TURBINE FLOWMETERS BY
HOFFER
PERFECTING MEASUREMENT

ACE CRYOGENIC SYSTEM
Product Bulletin ACE-103C

TECHNICAL DATA SHEET

ACE, an acronym for Advanced Cryogenic Electronics, is a system for the measurement and recording of LIN, LOX, LAR and CO2 for truck deliveries and in plant applications.

Outstanding Features

- Increased accuracy to ±0.1% by flowmeter linearization.
- Factory-programmed to user's specifications.
- Ease of operation with operator help prompts.
- Volumetric mode uses programmable temperature, pressure, and density.
- Temperature compensation (Optional).
- Fault tolerant; upon transducer failure, unit reverts to pre-programmed temperature, pressure, and density.
- Maintains and prints calibration records.
- Time and date stamping of delivery documents and reports.
- Malfunction warning messages.
- Password security to prevent unauthorized access to setup and maintenance modes.
- Preventive maintenance notification.
- Audit trail support.
- Ease of maintenance due to extensive self-checking provisions which simplify problem isolation.
- 32-character, alphanumeric display.

General Description

ACE's advanced design allows for superior performance and ease of use at low cost. ACE performs accurate measurement of commonly delivered industrial gases while having printer output capability. The system requires minimal operator involvement.

The simple panel design provides for ease of use by the operator and maintenance personnel. Both users will find the prompting messages on the alphanumeric display easy to follow.

The advanced compensation method allows for the density of the liquid to be inferred from the actual temperature measurement and pressure default value.

Problem isolation is greatly simplified by ACE's extensive self-checking functions and replacement of modular components by unskilled workers is possible.

ACE has advanced reporting and communication capabilities. These include provisions for delivery, trip, and maintenance reporting. These reports are available by either serial printing or computer communication.

Modes of Operation

Operating: When power is first applied, ACE will be functioning in the operating mode, displaying delivered mass total. This mode is used to perform and display all flow computations of product delivery. Delivery totals can be cleared and tickets printed. A password for the operator is not required.

Setup: This mode is used to enter all flowmeter parameters. Other entries may be made to configure the system for optional features. A password is required for access to setup.

Maintenance: In this mode, the user can perform maintenance operations, enter maintenance records, and display results of troubleshooting and factory adjustments test. Additional utilities are provided to allow for serial interface testing. A password is required for access to maintenance.

Display Selections

ACE performs a number of measurements, depending on how the system is configured. These are available to the operator, using the select key. The following is a list of variables calculated during a delivery and capable of being indicated.

- Delivered mass total.
- Accumulative mass total.
- Delivered volumetric total.
- Accumulative volumetric total.
- Volumetric flow rate.
- Mass flow rate.
- Temperature.
- Pressure.
- Density.
- Date and time.
- Audit Trail.

A volumetric system can display mass flow, provided that user-selected fixed temperature, pressure, and density parameters have been entered in the setup mode.

Measurements Performed

- Flow totalization.
- Flow rate indication.
- Temperature measurement and density determination (Optional).

Printer/Communication Capabilities

The industry standard RS232 port is provided on all ACE systems. ACE supports printers, remote terminals, and communication to host computers.

Optional Pump Interlock System

The pump interlock works in conjunction with the temperature measurement of liquid in the discharge line. If the temperature falls into the gas region, an internal relay shuts down operation. During cool down, the pump cannot be started until a liquid temperature is detected.

Optional Remote Electronic Counter

ACE offers an optional pulse output which may be connected to a counter to permit remote indication of the delivered quantity. This output may also be used by vehicle monitoring systems to record delivery status and results.

Optional Pressure Compensation

ACE is capable of taking in an analog signal from a pressure transmitter and using it to provide a more accurate measurement. This option also can enhance the pump interlock option by allowing ACE to precisely determine the two-phase region and monitor pump cavitation.

Factory Support

The Hoffer Applications Group is ready to assist you with sizing meters and recommending electronics options to meet your application needs. The Hoffer Engineering and Production Group ensures that each flow system is supplied fully programmed to the user's specifications, calibrated, and ready for easy installation.

Hoffer takes pride in its dedication to customer service and satisfaction. A toll free number is provided for factory support and service.

Specifications

Display

32-character, alphanumeric, backlit LCD display with optional heaters to prevent fogging. Character height is 0.3". English or metric units are user defined. Display indicates last delivery total when power is first applied.

Dedicated Fluid Property Tables/Temperature Compensated Range

Product	Compensated Temperature Range
LIN	75 to 125°K
LOX	90 to 135°K
LAR	85 to 125°K
CO_2	-30 to +20°F
CO_2	-60 to +30°F (optional)

CO_2 systems support both single and dual-pipe deliveries. During dual-pipe delivery, credit is automatically applied for CO_2 vapor returns. This is a unique feature of Hoffer CO_2 systems and is expected to be incorporated in the forthcoming metering code.

Keypad

LIN, LOX and LAR systems are equipped with five momentary keys defined as follows:

In Operating Mode:
Mode, Select, Clear, Print, Control.

In Setup Mode:
Mode, Select, Clear, Print, Control.

In Maintenance Mode:
Mode, Select, Clear, Print, Control.

In LIN, LOX and LAR systems, the control key allows forward and reverse scrolling in each mode.

In CO_2 systems, the control key selects between single- and dual-pipe operation.

Environmental

Operating temperature:
-20° to +70°C (+4° to +158°F)

Storage temperature:
-40° to +90°C (-40 to +194°F)

Flowmeter Input

Input Sensitivity: 10 mVrms.
RF and bandpass filtered.
Magnetic pickup compatible.

Temperature Probe

1000 ohm, platinum RTD-compatible.

Pressure Transmitter (Optional)

4 - 20 ma or 1 - 5 VDC analog output, 0 - 300 or 0 - 500 PSIA range transmitter.

Pulse Output (Optional)

The pulse output is a scaled pulse (1 pulse per gallon, SCF, etc.) It is offered as a TTL/CMOS or open collector type pulse. Maximum output is 125 pulses/second.

Power Input

Input voltage:

12 VDC ±10%(2 AMP maximum current)

24 VDC ±10%(2 AMP maximum current)

Optional 115/220 VAC with power pak converter.

Input-filtered, reverse polarity and fault-protector. Trailer power suitable for positive or negative ground.

Printer/Communication Interface

RS232 Drive level compatibility.

Handshake methods XON/XOFF, hardware handshake, or none.

Baud Rate: User selectable.

Optional Bluetooth® wireless interface.

Self-Checking Capabilities

System functionality test on startup checks resistance on pickup coil, temperature probe, and their respective cable assemblies.

Detects low power supply voltage. System is inoperative until 10.5 VDC minimum voltage is restored. Fault messages will be displayed periodically and logged internally for optional printout.

Malfunction Detection Capabilities

Coil failures, RTD failures, pressure transmitter failures, low power, Computer Operating Properly (COP) error detection, memory loss, and circuitry failure.

Operator Error Detection Capabilities

Low and High flow rate alarms.

Temperature compensation out of range.

Two-phase flow detection.

Enclosure

Dimensions: 5.26” High x 6.9” Wide x 9.30” Deep.

Rugged aluminum enclosure.

Environmentally-sealed MS connectors type E.

Optional Shock-Mounted with 10° up/down tilt bracket for variable viewing angle.

System Approvals

ACE has been tested and approved by the State of California and is approved for use throughout the United States.

ACE has also been tested and approved to O.I.M.L. Standards which include stringent accuracy, shock and vibration, electromagnetic electrostatic discharge, and heat and humidity testing.

A test certificate applicable in numerous countries around the world has been issued.

Overview of Cryogenic Flow Measurement

For 25+ years Hoffer Flow Controls has been providing turbine flowmeters to the cryogenic industry. Hoffer pioneered the commercial application of turbine flowmeters for cryogenic service. The resulting design brought about an increased service life and reliability second to none. Hoffer also pioneered temperature compensation for cryogenic products. Our focus is on product improvement and service to the industry.

Turbine Flowmeters in Liquid and Gas Service for the Cryogenic Industry

Turbine flowmeters have been reported as the most accurate flowmeters in industrial use. Hoffer offers a wide selection of turbine flowmeter sizes with flow ranges and physical configurations to fit most applications. The design is directed toward cryogenic service with ease of maintenance in mind. Special tools or training are not required to service Hoffer flowmeters.

The Hoffer line of cryogenic turbine flowmeters uses a unique self-lubricating bearing which prolongs the life of the flowmeter in fluids that offer poor natural lubricity such as liquid nitrogen. In fact, this bearing is used in gas service with excellent results. Hoffer flowmeters are designed to permit gas spinning with no damage to the flowmeter. The materials of construction assure oxygen compatibility.

For additional information on the Hoffer line of turbine flowmeters, request the Turbine Flowmeter Engineering Guide.

A Comparison of Volumetric and Temperature Compensated Systems

Broadly speaking, flow measurement systems may be classified as volumetric or mass types. Volumetric flowmetering systems measure the volume of fluid in units such as gallons or liters. Mass flowmetering systems measure in units such as pound or kilograms. Hoffer offers both volumetric and mass flow measurement systems.

What is Temperature Compensation? Most fluids change density in a consistent manner with temperature. This property allows the density to be inferred from the temperature measurement. Mass flow in an inferential mass measurement system is calculated by multiplying the volume flow times the inferred density on a continuous sampling basis. Using the Hoffer patented compensation schemes, an accuracy of ±0.25% can be obtained in temperature compensators for cryogenic fluids for saturated pressures to 225 psig. This corresponds to a density change of 20%. Second order curve fits are used since straight line approximations result in considerable error. Readouts in gallons at NBP and cubic feet at NTP may be provided in accordance with the requirements of HDBK 44.

Where is Temperature Compensation used? Temperature compensation should be utilized whenever the mass flow or weight of the quantity transferred is more important than the volume delivered. On pressure transfer trailers and on most customer stations it is a must. In bulk transports, the added measurement accuracy often justifies the additional cost. HDBK 44 states that all billing be done in terms of mass units Why not have your meters reading out in these units and simplify billing while improving accuracy?

Proven System Reliability and Accuracy

The Hoffer truck-mounted systems have been designed and built to withstand the rigors of over-the-road service and to operate reliably in the accompanying temperature extremes they will see in actual service.

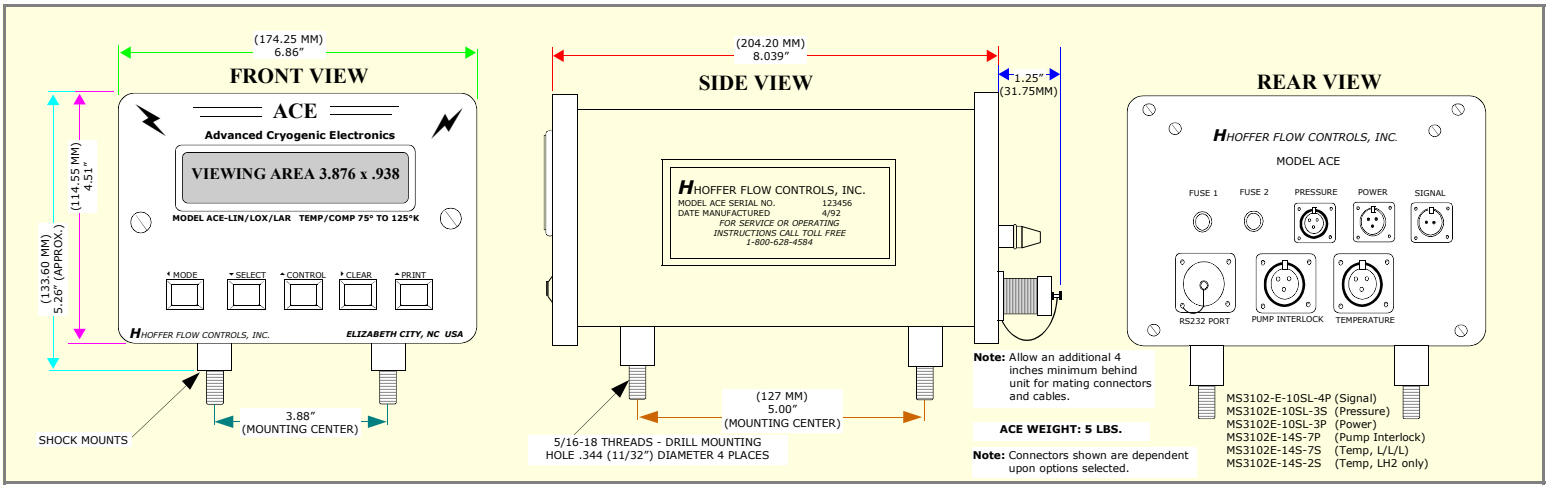
Through the years Hoffer has worked with key industry individuals and the National Bureau of Standards to provide workable systems which conform to government standards. Copies of various test reports are available.

Ease of Field Calibration and Adjustment

All Hoffer systems currently available have provisions to facilitate field proving.

Hoffer Systems are Designed to Comply with the Following Guidelines:

Handbook 44 Cryogenic Metering Code
Shock and Vibration MIL-STD 810B
NBS TN 361 (Revised)
ASHRAE Physical Properties of CO_2
State of California Department of Weights and Measures
O.I.M.L. - R81
Report of Tests are available on Volumetric and Temperature Compensated Systems



ORDERING INFORMATION

Basic Model Number ACE-B- (A) - (B) - (C) - (D) - (E) - (F)

A. Service

(1)	LIN/LOX/LAR - Volumetric (*"Corrected Gallon"*)
(1T)	LIN/LOX/LAR - (Compensated)
(2T)	CO_2 - Temp/Comp
(3T)	Nitrous Oxide - Temp/Comp
(4T)	Liquid Hydrogen - Temp/Pressure/Comp
(5T)	LPG - Temp/Pressure/Comp
(6)	Other
(6T)	LNG - Temp/Pressure/Comp
(7T)	LIN/LNG/Ethylene
(V)	True Volumetric
(P)	For pressure compensation (4-20 ma). Add "P" to any above "T" options, specify pressure range.

B. Pulse Output

(1)	TTL/CMOS
(2)	Open Collector
(3)	AC Square Wave ***Specify pulse width in MS as part of part number**
(PI)	Pump Interlock for 9.3, 24, 115 & 220 volts

C. Power

(7.5)	12 VDC works on 12 volt battery down to 7.5 VDC
(12)	12 VDC works on 12 volt battery down to 9.3 VDC
(24)	24 VDC
(AC)	110/220 VAC power**.** 24 VDC power output. Internal power supply can power both printer and ACE electronics with and without heaters.

D. Heaters

(H)	Heater-required for below 32°F
(X)	None

E. Mounting

(S)	Standard - Flat mount with shocks
(T)	Tilt - Tilt bracket with shocks
(NS)	Nema 4X Fiberglass enclosure with shocks
(E)	Explosion-proof with 5 switches on cover. Meets NEC Class I, Groups B,C, & D; Class II, Groups E, F, & G; Class III, UL standard 886. CSA Standard C22-2 No. 30 & NEMA 4.

F. Special Features

(CE)	Add –CE at end of model number for international.
(SP)	Any special features that are not covered in the model number. Give a written description of –SP.
(BT)	Bluetooth® option, mounted internally in the enclosure.
(PS-CE)	Special European approvals (PTB or MID), dual coil input.

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