



**SPECIALISTS IN FLOW MEASUREMENT AND HYDRAULIC SURVEYS**

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# Guide to flowmeter surveys

## Introduction

In flow measurement the quantitative expression for accuracy is stated in terms of uncertainty. The uncertainty of a flow measurement device is an estimate of the range of values within which the true flow rate lies.

Flowcheck specialise in providing detailed surveys of flowmeter installations to identify potential sources of error and to calculate the uncertainty within the complete flow measurement system (both primary and secondary devices).

Flowcheck are accredited by the Environment Agency to provide MCERTS certification on both open channel and closed pipe flowmeters.

We survey a flowmeter installation to assess:

- The suitability of its design
- If it has been installed, commissioned and maintained correctly
- The condition of the gauging structure or primary device
- The calibration of the measurement instrumentation
- The accuracy and performance of the measurement instrumentation
- Sources of process errors.

Where problems are found we will often perform corrective works, free of charge, to optimise the performance of the flowmeter installation.

## Open channel flowmeters

The majority of open channel flowmeters consist of a gauging structure e.g. a flume or weir, and a secondary device that measures level in the approach channel and converts it into units of flow.

To obtain accurate flow measurement the gauging structure must be in good condition, precisely constructed and correctly installed.

The secondary device, that measures the level and converts it into units of flow, must be correctly installed and be calibrated to match the dimensions of the gauging structure. The secondary device must be able to accurately measure level and correctly transpose the level measurement into units of flow.

The three main factors that affect the accuracy of an open channel flow measurement system are:

1. The condition of the gauging structure
2. The calibration of the secondary device
3. The accuracy of the secondary device

## 1. Condition of the gauging structure

The location of the gauging structure is of primary importance as the upstream and downstream conditions are critical to its ability to develop a head to flow relationship. The gauging structure needs to be precisely manufactured and correctly installed. Any deviation in the critical dimensions of a structure e.g. fluctuations in the width of a flume, will impact on the uncertainty of the flow measurements.

The acceptable tolerances for standard structures are detailed in BS3680 'Measurement of liquid flow in open channels'. Any deviations from the tolerances stated in BS3680 will introduce additional uncertainty to the flow measurements.

To survey an open channel flowmeter Flowcheck measure dimensions and take levels at critical points throughout the approach channel, gauging structure, and downstream sections. From the measurements we are able to determine the true zero datum level of the gauging structure and perform calculations to determine the head to flow relationship. Where the dimensions of a structure are found to deviate from the tolerances stated in BS3680 we are able to calculate the additional uncertainty introduced into the flow measurements.

## 2. Calibration of the secondary device

Incorrect calibration is one of the most frequent sources of error found in an open channel flow measurement device. The two most common reasons for calibration errors are:

1. The calculation being based on inaccurate structure dimensions
2. Installation and commissioning engineers using simplified versions of head/flow calculation equations. The simplified equations only provide an approximation of the head/flow relationship and should not be used for calibration purposes as they often ignore major contributing factors e.g. throat length and the effect of surface roughness.

*On flume installations the surface roughness of the structure has a significant effect on the head to flow relationship and must be considered when performing calibration calculations.*

Many of the calibration calculation formulas used for open channel flow measurement structures are complex and in practical terms need to be performed using dedicated computer software. Flowcheck has developed calculation software that fully replicates the computations detailed in BS3680. Where the British Standard describes more than one formula for a specific measurement structure, we use the one we believe to be the most accurate e.g. computations incorporating boundary layer theory.

For Clients who wish to check the calibration of an installation without incurring the expense of a detailed site survey, Flowcheck will provide calibration calculations to BS3680, based on the Client's measurements of the gauging structure.

## 3. Accuracy of the secondary device

Following calibration of the secondary device it is necessary to prove that it measures the level correctly and that it accurately transposes level measurements into units of flow. Flowcheck perform a test by installing reference plates below the level sensing head. At each simulated level we record the indicated head, the flow rate and the corresponding retransmission signal. If a discrepancy is identified between the indicated flow rate and the calculated flow rate, we can often correct this by programming a precise flow/head curve into the secondary device.

## Closed pipe flowmeters

Unlike open channel flowmeters, where all the components are clearly visible, closed pipe flowmeters provide few visual clues to indicate if they are functioning correctly. Many electromagnetic flowmeters and other types of closed pipe meters have a proven record of good reliability and accuracy. The performance of these devices however, will be impaired if they have been incorrectly sized, poorly located, badly installed, or have a component malfunction. Many of these devices rely on the pipe being full at the point of measurement and will be affected by air entrapment and settled solids.

To survey a closed pipe flowmeter we perform numerous checks on both the sensor head (primary element), which normally forms a spool piece within the pipeline, and the converter (secondary device), also referred to as the transmitter, which converts electrical signals from the primary element into units of flow.

We check:

- If the meter is located correctly
- If the installation conforms to the relevant British standard
- If the installation complies with the manufacturers installation guidelines
- If the meter has been sized correctly
- The probability of settled solids being present in the flowmeter spool piece
- The programming and configuration of the secondary device
- Matching of the primary and secondary devices

Following completion of the installation checks Flowcheck perform a functional test. If possible we will verify the meter under test against one of our own non-intrusive ultrasonic flowmeters. By installing an ultrasonic flowmeter on the same section of pipe as the flowmeter under test, the performance of the meter under test can be checked throughout its operational range.

These in situ comparisons can eliminate the need to have site meters removed and sent away for testing on a flow rig.

## Summary

Flowcheck are specialists in flow measurement and have a broad knowledge of open channel and closed pipe flowmeters. We have no commercial links to any manufacturer or supplier; our surveys and reports are therefore, completely impartial.

## Flowcheck perform

- Detailed surveys of flowmeter installations
- MCERTS certification of both open channel and closed pipe flowmeters
- Open channel flowmeter calibration calculations to BS3680
- Calibration and commissioning of flowmeters
- In situ verification of flowmeters by comparison to our own metering equipment
- Installation and hire of temporary flow metering equipment
- Flowmeter maintenance contracts

## Contact us

To discuss your specific requirements contact [Flowcheck Ltd](#)

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