

**Assessment of the CleanFlow Systems
ClearLine Profiler - schedule**

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1. Scope

CleanFlow Systems produce the ClearLine Profiler to provide accurate empirical data on the ovality, capacity and other conditions in new and existing pipelines. The Profiler is able to be retro fitted to several makes and models of CCTV cameras and produces a ring of laser light on the inside of the pipeline. The resulting CCTV images are analysed using their ClearLine software incorporating 'Machine vision' technology.

This assessment schedule applies to the performance of the 'Profiler' device and 'ClearLine' software.

As an innovative product there are no existing standards that are relevant to the testing schedule. WRc has drafted a minimum specification for the product area⁽⁵⁾. This specification has been based on the current needs of the UK Water Industry. In addition, where the product is claimed to provide specific benefits to those detailed in the specification these are addressed by the Assessment Schedule.

2. Assessment schedule

- 2.1 Documentation audit of:
- quality control information;
 - calibration and set up procedure;
 - method statements for interpreting data;
 - UK operation manual.

2.2 Type testing to assess the product against specification and additional product claims on behalf of the manufacturer.

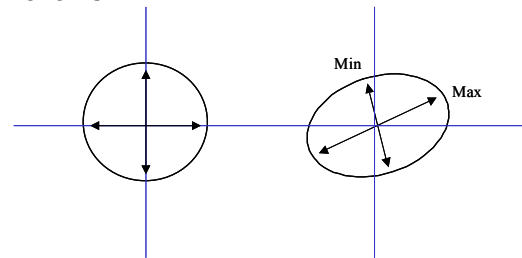
2.3 Operational testing, to assess the UK supplied operating manual in field conditions.

3. Review of properties

3.1 The ASTM F1216-09⁽⁶⁾ standard for cured in place pipes defines a percentage ovality of the original pipe q as:

$$\left\{ \frac{\text{Maximum Inside Diameter} - \text{Mean Inside Diameter}}{\text{Mean Inside Diameter}} \right\} \times 100$$

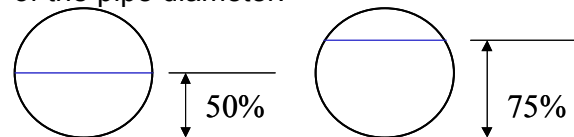
Where the maximum and minimum inside diameter is measured as follows:



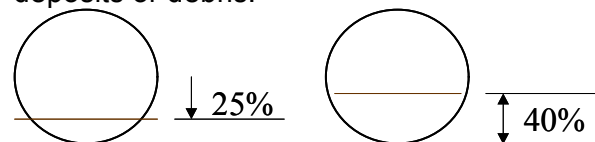
and the Mean Inside Diameter could be calculated as:

$$(\text{Min internal diameter} + \text{Max internal diameter})/2$$

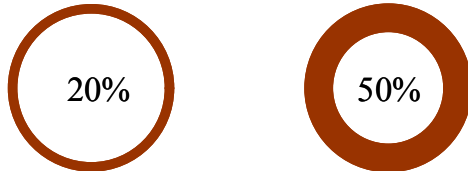
3.2 MSCC4⁽¹⁾ defines levels of surcharge by depth as a percentage of the pipe diameter:



3.3 MSCC4⁽¹⁾ defines levels of percentage area reduction by settled deposits or debris:



3.4 MSCC4⁽¹⁾ defines percentage area reduction:



4. Review of procedures-on site

As an innovative product type no existing procedures are appropriate for this technology. The manufacturer's document will be reviewed for clarity and assessed on site for usability.

5. Testing schedule - WRc Specification ****.

The device will be tested against the WRc specification⁽⁵⁾ that represents the minimum requirements of the UK water industry. This specifications includes general and specific requirements, as follows:

5.1 General requirements include objective judgements relating to fitness for purpose such as;

- Form;
- Design;
- Robustness;
- Durability;
- Capability;
- Safety.

5.2 Specific requirements are tested against the standard in terms of:

- Functionality;
- Calibration, scaling and image distortion;
- Accuracy and repeatability.

6. Testing schedule – manufacturers claims.

The device will be tested against the manufacturer's claims where they exceed those contained within specification⁽⁵⁾.

6.1 Automated reporting;

- Ovality;
- Capacity;
- Delta
- X/Y diameter
- Minimum and maximum diameter;
- Flat;
- 3D.

6.2 CSV data output.

6.3 Diameter range:150mm to 450mm

6.4 Materials:

- PE including "black" PE
- GRP
- Clay
- Brick
- Concrete
- Cured in place pipe liner materials
- Patch repair materials

6.5 Water level range in accordance with MSCC4. Range 0% to 30%. Function after complete

6.6 Debris range in accordance with MSCC4: 0% to 30%

6.7 Ovality q: 0% to 15%

6.8 The Cross-sectional area of 3 shapes that fall within the claimed



range of sewers to within +/- 3% of the measured area.

7. Testing Schedule

7.1 Prior to each test the system will set up and calibrated in accordance with the manufacturer's documentation.

7.2 Ovality will be assessed on a 230mm id black PE pipe at approximately 5%, 10% and 15%

7.3 Repeatability will be assessed by making 3 independent measurements on a deflected pipe. The pipe will be 300mm id and will be oval by approximately 8%.

7.4 Measurements will be verified with manual measuring techniques to an accuracy of +/- 1mm.

7.5 Cross-sectional area will be assessed on 3 computer generated images of cross sectional area approximately equal to pipes of id 150mm, 225mm and 450mm.

8. Operational defects (debris) will be assessed on a section of 225mm id black PE pipe with a debris range from 0% to 50%

9. Structural defects (non rehabilitated pipes) will be assessed on a section of concrete pipe id 300mm. Defect sizes will be inferred with the aid of the light ring product and verified by manual measurement. Defects will include:

- fracture longitudinal;
- crack longitudinal;
- hole.

10 Structural defects (rehabilitated pipes) will be assessed on a length of 300mm id clay pipe with an internal patch repair.

6.8 Surcharge will be assessed in a section of 225mm id black PE pipe. The surcharge level will be between 0% and 100% The unit will be subject to complete immersion.

7. Reference documents

1. ISBN 1 898920 50 8: Manual of Sewer Condition Classification Fourth Edition 2004 (MSCC 4).
2. ISBN 1 898920 56 7: Model Contract Document for Sewer Condition Inspection, Second Edition 2005.
3. European Union Directive on the approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Directive 1994/9/EC of 23/03/1999.
4. European Union Directive on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. Directive 1999/92/EC of 16/10/1999.
5. WRc Specification for Light Ring technology.
6. ASTM F1216-09 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.