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**VOLUME 5    CONTRACT DOCUMENTS  
FOR SPECIALIST  
ACTIVITIES**

**SECTION 9    MODEL CONTRACT  
DOCUMENTS FOR CCTV  
SURVEY OF HIGHWAY  
DRAINAGE SYSTEMS**

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**PART 2**

**SERIES 9000 - SPECIFICATION**

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## 9001 SCOPE

### General

1 Closed Circuit Television (CCTV) survey of highway drainage systems is the remote inspection of these systems by the insertion of a camera connected to a monitor and recording apparatus.

2 This Specification shall be read as an addition to the Manual of Contract Documents for Highway Works Volume 1 – Specification for Highway Works (SHW) (MCHW 1). Where the requirements of Series 9000 differ from those in the MCHW 1, Series 9000 shall take precedence.

## 9002 INFORMATION

### General

1 The approved code of practice on safe work in confined spaces as issued by the Health and Safety Executive recommends that man entry to sewer/drain pipelines is restricted to those in excess of 1200mm. All sewer/drain pipelines and associated manholes and access chambers are classified as confined spaces.

2 Access shall generally be avoided if other appropriate means can be employed. With pan and tilt camera, correct lighting and calibration, pipes up to 1800mm diameter can be inspected using CCTV without access.

## 9003 DEFINITIONS

1 Definitions relating to CCTV survey of highway drainage systems are formally defined below.

### **Axis of Drain**

A longitudinal line projected centrally along the inside of the drain.

### **Blockage**

An obstruction within the drainage system being surveyed that prevents forward movement of the camera and causes the survey to be abandoned.

### **CCTV**

Closed Circuit Television used to carry out internal inspections and surveys of the drainage systems, and comprises a camera linked directly to a monitor and/or video recorder together with a means of moving the camera along the drain.

### **Catchpit**

Access point that has a chamber base below the level of the outgoing pipe specifically to retain sediment and debris washed into the drainage system.

### **Confined space**

Any place, including a chamber, trench, pipe or similar space where, by reason of its nature, there is a reasonable risk of explosion or asphyxiation.

### **Overseeing Organisation's Representative**

The local authority, consultant or other body administering the contract on behalf of the Overseeing Organisation.

### **Exfiltration**

Escape of flow from the drain into the surrounding ground.

### **Forced ventilation**

The procedure of venting the drainage system by removing a number of chamber covers and using ducting, air jets and fans to force air into the system to purge potentially dangerous gases that may have accumulated within the system.

### **Infiltration**

Inflow of groundwater to the drain.

### **Node**

Manhole, catchpit, inspection chamber, outfall, gully, rodding eye or any other point from which the survey commences or terminates.

### **Pan and tilt camera**

A self-propelled camera with a directionally adjustable lens.

### **Pre-cleansing**

The removal of silt and debris prior to the commencement of the survey.

### **Remote survey**

The survey of drainage systems by means that preclude man-entry into the drain.

### **Rodding camera**

A CCTV camera that is moved along the drain using flexible rods. Such cameras are generally used to access small diameter pipes, 150mm or smaller, particularly those with bends.

### **Set-up**

The process of setting up the equipment at an access point for the purposes of the survey.

**Site**

The location or locations of the survey or surveys that constitute the Contract and as detailed in Appendix 1/7.

**Surveyor**

An appropriately qualified person who will undertake the survey and for whom evidence of qualification, WTI Training Group's WTI OS20X, has been provided.

**Survey Contractor**

The Contractor to whom the Contract for the survey has been awarded and is the employer of the Surveyor.

**Survey Shift**

The period of continuous surveying by an individual Surveyor during one working day.

## 9004 GENERAL REQUIREMENTS

### General

- 1 The survey shall be carried out as indicated on the plans and detailed in Appendix 90/1.
- 2 The location of the survey shall be as detailed in the Appendix 90/1.
- 3 The Survey Contractor shall provide sufficient vehicles and equipment, including stand-by units, to complete the survey within the contract period stated in the Contract.
- 4 Pre-cleansing of the drains shall be carried out where specified in Appendix 90/1.
- 5 The survey team shall be equipped with a suitable working means of being able to immediately contact or be contacted by the Overseeing Organisation's Representative for the duration of the survey.

### Traffic Management

- 6 Unless otherwise specified in Appendix 90/1, the Overseeing Organisation shall provide the traffic management for the duration of the survey.

### Hazards

- 7 The Survey Contractor shall immediately inform the Overseeing Organisation's Representative of any damage to the drainage system that is a potential hazard.
- 8 Should an access chamber cover or gully grating be damaged during the survey, the Survey Contractor shall provide temporary protection to the chamber and notify the Overseeing Organisation's Representative immediately. The Survey Contractor shall remain on site until the Overseeing Organisation's Representative is in attendance and the traffic management shall not be removed. The position shall be recorded in accordance with the Routine Maintenance Management System (RMMS) referencing system, Part 2, chapters 2.5, 2.6 and 2.7.

### Flows and blockages

- 9 The Survey Contractor shall be responsible for dealing with the flow by means of temporary stoppers for limited periods, insofar as this can be achieved without causing flooding or pollution of receiving waters.
- 10 Where there is a temporary increase in the flow rate in the drain, the Survey Contractor shall either move to another survey location, or suspend operations until the flow has abated. The Survey Contractor shall allow for costs associated with temporary flow increases resulting from natural causes.
- 11 Where a blockage is discovered in the drain, the contractor shall immediately inform the Overseeing Organisation's Representative who shall make arrangements for the blockage to be cleared. The Survey Contractor shall proceed to the next length to be surveyed. The Overseeing Organisation's Representative shall advise the Survey Contractor when the blockage has been cleared.

### Site Accessibility

- 12 Should any restrictions be imposed on access to the whole site, or sections of the site, or should the site only be available at certain periods of the day, these hours or periods shall be specified in Appendix 90/1 and in the Schedule of Constraints in Appendix 1/13.

## 9005 SURVEY REPORTING

### General

1 The content of the survey report shall be as specified in Appendix 90/1. The Survey Contractor shall supply the required number of copies and types of report for each item specified in Appendix 90/1.

2 Where the Contract requires that items of the Survey Report shall be supplied to the Overseeing Organisation during the course of the survey, these items will be listed in Appendix 90/1.

3 A separate report shall be provided for each drain length, in accordance with sub-Clause 9008.7.

4 On completion of the survey and as stated in Appendix 90/1, the Survey Contractor shall supply, to the Overseeing Organisation's Representative, one clean set of plans showing that the chamber numbers coincide with the reports and video tapes for the inspection. The plans shall be annotated to show any serious errors noted during the survey.

### Video recording

5 The type of format for the video recording shall be as specified in Appendix 90/1.

6 Video recordings on Compact Disc shall be in MPEG format in accordance with BS EN ISO/IEC 11172-4:1997.

7 All video cassette tapes shall be supplied new by the Survey Contractor and shall be in high quality VHS format in accordance with BS EN 60774-1:1994.

### Coding of survey

8 The information from the survey shall be coded in accordance with sub-Clause 9008.8 subject to any changes specified in the Appendix 90/1. Where the section of drain between consecutive access points is surveyed from each end, due to obstruction, then two separate coding sheets shall be used. The coded data shall be computer validated.

9 Site coding sheets shall be completed as specified in sub Clauses 9005.1 and 9008.7 by the Surveyor at the time of the survey. Direct entry of survey data into

an on-site computer recording system in accordance with the Highway Drain Condition Classification in Part 5, (MCHW 5.9.5) is acceptable.

10 At the commencement of the survey of every length of drain between consecutive access points, the Surveyor shall complete a new header sheet. Sub-Clause 9008.5 gives details of the information that is to be recorded on the header sheet.

11 The written report shall be machine printed in accordance with the format set out in Clause 9008 of this Specification.

12 A copy of the coded data shall be supplied in a digital format, on CD, that can be readily interrogated by commercial software available from more than one supplier.

### CCTV Photographs

13 The Survey Contractor shall provide colour photographs using either colour film or digital imagery specified in Appendix 90/1. The photograph size shall be 89mm x 125mm unless otherwise specified in Appendix 90/1. The minimum effective resolution for digital photographs shall be one million pixels. Digital images shall be stored in the JPEG format in accordance with BS ISO/IEC 10918-4:1999. Where colour film is specified, the number of copies required shall be stated in Appendix 90/1.

14 Photographs shall be taken of the internal condition at intervals specified in Appendix 90/1. Where defects exist at adjacent points, photographs shall not be taken at intervals less than 2 metres unless necessary to show the second defect.

15 Where photographs are not otherwise required, a general condition photograph shall be taken at intervals not less than 10 metres. Where a photograph is taken, the appropriate code shall be entered on to the report sheet.

16 Photographs shall show the correctly adjusted monitor display, clearly and accurately.

17 The location of the photograph shall be clearly identifiable by chamber start and finish number or pipe reference, survey direction, chainage, unique

photograph number and date. The annotation shall be clearly visible in figures less than 5mm and positioned remote from the photograph subject.

18 The format for presentation of the photographs shall be specified in Appendix 90/1. The photographs shall be in chronological order and be cross-referenced to the report.

19 Unless specified in Appendix 90/1, all negatives shall be supplied in a suitable, labelled folder and referenced to the photograph files and the report.



# 9006 QUALITY

## General

1 The Survey Contractor shall ensure that the personnel undertaking the survey hold an appropriate qualification in the interpretations of CCTV images of drains and in defect coding and classification, WTI Training Group's WTI OS20X Pipe Sewer Condition Classification, and shall verify that any certificates supplied are genuinely held by the operator. The Survey Contractor shall supply details and copies of certificates when requested.

## Quality control procedures

2 The Survey Contractor shall maintain a quality control system to control the accuracy of reporting. Details of the system shall be approved by the Overseeing Organisation's Representative prior to the commencement of the Survey.

3 The quality control system shall monitor a 5% sample of each Surveyor's work. The sample shall be selected randomly from the sequence of work carried out by each Surveyor.

4 The selected surveys shall be independently reviewed, by the Survey Contractor, comparing the video recording with the coded data. The percentage accuracy of recording key elements of the header information and the coded pipe survey information shall be recorded for each survey of an individual drain length.

5 Where the accuracy of either the header information calculated for any survey in accordance with sub-Clause 9006.4 falls below 95% or the coded survey information calculated for any survey in accordance with sub-Clause 9006.4 falls below 75%, an additional check shall be carried out in accordance with sub-Clause 9006.4. The additional check shall comprise the five surveys of drain lengths carried out by that Surveyor immediately preceding the failed survey and the five surveys carried out by that surveyor immediately following the failed survey. If any of these fail then the process shall be repeated until an acceptable standard is reached.

6 The average percentage accuracy of each five consecutive checks on the coded survey information shall be plotted on a graph and reviewed periodically.

7 Any reports failing the coding accuracy shall be recoded by another qualified surveyor and re-submitted to the Overseeing Organisation's Representative as a replacement for the failed survey.

8 Any Surveyor whose quality control results fall below 75% on more than 2 occasions in a specified period shall be deemed to have failed their quality control criteria and shall be invalidated from acting as a Surveyor on any contract until they have attended and passed the relevant training. Guidance is given in sub-Clause NG9006.1.

## CCTV Picture quality-camera, video tape and monitor

9 The electronic equipment, camera and monitor shall be of such quality to enable the following to be achieved using the approved test devices:

- (i) The grey scale shall allow equal changes in brightness ranging from black to white with a minimum of five clearly recognisable stages.
- (ii) With the monitor control adjusted for correct saturation, the six colours plus black and white shall be clearly resolved with the primary and complementary colours in order of decreasing colours in order of decreasing luminance. The grey scale shall appear in contrasting shades of grey with no tint.
- (iii) The background grid shall show squares of equal size without convergence or divergence over the whole picture. The centre circle shall appear round and have the correct height to width relationship ( $\pm 5\%$ ).
- (iv) The live picture must be clearly visible with no interference and capable of registering a minimum number of television lines/picture height lines. The resolution shall be checked with the monitor colour turned down. In case of tube cameras this shall be 400 lines and for CCD type cameras 300 lines.

- (v) To ensure that the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. To ensure colour constancy, there shall generally be no variation in illumination during the survey.

10 A test device shall be provided on site at all times to enable practical demonstration of compliance with the requirements of sub-Clause 9006.9. Test devices for the camera shall utilise the Marconi Resolution Chart No 1. The details of any equivalent chart shall be submitted to the Overseeing Organisation for approval before work commences. Test devices for the video tape recorder and monitor shall be submitted in accordance with sub-Clause 9006.9.

11 Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of a test tape or similar approved device. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device for a minimum period of 30 seconds and by completion of a picture quality audit sheet at the commencement of each day. The demonstration recordings shall be submitted to the Overseeing Organisation's Representative for approval each day.

## 9007 HEALTH AND SAFETY ISSUES

### General

- 1 Any chamber or pipeline forming part of a highway drainage system shall be classified as a Confined Space in respect of personnel entry.
- 2 All works shall be carried out in compliance with the Health and Safety Executive publication: 'Safe work in confined spaces – Confined spaces regulation', commonly referred to as the "Green Book" or any further legislation current at the time.
- 3 The Survey Contractor shall provide, and maintain on site, suitable and sufficient safety equipment and the necessary trained personnel in order to undertake the survey and maintain the safety and protection of employees, the general public and the systems and property of the Overseeing Organisation.

### Zone classification

- 4 The use of electrical equipment in potentially explosive atmospheres is governed by the Dangerous Substances and Explosive Atmospheres Regulations 2002 (SI 2002/2776).
- 5 Unless otherwise specified by the Overseeing Organisation's Representative all highway drainage systems are to be Classified as Zone 2 in accordance with Schedule 2 of the Dangerous Substances and Explosive Atmospheres Regulations 2002 (SI 2002/2776). The Survey Contractor shall confirm the Zone Classification with the Overseeing Organisation's Representative.
- 6 The use of gas detectors shall be mandatory and where possible the drainage system shall be vented by raising covers at both ends of the length to be surveyed. The Survey Contractor shall complete a risk assessment for each survey.

### Known Hazards

- 7 Any known hazards associated with the sections of drain to be surveyed shall be stated in the pre-tender Health and Safety file and be incorporated into the Survey Contractor's Health and Safety Plan. This information shall be used in the Risk Assessment before each survey is commenced.

## 9008 CODING OF SURVEY INFORMATION

### General

1 The coding system for highway drains shall comply with EN 13508-2:2001 Condition of Drain and Sewer Systems Outside Buildings, Part 2 Visual Inspection Coding Systems. The system comprises codes which shall be used to describe the features and defects observed in the drainage systems. The information shall be presented in the form of the UK national equivalent codes specified in National Annex NB of EN 13508-2:2001 and reproduced in Part 5, Highway Drainage Condition Classification (MCHW 5.9.5).

2 All codes applicable to highway drainage are listed and defined in Part 5 (MCHW 5.9.5).

3 Should there be no appropriate code for a particular defect then the remark code (REM) shall be used and a brief description inserted into the associated remarks column.

### Header information

4 A header sheet shall be completed for the survey of each section of drain between defined node points. Where a new node is located during the Survey, the Survey Contractor shall request that the Overseeing Organisation's Representative allocate a new number. The new number shall be used in the Survey report.

5 The following information, defined in Clause NG9008, shall be completed on every header sheet:

- i) Pipe reference and Start and Finish node references
- ii) Description of the location (e.g. name of street or marker post location on trunk road)
- iii) Coding system used
- iv) Length of drain
- v) Method of inspection
- vi) Pre-cleansing
- vii) Location type

- viii) Shape
- ix) Dimensions
- x) Material
- xi) Year of construction (where known)
- xii) Name of the surveyor
- xiii) Highways Agency Region/Overseeing Organisation Region
- xiv) Name of town/village
- xv) Route number
- xvi) Pre-cleaning
- xvii) Date surveyed

### Survey report

6 A separate survey report shall be completed for the survey of each section of drain between defined node points. An example of the report format from EN 13508-2:2001 is shown in Table NG 90/3 in Clause NG 9008.

7 Where different observation types occur at the same position, each defect or feature shall be coded separately.

8 The defects, features and the general condition shall be coded in accordance with EN 13508-2:2001 and shall be recorded on video tape or CD (see sub-Clause 9005.5) and shall be supported by photographs (see sub-Clause 9005.13) where specified in Appendix 90/1.

## 9009 DRAIN CONDITION INSPECTION

### Survey

1 Unless separately specified in Appendix 90/1, the Survey Contractor shall be responsible for removing and replacing all manhole or access chamber covers and the clearance of all equipment from the site on completion of the survey.

2 The Survey Contractor shall make all reasonable effort to gain access to the drain. If, after a period of 15 minutes, access has not been attained, the Survey Contractor shall move to the next survey location. The Survey Contractor shall immediately report the difficulty to the Overseeing Organisation's Representative.

### Equipment

3 The CCTV equipment shall be capable of surveying a length of drain up to 350 metres where the drain can be accessed from either end, up to 200 metres where a self-propelled camera is used and access is gained from only one end, or 30 metres where a rodding camera is used.

4 The Survey Contractor shall ensure that the equipment is in full working order and shall carry out quality checks in accordance with sub-Clause 9006.11 prior to the commencement of each shift's survey.

5 The camera shall pass through the drain being surveyed in a stable manner.

6 The Survey Contractor shall ensure that all bonds, guide ropes and cables are supported away from the drain or manhole structures and all CCTV cables and/or lines used to record the camera's location within the drain are taut and maintained at right angles, where possible, to run through or over the measuring equipment.

7 Each survey vehicle shall carry a range of equipment to control the flow within the drain during the survey. At least one item of each diameter from 100 mm to 500 mm shall be carried.

### Survey abandonment

8 Abandonment of the survey of any drain length shall be considered for the following reasons:

- i) where the Survey Contractor is unable to maintain acceptable picture quality for reasons of drain condition. The Survey Contractor shall inform the Overseeing Organisation's Representative as soon as possible on completion of the set-up and continue with the survey of the next drain length, pending the decision of the Overseeing Organisation's Representative on the merits of continuing;
- ii) where a situation occurs such that the Survey Contractor considers his equipment to be at risk. The Survey Contractor shall photograph the problem area, terminate the survey and, upon informing the Overseeing Organisation's Representative of the problem, proceed to the next survey length;
- iii) where further progress is impossible. The Survey Contractor shall photograph the situation causing the abandonment, abandon the survey of that drain length and inform the Overseeing Organisation's Representative. The Survey Contractor shall then proceed to survey the same drain length from the opposite direction or proceed to the next section of drain to be surveyed as appropriate;
- iv) where the contractor is unable to locate the access point, or is unable to gain access to the drain once the chamber has been located, or where the contractor considers that it would be unsafe to access the drain due to the condition of the access chamber. The Survey Contractor shall report the matter to the Overseeing Organisation's Representative immediately. The Survey Contractor shall then proceed to survey the drain from the opposite direction or proceed to the next section of drain to be surveyed;
- v) where the contractor is unable to survey from the chamber or continue the survey due to blockage, silt or high water level. The Survey Contractor shall comply with the requirements of sub-Clause 9004.10 with regard to high flows or

sub-Clause 9004.11 with regard to blockages. The Survey Contractor shall then proceed to survey the drain from the opposite direction, or proceed to the next section of drain to be surveyed.

### Buried chambers

9 Where buried chambers are encountered during the survey and the camera is pulled through the chamber, the camera shall be panned to view the internal condition of the chamber. Any defects observed shall be recorded on a separate sheet, in accordance with the EN 13508-2:2001 coding format and the defect record sheet submitted to the Overseeing Organisation's Representative.

### Equipment recovery

10 The Survey Contractor shall be responsible for all his costs relating to the recovery of or damage to camera systems and any other equipment in any drain forming part of the survey. The Survey Contractor shall also be liable for any associated costs incurred by the Overseeing Organisation in the recovery of such equipment **unless** the Survey Contractor can demonstrate that such loss was for reasons beyond the Survey Contractor's control.

### Camera position

11 The CCTV camera shall be positioned so as to minimise the risk of picture distortion. Where the drain is of a circular or regular cross-sectional profile, the camera lens shall be positioned centrally within the drain. A positioning tolerance of  $\pm 10\%$  of the vertical drain dimension shall be permitted.

### Camera speed

12 The speed of the camera within the drain shall be limited to the following maximum speeds:

0.10 m/s for drains of diameter less than 200mm

0.15 m/s for drains of diameters of 200mm or larger but less than 310mm

0.20 m/s for drains of diameter 310mm and larger

13 The camera shall be stopped whenever defects are being recorded on the coding sheet.

### Linear measurement

14 At the start of each drain length to be surveyed, the length of the drain from zero chainage up to the cable calibration point shall be recorded and reported in order to obtain a full record of the drain length.

15 The meter reading entered onto the data display at the cable calibration point shall allow for the distance from the start of the Survey to the cable calibration point such that the meterage at the start of the survey is zero.

16 At each manhole or other access point, a new header sheet is required. Refer to sub-Clause 9008.5 for details to be recorded in the header page.

17 Where the survey continues through a manhole or other access point, the meterage shall be re-set to zero with the camera focused on the outgoing pipe entrance.

18 The CCTV monitor shall display an automatically updated record, in metres and tenths of a metre, of the camera position from the calibration point.

19 The Survey Contractor shall use a suitable metering device that enables the accurate measurement of the cable length. The accuracy shall be to  $\pm 1\%$  or 0.3m whichever is the greater.

20 The Survey Contractor shall demonstrate compliance with the tolerances in sub-Clause 9009.11 on a daily basis by completion of a linear measurement audit sheet and using either a cable calibration device or the taped measurement of the surface between chambers. Where the Survey Contractor fails to comply with the tolerances in sub-Clause 9009.11, the Survey Contractor shall provide a new measurement device and shall resurvey the lengths of drain undertaken with the defective device.