10/2/12
21 May 2010

Australian Government
National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Notification of Change
Certificate of Approval No 10/2/12
Change No 1

Issued by the Chief Metrologist under Regulation 60
of the
National Measurement Regulations 1999

The following changes are made to the approval documentation for the

Hoffer Model HO Bulk Liquefied Carbon Dioxide Flowmetering System

submitted by Hoffer Flow Controls Inc.
107 Kitty Hawk Lane
Elizabeth City
North Carolina 27906 USA.

A. In Certificate of Approval No 10/2/12 dated 22 January 2010, the FILING ADVICE should be amended by adding the following:

"Notification of Change No 1 dated 21 May 2010"

B. In Technical Schedule No 10/2/12 dated 8 October 2008, clause **1.2 (vi) Calculator/Indicator** should be amended to read, in part:

"The Hoffer Flow Controls model ACE-B-**2**TP-3-X-X-S-CE calculator/ indicator …."

C. In FIGURE 10/2/12 – 3 dated 8 October 2008, the caption should be amended to read"

"Hoffer Model ACE-B-**2**TP-3-X-X-S-CE Calculator/Indicator"

Signed by a person authorised by the Chief Metrologist to exercise his powers under Regulation 60 of the *National Measurement Regulations 1999*.

Australian Government
National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Certificate of Approval

No 10/2/12

Issued by the Chief Metrologist under Regulation 60
of the
National Measurement Regulations 1999

This is to certify that an approval for use for trade has been granted in respect of the

Hoffer Model HO Bulk Liquefied Carbon Dioxide Flowmetering System

submitted by Hoffer Flow Controls Inc.
107 Kitty Hawk Lane
Elizabeth City
North Carolina 27906
USA.

NOTE: This Certificate relates to the suitability of the pattern of the instrument for use for trade only in respect of its metrological characteristics. This Certificate does not constitute or imply any guarantee of compliance by the manufacturer or any other person with any requirements regarding safety.

This approval has been granted with reference to document NMI R 117-1, *Measuring for Liquids Other Than Water*, dated December 2004.

CONDITIONS OF APPROVAL

This approval becomes subject to review on 1 November 2013, and then every 5 years thereafter.

Instruments purporting to comply with this approval shall be marked with approval number 'NMI 10/2/12' and only by persons authorised by the submittor.

It is the submittor's responsibility to ensure that all instruments marked with this approval number are constructed as described in the documentation lodged with the National Measurement Institute (NMI) and with the relevant Certificate of Approval and Technical Schedule. Failure to comply with this Condition may attract penalties under Section 19B of the National Measurement Act and may result in cancellation or withdrawal of the approval, in accordance with document NMI P 106.

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The National Measurement Institute reserves the right to examine any instrument or component of an instrument purporting to comply with this approval.

Auxiliary devices used with this instrument shall comply with the requirements of General Supplementary Certificate No S1/0/A.

DESCRIPTIVE ADVICE

Pattern: approved 3 October 2008

- A Hoffer model HO flowmetering system for bulk metering of liquefied carbon dioxide.

Variants: approved 3 October 2008

1. Using certain Hoffer flowmeters as listed in Table 1.
2. With a model ACE-II-1-TP calculator/indicator.

Technical Schedule No 10/2/12 describes the pattern and variants 1 & 2.

Variants: approved 9 December 2009

3. Using an alternative Hoffer flowmeter as listed in Table 2.
4. With a model ACE-II-2TP calculator/indicator.

Technical Schedule No 10/2/12 Variation No 1 describes variants 3 & 4.

FILING ADVICE

Certificate of Approval No 10/2/12 dated 8 October 2008 is superseded by this Certificate, and may be destroyed. The documentation for this approval now comprises:

Certificate of Approval No 10/2/12 dated 22 January 2010
Technical Schedule No 10/2/12 dated 8 October 2008 (incl. Table 1 and Test Procedure)
Technical Schedule No 10/2/12 Variation No 1 dated 22 January 2010 (incl. Table 2)
Figures 1 to 4 dated 8 October 2008
Figure 5 dated 22 January 2010

Signed by a person authorised by the Chief Metrologist to exercise his powers under Regulation 60 of the *National Measurement Regulations 1999*.

TECHNICAL SCHEDULE No 10/2/12

Pattern: Hoffer Model HO Bulk Liquefied Carbon Dioxide Flowmetering System

Submittor: Hoffer Flow Controls Inc.
107 Kitty Hawk Lane
Elizabeth City
North Carolina 27906 USA

1. Description of Pattern

A vehicle-mounted bulk flowmetering system incorporating a Hoffer model HO (*) turbine flowmeter (Figure 1 and Table 1) for bulk metering of liquefied carbon dioxide.

(*) The full model number of the meter is in the form 'HO-1½x1½-8-130-CB-1M-MS-CE'.

1.1 Field of Operation

The field of operation of the measuring system is determined by the following characteristics:

Product (#1)	Temperature Range (°C)	Pressure Range (kPa)	Density Range (kg/m³)
Carbon Dioxide (CO2)	–51 to –1	652 to 3447	833 to 1143

- Minimum measured quantity, V_{min} 100 kg (#2)
- Maximum flow rate, Q_{max} 500 kg/min
- Minimum flow rate, Q_{min} 100 kg/min
- Ambient temperature range –25°C to 55°C
- Accuracy class Class 1.5

(#1) The flowmeter is adjusted to be correct for the liquid for which it is to be verified/certified as marked on the data plate.

(#2) The calculator/indicator indicates the volume at least in 1 L increments.

1.2 Components of the Measuring System (Figure 1)

(i) Supply Tank

The supply tank is designed to maintain the liquefied carbon dioxide within the temperature range specified for the product in its liquid state. An outlet is provided at the bottom of the tank leading to the inlet of the pump via an isolation valve.

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(ii) Pump

Either a positive displacement or centrifugal pump with integral or external pump by-pass valve is positioned as close as possible to the outlet of the supply tank with sufficient flow capacity to maintain the delivery within the flow rate range specified for the flowmeter. The pipe from the supply tank has a continuous fall to the pump inlet and has a diameter not smaller than that of the pump outlet pipe. Provision is made between the pump and the meter for a by-pass line to allow liquid to flood the pump and the meter before measurements begin.

(iii) Measurement Transducer

The measurement transducer is a Hoffer model HO (*) turbine flowmeter (Figure 2) incorporating single signal pick-off with pre-amplifier. The signal is connected to the calculator/indicator, which has provision for monitoring the integrity of the meter pulse output.

The inlet of the meter is connected to a flow straightener pipe with a bore equal to that of the meter and is at least 10 pipe diameters long.

The outlet of the meter is connected to a straight pipe with a bore equal to that of the meter and is at least 5 pipe diameters long. A flow control valve may be fitted downstream of the straight pipe to regulate the flow and used to prevent flashing/cavitation by maintaining the downstream pressure greater than 70 kPa + (1.25 × vapour pressure of the product).

A check valve is fitted downstream of the flow control valve to prevent reverse flow.

(*) The full model number of the meter is in the form 'HO-1½x1½-8-130-CB-1M-MS-CE'.

(iv) Temperature Transducer

The temperature transducer is a Hoffer model PT 101S-1000-2-MSH-CE (1000 ohms, –220°C to +40°C) with a maximum operating pressure of 6.89 MPa. The temperature transducer is fitted downstream of the meter.

(v) Pressure Transducer

Flowmetering systems delivering liquefied carbon dioxide under pressure are fitted with a Hoffer model PT 570-08-A-A-4-X-X pressure transmitter (incorporating an isolation valve) or a pressure gauge installed downstream of the meter.

(vi) Calculator/Indicator

The Hoffer Flow Controls model ACE-B-1TP-3-X-X-S-CE calculator/indicator (Figure 3) has a two line 32 character alphanumeric liquid crystal display with LED backlight. The instrument has five buttons labelled Mode, Select, Control, Clear and Print to access/perform functions.

The calculator/indicator operates using Hoffer version (code) AB0618EXX1 software, which is marked on the instrument.

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(vii) Printer

For applications where the delivery is carried out without the presence of the customer, an approved printer such as Hoffer model ACE-P5-X-X-3-R-CE 12 or 24 V DC printer or equivalent (*) is interfaced to the calculator/indicator.

If a second docket needs to be re-printed the words “Duplicate ticket” will be printed at the bottom of the ticket.

(*) ‘Equivalent’ is defined to mean other proprietary equipment of the same or better specifications requiring no changes to software for satisfactory operation of the complete system including all checking facilities.

(viii) Power Supply

The instrument operates with either a 12 or 24 V DC battery. The built in time clock, and memory uses a lithium battery to maintain time, date and calculated totals.

(ix) Transfer Device

The measuring system incorporates a transfer device, located downstream of the meter, in the form of a valve (which may also be used to control the flow rate) that defines the start and stop of the measurement.

The piping and discharge hose after the transfer device shall be of empty-hose type.

The quantity between the transfer device and the connection to the delivery tank, defined by the length of the hose, is reconciled by subtracting from the metered delivery the priming quantity of the delivery hose.

(x) Checking Facilities

The calculator/indicator has the following checking facilities:

- To check the display segments press the Mode switch and when in maintenance menu press the Select switch until display test menu appears, then press Print switch to execute the test.
- Temperature probe checking with faults detected and displayed as either ‘Probe open’ or ‘Probe short’ message.
- Turbine meter pick-off coil checking with faults displayed as either ‘Coil open’ or ‘Coil short’ message.
- Liquid phase checking with faults displayed as ‘2 phase warning’ message when delivery approaches within 35 kPa of the saturated condition and may contain bubbles (vapour).
- Liquid phase checking with faults displayed as ‘gas inhibit’ message when delivery is below the saturated pressure and there is no longer liquid in the meter run.

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(xi) Set-up Functions

The calculator/indicator set-up functions are accessible by pressing the 'mode'-'select'-'control' switches at the front of the indicator allowing access to the following functions:

- Average k-factor
- Blades: (set to 6 blades)
- Fluid type: Carbon Dioxide (CO2)
- System of measure (OIML = 15ºC and 101.325 kPa)
- Unit of measure
- k-factor method
- Temperature method
- Pressure method
- Density method
- Default temperature
- Default density
- Linearisation
- and other non-metrological functions

1.3 Descriptive Markings and Notices

Each measuring system shall bear the following information, placed together either on the indicating device or on a data plate:

Pattern approval mark	NMI 10/2/12
Manufacturer's identification mark or trade mark	…..
Meter model	…..
Serial number of the instrument	…..
Year of manufacture	…..
Maximum flow rate, Q_{max}	….. kg/min
Minimum flow rate, Q_{min}	….. kg/min
Maximum pressure of the liquid, P_{max}	….. kPa
Nominal k-factor	..... pulses/litre
Type of the liquid for which the system is verified	….. (#)
Accuracy class	Class 1.5
Environmental class	Class I

(#) This may be located separately, e.g. on a metal tag sealed to the instrument.

The minimum measured quantity (V_{min}) and the software version (code) number are clearly visible on the indicating device, e.g. 'Minimum Delivery 100 kg' and 'SC – AB0618EXX1'.

A notice in the vicinity of the meter and pipework states the sequence procedure of operation/delivery.

1.4 Verification/Certification Provision

Provision is made for the application of a verification/certification mark.

1.5 Sealing Provision

Access to the calibration parameters for ACE-B series calculator/indicator is via the Mode-Select-Control switches on the calculator/indicator, which can be concealed by a cover fixed by two screws with provision for sealing (Figure 3).

Access to the calibration parameters for ACE-II series calculator/indicator (variant 2) is via the Menu soft key on the calculator/indicator, which may be sealed via software by means of a password.

2. Description of Variants

2.1 Variant 1

Using certain other Hoffer HO series liquefied carbon dioxide flowmeters as listed in Table 1.

TABLE 1

Flowmeter Model (*)	Minimum Flow (Q_{min})	Maximum Flow (Q_{max})	Minimum Delivery
HO-¾ x ¾ -2.5-29-B-1M-MS-CE	10 kg/min	50 kg/min	50 kg
HO-2 x 2 -15-225-B-1M-MS-CE	140 kg/min	700 kg/min	200 kg

2.2 Variant 2

With the Hoffer Flow Controls model ACE-II-1-TP (*) calculator/indicator.

(*) The full model number of the calculator/indicator is in the form ‘ACE-II-1-TP-PI-X-X-X-12-H-S-CE’.

The model ACE-II-1TP calculator/indicator (Figure 4) has a 128 × 68 pixel graphic liquid crystal display with LED backlight and adjustable contrast.

The instrument has 3 access/function buttons and 2 scroll buttons. The calculator/indicator operates using version 1.00.6298 software; the version number is displayed during the power-up sequence.

Access to the calibration parameters for ACE-II series calculator/indicator (variant 2) is via the Menu soft key on the calculator/indicator, which may be sealed via software by means of a password.

TEST PROCEDURE

Instruments should be tested in accordance any relevant tests specified in the Uniform Test Procedures. Tests should be conducted in conjunction with any tests specified in the approval documentation for any indicator/ controller and/or any conversion device, etc. used.

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Maximum Permissible Errors

For accuracy class 1.5

The maximum permissible errors are:

±1.0% for calibration adjustment of the meter; and

±1.5% for in service tolerance of the measuring system.

It is forbidden to adjust the calibration of the meter to an error other than as close as practical to zero error.

The meter is required to be verified/certified with the liquid that the meter is metering.

Other applicable maximum permissible errors are:

±0.6% for repeatability of a delivery at a set flow rate;

±0.5°C for temperature measurement;

±50 kPa for pressure measurement; and

±5 kg/m^3 for density measurement.

Tests

Check the calculator/indicator is marked with the software version (code) number.

Calibration Procedure

To ensure that the complete flowmetering system is measuring correctly, the accuracy of the flowmeter and the accuracy of the conversion device shall be checked separately.

The accuracy of the flowmeter is checked by setting the flowmetering system to indicate volume in litres. The accuracy of the conversion device is checked by comparing the average error for the flowmetering system indicating volume of gas against the average error for the flowmetering system indicating the volume in litres and manually converted to volume of gas. The difference shall not exceed 0.5%.

The calibration of the meter may be carried out volumetrically or gravimetrically by testing the flowmeter at least at the minimum, maximum and at the intermediate flow rate specified for the flowmetering system.

At least three deliveries at each flow rate are required to determine the repeatability of the flowmeter.

A delivery of at least 5 times the specified minimum delivery is recommended when determining the calibration of the meter. The minimum delivery for a flowmetering system shall not be less then 100 scale intervals.

At least one test comprising minimum delivery shall be performed.

TECHNICAL SCHEDULE No 10/2/12

VARIATION No 1

Pattern: Hoffer Model HO Bulk Liquefied Carbon Dioxide Flowmetering System

Submittor: Hoffer Flow Controls Inc.
107 Kitty Hawk Lane
Elizabeth City
North Carolina 27906 USA

2. Description of Variants

2.1 Variant 3

Using another Hoffer HO series liquefied carbon dioxide flowmeter as listed in Table 2.

TABLE 2

Flowmeter Model (*)	Minimum Flow (Q_{min})	Maximum Flow (Q_{max})	Minimum Delivery
HO-1 x 1 -4-60-B-1M-MS-CE	37 kg/min	190 kg/min	75 kg

2.2 Variant 4

With the Hoffer Flow Controls model ACE-II-2TP (*) calculator/indicator.

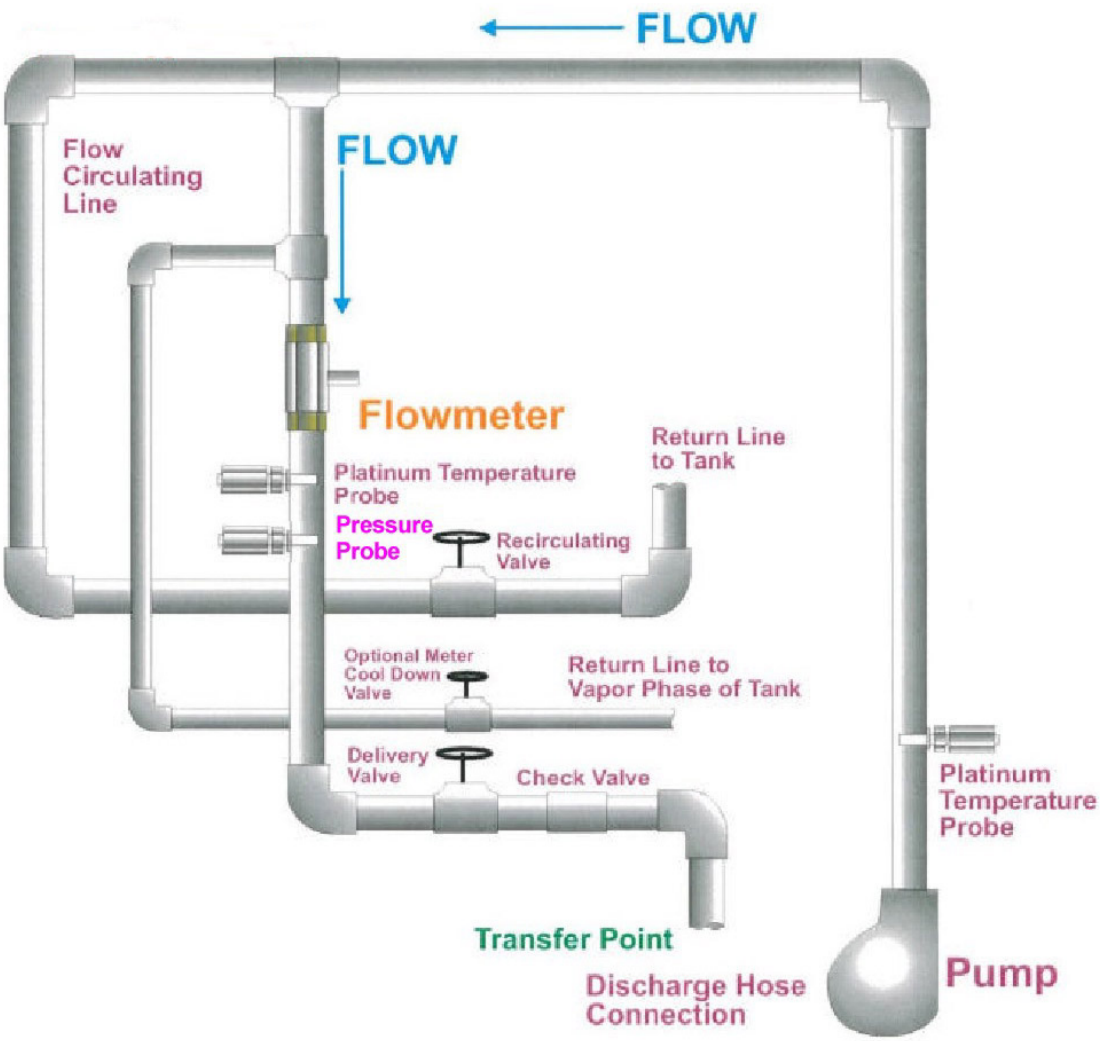
(*) The full model number of the calculator/indicator is in the form 'ACE-II-2-TP-PI-X-X-X-12-H-S-CE'.

The model ACE-II**2**-TP calculator/indicator (Figure 5) has a 128 × 68 pixel graphic liquid crystal display with LED backlight and adjustable contrast.

The instrument has 3 access/function buttons and 2 scroll buttons. The calculator/indicator operates using version 1.00.6**300** software; the version number is displayed during the power-up sequence.

Access to the calibration parameters for ACE-II series calculator/indicator is via the Menu soft key on the calculator/indicator, which may be sealed via software by means of a password.

FIGURE 10/2/12 – 1



Hoffer Model HO CO2 Flowmetering System

10/2/12
8 October 2008

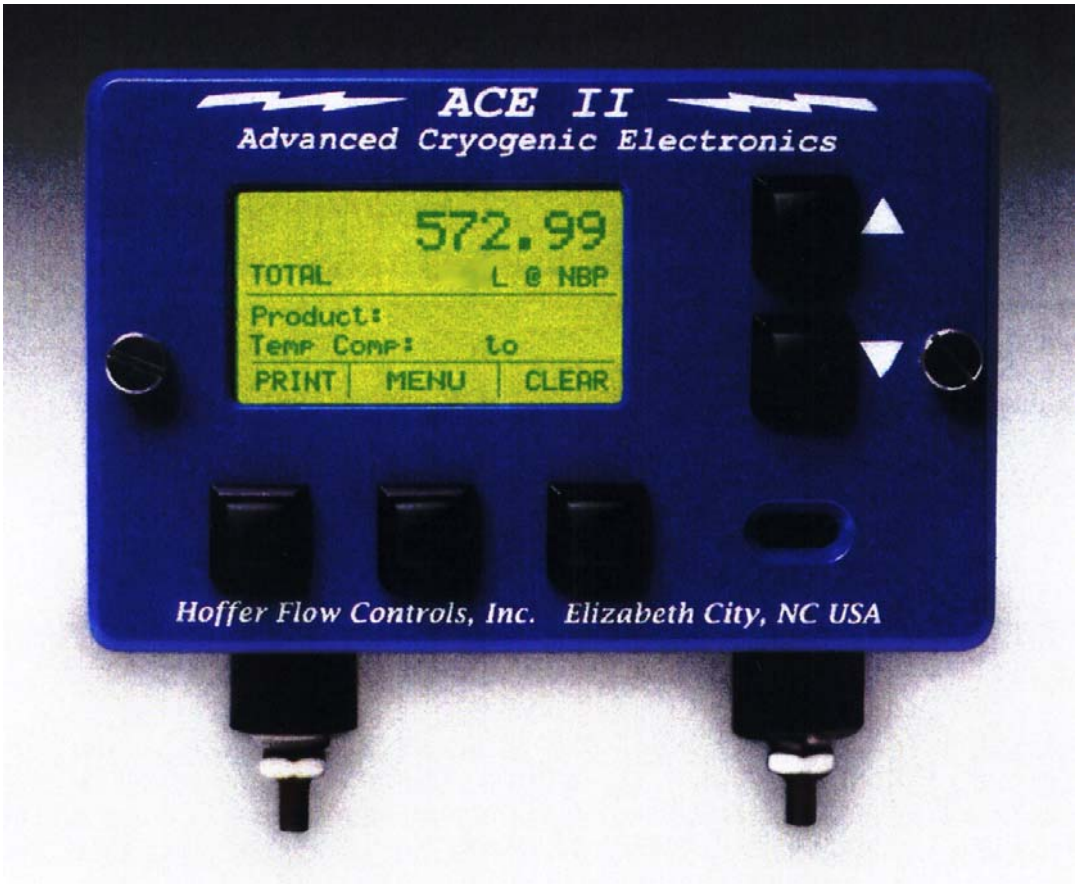
FIGURE 10/2/12 – 2

Hoffer Model HO* Flowmeter

FIGURE 10/2/12 – 3

Hoffer Model ACE-B-1TP-3-X-X-S-CE Calculator/Indicator

FIGURE 10/2/12 – 4



Hoffer Model ACE-II-1-TP* Calculator/Indicator

FIGURE 10/2/12 – 5

Hoffer Model ACE-II-2TP* Calculator/Indicator