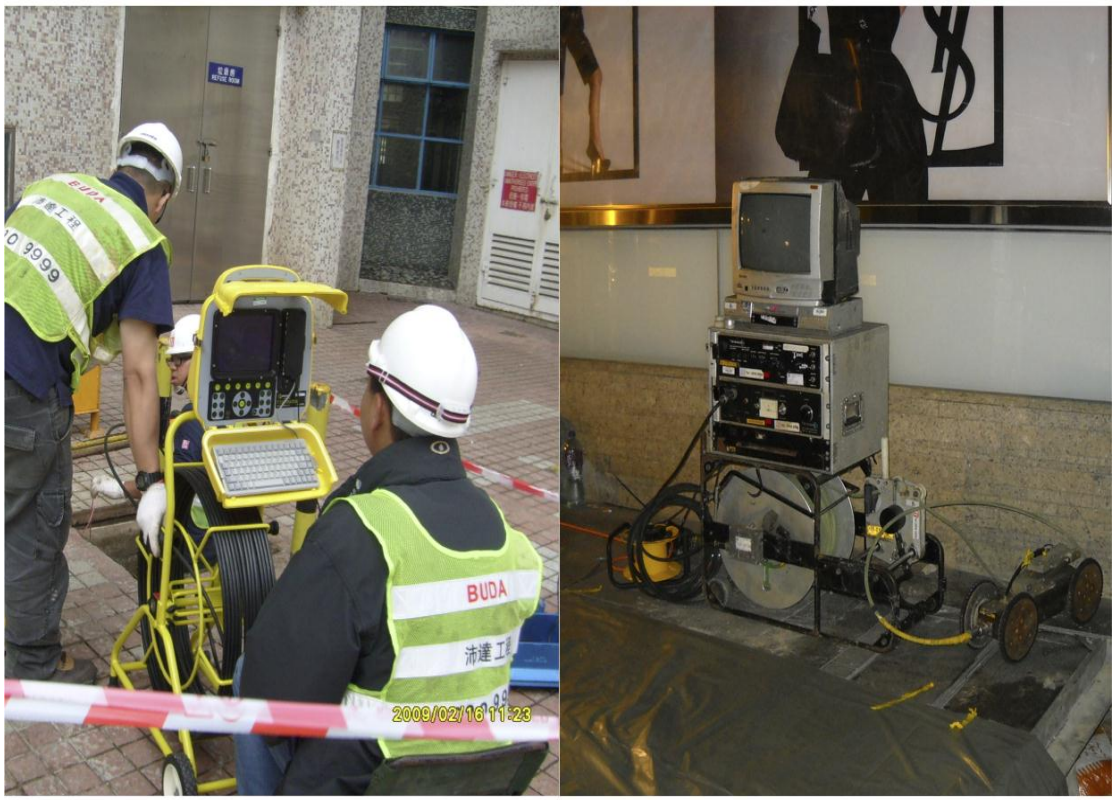
Guide to Conduit Condition Evaluation (Using CCTV in Hong Kong)



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FORWORD

After the disastrous landslip of 1994 occurred in Kwun Lung Lau on Hong Kong Island, the Government has paid more attention on utility maintenance with particular emphasis on leakage detection of buried water carrying services on both slopes and roads. The Government has increased resources and imposed additional legislation on the detection of underground utilities. As a direct result, the utility profession has been developing rapidly, and over the last decade, the number of "Utility Specialists" (管綫專業監理師) has grown as the Government's requirements for Competent Persons to carry out the investigations has been implemented. In addition, Recognized Professional Utility Specialist (RPUS) (管綫專業監察師) has been recognized in recent years. However, lack of standard surveying methods, centralized monitoring systems and organized management, have lead to unsatisfactory investigation results.

In order to address these issues, Hong Kong Institute of Utility Specialists (HKIUS) (香港管綫專業學會), targeting the promotion of knowledge and good practice in the utility profession, collaborated with Hong Kong Utility Research Centre (HKURC)(香港管線管理研究中心)and supported by the funding from the Professional Services Development Assistance Scheme (PSDAS) of HKSAR, published a series of guide books and pamphlets in 12 disciplines of the utility profession in order to set standards for the practitioners to follow. As part of HKIUS continual effort to enhance the professionalism of the utility profession, it is the intention of the series that the quality of the survey can be raised and that utility related incidents can be avoided by performing high quality utility practices. Hopefully, the resulting benefits can extend to the general public.

This first issue provides good practice of using CCTV Survey in conduit condition evaluation(管道狀況評價). It states the whole process and specification of conducting CCTV Survey from planning to finishing stages and intended to be used by all personnel involved in the works.

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April, 2011

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1. INTRODUCTION

The underground utility system of Hong Kong is extremely complicated and it is very difficult to investigate the condition of each pipe or line. However, as the underground drainage and sewage system of Hong Kong were built in early years, many of them have depreciated in different extent with wide variety of defects and potential risk of incidents. To prevent further deterioration of conduits, assessment of conduit condition shall be conducted so that appropriate remedial measures can be taken to alleviate the problem in time. Conduit condition evaluation (CCE) (管道狀況評估) is the assessment of conduit condition. It can be carried out by various methods including sonar survey, optical line beam survey, man entry survey, current measurement survey and closed circuit television survey.

As a starting point, Closed Circuit Television Survey (CCTV Survey) (閉路電視檢測) is an easy way to assess the condition of conduits. In the 1960s, the application of CCTV to investigate the underground drains began in the United Kingdom. The technology was later introduced to Hong Kong in early 1980s. Nowadays, it is the most widely used conduit condition evaluation method in Hong Kong. Due to the increasing number of utility specialists using the CCTV Survey, Hong Kong Institute of Utility Specialists (HKIUS) (香港管綫專業學會), aiming at promoting knowledge and good practice in the utility profession, prepared guidelines to provide a standardized method and process of conducting CCTV Survey in order to promote a good practice for the practitioners. Note that such standards are for reference only, any other standards or requirements are acceptable as long as stated in the contract or there is mutual agreement between the Contractor and the Engineer/ Client.

2. OBJECTIVE AND SCOPE

The CCTV Survey is a non-destructive assessment of the internal condition of sewers, drains as well as water pipes. The purpose of this guide is to provide recommendations on good practice of the methods and specification of CCTV Survey to enhance the quality of the survey. Since the result of the survey is a crucial indicator to the remedial actions, quality and accuracy are great concerns. Failures in meeting the specified level of accuracy are always due to non-compliance with standard requirements of surveying process and equipment. This document aimed at providing guidelines for the practitioners to follow in order to avoid an unsatisfactory quality of the survey. This makes the inspection itself more time and cost effective, and reduces chance for sewage related incidents on the other hand and in turn saves social resources and more importantly, avoids casualties.

An up-to-standard survey including process, equipment and personnel constitutes a high quality inspection. This guide provides information on the whole process and specification of conducting CCTV Survey from planning to finishing stages. Nevertheless, it shall be noted that the coding system of CCE using CCTV is not included in this document. The 4th edition of Hong Kong Conduit Condition Evaluation Codes (UTI, 2009) is available for an inclusive reference of code of practice of CCTV survey in Hong Kong. And the "Specification of Conduit Condition Evaluation (CCTV Survey)" (HKIUS, 2009) provides requirements on the components of the Survey in details. Also, users of this guide shall refer to relevant documents for further information on safety that are not covered in details. It must be stressed that the guidelines given in this guide are in no way exhaustive, and professional judgment must be employed in all cases.

This guide is intended to be used by all personnel who are involved in the planning, commencement and supervision of CCTV Survey, including contractors, utility companies, consultants, government departments and other parties concerned.

3. PRE-SURVEY PREPARATION

Before commencing the Closed Circuit Television Survey (CCTV Survey), preparation works including a comprehensive plan, qualified equipment and personnel, shall be well prepared to ensure a smooth and safe inspection process.

3.1 CCTV Survey Equipment

The surveying equipment shall be capable of surveying a length of drain up to 350m where entry to the drain may be obtained at both ends and up to 30m by rodding, or up to 150m where a self-propelled units is used where entry is at one end only. The Utility Specialist (管綫專業監理師) shall maintain this plant in full working order for each working shift. If the sites are difficult to be accessed, such as steps pipes and steep slopes, a complete range of CCTV inspection equipment must be available to enable a safe working condition.

In general, equipment of CCTV Survey includes a control unit to control the movement of tractor and camera, an image capture device (camera) to capture images of the conduit, a display device (monitor) to display images, a record device (video recorder) for recording, a text input device (keyboard) to input information, a tractor to transport camera and a winch and a bond to tow the camera. DO NOT use a cable to tow the camera as the cable is used to transfer images and data to the monitor.

Different types of CCTV Survey equipment shall be used depending on the environment to ensure a smooth inspection. Different tractors shall be used in drains of different sizes. For example, a big tractor and a 4 wheel tractor shall be used in drains with diameter of 450-2100mm and 150-1050mm respectively. An all in one tractor shall be put in use if the diameter of the drain is less than or equal to 150mm.

The Utility Specialist shall use colour cameras with a pan and rotate head with forward view and side viewing capability to enable a clear capture of internal conditions of junctions and connections of the drains. For winch and bond, the winch shall be stable with either lockable or ratcheted drums and inherently stable under loaded conditions; the bond shall be made up of steel or an equally non-elastic material to provide a steady progress of the camera. Sufficient numbers of guides and rollers shall be carried to make sure all bonds are supported away from the drain and manhole structures. All CCTV cables shall be maintained in a taut manner and set at right angles, wherever possible, to run through or over the measuring equipment.

A minimum of one item of flow control equipment of each size, as opposed to over

pumping equipment, shall be carried for controlling the flow during survey.

3.2 Planning for the Inspection

Before commencing a CCTV inspection, the client (usually the asset owner) shall consider the desirability of providing the operator with all information available regarding the asset. More information will enable the operator to present a better interpretation of the observations. Extra details such as map/ plan of the asset, size, material and class of the pipes, depth of manholes, etc, can then be permanently included in the operator's report, enabling a better comprehension and judgement by all those who might review the information.

On top, the client shall ensure the operator is aware of the operational requirements for the asset such as:

1. Critical flow patterns that could affect the quality or safety of an inspection;
2. Pumped discharges affecting the area to be inspected;
3. Asset isolation / flow control procedures;
4. Emergency procedures and a contact list in case of emergency;
5. All relevant Occupational Health and Safety information.

3.3 Drain Cleaning

The client may require the operator to clean the sewer/ drain prior to inspection after the initial survey. Yet, it is not a must unless instructed by the client.

The objective of drain cleaning is to expose the fabric of the drains by removing silt, grease and debris deposits so that more feature of interest can be properly observed during inspection and an accurate assessment can be obtained as a result. If instructed or the Utility Specialist considers as appropriate, drains shall be cleaned by high pressure water jetting (HPWJ) or other methods agreed by the client.

Although thorough drain cleaning normally yields the most detailed inspection results for structural assessment, this does not mean that pre-cleaning shall be performed as a pre-requisite for inspection. On the other hand, the sources of undesirable discharges can be traced by investigating the sediments or grease built-up in an un-cleaned drain.

For specification of drain cleaning, please refer to the “Specification for Conduit Condition Evaluation (CCTV Survey)” proposed by the Hong Kong Institute of Utility Specialists (HKIUS), available at http://www.hkius.org.hk.

Further information on drain cleaning and the method HPWJ can be found in Code of Practice for Sewer Jetting (WRc, 1997 or as amended or updated) and The Code of Practice for the use of High Pressure Water Jetting Equipment (AHPWJUS, 1986 or as amended or updated) respectively.

3.4 Statutory Requirements

Both employers and employees shall comply with relevant occupational health and safety legislations and obligations to ensure a safe working environment and minimize disturbance to the public caused by the work.

The Workplace Health and Safety Regulations of Hong Kong specify several requirements for personnel involved in works, some of the requirements are stated in relevant ordinances or regulations such as working in a confined space, road traffic control, excavation safety, dangerous substance, noise at work, etc. It is important to follow relevant ordinances stated on the Occupational Safety and Health Council (http://www.oshc.org.hk) before commencement of work.

Also, operators shall use Personal Protective Equipment (PPE) and shall have sufficient knowledge in both usage and maintenance of the equipment. PPE shall include:

1. Steel toe cap, rubber safety boots
2. Safety helmet
3. Safety vest (reflective at night)
4. Safety goggles/Anti-glare glasses
5. Breathing apparatus/Disposable respirator
6. Harness and Fall arrester
7. Gloves
8. Ear muffs / ear plugs
9. Handy gas detector
10. Audio-visual alarm
11. Resuscitator

In works for the Water Supplies, the Drainage Services or other government departments, appropriate steps shall be taken to minimize or even eliminate any potential risks of injuring the public. In case where excavations are required, the access around the work area has to be properly supervised by a Competent Person (CP) (合資格人士), under Cap. 406H, the Electricity Supply Lines (Protection) Regulation, at all times. The access for "essential services", e.g., police, fire services and

ambulance, has to be retained. Access to other public services, such as bus stops, footpaths, etc, shall also be maintained and supervised.

If excavations are required, no dirt, excess spoil or other material shall be left in the water channel to avoid polluting the drainage system. Sediment control procedures can refer to the Environmental Protection Department (http://www.epd.gov.hk).

3.5 Personnel Requirements

In order to maintain the Utility Profession's requirements for the consistency, reliability and accuracy of reports, CCTV inspection shall be performed by properly trained and accredited personnel. Accredited personnel shall hold a certified qualification issued by a Registered Training Organisation (RTO), such as Utility Training Institute or The Hong Kong Polytechnic University or equivalent.

In addition, a minimum of 3 years post training experience will be necessary for a person to become competent. Besides, qualified personnel are required to attend refreshment course in every 3 years to refresh and enhance their knowledge.

All works carried out within sewers, manholes or other confined spaces shall be performed in accordance with the requirements for works in the vicinity of Confined Space and Occupational Health & Safety Legislations, as well as any additional precautions that may be specified by the asset owner.

Table of personnel requirement

Training and Experience Requirements for Personnel Carrying Out Inspection (HKIUS standard, 2011)				
Title	Role	Minimum Training Requirement	Minimum Years of Practical Experience	Qualification
Project Leader	Responsible for contract administration and preparation, checking and certifying of reports for compliance with the technical specification.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Deputy Project Leader	Responsible for assisting project leader and acting the post of project leader when project leader temporary not with the team	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	10 years in contract administration, preferably in works related to the inspection, survey and in data management.	Either: M/FHKIUS, RPUS plus CP, CW or MHKIE/ R.P.E. plus CP, CW and relevant training in RTO (e.g. PolyU, UTI) for surveys and data management
Team Leader	Responsible for works arrangement and data processing including checking of raw data for quality and consistency.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	5 years in works related to the inspection, survey and in data management.	M/FHKIUS, RPUS, CP, CW
Crew Leader	Responsible for supervising the field works and site safety.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	3 years in works related to the inspection, survey and in data collection	O/MHKIUS, CP, CW
Operators	Responsible for operating equipment and carrying out inspection and survey.	➢ At least 35 hours of CPD every year ➢ At least 14 hours for refreshment training in every three years ➢ Relevant training in RTO (e.g. PolyU, UTI) for surveys and data collection ➢ Has attended training courses for relevant survey/detection methods, and Possesses a valid training certificate for relevant survey/detection methods used	2 years in works related to the inspection, survey and in data collection.	AMHKIUS, CP, CW

3.6 Prevention of damage to pipes and other utilities

The operators shall aware that there is an extensive network of utility underneath the pavements. Breaks of pipes are usually caused by direct or indirect road opening works. It is essential that the operators shall be careful to avoid causing damage to the pipes in the execution of their works.

Accident like the manhole cover falling back into the manhole when uplifting it may destroy other pipes and utilities passing through the manhole. Dropping of heavy materials may also cause damage to utilities. Therefore, the supervisor of the site shall perform close supervision to the workers. The supervisor shall remind the workers occasionally to be careful and the importance of preventing damage to the water pipe and other underground utilities and the consequences of damage.

Circulate the layout plans with relevant details to Water Supplies Department (WSD) to request for indication of the alignment of existing water mains so that the operator can have more comprehensive information about the pipes nearby and hence lower the risk of destroying other pipes. If excavation work is needed, operators shall use hand-digging method instead of using heavy mechanical plants near the water pipes.

As there may be explosive gases inside the chamber or pipe, explosion proof CCTV Survey equipment shall be used to prevent the drain from being damaged by unexpected explosions. Use of fire and smoking near the manhole must be strictly forbidden to avoid any fire-induced explosions and accidents.

4. CCTV INSPECTION

During inspection, the CCTV Survey equipment shall be set up and checked properly according to a specified standard to capture images in higher quality and hence raise the accuracy of the result.

4.1 Standards

Camera Settings

The principle method of inspection of sewers/ drains is performed by Colour Closed Circuit Television (CCCTV). If the sewer/ drain is very large (diameter≥ 1500 mm) and it is difficult to carry out a CCTV Survey, man-entry will be occasionally used for inspection.

The information obtained in a CCTV inspection very much depends on the quality of image captured, thus the machine has to be checked to ensure there is no distortion to the image, procedures of testing the monitor and camera are stated in section 4.2. It would be better for the camera to have panning function (side to side) by at least 90° to either side of centre and the camera shall be capable of tilting 90° up and down.

The camera shall be positioned in the correct position to avoid image distortion. In circular or regular shaped sewers/drains, the camera lens shall be positioned at the centre. In oval/oviform sewers the camera lens shall be positioned at a distance two thirds of the height or the vertical dimension of the sewer/drain and vertically above the invert. A positioning tolerance of ±10% of vertical pipeline dimension shall be allowed. In all instances the camera lens shall be positioned looking along the axis of the pipeline. In case the pipeline is very large, camera will be elevated on the tractor.

The travelling speed of the camera in the drain shall not exceed:

(1) 0.1 m/s for sewers/drains of less than 200 mm in internal diameter (ID);

(2) 0.15 m/s for sewers/drains greater or equals to 200 mm ID but less than or equal to 300 mm ID;

(3) 0.2 m/s for sewers/drains greater than 300 mm ID; or

Other agreed traveling speed as will enable all details to be extracted from the video tape recording

Whenever defects are noted, the camera shall stop for a while to ensure the record is accurate and clear.

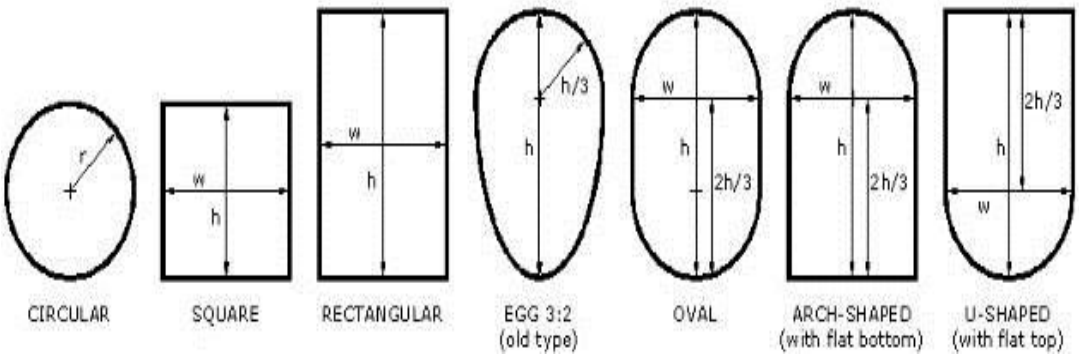


Fig. 4.1 Recommended camera position for special shaped sewer/drain

Linear Measurement

The CCTV monitor shall comprise an automatically updated record in metres and tenths of a metre of the meterage of the camera position from the cable calibration point, which is also called "adjusted zero". Normally, the zero position is set in the manhole, so that the pipe end connecting the manhole is captured to identify the exact physical location of the zero position. The accuracy of the measurement shall be within 1% of total length or 0.3 m, whichever is greater.

Besides using a cable calibration device, tape measurement of the surface between manholes is an alternative method. The Utility Specialist using either or both methods shall complete and submit the audit to the client each day. If the operator fails to meet the required standard of accuracy, the client may instruct the operator to provide a new device to measure the chainage.

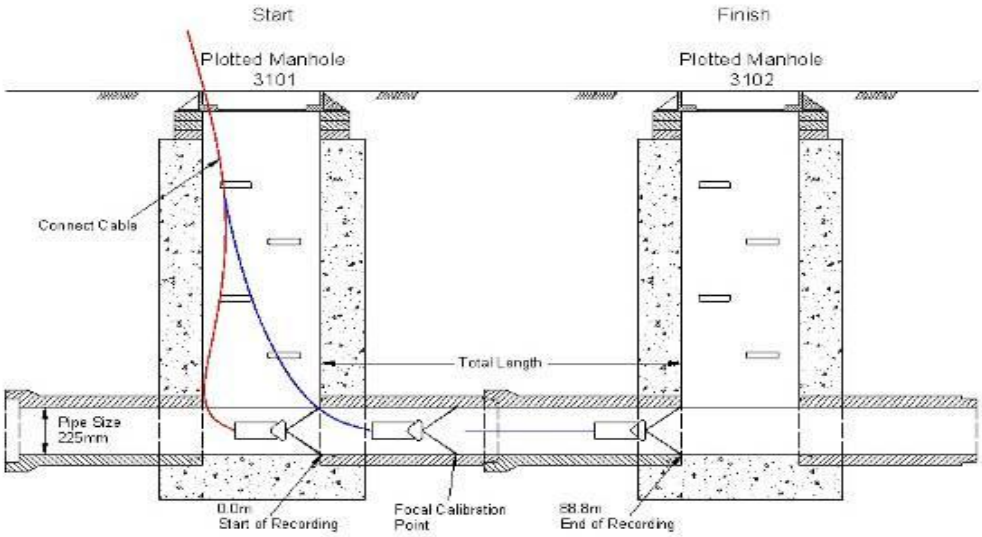


Fig. 4.2 Chainage recorded during inspection (From Manhole View)

Data Display and Video Recording

At the beginning of the survey, the supervisor shall ensure the meterage is zero and the meterage counter starts to register immediately after the camera moves. In case a new header sheet is required, the meterage shall be set at zero with the CCTV camera focused on outgoing drain entrance.

Before recording, the following information shall display for a time period not less than 15 seconds:

(1) Date of survey;
(2) Starting time of survey;
(3) Location of survey;
(4) Direction of travel of tractor;
(5) Pipeline classification (sewer/drain/conduit)
(6) Name of company (utility specialist firm) & qualified operator (utility specialist) performing the inspection;
(7) Project and client reference; and
(8) Node (From Manhole to Manhole) reference number.

The following information shall be displayed continually when recording so that they will be available in the playback:

(1) The camera's chainage along the pipe;
(2) The size and material of the pipe;
(3) Node reference numbers; and
(4) Name/code of operator and the corresponding company.

It shall be noted that the position and size of the displayed data shall not interfere the object of interest in the image.

The Utility Specialist shall supply all video tapes for recording. They shall be high quality grade (HG) and new in a Video Home System format or a format (such as DVD/VCD) as agreed with client. They shall also have a running time of 3 hours.

4.2 Testing of Inspection Equipment

To ensure both the camera and the monitor of the control panel are in good condition, the following testing procedures shall be performed before inspection on each working day.

Monitor Test

The following procedures are recommended for testing the monitor:

(1) Select the under scan mode on the CCTV monitor so that the edge of the raster scan can be clearly seen at the top, bottom, left and right of the screen. If the monitor does not have under scan, then it will need to be modified by a qualified technician.

(2) Play a standard Monitor Test Tape on a good quality video recorder (4 or 6 heads) and display it on the monitor screen.

(3) Ensure that the full centre circle is visible and that the edges of the test chart coincide with the edge of the raster image on the monitor.

(4) While playing the Monitor Linearity Test section of the test tape mark the position of the centre cross and the centre of the four "bow ties" with a chinagraph pencil.

(5) Measure the distances between the centre and all the "bow ties" marks with a transparent plastic ruler and ensure they are all within 5% of each other. If the marks are still not within this range, the linearity of the monitor will need to be adjusted by a qualified technician. Repeat the test until the required tolerance is achieved.

For other display device, testing may follow the manufacturer's instruction.

Camera Test

The camera can be tested using the following steps:

(1) Place the camera in a proprietary Test Chart Box and view the Test Chart (Marconi Resolution Chart Number 1). The chart shall be evenly illuminated from the rear. Illumination should be provided by a source compatible with the camera lighting being used, e.g. Quartz Halogen (3200K), White L.E.D.(5600K).

(2) With the monitor in the underscan mode, position the camera so that the edges of the Test Chart coincide with the edge of the raster image, they must now be in equal position at the top, bottom, left and right of the screen. The camera is now centred on the Test Chart.

(3) Check that all five shades of grey can be clearly seen on the grey scale. Adjustments of the monitor brightness and contrast controls may be required.

(4) Check the resolution by viewing the line wedges and line blocks. Adjust the camera focus to give the best view. The resolution shall be between 320 and 450 lines.

(5) Check the colour bars, the blue, red, magenta, green, cyan and yellow sections can be clearly seen with no tinting or smearing on their edges. Adjustment of the monitor colour/ chroma level control may be required.

(6) Record a section at the start of each new VHS tape of the camera viewing the Marconi Resolution Chart Number 1, as set up above.

(7) Record details of the camera checks in a picture quality form/log book.

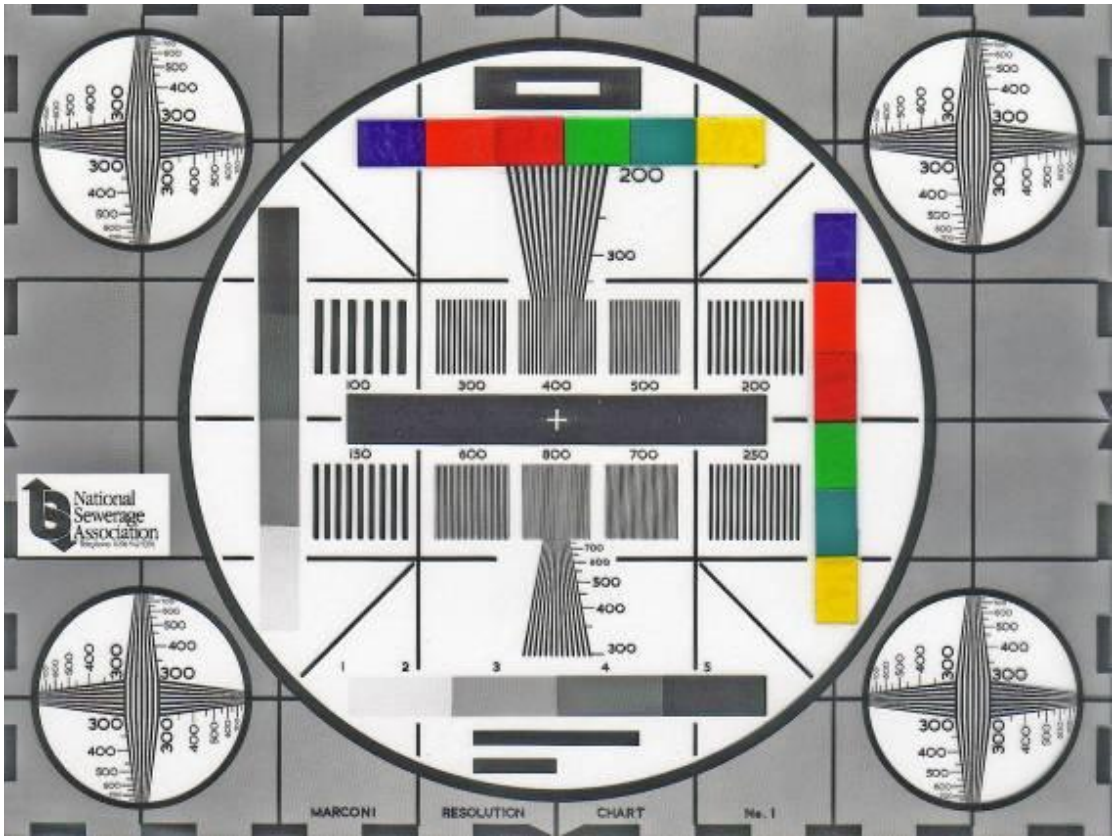


Fig. 4.3 Sample of Marconi Resolution Chart Number 1 (C-National Sewerage Association)

Camera Cable Calibration

The calibration of the distance measurement system, which is usually a measurement wheel on the cable, shall be checked on a daily basis. The recommended test procedure is described below:

(1) Ensure that the cable is fully wound onto the cable drum with the end of the cable passing through the measuring wheel.
(2) Set the counter to zero.
(3) Pull the cable off the drum until the counter indicates exactly 10 m.
(4) Measure the length of the cable that has been pulled off the drum with a standard tape, and record this length on the linear measurement audit form/log book.
(5) Repeat Steps (3) and (4) four times, pulling 10 m off the cable drum each time until a total of 50 m (minimum 30m) has been checked and recorded.
(6) Check that the error on the distance measurement is within the tolerance allowed in the specification (usually ±1% or 0.3 m, whichever is larger).
(7) File the completed forms/log book for further audits.

4.3 Measuring the Focal Distance of the Camera

The captured image is actually referring to a position of certain distance in front of the camera's lens. The distance is defined as the "focal length" of the lens. This length depends on the type of the camera used and the size of the sewer/drain. The distance shall be calculated before commencing the survey.

To calculate the distance, the following procedure is recommended:

(1) Hold a tape equivalent to the largest dimension of the cross-section of the pipe to be surveyed in front of the lens, for a circular pipe this will equal to the diameter, for other shapes this will equal to the largest dimension. The tape shall be held vertically unless horizontal dimension is the largest.
(2) View the tape through the camera. Adjust the position of the tape until the screen can just view the whole length of the tape.
(3) The distance of the tape from the rear of the camera is then measured.

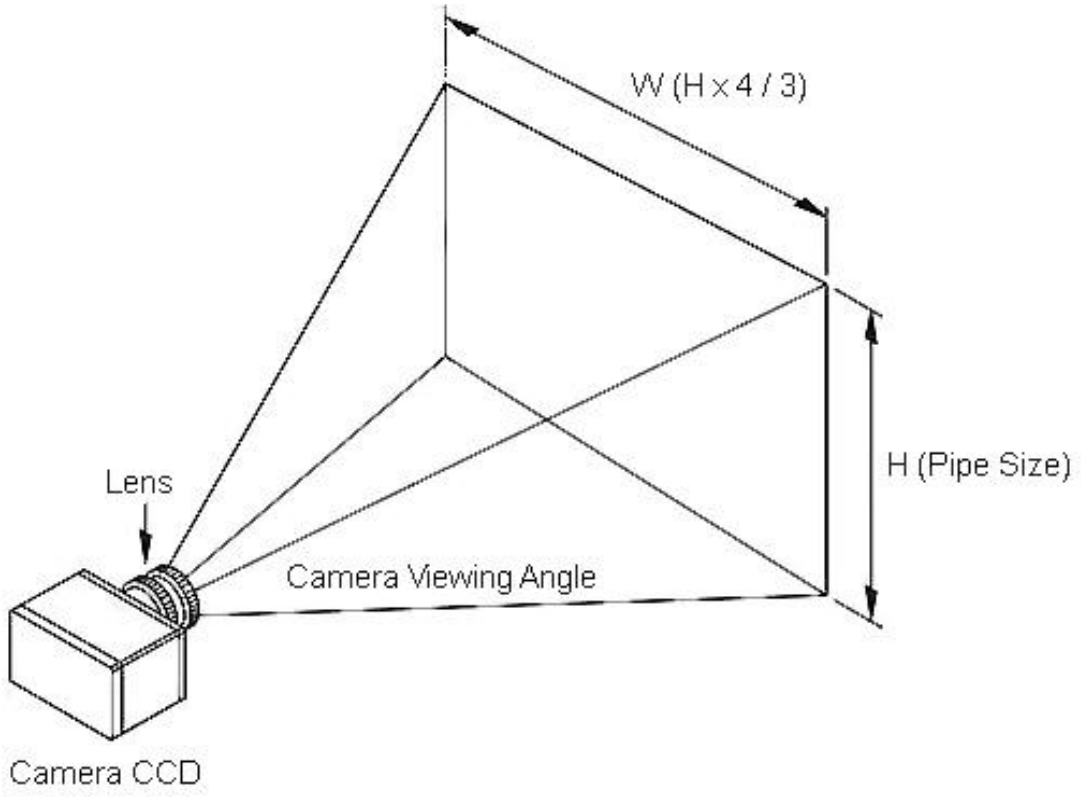


Fig. 4.4 Measurement of focal length

4.4 Deliverables

Utility Specialist shall prepare documents in preliminary, interim and final stages for each site for client's reference.

In preliminary stage, the following shall be provided:

(1) One set of preliminary digital data;
(2) One set of paper copy of drawings;
(3) Control results;
(4) One copy of brief technical report;
(5) One set of photographs.
(6)

In interim stage, the following shall be supplied:

(1) One set of interim digital data;
(2) Paper drawings in 1:100 scale;
(3) One copy of interim technical report.

For the final stage, the following shall be prepared:

(1) 2 copies of Final Report compiling of all deliverables and comments provided by the Engineers;
(2) All reports shall be prepared by Competent Person on site and be checked by Recognized Professional Utility Specialist (RPUS) before submission.

Preliminary report shall be ready within one week after completion of the programmed completion of the works. However, the operator may need to submit the report within one week upon client's request during the execution of investigation. In response, the client shall return a commented report to the operator within one week. After completing the works, the Utility Specialist has four weeks time to complete and submit the final report to the client.

5. POST-SURVEY DATA PROCESSING

After the CCTV Survey inspection, the operator shall report the results to the client. Data collected during the investigation shall be arranged and presented in the inspection report. A standardized coding system describing defects has been established and shall be followed when writing the report. It is essential to carry out quality control in order to monitor the standard of the coding and the accuracy of the survey.

5.1 Inspection Report

Documents

The operator shall provide a report on the location and characteristics of reportable features including defects and features of interest together with such Header details necessary to define the details of the inspection in accordance with the requirements of the Code of Practice for Conduit Condition Evaluation Using CCTV in Hong Kong (UTI, 2009) or any other equivalent code on site. The operator's report shall be written, printed or in the form of digital format. It shall include all mandatory details such as a plan showing the locations of the pipes surveyed, a summary of manhole references, sewers or drain lengths surveyed, diameter/section details and other information required by the client.

The Utility Specialist shall prepare the CCTV survey's video record containing the whole inspection in VHS tape, MPEG 1 format in a CD-Rom or MPEG 1 or MPEG 2 format in a DVD-Rom or other format agreed by the client. Video clips of general condition and significant features shall be edited to meet client's need. When the field of view moves from general condition to the feature of interest, the camera shall be stopped for 2 seconds as "familiarisation time".

Photographs and video prints of general situation, significant changes and general condition of each significant portion of the sewer/ drain shall be taken to record. High quality colour video prints showing details clearly and accurately shall be provided. Photographs shall be taken whenever the following defects are encountered: collapse, holes, fractures, deformation, significant erosion and infiltration, displacements, obstructions of roots. Sample photographs of various defects are given in Appendix A for reference. All junctions and/ or connections shall also be taken. For continuous defects, photographs shall be taken from the beginning and thereafter in 5m intervals till finish. Photographs shall be at a minimum size of 80mm×75 mm in dimension preferably in a digital format of BMP or JPEG.

The report shall contain a summary of ranking scores for both structural and service conditions of sewers and drains surveyed. The grading shall be determined in accordance with the structural assessment of photographs for drains as contained in the WAA/WRc Sewage Rehabilitation Manual or HKCCEC2009 (UTI). Also a summary ranking score for cross referencing the manhole survey results shall also be included to demonstrate that no sewers or drains are missing from the survey. Various sample CCTV Survey report forms are given in Appendix B for reference.

"Particular Specification For Conduit Condition Evaluation (CCTV and Man Entry Survey)" (HKIUS, 2011) states detail criteria on the reporting of the survey.

Coding System

The coding system for sewers/drains comprises of a series of codes that can be used to describe the defects and features observed, as well as other information collected during the inspection. Codes are entered instead of full description in order to facilitate the inspection, as well as to enable a computerized grading of sewer or drain. A Conduit Condition Evaluation Coding Form is used to record the observations through a CCTV inspection. The form consists of two parts, header information and observation. The header information is related to the whole section of sewer or drain to be surveyed, the observation is about the condition, defects and features of the conduit.

The coding system is equally applicable to all types of camera of CCTV Survey and even man-entry survey for large drains. In order to manage the collected information more efficiently, it is suggested that all observations shall be encoded into a computerized logging system directly during inspection and checked by a qualified person afterwards. However, a written coding sheet may also be accepted for a qualified person to input into a computer system later.

There are two types of codes, which are main codes and sub-codes. The former is used to describe features encountered during the inspection like the structural and service condition of the pipes, blockage and leakage of the drains, etc. The latter provides supporting information like characterization, quantification, longitudinal location, etc, to the coding.

Defects are divided into three types in the coding system, structural defects refer to the physical condition of drains; service defects indicate the reduction in capability of the conduit to meet its service requirement and loss of designed hydraulic flow

capacity; construction defects are characteristics and defects related to the construction of the manhole. Besides, all repair features shall also be recorded using codes.

The inspection report shall include a preliminary grading. The grading and scoring process can be used to determine the priority with which the entire circumstances of the sewer/drain shall be thoroughly investigated. To assess both structural and service condition grades, three different grading, Internal Condition Grade (ICG), Structural Performance Grade (SPG) and Service Condition Grade (SCG) are calculated. ICG mainly reflexes the structural completeness and integrity of the sewer assessed by internal visual inspection. SPG includes supplementary information about the surrounding environment on top of ICG. Factors such as soil type, geographical feature, age of the drains, etc, are taken into account to obtain a more comprehensive analysis. So, SPG equals to ICG+V while V is a variable representing the additional information. However, only in marginal cases (middle grades) that the decision of rehabilitation cannot be determined by ICG shall the supplementary information be useful. SCG considers factors which reduce hydraulic capacity of the sewer and drainage. There are 5 grades for all types of grading with the higher the grade, the worse the condition.

The preliminary grading given on site is a rather rough judgment of the conduit condition. To obtain a more accurate analysis, a scoring system is employed. It is the scores that determine the final grade of the conduit. The defects are first assigned a score; then the peak score and the mean score are calculated. A final grade can be assigned according to the scores. A computerized reporting system is recommended for the calculation as the process can be accelerated and the programme can check the accuracy. The peak score is calculated by determining the score of the worst defect among all defects in any one length /in one metre (whichever is appropriate). The mean score is determined by summing all individual defect scores for the entire length (node to node), and then divided by the total length from node to node. The final grade of ICG mainly depends on the peak score, the mean score is sometimes considered. For SCG, the final grade is taken from the peak or mean score, whichever is higher.

This guide is not intended to illustrate the whole system. The HKCCEC2009 (UTI) provides comprehensive and detailed information on the coding system.

5.2 Quality Control Procedures

The quality control procedures and the level of accuracy shall be agreed with the client prior to the commencement of any contract. The system shall measure the accuracy of reporting and in particular the number of omissions of defects and the correctness of coding and classification. Inaccuracies in either the Header or Observation Sections may lead to failure of the report.

Self-assessment enhances the professional development of utility specialist. The quality control process monitors the quality of the works. The procedures are suggested as follows:

(1) The surveyed conduits are numbered according to the time of survey;

(2) A portion of the survey results for each specialist is selected randomly by the computer for quality checking;

(3) The portion is normally set at 5%, or at least the survey results for 1 conduit shall be reviewed;

(4) Video clippings for the selected pipes shall be retained;

(5) Information and codes of the selected lengths are entered into a survey selection log;

(6) All header information, codes and numbers shall be checked to ensure correct entries;

(7) All the compulsory fields shall not leave blank.

To measure the accuracy of the result, the accuracy of each survey is determined by:

$$Accuracy = \frac{(The\ acutal\ number\ of\ entries - The\ number\ of\ actual\ errors\ /\ omissions) \times 100\%}{(The\ actual\ number\ of\ entries)}$$

Note that any error input/ omission shall be weighted equally, without dependency on the level of inaccuracy.

If the report of any survey length fails to meet the specified accuracy level, re-coding and re-submission of the report are required.

Besides, additional quality checking is required by evaluation of the coding results for 5 conduits surveyed immediately before and after the failed length.

Should a report of any survey length fail to achieve the specified standard, it should be recoded and the report of that length resubmitted.

In addition the coding of the five lengths completed immediately before and after the failed length should also be subjected to rechecking as part of an additional quality control check.

If there are any failed reports in this additional check, these should be recoded and resubmitted. Should any failure occur in the increased sample the selection should be increased by a further five lengths before and after, as above, until the required accuracy is achieved.

The ongoing accuracy of the specialist (the confidence level) should be calculated by taking the mean of each 5 percentage results (each 5 representing one control unit).

Both the individual survey percentages and the mean results should be entered on to the Specialist's Accuracy Graph. This graph should have three boundaries:

(1) Header - Record Accuracy

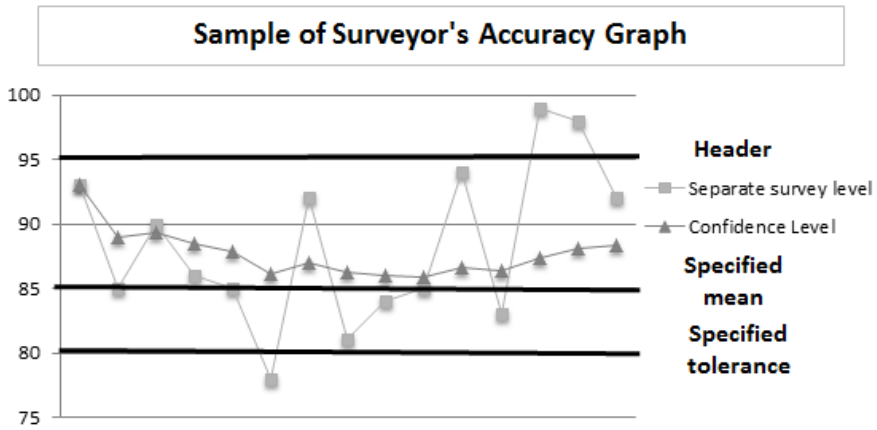
(2) Specified mean – Average surveyor's accuracy for each survey or inspection

(3) Specified tolerance – The minimum surveyor's accuracy for each survey or inspection

Any Specialist whose particular report is scored below the tolerance, the report has to be reviewed and re-submitted until achieving the HKIUS requirement.

For the separate survey level which means the particular surveyor's accuracy for his each survey or inspection. It should be recorded and submitted by particular surveyor's supervisor who shall be RPUS. For the confidence level which means the mean of particular surveyor's accuracy for each year. It represents how much confidence the utility specialist can provide to client.

Sample of Surveyor's Accuracy Graph



5.3 Rehabilitation

The rehabilitation works shall be determined by the engineer depending on the grades obtained in the survey. When the problems of the conduit have been identified, solutions against the problems shall be developed. Integrated solutions that cover all existing and foreseeable needs and solve more than one problem shall be considered. However, some problems may be more urgent, priorities shall be set for each specific problem. The most cost-effective solutions are then selected among several suggested solutions to establish a rehabilitation plan with information on the actions to be carried out and schedule of the works.

Different rehabilitation methods are available for problems of different nature and extent. For structural defects (refer to ICG/ SPG), renovation, renewal or repair works can be performed. For service defects (refer to SCG), for example, preventing grease discharge, relining to prevent growth of tree roots and planned cleaning are ways to resolve the blockage problems so that the hydraulic flow capacity of the sewers can be restored. Sewage Rehabilitation Manual (2001) published by WRc states the procedures and methods of sewage rehabilitation.

After the investigation and rehabilitation (if applicable), it is important to note that all drains/ sewages are subjected to resurvey periodically no matter the condition of the conduit is good or poor.

5.4 Non-compliance with specified requirements

If the position or level of underground services reported in the preliminary deliverables does not comply with the requirement of HKCCEC 2009 (UTI) or its latest version, the result of the survey may be regarded as not complying with the specified requirements.

If the conduit condition evaluation does not comply with specified requirements, the Contractor may need to re-execute the investigation within one week after being notified by the Engineer. The Utility Specialist shall submit the result in 2 weeks after the notification as deliverables. If the result fails again, the Utility Specialist may have to repeat the work specified until the result meet the requirements probably with the cost borne by the Utility Specialist.

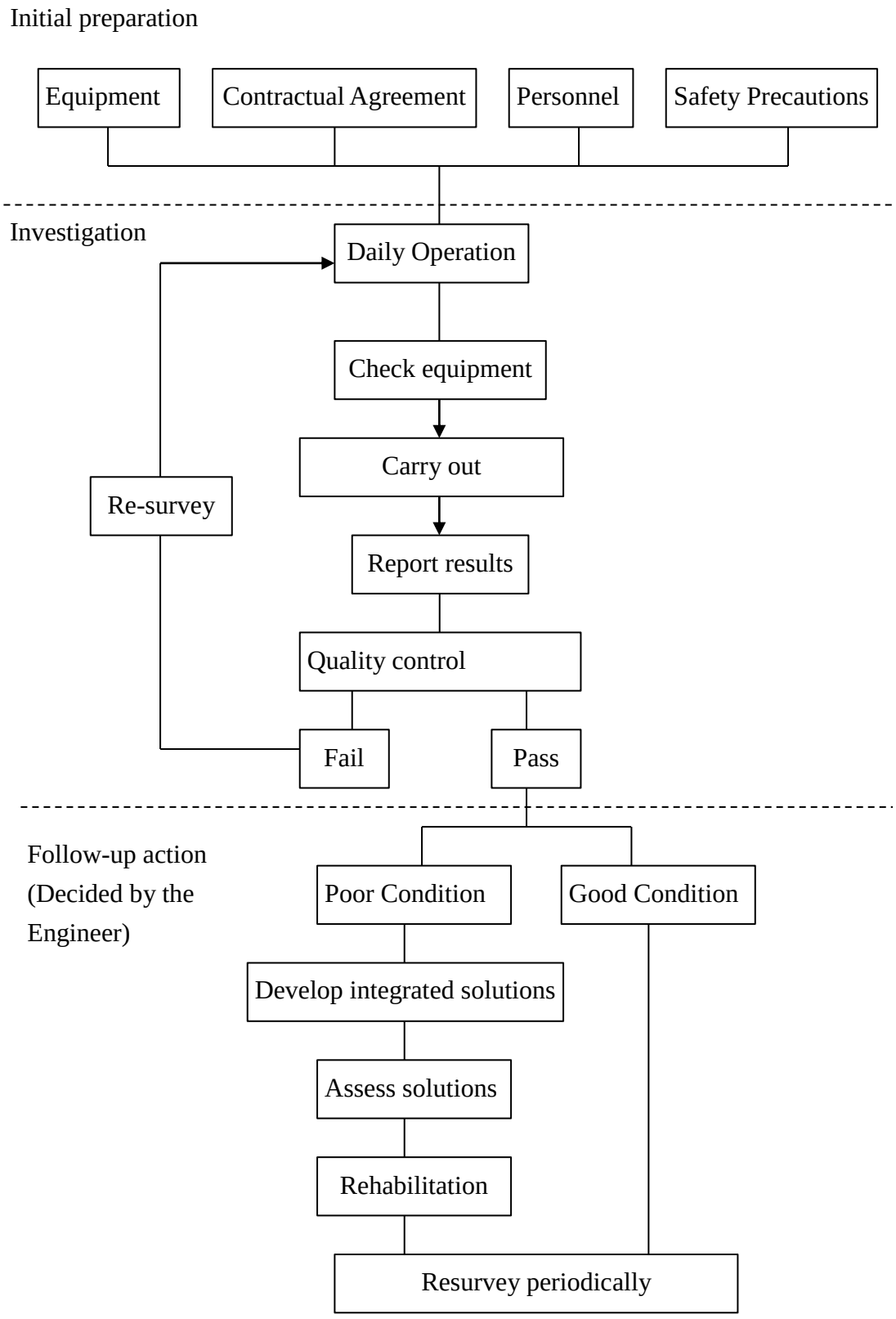


Fig. 5.3 Flow chart of conducting CCTV Survey and the follow-up actions.

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(22) Particular Specification for Conduit Condition Evaluation(CCTV Survey) (2011). Hong Kong: Hong Kong Institute of Utility Specialists (HKIUS) & UTI.
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Appendix A: Abbreviations

Company/ Organization	
Code	Description
BD	Buildings Department, HKSARG
CEDD	Civil Engineering and Development, HKSARG
DSD	Drainage Services Department, HKSARG
EMSD	Electrical and Mechanical Services Department, HKSARG
EPD	Environmental Protection Department, HKSARG
HA	Hong Kong Housing Authority, HKSARG
HKIUS	Hong Kong Institute of Utility Specialists
HKURC	Hong Kong Utility Research Centre
HyD	Highways Department, HKSARG
LandsD	Lands Department, HKSARG
LD	Labour Department, HKSARG
PolyU	The Hong Kong Polytechnic University
UTI	Utility Training Institute
WRc	Water Research Centre
WSAA	Water Services Association Australia
WSD	Water Supplies Department, HKSARG
WTI	Water Training Institute
Others	
Code	Description
%	Percentage

Company/ Organization	
BMP	Bitmap (Picture Format)
BWCS	Buried Water Carrying Service
CCE	Conduit Condition Evaluation
CCE(CCTV & ME)	Conduit Condition Evaluation(Closed Circuit Television & Man-Entry)
CCES	Conduit Condition Evaluation Specialists
CCTV	Closed Circuit Television
CD	Compact Disc
CL	Cover Level
COP	Code of practice
CP	Competent Person
DN	Nominal Diameter
DP	Design Pressure
DVD	Digital Versatile Disc
e.g.	Exempli Gratia
GIS	Geo-Information System
EPR	Environmental Protection Requirements
etc.	et cetera
GL	Ground Level
H	Height
HKCCEC	Hong Kong Conduit Condition Evaluation Codes
HPWJ	High Pressure Water Jetting

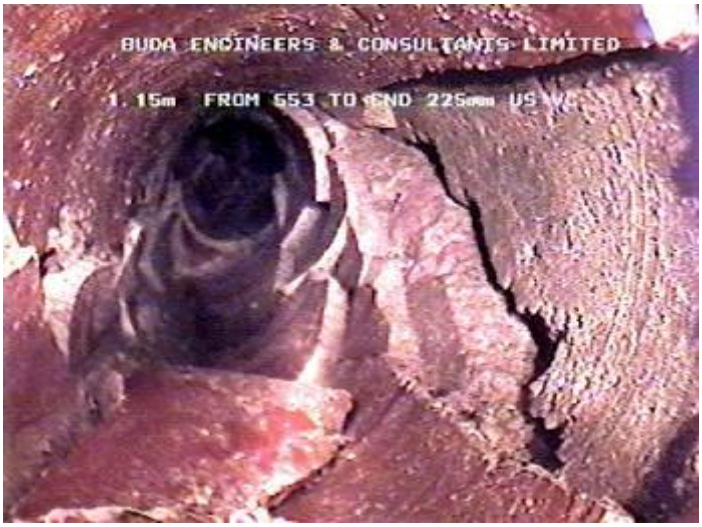
Company/ Organization	
hr	Hour
Hz	Hertz
ICG	Internal Condition Grade
ID	Internal Diameter
IDMS	Integrated Data Management System
IL	Invert Level
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group (Picture Format)
kHz	Kilo- Hertz
kPa	Kilopascal
m	Meter(s)
ME	Man Entry
MHICS	Manhole Internal Condition Survey
mm	Millimetre(s)
Mpa	Megapascal
MPEG	Motion Picture Experts Group (Video Format)
MS	Method Statement
MSCC	Manual of Sewer Condition Classification, UK
OHSAS	Occupational Health and Safety Assessment Series
PPE	Personal Protective Equipment
ppm	Parts per million
PS	Particular Specification

Company/ Organization	
PSI	Pound Per Square Inch
QA/ QC	Quality Assurance/ Quality Control
Ref.	Reference
RMSE	Root Mean Square Error
RPUS	Recognized Professional Utility Specialist
RTO	Recognized Training Organization
SCG	Service Condition Grades
SOPs	Safe Operator Procedures
SPF	Sun Protection Factor
SPG	Structural Performance Grade
SRM	Sewer Rehabilitation Manual
STP	System Test Pressure
TTA	Temporary Traffic Arrangement
US	Utility Specialist
VHS	Video High Speed
W	Width
WLD	Water Leakage Detection
WO	Works Order
WP	Work Procedure

Appendix B: Sample Photographs of Defects

A1 Plate 1 - Structural Defects

A: Broken- no missing pieces but some have noticeable displacement

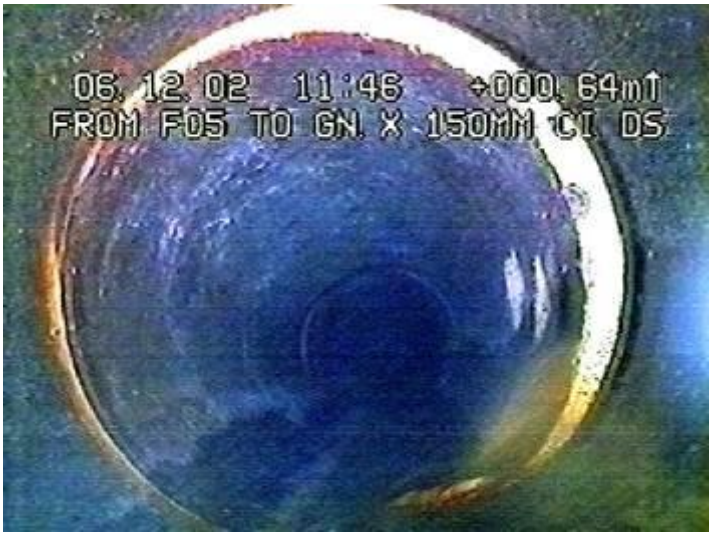


B: Collapse of pipe section with 30% reduction in cross sectional area

C: Multiple Crack from 9 to 2 O'clock

D: Circumferential Fracture from 9 to 3 O'clock

E: Hole at 12 to 01 O'clock



F: The displaced joint appeared as a meniscus

A2 Plate 2 - Service Defects

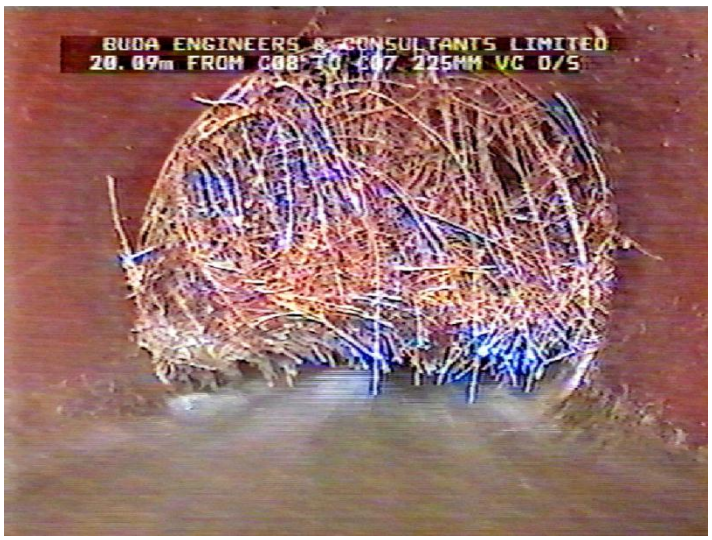
A: Deposit Attached- Foul material from the sewage attached to the inner wall of the pipe

B: Deposit Settled- Coarse material deposits at the bottom of the pipe

C: Encrustation- Heavy encrustation

D: Infiltration- Groundwater running continuously through faulty joint

E: Obstruction- Boulders laying in the invert



F: Tree Root- Roots mass blocking over 80% of the cross –sectional area of the pipe

A3 Plate 3 - Construction Defects

A: Connection- A connection at 12 O'clock with defects and is in service

B: Connection Defective- A connection intruding into the main pipe at 2 O'clock

Photos are adapted from HKCCEC 2009.

Appendix C: Sample Forms

A4 CCTV Survey Form A

UTILITY TRAINING INSTITUTE (UTI)
A trade name of UTI (International) Ltd. 管綫學院

Summary of Pipes
(Form A)

Project No. & WO No.: ____________ Client: ____________ Date: ____________

Location: ____________ Slope No.: ____________ Surveyed By: ____________

Survey ID	Manhole				Pipe				Manhole (Start)			Grades			Remarks
	Use	Start Manhole Ref.	Flow	Finish Manhole Ref.	Size (mm)	Mat.	Shape	Length (m)	Depth (m)	I.L. (m)	C.L. (m)	SCG	ICG	SPG	
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
Total															

Note:
SCG: Service Condition Grade
ICG: Internal Condition Grade
SPG: Structural Performance Grade
In general SCG & ICG will be used
Inspecial case SPG will be used and in accordance with Appendix E of HKCCEC 2009

CCTV Survey Report Form A
Revision 1 : Mar 2009

Form: CR-A

A5 CCTV Survey Form A (Filled)

Summary of Pipelines

Project/Contract/Wo No. W.O.36 Slope Reference No -

Date : 10-11-10

Location : Sun Tin Wai Estate

Drain / Sewer use : Surface water / Foul

Item	Manhole		Pipe			Manhole(From)			Grades			Remarks
	From	To	Lengths(m)	Size(mm)	Material	I.L.	C.L.	Depths(m)	SCG	ICG	SPG	
1	S18.4	S18.5	026.1	450	CO	36.100	38.070	1.97	1	4	4	Counter Start Reading 1.0m
2	S18.5	S18.6	016.7	450	CO	35.920	37.720	1.80	1	2	2	--
3	S18.6	S18.7	019.1	450	CO	35.680	37.400	1.72	1	2	2	--
4	F10.8	F10.9	040.2	300	CO	35.690	38.050	2.36	2	4	4	Counter Start Reading 1.0m
5	F10.9	F10.10	017.2	300	CO	35.330	37.440	2.11	2	2	2	--

A6 CCTV Survey Form B

UTILITY TRAINING INSTITUTE (UTI)
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Summary of Defects (Form B)

Project No. & WO No.: ____________ ____________ Date: ____________

Location: ____________ ____________ Surveyed By: ____________

Survey ID	Manhole				Pipe				Pipe											Service Condition									Misc.				
	Use	Start Manhole Ref.	Flow	Finish Manhole Ref.	Size (mm)	Mat.	Shape	Length (m)	Urgent	Surface Damage Spalling	Crack	Fracture	Broken	Hole	Defective Con. / Jun.	Deformed	Collasped	Joint Displaced	Open Joint	Roots	Infiltration	Encrustation	Debris	Grease	Obstruction	Water Level - 20%	Line	Survey Abandoned	Camara Under Water	Loss of Vision	Brick Defects	Others
1																																
2																																
3																																
4																																
5																																
6																																
7																																
8																																
9																																
10																																
11																																
12																																
13																																
14																																
15																																
16																																
17																																
Total																																

CCTV Survey Report Form B
Revision 1 : Mar 2009

Form: CR-B

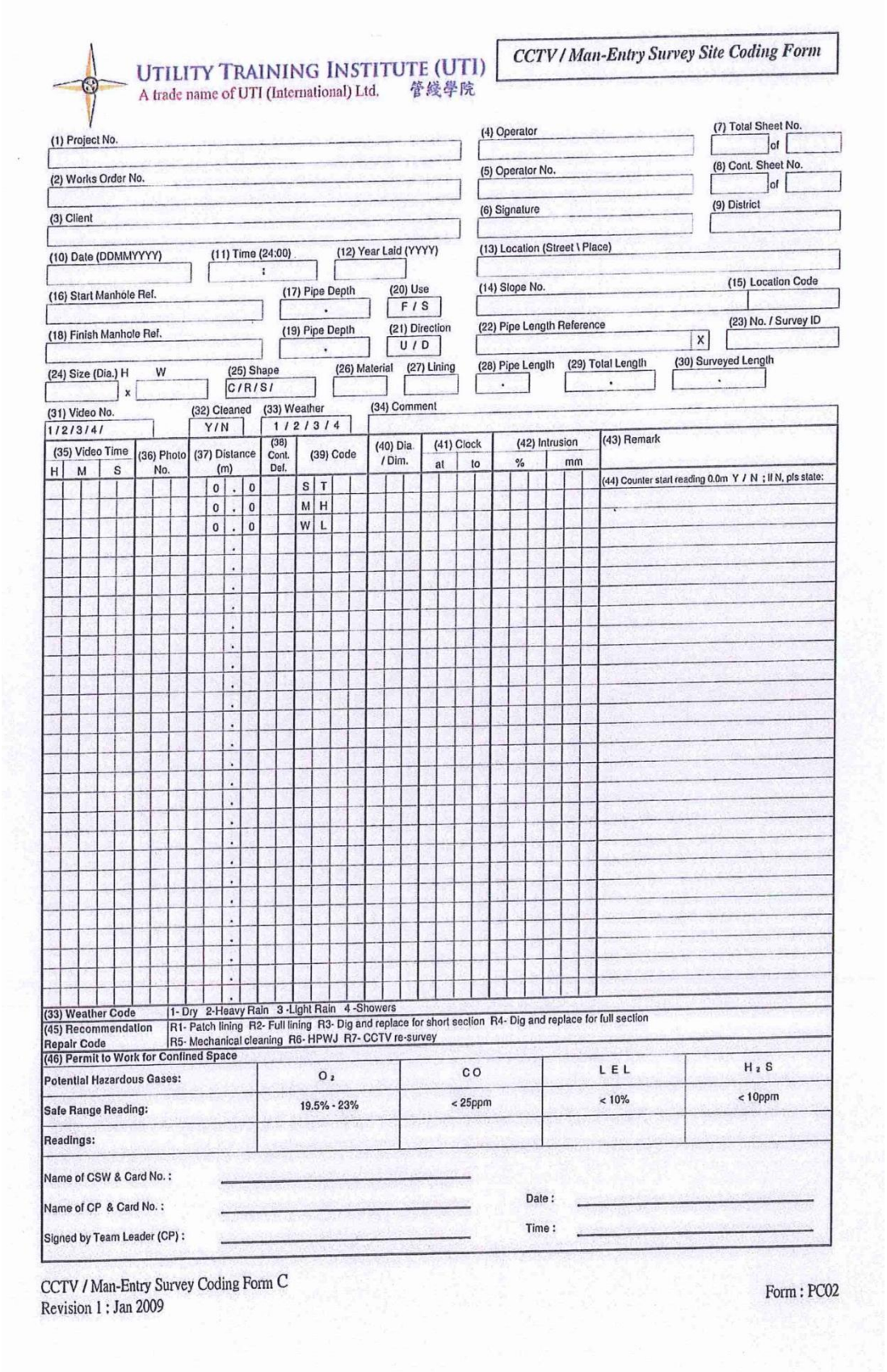
A7 CCTV Survey Form B (Filled)

Summary of Defects

Works Order No.					Colour CCTV Drainage Survey																		
W.O.36					Pipe									Service Condition								MISC	
Item No.	Manhole		Meters (m)	Urgent	Cracked	Fractured	Broken	Deformed	Collapsed	Hole	Surface Spalling/Wear	Joint Displaced	Open Joint	Roots	Infiltration	Encrustation	Silt	Grease	Obstruction	Water Line	Line	Survey Abandoned	Camera Under Water
	From	To																					
001	S18.4	S18.5	026.1	1	6		1				3									1			
002	S18.5	S18.6	016.7		7						2									1			
003	S18.6	S18.7	019.1		7						3									1			
004	F10.8	F10.9	040.2	1	3		1				3									1			
005	F10.9	F10.10	017.2		3						2	2	1							1			
		Total	119.3	2	26		2				13	2	1							5			

A8 CCTV Survey Form C

Hand Report (Computer Generated with Defect Codes, Scores and Grades)



UTILITY TRAINING INSTITUTE (UTI)
A trade name of UTI (International) Ltd. 管綫學院

CCTV / Man-Entry Survey Site Coding Form

(1) Project No.
(2) Works Order No.
(3) Client
(4) Operator
(5) Operator No.
(6) Signature
(7) Total Sheet No. ___ of ___
(8) Cont. Sheet No. ___ of ___
(9) District
(10) Date (DDMMYYYY)
(11) Time (24:00) :
(12) Year Laid (YYYY)
(13) Location (Street \ Place)
(14) Slope No.
(15) Location Code
(16) Start Manhole Ref.
(17) Pipe Depth .
(20) Use F / S
(18) Finish Manhole Ref.
(19) Pipe Depth .
(21) Direction U / D
(22) Pipe Length Reference X
(23) No. / Survey ID
(24) Size (Dia.) H x W
(25) Shape C / R / S /
(26) Material
(27) Lining
(28) Pipe Length .
(29) Total Length .
(30) Surveyed Length .
(31) Video No. 1 / 2 / 3 / 4 /
(32) Cleaned Y / N
(33) Weather 1 / 2 / 3 / 4
(34) Comment

(35) Video Time H M S	(36) Photo No.	(37) Distance (m)	(38) Cont. Def.	(39) Code	(40) Dia. / Dim.	(41) Clock at to	(42) Intrusion % mm	(43) Remark
		0.0		ST				(44) Counter start reading 0.0m Y / N ; if N, pls state:
		0.0		MH				
		0.0		WL				

(33) Weather Code: 1- Dry 2-Heavy Rain 3 -Light Rain 4 -Showers
(45) Recommendation Repair Code: R1- Patch lining R2- Full lining R3- Dig and replace for short section R4- Dig and replace for full section R5- Mechanical cleaning R6- HPWJ R7- CCTV re-survey

(46) Permit to Work for Confined Space

Potential Hazardous Gases:	O_2	CO	LEL	H_2S
Safe Range Reading:	19.5% - 23%	< 25ppm	< 10%	< 10ppm
Readings:				

Name of CSW & Card No. : _____
Name of CP & Card No. : _____ Date : _____
Signed by Team Leader (CP) : _____ Time : _____

CCTV / Man-Entry Survey Coding Form C
Revision 1 : Jan 2009
Form : PC02

A9 CCTV Survey Form C (Filled)

UTILITY TRAINING INSTITUTE (UTI) 管綫學院
A trade name of UTI (International) Ltd.

CCTV / Man-Entry Survey Site Coding Form

Project No.	Y09-P-033-999 20090061	Operator	W.Y.LAW
Works Order No.	W.O. 036	Operator No.	/
Client	H.K.-H.A	Signature	[illegible]
Date (DDMMYYYY)	10.11.17	Location (Street \ Place)	Sun Tin Wai Estate
Time (24:00)	:	Slope No.	N/A
Year Laid (YYYY)	/	Location Code	/
Start Manhole Ref.	7-10.P	Pipe Length Reference	/
Finish Manhole Ref.	7-10.10	No. / Survey ID	X - /
Pipe Depth	/	Total Sheet No.	1 of 1
Use	(F) / S	Cont. Sheet No.	/ of /
Direction	U / (D)	District	/
Size (Dia.) H × W	300 ×	Pipe Length	/
Shape	(C) / R / S /	Total Length	17.2
Material	CO	Surveyed Length	17.2
Lining	/	Comment	
Video No.	1/2/3/4/	Cleaned	Y/N
Weather	1/2/3/4		

Video Time H	M	S	Photo No.	Distance (m)	Cont. Def.	Code	Dia. / Dim.	Clock at	Clock to	Intrusion %	Intrusion mm	Remark
	6											Main pipe 是否已plug (Y)/N
												是否有分支pipe而無法plug水 (Y)/N
												有無用車仔 (Y)/N
				0.0		ST						Counter start reading 0.0m (Y)/N ; If N, pls state:
				0.0		MH						7-10.P
				0.0		WL				05		
				0.0		DEC		05	07	10		
				2.9		CC		12	12			
				3.5		JDM						
				4.1		JDM						
				6.2		OJM						
				16.7		CSS		0P				
				16.6		CSL		12				
				16.6		CL		12				
				17.2		MM						7-10.10 [illegible]
				17.2		ZM						[illegible]
												[illegible]

Weather Code: 1- Dry 2-Heavy Rain 3-Light Rain 4-Showers

Recommendation Repair Code: R1- Patch lining R2- Full lining R3- Dig and replace for short section R4- Dig and replace for full section R5- Mechanical cleaning R6- HPWJ R7- CCTV re-survey

Permit to Work for Confined Space

Potential Hazardous Gases:	O_2	CO	LEL	H_2S
Safe Range Reading:	19.5% - 23%	< 25ppm	< 10%	< 10ppm
Readings:				

Name of CSW & Card No. : ____________________

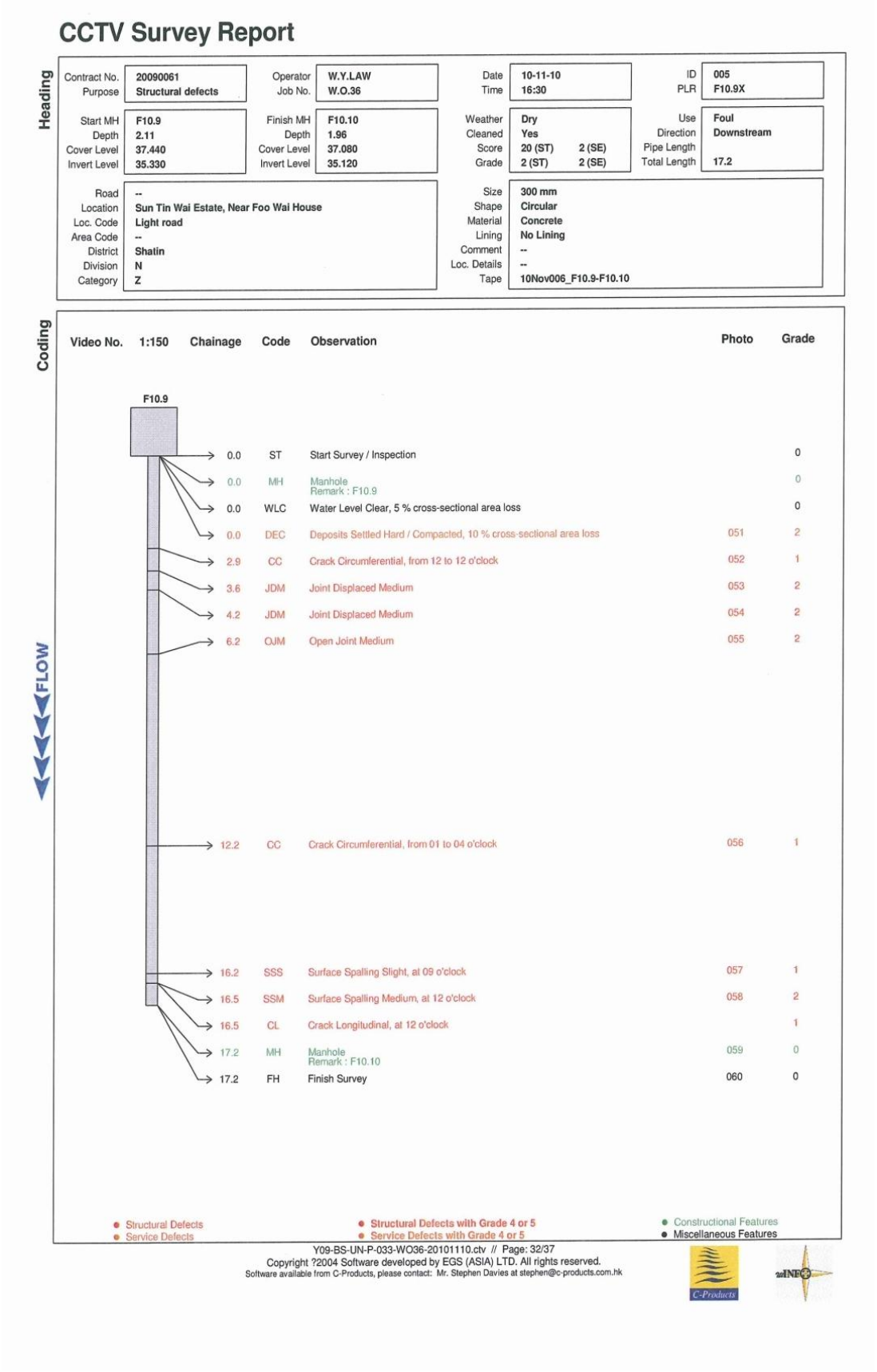
Name of CP & Card No. : ____________________ Date : ____________________

Signed by Team Leader (CP) : ____________________ Time : ____________________

CCTV / Man-Entry Survey Coding Form
Revision 1 : Jan 2009

Form : PC

A10 CCTV Survey Form C (Computerized)



CCTV Survey Report

Heading

Contract No.	20090061	Operator	W.Y.LAW	Date	10-11-10	ID	005
Purpose	Structural defects	Job No.	W.O.36	Time	16:30	PLR	F10.9X
Start MH	F10.9	Finish MH	F10.10	Weather	Dry	Use	Foul
Depth	2.11	Depth	1.96	Cleaned	Yes	Direction	Downstream
Cover Level	37.440	Cover Level	37.080	Score	20 (ST) 2 (SE)	Pipe Length	
Invert Level	35.330	Invert Level	35.120	Grade	2 (ST) 2 (SE)	Total Length	17.2

Road	--	Size	300 mm
Location	Sun Tin Wai Estate, Near Foo Wai House	Shape	Circular
Loc. Code	Light road	Material	Concrete
Area Code	--	Lining	No Lining
District	Shatin	Comment	--
Division	N	Loc. Details	--
Category	Z	Tape	10Nov006_F10.9-F10.10

Coding

FLOW

Video No.	1:150	Chainage	Code	Observation	Photo	Grade
	F10.9					
		0.0	ST	Start Survey / Inspection		0
		0.0	MH	Manhole Remark : F10.9		0
		0.0	WLC	Water Level Clear, 5 % cross-sectional area loss		0
		0.0	DEC	Deposits Settled Hard / Compacted, 10 % cross-sectional area loss	051	2
		2.9	CC	Crack Circumferential, from 12 to 12 o'clock	052	1
		3.6	JDM	Joint Displaced Medium	053	2
		4.2	JDM	Joint Displaced Medium	054	2
		6.2	OJM	Open Joint Medium	055	2
		12.2	CC	Crack Circumferential, from 01 to 04 o'clock	056	1
		16.2	SSS	Surface Spalling Slight, at 09 o'clock	057	1
		16.5	SSM	Surface Spalling Medium, at 12 o'clock	058	2
		16.5	CL	Crack Longitudinal, at 12 o'clock		1
		17.2	MH	Manhole Remark : F10.10	059	0
		17.2	FH	Finish Survey	060	0

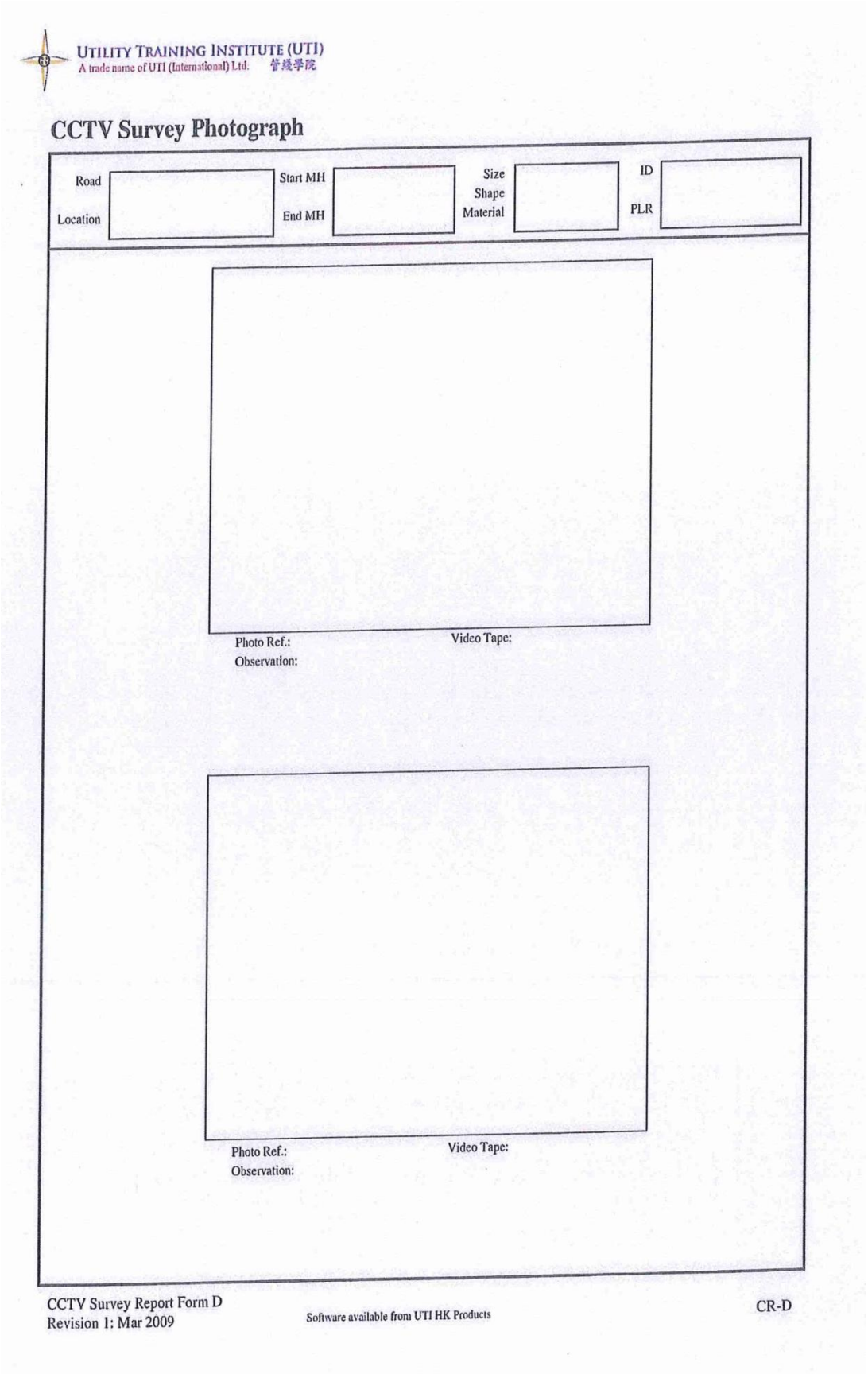
- Structural Defects
- Service Defects
- **Structural Defects with Grade 4 or 5**
- **Service Defects with Grade 4 or 5**
- Constructional Features
- Miscellaneous Features

Y09-BS-UN-P-033-WO36-20101110.ctv // Page: 32/37

C-Products

A11 CCTV Survey Form D

Defect or General Photos



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CCTV Survey Photograph

Road Location		Start MH End MH		Size Shape Material		ID PLR	

Photo Ref.: Video Tape:
Observation:

Photo Ref.: Video Tape:
Observation:

CCTV Survey Report Form D
Revision 1: Mar 2009

Software available from UTI HK Products

CR-D

A12 CCTV Survey Form D (Filled)

CCTV Photographs

Road	--	Start MH	F10.9	Size	300 mm	ID	005
Location	Sun Tin Wai Estate, Near Foo Wai House	Finish Pt.	F10.10	Shape	Circular	PLR	F10.9X
				Material	Concrete		

Photo Ref. : 051 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Deposits Settled Hard / Compacted, 10 % cross-sectional area loss

Photo Ref. : 052 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Crack Circumferential, from 12 to 12 o'clock

- Structural Defects
- Service Defects
- **Structural Defects with Grade 4 or 5**
- **Service Defects with Grade 4 or 5**
- Constructional Features
- Miscellaneous Features

CCTV Photographs

Road	--	Start MH	F10.9	Size	300 mm	ID	005
Location	Sun Tin Wai Estate, Near Foo Wai House	Finish Pt.	F10.10	Shape	Circular	PLR	F10.9X
				Material	Concrete		

Photo Ref. : 053 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Joint Displaced Medium

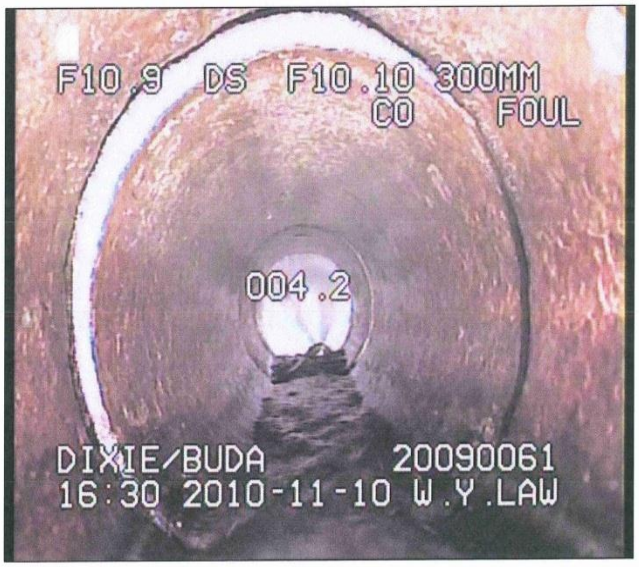

Photo Ref. : 054 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Joint Displaced Medium

- Structural Defects
- Service Defects
- **Structural Defects with Grade 4 or 5**
- **Service Defects with Grade 4 or 5**
- Constructional Features
- Miscellaneous Features

CCTV Photographs

Road	--	Start MH	F10.9	Size	300 mm	ID	005
Location	Sun Tin Wai Estate, Near Foo Wai House	Finish Pt.	F10.10	Shape	Circular	PLR	F10.9X
				Material	Concrete		

Photo Ref. : 055 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Open Joint Medium

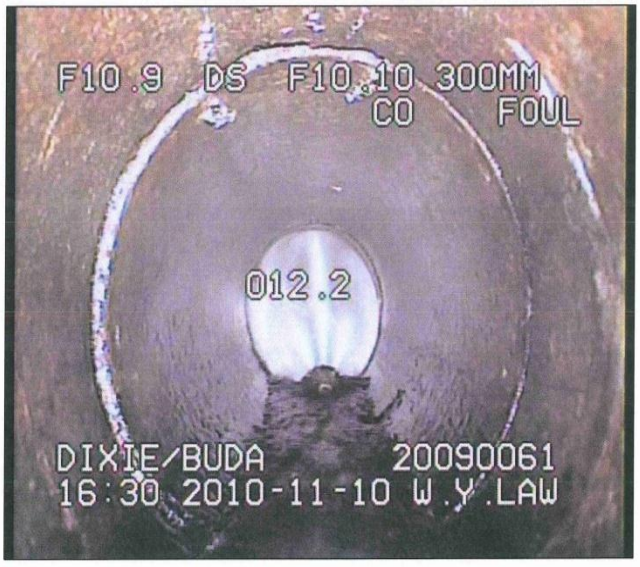

Photo Ref. : 056 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Crack Circumferential, from 01 to 04 o'clock

- Structural Defects
- Service Defects
- **Structural Defects with Grade 4 or 5**
- **Service Defects with Grade 4 or 5**
- Constructional Features
- Miscellaneous Features

CCTV Photographs

Road	--	Start MH	F10.9	Size	300 mm	ID	005
Location	Sun Tin Wai Estate, Near Foo Wai House	Finish Pt.	F10.10	Shape	Circular	PLR	F10.9X
				Material	Concrete		

Photo Ref. : 057 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Surface Spalling Slight, at 09 o'clock

Photo Ref. : 058 **Video Tape :** 10Nov006_F10.9-F10.10
Observation : Surface Spalling Medium, at 12 o'clock

- Structural Defects
- Service Defects
- **Structural Defects with Grade 4 or 5**
- **Service Defects with Grade 4 or 5**
- Constructional Features
- Miscellaneous Features

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Guideline Amendment Form

Please fill in the following form if any error or mistake is found in this manual. We thank for your support and appreciate your continuous help in improving this manual.

Discipline*	Page No.	Description of Existing Content	Suggested Amendment

* A. Conduit Condition Evaluation (CCTV and ME Survey)
B. Manhole Internal Condition Survey
C. Utility Survey (Pipe Cable Locator Survey, PCL)
D. Water Leakage Detection and Control
E. Advanced Leakage Detection of Buried Water Carrying Services Affecting Slopes
F. Pipe Rehabilitation by Trenchless Technology
G. GPR(Ground Penetrating Radar) Survey
H. Flow Study in Drainage Conduit (流量監控)
I. Pipe Condition Surveys by other non-destructive methods
J. Data Management for Utility Records
K. Utility Management
L. Safety

Please fill in your contact information in case follow up is needed.

First Name: _____ Second Name: _____ Last Name: _____

Title: _____

Organization: _____

#Telephone No.: _____ #Email Adress: _____

#Address: _____

Please fill in one or more contact information in the blanks provided
This amendment form is available at: www.uti.hk

C C T V & M E

Professional Service Development Assistance Scheme (PSDAS)
Professional Guide Notes and Pamphlet for utility professionals in Hong Kong
Project ref: Y09-HKIUS-P02-PSDAS