



Australian Government
Department of Industry,
Science and Resources

**National
Measurement
Institute**

36 Bradfield Road, West Lindfield NSW 2070

**Supplementary Certificate of Approval
NMI S790**

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.

Liquid Controls LLC Model LCR.iQ Calculator/indicator for use in Liquid-measuring Systems

submitted by Advanced Flow Solutions, Inc.
trading as Liquid Controls
9201 North I-35 Service Road
Oklahoma City OK 73131
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, *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 & variants 1 approved – certificate issued	31/03/20
1	Variant 2 approved – certificate issued	18/08/20
2	Variant 3 approved – certificate issued	12/02/21
3	Pattern amended (submitted by) – certificate issued	08/12/21

Document History (cont...)

Rev	Reason/Details	Date
4	Variant 4 approved – certificate issued	19/05/23
5	Variant 5 approved – certificate issued	24/08/23
6	Variant 6 approved – certificate issued	10/04/24

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI S790' and only by persons authorised by the submittor.

Instruments incorporating a component purporting to comply with this approval shall be marked 'NMI S790' 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*.



Darryl Hines
Manager
Policy and Regulatory Services

TECHNICAL SCHEDULE No S790

1. Description of Pattern approved on 31/03/2020

A Liquid Controls LLC model LCR.iQ calculator/indicator (Figure 1) interfaced with 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.

The pattern may also be known as a Liquid Controls model MASTERLOAD.iQ or Avery Hardoll model MASTERLOAD.iQ.

(#) '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:

- Maximum Input Frequency 7500 Hz / channel
- Accuracy class 0.5
- Environment temperature ranges -40 °C to 70 °C
- Liquid temperature ranges -40 °C to 140 °C
- Input Voltage 9 V DC to 28 V DC
- 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

1.2 Indicator

The model LCR.iQ (Figure 1) uses software version SR1000 v1.08.01 (*) and includes an alphanumeric liquid crystal display with the following maximum delivery volume display:

99 999.99 L when the resolution is set to 0.01 L

999 999.9 L when the resolution is set to 0.1 L

9 999 999 L when the resolution is set to 1 L

The accumulated total for the delivery is displayed up to the value indicated above, at which point LCR.iQ ends the delivery using pre-installed solenoid valve.

(*) The software version can be shown by the following sequence of screens: Main Menu -> Diagnostics -> About. The software version is also displayed during restarting.

1.3 Features

The instrument is configured via the keypad. 'Weights and Measures' parameters are locked out with a sealed calibration screw. The seal must be broken, and the screw partially removed in order to interface with the 'Weights and Measures' parameters.

An optional Liquid Controls model SENSEiQ expansion board may be fitted to the device to provide additional inputs and outputs.

The indicator and keypad of the device is installed in a Zone 2 IECEx rated housing. The instrument can display the temperature of the liquid, the set density, and the volume at 15°C.

1.4 Pulse Generator

The calculator/indicator is interfaced to a Liquid Controls model PODx (Pulse Output Device) (Figure 2) or other compatible (#) NMI-approved dual channel 90° phase shift pulse generator designed to produce pulses proportional to volume throughput, when fitted to any compatible (#) NMI-approved flowmeter.

The 'x' of the PODx model number may be any character representing sealing material or coupling mechanisms to the NMI-approved flowmeter.

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

1.5 Field of Operation

The field of operation of the pulse generator is determined by the following characteristics:

- Pulses per shaft revolution 100 pulses/revolution/channel
- Maximum pulser shaft speed 2500 revolutions/minute
- Output pulses Rectangular waveform
- Power supply range 5 to 30 volts DC
- Environmental class Same as calculator/indicator
- Accuracy class Same as calculator/indicator

1.6 Calibration

The Liquid Controls model LCR.iQ calculator/indicator is configured for a single k-factor with up to 16 correction points to define the relationship between the volume throughput and the pulses generated by the measurement transducer. The device can perform correction of the flowmeter error based on linearization. Correction points with a range of $\pm 3.0\%$ can be programmed as a function of flow rate.

1.7 Checking Facilities

The instrument incorporates the following checking facilities:

- A display test is performed at the start of each delivery.
- 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 configured for use with a printer, the LCR.iQ checks for the presence and correct operation of the printer.

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 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 a label "Volume corrected to 15 °C. The volume at base conditions can be displayed and printed, as configured via Setup Menu.

The conversion is based on *ASTM-IP- API Petroleum Measurement Table 54/54E* for LPG, or Table 54B for Generalised Petroleum Products, or Table 54C for pure biodiesel, or Table 54D for Lube Oils, where the product property (e.g., density, coefficient of thermal expansion) is set for the product for which the instrument is verified.

The density is fixed via the Setup Menu -> Calibration or can be measured using densitometer connected via RS485 port. In such applications, temperature measurement is required which can be displayed by the LCR.iQ calculator/indicator.

For temperature measurement, a PT100 4-wire 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 LCR.iQ is connected to an Epson model TM-295 printer (Figure 3) or to any other equivalent (*) printer.

If the product to be measured is to be selected in 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.

1.10 Verification Provision

Provision is made for the application of a verification mark.

1.11 Sealing Provision

Access to the calibration parameters is via the calibration screw in the enclosure of the indicator (Figure 4), which has provision to be sealed using a wire lead seal, or similar.

1.12 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 S790	
Year of manufacture	
Environmental class	-40 °C to 70 °C	(#1)
Liquid temperature range°C to°C	(#2)

(#1) Environmental class for printers is -10 °C to 40 °C (Class B)

(#2) Required when the volume conversion for temperature facility is activated and the liquid temperature range differs from -10 °C to 50 °C

For applications other than LPG, when the volume conversion facility is activated, the indicator reading face shall display or be marked "Volume corrected to 15 °C".

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

2. Description of Variant 1 approved on 31/03/2020

A Liquid Controls model LCRx.iQ or MASTERLOADx.iQ (Figure 5) which comprises a Zone 1 IECEx rated explosion proof enclosure. The variant uses the same electronics as the pattern.

3. Description of Variant 2 approved on 18/08/20

With the LCR.iQ using software version SR1000 v1.09.xx.

The updated software enables additional functions of the SENSEiQ expansion board described in **1.3 Features**.

4. Description of Variant 3 approved on 12/02/21

With the LCR.iQ using software version SR1000 v1.11.xx.

The updated software includes fixes and additional features which do not affect the metrological performance of the pattern.

5. Description of Variant 4 approved on 19/05/23

With the LCR.iQ using software version SR1000 v1.12.xx, SR1000 v1.13.xx, SR1000 v1.14.xx or SR1000 v1.15.xx

The updated software includes fixes and additional features which do not affect the metrological performance of the pattern.

6. Description of Variant 5

approved on 24/08/23

With the LCR.iQ using software version SR1000 v1.16.xx

The updated software includes fixes and additional features which do not affect the metrological performance of the pattern.

7. Description of Variant 6

approved on 10/04/24

With the LCR.iQ using software version SR1000 v1.17.xx

The updated software includes fixes and additional features which do not affect the metrological performance of the pattern.

The system is able to display and print delivery information included in QR matrix barcodes.

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.

Maximum Permissible Errors

The maximum permissible errors are specified in Schedule 1 of the *National Trade Measurement Regulations 2009*.

FIGURE S790 – 1



Liquid Controls Model LCR.iQ Calculator/Indicator

FIGURE S790 – 2



Liquid Controls Model PODx Pulse Generator

FIGURE S790 – 3



Epson Model TM-295 Printer

FIGURE S790 – 4



Access to Calibration ('W&M') Switch Including Typical Sealing for Zone 2 enclosure (left) and Zone 1 enclosure (right)

FIGURE S790 – 5



Liquid Controls Model LCRx.iQ Calculator/Indicator (Variant 1)

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