



## Liners Troubleshooting Manual :: Inward Folding of the Liner - Lifts

Inward folding has been observed on finished liners, sometimes on the invert, but not exclusively. Such folds can be small, raised areas which do not seriously hamper flow or access. Equally, they can be catastrophic, almost completely obstructing flow and access.

**Causes:** The formation of lifts as opposed to fins is associated with the reduction or removal of internal pressure within a liner.

While a cured liner is hot, it has a reduced stiffness. If the internal pressure is removed while the liner is still hot then external water pressure may overcome the buckling resistance of the liner.

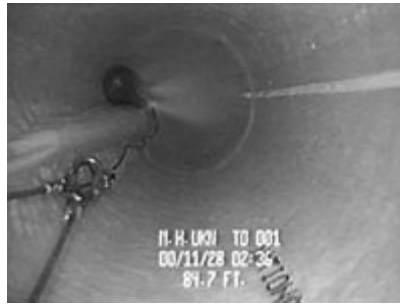
Even if the internal pressure is not removed, it is possible for side connections to fill with water to such a level that it overcomes the internal pressure in the liner.

In the case of a liner which has been damaged, water may find its way under the coating and wash some of the resin out before it has cured. Depending on the external water pressure on the removal of the internal pressure the liner, and with the liner being partly devoid of resin, it may collapse in those locations.

In some cases, the water circulation may have been inadequate such that the top of the liner has cured, but the bottom has not. In this case, it is possible for the invert to lift under the influence of external ground water pressure after internal pressure is removed.



**Figure 1 :: A lining showing small areas of inward folding.**



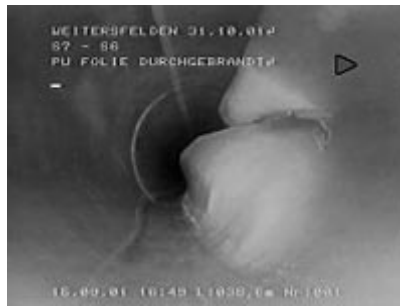
**Figure 2 :: A lining showing another example of inward folding of relatively small extent.**



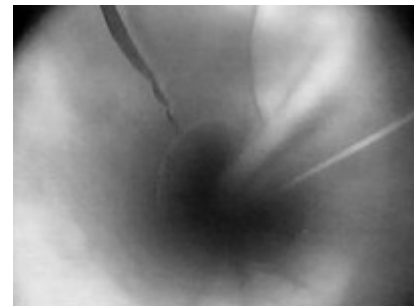
**Figure 3 :: An area of inward folding being cut out remotely.**



**Figure 4 :: An area of inward folding being cut out by hand.**



**Figure 5 :: An area of severe inward folding.**



**Figure 6 :: An area of inward folding associated with a cracked lining.**

**Solutions:** Make sure that the liner is fully cured around the complete circumference.

For heat cured liners, the water circulation system should be a vertical circulation that is established in the pipe to avoid stratification and hence avoid cold spots at the invert.

Damage to the coating should be avoided to prevent leaks through the coating.

Ensure that the lining has cooled adequately before releasing the internal pressure.

Ensure that side connections are stopped-off or kept pumped-out where they could otherwise allow an external head to develop.