



Australian Government
Department of Industry,
Innovation and Science

National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Certificate of Approval

No 5/6B/216

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

Daniel Measurement Model 3804 *Liquid Ultrasonic* Liquid-Measuring System

submitted by Emerson Process Management Australia Pty Ltd
471 Mountain Highway
Bayswater VIC 3153.

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, Measuring Systems for Liquids Other than Water, dated June 2011.

This approval becomes subject to review on 14/09/22, and then every 5 years thereafter.

DOCUMENT HISTORY

Rev	Reason/Details	Date
0	Pattern & variants 1 approved –certificate issued	07/05/10
1	Pattern & variants 2 & 3 approved & certificate reviewed – certificate issued	14/08/17

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with approval number 'NMI 5/6B/216' 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.

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

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



Darryl Hines

TECHNICAL SCHEDULE No 5/6B/216

1. Description of Pattern

approved on 07/05/10

A Daniel Measurement model 3804 *Liquid Ultrasonic* DN100 (100 mm) flowmeter (Figure 1 and Table 1) for bulk metering of petroleum products other than LPG.

Approved products include various grades of liquid hydrocarbons including petrol/ethanol blends and pure ethanol ('E100') and various grades of pure biodiesel and biodiesel/distillate blends (to Australian government standard).

1.1 Field of Operation

The field of operation of the measuring system is determined by the following characteristics (see also Table 1):

- Minimum measured quantity, V_{min} 2000 L
- Maximum flow rate, Q_{max} 6000 L/min)
- Minimum flow rate, Q_{min} 600 L/min)
- Maximum pressure of the liquid, P_{max} 15 500 kPa
- Minimum pressure of the liquid, P_{min} (#1)
- Dynamic viscosity, η (at 20°C) 0.4 to 20 mPa.s (#2)
- Liquid temperature range -50°C to 150°C
- Ambient temperature range -25°C to 55°C
- Accuracy classes 0.3 and 0.5
- Power supply (nominal) 24 V DC/240 V AC
- Applications Static, pipeline or mobile
- Accuracy classes 0.3 and 0.5

(#1) Minimum pressure of the liquid, $P_{min} = P_b \geq 2 \Delta p + 1.25 p_e$

Where: P_b = minimum back pressure (kPa)
 Δp = pressure drop across meter (kPa)
 p_e = equilibrium vapour pressure (kPa)

For liquids at greater than atmospheric pressure, a back pressure greater than 138 kPa above the liquid vapour pressure at metering conditions is sufficient.

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

1.2 The Liquid-Measuring System (Figure 1)

(i) Supply Tank

A supply tank, which may incorporate a detector for low liquid level. The detector is used to prevent further deliveries when the low liquid level is reached, and prevents air from entering the pipework.

(ii) Pump

A positive displacement, centrifugal or submersible turbine type pump may be used to provide flow through one or more flowmeters. The pump is fitted in a positive suction head (flooded suction) installation, i.e. below the liquid level in the supply tank (Figure 1). For all combination of usage, the pump(s) shall be of sufficient capacity to ensure that each flowmeter can operate within its approved flow rate range.

Systems fitted with a positive displacement pump shall include a gas elimination device capable of continuously separating any air/vapour entrained in the liquid upstream of the flowmeter.

A centrifugal type pump may only be installed below the liquid level of the supply tank and a submersible type pump may be used either alone or supplying a centrifugal type pump positioned above or below the liquid level of the supply tank. These systems shall include a gas elimination device capable of removing any pockets of air/vapour that may form in the pipework upstream of the flowmeter.

In any case, for all combination of usage, the pumps(s) shall be of sufficient capacity to ensure that each flowmeter can operate over its approved flow rate range.

(iii) Non-return Valve

A non-return valve is fitted at least between the pump and the flowmeter to prevent the reverse flow of the liquid and keep the flowmeter full of liquid at all times.

(iv) Gas Elimination

A Brodie model RL-36-6 gas elimination device (or any other equivalent gas elimination device) fitted upstream of the flowmeter to prevent vapour entering the flowmeter. The gas purger/strainer assembly may be modified for use as a strainer only where the tank has automatic alarming of low-liquid level.

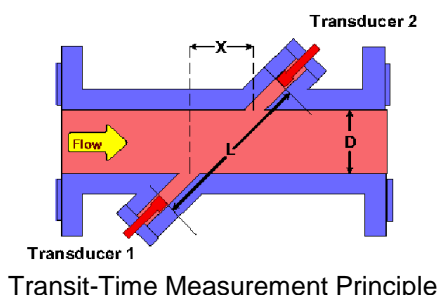
(v) Straightening Elements

The meter is installed between straightening elements of straight pipe of at least 10 pipe diameters in length upstream of the meter inclusive of a flow conditioner and straight pipe 5 pipe diameters in length downstream of the meter. The upstream conditioner (straightening vanes) shall include a Daniel Tube Bundle (preferred option), or profiler or flow conditioner to prevent swirl.

(vi) Measurement Transducer

The measurement transducer is a Daniel Measurement model 3804 *Liquid Ultrasonic* flowmeter with sensor LT-01 (Figure 2) consisting of meter body with four pairs of ultrasonic transducers installed at specific locations across the flowmeter, and an electronics assembly that provides dual pulse outputs (phase-shifted) to a calculator/indicator.

The flowmeter precisely measures the transit times of ultrasonic pulses passing through the liquid on four parallel planes. The measurement paths (also referred to as 'chords') are angled to the pipe axis, and each chord has two transducers acting alternately as transmitter and receiver as shown below. This permits the meter to measure bi-directional flow in that the transit times to be measured both with and against the flow (upstream and downstream). The transducers are mounted on the meter body at accurately known locations for each pipe size so the distance L between opposing transducers and the angle are precisely defined for the measurement path.



For bi-directional flow applications, the installation shall ensure the requirements of the pump, the non-return valve, the gas elimination device (sub-clauses (ii), (iii) and (iv) above) are met. Additionally, the meter shall have straightening elements on both sides of the meter as per sub-clause (v) above.

Operating system, Kernel	File system	Firmware
2.4.21	1.08	1.02
2.4.21-USM-1	2.02	1.60
	2.04	1.61
	2.08	1.70
		1.75
	2.09	1.76

The software versions are marked on the marking nameplate or on a separate stainless steel plate.

(vii) Calculator/Indicator

An Enraf Contrec model Trac-40 calculator/indicator (as described in the documentation of approval S367A) or any other compatible NMI-approved calculator/indicator is interfaced to the model 3804 flowmeter and configured to provide a frequency/pulse output proportional to volume throughput at observed temperature, or volume throughput referenced to 15°C.

The calculator/indicator may display volume throughput at observed temperature, or the volume throughput at 15°C. In the latter case the display facia is clearly marked "Volume at 15°C" or similar wording. The volume conversion calculations may be performed in the calculator/indicator.

(viii) Checking Facility

When the voltage supply to the transmitter is interrupted, the calculator/indicator is to stop the delivery.

(ix) Transfer Device

A transfer device, which defines the start and stop of the quantity measured, is installed downstream of the flowmeter. The transfer device is in the form of a positive shut-off component such as a manually or automatically-operated shut-off valve (e.g. a Daniel model V788B control valve or any other equivalent valve).

The transfer device may also be designed to control the flow rate within the specified flow rate range of the flowmeter.

1.3 Sealing and Verification Provision

The Daniel Measurement model 3804 *Liquid Ultrasonic* flowmeter is sealed after commissioning. Switch S2 - Position 4 on the CPU board is set to the OPEN position prior to sealing the enclosure (to write-protect the meter's configuration). Sealing of the enclosure includes sealing both covers and sealing the upper electronics housing base unit cover to the base unit.

Provision is also made for a verification mark to be applied.

1.4 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 5/6B/216
Manufacturer's identification mark or trade mark
Meter model
Serial number of the instrument
Year of manufacture
Maximum flow rate, Q_{max} L/min
Minimum flow rate, Q_{min} L/min
Maximum viscosity, η (at 20°C) mPa.s
Type of the liquid for which the system is verified (#1)
Environmental class	class C
Accuracy classes	0.3 and 0.5 (#2)

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

(#2) Instruments shall be marked with an accuracy class 0.3 or accuracy class 0.5 depending on application.

The minimum measured quantity (V_{min}) is to be clearly visible at the indicating device, e.g. “Minimum Delivery 2000 L”, or alternatively the calculator/indicator is programmed for deliveries equal to or greater than the stated minimum delivery.

2. Description of Variants

2.1 Variant 1

approved on 07/05/10

A bulk liquid-measuring system using any 3804 *Liquid Ultrasonic* series flowmeter and sensors listed in Table 1 and Table 2 respectively.

TABLE 1

Meter type/size	Nominal bore (mm)	Flowrate Range (L/min)	Minimum Measured Quantity (L)	Liquid dynamic viscosity (mPa.s)	Notes
DN100 (4")	100	600 – 6000	1000	20 max.	#1
DN150 (6")	150	1200 – 12 000	2000	10 max.	
DN200 (8")	200	2416 – 24 160	5000	60 max.	#2
DN250 (10")	250	3750 – 37 500	5000	25 max.	#2,#3
DN300 (12")	300	5083 – 50 830	10 000	145 max.	#2,#3
DN400 (16")	400	8333 – 83 330	10 000	30 max.	#3, #4

- (#1) This meter is as described in the pattern.
- (#2) The DN200, DN250 and DN300 flowmeters may only be used on multiple liquids in one installation providing calibration/adjustment is made for each liquid.
- (#3) The DN250, DN300 and DN400 meters can be used for multiple liquids without adjustment if the dynamic viscosities are similar values.
- (#4) The DN400 meter is approved for use with a flowrate range from 16 666 – 166 666 L/min for products with a viscosity of greater than 30 mPa.s and up to a maximum of 75 mPa.s.
- (5) Transducers Table with specifications

TABLE 2

4"- 10" Meter Sizes	12" – 16" Meter sizes	Liquid Temperature Range	Viscosity Range
LT-01	LT-03	-50 °C to 100 °C	Up to 130 cSt
LT-04	LT-05	-50 °C to 100 °C	Up to 1000 cSt
LT-08	LT-09	-50 °C to 100 °C	Up to 130 cSt

2.2 Variant 2

approved on 14/08/17

using any 3814 *Liquid Ultrasonic* four-path Flow meter using alternate electronics and sensors Listed in Table 3 and Table 4 respectively.

TABLE 3

Meter size	Q_{min} L/min	Q_{max} L/min	Minimum Reynolds number	Minimum measured Quantity (L)
4"	36	360	10000	1
6"	82	720	10000	2
8"	142	1450	6000	10
10"	223	2250	6000	20
12"	300	3170	6000	50
16"	300	4890	10000	100
18"	450	6334	10000	200

Transducers Table with specifications

TABLE 4

4"- 10" Meter Sizes	12" – 18" Meter sizes	Liquid Temperature Range	Viscosity Range
LT-01	LT-03	-50 °C to 100 °C	Up to 130 cSt
LT-04	LT-05	-50 °C to 100 °C	Up to 1000 cSt
LT-08	LT-09	-50 °C to 100 °C	Up to 130 cSt

2.3 Variant 3-Low temperature/LNG

approved on 14/08/17

Using any 3818 *Liquid Ultrasonic eight-path Flow* meter using alternate electronics and sensors Listed in Table 5 and Table 6 respectively.

TABLE 5

Meter size	Q_{min} L/min	Q_{max} L/min	Minimum Reynolds number	Minimum measured Quantity (L)
4"	36	360	10000	1
6"	82	720	10000	2
8"	142	1450	6000	10
10"	223	2250	6000	20
12"	300	3170	6000	50
16"	300	4890	10000	100
18"	450	6334	10000	200

Transducers Table with specifications

TABLE 6

4"- 10" Meter Sizes	12" – 18" Meter sizes	Liquid Temperature Range	Viscosity Range
LT-06	LT-07	-200 °C to 60 °C	Up to 130 cSt

TEST PROCEDURE

Instruments shall be tested in accordance with any relevant tests specified in the National Instrument Test Procedures.

The instrument shall not be adjusted to anything other than as close as practical to zero error, even when these values are within the maximum permissible errors.

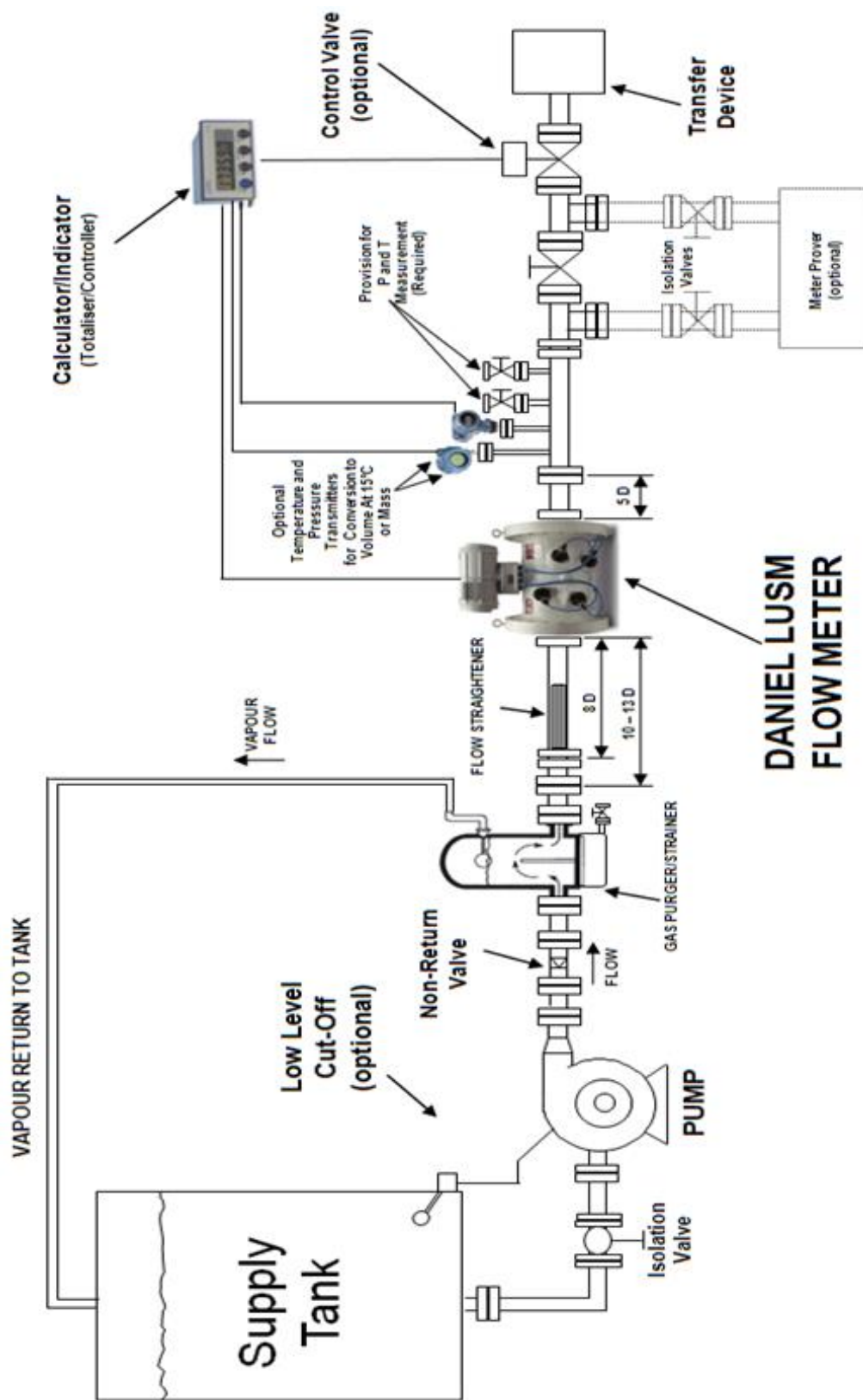
A suitable Test Procedure may be obtained from NMI

Instruments should be tested using a suitable test procedure.

Maximum Permissible Errors

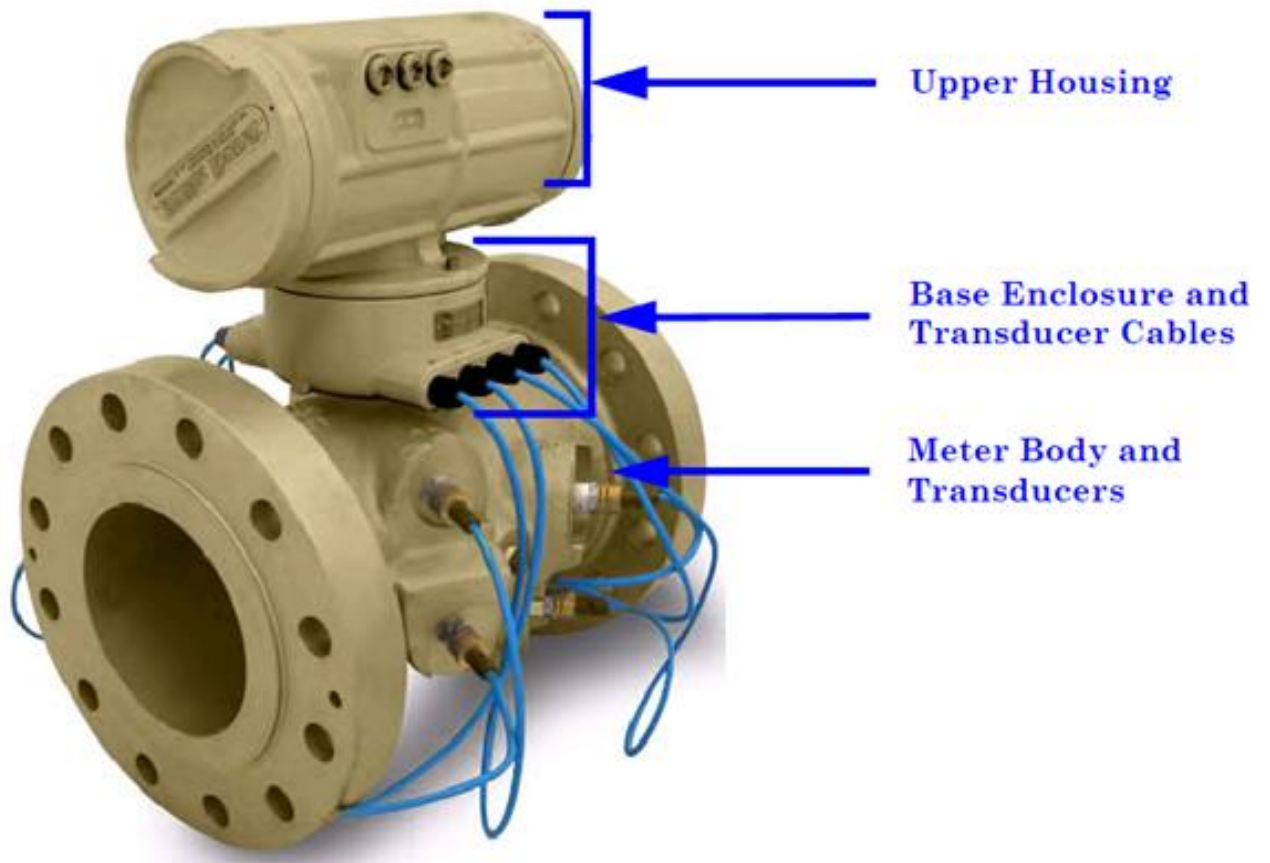
The maximum permissible errors are specified in the *National Trade Measurement Regulations 2009*.

FIGURE 5/6B/216 – 1



Typical Daniel Measurement Model 3804 *Liquid Ultrasonic* Liquid-Measuring System

FIGURE 5/6B/216 – 2



Daniel Measurement Model 3804 *Liquid Ultrasonic* Flowmeter

~ End of Document ~