

SAGE METERING, INC. THERMAL MASS FLOW METERS FOR GAS FLOW

LANDFILL GAS EMISSION MONITORING AND REPORTING



Sage Metering, Inc.



- ◆ Manufacturer since 2002 of High Quality Thermal Mass Flow Meters (TMFMs) for Gas Flow Rate and Consumption
- ◆ Common Applications include Biogas, Digester Gas and Landfill Gas Flow Rate as well as Methane and Natural Gas Flow

Typical Landfill Gas Applications



- ◆ Quantify Flare Gas emissions to comply w/ GHG Rules (40 CFR Part 98) for Municipal Solid Waste Landfills (Subpart HH)
- ◆ Flare Gas emission compliance for Industrial Waste Landfills (Subpart TT)
- ◆ LFG from wellheads and collection pipes
- ◆ Monitor LFG for Carbon Offset Projects through Methane destruction
- ◆ Comply with LFG Project Protocol CAR 4.0E

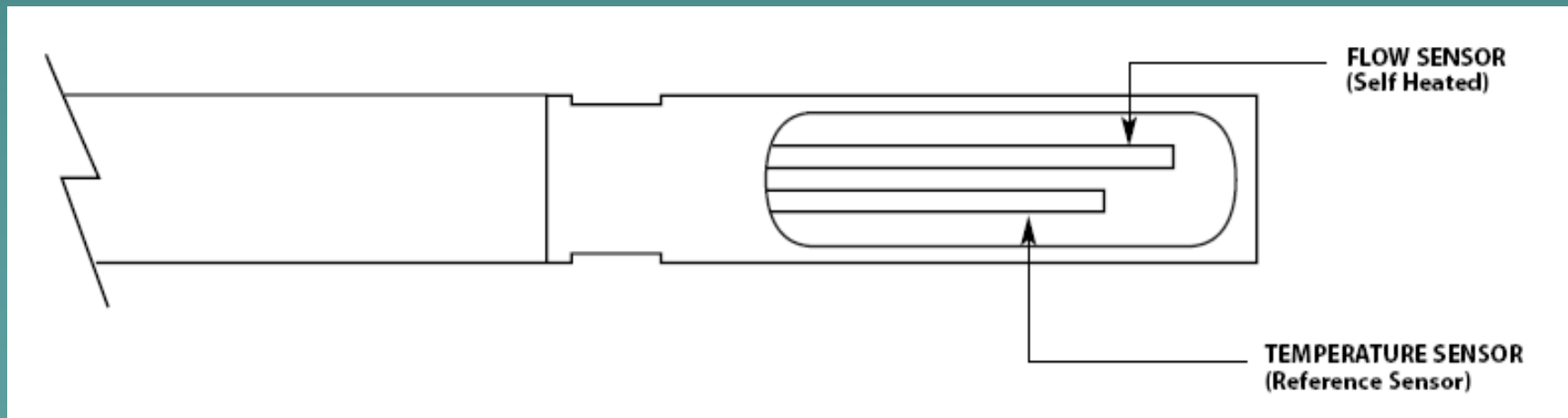
Why Thermal Mass Flow Meters?

- ◆ Thermal Mass Flow Meters (TMFMs) can quantify emissions saved by measuring Mass Flow Rate
- ◆ TMFMs have rangeability of at least 100:1 – making them extremely accurate over the wide flow ranges due to gas spikes and seasonal changes
- ◆ They have low-end sensitivity & fast response time, making them accurate at fluctuating low flows – common in LFG monitoring



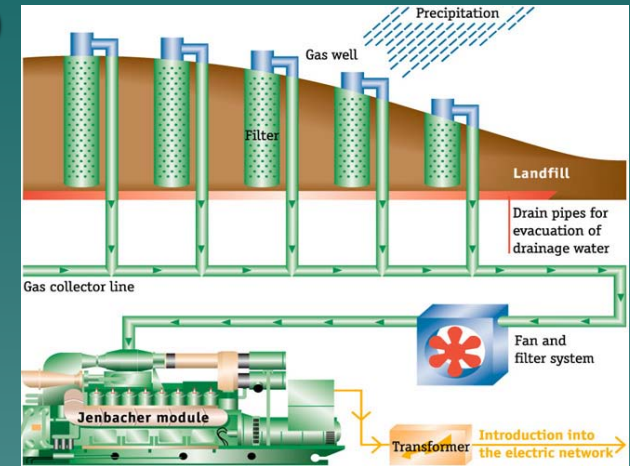
WHAT IS A THERMAL MASS FLOW METER?

- ◆ It is a Meter that directly measures the Gas Mass Flow based on the principle of conductive and convective heat transfer



Thermal MFMs & Renewable Energy

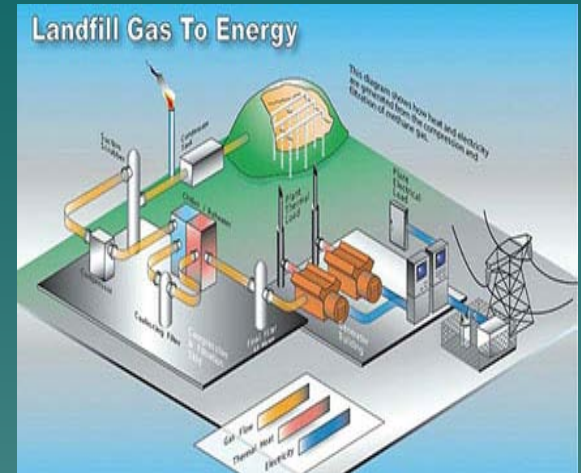
- ◆ Landfill Gas (typically 50% CH₄ and 50% CO₂) is a source of fuel, and many facilities are using LFG to create renewable energy (LFGTE) by collecting the gas from multiple wellheads through a network of pipes to a common header



- ◆ TMMs can monitor this fuel source to run generators to create electricity, or to create energy to heat onsite buildings, boilers and kilns (co-generation)

Accurate Flow Measurement

- ◆ Accurate flow measurement is required to quantify the emissions being saved for landfill gas monitoring and reporting
- ◆ Whether the gas is being extracted from wellheads, recovered in LFGTE applications, collected for carbon offset projects, or flared to prevent its release, TMFMs offer accurate and repeatable measurement
- ◆ The calibration of the Sage meter can be verified on site through an easy check without removing the meter from the pipe



Verifying the Calibration

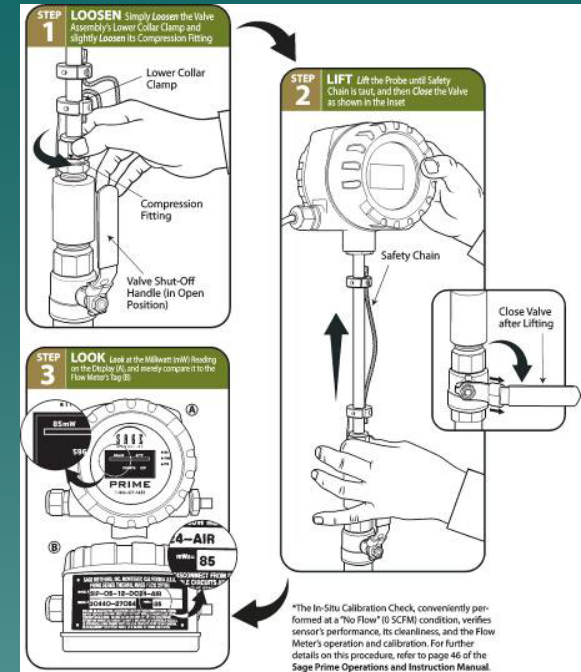
- ◆ EPA 40 CFR part 98 requires emitters to report annual GHG emissions, and flow meters are being scrutinized to find the best way to measure and report data
- ◆ Landfill Project Protocol Version 4.0 (paragraph 6.2) states that monitoring instruments shall be inspected and calibrated ... per manufacturer's guidance, at the end of – but no more than two months prior to or after – the end date of the reporting period (typically 1 year or less)

..... How to Verify

- ◆ In 2007 Sage pioneered the “In-Situ Calibration Check”, a convenient user verification of the meter’s calibration – simple enough for virtually any user to perform
- ◆ This important contribution to the industry, a result of our unique hybrid-digital bridge technology, eliminated the expense and inconvenience of the commonly held practice of sending flow meters back for recalibrations
- ◆ As a result, the GHG emission verification process has become much easier, as demonstrated in the following video

In-Situ Calibration Check

- ◆ The following video describes the Sage In-Situ Calibration Check. This three minute procedure is conducted at a "no flow" condition – within the existing pipe
- ◆ The check is reliable, regardless of the test gas temperature, and assures that the sensor is clean, and that the Flow Meter hasn't drifted, shifted, or changed since its initial NIST Traceable Factory calibration



◆ <http://sagemetering.com/in-situ-calibration-check/>

More on Thermal Mass Flow Meters



- ◆ Thermal Mass Flow Meters (TMFMs) have no moving parts to wear out or to replace
- ◆ They measure Mass Flow directly, there's no need for separate Temperature & Pressure Transmitters
- ◆ TMFMs have sensitivity down to 5 Standard Feet per Minute (5 SFPM)
- ◆ They're temperature compensated, so process temp changes are not an issue

More on TMFMs



- ◆ Calibrated for known mix (e.g., 50% CH₄/50% CO₂) in NIST Traceable cal facility — and can be factored for gas mix variations
- ◆ Negligible pressure drop – ideal for low flows that result from low gas output
- ◆ Dirt insensitive, yet easy to clean if needed
- ◆ Easy-to-read graphical display of Flow Rate, Totalized Flow and Temperature
- ◆ Low Power Dissipation (only draws 2.5 W)

Insertion Thermal Mass Flow Meters

Insertion Style



< Remote Style



Sensor
Detail



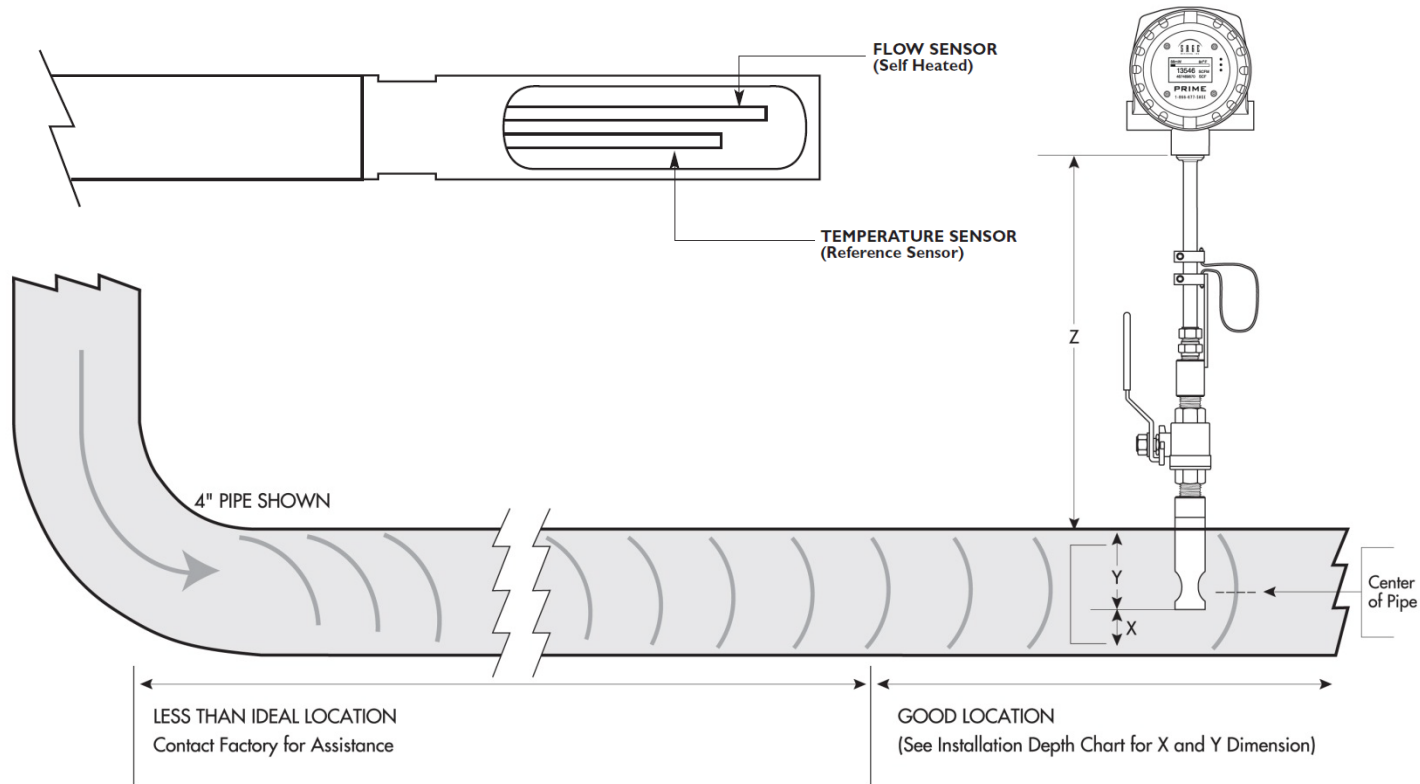
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w/ Mtg
Hardware



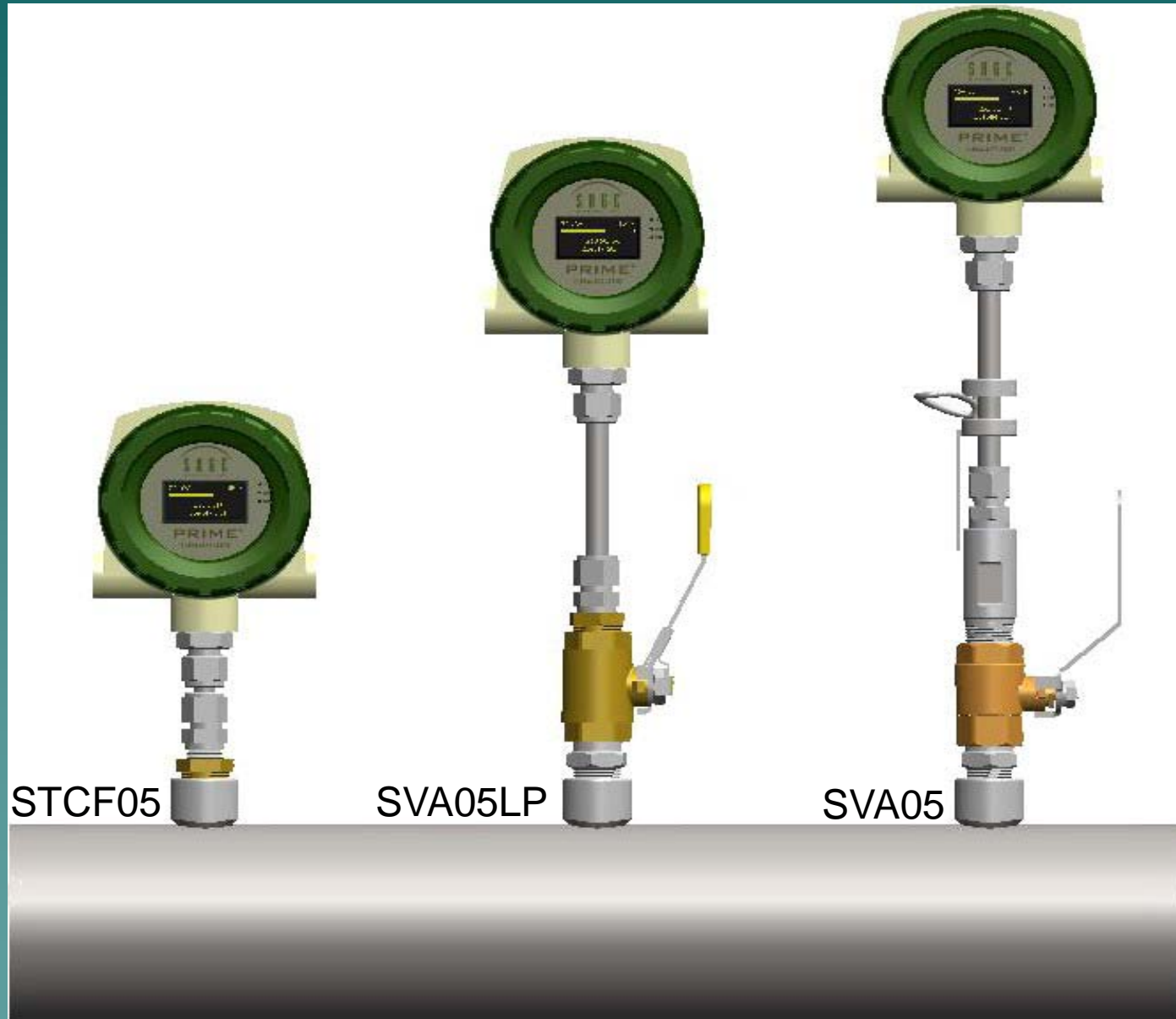
Typical Installation

Easy to Install

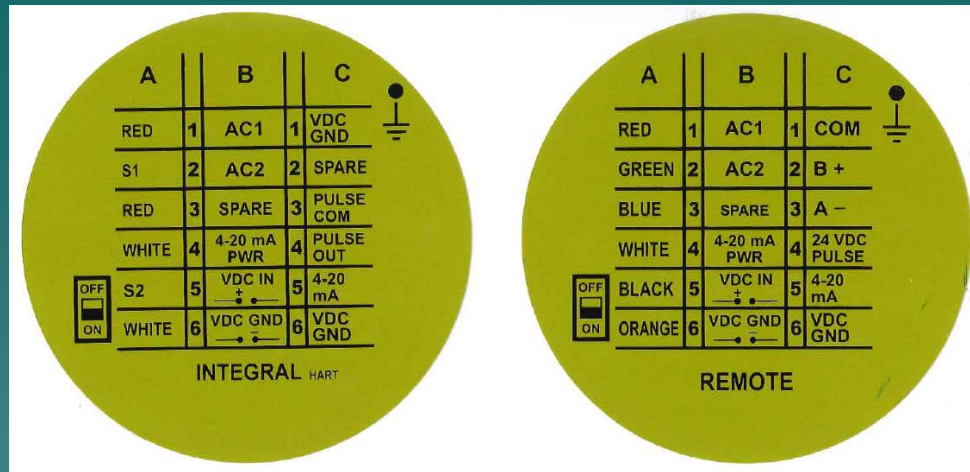
(Choices of Mounting Hardware)



Insertion Flow Meter Mounting Hardware



Terminals and Outputs



- ◆ Powered by 24 VDC or optionally 12 VDC (for Solar Energy) or 115/230 VAC
- ◆ 4 – 20 mA proportional to Mass Flow Rate
- ◆ Pulsed Outputs of Totalized Flow — ideal for tracking SCF or Lbs of LFG being flared, or for Carbon Credits (CH₄ destruction)
- ◆ Modbus Communication or HART

DUAL COMPARTMENT (Separate Rear Enclosure)

- ◆ The rear compartment, which is separated from the electronics, has large, easy-to-access and well marked terminals, for ease of customer wiring



Sage Prime Display



Diagnostics
Graphical Flow Indication
Flow Rate
Totalized Flow (non-resettable)



Temp

INSTALLATION STYLES



Integral Insertion



Integral In-Line



Remote Insertion



Remote In-Line

PORTABLE SAGE FLOW METERS



SAGE™
METERING, INC.

PWR

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LOG#0007 86°F

174 SCFM

■ CHAN B-AIR 4"

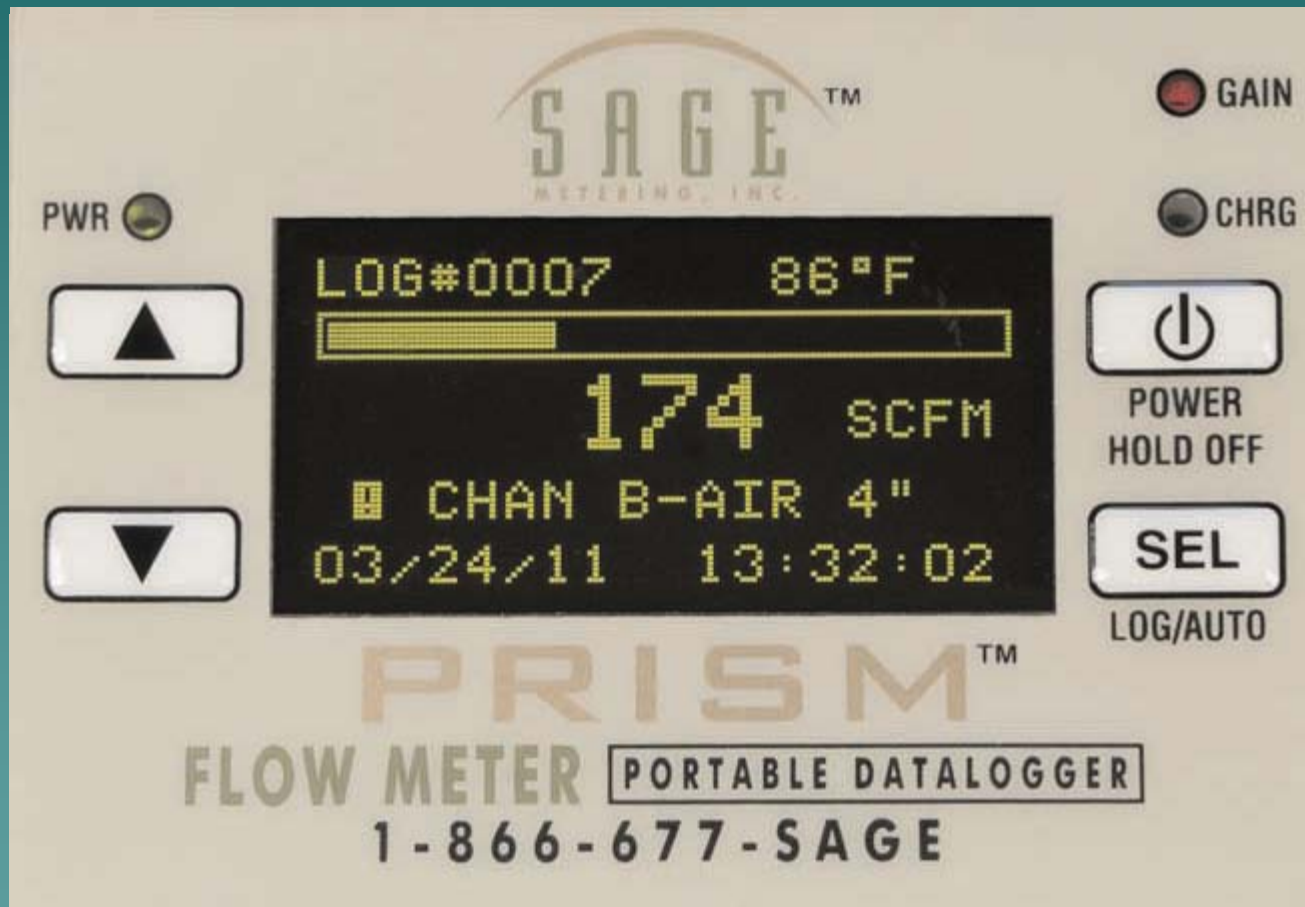
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PRISM™
FLOW METER PORTABLE DATALOGGER
1-866-677-SAGE

GAIN

CHRG

SAGE PRISM PORTABLE BATTERY OPERATED DATALOGGING TMFMM



PRISM KEYPAD SCREEN



SAGE PRISM OVERVIEW

- ◆ The versatile Sage Prism™ combines our hybrid-digital technology for gas TMFM measurement with extensive datalogging capability and portability – ideal for balancing well heads or verifying flow rate
- ◆ The ergonomically designed Prism portable operates up to 10 hours on a built-in rechargeable lithium-ion battery, or for weeks off of the power pack, and can capture up to 3800 data points of gas flow
- ◆ Keypad selectable for multiple pipes sizes

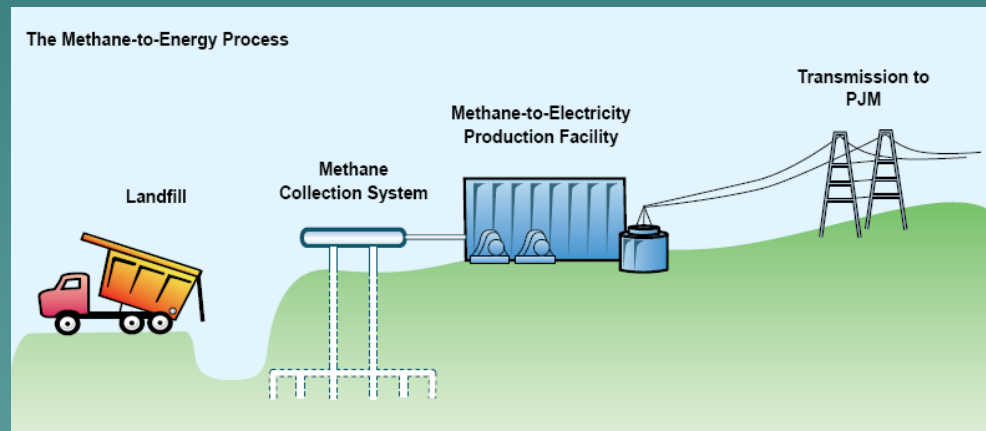
The Thermal MFM Advantage

- ◆ They offer direct Mass Flow readings, have excellent sensitivity, fast response time, and are not effected by process temperature or pressure variations – thus an ideal instrument for the challenges of Landfill Gas emission reporting, or to measure Flow Rate or consumption in LFGTE applications
- ◆ Easy-to-install insertion style meters, or convenient datalogging portables provide a choice of monitoring solutions
- ◆ And, with the Sage unique In-Situ calibration check, verification to comply with the protocols is quick and reliable



SAGE METERING, INC.

We thank you for your time and attention,
and welcome the opportunity to assist
you with your Landfill Gas Flow
Monitoring needs



For additional information, please visit
our website at www.sagemetering.com