backfilled. Pipe deflection measurement shall be performed using a laser profiler measuring the full circumference of the sewer whilst simultaneously undertaking a CCTV survey. The Contractor shall not remove any dewatering system until the pipeline has successfully passed the initial deflection test requirements.

b) The type of laser profiler used for measuring the pipe deflection shall be approved by the Engineer. The equipment shall be maintained in good working order and have a valid calibration certificate that shall be submitted upon request and or before every period of use. The dimensional measurement shall cover the full circumference of the pipe and shall be able to measure the degree of deflection with an minimum accuracy of +/- 0.25 %.

c) Deflection measurements shall be taken along the entire length of the pipeline at regular intervals not exceeding 5 metres and the survey details shall be provided as a continuous print out of the results in numerical and graphical displays. Additionally a visual display of the measurements on a remote monitor shall be provided. This shall be recorded on re-playable media on site and shall allow the results to be printed in graphical or numerical format at later date. A stand-alone CCTV inspection is not accepted as a substitute for deflection testing.

d) In the case of small diameter pipelines, which are too small to accept a laser profiler, the deflection shall be checked by drawing a rigid mandrel through the pipeline. It shall be sized and designed as detailed below.

i. **Mandrel Size**

Depending on whether the mandrel is being used to measure initial or long term deflection it shall have an outside diameter (O.D.) equal to 96% or 94% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

ii. **Mandrel Design**