
**Construction Specification for the
Digital Scanning of Maintenance Holes**

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TS 473.01 SCOPE

This specification covers the requirements for the inspection of sanitary and storm maintenance holes that utilizes a digital inspection system for the purposes of observing, assessing and recording structural and service defects. All maintenance hole assessments shall be conducted in accordance with NASSCO MACP – Level 2 requirements.

The work involved requires special equipment to be handled by persons experienced in all phases of the Work.

TS 473.02 REFERENCES

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

National Association of Sewer Service Companies (NASSCO)

Pipeline Assessment and Certification Program (PACP)
Maintenance Hole Inspection: NASSCO MACP – Level 2

TS 473.03 DEFINITIONS

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

IPF means Individual Panoramio File

MACP means the Maintenance Hole Assessment Certification Program

MH refers to Maintenance Hole or Manhole

NASSCO means the standards developed by the National Association of Sewer Service Companies for sewer inspection

PACP refers to Pipeline Assessment Certification Program

TS 473.04 DESIGN AND SUBMISSION REQUIREMENTS – Not Used

TS 473.05 MATERIALS

Media storage shall be as specified in the Contract Documents. DVD submissions will no longer be accepted. All submissions to be made on a removable hard-drive of reliable quality. Hard drives will become the property of the City and will not be returned to the Contractor.

USB flash drive and USB hard drives shall be identified with the following information or as specified in the Contract Documents:

- a) Contract Number or project number
- b) Contractor's name
- c) Consultant's name
- d) Street location
- e) Inspection Date

TS 473.05.01 Photographs

Photographs shall be in colour, clear and distortion free, shall be TIFF, JPEG, GIF or PNG format and shall be at least 720 horizontal lines resolution.

TS 473.05.02 Video

Video files shall be in IPF format and shall meet or exceed the requirements outlined in TS 473.06.01. The following file naming convention shall apply:

MHID_DateMilitaryTime.IPF

Example: MH4621905398_201303011423.ipf.

TS 473.06 EQUIPMENT

The inspection system used by the Contractor shall meet the following specifications outlined in this section.

TS 473.06.01 Data Collection

Maintenance Hole inspections are to be performed using digital panoramic inspection system such as the IBAK PANORAMO SI or equivalent meeting the following criteria:

- 1) The inspection camera system must be 100% digital. Any analog or National Television System Committee (NTSC) video camera will be deemed unacceptable.
- 2) The inspection camera system must have two independently or simultaneously controlled digital cameras, one facing in the downward direction and one facing in the upward direction. Each camera must have a minimum of 185-degree field of view.
- 3) The inspection camera system must illuminate the interior of the maintenance hole using a xenon strobe light. The light shall be positioned 360 degrees around the camera lens to distribute the light evenly onto the structure walls. The lighting must be able to illuminate maintenance holes without the need of any auxiliary lighting. Any systems not using strobe light technology will be deemed unacceptable due to motion blur during imaging recording.
- 4) The inspection system shall produce individual images or frames with no more than 0.025 mm (0.001 inches) of movement during image or frame exposure to produce crisp, clear images.
- 5) The inspection camera must provide a minimum of 3000 line of vertical resolution in the side view and a minimum of 500 lines in the perspective view.
- 6) The digital film files must include an unfolded view of the maintenance hole with a minimum of 3000 lines of vertical resolution.
- 7) The inspection system must descend to the lowest point within the maintenance hole chamber to a depth that will facilitate accurate wall measurements' using the software's measuring tools.

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- 8) The digital film files must include the capability to produce a three-dimensional representation of the maintenance hole structure. This data shall be used to perform geometric measurements.
 - 9) The digital file files must include a distortion-free virtual pan and tilt allowing the review of the maintenance hole structure from any angle from any depth. The virtual pan and tilt must be able to view 360-degrees in any direction. The virtual pan and tilt must consist of views from the top and bottom camera, any virtual pan and tilts that artificially create this view from a single camera will be deemed unacceptable due to distorted images on the direct side view.
 - 10) The virtual pan and tilt and unfolded views must be able to be viewable by the City with all the required software included.
 - 11) The system must be capable of inspection speeds of 350 mm per second to ensure maximum production per day with each inspection system and to minimize the time at each location to maintain traffic flow and reduce safety concerns of Contractor's employees.
 - 12) Collected digital film files and header files shall be recorded onto a hard drive and original un-edited data shall be archived for a minimum of 5 years after project complete in the event the City request copies for internal use.

TS 473.06.02 Survey Vehicle

Inspection units are to consist of a self-contained vehicle with separate areas for viewing and storage complete with the following equipment as a minimum:

- 1) Cellular telephone and suitable communication system linking all crew members.
- 2) Fans and blowers capable of removing fog that may be present in sewers at the time of the inspection.
- 3) Video cameras, lighting, cables and power source.
- 4) Video monitor and digital video recorder.
- 5) Computer system with video capture capability or dedicated unit and other related equipment.
- 6) A device that will securely orient the camera with the 12:00 video position facing north and capable of moving the camera through the entire vertical depth of the maintenance hole.
- 7) Capable of inspection system deployment within the right-of-way and off-road conditions.

TS 473.07 CONSTRUCTION

TS 473.07.01 Operator Qualifications for Inspection and Condition Coding

Ensure each operator is fully trained in all aspects of maintenance hole inspections with at least 5 years' experience and capable of making accurate observations and recording all conditions that may be encountered in the maintenance holes.

Perform condition coding using operators who can demonstrate proficiency coding in accordance with the requirements of the MCAP Requirements Manual.

TS 473.07.02 Maintenance Hole Pre-inspection

The Contractor shall perform an above grade visual inspection of the maintenance hole structure to ensure that existing maintenance hole appurtenances such as safety platforms, landings, and so on, or protruding objects do not interfere or obstruct deployment of the maintenance hole inspection system. Immediately advise the Contract Administrator when a complete maintenance hole inspection cannot be conducted. The Contract Administrator shall advise the Contractor to proceed with one of the following operations:

- a) Continue with the inspection of the maintenance hole or
- b) Proceed to the next maintenance hole identified for scanning

TS 473.07.03 Inspection

Each identified maintenance hole shall be inspected using digital scanning technology, and any relevant defects and observations are to be coded and documented. The inspection of the maintenance hole to include the following:

- Condition, material and diameter of pipes entering and exiting the maintenance hole,
- Condition of the benching,
- Observe any inflow or infiltration of the maintenance hole structure from the benching to the bottom of the frame and cover,
- Structural condition of the poured in place concrete structure or the precast sections,
- Gaskets in the case of precast structures,
- Bricking and adjustment units,
- Chimney,
- Steps, ladders and safety platforms, and
- Frame and cover,
- Drop structures, if any.

Utilize current version of the NASSCO Maintenance Hole Assessment Certification Program Level 2 (MACP) format for the inspection of all maintenance holes.

TS 473.07.04 Data Review, Reporting, and Delivery

The digital film files must include an unfolded view of the maintenance hole with a minimum of 3000 lines of vertical resolution.

The digital files produced shall be video files and shall be non-proprietary and viewable with free viewers that can be installed on multiple computer stations.

The digital files must include the capability to produce a three-dimensional representation of the maintenance hole structure.

The Contractor shall review the files offsite using MACP certified personnel.

The Contractor shall supply the Contract Administrator with USB keys, external hard drives or other pre-approved media with the data and associated reports.

TS 473.07.05 Global Positioning System Coordinates for Maintenance Hole

All identified maintenance holes shall be spatially verified via global positioning system coordinates in the field to a minimum +/- 5 cm accuracy as specified in the Contract Documents. The spatial survey information for each maintenance hole inspected must be submitted for migration into the City's GIS, in ESRI ArcView shape file format.

The data must be georeferenced to the 3-degree Modified Transverse Mercator (MTM) Ontario Zone 10, North American Datum (NAD27) 1968 Adjustment. All attribute information must accompany the submitted graphical data files. The maintenance hole graphical digital data must be submitted to the City as "point" features.

TS 473.07.06 Coding Accuracy

Coding accuracy will be a function of the number of defects or construction features not recorded or omitted and the correctness of the coding and classification recorded. Coding accuracy is to satisfy the following requirements

- Header accuracy – 95%
- Detail accuracy – 85%.

Implement a formal coding accuracy verification system before starting the Work.

Verify coding accuracy on a random basis on a minimum of 10 per cent of the inspection reports. Submit coding accuracy checks with the corresponding video recording.

Perform a minimum of two accuracy verifications for each operator and submit the results to the Contract Administrator for review. Operators failing to meet the accuracy requirements on two occasions will not be permitted to code on the remainder of the Contract until they can demonstrate to the Contract Administrator that they can code in accordance with the requirements of the latest edition of the NASSCO PACP Manual.

Re-code inspections not satisfying the accuracy requirements and verify the accuracy of the inspection immediately preceding and following the non-compliant inspection. Repeat the process until the preceding and subsequent inspections satisfy the accuracy requirements.

TS 473.07.07 Sample Inspection Report

Submit a sample inspection report, digital IPF video recording of an actual maintenance hole inspection performed by each camera that will be used to the Contract Administrator for review at least 14 Days before beginning the inspection work.

Clearly identify the camera make, model and serial number on each video.

Use the report submission accepted by the Contract Administrator as a benchmark for subsequent inspection report submissions.

No inspection work is to be performed until the sample inspection report has been accepted by the Contract Administrator.

TS 473.07.08 Maintenance Hole Inspections

Notify the Contract Administrator of the locations where maintenance hole inspections will be performed one full day before starting inspection work at that location.

Keep the camera lens clean during the entire maintenance hole inspection.

Ensure the picture is in focus and there is adequate, even lighting free of shadows and glare ahead of the maintenance hole riser at all times to be able to determine general condition, features and upcoming defects. Provide better lighting as directed by the Contract Administrator.

Perform maintenance hole inspections in accordance with the following

- 1) From the top to the bottom of the maintenance hole.
- 2) From the maintenance hole frame to the center line elevation of the exiting sewer.
- 3) Ensure the frame of the maintenance hole is clearly visible at the start of the inspection.
- 4) Block ambient light during the inspection to minimize problems related to lens flare and poor contrast.
- 5) Inspect the maintenance hole to the lowest depth that will facilitate accurate perpendicular measurements using the software's measuring tools.

Re-perform maintenance hole inspections where the Contract Administrator has determined the tolerance requirements for camera position and speed and internal distance measurement requirements have not been satisfied.

TS 473.07.09 Incomplete Inspections

Immediately advise the Contract Administrator when a complete sewer inspection cannot be completed due to collapse, excessive deformation, intruding connections, obstructions or large displaced joints. Jointly decide with the Contract Administrator one of the following alternatives

-
- abandon the inspection, or
 - repeat the inspection subsequent to one of the removal of the intruding connections or obstructions.

Note in a log the maintenance hole ID number, steel tape measurement, maintenance hole depth inspected, length of missing video and the reason the inspection could not be completed and review with the Contract Administrator.

TS 473.07.10 Acceptance of Inspections

The Contract Administrator shall review inspection reports, video recordings, and to ensure compliance with the specifications within 10 Working Days of submission unless otherwise indicated by the Contract Administrator.

Re-perform maintenance hole inspections where the Contract Administrator has determined the requirements of the specification have not been satisfied.

Correct non-compliant inspection submissions and resubmit the corrected inspections to the Contract Administrator within 5 Working Days.

Repeat the process until the inspection submissions are accepted by the Contract Administrator.

TS 473.07.11 Observed Failures During Maintenance Hole Inspections

Capture photograph or digital images and notify the Contract Administrator immediately where a flow disparity, clear water infiltration, hole or missing bricks, damaged or missing maintenance hole cover, collapse, void or deformation greater than 10 per cent is observed during the maintenance hole inspection. Provide the captured images to the Contract Administrator at the end of each work day.

The Contract Administrator will arrange for emergency maintenance hole repairs to be performed if required as soon as possible if the inspection cannot be completed or the maintenance hole condition poses an immediate operational or safety concern such as a complete collapse.

TS 473.07.12 Retention of Inspection Reports

The Contractor shall maintain backup copies of all digital video and inspection data submissions for the duration of the Warranty Period.

TS 473.08 QUALITY ASSURANCE – Not Used

TS 473.09 MEASUREMENT FOR PAYMENT

TS 473.09.01 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in Pricing Form.

TS 473.09.02 Maintenance Hole Inspections

Maintenance hole inspection shall be measured on a unit basis and paid for at the Contract Unit Price as indicated in the Pricing Form. Quantity of units to be paid for will be the total number of maintenance hole's inspected in accordance with this specification, accepted and measured by the Contract Administrator.

Payment will not be made until the required report submissions are accepted by the Contract Administrator.

Payment will not be made for inspections re-performed where the Contract Administrator has determined the requirements of the specification have not been satisfied.

TS 473.10 BASIS OF PAYMENT

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

Appendix 473-A, September 2019
For Use While Designing and Administrating City Contracts

Note: This is a non-mandatory commentary appendix intended to provide information to a designer and contract administrator during the design and construction stage of a contract on the use of this TS specification in a City contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an owner's design decisions and methodology.

Notes to Designer:

The designer should specify the following in the Contract Documents:

- x,y,z coordinates of maintenance hole if needed (473.07.05)