLE 2
Aggregate Physical Property Requirements

Test Number	Laboratory Test	Acceptance Limit
LS-610	Organic Impurities, Organic plate number (Note 1)	3
LS-619	Micro-Deval Abrasion, fine aggregates, maximum (Note 2)	30%
LS-618	Micro-Deval Abrasion, coarse aggregates, maximum (Note 2)	25%
CSA A23.2-3B CSA A23.2-8B	Sulphate content (SO ₄), maximum (Note 3)	1.5%
ASTM D1411	Water soluble chloride maximum, (Note 4)	0.010%
Notes: 1. For the natural sand component only. An aggregate that produces a colour darker than standard colour No. 3 shall be considered to have failed this requirement. 2. Test samples shall be prepared by blending all aggregate components based on their individual percentages stated in the mix design. The blended aggregate shall be split on the 4.75 mm sieve and the individual coarse and fine aggregate fractions set aside for testing as required. 3. For unshrinkable fill in contact with permanent concrete elements, the limit of SO ₄ shall be a maximum of 0.20% unless the permanent concrete element meets the requirements of S1, S2, or S3 of CSA A23.1-14 Table 3 as appropriate. 4. This requirement is specified where the unshrinkable fill will be in direct contact with concrete or steel pipe.		



CONSTRUCTION SPECIFICATION FOR INSTALLATION OF POLES

TABLE OF CONTENTS

615.01	SCOPE
615.02	REFERENCES
615.03	DEFINITIONS - Not Used
615.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
615.05	MATERIALS
615.06	EQUIPMENT - Not Used
615.07	CONSTRUCTION
615.08	QUALITY ASSURANCE - Not Used
615.09	MEASUREMENT FOR PAYMENT
615.10	BASIS OF PAYMENT
APPENDICES	Not Used

615.01 SCOPE

This specification covers the requirements for the installation of poles used for the mounting of lighting equipment, traffic signals and control equipment, low-voltage aerial cables, and extra low-voltage aerial cables.

615.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

615.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

615.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Material and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 2420	Wood Poles
OPSS 2421	Spun Concrete Poles
OPSS 2422	Heavy Class Steel and Sectional Steel Poles, Base Mounted
OPSS 2423	Steel Poles, Base Mounted
OPSS 2452	Aluminum Poles, Base Mounted
OPSS 2453	Sectional Steel Poles

CSA Standards

C83-96 (R2011)	Communication and Power Line Hardware
G12-14	Zinc Coated Steel Wire Strand

Others

Ontario Electrical Safety Code

615.05 MATERIALS

615.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

615.05.02 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440.

615.05.03 Poles

Concrete poles shall be according to OPSS 2421.

Steel poles for base mounting shall be according to OPSS 2423.

Aluminum poles for base mounting shall be according to OPSS 2452.

Sectional steel poles for direct burial or base mounting shall be according to OPSS 2453. Where sectional steel poles have heights not listed in OPSS 2453, the sectional steel poles shall be according to OPSS 2453 in all other respects.

Wooden poles shall be according to OPSS 2420.

Heavy class steel poles and heavy class sectional steel poles shall be according to OPSS 2422. This class is required for poles with mast arms longer than 5.5 m.

Heavy class steel sectional poles and heavy class steel poles of the same height may be substituted for one another provided that the poles are fully compatible with the installation and all other associated work is according to the Contract Documents.

615.05.04 Frangible Bases

Frangible bases shall be as specified in the Contract Documents.

615.05.05 Pole Hardware and Accessories

Pole line hardware shall be according to CSA C83.

Steel guy cable shall be according to CAN/CSA G12.

Guy anchors shall be of the helical power driven or direct buried expandable type with a minimum diameter of 250 mm and a minimum anchor rod ultimate strength of 50 kN.

The hardware and accessories for wood pole anchors installed in rock shall be according to Table 1.

615.07 CONSTRUCTION

615.07.01 General

The general requirements for electrical work shall be as specified in the Contract Documents.

Concrete, wooden, and metal poles shall be installed at locations specified in the Contract Documents.

All compaction shall be according to OPSS 501.

Grounding of poles shall be according to OPSS 609 and the Contract Documents.

615.07.01.01 Pole Orientation

Concrete and metal poles shall be installed with the handhole location on the pole as specified in the Contract Documents and such that the top wiring aperture is at right angles to the centreline of the road being served.

615.07.01.02 Pole Handling

Poles shall be handled using suitable non-abrasive slings at the pole pick up points as specified by the pole manufacturer.

615.07.01.03 Removals

Removals shall be according to OPSS 610.

615.07.02 Sectional Steel Poles

615.07.02.01 Assembly

Sectional steel poles shall be assembled in order of section number, taper, and diameter. Sections with wiring apertures shall be set with consideration given to the handhole location.

All sections shall be assembled by compression according to the manufacturer's instructions such that each section meets the normal overlap limits marked on the pole or refusal. Seam welds shall be slightly offset during assembly. The finished length of the pole shall be less than or equal to the nominal pole length.

Pole lengths of 5.64 m or more shall be assembled using three self-tapping screws or impact inserted pins. Screws and pins shall be installed in the overlap of all sections below the signal bracket so that they are spaced equally around the pole.

615.07.03 Direct Buried Poles

615.07.03.01 Installation in Earth

Excavation shall be by auger or by other suitable means to obtain a hole large enough to accommodate concrete encasement and backfill. Where the excavation extends beyond the neat limits specified in the Contract Documents, and, where concrete encasement is specified in the Contract Documents, concrete may be placed to the undisturbed earth or the encasement may be formed with the remainder of the backfill made up of native material.

615.07.03.02 Installation in Rock

Where rock is encountered, the method of installation shall be chosen from those specified in the Contract Documents and be based on the depth of rock below finished grade. Each method of installation in rock shall be approved by the Contract Administrator prior to construction.

Rock anchors, bolts for rock mounts, and steel dowel bars shall be installed in drilled holes and grouted in place with non-shrink grout. Poles shall be cut off at the top end to provide the correct top of pole elevation. Wooden poles that have been cut off shall have the ends treated with preservative according to the pole manufacturer's specifications.

Concrete levelling pads, concrete backfill up to the top of the rock grade, and formed concrete encasement shall be placed according to OPSS 904.

Native or imported earth material shall be used as backfill above or around the concrete encasement and compacted.

Rock excavation shall be according to OPSS 603.

615.07.03.03 Pole Alignment

Direct buried poles shall be held plumb by using a suitable temporary support assembly during concrete setting time and during backfilling operations.

615.07.04 Base Mounted Poles

615.07.04.01 Preparation

Anchorage templates shall be removed prior to installation of poles and frangible bases.

All studs, bolts, and nuts shall be cleaned and coated with white lithium-based grease.

615.07.04.02 Installation of Frangible Bases

When frangible bases are specified in the Contract Documents, they shall be installed according to manufacturer's specifications.

615.07.04.03 Pole Installation

When specified in the Contract Documents, poles shall be installed on frangible bases.

Poles shall be set plumb.

615.07.05 Apertures

Drilled apertures shall be accurately aligned to suit pole attachments or equipment. Wiring apertures in metal poles shall be provided with rubber grommets. Apertures in metal poles shall be deburred, and in galvanized steel poles, be coated with grey zinc-rich paint and allowed to dry before placing rubber grommets in them.

Unused pole apertures shall be plugged with rubber, neoprene, or plastic plugs.

615.07.06 Guy Anchors

Guy anchors and associated hardware shall be installed as specified in the Contract Documents and the Ontario Electrical Safety Code. Anchorage plates shall be installed at the specified guy lead distance and

adjusted to remain clear of any existing guy anchors by a minimum distance of 600 mm and then backfilled with native material and compacted.

Guy anchors shall be installed with single or double guy cable sets as specified in the Contract Documents.

All guy cables shall be installed to a snug condition prior to aerial cable stringing and readjusted upon completion to maintain poles in a plumb position.

Guy cables shall be tightened to maintain pole alignment and aerial cable clearances.

615.07.07 Quality Control

615.07.07.01 Pre-Installation Testing and Inspection

Poles shall be inspected for any obvious flaws, prior to installation.

Heavy class steel and sectional steel poles shall be certified that they are according to the supplier's design and drawings as specified in OPSS 2422. The certification shall reference the supplier's drawing numbers.

Sectional steel poles shall be certified that they are according to the supplier's design and drawing numbers as specified in OPSS 2453. The certification shall reference the supplier's drawing numbers.

615.07.07.02 Proof of Performance Testing and Inspection

The work of pole installation shall be inspected to ensure that it is according to the Contract Documents. The inspection shall ensure that:

- a) Poles and appurtenances have been properly installed.
- b) Poles are plumb.
- c) Anchorage assemblies and frangible bases are installed correctly.

615.07.08 Temporary Electrical Work

The work for temporary electrical installations shall be the same as for permanent installations of the same type of work, except the work shall include the removal of the installations when they are no longer required.

615.07.09 Site Restoration

Site restoration shall be according to OPSS 492.

615.07.10 Management of Excess Materials

Management of excess material shall be as specified in the Contract Documents.

615.09 MEASUREMENT FOR PAYMENT

615.09.01 Actual Measurement

615.09.01.01 Poles

For measurement purposes, a count shall be made of the number of poles installed regardless of the type and size of the poles, and shall include any frangible bases and guy anchors installed with the poles.

615.09.01.02 Sectional Steel Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of sectional steel poles direct buried in earth.

615.09.01.03 Concrete Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of concrete poles direct buried in earth.

615.09.01.04 Wooden Poles, Direct Buried in Earth

For measurement purposes, a count shall be made of the number of wooden poles direct buried in earth.

615.09.01.05 Sectional Steel Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of sectional steel poles direct buried in rock.

615.09.01.06 Concrete Steel Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of concrete poles direct buried in rock

615.09.01.07 Wooden Poles, Direct Buried in Rock

For measurement purposes, a count shall be made of the number of wooden poles direct buried in rock.

615.09.01.08 Sectional Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted sectional steel poles installed.

615.09.01.09 Heavy Class Sectional Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted heavy class sectional steel poles installed.

615.09.01.10 Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted steel poles installed.

615.09.01.11 Heavy Class Steel Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted heavy class steel poles installed.

615.09.01.12 Aluminum Poles, Base Mounted

For measurement purposes, a count shall be made of the number of base mounted aluminum poles installed.

615.09.01.13 Frangible Bases

For measurement purposes, a count shall be made of the number of frangible bases installed.

615.09.01.14 Guy Anchors

For measurement purposes, a count shall be made of the number of guy anchors installed, regardless of the size and type.

615.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

615.10 BASIS OF PAYMENT

615.10.01 Poles - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Materials to do the work.

615.10.02 **Sectional Steel Poles, Direct Buried in Earth - Item**
Concrete Poles, Direct Buried in Earth - Item
Wooden Poles, Direct Buried in Earth - Item
Sectional Steel Poles, Direct Buried in Rock - Item
Concrete Poles, Direct Buried in Rock - Item
Wooden Poles, Direct Buried in Rock - Item
Sectional Steel Poles, Base Mounted - Item
Heavy Class Sectional Steel Poles, Base Mounted - Item
Steel Poles, Base Mounted - Item
Heavy Class Steel Poles, Base Mounted - Item
Aluminum Poles, Base Mounted - Item
Frangible Bases - Item
Guy Anchors - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

615.10.03 **Sectional Steel Poles, Direct Buried in Earth (Temporary) - Item**
Concrete Poles, Direct Buried in Earth (Temporary) - Item
Wooden Poles, Direct Buried in Earth (Temporary) - Item
Sectional Steel Poles, Direct Buried in Rock (Temporary) - Item
Concrete Poles, Direct Buried in Rock (Temporary) - Item
Wooden Poles, Direct Buried in Rock (Temporary) - Item
Sectional Steel Poles, Base Mounted (Temporary) - Item
Steel Poles, Base Mounted (Temporary) - Item
Aluminum Poles, Base Mounted (Temporary) - Item
Frangible Bases (Temporary) - Item

Guy Anchors (Temporary) - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials to do the work.

Progress payment for the above tender items shall be based on the following percentages of the Contract price:

- a) 80% for supply and installation.
- b) 20% for removal.

615.10.04 Rock Excavation

Payment for rock excavation shall be according to OPSS 603.

Rock excavation shall not include holes drilled in rock for the placement of steel dowel bars.

TABLE 1
Hardware and Accessories for Wood Pole Anchors in Rock

Manufacturer	Product Identity	Model	Assembly #	Product Notes
Locweld Inc 50 Iberville Candiac, QC J5R 1J5 Tel: 450.659.9661 Fax: 450.444.3111 OR 2159 Vincent Massey Drive P.O. Box 1900 Cornwall, Ontario, K6H 6N6 Tel: 613.936.9190 Fax: 613.936.9217 Email: sales @locweld.ca Homepage: www.locweld.ca Canadian Source: Poltec Industries Ltee 10, 440 Henault, Montreal, QC H1G 5R4 Tel: 514.326.6030 Fax: 514.326.9923	Anchor for Pole Butt Diameter 200 to 305 mm	P-9UT	Assembly 9-3 for 3 Anchor Configuration	Rock Drill 50 mm. Use drilling template for 3- Anchor Configuration.
	Anchor for Pole Butt Diameter 280 to 406 mm	P-9UT	Assembly 9-4 for 4 Anchor Configuration	Rock Drill 50 mm. Use drilling template for 4- Anchor Configuration
	Anchor for Pole Butt Diameter 355 to 508 mm	P-9UT	Assembly 9-5 for 5 Anchor Configuration	Rock Drill 50 mm. Use drilling template for 5- Anchor Configuration



CONSTRUCTION SPECIFICATION FOR TRAFFIC SIGNAL EQUIPMENT

TABLE OF CONTENTS

620.01	SCOPE
620.02	REFERENCES
620.03	DEFINITIONS
620.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
620.05	MATERIALS
620.06	EQUIPMENT - Not Used
620.07	CONSTRUCTION
620.08	QUALITY ASSURANCE
620.09	MEASUREMENT FOR PAYMENT
620.10	BASIS OF PAYMENT
APPENDICES	Not Used

620.01 SCOPE

This specification covers the requirements for the installation of traffic signal equipment, including traffic signal heads, mast arms, brackets, signal hangers, optically directed lens assemblies, LED modules, aerial mounting equipment and equipment modifications.

620.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

620.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

620.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials

Ontario Provincial Standard Specifications, Material

OPSS 2409	Traffic Signal Cable
OPSS 2460	Traffic Signal Arms, Brackets, Hangers, Fittings and Hardware
OPSS 2461	Signal Heads

CSA Standards

C22.2 No. 45.2-08 (R2013)	Electrical Rigid Metal Conduit - Aluminum, red brass, and stainless steel (Tri-national standard, with NMX-J-576-ANCE and UL 6A)
C22.2 No. 65-13	Wire connectors (Tri-national standard, with UL 486A-486B and NMX-J-543- ANCE)
C22.2 No. 85-14	Rigid PVC Boxes and Fittings
C22.2 No. 197-M1983 (R2013)	PVC Insulating Tape
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit

620.03

DEFINITIONS

For the purpose of this specification the following definitions apply:

Auxiliary Signal Head means a traffic signal head that is supplementary to the primary and secondary heads and which may be necessary due to local conditions.

Backboard means a panel surrounding a signal head.

Conflict Monitor means a device used to prevent conflicting signal phases.

Controller unit means a traffic signal controller

Highway Signal Head means a traffic signal head with 300 mm diameter red, amber and green lenses.

Light Emitting Diode (LED) means a semiconductor device that emits incoherent monochromatic light when electrically biased in the forward direction. This effect is a form of electroluminescence. The colour depends on the semiconducting material used, and can be near-ultraviolet, visible or infrared. These LEDs are used to provide red, amber, green or green arrow, etc. indications in traffic signal heads.

Load Switch means a device used to switch 120-volt power to the traffic control signal heads. Load switches are normally semi-conductor devices, which are switched by low voltage signal from the controller unit.

Pedestrian Signal Head means a traffic signal head comprising of a "walk" and "don't walk" symbol.

Primary Signal Head means a traffic signal head mounted on the far right side of an intersection approach.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Secondary Signal Head means a traffic signal head mounted on the far left side or in the median of an intersection approach.

Signal Head means an assembly containing the signal face.

Special Signal Head means a traffic signal head comprised of a combination of sections with red, amber and green or green arrow indications.

Standard Signal Head means a traffic signal head with 200 mm diameter red, amber and green lenses.

620.05

MATERIALS

620.05.01

Traffic Signal and Pedestrian Heads

Each traffic signal head shall be provided with LED modules unless otherwise specified in the Contract Documents.

Each traffic signal head shall be a highway signal head unless otherwise specified in the Contract Documents.

Traffic signal heads and pedestrian heads shall be according to OPSS 2461.

620.05.02 Mast Arms, Brackets, Signal Hangers

Mast arms, brackets and signal hangers shall be according to OPSS 2460. Signal hangers shall be adjustable mid-section hanger or dual-end hanger as specified in the Contract Documents.

620.05.03 Traffic Signal Cables

Traffic signal cables shall be according to OPSS 2409.

620.05.04 Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197, rated for -10 °C to 90 °C use, 600 V.

620.05.05 LED Modules

LED modules shall be according to OPSS 2461.

620.05.06 Conduits and Fittings

Rigid PVC conduits and fittings shall be according to CSA C22.2 No. 211.2. Rigid aluminum conduits and fittings shall be according to CSA C22.2 No. 45.2.

620.05.07 Wire Connectors

Wire connectors shall be of the insulated wing nut vibration proof spring type and shall be according to CSA C22.2 No 65.

620.05.08 Junction Boxes and Fittings

PVC junction boxes and fittings shall be according to CAN/CSA C22.2 No. 85.

620.05.09 Strapping

Stainless steel strapping and buckles shall have a minimum ultimate strength of 4.5 KN.

620.05.10 Traffic Signal Mounting Equipment

Fittings, accessories and hardware shall meet the requirements specified in the Contract Documents.

620.05.11 Grommets

Grommets shall be rubber or neoprene sized to suit the aperture metal thickness and cable diameter.

620.05.12 Grounding Materials

Grounding materials shall be according to OPSS 609.

620.07 CONSTRUCTION

620.07.01 Mast Arms

The attachment point of the mast arm shall be set on the pole to obtain the required clearance from finished grade to the bottom of the signal head. When two or more mast arms are mounted on the same pole, the

primary head shall be set to obtain the required clearance height specified in the Contract Documents. Other mast arms, with secondary or auxiliary heads, shall be adjusted on the pole so that a minimum separation of one pole diameter is obtained between fittings or bolts touching the pole.

For wood pole mounting, holes shall be drilled to accommodate through bolts. Nuts shall be tightened to obtain a minimum wood compression of 3 mm under the washers.

Mast arm attachment to steel poles using "U" bolts or pole plates shall be tightened to a point where the pole just begins to deform.

Mast arms shall be installed perpendicular to the through lanes of traffic being served.

620.07.02 Traffic Signal Hangers

Traffic signal hangers shall be slip-fitted on the tenon of the mast arm and secured in position with the signal heads adjusted to vertical.

Installation of the signal hanger shall be according to the manufacturer's instructions.

620.07.03 Double Arm Brackets

Double arm brackets shall be assembled on signal heads prior to pole mounting. The arm shall be installed in parallel alignment and all locknuts securely tightened.

Pole plates shall be mounted on the side of the pole so the bottom of the signal head meets the required clearance height from finished grade. Pole plates shall be secured with stainless steel strapping which shall not overlap or secure any other equipment on the pole.

620.07.04 Signal Heads

Signal heads shall be installed facing the direction of approaching traffic according to the legal drawing, Form PHM-125, approved for the intersection.

Signal heads shall be securely covered with an opaque covering and shall remain in place until all tests have been completed and the signal heads are put into operation. Pedestrian heads shall be turned to face the pole prior to operation.

Signal heads shall be adjusted for maximum visibility and focusing prior to final tightening or sealing of hardware. Unused hubs in signal heads shall be plugged with sealing caps, without a gasket.

620.07.05 Wiring Apertures

In metal poles, wiring apertures shall be drilled as required. Apertures shall be located clear of the vertical seam and overlapping sections of sectional steel poles. Apertures shall be de-burred and painted with grey zinc rich paint. Rubber grommets shall be installed after paint is dry.

620.07.06 Pole Mounted Conduit Systems

Pole mounted conduit systems including rigid PVC junction boxes and all necessary fittings and hardware shall be installed where traffic signal equipment is to be installed on concrete or wood poles. Conduit shall be installed in straight lengths to follow the taper of the pole using stainless steel strapping or galvanized lag screws at 1.5 m maximum spacing. Offset bends shall be used where required to avoid pole attachments and conduits shall be kept free of kinks or scorch marks.

620.07.07**Wiring**

Traffic signal cable shall be installed between the signal head and either the pole handhole or the pole mounted PVC junction box. Wiring shall be run through the mast arms, signal hangers and the upper arm of double arm brackets. A minimum length of 600 mm of riser cable shall be left in pole handholes.

Drip loops shall be left on all external cable. Cable shall be protected with rigid PVC conduit where slack lengths of more than 450 mm are externally exposed. Aerial cable from the PVC junction box to the signal head shall be installed according to OPSS 604.

Riser cables shall be connected to LED modules via terminal blocks, or with insulated wing nut vibration proof spring connectors. Termination of spare conductors and handhole or junction box connections shall be made with insulated spring connectors. All insulated spring connectors shall be held in place with three half laps of electrical vinyl tape. Upon completion of connections, all conductors shall be neatly bundled together and secured with four wraps of electrical vinyl tape.

Metal signal heads shall be grounded according to OPSS 609 by use of the designated spare conductor in the riser cable, connected securely to the ground terminal in the signal head and either the pole ground stud or the system ground wire in PVC junction boxes.

620.07.08**Optically Directed Signal Heads**

Optically directed signal heads shall be installed according to the manufacturer's instructions. Signal heads shall be adjusted to focus along the designated roadways or traffic lanes.

620.07.09**Aerial Mounted Equipment**

All equipment and fittings, hardware, PVC junction boxes, and accessories necessary for the mounting of equipment on aerial messenger cable systems shall be installed as specified in the Contract Documents. All compression nuts, locknuts and fitting hardware shall be securely tightened to prevent shifting of equipment by natural elements (i.e. wind, rain, ice or snow, etc.)

620.07.10**Equipment Modifications**

Removal of existing equipment shall be according to OPSS 610. Installation of new, refurbished or modified equipment shall be according to the requirements for installation of the particular items of equipment as described herein.

620.07.11**Quality Control****Pre-installation Testing and Inspection (PIT):**

Signal heads, mast arm, double arm brackets and connection components shall be inspected prior to installation to ensure that they are according to the Contract Documents.

Proof of Performance Testing and Inspection (POP):

The work shall be inspected and tested to ensure that it meets the requirements of the Contract Documents and without limiting the foregoing, to ensure the following:

- a) All components are installed, tested and proven as specified in the Contract Documents
- b) All cables are energized and in working order prior to activating the traffic signals for public display.

The inspection, testing, and test results shall be witnessed by the Quality Verification Engineer.

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the work. The Quality Verification Engineer shall affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:

- a) Work
- b) Material and installations
- c) Inspection, testing, and test results

620.08 QUALITY ASSURANCE

The Contract Administrator may provide direction for the aiming of signal heads, optically directed lens assemblies and LED modules. At any time, the Contract Administrator may test-drive the controlled traffic lanes and notify the Contractor of any adjustments required.

620.09 MEASUREMENT FOR PAYMENT

620.09.01 Actual Measurement

620.09.01.01

- Single Member Arms and Signal Hangers**
- Single Member Arms and Signal Hangers (Temporary)**
- Overbrace Arms and Signal Hangers**
- Overbrace Arms and Signal Hangers (Temporary)**
- Double Arm Brackets**
- Double Arm Brackets (Temporary)**
- Highway Type Signal Heads**
- Highway Type Signal Heads (Temporary)**
- Special Type Signal Heads**
- Special Type Signal Heads (Temporary)**
- Standard Type Signal Heads**
- Standard Type Signal Heads (Temporary)**
- Pedestrian Type Signal Heads**
- Pedestrian Type Signal Heads (Temporary)**
- Single Signal Head Section**
- Single Signal Head Section (Temporary)**
- Optically Directed Signal Heads**
- Optically Directed Signal Heads (Temporary)**

For measurement purposes, a count shall be made of the number of arms, hangers, brackets, and signal heads installed.

620.09.01.02 Traffic Signal Equipment Modifications

For measurement purposes, a count shall be made of the number of intersection locations where traffic signal equipment modification is carried out.

620.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

620.10 BASIS OF PAYMENT

- 620.10.01 Single Member Arms and Signal Hangers – Item**
Single Member Arms and Signal Hangers (Temporary) – Item
Overbrace Arms and Signal Hangers – Item
Overbrace Arms and Signal Hangers (Temporary) – Item
Double Arm Brackets – Item
Double Arm Brackets (Temporary) – Item
Highway Type Signal Heads – Item
Highway Type Signal Heads (Temporary) – Item
Special Type Signal Heads – Item
Special Type Signal Heads (Temporary) – Item
Standard Type Signal Heads – Item
Standard Type Signal Heads (Temporary) – Item
Pedestrian Type Signal Heads – Item
Pedestrian Type Signal Heads (Temporary) – Item
Single Signal Head Section – Item
Single Signal Head Section (Temporary) – Item
Optically Directed Signal Heads – Item
Optically Directed Signal Heads (Temporary) – Item
Traffic Signal Equipment Modifications - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR ELECTRICAL TRAFFIC CONTROL DEVICES

TABLE OF CONTENTS

621.01	SCOPE
621.02	REFERENCES
621.03	DEFINITIONS – Not Used
621.04	DESIGN AND SUBMISSION REQUIREMENTS – Not Used
621.05	MATERIALS
621.06	EQUIPMENT – Not Used
621.07	CONSTRUCTION
621.08	QUALITY ASSURANCE – Not Used
621.09	MEASUREMENT FOR PAYMENT
621.10	BASIS OF PAYMENT
APPENDICES	Not Used

621.01 SCOPE

This specification covers the requirements for the installation of traffic control devices including flasher beacons, flasher mechanisms, downlights, sign light assemblies and internally illuminated signs.

621.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

621.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

621.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 604	Installation of Cable
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment and Materials
OPSS 620	Traffic Signal Equipment

Ontario Provincial Standard Specifications, Material

OPSS 2461	Signal Heads
OPSS 2492	Rigid Polyvinyl Chloride (PVC) Junction Boxes

CSA Standards

C22.2 No. 45.1-07 (R2012)	Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007)
C22.2 No. 45.2-08 (R2013)	Electrical Rigid Metal Conduit - Aluminum, red brass, and stainless steel (Tri-national standard, with NMX-J-576-ANCE and UL 6A)
C22.2 No. 207-15	Portable and Stationary Electric Signs and Displays
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit

621.05 MATERIALS

621.05.01 Flasher Beacons

Flasher beacons shall be according to OPSS 2461.

Each flasher beacon that provides intersection control and each red flasher beacon shall be 300 mm diameter unless otherwise indicated in the Contract Documents.

621.05.02 Lamps and LED Modules

Lamps and LED modules shall be according to OPSS 2461.

621.05.03 Internally Illuminated Signs

Internally illuminated signs shall be according to the general requirements of CSA C22.2 No. 207 and as specified in the Contract Documents.

621.05.04 Cable

Cables shall be according to OPSS 604.

621.05.05 Connectors

Connectors shall be according to OPSS 604 and OPSS 609.

621.05.06 Conduit and Fittings

Rigid PVC conduit and fittings shall be according to CSA C22.2 No. 211.2.

Rigid galvanized steel conduit and fittings shall be according to CSA C22.2 No. 45.1.

Rigid aluminum conduit and fittings shall be according to CSA C22.2 No. 45.2.

621.05.07 PVC Junction Boxes

PVC junction boxes shall be according to OPSS 2492.

621.05.08 Grounding Materials

Grounding materials shall be according to OPSS 609.

621.07 CONSTRUCTION

621.07.01 Flasher Beacons and Downlights

Flasher beacons and downlights for post top mounting shall be aligned facing the direction of approaching traffic and secured with set screws tightened to bite into the pole top tenon by approximately 1 mm.

Flasher beacons for pole front or side mounting shall be aligned facing the direction of approaching traffic and mounted on double arm brackets or mast arms and signal hangers according to OPSS 620.

Flasher beacons, single or in multiple clusters, for aerial mounting shall be arranged on the overhead support cable to provide the required visibility and clearances for each direction of approaching traffic. Mounting hardware shall be securely tightened.

621.07.02 Flasher Mechanisms

Flasher mechanisms shall be mounted on poles or in enclosures with the accompanying conduit, conduit fittings and wiring systems.

621.07.03 Sign Light Assemblies

Sign light assemblies shall be constructed of rigid aluminum conduit and fittings, lamp holders and lamps and shall be installed facing the direction of approaching traffic. Lengths of conduit shall be secured against fittings with lock nuts.

621.07.04 Internally Illuminated Signs

Internally illuminated signs shall be installed on double arm brackets, mast arms and signal hangers or aerial support cables according to OPSS 620.

621.07.05 Wiring

Wiring between the traffic control device and the pole handhole or pole mounted junction box shall be installed and connected according to OPSS 620.

621.07.06 Grounding

Traffic control devices shall be grounded according to OPSS 609.

621.07.07 Removals

Removal of traffic control devices necessary for the installation of work described herein shall be according to OPSS 610.

621.07.08 Quality Control

Pre-installation Testing and Inspection (PIT)

Traffic control devices and connection components shall be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.

Proof of Performance Testing and Inspection (POP)

The work shall be inspected and tested to ensure that it meets the requirements of the Contract Documents; and, without limiting the foregoing, the work shall be inspected to ensure the following:

- a) All components are installed, tested and proven as specified in the Contract Documents
- b) All cables are energized and in working order prior to activating the flasher beacons for public display.

The testing and inspection results shall be documented in a report and submitted to the Contract Administrator within 3 Days of completion of the testing and inspection.

621.09 MEASUREMENT FOR PAYMENT

621.09.01 Actual Measurement

621.09.01.01 Flasher Beacons Flasher Beacons and Downlights

**Sign Light Assemblies for Keep Right Signs
Internally Illuminated Signs
Flasher Mechanisms**

For measurement purposes, a count shall be made of the number of flasher beacons and downlight combinations, flasher beacons, flasher mechanisms, sign light assemblies and internally illuminated signs installed.

621.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

621.10 BASIS OF PAYMENT

**621.10.01 Flasher Beacons - Item
Flasher Beacons and Downlights - Item
Sign Light Assemblies for Keep Right Signs - Item
Internally Illuminated Signs - Item
Flasher Mechanisms – Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials to do the work.

When the Contract contains a separate item for the Removal of Electrical Equipment, payment shall be at the Contract price and according to OPSS 610.



CONSTRUCTION SPECIFICATION FOR THE INSTALLATION OF TRAFFIC SIGNAL CONTROLLERS

TABLE OF CONTENTS

622.01	SCOPE
622.02	REFERENCES
622.03	DEFINITIONS
622.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
622.05	MATERIALS
622.06	EQUIPMENT - Not Used
622.07	CONSTRUCTION
622.08	QUALITY ASSURANCE
622.09	MEASUREMENT FOR PAYMENT
622.10	BASIS OF PAYMENT

APPENDICES	Not Used
-------------------	-----------------

622.01	SCOPE
---------------	--------------

This specification covers the requirements for the installation of traffic signal controllers and associated components.

622.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

622.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

622.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 603	Installation of Ducts
OPSS 609	Grounding
OPSS 610	Removal of Electrical Equipment
OPSS 623	Traffic Actuation Equipment

Ontario Provincial Standard Specifications, Material

OPSS 1350	Concrete - Materials and Production
OPSS 2475	Uninterruptible Power Supply Systems for LED Traffic Signals

Ontario Ministry of Transportation Publications:

Ontario Traffic Signal Control Equipment Specifications (OTSCES)

CSA Standards

C22.2 No. 65-13	Wire Connectors (Tri-national standard, with UL 486A-486B and NMX-J-543-ANCE)
C22.2 No. 75-14	Thermoplastic Insulated Wires and Cables (Tri-national standard, with UL 83 and NMX-J-010-ANCE-2010)
C22.2 No. 197-M1983 (R2013)	PVC Insulating Tape
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit

International Municipal Signal Association (IMSA)

MTO 170/332 Training Manual

Others

Caltrans Transportation Electrical Equipment Specifications (TEES)

622.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

AC+ means 120 V AC, 60 Hz power bus.

AC- means 120 V AC, 60 Hz neutral bus, grounded at power source.

Conflict Monitor means a device for detecting and interrupting conflicts in the traffic signal output circuits.

Controller means a complete traffic signal control equipment package including cabinet, controller unit and all associated power control, actuation or interconnection devices.

Controller Cabinet means an outdoor enclosure used for the housing of the controller unit and all associated power, control, activation or interconnection devices.

Controller Unit means that portion of the controller assembly devoted to the selection and timing of traffic movements.

Detection means the operation of a detector sensor unit in registering the presence or passage of a vehicle or pedestrian.

Hold means a command to the controller unit which causes it to retain the existing traffic signal phase.

Interconnection means the system of cables and devices which operate traffic signal controllers at consecutive intersections in a fixed or preprogrammed timing sequence.

Interval means the part or parts of the signal cycle during which signal indications do not change.

Interval Sequence means the order of appearance of signal indications during successive intervals.

Interval Sequence Chart means a chart designating the order in which the signal phases occur and the associated signal display for each interval.

Light Emitting Diode (LED) means as defined in OPSS 620.

Microprocessor means a small, self-contained limited capability computer with the central processing unit on a single chip.

Motherboard means a printed circuit connector interface board with no active or passive components.

Phase Skip means a controller function used to provide omission of a phase in the absence of actuations on that phase.

Pre-emption means the transfer of the normal control of signals to a special control mode which may be required by railroad trains at crossings, emergency vehicles, mass transit vehicles, or other special needs.

Vehicle Extension means the time in seconds added to the green interval to permit additional green time upon actuation by a vehicle approaching the intersection.

622.05 MATERIALS

622.05.01 Conduits and Fittings

Rigid PVC conduits and fittings shall be according to CSA C 22.2 No. 211.2.

622.05.02 Low Voltage Cables

Low voltage cables single conductor, shall be stranded copper type TWH according to CSA C 22.2 No. 75.

622.05.03 Wire Connectors

Wire connectors shall be of the fork tongue compression type for terminal connections of the insulated wing nut vibration proof spring type for wire to wire connections and shall be according to CSA C 22.2. No. 65.

622.05.04 Electrical Insulating Tape

Electrical insulating tape shall be rated for 600 V at -10°C to 90°C working temperature and conform to CSA C22.2 No. 197.

622.05.05 Grounding Materials

Ground wire and connectors shall be according to OPSS 609.

622.05.06 Traffic Signal Controllers

A used traffic signal controller may be used for a temporary installation provided that it is in good condition and it complies with the requirements of the contract.

622.05.07 Concrete

Concrete shall be 30 MPa class according to OPSS 1350.

622.05.08 Solder

Solder shall be 60% tin and 40% lead mix resin core type.

622.05.09 Uninterruptible Power Supply (UPS) System

The UPS system shall be according to the OPSS 2475.

Used UPS systems may be used for temporary installations provided that they are in good condition and meet the requirements of the Contract Documents.

The information contained in this specification covers the UPS system to be used with a Model 332 controller cabinet. If the Contractor uses a different type of traffic signal controller cabinet, such as a NEMA cabinet, then the Contractor shall make all necessary modifications to suit the type of cabinet used.

Uninterruptible power supply systems for LED traffic signals shall include an Arc Flash and Shock Hazard warning label according to Figure 1. The warning sign shall be prominently displayed on the outside of each exterior door. The Contractor shall enter the location information in Figure 1 as indicated by the local MTO electrical coordinator.

The DC arc flash analysis and results in Figure 1 are applicable only to ministry traffic signal UPS systems with the following characteristics:

- a) Application – DC system for back-up power for traffic signals
- b) Nominal DC system voltage of 60 VDC or less.
- c) DC system short circuit current of 5000 A or less.
- d) Condition of electrical plant shall be in good condition and well maintained.

622.05.10 Forced Flash Relay

The forced flash relay shall be 10 Amp, 60 Hz, Double Pole Double Throw (DP DT) relay.

622.05.11 Heater/Fan Breaker

The heater/fan breaker shall be 15 Amp breaker mounted on the service panel.

622.07 CONSTRUCTION

622.07.01 Controller Supplied by the Owner

When the controller is supplied by the Owner, the controller shall be picked up and transported from the location specified in the Contract Documents. The Contractor shall ensure that all components are safely connected, secured or packaged prior to transporting the controller.

The Owner guarantees to the Contractor that the controller and all associated equipment is free of any defects.

622.07.02 Controller Supplied by the Contractor

When the Contractor supplies the controller, the Contractor shall carry out all pre-shipping shop tests specified in the Pre-installation Testing and Inspection clause.

Acceptable storage and testing facilities with temperature and humidity regulated environment shall be provided.

Each traffic signal controller cabinet shall be a model 332 traffic signal controller cabinet capable of 2 to 8 phase operation. Each traffic signal controller cabinet shall be complete with mounting pedestal base, uninterruptible power supply (UPS), 170 type traffic signal controller, conflict monitor, and all other equipment required to perform its intended function, either in standalone operation or as part of the ministry's traffic signal control system, according to the timing sheets, PHM-125 drawing, and the Contract Documents. Without limiting the foregoing, each traffic signal controller cabinet shall include the components listed in Table 1.

All traffic signal control equipment shall be according to the Ontario Traffic Signal Control Equipment Specifications (OTSCES) or the Caltrans Transportation Electrical Equipment Specifications (TEES).

Each traffic signal controller cabinet shall be supplied fully assembled and tested. The testing shall be carried out according to the MTO Operation Guidelines and Procedures in the MTO 170/332 Training Manual. The MTO 170/332 Training Manual may be purchased from the Ontario Section of the International Municipal Signal Association.

All temporary traffic signal controllers shall be equipped with an UPS system.

622.07.03 Timing of Work

The controller shall be installed and the controller cabinet shall be energized within 48 hours of shipment from the place of storage.

622.07.04 Signal Controller Cabinet and UPS Cabinet

622.07.04.01 Pole Mounted Controller Cabinet

Cabinets shall be installed complete with all mounting brackets, hardware stainless steel strapping and pole mounted conduits and fittings.

Pole mounted controller cabinets shall be located such that:

- a) A person operating the controls will be facing the intersection.
- b) The edges of the cabinet do not protrude over a sidewalk or beyond the pole in the direction of the pavement.
- c) Pole handholes and pedestrian push-buttons remain unobstructed.

622.07.04.02 Pad Mounted Controller Cabinet

The cabinet shall be installed complete with all hardware and accessories in an orientation that allows a person operating the controls to face the intersection.

The neoprene gasket shall be attached squarely and symmetrically on the bottom channel of the cabinet prior to installation, with holes for mounting bolts drilled where necessary.

Anchor bolts shall be secured in place in the locations specified in the manufacturer's instructions or where bolt holes have been provided.

Clear silicone shall be used as a sealant between the top of an extension and the bottom of the controller cabinet.

622.07.04.03 Pedestal Mounted Controller Cabinet

Pedestals for controller cabinet mounting shall be installed in an orientation that allows a person operating the controls to face the intersection.

In earth, where the excavation extends beyond the neat limits, concrete may be placed to the undisturbed ground or the concrete encasement may be formed.

The excavation shall be backfilled with native material and compacted according to OPSS 501.

Where bedrock is encountered, rock excavation shall be done such that a minimum of 600 mm length of steel pedestal can be installed in sound rock. The bottom of the pedestal shall be cut off to obtain the proper controller mounting height above finished grade. Rock excavation shall be according to OPSS 603.

The cabinet shall be installed complete with all hardware and accessories.

622.07.04.04 Power Connection

Low voltage feeder cables shall be connected to the controller cabinet. The neutral shall be connected to the AC-terminal bus.

622.07.04.05 Equipment Ground

Stranded copper ground cable shall be installed between the controller cabinet ground bus and the service ground bus. Connections shall be according to OPSS 609 and the manufacturer's drawings or instructions.

For microprocessor type controllers, the AC-terminal bus shall not be grounded to the cabinet or connected to logic ground.

622.07.04.06 Pad Mounted UPS Cabinet

The pad mounted UPS cabinet shall be installed on a pedestal manufactured of the same material as the traffic signal controller cabinet and supplied with the same lock and key. The pedestal shall be anchored to the pad and secured in place at the location specified according to the Contract Documents.

The UPS control unit and the UPS automatic switch shall be installed in the traffic signal controller cabinet according to the Contract Documents. A forced flash relay shall be installed in the traffic signal controller cabinet to allow flash operation when initiated by the UPS control unit. All wiring shall be according to the Contract Documents.

622.07.04.07 Pole Mounted UPS Cabinet

The pole mounted UPS cabinet including batteries and heating pads shall be installed complete with all mounting brackets, hardware, stainless steel strapping and pole mounting conduits and fittings.

The edges of the cabinet shall not protrude over a sidewalk or roadway pavement. The cabinet shall not obstruct access to the pole handhole and pedestrian pushbuttons.

The UPS control unit and the UPS automatic switch shall be installed in the signal controller cabinet according to the Contract Documents. A forced flash relay shall be installed in the traffic signal controller cabinet to allow flash operation when initiated by the UPS control unit. All wiring shall be according to the Contract Documents.

622.07.04.08 UPS Automatic Switch, Forced Flash Relay and Heater/Fan breaker

The UPS automatic switch, forced flash relay, heater/fan breaker and terminal block shall be installed in the signal controller cabinet according to the Contract Documents.

622.07.05 Installation of Controller Equipment

622.07.05.01 Shelf-mounted Equipment

Shelf-mounted controller equipment shall be neatly and suitably arranged on the shelves such that all preformed wiring harnesses are of adequate length to allow connections and may be trained to out-of-the-way locations. Similar items of equipment shall be grouped together. All equipment shall be installed with the front facing outward such that the main operational controls and switches are readily accessible.

622.07.05.02 Rack-mounted and Jack-mounted Equipment

Controller equipment shall be installed only in the racks or jacks intended for use with the particular item of equipment. Equipment shall be installed within the guide provided and shall be set snug so as to lock into any motherboard, channel or connection specified.

622.07.05.03 Cabinet Wall-mounted Equipment

Equipment shall be installed level and clear of nearby components. The equipment shall be bolted in place with 5 mm diameter stainless steel machine bolts, nuts and lock washers.

622.07.05.04 Identification of Equipment

Equipment used for different traffic phases or operations shall be identified by traffic phase with labels of plastic embossed tape.

622.07.05.05 Wiring and Connections

All connections to terminal boards or screw type equipment terminals shall be made with insulated fork-tongue compression connectors only when using stranded cable. All wiring to bulkhead connectors on equipment housings shall be made with military specification (MS) bayonet type connectors according to the Contract Documents or in the manufacturer's drawings.

All connector joints for use with extra-low voltage systems shall be soldered, with the joint metals preheated to the flow temperature of the solder.

Traffic signal cables shall be connected to the terminal board address as assigned on the Contract Drawings. The controller output circuit assigned shall match the proper traffic signal cable circuit. The traffic signal cable neutral(s) shall be securely connected to the AC-bus in the cabinet.

Extra-low voltage cables and interconnection cables shall have the outer jacket removed to expose approximately 150 mm of the shielding and/or drain wire. The shielding or drain wire for all cables serving a similar function shall be twisted together and soldered with a green #10 AWG minimum insulated ground lead securely connected to the cabinet ground bus.

Upon completion of wiring and connections, all incoming cables shall be bundled and held in place with nylon cable ties.

Unused conductors shall be terminated with insulated wing nut vibration proof spring connectors, leaving sufficient cable to reach terminal boards. Incoming cables shall be identified as follows:

- a) Extra-low voltage cable shall be identified with PVC sleeve wire markers having the same number as the traffic phase served.

- b) Traffic signal cable shall be identified with PVC sleeve wire markers placed over the outer multi conductor cable, naming the corner of the intersection that the cable is routed towards such as "northeast", "south-west", etc.
- c) Interconnection cable shall be identified similar to traffic signal cable, naming the direction that the cable is routed towards such as "north", "south", etc.

622.07.05.06 Controller Security

The controller cabinet shall be kept locked during all non-working times. Upon completion of the work, the controller keys shall be given to the Contact Administrator.

622.07.06 Quality Control

622.07.06.01 Pre-installation Testing and Inspection

622.07.06.01.01 General

All tests shall be completed prior to transporting the controller to the Working Area.

Traffic signal controllers, UPS systems, and other components shall be inspected prior to installation to ensure that they are according to the Contract Documents.

622.07.06.01.02 Cabinet Assembly and Components

A visual check shall be made to ensure that all components necessary to the complete controller are present and that all pre-assembled equipment is securely mounted and connected.

622.07.06.01.03 Circuit Output

The output terminal board voltage shall be tested for 108 V minimum output from load switches and for proper terminal assignment according to the manufacturer's wiring diagram.

622.07.06.01.04 Interval Sequence

With the proper programming for the intersection in operation but with modified timing values suitable to test conditions, the controller unit shall be cycled through all phases for a minimum of six hours. Controller output shall be tested to ensure that the proper phases and phase intervals appear in the correct sequence by use of a 120 V test board with lamps or by use of a 24 V test board with LED or other appropriate indicators wired to the input side of the load switches. Test results shall be confirmed a minimum of six times.

622.07.06.01.05 Actuation

With an appropriate test board, the effect of detection devices and pedestrian push-buttons in entering a call to the controller unit shall be tested. All modes of detector sensor unit program and vehicle extension calls shall be tested. Tests shall confirm that all calls are registered, activated and are associated with the correct traffic phase.

622.07.06.01.06 Conflict Monitor

The conflict monitor shall be tested by removal of the monitor programming card or by methods recommended by the manufacturer. Diode breakouts in the monitor card shall be according to the signal operation required. All flash and reset functions shall be tested.

622.07.06.01.07 Flasher

The output of flasher units and flash transfer relays shall be tested for proper functioning over a two hour period.

622.07.06.01.08 Recall

Recall switch functions for each phase shall be tested to ensure that the controller recalls to the phase selected and remains on 'hold' in the absence of a call on an opposing phase.

622.07.06.01.09 Programming

With actual phase timing for the intersection operational, the controller programming or cam breakouts shall be tested to ensure that the intended operation is accomplished. This test shall include all possible combinations of actuation and recall settings together with any special features such as advance green, phase skip, pre-emption or co-ordination.

622.07.06.01.10 Manual Control

The manual over-ride controls shall be tested for proper operation under all possible switching combinations.

622.07.06.01.11 Environmental Protection

The heater element and circuitry shall be tested for continuity and proper resistance. The ventilation fan shall be checked for proper operation in conjunction with the thermostat control system. If the average temperature during the installation period is below 5°C and falling, the cover plate shall be installed over the louvres and the heater circuit shall be prepared for operation.

622.07.06.02 Proof of Performance Testing and Inspection

622.07.06.02.01 Controller

These tests shall be performed upon installation of the controller. The controller shall be allowed to operate functionally only after all testing has been completed and all components are operational.

The Contract Administrator and ministry electrical staff shall be notified of the time and location of all testing 3 Business Days prior to the start of each test.

The work shall be inspected and tested 3 Business Days prior to the actual switch on of the signals to ensure that it according to the requirements of the Contract Documents and without limiting the foregoing, the Contractor shall ensure the following:

- a) All components are installed, tested and proven as indicated in the Contract Documents.
- b) All systems are energized and in working order
- c) The signal timing is consistent and complete, without activating the traffic signals for public display.

The testing and inspection results shall be documented in a report and submitted to the Contract Administrator within 3 Days of completion of the testing and inspection.

622.07.06.02.02 Signal Cable

All traffic signal cable circuits shall be tested disconnected for continuity and the absence of short circuits as determined by an ohmmeter test.

622.07.06.02.03 120 V Test

The operation of all signal head lamps and the absence of short circuits shall be tested by progressively connecting each active signal cable conductor to the AC+ bus through a temporary 10A fuse bypassing the load switches.

622.07.06.02.04 Interval Sequence

With the proper programming and timing functions in operation, the controller shall be cycled through all phases for a minimum of 1 hour with all signal circuits connected but with signal heads covered.

622.07.06.02.05 Actuation

All calls shall be observed to be registered and activated. Actuation equipment shall be tested according to OPSS 623.

622.07.06.03 Testing of UPS System

The UPS system shall be activated according to the manufacturer's recommendations. The Contractor shall be responsible for all testing and documentation required to establish acceptance of the installation and operation of material supplied.

622.07.06.03.01 Pre-installation Testing and Inspection of UPS System

Prior to the installation of the UPS system, the UPS system shall be tested and inspected to verify that it performs according the manufacturer's specifications and the Contract Documents. In particular, and without limiting the foregoing, the UPS system shall be operated and tested to verify the following:

- a) Transfer time in case of power failure is less than 60 milliseconds.
- b) Voltage regulation at 120 VAC is +/- 3 percent.
- c) Frequency regulation at 60 Hz is +/- 3 Hz.
- d) Thermostat controlled battery heating mats operate according to the manufacturer's specifications.
- e) When powered by the batteries alone, the UPS system provides full signal operation at full load for a minimum of 4 hours, and then switches over to flashing operation and provides flashing operation for a further 6 hours.

Prior to installation, certification from the manufacturer stating that the product is according to the Contract Documents shall be submitted to the Contract Administrator. This certification shall include an explicit certification that, when powered by the batteries alone, the UPS system provides full signal operation at full load for a minimum of 4 hours, and then switches over to flashing operation and provides flashing operation for a further 6 hours.

622.07.06.03.02 Proof of Performance Testing and Inspection

The UPS system and all components shall be tested and inspected to verify that it performs according to the manufacturer's specifications and the Contract Documents.

The proof of performance testing and inspection shall include all testing and inspection identified under the Pre-installation Testing and Inspection clause and the testing of grounding equipment according to OPSS 609.

In particular, and without limiting the foregoing, the Contractor shall ensure that all components are installed, tested and proven as specified in the Contract Documents. In addition, the Contractor shall perform visual inspection on the installed UPS system and perform all tests on grounding of equipment according to OPSS 609.

The testing and inspection results shall be documented in a report and submitted to the Contract Administrator within 3 Days of completion of the testing and inspection.

622.07.06.03.03 Testing for New UPS System "Switch On"

A new UPS system installed at a location not previously equipped with a UPS system or to replace an existing UPS system shall be initially switched on for operation according to the following requirements:

- a) The Contract Administrator shall be given a minimum of 3 Business Days notice of when the UPS system is to be installed or switched over and 24 hours notice prior to the start of the work.
- b) All repairs or replacement of defective components shall be completed prior to activation.
- c) Switch on for operation of UPS shall not be permitted on Fridays, Saturdays, Sundays, Mondays, and statutory holidays.
- d) Switch on for operation of UPS shall be under police supervision.

622.07.07 Traffic Signal Controller Modifications

Traffic signal controller modifications shall include the following:

- a) Relocation, rearrangement repair or replacement of traffic signal controller components.
- b) Modification to actuation equipment.
- c) Modification to interconnection equipment.
- d) Removal and salvage or disposal of components according to OPSS 610.

622.07.08 Traffic Signal Control Programming and Timing

Traffic signal interval timing as provided on the Generic Signal Timing Sheet specified in the Contract Documents shall be installed into the traffic signal controller only after verifying that it is complete and consistent and all controller and conflict monitor programming is installed and all timing controls, switches and programming controls are set.

The temporary traffic signals shall have full manual mode operation functionality to allow an operator to interrupt the other modes (e.g. fixed time or actuated) and return to the previous mode when finished.

When directed by the Contract Administrator, the traffic signal operation shall be manually overridden to operate in fixed/actuated or manual as required to reduce or eliminate queuing traffic. The date, start and end time of each manual override occurrence shall be recorded in a log book as specified elsewhere in the Contract Documents.

All routine and emergency maintenance work required for 24-hour operation of the temporary traffic signals shall be performed as specified in the Contract Documents.

622.08 QUALITY ASSURANCE

The testing of the traffic signal controller and UPS system performed by the Contractor shall be witnessed by the Contract Administrator and the Ministry electrical coordinator or inspector. The Contract Administrator shall also be in attendance during the "turn-on" of the traffic signal.

622.09 MEASUREMENT FOR PAYMENT

622.09.01 Actual Measurement

622.09.01.01 Traffic Signal Controllers

For measurement purposes, a count shall be made of the number of traffic signal controllers installed.

622.09.01.02 Traffic Signal Controllers Modifications

For measurement purposes, a count shall be made of the number of traffic signal controllers modified.

622.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

622.10 BASIS OF PAYMENT

622.10.01 Traffic Signal Controllers - Item

Payment at the Contract price for the above items shall be full compensation for all labour, Equipment, and Materials to do the work.

622.10.02 Traffic Signal Controller Modifications – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Materials required to modify traffic signal controllers, and such work shall include the removal, salvage, installation, relocation, rearrangement, repair or replacement of components.

622.10.03 Rock Excavation

Payment for rock excavation shall be according to OPSS 603.

Table 1
Traffic Controller Components

Item Quantity	Description
1	170 type traffic signal controller
1	Conflict Monitor
1	412C Prom Module with McCain's MTO 233ON1.D local intersection control program
0	412C Prom Module with McCain's MTO 245FM02.09.16 field master control program local intersection control program
1	412C Prom Module with the latest MTO approved McCain PROM Chip
8	Loop Detector, Model 222
8	Load Switch, Model 200
8	DC Isolator, Model 242
1	AC Isolator, Model 252
1	Uninterruptible Power Supply (UPS) system
1	Bell Mobility Sierra GX400 Modem with I/O module Note: To be supplied by the Owner.
1	170 Communication board M33329 Rev B or later (Serial to Ethernet).
1	Cat 5E Ethernet Cable – 2 metres
1	BMAX 824/1850 Antenna
1	GPSPSM-MSMA/MSMA (stud mount) Antenna base.

Figure 1
Arc Flash and Shock Hazard Warning Label

	
Arc Flash and Shock Hazard	
Location: _____	
Arc Flash	Shock
Working distance: 460 mm (19 in.) Incident energy: 4.4 cal/cm ² Arc Flash Boundary: 870 mm (35 in.)	Nominal system voltage: 60 VDC Limited approach: 1000 mm (40 in.) Restricted approach: 300 mm (12 in.)
Minimum PPE Requirements: PPE according to CSA Z462 Arc Flash PPE Category 2 and all other PPE required for protection from battery hazards	
Analysis Date: October 2015	



CONSTRUCTION SPECIFICATION FOR TRAFFIC ACTUATION EQUIPMENT

TABLE OF CONTENTS

623.01	SCOPE
623.02	REFERENCES
623.03	DEFINITIONS
623.04	DESIGN AND SUBMISSION REQUIREMENTS
623.05	MATERIALS
623.06	EQUIPMENT
623.07	CONSTRUCTION
623.08	QUALITY ASSURANCE
623.09	MEASUREMENT FOR PAYMENT
623.10	BASIS OF PAYMENT
APPENDICES	Not Used

623.01 SCOPE

This specification covers the requirements for the installation of vehicular and pedestrian traffic actuation equipment.

623.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

623.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

623.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 603	Underground Ducts
OPSS 604	Installation of Cables
OPSS 609	Grounding

Ontario Provincial Standard Specifications, Material

OPSS 2492	Rigid Polyvinyl Chloride (PVC) Junction Boxes
-----------	---

Ontario Ministry of Transportation Publications

Ontario Traffic Manual

CSA Standards

B137.1-13	Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services
C22.2 No. 38-14	Thermoset-Insulated Wires and Cables (Tri-National Standard, with UL 44 and ANCE NMX-J-451-2014)
C22.2 No. 197- M1983 (R2013)	PVC Insulating Tape
C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
C22.2 No. 227.1-06 (R2016)	Electrical Nonmetallic Tubing (Bi-National standard, with UL 1653)

International Municipal Signal Association Specification

IMSA No. 51-5, Loop Wire

Canadian and Provincial Statutes

Accessibility for Ontarians with Disabilities Act (AODA), 2005, - O. Reg. 413/12: Integrated Accessibility Standards

623.03 DEFINITIONS

For the purpose of this specification the following definitions apply:

Non-Intrusive Detection means the operation of an aerial sensor unit in detecting and registering the presence of a vehicle

Non-Intrusive Detection System means an assembly of interdependent components composed of one or more microwave, radar, video, or other aerial detectors; software, firmware and hardware for processing of the detector signal; and, power and communication links providing traffic actuation inputs to a traffic signal controller or similar device.

623.04 DESIGN AND SUBMISSION REQUIREMENTS

623.04.01 Submission Requirements

623.04.01.01 Documentation

Three (3) copies of service manuals for the following equipment shall be submitted to the Contract Administrator:

- a) Non-intrusive detection system equipment
- b) Accessible pedestrian signals.

The service manuals for the equipment shall be according to the manufacturer's specifications and the Contract Documents.

623.05 MATERIALS

623.05.01 Cables

Cables for loop detectors shall be #14 AWG type RWU 90, x-link - 40°C rated 1000 V stranded copper conductor according to CSA C22.2 No. 38.

Cables for loop detectors in tubing shall be #14 AWG THHN rated 600 V stranded copper conductor with polyethylene tube, according to IMSA No. 51-5.

623.05.02 Probe Detectors

Probe detectors shall be as specified in the Contract Documents.

623.05.03 Ducts and Fittings

Flexible polyethylene ducts and fittings shall be according to CSA B137.1, Series 75.

Rigid PVC conduits and fittings shall be according to CSA C22.2 No. 211.2.

Electrical non-metallic tubing and fittings shall be according to CSA C22.2 No. 227.1.

623.05.04 Electrical Insulating Tape

Electrical insulating tape shall be according to CSA C22.2 No. 197, rated for - 18°C to 105°C use, 600 V.

623.05.05 Pedestrian Pushbuttons and Signs

Pedestrian pushbuttons shall be as specified in the Contract Documents.

Pedestrian pushbutton signs shall be according to the Ontario Traffic Manual.

623.05.06 Solder

Solder shall be 60/40 tin/lead mix, resin core type.

623.05.07 Sealant Compound

Sealant compound shall be of cold type or hot poured type.

623.05.08 Extra Low Voltage Splice Insulation Kit

Extra low voltage splice insulation kit shall be as specified in the Contract Documents.

623.05.09 Aerial Mounting Equipment

Fittings, accessories and hardware shall be as specified in the Contract Documents.

623.05.10 Junction Boxes

PVC junction boxes shall be according to OPSS 2492.

623.05.11 Prefabricated Detector Loops

Prefabricated detector loops shall be either prefabricated PVC detector loops or prefabricated heavy-duty rubber detector loops as specified in the Contract Documents.

623.05.11.01 Prefabricated PVC Detector Loops

Prefabricated PVC detector loops shall be constructed with rigid PVC conduit, filled with a flexible urethane. The corner of the loops shall be rounded to a radius of 100 mm with the same continued conduit without any visible malformation. A "T" type access conduit fitting shall complete the loops geometric form and allow for the junction lead-in conduit. The number of turns of the wires shall be as specified in the Contract Documents.

The wires in the prefabricated detector loop conduit shall come out of the "T" type fitting and be of adequate length to reach the traffic count station or the handholes without splices. After wiring, the end of the prefabricated PVC detector loop conduit shall be injected with malleable urethane. The number of turns per loop shall be as specified in the Contract Documents.

623.05.11.02 Prefabricated Heavy-Duty Detector Loops

Prefabricated heavy-duty rubber detector loops shall be constructed with 9 mm I.D. (17 mm O.D) reinforced rubber hose with a 1.72 MPa internal pressure rating. The hose for the loops shall be of one continuous piece. Hose "T" type connections constructed of high temperature rubber shall complete the loops geometric form and allow for the junction lead-in conduit. The ends of the "T" type access conduit

fitting shall be of proper sizes to attach directly to the hose. The number of turns in the detector loop shall be as specified in the Contract Documents.

The wires used shall be No.16 THWN stranded copper. The wires shall come out of the "T" type fitting and be of adequate length to reach the traffic count station without any splice. The wires shall be twisted a minimum of ten turns per metre. After the insertion of the detector loop and lead-in wires, the hose shall be filled and sealed with a flexible sealant.

623.05.12 Traffic Count Station Type 1

623.05.12.01 Post

The post for the traffic count station type 1 shall be wooden; pressure treated and of the dimensions specified in the Contract Documents.

623.05.12.02 Terminal Electric Box

The terminal electric box (TEB) shall consist of a PVC electrical panel, conduit opening, and double-row barrier terminal block(s) with current capacity equal to the ampacity of #14 AWG stranded copper wire. The size and number of the terminal blocks and the size of the conduit opening shall suit the number of the detector loop cable leads.

The TEB for the traffic count station type 1 shall be constructed using a durable non-corrosive material, grey in colour, and shall be of the size specified in the Contract Documents.

The TEB shall have a cover of similar material or a piano hinge and hasp of similar non-corrosive material. The cover shall be attached to the TEB with four non-corrosive screws.

623.05.12.03 Assembly

The traffic count station Type 1 shall be completely assembled and installed as specified in the Contract Documents.

623.05.13 Traffic Count Station Type 2

623.05.13.01 Base

The base of the traffic count station type 2 shall be a pre-fabricated surface pin-lock base (SPLB). The base shall be constructed of a durable, non-corrosive material, which is black in colour. The dimension of the base diameter shall be smaller than the diameter of the electrical handhole cover over which the base shall be installed. The base shall be constructed in a way so that it can be attached to the electrical handhole, using non-corrosive replaceable fasteners.

623.05.13.02 Post

The post of the traffic count station type 2 shall be pre-fabricated, tubular in shape and made from a flexible, durable, non-discolouring white polypropylene. The post shall be strong enough to hold a terminal electric box. The post shall have two 75 mm wide strips of reflective high intensity amber sheeting, approximately 75 mm apart, located on its upper end. The post shall be of 914 mm in length and shall have a diameter, allowing the accommodation of the necessary number of detector loop cables.

The upper end of the post shall have an additionally installed 60 mm diameter PVC rigid reducer bushing, necessary for the installation of the terminal electric box on the post.

The lower end of the post shall be constructed in such a way that it can easily be mounted on the base (SPLB).

623.05.13.03 Terminal Electric Box

The TEB of the traffic count station type 2 shall be a PVC Rigid Conduit Access Fitting, Type LB ("L" shaped with back entry), constructed using a durable, UV and impact resistant, non-corrosive and non-metallic material, which is grey in colour.

The TEB shall have a cover of the same material and colour, and shall be fastened to the back of the box using two non-corrosive screws.

An ABS fitting cleanout adaptor with a plug having a minimum diameter of 25 mm shall be attached to the front of the TEB.

The bottom of the TEB shall be constructed in such a way, so that it can be mounted on the reducer bushing, already assembled together with the post.

623.05.13.04 Assembly

The traffic count station Type 2 shall be completely assembled with the parts listed above and installed as specified in the Contract Documents.

623.05.14 Accessible Pedestrian Signals

Accessible pedestrian signals (APS) shall meet the requirements of the Accessibility for Ontarians with Disabilities Act (AODA), Ontario Regulation 413/12 as specified in the Contract Documents.

Accessible pedestrian signals shall consist of all material required for the operation of the APS, including but not limited to, all APS displays, pushbuttons, hardware, software, firmware, housings, wiring, and all setup hardware and software required to set up and configure the APS.

Accessible pedestrian signals shall have a locator tone that is distinct from a walk indicator tone. The accessible pedestrian signals shall include both audible and vibro-tactile walk indicators.

The APS shall include both manual and automatic activation features.

The pushbutton locating tone shall be repeated every 1 second and each tone shall be less than 0.15 seconds in duration. The locator tone must be audible up to but not beyond 3.7 m from the pushbutton. The APS shall automatically adjust the locating tone to maintain the tone at 2 to 5 dB over the ambient noise level.

The industry standard "cuckoo" sound shall be used for the north-south direction of travel, and the "Canadian APS melody" sound shall be used for the east-west direction of travel. Where two APS assemblies are installed at the same corner, they must be a minimum of 3000 mm apart. If the separation of 3000 mm cannot be achieved due to site constraints, each APS assembly at that particular corner must play a verbal announcement stating which crossing is active. Each verbal announcement shall be as specified in the Contract Documents.

623.05.15 Non-Intrusive Detection System

The non-intrusive detection system equipment shall be according to the requirements as specified in the Contract Documents.

All hardware and software, including but not limited to all connecting cables, mounting brackets, detector port hubs, interface panels, cabinet wiring harnesses, processor units, set-up hardware, testing hardware, and firmware, shall be according to the non-intrusive detection system manufacturer's specifications and the Contract Documents.

623.06 EQUIPMENT

623.06.01 Slot-cutting Equipment

Slot-cutting equipment shall include a minimum 18 hp engine and a minimum 250 mm diameter diamond tooth blade adjustable between 20 mm and 100 mm depth of cut.

623.07 CONSTRUCTION

623.07.01 Loop Detectors

623.07.01.01 Layout

Loops detectors shall be laid out on the pavement accurate to the dimensions specified in the Contract Documents. Slot cutting lines shall be marked with non-permanent materials. Saw cutting of slots shall not begin until the loop layout has been inspected by the Contract Administrator.

Locations where the layout of a loop crosses a major pavement crack, butt, expansion joint or transition area shall be reported to the Contract Administrator. In such instances, the treatment for crossing the pavement irregularity shall be as specified in the Contract Documents; or, at the discretion of the Contract Administrator, the loop shall be re-marked into 2 separate loops, each beginning approximately 300 mm away from the irregularity.

623.07.01.02 Saw Cutting

Saw cutting of loop slots in pavement shall be in straight lines with slot depths and widths as specified in the Contract Documents. Corner cutting for slots shall be extended only far enough past each corner point to obtain the full depth of the slot. Slot crossing of pavement irregularities shall be constructed using additional widths and depths of slots as specified in the Contract Documents.

Where specified in the Contract Documents, saw cut marks shall be made on the curbs to indicate location of the loop.

623.07.01.03 Slot Preparation

Upon completion of saw cutting, the slot shall be cleaned with a pressurized water stream and dried by means of compressed air forced through a nozzle at a minimum pressure of 300 kPa. The air shall be heated to a maximum of 160 °C where required to remove excess moisture.

The corners of all slots shall be rounded using hand tools. All slots and corners shall be examined for protrusions of sharp stone aggregates or debris which may damage cable. Any such protrusions or debris shall be removed. Final slot preparation shall be done immediately prior to the installation of cable.

623.07.01.04 Flexible Duct Installation

A hole shall be drilled through the pavement to accommodate a flexible duct at the location specified in the Contract Documents.

All work for flexible duct installation, including earth excavation, backfill, removal and restoration, shall be according to OPSS 603.

623.07.01.05 Loop Cable

The loop shall be installed with the size, winding direction, configurations, number of turns and type of cables as specified in the Contract Documents.

The loop cable end which progresses clockwise shall be marked at the splice point with two bands of electrical insulating tape.

Cable in slots shall be firmly and carefully tamped in place using a blunt instrument on each successive turn of cable. To prevent floating, cables shall be held in place using 25 mm lengths of foam backer rod at 600 mm centres.

Where cables are installed in slots crossing pavement irregularities, all cables shall be installed through split neoprene tubing.

Loop cables between the loop and the splice point, including those in the slot, shall be twisted together to form a consistent lay of 10 turns per metre. The entire loop and lead cable system shall be formed of a continuous and unspliced length of cable.

Each loop cable and extra low voltage cable shall be identified with a vinyl sleeve wire marker in the splice point as shown on the Contract Drawings.

623.07.01.06 Sealant

All sealing compounds shall be installed in slots as protection for detector loop cables according to the manufacturer's instructions and recommendations for the type of installation (e.g. installation in top course versus installation in binder course).

The sealing compound shall be allowed to set prior to allowing vehicles to cross over the loop. Cement dust may be added to tacky sealant where necessary. Spilled detector loop sealant or other excess loop sealant on the road surface that is not within the detector loop slot shall be removed from the road surface.

a) Cold Type

Cold pumped sealant shall be installed using a pressure pump or cartridge gun.

b) Cold Type Single Component Polyurethane

Cold pumped single component polyurethane sealant shall be installed using a pressure pump or cartridge gun. Single component polyurethane sealant shall not be used when detector loops are to be installed in the binder course pavement prior to placement of the top course of pavement over the loops.

"Summer Grade" cold pumped single component polyurethane sealant shall not be used at ambient temperatures less than 20 °C.

"Winter Grade" cold pumped single component polyurethane sealant shall not be used at ambient temperatures less than 0 °C.

c) Hot-Poured Type

Hot poured sealant shall not be used when detector loops are to be installed in the binder course pavement prior to placement of the top course of pavement over the loops.

Hot poured sealant shall not be used when the ambient temperature is greater than 0 °C or less than minus 18 °C.

623.07.01.07 Splicing

Splices of cables shall be made only at the designated splice point. Cables shall be stripped of approximately 12 mm of insulation, twisted together with a minimum of four turns and soldered to produce a bonded connection with a maximum resistance of 0.1 Ohm.

Splices shall be insulated with four half-laps of electrical insulating tape and encased in a resin splice with the splices positioned to obtain a minimum coverage of 6 mm of resin around each splice. The black conductor of the extra low voltage cable shall be connected to the clockwise winding lead cable as specified in the Loop Cable clause.

The metallic shield of cables shall be cut off cleanly and left unconnected in the resin splice.

623.07.02 Probe Detectors

Slot preparation, flexible duct installation and splicing for probe detectors shall be as specified in the Loop Detectors subsection.

623.07.02.01 Aerial Installation

Probe detectors, cables, equipment and fittings, hardware, PVC junction boxes, and accessories necessary for the mounting of equipment on aerial messenger cable system shall be installed as specified in the Contract Documents. All compression nuts, locknuts and fitting hardware shall be securely tightened to prevent shifting of equipment by wind.

623.07.02.02 Underpavement Installation

Probe detectors shall be installed in holes vertically, according to the manufacturer's instructions.

Cable in slots shall be firmly and carefully tamped in place using a blunt instrument on each successive turn of cable. To prevent floating, cables shall be held in place using 25 mm lengths of foam backer rod at 600 mm centres.

Where cables are installed in slots crossing pavement irregularities, they shall be installed through split neoprene tubing.

623.07.02.03 Saw Cutting and Drilling

Saw cutting of slots in pavement shall be in straight lines with slot depths and widths as specified in the Contract Documents. Slot crossing of pavement irregularities shall be constructed using additional widths and depths of slots as specified in the Contract Documents.

Holes for probe detectors shall be 25 mm diameter at a depth of 460 mm below grade and in line with the saw cut slot.

623.07.02.04 Bedding and Sealant

Clean and dry silica sand shall be used as bedding for probe detectors. Sealant shall then be applied to the upper portion of the hole. Cold pumped sealant compound shall be installed using a pressure pump or cartridge gun according to the manufacturer's instructions.

The sealant compound shall be allowed to set according to the manufacturer's instruction prior to allowing vehicles to cross the probe detectors. Cement dust may be added to tacky sealant where necessary.

623.07.03 Pedestrian Pushbuttons

623.07.03.01 Installation

Pedestrian pushbuttons and signs shall be mounted on the side of the pole such that the pedestrian signal pushbutton sign arrow indicates the proper direction for which roadway crossing is required.

Pedestrian pushbuttons shall be installed with stainless steel self-tapping screws or stainless steel straps. A wiring aperture shall be drilled in metal poles and fitted with a rubber gromet or a rigid conduit shall be installed on poles, for wiring access.

Pushbuttons for metal poles shall be installed with an integral sign frame or separately mounted with stainless steel straps or screws where specified in the Contract Documents.

623.07.04 Prefabricated Loops

623.07.04.01 Installation

Prefabricated loops shall be installed as specified in the Contract Documents and as described below.

Prefabricated detector loops shall be accurately laid out to the dimensions specified in the Contract Documents when covered by paving materials.

Prefabricated PVC detector loops shall be installed for burial in granular base, for saw cut installation in subsurface pavement course, open-graded drainage layer, or for embedding in concrete.

Heavy-duty rubber detector loops shall be installed for saw cut installation in subsurface pavement course, open-graded drainage layer, or for embedding in concrete.

When installed in concrete with rebar, prefabricated detector loops shall be mounted a minimum 50 mm above the rebar grid and as specified in the Contract Documents.

Any extra length of wiring of the prefabricated detector loop shall be coiled in the electrical handhole.

623.07.04.02 Flexible Duct Installation

Flexible duct installation, including earth excavation, backfill, removal and restoration, shall be according to OPSS 603.

623.07.05 Traffic Count Station Installation

The work for traffic count station shall include the installation of traffic count station, regardless of type.

The traffic count station and all associated equipment shall be installed as specified in the Contract Documents.

623.07.06 Accessible Pedestrian Signals

The installation of APS shall meet the requirements of the AODA Ontario Regulation 413/12 and shall be installed according to the manufacturer's recommendations and the Contract Documents.

Accessible pedestrian signal pushbuttons shall be installed within 1,500 mm of the edge of the curb, and shall be mounted at a maximum of 1,100 mm above ground level as specified in the Contract Documents.

Accessible pedestrian signals shall have tactile arrows that align with the direction of crossing.

623.07.07 Non-Intrusive Detection System

Detectors shall be installed at locations and mounting heights specified in the Contract Documents and according to the manufacturer's guidelines. The detectors shall be oriented and configured for operation according to the manufacturer's specifications and the Contract Documents.

Wiring and cabling shall be installed according to OPSS 604 and shall run continuously from source to destination. Splicing of wires and cables shall not be permitted.

All cabling and equipment required to transmit, receive, and process non-intrusive detection signals shall be installed according to the manufacturer's specifications and the Contract Documents.

Anti-seize compound shall be applied to the mounting bracket.

Drip loops and expansion loops shall be formed at each pole or conduit entry and held free of the pole or of other cables or connections.

Cable shall be protected with rigid PVC conduit where slack lengths of more than 450 mm are externally exposed.

Setup equipment shall be ruggedized and shall have 1 serial port, 1 USB port, 1 ethernet port, and a daylight-readable display. The setup equipment shall include a ruggedized notebook or equivalent device. The setup equipment shall operate correctly in ambient temperatures from 5 to 35 °C.

Metal detector housings shall be connected to the pole ground connector, or the system ground wire in surface mounted PVC junction boxes. All grounding work shall be according to OPSS 609.

For installation on metal poles, wiring apertures shall be drilled as required. The apertures shall be located clear of the vertical seam and overlapping sections of sectional steel poles. Apertures shall be deburred and painted with grey zinc rich paint. Rubber grommets shall be installed after the paint has dried.

623.07.08 Quality Control

623.07.08.01 Pre-installation Testing and Inspection

Prior to installation, an inspection of the following shall be conducted to ensure they are according to the Contract Documents:

- a) Detection devices and connection components
- b) Prefabricated detector loops and components
- c) Traffic count stations

The Contractor shall ensure that the temperature is within allowable limits prior to saw cutting and ensure that any dampness or precipitation can be successfully blown out of saw cut slots prior to beginning installation.

Prior to the overlaying of asphalt, detector loop wiring shall be tested for continuity, for leakage to ground and for inductance. Resistance to ground shall be 10 megohm or greater. Inductance shall be within 25% of the value indicated in the Contract Documents using a 100 kHz signal at 5V. Any prefabricated detector loop not passing these tests shall be replaced.

Prior to installation of probe detectors, the coil resistance shall be tested and shall be within 25% of the manufacturer's rated resistance. For multiple installations of probe detectors, the set shall be tested for total resistance value. Any detector not passing the foregoing tests shall not be used.

623.07.08.01.01 Accessible Pedestrian Signals

Actuation devices and connection components shall have been inspected prior to installation to ensure that they meet the requirements of Ontario Regulation 413/12 of the AODA and the Contract Documents.

623.07.08.01.02 Non-Intrusive Detection System Equipment

Non-intrusive detection system equipment shall be tested and inspected prior to installation to verify that it performs according to the manufacturer's specifications and the Contract Documents.

623.07.08.02 Proof of Performance Testing and Inspection

The Work shall be inspected and tested to ensure that all components are according to the requirements of the Contract Documents.

When the installation of traffic signals is included in the contract, all auxiliary components such as sensor units shall be tested to ensure they are in working order without activating the traffic signals for public display.

The testing and inspection results shall be documented in a report and submitted to the Contract Administrator.

623.07.08.02.01 Detector Loops

Loop wiring shall be tested for continuity, leakage to the ground and for inductance as follows:

- a) Prior to sealing slots.
- b) At the controller cabinet upon the completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches.

Testing requirements shall be the same as specified in the Pre-installation Testing and Inspection clause. Any loop not passing these tests shall be replaced.

Loops to be replaced shall be re-cut in cut in the original slot with new wiring and sealant installed and retested.

623.07.08.02.02 Probe Detectors

Probe detectors shall be tested at the splice point for coil resistance and leakage to the ground prior to sealing all slots and holes. Testing requirements shall be the same as specified in the Pre-installation Testing and Inspection clause.

For aerial installations, the coil resistance shall be tested at the controller cabinet upon the completion of splices to extra low voltage cables.

623.07.08.02.03 Pedestrian Pushbuttons

Upon completion of the installation of pedestrian pushbuttons, the APS system shall be tested at the controller cabinet.

623.07.08.02.04 Prefabricated Detector Loops

Loop wiring shall be tested for continuity, leakage to the ground and for inductance as follows:

- a) After covering with paving materials.
- b) At the controller cabinet or the traffic count station upon the completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches.

Resistance to ground shall be 10 megohm or greater. Inductance shall be within 25% of the value indicated in the Contract Documents.

623.07.08.02.05 Traffic Count Station

Upon completion of the installation of the traffic count station and the connection to the loops, the APS system shall be tested for its wiring continuity, leakage to ground and inductance, as specified in the Prefabricated Detector Loops clause.

623.07.08.02.06 Accessible Pedestrian Signals

The installed APS shall be inspected and tested to confirm that they meet the requirements of Ontario Regulation 413/12 of the AODA and the Contract Documents. The APS shall be tested according to the manufacturer's recommendations.

623.07.08.02.07 Non-Intrusive Detection System

Each non-intrusive detection system shall be inspected and tested to verify that it performs according to the manufacturer's specifications and the Contract Documents. In particular, and without limiting the foregoing, the Contractor shall ensure that all components are installed, tested, and proven to work as indicated in the Contract Documents, and that all cables are energized and in working order.

623.07.08.03 Testing and Training for Non-Intrusive Detection System "Switch On"

A new non-intrusive detection system at a location not previously equipped with a non-intrusive detection system, or a new non-intrusive detection system to replace an existing detection system, shall be switched on for operation according to the following requirements:

- a) The Contract Administrator shall be given a minimum of 3 Business Days' notice of when the new detection system will be installed or switched over, and shall reconfirm that the work will be done as scheduled 24 hours prior to doing the work.
- b) The Contractor shall provide training from the manufacturer to ministry staff, up to a maximum of six (6) persons, on the following topics:
 - i. Overview of the non-intrusive detection system
 - ii. Hardware and software operation

- iii. Field setup procedures (detection zones setup)
 - iv. Configuration procedures and techniques
 - v. Operation and maintenance of the detection system
- c) The training shall include hand-outs and reference material for each participant.
 - d) Training shall be completed on or before the detection system is installed and operational.
 - e) The setup equipment shall be handed over to the MTO electrical coordinator responsible for the maintenance of the non-intrusive detection system equipment, at the time of training.
 - f) All repairs or replacement of defective components shall be complete prior to activation.
 - g) Non-intrusive detection system "Switch On" for operation shall not be permitted on Fridays, Saturdays, Sundays, Mondays, or statutory holidays.
 - h) Traffic shall be under police supervision during this operation.

The Contract Administrator may witness any test performed and may make random inspections of the work.

The accessible pedestrian signals shall be tested in the presence of the Contract Administrator and the ministry's electrical coordinator.

The Contract Administrator may provide direction for the aiming of non-intrusive detectors or the adjustment of the non-intrusive detection system.

623.08 QUALITY ASSURANCE

623.08.01 General

The Contractor shall give the Contract Administrator 24 hours notice of when final tests are to be performed. The final tests shall be done after all work is completed.

The Contract Administrator shall witness all final tests. All test results shall be submitted to the Contract Administrator.

The accessible pedestrian signals shall be tested in the presence of the Contract Administrator and the ministry's electrical coordinator.

The Contract Administrator and the ministry's electrical coordinator may witness any testing performed and may make random inspections of the work.

The Contract Administrator may provide direction for the aiming of non-intrusive detectors or the adjustment of the non-intrusive detection system.

The Contract Administrator may witness any test and may make random inspections of the work.

623.08.02 Loop Detectors

Prior to sealing slots, loop wiring shall be tested for continuity, for leakage to ground and for inductance. Resistance to ground shall be 10 mega ohm or greater. Inductance shall be within 25% of the value indicated in the contract using a 100 kHz signal at 5V.

Upon completion of splices, installation of extra low voltage cable, sealing of slots and backfilling of trenches, the foregoing tests shall be repeated at the controller cabinet.

Any loop detector required to be replaced shall be re-cut in the original slot with new wiring and sealant installed. All such loops shall be tested to conform to the foregoing requirements.

623.08.03 Probe Detectors

Prior to installation of probe detectors, the coil resistance shall be tested and shall be within 25% of the manufacturer's rated resistance. For multiple installations of probe detectors, the set shall be tested for total resistance value. Any detector not passing the foregoing tests shall not be used.

623.08.03.01 Aerial Installation

Upon completion of splices, installation of extra low voltage cable, the coil resistance shall be tested at the controller cabinet.

623.08.03.02 Underpavement Installation

Prior to sealing of slots and holes for probe detectors, the coil resistance shall be tested at the splice point. The probe detectors shall also be tested for leakage to ground at the splice point.

623.08.04 Pedestrian Pushbuttons

Upon completion of the installation of the pedestrian pushbuttons, the system shall be tested at the controller cabinet.

623.09 MEASUREMENT FOR PAYMENT

623.09.01 Actual Measurement

623.09.01.01 Loop Detectors Loop Detectors (Temporary) Probe Detectors Probe Detectors (Temporary) Pedestrian Pushbuttons Pedestrian Pushbuttons (Temporary) Prefabricated Detector Loops Traffic Count Station

For measurement purposes, a count shall be made of the number of loops, detectors, pushbuttons and traffic count stations installed.

623.09.01.02 Accessible Pedestrian Signals Accessible Pedestrian Signals (Temporary) Non-Intrusive Detection Systems Non-Intrusive Detection Systems (Temporary)

For measurement purposes, a count shall be made of the number of intersections where accessible pedestrian signals and non-intrusive detection systems are installed. Each intersection shall be counted only once, regardless of the number of times all or part of the accessible pedestrian signals or non-intrusive detection systems are relocated.

623.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

623.10 BASIS OF PAYMENT

623.10.01 **Loop Detectors - Item**
 Loop Detectors (Temporary) – Item
 Probe Detectors - Item
 Probe Detectors (Temporary) - Item
 Pedestrian Pushbuttons – Item
 Pedestrian Pushbuttons (Temporary) - Item
 Prefabricated Detector Loops - Item
 Traffic Count Station - Item
 Accessible Pedestrian Signals – Item
 Accessible Pedestrian Signals (Temporary) - Item
 Non-Intrusive Detection Systems – Item
 Non-Intrusive Detection Systems (Temporary) – Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Materials required to do the work, including, but not limited to, installation, removal, salvage, relocation, reinstallation, rearrangement, and recalibration of all equipment system components.

Payment for loop detectors that were to be constructed as a single loop but constructed as two loops due to pavement irregularities, as directed by the Contract Administrator, shall be made at the Contract price plus 20%.



CONSTRUCTION SPECIFICATION FOR ROOTWAD STRUCTURES

TABLE OF CONTENTS

810.01	SCOPE
810.02	REFERENCES
810.03	DEFINITIONS
810.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
810.05	MATERIALS
810.06	EQUIPMENT - Not Used
810.07	CONSTRUCTION
810.08	QUALITY ASSURANCE - Not Used
810.09	MEASUREMENT FOR PAYMENT
810.10	BASIS OF PAYMENT
APPENDICES	Not Used

810.01 SCOPE

This specification covers the requirements for the installation of rootwad structures to provide streambed and waterbody bank stabilization and to improve fish habitat.

810.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

810.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

810.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 517	Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1440	Steel Reinforcement for Concrete
-----------	----------------------------------

810.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Anchoring Stone means large stones used to anchor rootwad structures into a waterbody bank.

Excavated Bank Material means the existing earth material removed from the waterbody bank prior to the installation of a rootwad structure and replaced on top of the anchoring stone when backfilling the installation.

Footer Log means a log used to provide support under the rootwad trunk of a rootwad structure installed into a waterbody bank.

Rootfan means the root mass at the end of a rootwad trunk.

Rootwad Structure means the trunk of a tree with the limbs removed and the rootfan attached and exposed from earth that is installed along the toe of a waterbody bank to stabilize the slope and provide fish habitat, and includes a footer log, anchoring stone, and may include reinforcing steel.

Rootwad Trunk means the trunk of a tree used in a rootwad structure.

810.05 MATERIALS

810.05.01 General

All materials shall be free of deleterious substances.

810.05.02 Trees

Trees used for rootwad structures and footer logs shall be natural and untreated oak, maple, cedar, spruce, pine, or beech, unless otherwise specified in the Contract Documents.

Preference shall be given to trees sourced on-site.

810.05.03 Rootwad Trunk

The rootwad trunk shall be sized as specified in the Contract Documents. All limbs shall be removed from the rootwad trunk.

810.05.04 Rootfan

The rootfan shall be maintained intact at the end of the rootwad trunk.

810.05.05 Footer Log

Footer logs shall be generally straight and sized as specified in the Contract Documents.

810.05.06 Anchoring Stone

Anchoring stone shall be large field stone or quarried bedrock.

810.05.07 Reinforcing Steel

Reinforcing steel shall be according to OPSS 1440.

810.07 CONSTRUCTION

810.07.01 General

Rootwad structures shall be installed in the dry. The outside edge of the rootfan of a rootwad structure shall be installed so that it is no lower than the bottom of the waterbody or otherwise so that it is 1/3 below the low water level of the waterbody as specified in the Contract Documents.

810.07.02 Installation

Installation of rootwad structures shall be completed in the following sequence:

- a) The streambed and waterbody bank shall be excavated to accommodate the entire length of the rootwad trunk and the footer log. The excavation shall be slightly angled to become deeper further inland from the edge of the waterbody.
- b) The excavated bank materials shall be reused for the final layer when backfilling.
- c) The footer log shall be installed so that it sits at the waterbody edge of the excavation, parallel to the waterbody bank, and at the depth specified in the Contract Documents. When more than one rootwad structure is to be installed in series, the footer logs shall be installed starting at the downstream end of the installation.
- d) The rootwad trunk shall be placed in the excavation resting on the footer log so that it is embedded into the waterbody bank up to the rootfan. The rootwad trunk shall be angled slightly in the excavation so that the rootwad structure is facing upstream at an angle, as specified in the Contract Documents, to the waterbody bank and shall be anchored into the bank with reinforcing steel if specified in the Contract Documents.
- e) Anchoring stone shall be installed on the rootwad trunk and footer log to secure the rootwad structure in place. The anchoring stone shall cover minimum 1.5 times the diameter of the rootwad trunk, both in horizontal and vertical directions, and the entire length of the rootwad trunk and the footer log so that neither is visible from above.
- f) The previously excavated bank material shall be placed over the anchoring stone and graded according to OPSS 206.
- g) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

810.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

810.07.04 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

810.07.05 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

810.09 MEASUREMENT FOR PAYMENT

810.09.01 Actual Measurement

810.09.01.01 Rootwad Structure

For measurement purposes, a count shall be made of the number of rootwad structures installed along the waterbody bank.

810.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

810.10**BASIS OF PAYMENT****810.10.01****Rootwad Structure - Item**

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR LARGE WOODY DEBRIS

TABLE OF CONTENTS

811.01	SCOPE
811.02	REFERENCES
811.03	DEFINITIONS
811.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
811.05	MATERIALS
811.06	EQUIPMENT - Not Used
811.07	CONSTRUCTION
811.08	QUALITY ASSURANCE - Not Used
811.09	MEASUREMENT FOR PAYMENT
811.10	BASIS OF PAYMENT
APPENDICES	Not Used

811.01 SCOPE

This specification covers the requirements for the installation of large woody debris to provide and improve fish habitat on streambeds and waterbody banks.

811.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

811.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

811.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 517	Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
-----------	----------------------------

811.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Backfill Stone means a stone mixture used to hold in place large woody debris installed at the toe of a waterbody bank.

Excavated Bank Material means the existing earth material removed from the waterbody bank prior to the installation of large woody debris and replaced on top of the backfill stone when backfilling the installation.

Large Woody Debris means one or more woody materials including, natural logs, tree trunks and limbs, or tree stumps with rootfans intertwined together and applied along the toe of a waterbody bank when the toe of the waterbody bank is being eroded and includes backfill stone.

Rootfan means the root mass at the end of the trunk of a tree.

811.05 MATERIALS

811.05.01 Large Woody Debris

Large woody debris materials shall be sized as specified in the Contract Documents.

Preference shall be given to wood debris and dead trees sourced on-site.

811.05.02 Backfill Stone

Backfill stone shall be pit run material according to OPSS 1004 and as specified in the Contract documents. Alternatively, previously excavated waterbody bank material may be used if specified in the Contract Documents.

811.07 CONSTRUCTION

811.07.01 General

Large woody debris shall be installed in the dry.

Adjacent to, but not within the installation area, the large woody debris shall be intertwined to create a mass, sized as specified in the Contract Documents.

811.07.02 Installation

Installation of large woody debris shall be completed in the following sequence:

- a) The installation area shall be excavated as specified in the Contract Documents. Excavated material shall be reused for the final layer when backfilling.
- b) The large woody debris shall be intertwined together to create a mass. The mass shall be placed in the excavation, ensuring that the large woody debris is situated in an irregular fashion as specified in the Contract Documents. The large woody debris mass shall extend to the back of the excavation and also extend into the waterbody as specified in the Contract Documents.
- c) The large woody debris shall be covered with backfill stone as specified in the Contract Documents and tamped down. The backfill stone shall be covered with a layer of the previously excavated bank material and graded according to OPSS 206.
- d) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

811.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

811.07.04 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPS 517.

811.07.05 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

811.09 MEASUREMENT FOR PAYMENT

811.09.01 Actual Measurement

811.09.01.01 Large Woody Debris

Measurement of large woody debris shall be in linear metres, in place, as measured along the top of the waterbody bank.

811.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

811.10 BASIS OF PAYMENT

811.10.01 Large Woody Debris - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR LUNKERS

TABLE OF CONTENTS

812.01	SCOPE
812.02	REFERENCES
812.03	DEFINITIONS
812.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
812.05	MATERIALS
812.06	EQUIPMENT - Not Used
812.07	CONSTRUCTION
812.08	QUALITY ASSURANCE - Not Used
812.09	MEASUREMENT FOR PAYMENT
812.10	BASIS OF PAYMENT
APPENDICES	Not Used

812.01 SCOPE

This specification covers the requirements for the construction of LUNKERS for the stability of waterbody banks and fish habitat enhancement.

812.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

812.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

812.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 206	Grading
OPSS 517	Dewatering

Ontario Provincial Standard Specifications, Materials

OPSS 1005	Aggregates - Streambed Material
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1440	Steel Reinforcement for Concrete

812.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Cover Stone means one or more large stones used to create the top of stone LUNKERS.

Excavated Bank Material means the existing earth material removed from the streambed and waterbody bank prior to the installation of LUNKERS and replaced onto the streambed material when backfilling the installation.

LUNKERS means an acronym for Little Underwater Neighbourhood Keepers Encompassing Rheotactic Salmonids that are crib-like, wooden, or stone structures installed along the toe of a waterbody bank.

Spacer Stone means a stone installed under the cover stone of stone LUNKERS and on top of the streambed material to create space under the cover stone.

812.05 MATERIALS

812.05.01 General

All materials shall be free of deleterious substances.

812.05.02 Wood

Wood LUNKERS shall be constructed of local wood, untreated lumber or rough-hewn logs.

Wood LUNKERS planks, stringers, backboards, and posts shall be as specified in the Contract Documents.

Planks shall be placed side-by-side, without any gaps.

812.05.03 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

812.05.04 Granular B Aggregate

Granular B aggregate shall be according to OPSS 1010, except that it may not contain reclaimed asphalt pavement, reclaimed concrete material, glass, ceramic, fly ash, any type of slag, or any other industrial by-product, and shall be made from unwashed, quarried bedrock.

812.05.05 Spacer and Cover Stones

Spacer and cover stones shall be as specified in the Contract Documents.

812.05.06 Reinforcing Steel

Reinforcing steel shall be according to OPSS 1440.

812.07 CONSTRUCTION

812.07.01 General

LUNKERS shall be installed in the dry.

812.07.02 Installation

812.07.02.01 Wood LUNKERS

Wood LUNKERS shall be constructed on land outside the waterbody as specified in the Contract Documents, prior to installation in the waterbody bank.

Installation of wood LUNKERS shall be completed in the following sequence:

- a) The waterbody bank and streambed shall be excavated to accommodate wood LUNKERS as specified in the Contract Documents. Excavated bank materials shall be reused for the final layer when backfilling.

- b) Wood LUNKERS shall be installed in the excavation as specified in the Contract Documents. Adjustments to level and stabilize wood LUNKERS shall be made by hand.
- c) Holes shall be drilled through the posts of wood LUNKERS to accommodate the reinforcing steel and the reinforcing steel shall be driven through wood LUNKERS and into the streambed.
- d) Streambed material shall be placed on wood LUNKERS and extend to the high water level of the waterbody to re-establish the waterbody bank as specified in the Contract Documents. Granular B aggregate shall be installed at the rear of the excavation as specified in the Contract Documents.

The previously excavated bank material shall be installed on top of the streambed material and Granular B aggregate as specified in the Contract Documents and graded according to OPSS 206.

Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

812.07.02.02 Stone LUNKERS

Stone LUNKERS shall be installed in the dry.

Installation of stone LUNKERS shall be completed in the following sequence:

- a) The waterbody bank and streambed shall be excavated to accommodate stone LUNKERS as specified in the Contract Documents. Excavated bank material shall be reused for the final layer when backfilling.
- b) Streambed material shall be placed on the streambed to create a flat, stable base for stone LUNKERS as specified in the Contract Documents.
- c) Spacer stones shall be installed on the streambed material as specified in the Contract Documents. Spacer stones shall be installed to be at the mid-point and at each end of the length of the cover stone. The cover stone shall then be lowered onto the spacer stones. Adjustments shall be made to level and stabilize stone LUNKERS.
- d) Streambed material shall be placed on the cover stone of stone LUNKERS to re-establish the waterbody bank as specified Contract Documents. Granular B aggregate shall be installed on top of the streambed material and extend to the high water level of the waterbody as specified in the Contract Documents.
- e) The previously excavated bank material shall be placed over the Granular B aggregate as specified in the Contract Documents and graded according to OPSS 206.
- f) Vegetative cover shall be applied to the graded area as specified in the Contract Documents.

812.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be as specified in the Contract Documents.

812.07.04 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

812.07.05 Management of Excess Materials

Management of excess materials shall be as specified in the Contract Documents.

812.09 MEASUREMENT FOR PAYMENT

812.09.01 Actual Measurement

**812.09.01 Wood LUNKERS
Stone LUNKERS**

Measurement of wood and stone LUNKERS shall be in linear metres, in place, as measured along the top of the waterbody bank.

812.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

812.10 BASIS OF PAYMENT

**812.10.01 Wood LUNKERS - Item
Stone LUNKERS - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR RIFFLES ON STREAMBEDS

TABLE OF CONTENTS

820.01	SCOPE
820.02	REFERENCES
820.03	DEFINITIONS
820.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
820.05	MATERIALS
820.06	EQUIPMENT - Not Used
820.07	CONSTRUCTION
820.08	QUALITY ASSURANCE - Not Used
820.09	MEASUREMENT FOR PAYMENT
820.10	BASIS OF PAYMENT
APPENDICES	Not Used

820.01 SCOPE

This specification covers the requirements for the construction of riffles on streambeds.

820.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

820.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

820.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517	Dewatering
OPSS 823	Low Flow Channels

Ontario Provincial Standard Specifications, Material

OPSS 1005	Aggregates - Streambed Material
-----------	---------------------------------

820.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Anchor Stones means large streambed material used to create a stable base.

Interstitial Space means an empty space or gap between spaces full of structure or matter.

Low Flow Channel means as defined by OPSS 823.

Riffle means shallow areas of a waterbody with the steepest streambed slopes and shallowest depths where streambed material that break up the flow of water.

Riffle Crest means the highest point of a riffle at its upstream end.

Streambed Material means as defined by OPSS 1005.

820.05 MATERIALS

820.05.01 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

820.07 CONSTRUCTION

820.07.01 General

Riffles shall be constructed in the dry.

820.07.02 Streambed Excavation

All required streambed excavation shall be carried out as specified in the Contract Documents.

820.07.03 Streambed Material

The streambed material shall be blended on site and as specified in the Contract Documents. Approximately 10 - 20% of the largest size of streambed material to be used shall be set aside and positioned on top of the smaller streambed material to direct the stream flow.

Streambed material placement shall commence at the downstream end of the waterbody as specified in the Contract Documents and progress to the upstream end. Streambed material shall be compacted and interstitial spaces shall be filled as specified in the Contract Documents.

The riffle crest shall be constructed across the streambed with large diameter streambed material backed up with the next largest streambed material size downstream. Anchor stones shall be placed on the streambed to create the upstream slope of the riffle and shall extend to the high water level on both sides of the waterbody as specified in the Contract Documents. The thickness of each riffle crest shall be two to three times the diameter of the largest streambed material size.

The surface of the downstream face of the riffle shall have large streambed material placed so that they are spaced 20 - 30 cm apart to form gaps as specified in the Contract Documents.

Once placed, the streambed material shall form a non-uniform surface with larger stones protruding above smaller stones.

820.07.04 Low Flow Channel

A low flow channel shall be installed within the riffle according to OPSS 823.

820.07.05 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

820.07.06 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

820.07.07 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

820.09 MEASUREMENT FOR PAYMENT

820.09.01 Actual Measurement

820.09.01.01 Riffles

Measurement for riffles shall be by horizontal area in square metres.

820.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

820.10 BASIS OF PAYMENT

820.10.01 Riffles - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR POOLS IN STREAMBEDS

TABLE OF CONTENTS

821.01	SCOPE
821.02	REFERENCES
821.03	DEFINITIONS
821.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
821.05	MATERIALS
821.06	EQUIPMENT - Not Used
821.07	CONSTRUCTION
821.08	QUALITY ASSURANCE - Not Used
821.09	MEASUREMENT FOR PAYMENT
821.10	BASIS OF PAYMENT
APPENDICES	Not Used

821.01 SCOPE

This specification covers the requirements for the construction of pools in streambeds.

821.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

821.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

821.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1005 Aggregates - Streambed Material

821.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Pool means hydrologic segments of a waterbody where the water is deeper and slower.

Streambed Material means as defined by OPSS 1005.

821.05 MATERIALS

821.05.01 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

821.07 CONSTRUCTION

821.07.01 General

Pools shall be excavated in the dry.

Any materials to be reused that must be temporarily removed from the streambed shall be stored on-site as specified in the Contract Documents.

821.07.02 Pool Excavation

Pools shall be excavated in the streambed as specified in the Contract Documents.

821.07.03 Streambed Material

Streambed material shall be installed as specified in the Contract Documents.

821.07.04 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

821.07.05 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control for construction in waterbodies shall be according to OPSS 517.

821.07.06 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

821.09 MEASUREMENT FOR PAYMENT

821.09.01 Actual Measurement

821.09.01.01 Pools

Measurement for pools shall be by horizontal area in square metres.

821.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

821.10 BASIS OF PAYMENT

821.10.01 Pools - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR ROCKY RAMPS ON STREAMBEDS

TABLE OF CONTENTS

822.01	SCOPE
822.02	REFERENCES
822.03	DEFINITIONS
822.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
822.05	MATERIALS
822.06	EQUIPMENT - Not Used
822.07	CONSTRUCTION
822.08	QUALITY ASSURANCE - Not Used
822.09	MEASUREMENT FOR PAYMENT
822.10	BASIS OF PAYMENT
APPENDICES	Not Used

822.01 SCOPE

This specification covers the requirements for the construction of rocky ramps on streambeds.

822.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

822.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

822.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1005 Aggregates - Streambed Material

822.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Anchor Stones means large streambed material used to create a stable base.

Boulder Weir means a grade control structure to slow water behind it.

Boulder Weir Crest means the top of the boulder weir.

In-stream Obstruction means a barrier in a waterbody that prohibits fish passage.

Pool means as defined by OPSS 821.

Rocky Ramp means a longitudinal series of boulder weirs and pools creating a low slope that simulates a rocky streambed.

Streambed Material means as defined by OPSS 1005.

822.05 MATERIALS

822.05.01 Streambed Material

Streambed material shall be according to OPSS 1005 and as specified in the Contract Documents.

822.07 CONSTRUCTION

822.07.01 General

Rocky ramps shall be constructed in the dry.

822.07.02 Removal of In-Stream Obstructions to Fish Passage from Waterbodies

Pre-existing, in-stream obstructions to fish passage shall be removed from the waterbody as specified in the Contract Documents.

822.07.03 Streambed Excavation

Prior to construction of rocky ramps, the streambed shall be graded to create the slope and pools as specified in the Contract Documents.

The top layer of the excavated streambed material shall be stockpiled on-site and reused later as the top layer of the rocky ramp as specified in the Contract Documents.

822.07.04 Streambed Material

All imported streambed material shall be stockpiled within graded piles on-site adjacent to the rocky ramp construction location.

The downstream end of the rocky ramp shall be flatter than the rest of the ramp, approximately 10H:1V or as specified in the Contract Documents.

Streambed material placement shall commence at the downstream end of the waterbody as specified in the Contract Documents and progress to the upstream end. Streambed material shall be placed first in the centre of the boulder weir crest and then outwards toward the waterbody banks.

Each boulder weir shall be shaped like an arch so that adjacent streambed materials support each other along the length of the boulder weir. Individual pieces of streambed material shall be carefully placed in a manner that allows the material to be rotated for precise alignment and fitting during construction.

Anchor stones shall form the first layer of streambed material and be placed below the elevation of the final grade to support a second row of streambed material.

The top row of streambed material shall then be placed against the anchor stones and slightly upstream of them so that they are supported with multiple points of contact.

When the arch of the boulder weir is complete, each boulder shall bear against its downstream neighbour and against the two anchor stones below it.

Anchor stones shall also be placed at the ends of each boulder weir well into the waterbody banks to the high water level and backfilled as specified in the Contract Documents.

Each pool shall be lined with streambed material as specified in the Contract Documents.

The bottom of each subsequent boulder weir shall be equal to the elevation of the crest of the boulder weir immediately downstream as specified in the Contract Documents.

Well-graded streambed material with some fines shall be placed on the upstream side of the boulder weir as specified in the Contract Documents.

Upon completion of construction of the rocky ramp, the center stone of each boulder weir crest shall be removed to form a notch for a low flow channel.

822.07.05 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

822.07.06 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

822.07.07 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

822.09 MEASUREMENT FOR PAYMENT

822.09.01 Actual Measurement

822.09.01.01 Rocky Ramps

Measurement for rocky ramps shall be by horizontal area in square metres.

822.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

822.10 BASIS OF PAYMENT

822.10.01 Rocky Ramps - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR LOW FLOW CHANNELS

TABLE OF CONTENTS

823.01	SCOPE
823.02	REFERENCES
823.03	DEFINITIONS
823.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
823.05	MATERIALS
823.06	EQUIPMENT - Not Used
823.07	CONSTRUCTION
823.08	QUALITY ASSURANCE - Not Used
823.09	MEASUREMENT FOR PAYMENT
823.10	BASIS OF PAYMENT
APPENDICES	Not Used

823.01 SCOPE

This specification covers the requirements for the construction of low flow channels to maintain and enhance fish passage in a waterbody or a culvert.

823.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

823.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

823.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering

Ontario Provincial Standard Specifications, Materials

OPSS 1005 Aggregates - Streambed Material

823.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Low Flow Channel means the part of a streambed occupied by water during periods of low flow.

Streambed Material means as defined by OPSS 1005.

823.05 MATERIALS

823.05.01 Streambed Material

When the installation of a low flow channel includes supply of streambed material, it shall be according to OPSS 1005 and as specified in the Contract Documents.

823.07 CONSTRUCTION

823.07.01 General

Low flow channels shall be installed in the dry.

Excavation of the streambed and supply of streambed material from off-site may not be required if the existing streambed material can be adjusted to create the required low flow channel as specified in the Contract Documents.

When excavation of the streambed and supply of streambed material are required to achieve the design as specified in the Contract Documents, any materials that are suitable for reuse that must be temporarily removed from the streambed shall be stored on-site as specified in the Contract Documents.

823.07.02 Low Flow Channel

Once the streambed has been prepared, streambed material according to OPSS 1005 shall be installed as specified in the Contract Documents.

Streambed material placement shall be adjusted as necessary to achieve the design as specified in the Contract Documents.

Proper function shall be verified to ensure the flow is contained within the low flow channel, as constructed, when waterbody flow has been reinstated and that the grade and transition areas from the low flow channel to the waterbody do not present any barriers to flow or fish passage or direct flow outward towards the waterbody banks.

Streambed material placement may need to be adjusted to rectify any of these conditions.

823.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

823.07.04 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

823.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

823.09 MEASUREMENT FOR PAYMENT

823.09.01 Actual Measurement

823.09.01.01 Low Flow Channel

Measurement of low flow channels using existing streambed material shall be in linear metres installed.

Measurement of low flow channels that include supply of streambed material shall be by mass in tonnes of streambed material.

823.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

823.10 BASIS OF PAYMENT

823.10.01 Low Flow Channel - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR BAFFLES IN A CULVERT

TABLE OF CONTENTS

824.01	SCOPE
824.02	REFERENCES
824.03	DEFINITIONS
824.04	SUBMISSION AND DESIGN REQUIREMENTS - Not Used
824.05	MATERIALS
824.06	EQUIPMENT - Not Used
824.07	CONSTRUCTION
824.08	QUALITY ASSURANCE - Not Used
824.09	MEASUREMENT FOR PAYMENT
824.10	BASIS OF PAYMENT
APPENDICES	Not Used

824.01 SCOPE

This specification covers the requirements for the construction of baffles in culverts using streambed material to direct the flow of water within the culverts and to enhance fish passage through the culverts.

824.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

824.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

824.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 517 Dewatering

Ontario Provincial Standard Specifications, Materials

OPSS 1005 Aggregates - Streambed Material

824.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Baffle means one or a series of partial obstructions in a channel designed to increase flow depth or dissipate the energy of water flowing at high velocity while at the same time providing fish passage.

Culvert means a structure that provides an opening through an embankment and to which roadway loads are distributed through fill or that is designated as a culvert in the Contract Documents.

Low Flow Channel means the part of a streambed occupied by water during periods of low flow.

Streambed Material means as defined by OPSS 1005.

824.05 MATERIALS

824.05.01 Streambed Material

Streambed material used to construct baffles in a culvert shall be according to OPSS 1005 and as specified in the Contract Documents.

824.07 CONSTRUCTION

824.07.01 General

All baffles shall be constructed in the dry.

824.07.02 Baffles in a Culvert

Baffles shall be installed in a culvert to be a permanent feature within the culvert as specified in the Contract Documents.

When the construction of the baffles in a culvert is complete and the waterbody flow has been reinstated, streambed material placement shall be adjusted by hand to achieve the design specified in the Contract Documents.

The baffles in a culvert shall be monitored after installation is complete to verify that the grade and transition of flow to the low flow channel within the culvert does not present any barriers to fish passage.

The placement of streambed material shall be adjusted to rectify any barriers to fish passage.

824.07.03 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

824.07.04 Dewatering and Temporary Flow Control

Dewatering and/or temporary flow control shall be according to OPSS 517.

824.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

824.09 MEASUREMENT FOR PAYMENT

824.09.01 Actual Measurement

824.09.01.01 Baffles in a Culvert

For measurement purposes, a count shall be made of the number of baffles installed in a culvert.

824.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

824.10

BASIS OF PAYMENT

824.10.01

Baffles in a Culvert - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR LOCAL SEED BANK

TABLE OF CONTENTS

830.01	SCOPE
830.02	REFERENCES
830.03	DEFINITIONS
830.04	DESIGN AND SUBMISSION REQUIREMENTS – Not Used
830.05	MATERIALS
830.06	EQUIPMENT - Not Used
830.07	CONSTRUCTION
830.08	QUALITY ASSURANCE - Not Used
830.09	MEASUREMENT FOR PAYMENT
830.10	BASIS OF PAYMENT
APPENDICES	Not Used

830.01 SCOPE

This specification covers the requirements for the salvage, stockpiling and installation of local seed bank.

830.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are written to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

830.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

830.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, General

OPSS 206	Grading
OPSS 804	Seed and Cover
OPSS 805	Temporary Erosion and Sediment Control Measures

Ontario Provincial Legislation

Invasive Species Act, 2015, as amended

830.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Invasive Species means as in the Invasive Species Act.

Local Seed Bank means the seeds of species native to a project site and the topsoil the seeds are contained in located within a riparian vegetation area.

830.05 MATERIALS

830.05.01 Local Seed Bank

Local seed bank shall be sourced on-site from designated salvage areas as specified in the Contract Documents.

Local seed bank shall not contain prohibited or restricted invasive species.

830.07 CONSTRUCTION

830.07.01 Local Seed Bank Salvage

Local seed bank shall be salvaged from April to October.

Designated salvage areas for local seed bank shall be excavated to a depth of 150 – 300 mm or as otherwise specified in the Contract Documents.

830.07.02 Local Seed Bank Stockpiles

Salvaged local seed bank may be stockpiled for storage in locations specified in the Contract Documents for up to 6 months if it cannot be installed on designated receiving sites immediately.

Local seed bank stockpiles shall not exceed 1500 mm in height and shall not be compacted. Machinery shall not be allowed on stockpiles.

Local seed bank stockpiles shall be kept moist to prevent seeds from drying out during storage.

Local seed bank stockpiles shall be covered with tarps or woven geotextile material to prevent soil erosion and contamination by weeds during storage. Alternatively, local seed bank stockpiles shall be stabilized with vegetation according to OPSS 804.

Light duty sediment barrier according to OPSS 805 shall be installed around the entire base of local seed bank stockpiles.

830.07.03 Local Seed Bank Installation

Salvaged local seed bank shall be installed on designated receiving sites as specified in the Contract Documents immediately, when practicable.

Receiving sites as specified in the Contract Documents shall be fine graded to a uniform surface according to OPSS 206 prior to installation of local seed bank. The surface of the receiving site shall be loosened to a depth of 25 mm and be free of vegetation, stones and other debris which would not be covered by the depth of local seed bank depth specified in the Local Seed Bank Salvage subsection.

If any designated receiving area is subsequently re-graded after installation of local seed bank, additional local seed bank shall be salvaged and installed according to this specification.

Should local seed bank no longer be available, the area shall be seeded according to OPSS 804.

830.07.04 Protection of Waterbodies and Waterbody Banks

Protection of waterbodies and waterbody banks shall be according to the Contract Documents.

830.07.05 Management of Excess Materials

Management of excess materials shall be according to the Contract Documents.

830.09 MEASUREMENT FOR PAYMENT

830.09.01 Actual Measurement

830.09.01.01 Local Seed Bank

Measurement of local seed bank shall be by area in square metres.

804.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

830.10 BASIS OF PAYMENT

830.10.01 Local Seed Bank – Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.



CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS

TABLE OF CONTENTS

918.01	SCOPE
918.02	REFERENCES
918.03	DEFINITIONS
918.04	DESIGN AND SUBMISSION REQUIREMENTS
918.05	MATERIALS
918.06	EQUIPMENT - Not Used
918.07	CONSTRUCTION
918.08	QUALITY ASSURANCE - Not Used
918.09	MEASUREMENT FOR PAYMENT – Not Used
918.10	BASIS OF PAYMENT
APPENDICES	Not Used

918.01 SCOPE

This specification covers the requirements for the design, supply, construction, maintenance, and removal of modular bridge structures used for temporary installations, including ramps, bank seats, decking, sidewalks, and railings.

918.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

918.01.02 Appendices Significance and Use

Appendices are not for use in provincial Contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

918.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 501	Compacting
OPSS 906	Structural Steel for Bridges
OPSS 907	Structural Wood Systems
OPSS 908	Metal Traffic Barriers and Metal Railings for Structures

Ontario Provincial Standard Specifications, Material

OPSS 1601	Wood, Preservative Treatment, and Shop Fabrication
-----------	--

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

CSA S6-14	Canadian Highway Bridge Design Code
-----------	-------------------------------------

918.03

DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bank Seats means mud sills, timber matting and other components to support the base plates and ramps.

Modular Bridge means a superstructure comprised of commercially available standard proprietary prefabricated components that can be assembled and disassembled on site.

Temporary Installation means an installation that maintains traffic at a construction site for a length of time not exceeding three years.

918.04

DESIGN AND SUBMISSION REQUIREMENTS

918.04.01

Design Requirements

The modular bridge structure shall be designed according to the Contract Documents, CAN/CSA S6 and the Structural Manual except that:

- a) The following requirements of the CAN/CSA S6 are not mandatory:
 - i. Traffic lane widths, side clearance, and sidewalks.
 - ii. Deck crossfall and drain outlets.
 - iii. Limitation of maximum deflection.
 - iv. Designing floor beam and diaphragms for jacking.
 - v. Provision of a protective coating.
 - vi. Fatigue.
 - vii. Accessibility for inspection and coating, the avoidance of pockets, and the provision of drain holes in pockets and their filling with waterproofing.
 - viii. Camber.
 - ix. Provision of two bolts at the end of bracing members.
 - x. Nuts with safety pins or snap rings may be used instead of hexagonal recessed nuts or hexagonal solid nuts with washers.
- b) In addition to the requirements of CAN/CSA S6, a minimum of three girders or two pairs of trusses shall be used to form the main load carrying system of the bridge.

918.04.02

Submission Requirements

918.04.02.01

Working Drawings, Procedures & Certifications

The following documents, bearing the seal and signature of a design Engineer and a design-checking Engineer, shall be submitted to the Contract Administrator at least 7 Days prior to commencement of the installation of the modular bridge, for information purposes only:

- a) Working Drawings of the modular bridge.
- b) Launching, installation and removal procedures.
- c) A letter and design calculations certifying that the modular bridge has been designed according to the Contract Documents.

- d) Where modular bridge components are fabricated outside of Canada, a letter shall be submitted certifying that the materials used, and the fabrication of the modular bridge components are according to the Contract Documents.
- e) Where the load carrying capacity of the modular bridge or any of its components has been established by testing, the load test reports provided by the manufacturer of the modular bridge shall be submitted confirming the bridge satisfies the requirements of the Evaluation Section of CAN/CSA S6, using a Reliability Index (β) not less than 3.75.

Where previously used components are utilized in the modular bridge, a letter signed and sealed by an Engineer shall be submitted certifying that all used components are in good structural condition and free from any damage or defects that could adversely affect their load carrying capacity and performance.

When other authorities are involved in the approval of the design or construction of the modular bridge, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority.

The requirements of each authority shall be satisfied prior to commencement of the work.

918.04.02.02 Notice of Installation

A written notice shall be submitted to the Contract Administrator at least 7 Days prior to the installation of the modular bridge superstructure.

918.05 MATERIALS

918.05.01 General

All materials and components shall be according to the Working Drawings.

918.05.02 Modular Bridge Components

All modular bridge steel components shall be fabricated according to the requirements of OPSS 906.

The use of modular bridge components that have been used previously is permitted provided they are free from damages or defects that could adversely affect their load carrying capacity and performance.

918.05.03 Hardware

The hardware used in the assembly and installation of the modular bridge shall be according to the modular bridge manufacturer's requirements.

918.05.04 Structural Steel

Any structural steel components that are not part of the modular bridge shall be designed and constructed according to OPSS 906.

918.05.05 Wood

Wood shall be according to OPSS 1601. Preservative treatment of wood is not required. Fasteners and hardware for wood construction shall be according to OPSS 907.

918.05.06 Railings

Railings shall be according to OPSS 908 or an equivalent modular bridge manufacturer railing system.

918.07 CONSTRUCTION

918.07.01 General

Documentation indicating that the modular bridge Superintendent who shall be in charge of the installation of the modular bridge has had experience and has successfully performed these duties on at least 3 similar bridges shall be submitted to the Contract Administrator at least 7 Days prior to installation of the modular bridge.

918.07.02 Construction of Bank Seats

Fill under bank seats shall be compacted according to OPSS 501 to a minimum of 95% of the maximum dry density.

918.07.03 Installation and Removal of Modular Bridge

The modular bridge, including bank seats, shall be assembled, installed, and removed according to the Working Drawings, procedures and Contract Documents.

918.07.04 Certificate of Conformance

Upon the completion of construction of the modular bridge, a Certificate of Conformance bearing the seal and signature of a Quality Verification Engineer shall be submitted to the Contract Administrator. The certificate shall state that the modular bridge has been constructed in general conformance with the Working Drawings, procedures and Contract Documents.

918.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

918.07.06 Modular Bridge Maintenance

For the duration of the Contract, excluding seasonal shutdown, the modular bridge, including bearings, bank seats, ramps, decking, sidewalks, railing, approaches, and substructure elements shall be inspected, and have any deficiencies corrected, to ensure its structural integrity, safety and performance are not compromised.

918.10 BASIS OF PAYMENT

918.10.01 Temporary Modular Bridge - Item

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment, and Material to do the work.

For payment purposes, the construction of the modular bridge shall constitute 50% of the work of the tender item.

