

THERMAL MASS FLOW METERS MONITOR LANDFILL GAS FLOW RATE AND CONSUMPTION

There are over 1000 Waste Disposal Landfill sites throughout the country. Typically, the gas that is naturally generated from these sites consists of a mix that is typically 55% CH₄ and 45% CO₂. This Landfill Gas is an energy source, and is frequently used to run engines that produce electricity. However, the gas flow is at a very low pressure and the associated velocity is extremely low – well below the threshold of most Flow Meter technologies. However, there is one technology that has been proven to handle this difficult measurement: A Thermal Mass Flow Meter.

A Thermal Mass Flow Meter is based on the principle of conductive and convective heat transfer, and essentially picks up the movement of gas as the molecules of gas cool off the heated sensor. As such, they are extremely accurate devices (typically 1%) and have extraordinary low-end sensitivity – they can detect even the slightest flow of the Landfill Gas. They are temperature compensated, have negligible pressure drop, are resistant to contamination, and the more modern devices can tolerate wide gas temperature fluctuations. They use reference grade platinum RTD windings as the sensors, and therefore the measurements are extremely stable over time. Typical Thermal Mass Flow Meters have a 100 to 1 turndown, so a very wide range of measurement is available.

Most importantly, they are easy to install. Most manufacturers provide 1/2" or 3/4" diameter probes that are easy to insert into existing pipes (from 2" to 24"). Merely tap a hole, weld a half coupling, and insert using a manufacturer provided isolation valve assembly, or even a simple compression fitting. Most manufacturers provide guidelines where in the pipe to locate the sensor, and some manufacturers offer a variety of strategies, even if the flow profile is not ideal. (The flow profile depends on a number of factors, the most important of which is the length of unobstructed straight run prior to the flow meter).

Specifically, the Flow Meter will report Gas Mass Flow rate in SCFM, SCFH, LBS/H or other convenient measurement units (without requiring external temperature or pressure devices to do so), and the devices will also totalize the ongoing gas consumption (SCF or LBS). The flow rate is reported over 4-20 ma outputs, as well as on a display (LCD or LED depending on the manufacturer), and can also be accessed on a laptop. Some manufacturers provide the ability for the totalizers to be reset externally by a simple contact closure, or by utilizing menuing systems accessed by a keypad or via RS232 and a laptop. In some models Relays are available that can be configured as pulsed outputs, and a remote counter can then be used as an independent method of reporting consumption.

Thermal Mass Flow Meters are available with integral or remote enclosures that are powered from either 24 VDC or 115 VAC, and are typically under \$3000. Some of the recent entries in the market place offer (as a standard feature) remote enclosures that contain all the electronics (as well as a display of flow rate, temperature and total), eliminating the need for any electronics at the sensor location. In this type of configuration, the sensor has a convenient weather proof and explosion proof junction box for the 6-conductor cable, but no electronics - a major advantage in very hot or cold climates where electronic components may be degraded or be susceptible to failure. The robust NEMA 4X remote electronics enclosure can be mounted up to 2000 feet away, and thus can be mounted indoors, or at least in a cabinet, where the ambient temperature is not severe. Neither the cable length nor cable temperature effect the meter's accuracy, since the circuitry in the remote enclosure has lead-length compensation of the sense leads, nulling out any changes from original factory calibration.

Most seasonal variations of the landfill mix are minor, and as such, a single NIST traceable factory calibration of the meter is usually satisfactory. However, the more advanced manufacturers of this equipment have the ability to calibrate for up to four different gas mixes, if necessary, and these calibrations are stored as separate ranges (or channels). They are selectable in the field by keypad,

laptop, or remotely selectable with contact closures. Finally, the more advanced equipment have routines to check the calibration of the meter by utilizing "zero flow" as a test point, and comparing it to the original factory calibration which is furnished upon shipment. These routines also verify if the sensor is clean, as well as assuring that the meter is still in calibration. In extreme situations, where moisture is present (although it is best to eliminate excess moisture with traps, dryers and filters), splash guards are available with some manufacturers to minimize the effect of moisture on the flow sensor.

In summary, Thermal Mass Flow Meters provide an affordable and accurate means to measure Landfill Gas Mass Flow Rate and consumption, and they do not require any external temperature or pressure devices. Furthermore, their extreme low-end sensitivity (velocities as low as 10 SFPM), negligible pressure drop, high accuracy, long term stability and ease of installation, are important features that benefit the Landfill Operator for electricity billing, environmental compliance, safety and efficient plant operation.

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