Chapter 12

Step testing

Step testing is an effective, flow-based method of localising water loss within a zoned distribution system. It is particularly suited to identifying areas of high leakage and to use on plastic pipe materials, where leak noise is absorbed and conventional acoustic methods are less effective.

To perform a step test the inflow into a zone must be monitored. This can be achieved by deploying a data logger upon the inlet water meter to automatically transmit flow data to the operative in the network. Alternatively an additional operator can be left upon the inlet meter to manually record flow and network activity.

Once a method of monitoring has been established, then valves are closed to cut off sections of the zone known as "steps". This demonstrates how much water is consumed in each step. Each step has an estimated customer consumption which is compared with the drop in flow at the inlet meter. If the difference between the actual drop in demand and estimated consumption is significant, this provides an indication to the operative that leakage is contained within that Step.

There are several different variations on the approach depending on the technology available, whether it is important to maintain supply or the configuration of the network.

12.1 PRINCIPLES OF STEP TESTING

The following outlines the principles of step testing.

- Each zone will require a plan that identifies which pipe lengths are to be used, valves to shut and in which order valves are to be shut. This should be used for all subsequent step tests, providing the zone does not change. By keeping the plan consistent the operators can provide further judgement based upon experience.
- When designing a step test plan it is important to have an optimum amount of "steps". This will largely depend upon the size of the zone. Too few steps may not achieve the desired reduction in

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leakage detection time and costs. Too many steps can be time consuming and the rate of leakage may be too insignificant for the flow meter to register.

- Another consideration when designing steps is to calculate an estimation of customer consumption so that the operative has an expectation of a typical flow rate into a step.
- Step tests should be carried out when demand is at its lowest. This tends to be at night between the hours of 01:00–04:00 am. This helps contributes to a more accurate step test as fluctuations in demand are minimised.
- Before a step test is implemented all valves required must be located on site. Once located then the integrity of the valve must be tested. This will include ensuring the valve is accessible and operable. A Zero Pressure Test (ZPT) can conclude if the valve can be closed completely without passing any water, this helps contributes to further reassurance of an accurate step test.
- There are two options in providing essential flow data to the operator closing valves in the network:
  (1) Another operator upon the inlet meter with telephone/radio communication to the operator in the network operating valves;
  (2) Radio/GPRS data logger to transmit flow data to a suitable receiving device for the operator in the network to see live flow data.
- There are three types of valves when operating a step test:
  (1) Valves that are permanently shut to create a zone. These can sometimes be called boundary valves or zone valves.
  (2) Valves that need to be shut before the start of the test in order to create steps that can be closed off during the test with a single valve, as sometimes it is not possible to shut off a section by using only one valve closure. These valves are only shut for the duration of the test and re-opened once the test is completed. They are sometimes known as circulating valves.
  (3) The final type of valve is one that isolates a step from the zone. They are numbered according to the order that they need to be shut in during the test. Step 1 is typically the step that is the furthest away from the meter and the last step closure is the one nearest the meter (Figure 12.1).

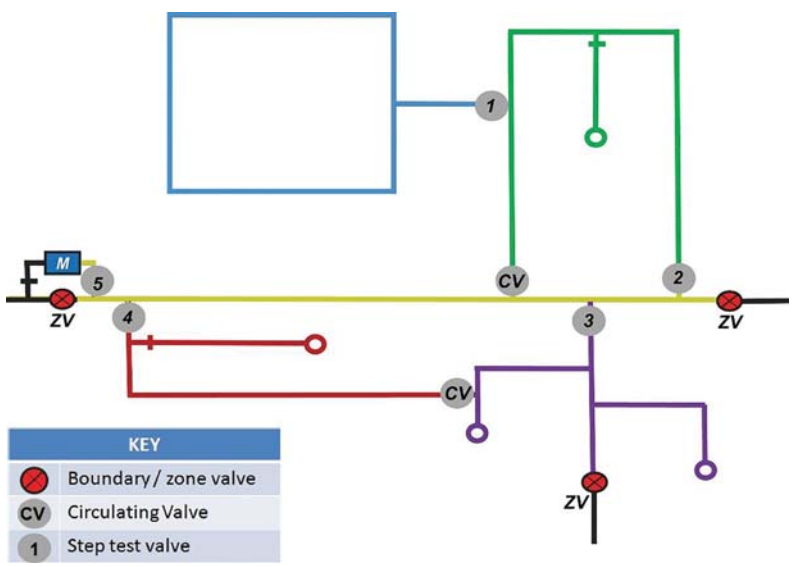

Figure 12.1 Showing a Step test plan with valves labeled accordingly. (Source: Primayer)

Table 12.1. Step test valving schedule (Source: Halma Water Management)

DMA Name		Test Area		DMA Number	555
Test Details:					
Valve Number	**Operation**	**Time**	**Flow(l/s)**	**Comments**	
Circ 1	Shut	02:00	10		
Circ 2	Shut	02:15	10		
Test 1	Shut	02:20	8		
Test 1	Open	02:25	10		
Test 2	Shut	02:37	9		
Test 3	Shut	02:51	5		

- It is important to allow a settling time (approximately 15 minutes) between each step closure so that a stable and realistic flow rate can be obtained.
- It is good practice to record when all network events occurred, for example valve closures. So that thorough analysis, if required, can occur at a later date (Table 12.1).

In Figure 12.2 drops in flows are shown as the steps are being closed. The burst was located in the final step where the flow reduces considerably. The opening of the closed step valves after the test has been completed can be seen to the right hand side of the graph (Figure 12.3).

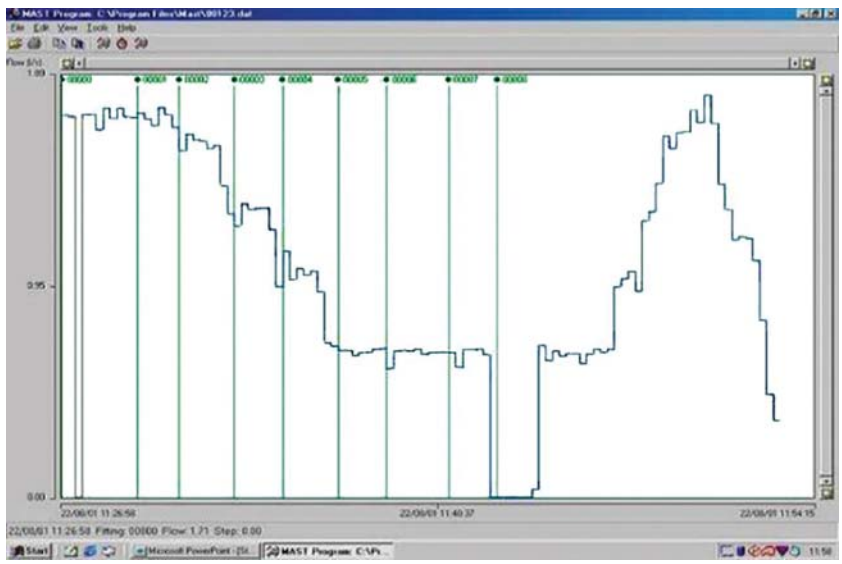

Figure 12.2 Graph showing results of a step test. (Source: MAST PC Software V5.03, Halma Water Management, Cwmbran, Wales)

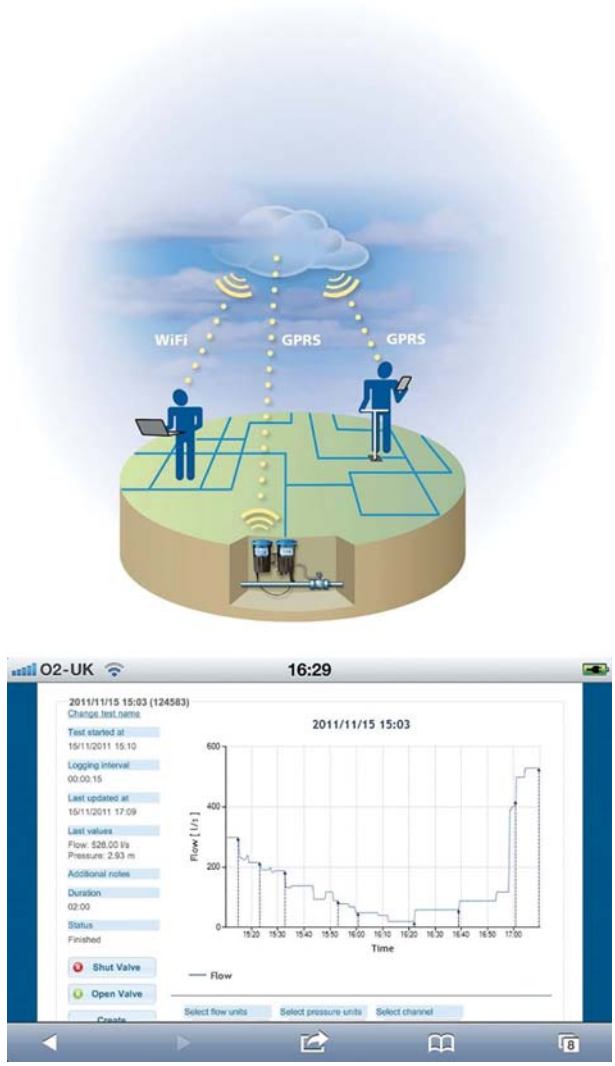

Figure 12.3 Advanced step testing (top) and data from advanced step test (bottom). (Source: Primayer)

12.2 ADVANCES IN STEP TESTING

Current technology and consumer pressures on levels of service have led to an alternative method of step testing that avoids using predetermined steps. By obtaining real time data operators can instantly view the flow changes in the network. This can reduce leakage detection time and costs further.

The approach of step testing using real time monitoring now provides the opportunity to carry out a halving and quartering technique where the zone in question is "sectioned off" for very short periods of time. This helps minimizes the disruption to supply as length of mains are not left in the closed position for a period of time. This is essential in regards to water quality and as society is becoming more active over the night-time period.

A valve which will allow the zone to be cut in half is located and closed to see which half contains the leak; this subzone is then halved again and so on until the leak is located to a section of main. There are no criteria as to how this is completed but potentially a leak could be found by only closing a couple of valves. As with the traditional method of step testing, customer consumption must be estimated for each half, quarter and any subsequent division. The operator can then compare the actual flow rate with the expected flow rate, again any significant difference raises an indication for further leakage investigation.