

- 1 GENERAL** .1 This section refers to the works that are unique to the requirements for inspecting new and existing sanitary and storm pipes and pipe culverts by closed circuit television. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.1 Related Work**
- .1 Traffic Regulation “*Traffic Control Manual for Works on Roadways*” (second edition), published by MoT
- .2 Flushing and Cleaning of Sewers - Section 02736s UBC Utilities Supplementary specifications
- 1.2 References**
- .1 These specifications must be referenced to and interpreted simultaneously with all other Standards and Specifications pertinent to the works described herein.
- .2 Reference standards, specification or publications.
- .1 Water Research Centre (WRC) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
- .2 NAAPI Manual of Sewer Condition Classification, Second Edition, 2007
- .3 Nomenclature
- .1 CCTV Closed Circuit Television
- .2 JPEG Joint Photographic Experts Group
- .3 MPEG Movie Photographic Experts Group
- .4 S-VHS Super VHS format video
- .5 DVD Digital Video Disk
- .6 MSCC Manual of Sewer Condition Classification (WRC. – 3rd edition)
- 1.3 Submission of Certification**
- .1 Submit a copy of the CCTV operator’s current NAAPI certification certificate to the Contract Administrator at least one week prior to the start of the CCTV inspection operations.
- .2 Submit copies of certificates for each CCTV operator

working on the contract.

- 1.4 Work Regulations** .1 Work shall conform to all applicable regulations of WorkSafe BC. The Contractor shall confirm training compliance in the following:
- .1 Confined space entry
 - .2 Ventilation
 - .3 Atmospheric monitoring
 - .4 Personal protective equipment
- .2 The Contractor shall provide dates of confined space training completion for each worker and a list of equipment required for confined space entry.
- 1.5 Scheduling of Work** .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11)
- 1.6 Measurement for Payment** .1 All units of measurement for payment will be as specified herein unless shown otherwise in Form of Tender
- .2 CCTV pipeline inspection will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement will be determined by calibrated electronic measure along the sewer from the inside wall of manhole to inside wall of manhole or end to end of sewer pipe for all sections except where a blockage or obstruction occurs.
- .4 For sections of pipe where a blockage or obstruction occurs, measurement will be from the start of inspection (inside wall of manhole) to the point of abandonment of survey.
- .5 For sections of pipe with the WRc. condition code CU

(camera underwater) that has a continuous distance greater than five (5) metres, the measurement above will be reduced by the distance in excess of the five metres.

- .6 Bypass pumping for each situation as described in the Form of Tender will be made as lump sum.

2.0 PRODUCTS

2.1 Equipment

- .1 A Survey Vehicle, containing a separate area for viewing, recording and controlling of the CCTV operation is required as follows:
- .1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation shall be provided to enable one person, in addition to the operator, to clearly view the monitor screen.
 - .2 All equipment utilized within the pipeline shall be stored outside the viewing, recording and control area.
 - .3 Vehicle to be equipped with a telephone for communication with the Engineer for the duration of the work.
 - .4 Electrical power for the system to be self contained. External power sources from public or private sources will not be permitted.
- .2 Survey Equipment shall have sufficient cables to view the lengths of pipe as specified.
- .1 Survey unit shall be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - .2 Each unit shall carry sufficient numbers of guides and rollers such that, when surveying, all cables are

supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.

- .3 Each unit shall interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.
- .3 The camera shall be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - .1 The camera shall be a "Pan & Tilt " type having the capability of panning the pipe at 360° and tilt capability of 270°.
 - .2 The camera shall be equipped with an inclinometer to record the slope of inspected pipe.
 - .3 The live picture is to be visible with no interference and capable of registering a minimum of 360 lines of resolution at the periphery.
 - .4 Focus and iris adjustment shall allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - .5 The camera is to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights shall provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.

- 2.2 Materials**
- .1 Digital video files are to be stored on new, unused DVD-R media in MPEG 2 format.
 - .2 Photographs are to be in colour, with a minimum image size of 90mm x 70mm and shall be reproduced on premium glossy photo quality paper.

3.0 EXECUTION

3.1 CCTV Inspection

- .1 The Contractor shall submit samples of inspection reports, video (in MPEG 2 DVD format) together with corresponding digital data files for the Owners review within one week of receipt of notice to proceed with contract. This submission shall demonstrate compliance with the contract specifications and the accepted submission will be used as a benchmark for subsequent inspection report submissions.
- .2 No inspection surveys are to be carried out under this contract until an acceptable sample inspection report has been approved by the Contract Administrator.
- .3 Flow in the pipeline is not to exceed approximately $\frac{1}{3}$ of the pipe diameter. Notify of excessive flows, inspect using flow reduction method (See Clause 3.10).
- .4 Steaming and fogging encountered during the inspection survey shall be eliminated by introducing forced air flow by means of fan.
- .5 The camera lens is to remain free of grease or other deleterious matter to ensure optimal clarity.
- .6 Inspection video images are to be produced in MPEG2 format by the following method:
 - .1 Video capture card and software designed to create and store real-time MPEG2 digital file direct to computer hard drive.

- .2 Create a separate digital file and a separate title for each individual manhole-to-manhole inspection report. Format for the video file numbering to be provided by the Contract Administrator.
- .7 Set zero chainage at face of every manhole, or on entrance into pipe or start of pipe culvert.
- .8 Report and record on the full length of pipeline from inside face to inside face between manholes or outlet end of pipes and from one end of the pipe culvert to the other.
- .9 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- .10 The data generator shall electronically generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information prior to the start of each run:
 - .1 Manhole (from-to) / pipe length reference numbers.
 - .2 Pipeline dimensions
 - .3 Pipe material (ie vitrified clay, concrete, pvc etc.)
 - .4 Type or use of pipe (ie sanitary or storm sewer)
 - .5 Date of survey (yyyy.mm.dd)
 - .6 Road name/location
 - .7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - .8 Inspection (report) number. Format to be provided by the Contract Administrator.
 - .9 Verbal description of all the above on screen information.
- .11 The data generator shall continuously electronically

generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information during each run:

- .1 Automatic update of the camera's metre reading position from adjusted zero.
 - .2 Manhole/pipe length reference numbers.
 - .3 Type or use of pipe (ie sanitary or storm sewer)
 - .4 The unique inspection/report number of the run.
 - .5 Display digital information such that it will not interfere with the video image on the screen.
 - .12 The camera must stop at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.
 - .13 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
 - .14 Immediately notify Contract Administrator of any blockage or obstruction that will not allow passage of survey equipment.
 - .15 Restart the inspection survey from the opposite end of pipeline or culvert when a blockage or obstruction is encountered unless directed by Contract Administrator.
- 3.2 Site Coding Sheets**
- .1 Each pipeline length to be recorded according to the WRc, MSCC 3rd edition. Any variation from the manual is to be noted in the survey report.
 - .2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - .1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day)

- .2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds)
 - .3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC
- 3.3 Camera Position**
 - .1 Position the camera lens centrally in the pipeline to a tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned $2/3$ the height of the pipe measured from the invert.
 - .2 Position the camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.
- 3.4 Camera Travel Speed**
 - .1 Travelling speeds of the camera in the pipeline shall be as follows:
 - .1 0.1m/s for pipeline of diameter less than 200mm.
 - .2 0.15 m/s for diameters 200mm and larger but not exceeding 310 mm: and
 - .3 0.20 m/s for diameters exceeding 310 mm.
- 3.5 Camera Position Chainage Device**
 - .1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera.
 - .1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
 - .2 Chainage device shall be accurate to within 0.3 m up to the first 50 m of pipe length and within $\pm 1\%$ for lengths exceeding 50 m.

- .3 Chainage tolerance shall be checked at the start of contract and a minimum of once every two weeks there after or every 5000 m of pipeline inspected, whichever is greater.
 - .4 Provide an audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.
- 3.6 Photographs and/or Digital Images**
- .1 Photograph all major defects as defined by condition codes: B, CM, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X
 - .2 The following data, in alpha-numeric form, shall be overlaid on photographs such that it will not interfere with the defect condition reported:
 - .1 Report/job number
 - .2 Metre reading position (chainage)
 - .3 Manhole/pipe length reference numbers (from - to)
 - .4 Photograph number
 - .5 WRc. condition defect code
 - .6 Date of survey (yyyy.mm.dd)
 - .3 Capture photographs and alpha-numeric data as a digital image in JPEG. format if required, as specified in contract documents.
 - .4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.
- 3.7 Inspection Reporting
Hard copies & Digital**

format

- .1 Submit reports to the Contract Administrator within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- .2 Present machine printed (hard copy) and computer generated database reports according to the MSCC format as follows:
 - .1 Each binder to commence with an index of all survey inspection reports contained within.
 - .2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
 - .3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.
 - .4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - .5 Digital information to be presented in tabular configuration in accordance with the UBC standard file format in Microsoft ACCESS (.MDB) (See Clause 3.12). A single master database file to be presented at the end of the project containing all the project CCTV reports.
 - .6 Provide a CD ROM of digital photographs. Each disk to be labelled with photo and contract numbers.
 - .7 Include Owner supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.

- .3 Present reports in 215 mm x 280 mm three ring (D type) binders.
 - .4 Attach computer disks (DVD and CD) in three hole plastic diskette sheet holder in back of binder.
 - .5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
 - .6 Provide additional copies of printed reports, if required, or as specified in contract documents.
 - .7 All dimensions and chainages in the reports shall be in metric units.
- 3.8 Flushing and Cleaning**
- .1 Clean or flush sewers immediately prior to CCTV inspection survey, unless otherwise specified in the contract documents or directed by the Contract Administrator.
- 3.9 Root Cutting & Removal**
- .1 Remove roots for condition codes RM where required, to allow for CCTV equipment to pass.
- 3.10 Flow Reduction**
- .1 Reduce flow in pipeline to approximately $\frac{1}{4}$ pipe diameter to allow CCTV inspection by combination of the following:
 - .2 Schedule work for off peak flow times.
 - .3 Plug or block flow at upstream manhole.
 - .1 Plug designed to either plug all flow or impede flow to the approximate $\frac{1}{4}$ pipe diameter.
 - .2 Obtain Contract administrator's approval prior to plugging or impeding any flow.
 - .3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.

- .4 Temporary bypass pump flow around inspection section when required, as specified in contract documents. Plug to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain Contract Administrator's approval prior to setting up temporary bypass pump system.

3.11 Coding Accuracy

- .1 Coding accuracy shall be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
 - .1 header accuracy 95%
 - .2 detail accuracy 85%
- .2 The Contractor shall implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Contract Administrator will be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.
- .3 A minimum of two accuracy verifications shall be performed for each operator for each working week. Coding not satisfying the accuracy requirements shall be re-coded and the accuracy of the inspection report immediately proceeding and following the non compliant inspection shall be verified. The process shall be repeated until the proceeding and subsequent inspections meet accuracy requirements.

3.12 Standard CCTV Digital File Format – Header Table

- .1 Below are two tables listing fields and data types to be used in the Digital file (MDB) submission.

HEADER TABLE

NAAPI FIELD NAME	DATA TYPE	FIELD PROPERTIES	CITY OF FIELD NAME
ID	AutoNumber		
SURVEYEDBY	Text	12	
CONTRACTNUMBER	Text	8	
JOBNUMBER	Text	10	
CATCHMENT	Text	10	
DIVISION	Number	Byte	
DISTRICT	Text	3	
PIPELENGTHREF	Text	11	
DATE	Date/Time		
TIME	Date/Time		
LOCATION	Text	50	
STARTMANHOLE	Text	10	
SDEPTH	Text	4	
SCOVER	Number	Single	
SINVERT	Number	Single	
FINISHMANHOLE	Text	10	
FDEPTH	Text	4	
FCOVER	Number	Single	
FINVERT	Number	Single	
USESEWER	Text	1	
DIRECTION	Text	1	
SIZE1	Number	Integer	
SIZE2	Number	Integer	
SHAPE	Text	1	
MATERIAL	Text	3	
LINING	Text	3	
PIPELENGTH	Number	Single	
TOTALLENGTH	Number	Single	
YEARLAID	Text	4	
VIDEONUMBER	Text	5	
COMMENTS	Text	50	
PURPOSE	Text	1	
SEWERCATEGORY	Text	1	
PRECLEANING	Text	1	
WEATHER	Text	1	
LOCATIONCODE	Text	1	
FURTHERDETAILS	Text	48	

CONDITION DETAILS TABLE

FIELD NAME	DATA TYPE	FIELD PROPERTIES		CITY OF..... FIELD NAME
ID	AutoNumber	Long integer		
VIDEONUMBER	Date/Time	hh:nn:ss		
PHOTOGRAPHNUMBER	Number	Integer		
DISTANCE	Number	Single		
CONTINOUSDEFECT	Text	2		
CODE	Text	4		
DIAMETER_DIMENSION	Number	Integer		
CLOCKFROM	Number	Integer, "00"		
CLOCKTO	Number	Integer, "00"		
PERCENTAGE	Number	Byte		
INTRUSION	Number	Integer		
JOBNUMBER	Text	10		
REMARKS	Text	34		

END OF SECTION