Australian Government
Department of Industry, Science and Resources

National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

Supplementary Certificate of Approval

NMI S609

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 instruments herein described.

Liquip Model DFV100 Calculator/Indicator for Liquid-measuring Systems

submitted by Liquip International Pty Limited
148B Newton Road
Wetherill Park NSW 2164

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

This approval is subject to review at the decision of the Chief Metrologist in accordance with the conditions specified in the document NMI P 106.

DOCUMENT HISTORY

Rev	Reason/Details	Date
0	Pattern approved – certificate issued	5/12/12
1	Variant 1 approved – pattern amended (Test Procedure) – certificate issued	31/05/13
2	Variant 2 approved – certificate issued	16/12/13
3	Variant 3 approved – certificate issued	06/11/14
4	Variants 4 & 5 approved – certificate amended (submittor **name**) – certificate issued	17/08/16

Document History (cont…)

Rev	Reason/Details	Date
5	Variant 6 approved – certificate issued	17/10/16
6	Variant 7 approved – certificate issued	4/04/17
7	Amend address – certificate issued	25/11/20
8	Pattern amended (Density range) – Variant 8 approved – certificate issued	30/08/22
9	Pattern amended – certificate issued	5/12/22

CONDITIONS OF APPROVAL

General

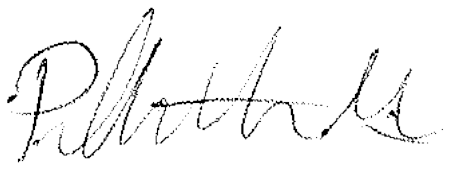
Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI S609' and only by persons authorised by the submittor.

Instruments incorporating a component purporting to comply with this approval shall be marked 'NMI S609' in addition to the approval number of the instrument, 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 their powers under Regulation 60 of the *National Measurement Regulations 1999*.



Phillip Mitchell
A/g Manager
Policy and Regulatory Services

TECHNICAL SCHEDULE No S609

1. Description of Pattern

approved on 5/12/12
amended on 5/12/22

The pattern is a Liquip model DFV100 calculator/indicator (Table 1 and Figure 1) with a Liquip model ERP200 remote pulse transmitter or any NMI-approved measurement transducer generating compatible (#) pulse output proportional to volume throughput, for use in liquid-measuring systems incorporating compatible (#) NMI-approved flowmeters or NMI-approved vehicle-mounted flowmeters.

May also be known as Liquip International instruments of the same model.

(#) 'Compatible' is defined to mean that no additions/changes to hardware/software are required for satisfactory operation of the complete system.

1.1 Field of Operation

The field of operation of the pattern is determined by the following characteristics:

- Input pulse rate — less than 667 Hz/channel
- Input voltage ranges:
  - for the calculator/indicator — 9 V DC to 45 V DC
  - for the pulse generator — 9 V DC to 30 V DC
  - for the printer — 20.4 V DC to 28.6 V DC
- Liquid temperature range — −40 °C to 60 °C
- Environment temperature ranges:
  - for the calculator/indicator — −25 °C to 55 °C
  - for printers — −10 °C to 40 °C
- Non-linearity correction facility
- Density range for volume conversion to 15 °C:
  - for generalised products — 0.653 kg/L to 1.075 kg/L
  - for LPG — 0.500 kg/L to 0.600 kg/L
  - for Lubricating oils — 0.800 kg/L to 1.164 kg/L

1.2 Indicator

The model DFV100 (Figure 1) with software version 1.00.xx includes an alphanumeric liquid crystal display with the following maximum volume display:

99 999.9 L when the resolution is set to 0.1

9 999 999 L when the resolution is set to 1

9 999 999 daL when the resolution is set to 10 for displaying in dekalitres (*)

(*) This setting may only be selected for non-trade applications.

The accumulated total is displayed up to 99 999 999 L before rolling over to 0. The total can be reset to zero via the calibration mode.

1.3 Features

The instrument is configured via the Menu and Cal switches, where Cal has provision for sealing. The instrument can display the temperature of the liquid, the set density, and the volume at 15 °C. It can also store up to 12 separate k-factors for different products. Selection of different products (k-factors) cannot be used simultaneously with flow rate correction mentioned above.
The instrument features the following functions:

- The TOTAL button displays the accumulative total.
- The RESET button prints a delivery report and resets the register to zero. Pressing the RESET button during delivery will display the flow rate.
- Pressing the TOTAL button and then the RESET button will print management information. This will reset the power interrupts and delivery number to zero, without resetting the indication to zero.
- When interfaced to a flow control valve, the STOP/START button will begin a delivery or restart a delivery from the point at which it was stopped.
- If remote density setting is enabled, pressing the TOTAL five times will display the density which can be changed using the TOTAL and RESET buttons and can be saved by pressing the STOP/START button.
- In the same mode the operator can print a configuration report.

Note that the displayed density can only be changed when the delivery has been reset to zero.

1.4 Pulse Generator

The Liquip model ERP200 pulse transmitter (Figure 2) comprises a 25-slot disk with three optic sensors to provide a three-channel pulse output. The calculator uses a combination of high/low states from each channel to obtain a total count of 150 pulses per shaft revolution of the pulse generator. The maximum shaft speed for the pulse generator is 1600 revolutions per minute at which the calculator produces 4000 counts per second.

1.5 Calibration

The Liquip model DFV100 calculator/indicator is configured either for a single k-factor or up to eight k-factors to define the relationship between the volume throughput and the pulses generated by the measurement transducer.

There are two ranges for the k-factor; the instrument is configured either for ST mode or EX mode, which define the following ranges of k-factor settings:

ST 1 to 999.9999 pulses/litre

EX 1000 to 9999.999 pulses/litre

To adjust the volume delivered by the measurement transducer, change the current k-factor using the following formula:

New k-factor = (1 + % Error / 100) × current k-factor

Note: The DFV100 limits the variation between any two k-factors to ±0.25%

1.6 Checking Facilities

The instrument incorporates the following checking facilities:

- A segment check is performed on the display only at power up. An easily accessible power switch is located on the vehicle to enable the checking of the segments before each delivery, should this be required.
- A check of the presence and of the correct signal output from the measurement transducer.
- Outputs are provided to control the delivery process and if necessary prevent measurements when errors are detected.
- When the indication reaches 90% of the maximum indication the displayed figure starts flashing and shutdown of the solenoid valves is commenced to prevent the indication from rolling over to zero.
- When configured for use with a printer, the DFV100 checks for the presence and correct operation of the printer.

1.7 Volume Conversion for Temperature Facility

An electronic volume conversion for temperature facility is used to convert the measured volume to volume at 15 °C. Activation of the volume conversion feature is indicated by the □ symbol in the top left corner of the display and is activated via the management mode for the approved products. The conversion is based on ASTMIP-API Petroleum Measurement Table 54 for LPG or Table 54B for Generalised Petroleum Products.

The density is either fixed via the calibration mode or is available for adjustment using the TOTALS button prior to measurements taking place. In such applications, temperature measurement is required which can be displayed by the DFV100.

For temperature measurement, a Liquip part number 4155, PT100 3-wire (plus shield) RTD probe, which has a resistance of 100 ohms at 0 °C can be used, or any other compatible (#) temperature probe with similar characteristics.

When displaying the volume at 15 °C, the DFV100 is connected to a Liquip Touchstar Blaster model BD422003-C17 printer (Figure 3a) or to an Epson model TM-295 printer (Figure 3b) or to any other equivalent (*) printer.

If the nature of the measured volume is entered into the calculator/indicator at the beginning of the measurement operation, then a printer is mandatory for printing the delivery details and the manually-entered density for which the volume conversion is set.

(#) ‘Compatible’ is defined to mean that no additions/changes to hardware/software are required for satisfactory operation of the complete system.

(*) ‘Equivalent’ is defined to mean other proprietary equipment of the same or better specifications requiring no changes to the software specified in this approval for satisfactory operation of the complete system.

Notes:

1. The above printers must be situated in a location that will satisfy the temperature requirements of -10 °C to 40 °C.
2. Where the vehicle battery supply is 12 V, a voltage doubler is required.

1.8 Flow Control Valve

Any compatible solenoid-operated flow control valve, located downstream of the flowmeter, may be interfaced to the instrument for controlling the delivery process and to stop measurements in the event of errors detected by the checking facility.

1.9 Verification Provision

Provision is made for the application of a verification mark.

1.10 Sealing Provision

Access to the calibration parameters is via the Cal button (on the lower left of the indicator facia, Figures 1 and 4), which has provision to be sealed using a sealing plug/wire and lead seal to one of the four screws at the rear which affix the cover of the indicator (Figure 4).

1.11 Descriptive Markings and Notices

Instruments are marked with the following data, together in one location, in the form shown at right:

Manufacturer's mark, or name written in full	.....	
Model number	.....	
Serial number	.....	
Pattern approval number	NMI S609	
Year of manufacture	.....	
Accuracy class	0.5 or 1.0	
Environmental class	I	(#1)
Liquid temperature range	.....°C to .....°C	(#2)

(#1) Environmental class for printers is Class B
Environmental class for DFV130-12 (variant 4) is Class N

(#2) Required when the volume conversion for temperature facility is activated

For applications other than LPG, when the volume conversion facility is activated, the indicator reading face shall be marked 'Litres at 15 °C' or 'Volume at 15 °C'.

The minimum measured quantity specified for the fuel dispenser is marked or displayed on the face of the indicator in the form 'Minimum Delivery 1000 L'.

2. Description of Variant 1 approved on 31/05/12

Model DFV102 calculator/indicator which is similar to the pattern (model DFV100) however the circuit boards are 'unpotted', i.e. they are not protected with an encapsulation compound.

3. Description of Variant 2 approved on 16/12/13

Certain other models in the DFV1** series of calculator/indicators as listed below in Table 1, including for use with up to nine (9) Liquip model Diptronic DIP1xx radar level gauges (measurement transducers) as described in the documentation of approval NMI 5/1/5A. Instruments are now fitted with version 02.00.xx software. The system determines the volume of liquid (other than LPG) contained in the non-pressurised tank or compartment and measures partial transfers by calculating the difference between the initial volume and the final volume.

The model DFV101, which may operate both as a calculator/Indicator (aka '*Register'*, similar to the DFV100 and DFV102) or can also be switched to measure volume using the level gauges (aka '*Diptronic'*);

The DFV100, DFV101 and DFV103 models all have the same hardware for the calculator/indicator.

The DFV100, DFV101 and DFV103 models share the same metrological software for the calculator/indicator.

TABLE 1 – Approved Models of the DFV1** Series

Model	Function
DFV100	**'*Register'* only**
DFV101	'*Register'* or '*Diptronic'*
DFV102	'*Register'* only – non-encapsulated (variant 1)
DFV103	'*Diptronic'* only

(The models DFV100 and DFV103 can be upgraded to model DFV101.)

The pattern is shown in **bold** text.

4. Description of Variant 3 approved on 06/11/14

A Liquip model DFV 100(*) calculator/indicator connected via a Liquip model DPI100 interface (Figure 5) to an NMI-approved ACME VTM series dual coil turbine flowmeter (as described in the documentation of approval NMI 10/2/17) or to any compatible (#) approved dual channel pulse generator.

The model DFV 100(*) calculator/indicator now has version 01.01.xxx and 02.02.xxx software.

(*) Refer to variant 2 for model numbers

(#) 'Compatible' is defined to mean that no additions/changes to hardware/software are required for satisfactory operation of the complete system.

5. Description of Variant 4 approved on 17/08/16

Liquip model DFV 130-12 (aka DFV 130/DFV 150 radar level gauge (measurement transducer) which has the same features and field of operation as the Diptronic DIP1xx radar level gauge (as described in variant 2) except that this model operates within an environment (ambient) temperature range of −10 °C to 55 °C (environmental class N).

6. Description of Variant 5 approved on 17/08/16

The DreamTec model i-meter GPS tracking module (Figure 6) or similar models connects to the printer output of the DFV1**, DIP200 series, EMH500 series or EMH600 series of calculators/indicators.

The i-meter sends information from the calculator/indicator to the source location. The i-meter transmits GPS locations and delivery data from the delivery truck. The customer is able to download PDF delivery notes for invoicing as well as GPS records.

7. Description of Variant 6 approved on 17/10/16

The DFV1**EM is an addition to the DFV1**series of calculator/indicator. It is an expansion module, optional slave unit used with the DFV1** to add extra input/output ports for communications and auxiliary device interface. It uses the same hardware and software as the DFV1**. It communicates with the master DFV1** via a communication port.

Model	Function	Software
DFV100	Register only	01_02_xx
DFV101	Register or Diptronic	02_02_xx
DFV103	Diptronic only	03_02_xx
DFV1**EM	Expansion Module	04_02_xx

8. Description of Variant 7 approved on 4/04/17

A Microchip RN-240F Bluetooth module (Figure 7) or equivalent (*) may be connected to the serial communication port to provide a wireless communication interface.

Additional devices connected using the interface shall not interact with the system in a way that would cause an incorrect indication of measurement.

(*) ‘Equivalent’ is defined to mean other proprietary equipment of the same or better specifications requiring no changes to the software specified in this approval for satisfactory operation of the complete system.

9. Description of Variant 8 approved on 30/08/22

An electronic volume conversion for temperature facility described in **1.7 Volume Conversion for Temperature Facility** configured to convert the measured volume to volume at 15 °C. The conversion is based on API MPMS for Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils: API MPMS Chapter 11.1.

This conversion facility is equivalent to the superseded ASTMIP-API Petroleum Measurement Table Petroleum Measurement Tables, e.g. Table 54D.

TEST PROCEDURE No S609

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.

Maximum Permissible Errors

The maximum permissible errors applicable are those applicable to the fuel dispensers to which the instrument approved herein is fitted, as stated in the approval documentation for the fuel dispensers or in Schedule 1 of the *National Trade Measurement Regulations 2009*.

FIGURE S609 – 1

Liquip Model DFV100 Calculator/Indicator for Liquid-measuring Systems

FIGURE S609 – 2

Liquip Model ERP200 Pulse Transmitter

FIGURE S609 – 3

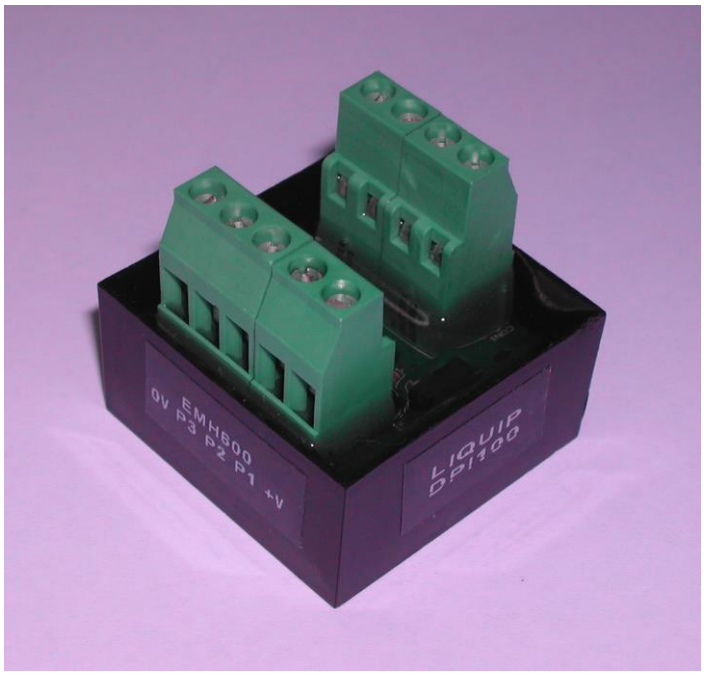
(a) Blaster Model BD422003-C17 Printer

(b) Epson Model TM-295 Printer

FIGURE S609 – 4

Typical Sealing of the Cal Button to a Cover-mounting Screw (not shown)

FIGURE S609 – 5



Liquip Model DPI100 Interface

FIGURE S609 – 6

DreamTec Model i-meter GPS Tracking Module

FIGURE S609 – 7

Microchip RN-240F Bluetooth module

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