# Guidelines for As-Built CCTV Inspections of Lined/Rehabilitated Pipe

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## Supplementary Document to the CCC Specification "CCTV for Christchurch City Council Earthquake Recovery"

This document provides a guideline for the assignment & interpretation of feature and defect codes, as part of the CCTV as-built inspections of Lined/Rehabilitated pipes for the Christchurch earthquake recovery.

# Revision History

| Version | Date | Name | Brief Description of Change |
|---|---|---|---|
| 1.0 | 15 October 2013 | S. Apeldoorn | Draft |
| 2.0 | 7 November 2013 | S. Apeldoorn | Updates following draft review feedback. |
| 3.0 | 8 November | S. Apeldoorn | Update Manhole termination defect descriptions. |
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# Introduction

This document has been produced to provide CCTV Operators, Reviewers, SCIRT Delivery Teams and Christchurch City Council, guidance on the assignment and interpretation of feature & defect codes (condition codes) for the as-built inspection of lined/ rehabilitated pipe as part of the Christchurch earthquake recovery.

This document is supplementary to the CCC Specification "CCTV for Christchurch City Council Earthquake Recovery", and does not supersede or alter any clauses or obligations of the specification, or that of the New Zealand Pipe Inspection Manual. Its sole purpose is to assist those that are inspecting the pipes (CCTV Operators/Reviewers) to appropriately assign condition codes, and for those assessing the liner conditions (Delivery Teams/Contractors/Christchurch City Council Engineers) to interpret the coverage or meaning of the condition codes and how they relate to defects or features within the lined/rehabilitated pipes.

The feature codes and defect codes, included within this guideline, comply with the New Zealand Pipe Inspection Manual, but are described, specifically, for inspection of trenchless repair or rehabilitation of pipes.

# Interpretation

The inspection of lined/rehabilitated pipe is quite different to that of other pipe systems. What makes lined pipes different, from other systems, is that it is a new pipe installed within an existing pipe with defects, (referred to as latent defects) which can be reflected in the newly lined pipe. Latent defects include:

- Dips;
- Deformations;
- Varying dimensions;
- Holes; and,
- Displacements.

Latent defects are not liner defects, but are instead features of the lined pipe and should be identified, as part of the CCTV inspection, with a General Comment, (GC code) with a description to explain or describe the circumstance. In addition, the liners themselves, have their own features due to their specific manufacture and installation methodology.

Not all CCTV defect codes are appropriate for coding defects in lined pipes. Table 1 below identifies both the feature and defect codes that are specifically applicable to the inspection of lined pipe:

**Table 1 Applicable Feature & Defect Codes for lined/rehabilitated pipes**

| Main Code | Description | Comment |
|---|---|---|
| **Specific Applicable Condition Codes** | | |
| CF | Construction Features | Feature Code |
| GC | General Comments | Feature Code |
| LC | Lining Change | Feature Code |
| | | |
| PL | Protective Lining Defective | Defect Code |
| SD | Surface Damage | Defect Code |
| LF | Lateral Faulty | Defect Code |
| LX | Lateral Problem | Defect Code |
| | | |
| **Other Applicable Condition Codes** | | |
| LD, LU, LL, LR | Line Direction Deviations | Feature Code |
| IP | Infiltration Present | Defect Code |
| RI | Root intrusion | Defect Code |
| ED | Encrustation Deposits | Defect Code |
| DE | Silty Deposits | Defect Code |
| DP | Dip | Defect Code |
| OT, OP | Obstructions | Defect Code |
| JF | Joint Faulty ***(applies to manhole termination seals only)*** | Defect Code |
| IS | Inspection Starts | Feature Code |
| IE | Inspection Ends | Feature Code |
| IA | Inspection Abandoned | Feature Code |

### What should you do when you are uncertain of which code to use?

In some circumstances, it may be difficult to determine whether the liner abnormality, identified in the as-built CCTV inspection, is a feature, as a result of a latent defect, or is a defect in the liner itself. Table 2 outlines the most likely situations where this uncertainty may occur.

**Table 2 Common situations that may cause uncertainty**

| Appearance | Description | Possible Codes |
|---|---|---|
| Bulges | a localised reduction in the diameter that could be due to a latent defect or as a result of lining over debris or sagging of the liner | GC or PL |
| Deformation or "out of round" | a localised reduction in the diameter that could be due to a latent defect or as a result of the liner separating from the host pipe wall | GC of PL |
| Cracking or tearing | A definitive circumferential, longitudinal, or spiral line/discontinuity that could be as result of the liner tearing/cracking, or could be a lap or joint in the liner. | CF or SD |
| Staining (leakage) | A discoloration/staining of the liner which could be as a result of holes or tearing of the liner, allowing ground water infiltration, or it could be as a result of staining, from the lubricant used for installation, or from pen/marker notes scribed on the liner material. | GC or SD |
| Surface of the liner is peeling off. | The surface of the liner appears to be peeling or delaminating which could be due to damage to the liner from abrasion or could be just the sacrificial (PE/PVC/PU) coating coming away. | GC or SD |

Where the operator cannot clearly determine which possible code should be applied, the following actions, outlined in Table 3 below should be undertaken.

**Table 3 Actions to be undertaken in the event of uncertainty of which code to use**

| Situation | Action |
|---|---|
| Bulging or deformation | Code as PL. Compare the as-built CCTV with pre-lining CCTV to confirm presence of Latent defect. If a latent defect is confirmed at that location, recode to GC |
| Tearing or peeling | Code as SD. Review as-built CCTV video for confirmation of the defect. Recode to CF or GC if not defective. |
| Staining | Code as SD. Review as-built CCTV video and if necessary undertake an air test of the lined pipe to confirm leakage. Recode to GC if not defective. |

The general approach for all uncertainty, between the application of a defect code or feature code, is to initially apply the defect code, followed by a review and recoding as necessary.

### Liner terminations in Manholes

Liners within pipes are not bonded to the host pipe wall. They are instead in 'close fit' to the pipe wall; in contact but with no adhesion. As a result there is an annulus which can allow ground water or roots, passing through defects in the host pipe, to enter the manholes by tracking along between the host pipe and the liner. It therefore important, that a "seal" is constructed between the liner,

host pipe and the manhole wall following the liner installation. This seal is constructed of a non-shrink epoxy mortar. There should not be any visible gaps or cracks in this seal.

In addition to the creating a seal, the mortar offers two other functions:

- A transition or "ramp" at the liner interface in the manhole – the liner internal diameter is smaller than the host pipe, so a step is created in the channel invert, and a mortar ramp smoothly transitions the flow from the channel into the liner. Ideally this ramp would have a 2:1 slope, but a 1:1 is acceptable to prevent debris building up.
- Smooth and tidy surface within the manhole that prevents paper or other material catching or building up around the entrance to the liner.

It is important that a clear view of the pipe entrance and exit is captured as part of the CCTV inspection so that the liner terminations at the upstream and downstream manholes can be checked (refer to section 3.23.3 of the, CCTV for CCC Earthquake Recovery specification). As-built CCTV inspections should not be undertaken until the manhole liner termination work has been completed.

Defects associated with manhole terminations should be coded as per Table 4, which follows:

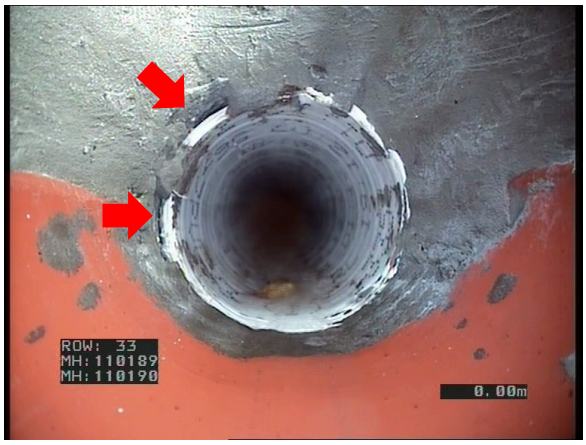
**Table 4 Defect codes used to descibe defects in the manhole termination seal.**

| Observation | Defect Code | Description |
|---|---|---|
| End seal has gaps or is leaking | JF | The end seal is defective. The severity is applied as per NZPIM, based on the evidence of a pathway through to the outside:<br><br>**Large** – Clear evidence (e.g. IP, staining, etc.)<br>**Medium** – Possible pathway (e.g. cracking or small gaps but no clear evidence)<br>**Small** – defective but no pathway to the outside. |
| Poor or no transition<br>Excess Mortar obstructing the entry to the liner | OP | The flow into the liner is obstructed or debris/fat could build-up at the entry to the liner. The severity is applied as per NZPIM, based on % reduction relative to the liner diameter:<br><br>**Large** - >25% of the liner diameter<br>**Medium** - >10% up to 25% of the liner diameter<br>**Small** – up to 10% of the liner diameter |

Following are examples of manhole/Liner terminations:


Good example of an end seal and transition in an Expanda (Spiral Wound) pipe.


Excess mortar on the end seal causing rough entry and an obstruction – coded as OP, Small.




Good transition, but the end seal has gaps between the Expanda liner and the host pipe – Gap, but no evidence of pathway, coded as JF, Medium.

Good example of an end seal and transition for a CIPP liner.


Excess mortar on end seal for a CIPP liner, affecting the transition between the channel and the liner (causing an obstruction) – coded as OP, Small.

# Condition Code Descriptions

The following pages provide a description for each of the "**specific applicable condition codes**", as identified in table 1, their data capture requirements and examples of the features and defects, in lined pipes, as they would apply in each case.

The examples provided do not provide an exclusive coverage of the types of features or defects that might be encountered, under each of the condition codes, but are only examples of the types of features or defects and their code and severity assignment.

Additional guidance notes have not been provided for the "other applicable condition codes" as the interpretation of these codes is the same regardless of the type of pipe.

# CF: Construction Feature

## Description of Lining Construction Features

Construction features, in lined pipe, are either components of the liner manufacture, or features that occur as part of the liner installation. These features are not defects, and although they may appear as discontinuities, or as apparent marks in the liner surface, they are normal elements of trenchless liners. Examples of these elements include:

- **Vacuum/impregnation patches**: During the liner wet out a vacuum is applied to ensure the resin fills all the voids in the liner without having excessive resin. A small incision is made through the liner coating into the felt of the liner. As the wet out process is worked through, the vacuum points are removed and the holes patched with a small glue on patch (PVC coated liners) or a small hot glue gun application patch (PE and PU coated liners). This may be a small patch repair or a hot glue gun repair.
- **Grouting ports**: These are small holes (10mm) drilled in the soffit of a liner (specifically the larger man entry spiral wound liners) to introduce grout in behind the liner. Once the grouting is complete, the hole is plugged and epoxied over to complete the seal.
- **Seams**: CIPP liners are generally manufactured by forming a PVC/PE or Poly Urethane (PU) coated felted material into a tube, by stitching the two edges of the material together. The seam is produced by a 'flat seam lock stitch' machine. An alternative method of constructing this seam is with an ultrasonic weld. The stitching is not present however the seam is still visible. This produces a continuous seam along the longitudinal axis of the liner. This seam maybe visible at different positions around the circumference of the pipe.
- **Seam tapes**: As part of the seam production, the seam is sealed with a tape that is applied by either heat or ultrasonic welding. The tape will seal up the holes made by the stitching process and is placed over the seam to ensure there is no resin leakage before installation and to isolate the resin from water or steam during the curing process. The seam tape is sacrificial and once the liner is cured it is no longer required. It does not provide any strength to the liner. The seam tape will, occasionally, come away (peeling off) from the liner after a period of time in service, usually after cleaning.
- **Joints (CIPP)**: The process for manufacturing CIPP felt liners is usually a continuous process which can produce lengths in excess of 1000m. The liner is cut to length for a specific line. Occasionally a circumferential seam, connecting more than one length of the felt fabric, is required to gain continuous length of liner for a particular job. These joints are visible in the finished CIPP. These are characterised by a raised 360° spiral, often from 6 o'clock to 6 o'clock over a 0.5m length of the liner.
- **Joints (Large spiral wound pipe)**: The nature of spiral winding large bore pipes is such that multiple coils of material are required to line most pipes. The old coil will be cut off at 12 o'clock with the new coil butted up to it and the winding process re started. The butt joint is then sealed with an epoxy resin.
- **Laps**: These are most commonly observed in "*Pull and Inflate*" (such as the Nuflow liner) type of liners where multiple installations may be required to line the full length of pipe. The lap should face downstream, e.g. the upstream liner should be installed over (after) the downstream liner. The lap will be seen as a slight constriction and a feathered edge on the downstream face of the lap.

- **Inverted Wrinkles**: Occasionally there are surface indentations (inverted wrinkles) visible in the liners surface. These result commonly in patches or pull and inflate resin liners. They result from the resin conforming to the packer surface and do not compromise the liner performance or strength.

The type or description of the feature is to be provided in the Remarks.

Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| Yes | Yes | NA | Yes | Yes/No | Yes/No | Yes |

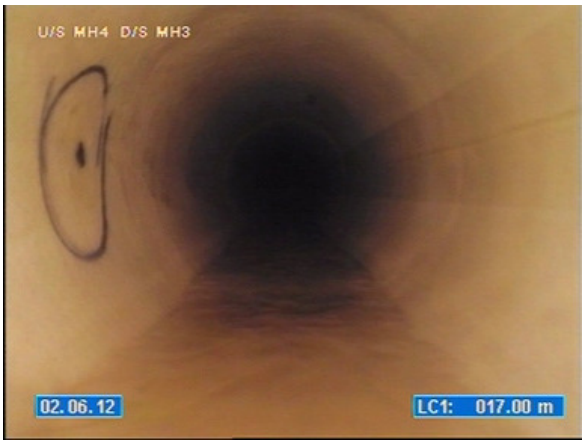
Examples

Vacuum/Impregnation patch – hot patch



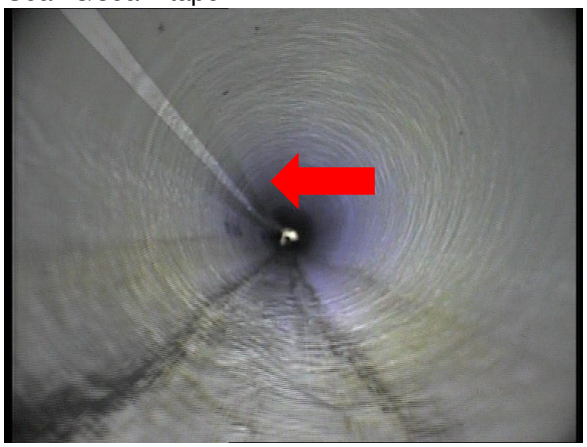
Hot patches will appear a bit like a 'repaired hole' in the liner. Will often stain quickly, (and the pipe wall around it, as though there had been infiltration) as a result of the lubricant used to install the liner. An actual hole in the liner would look like a 'cut out' section in the liner and would not appear to be repaired.

Vacuum/Impregnation patch – glued

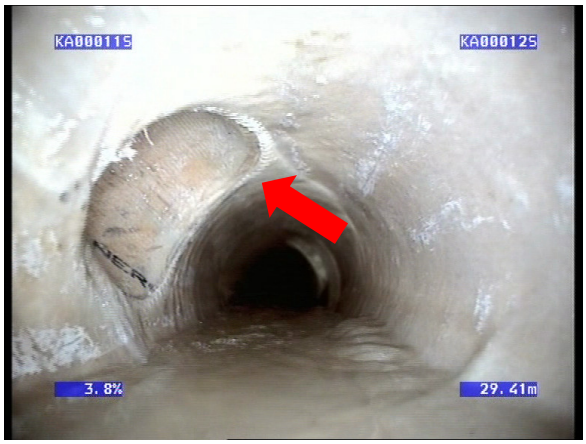



Glued patches are a circular or rectangular patch sealed (glued) onto the liner – very similar to a tyre puncture repair patch. The example in the picture also has a visible mark drawn on to the liner to guide the placement of the patch (this may not always be visible). Patchs may come loose with jetting, which is not a defect in the liner, as the patch is only required for the installation (record if the patch is loose in the remarks)

Seams/seam tape



The seam can be either heat sealed (pictured) or stitched. This seam is covered by a seam tape (note the tape band).




This picture shows an example of a 'stitched' seam used to join the lateral stub to this lateral junction repair (LJR or LCR). This stitching would not be recorded as a specific CF.

Joints (CIPP)


An example of a CIPP liner joint. These appear as 'spiral joint' in the liner. The spiral will start and end on the seam. The presence of the joint does not affect the performance of the liner

.

Laps


Lap in a CIPP Patch


A 'Pull and Inflate' liner (installed in sections). The lap for this type of liner should ideally cover the downstream section to minimise the hydraulic effect on the flow. The example in the picture has the lap over the upstream section, which is not ideal (this should be noted in the remarks). A slight lifting if the lap edge is acceptable.

# GC: general comment

## Description of General Comments for used for Liners

This code is used to provide any comments on features (other than construction features) observed with the installed liners, at a particular distance in the pipe that is not provided for elsewhere, or covered satisfactorily by an appropriate defect or feature code.

Examples of features where a GC is provided for include:

- **Staining of the liner material:** The liner material can be stained as a result of measurements marked on the liner during the 'wet out' or from lubricant (vegetable or mineral oils) used to assist installation, or over time from bacterial growth on the liner surface.
- **Extruded excess resin (feathering at the edges of patch liners or LJR's):** A small amount of resin will ooze out from the end of CIPP patches (patches or LJR's) when the packer, used to install the patch, is inflated. The extrusion may be uneven, or feathered, and may lift or break off over time. It is a characteristic of resin patches.
- **Burring/Swarf (on Spiral Wound pipe locking joints):** Swarf may be seen on some spiral wound pipes and look like very fine fibres hanging/protruding from the spiral locking joints, and can appear to look like very small roots (they should not be confused with roots). The swarf is a result of the construction of the 'sealing joint' during the liner installation.
- **Dimples (over open joints, or Sealed over laterals):** CIPP or Fold and Form liners when installed over laterals or open joints will form a dimple or concave shape in the liner.The size of the dimple, will be reflected by the size and shape of the lateral or open joint that has been lined over. This is a characteristic of a flexible liner.
- **Reflective shape of the host pipe** (where liner is over accepted pre-lining deformations, displacements or holes in the host pipe): Flexible liners, such as CIPP or Fold and Form, will take the shape of the pipe that is being lined. Any defects or deformations in the host pipe will be reflected in the liner. Remaining defects in the pipe to be lined are called 'Latent Defects'. Types of latent defects which will commonly be reflected in flexible liners include: dips, deformed pipe, pipe holes, displaced joints, minor protrusions. These will appear as bulges and deformations in the liner. Latent defects are not liner defects. Reflective latent defects, identified with a GC should be compared against the pre lining CCTV inspection to confirm the nature of the pipe prior to lining. A comment should be added.to remarks to describe the latent defect reflected in the liner. Where the deffective pipe diameter is reduced by latent defect, the estimated percentage reduction in the diameter should also be included in the remarks.
- **Peeling of sacrificial coating:** A CIPP liner has a sacrificial PE, PVC or PU coating to ensure resin is not lost or contaminated during the wet out, installation and curing process. This is a thin film. Once the pipe is cured, the coating will assist with flow however does not serve any particular purpose. It can be dislodged by jetting at too high a pressure and will peel off. This is not a liner defect and does not compromise the integrity of the lined pipe.

**A description must be provided in the Remarks to describe the nature of the feature in the liner**.

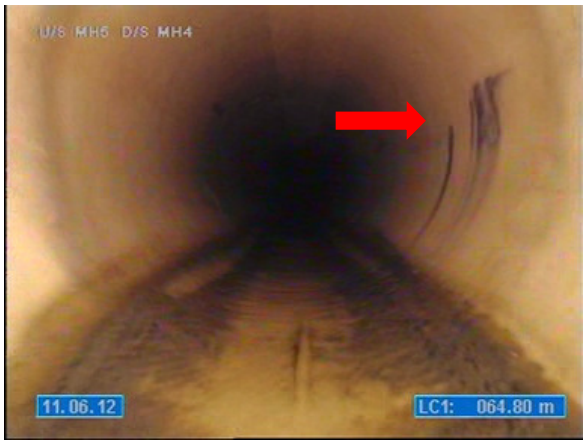
Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| Yes | Yes | NA | Yes/No | Yes/No | Yes | Yes. Include estimated % reduction in diameter for any deformations/protrusions |

Examples:

**Staining of the liner material including measurements marked on liner**


Photo, above, typical staining on the soffit (roof) of a liner, from the lubricants used during installation.

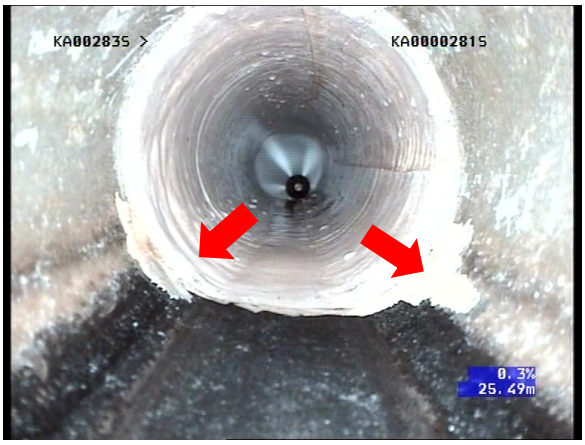


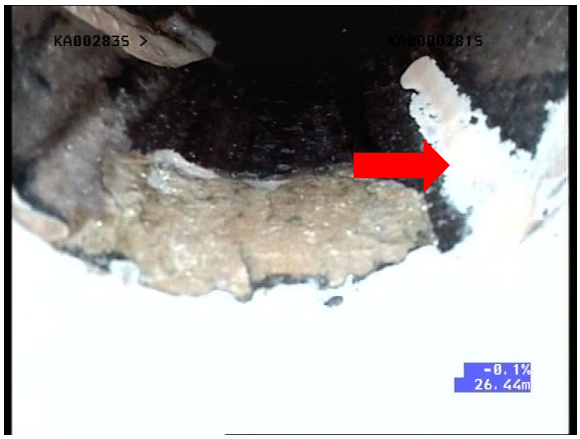

Photo, above, shows typical staining from notes written on the liner prior to installation. Staining such as this can also occur where:

- The installation lubricant has been concentrated, if water was used during the curing process; or,
- It could indicate a pinhole in the liner. If in doubt, a pressure test should be carried out to confirm the integrity of the liner.


Photo,left, shows notes marked on the liner during wet out.

**Extruded excess resin (feathering at the edges of patch liners or LJR's)**



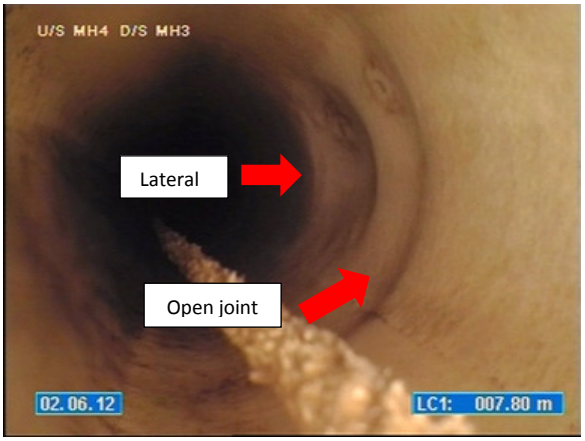




The photo on the left shows feathering of resin on the upstream edge of a CIPP patch. The photo on the right, shows feathering of extruded resin (appearing as white) on the downstream edge of the patch. This expoxy extrusion assists with a smooth transition between the pipe and the patch (i.e. no 'step' between the two).

**Dimples (over open joints, or Sealed over laterals)**



Both photos above show 'dimples' in a flexible liner over a lateral connection (left) and inspection point/inspection eye, (right). The size and shape of the lateral and inspection point is clearly reflected in the liner.




Flexible liner over an open joint (dimple foreground) and lateral connection.

**Reflective shape of the host pipe**


Flexible liner showing reflective shape of the pipe beneath the liner.


Flexible liner over a minor displaced & open joint in the host pipe


Another example, above, of a flexible liner over a displaced joint in the host pipe

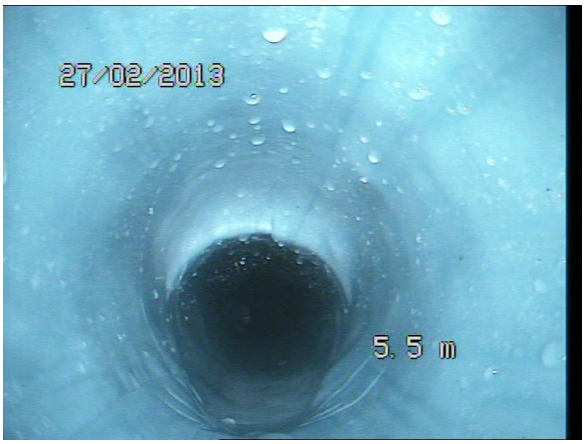

Flexible liner, above, installed in a deformed lateral junction – liner takes on the deformed pipe shape.


Flexible liner installed in a deformed pipe – liner takes the shape of the host pipe.


Flexible liner covering an inspection point in an EW pipe (100mm). The liner reflects the shape of the host pipe feature (expanding out to fill the

shape


Flexible liner over what appears to be either a slight displacement or an uneven (irregular) wall thickness at the joint that you commonly see in EW pipes.




Flexible liner over a displaced joint in 100mm diameter pipe


Dips in the host pipe are reflected in the lined pipe.

# LC: lining change

## Description for change of lining type, in lined pipes

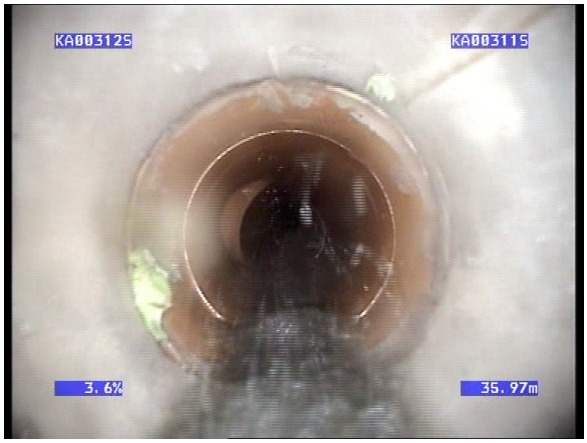
This code is used to record the start and end of any inserted patch liners or LJR's. Record the patch/LJR lining type in the "Remarks" field. Both the start and end of the patch/LJR is recorded.

Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| No | Yes | NA | No | No | If specified | Yes |

Examples


LJR installed in a lined pipe. The lap of the LJR at the start of the patch is visible as a 'lip'.




Picture above, shows the transition from a CIPP patch to the original pipe that has been repaired. The green material at 8 o'clock is masking tape used to bind the patch to the packer for installation. The tape is protruding from the end of the patch, caught between the pipe and liner. This is not a defect in the patch liner. The tape will eventually break off – this can be recorded as a temporary obstruction (OT).

# LF: Lateral, Faulty

## Description of lateral faulty with Lined pipes

The “LF” code is used to record defects at lateral connection associated with the ‘sealing’ between the installed liner and the host pipe/lateral. This code is generally used where a lateral has been re-opened, or cut out, but a LJR or LCR has not been installed.

| Severity | Definition |
|---|---|
| Small | NA |
| Medium | There is no LJR/LCR installed, but there is no evidence of leakage between the host pipe/lateral and the Liner |
| Large | There is no LJR/LCR installed, and there is evidence of leakage between the host pipe/lateral and the Liner |

Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| No | Yes | Yes | Yes | No | Yes | Yes |

Examples:



Photos above show examples of where the liner has been re-opened (cut out) to reinstate a lateral connection, but an LJR/LCR has not been installed. There is evidence of leakage (LF, Large)


Panned view, left, of the cut out liner at a lateral connection with no LJR/LCR – showing gap between the liner and the host pipe/lateral.

# LX: Lateral, Problem

## Description of lateral problems with Lined pipes

The “LX” code is used to record any defect that is identified inside lateral pipes (upstream of the point of connection that have either been lined or have an LJR installed. The nature of the defect is noted in the “Remarks” field. Defects at the point of connection are either coded under PL or LF.

| **Severity** | **Definition** |
|---|---|
| Small | Small severity defect (based on the criteria of the defect in the lateral as if it were in the main) |
| Medium | Medium severity defect (based on the criteria of the defect in the lateral as if it were in the main) |
| Large | Large severity defect (based on the criteria of the defect in the lateral as if it were in the main) |

Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| No | Yes | Yes | Yes | No | Yes | Yes |

# PL: Protective lining defective

## Description of protective lining defects

This code covers defects in the pipe liner material. This may include:

- **Bulges:** These can result from lining over debris/object in the pipe, or protrusions in the host pipe. They can also be caused by poor quality control of pressure or temperature during the curing process, causing local 'sagging'.
- **Wrinkles:** Longitudinal wrinkles commonly occur, in CIPP liners, when a liner is larger than the host pipe. For example, CLS is typically a 138mm internal diameter for a nominal 150mm pipe. Material changes where a localised repair has been done can also produce wrinkles. Circumferential Wrinkles occur on the inside radius of a bend. Wrinkles are often present, in CIPP liners, at the upstream and downstream manholes as a result of the change in direction of the liner at these locations (transition of the liner in and out of the manhole during installation).
- **Separation from the host pipe wall**: This will typically occur on the outside of bends.
- **Lifting/separation of a patch liner/LJR from the pipe liner:** This is most commonly caused by post patch installation cleaning or maintenance using mechanical methods such as rodding. It can also be caused by poor quality control of the patch wet out and patch preparation or poor quality control of pressure during installation.
- **'Bunching' or restriction at lateral connections:** This is where the lateral connection opening is restricted by the installed LJR/LCR. This can be caused by:
  - Difficult geometry of the lateral connection (Position of the lateral or the angle of the lateral pipe away from the main pipe)
  - Poor planning or workmanship. E.g. inflation of the packer, timing, or incorrect size of the LJR material.
- **'Bunching' or restriction mid line:** Most commonly seen in small diameter pipes or when a very flexible liner is utilised. It will appear as a circumferential wrinkle and constriction mid line. The pre lining video should be compared to ensure there is no other reason for the bunching in the pipe.

**The type or nature of the liner defects is to be provided in the "Remarks" field**

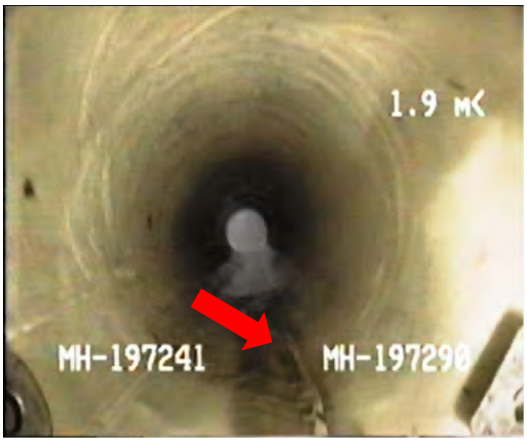
| Severity | Definition |
|---|---|
| Small | Size relative to Diameter, up to 10% |
| Medium | Size relative to Diameter, >10% up to 25% |
| Large | Size relative to Diameter, >25% |

Data Capture Requirements

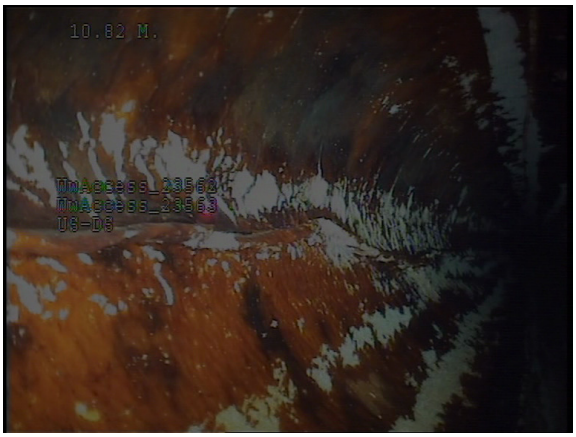
| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| No | Yes | Yes | Yes | Yes | Yes | Yes |

Examples

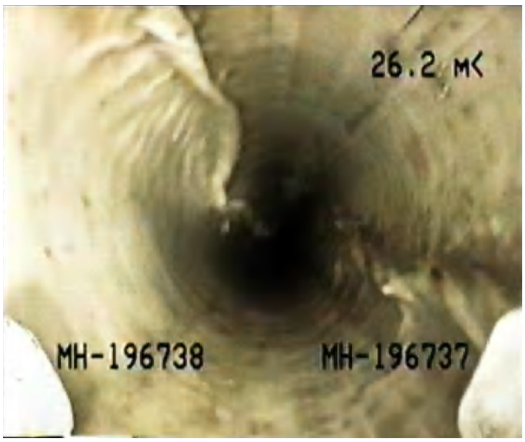
**Wrinkles**



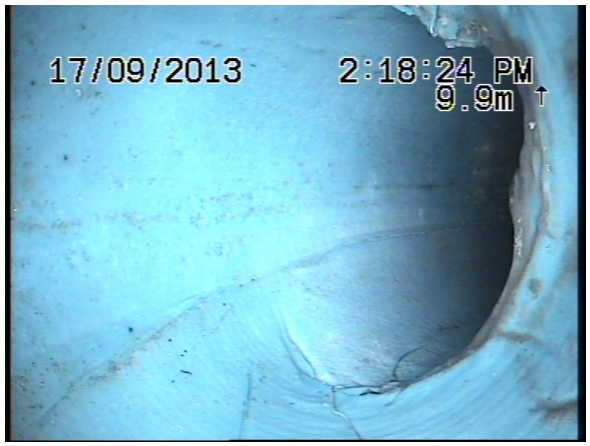

Small, longitudinal wrinkle in the invert




Small, longitudinal wrinkle on the side wall




Large, longitudinal wrinkles

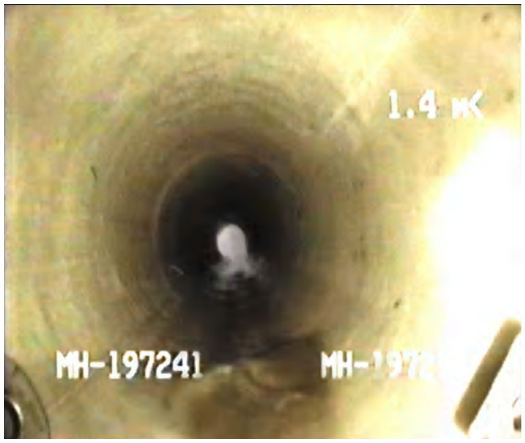



Large, Circumferential wrinkle on the inside of a bend.


Medium, longitudinal wrinkle mid-line.

**Bulges**


Large, bulge in the liner




Small, bulge in the liner, appears that there was debris in the pipe, not removed, prior to lining


Medium, bulge in the liner.

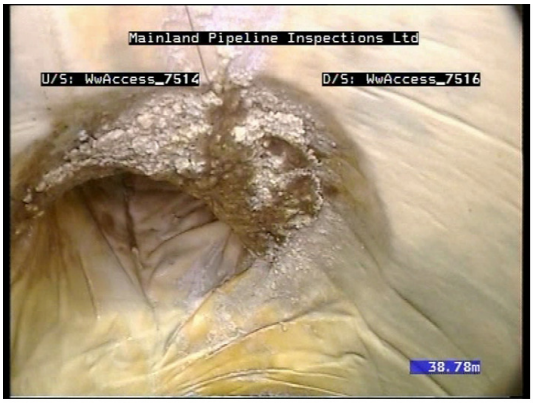
Small, bulge where the liner has gone over an object.

**Lifting/Separation of a patch from the liner**


Medium PL, LJR/LCR lifted/separated from the spiral wound liner.


Small PL, CIPP patch lifted/separated from the spiral wound liner.

**Bunching or restrictions at lateral connections**




Large, PL – appears that an incorrect size LJR/LCR used, with excess resin.

# SD: Surface damage

## Description of surface damage to liners

This code is used to describe defects with the pipe liner, in relation to abrasive damage occurring during the installation of the liner or as a result of associated work or cleaning.

Examples of surface damage to liners include:

- **Tearing:** This can occur as a result of mishandling of a resin impregnated liner prior to installation or from mechanical damage to the liner after the installation
- **Abrasion:** Damage to the liners as result of water blasting or drain cleaning rods etc.
- **Popped Locks:** This can occur in spiral wound liners. It is seen as a joint in the liner sitting above the liner.
- **Holes:** This can occur as a result of mishandling of a resin impregnated liner prior to installation, or hole being cut in the liner in the wrong location, during the opening of laterals. The hole may only be a small pinhole and may appear as a staining on the liner. Care should be taken to determine if the staining is as a result of a hole, or if it is staining on the surface of the liner. Holes can also occur when the pipe is damaged by an external third party operation such as piling or drilling through the pipe.
- **Leakage:** Any of the above defects can result in leakage (infiltration).

A CIPP liner has a sacrificial PE, PVC or PU coating to ensure resin is not lost or contaminated during the wet out, installation and curing process. This is a thin film. Once the pipe is cured, the coating will assist with flow however does not serve any particular purpose. It can be dislodged by jetting at too high a pressure and will peel off. This is not a liner defect and does not compromise the integrity of the lined pipe. Likewise, seam tapes, in CIPP liners, are also sacrificial and once the liner is cured it is no longer required. It does not provide any strength to the liner. The seam tape will, occasionally, come away (peeling off) from the liner after a period of time in service, usually after cleaning.

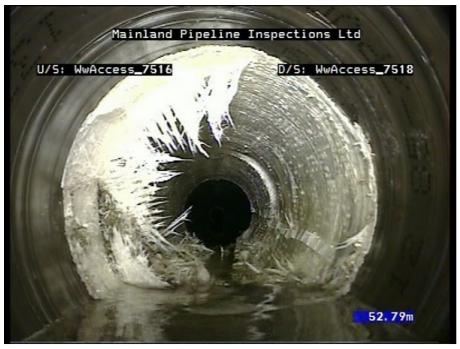
**The nature of the damage is noted in the "Remarks" field**.

| **Severity** | **Definition** |
|---|---|
| Small | Damage effect has minor effect on the integrity of the pipe wall |
| Medium | Damage effect has moderate effect on the integrity of the pipe wall |
| Large | Damage effect has significant effect on the integrity of the pipe wall |

Data Capture Requirements

| Continuity | Condition Code | Severity Rating | Position From | Position To | Photo (s) | Remarks |
|---|---|---|---|---|---|---|
| Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Examples




mechanical damage to patch possibly due to water blasting of the pipe