Australian Government
Department of Industry, Science and Resources
National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

Supplementary Certificate of Approval

NMI S742

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.

Smith Meter® AccuLoad® model ALIV Controller for Liquid-measuring Systems

submitted by FMC Technologies Measurement Solutions Inc.
1602 Wagner Avenue
Pennsylvania 16510
United States of America

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 & variant 1 approved – certificate issued	10/03/17
1	Variant 2 & 3 approved – certificate issued	07/02/24

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI S742' and only by persons authorised by the submitter.

It is the submitter'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 S742

1. Description of Pattern approved on 10/03/17

A Smith Meter® AccuLoad® IV model ALIV-QT-XP (*) loading controller (Figure 1) for liquid-measuring systems incorporating compatible (#) NMI-approved flowmeters.

(*) Abbreviated model number - the full model number for the pattern is

ALIV-QT-XP-ARM6-A*****-* where '*' represents product features which do not affect the meteorological performance of the measuring system

1.1 Field of Operation

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

- Environmental class -40°C to 55°C
- Power supply 240 V AC mains supply
- Maximum input frequency 10 000 pulses/second/channel
- Accuracy applications Class 0.5

For volume conversion for temperature facility:

- Liquid temperature range -50°C to 150°C
- The conversion is based on *ASTM-IP-API Petroleum Measurement,* metric editions, Table 54A for Crude Oils, or Table 54B for Generalised Petroleum Products, or Table 54C for pure biodiesel (to Australian government standard), or Table 54D for Lube Oils, or Table 54 for LPG.

1.2 Controller

The AccuLoad IV controller (Figure 1) utilises an 8.4 inch touchscreen graphic colour display for messages/prompts, and volume display for each flowmeter loading arm/line.

The ALIV-QT-XP can control the delivery of up to 6 separate loading arms/lines. The delivery operation is authorised by entering a personal identification number (PIN) for identifying the user, if configured. The data entry/selection is made via the touch screen user interface. The volume display resolution can be programmed for 1 L, 0.1 L, or 0.01 L increments.

The firmware version is ARM#, where # represents the number of loading arms from 1 to 6. The number of allowed arms is identified in the "Device Information" sub menu which is in the Main display screen.

Selecting "Device Information" will display the following:

Firmware Revision – Revision of the firmware

Firmware Identifier – Unique hexadecimal code

Maximum Available Arms – Number of load arm that were purchased

Firmware Lock – (Unlocked or Locked) when locked, disallows new firmware downloads

Additional information is available for network communications

1.3 Pulse Generator

The AccuLoad IV controller is approved for use with a Smith Meter® model UPT pulse transmitter, or any other compatible (#) NMI-approved measurement transducer(s).

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

1.4 Non-Linearity Correction Facility

A multi-point correction facility is available, which allows up to five meter factors in the range 0 to 9.99999 to be programmed as a function of flow rate within the approved range. The AccuLoad IV controller applies interpolation processes to calculate the meter factor for the current flow rate based on the meter factor programmed for the next highest and the next lowest flow rate.

Meter factors entries must be within 2% of the value entered for the master meter factor, otherwise the self-checking facilities of the AccuLoad IV will produce a critical error alarm.

1.5 Checking Facilities

- A graphical display test can be initiated by the user. The screen test is found under the Device Setting sub directory, selecting the "Screen Test" icon.
- Monitors the dual output signal from the measurement transducer.
- Outputs are provided to control solenoid-operated valves to control the delivery process and prevent measurements when errors are detected, e.g. when temperature measurements are outside the approved range.
- To display the delivered volume during power failure, an uninterruptible power supply (UPS) is required. The UPS design must include:
  - (a) the capacity to allow for display of data on all AccuLoad IV controllers for a period of 30 minutes; and
  - (b) a monitoring system providing a low battery alarm to the Loading Control Room.

1.6 Operational Procedures

The AccuLoad IV controller is predominately designed to automatically control the delivery of a flow metering system based on the entered pre-set volume and the pre-programmed flow profile.

The following is a typical operating sequence; however, each site may require a different operating procedure depending on the configuration parameters of the AccuLoad IV.

- Connect overfill protection system, if configured
- Enter driver personal identification number (PIN), if configured
- Select the required loading arm/line by touching any area in the arm window identified by "Press to Set Up" for the desired arm, up to six arm windows for the -QT version
- Select recipe icon and then the "Next" icon

- Enter pre-set quantity, then select the “Next” Icon
- Select the “Start” icon
- To stop the load prior to the end of the pre-set quantity, touch any area within the load arm window
- Select either “End Batch” or “Continue Batch”
- Upon completion of the load, select “End Transaction”, this concludes the load sequence

To display metered data / properties, select the “Dynamic Displays” icon on the top of the display window.

1.7 Flow Control Valve

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

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

1.8 Temperature Probe

For temperature measurement applications and for volume conversions utilising the “RTD” module option, a PT 100 4-wire 100 ohm RTD element or any other compatible (#) temperature transducer may be used. For measurements utilising the “Current Input” module option, any compatible (#) temperature transmitter may be used.

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

1.9 Volume Conversion for Temperature Facility

An electronic volume conversion for temperature facility can be enabled to convert the measured volume to volume at 15°C. The conversion is based on *ASTM-IP-API Petroleum Measurement* Table 54A for Crude Oils, or Table 54B for Generalised Petroleum Products, or Table 54C for pure biodiesel, or Table 54D for Lube Oils, or Table 54 for LPG, where the density is set for the product for which the instrument is verified.

1.10 Blending Facility

The AccuLoad IV controller combes the output of multiple meters where fuels are being blended for delivery by a single loading arm.

The controller controls the blending ratio and provides the summation of the volumetric output of the meters.

1.11 Markings and Notices

A. Instruments are marked with the following data, together in one location:

Pattern approval number	NMI S742	
Manufacturer's identification mark or trade mark	…..	
Model number	…..	
Serial number of the instrument	…..	
Year of manufacture	…..	
Environmental class	-40°C to 55°C	
Type of liquid for which the system is verified	…..	(*)(#)
Maximum temperature of the liquid (T_{max})	150°C	(*)(#)
Minimum temperature of the liquid (T_{min})	-50°C	(*)(#)

(*) Required when volume conversion for temperature is utilised.

(#) Marking may alternatively be displayed in software under menu option "Device Information"

B. For applications (other than LPG) when the delivered volume is enabled for temperature corrections to 15ºC the display indicates "L GST 15°C". GST indicates volume Gross at Standard Temperature.

Note: The minimum measured quantity specified for the meter shall be programmed into the AccuLoad IV controller to prevent deliveries less than the specified minimum delivery for the flowmeter to which the controller is interfaced.

1.12 Sealing Provision

Provision is made for the calibration adjustments to be sealed by means of a lead wire passing through two long screws at the side of the indicator (Figure 2). Calibration parameters can also be changed electronically via PIN (Security Level) access code.

All variants of the AccuLoad IV controller utilise category III Audit trail logging.

All program parameters are capable of being placed under a programmable security level (Levels 1 through 5). This is accomplished by the companion AccuMate software with a personal computer through the communications interface or (future option) through the touch display on the AccuLoad IV. All five security levels do not necessarily need to be used.

Parameters designated to be under Weights and Measures control and tracked by the category III audit trail logging must be configured to either level 4 or level 5. Additionally, the AccuLoad IV has a feature that if only one password is selected for either level 1 through 4, it will notify the user with a "Fatal Alarm" that a level five password must also be configured.

A data log of all metrological parameter changes is provided and is accessible via the sub menu "Audit Trail" which is located under the "Report/Logs" screen. The audit trail may be viewed or printed if a printing device is connected and available.

1.13 Verification Provision

Provision is made for the application of a verification mark.

2. Description of Variant 1 approved on 10/03/17

Certain other models of the AccuLoad® IV model ALIV series loading controllers as listed below:

ALIV-QT-XP-ARM# - A***** for use with up to six loading arms; and

ALIV-ST-XP-ARM# - A***** for use with up to two loading arms

ALIV-QT-UG3-ARM# - A***** for use with up to six loading arms; and

ALIV-ST-UG3-ARM# - A***** for use with up to two loading arms

where:

* relates to optional hardware such as analogue input/output boards for temperature probe(s) and hardware for specific process control not subject to approval.

# denotes the number of loading arms and is any digit from 1 to 6, inclusive for the -QT and 1 or 2 for the -ST.

Figure 3 shows a typical ALIV-ST series controller, which is similar to the pattern but is mounted in a smaller enclosure and eliminates additional optional boards.

Upgrade kits, either Model ALIV-QT-UG3 or ALIV-ST-UG3 (not shown) allow upgrade of existing AccuLoad III model ALIII-Q or -S instruments. The upgrade kits utilise the original back housing and field wiring, and provide a new front cover and replacement boards. The original AccuLoad III wiring plugs fit the new board assemblies.

3. Description of Variant 2 approved on 07/02/24

Certain other models of the AccuLoad® IV model ALIV series loading controllers as listed in Table 1 below:

TABLE 1

Abbreviated Model Number	**Hardware Model Designation**
ALIV-N4	NEMA 4X
ALIV-N4-MMI	NEMA 4X Man-machine interface
ALIV-FCM	Flow control module
ALIV-FMU	FCM upgrade kit for ALIII

Additional characters in the model number denotes the number of loading arms, optional hardware such as analogue input/output boards for temperature probe(s) and hardware for specific process control not subject to approval.

Figure 4 shows a typical ALIV-N4 controller which is similar to the pattern but is mounted in a stainless-steel enclosure.

Figure 5 shows the ALIV-N4-MMI and ALIV-FCM which is similar to the pattern but is mounted in stainless-steel enclosures and is the split architecture variant.

4. Description of Variant 3 approved on 07/02/24

With the electronic volume conversion for temperature facility described in **1.1 Field Of Operation** configured to convert the measured volume to volume at 15 °C.

The conversion is based as applicable on API MPMS for Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils: API MPMS Chapter 11.1 (2004 tables).

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

TEST PROCEDURE No S724

Instruments shall be tested in accordance with any relevant tests specified in the National Instrument Test Procedures and in accordance with any tests included in the approval documentation for the system in which the pattern is fitted, and in accordance with any relevant tests.

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 liquid-measuring system to which the instrument approved herein is fitted, as stated in the approval documentation for the liquid-measuring system or in Schedule 1 of the *National Trade Measurement Regulations 2009*.

For checking the linearity correction facility, refer to the operating manual.

Check that the minimum measured quantity specified for the flowmeter is programmed into the loading controller to prevent deliveries less than the specified minimum delivery for the flowmeter to which the controller is interfaced.

Tests

Recommended Procedure for Systems with Volume Conversion for Temperature Facility Enabled

1. Verify the accuracy of the flowmeter for the arm/line selected using the displayed metered volume at operating conditions (unconverted volume).
2. For each delivery, record the volume at 15°C, the set density and the average temperature displayed by the instrument. Verify that the density setting is within ±1 kg/m³ for Class 0.5 applications, and that temperature measurement is within ±0.5°C.
3. For the temperature and density displayed by the instrument, use the appropriate petroleum tables to determine the volume conversion factor and calculate the volume at 15°C. The maximum permissible error between the calculated volume at 15°C and the volume at 15°C displayed by the instrument is 0.05% for Class 0.5 applications.

Notes:

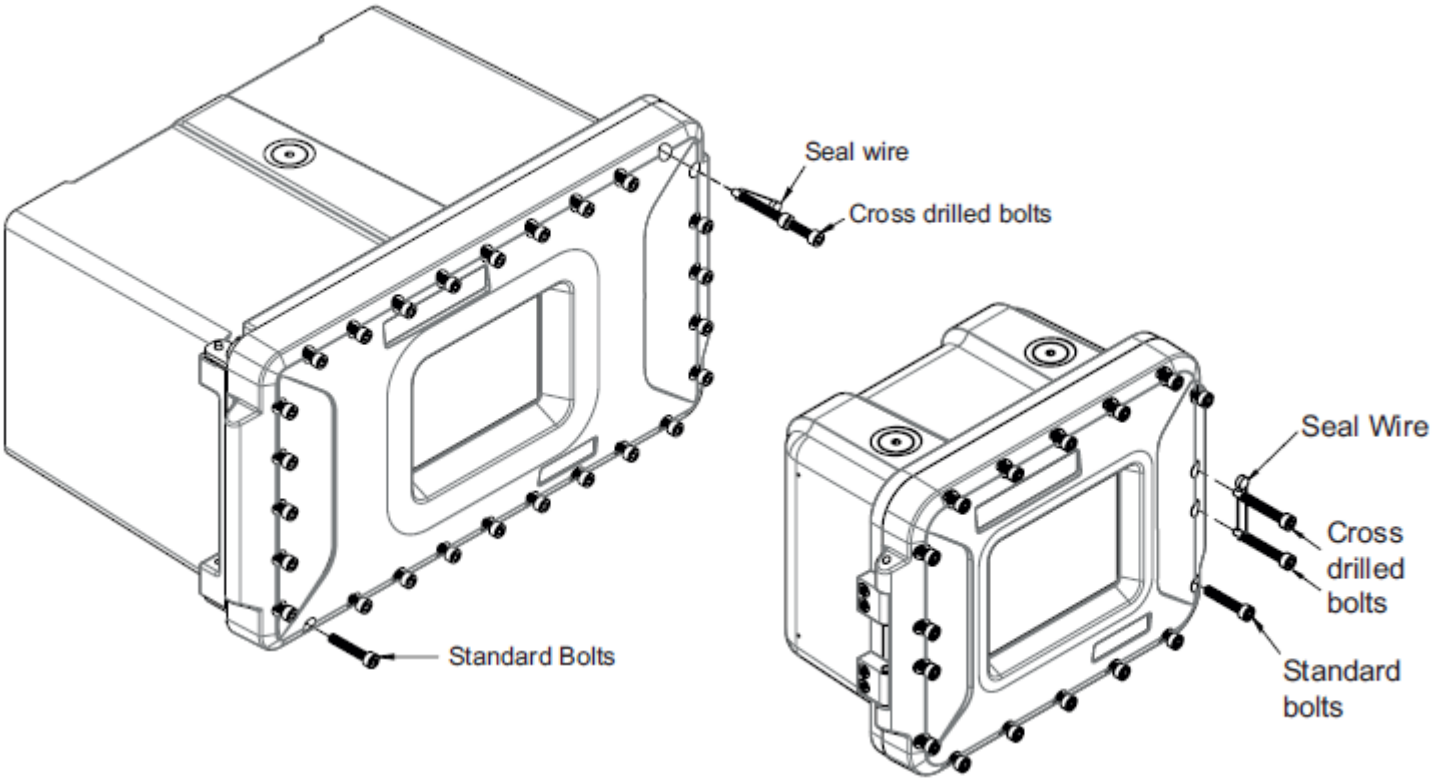
(i) Refer to clause **1.6 Operational Procedures** to obtain the required readings of volume at 15ºC.

(ii) When verifying the accuracy of the flowmeter, it is recommended that this be done with a single k-factor and the linearity correction facility disabled. Once the linearity of the flowmeter has been established, the appropriate meter factors as a function of flow rate can be calculated and entered into the instrument. A final calibration check shall be carried out to check for correct implementation of the linearisation factors entered.

FIGURE S742 – 1

Smith Meter™ AccuLoad IV Model ALIV-QT Controller for Liquid-measuring Systems

FIGURE S742 – 2



Typical Mechanical Sealing

FIGURE S742 – 3

Smith Meter™ AccuLoad IV Model ALIV-ST Controller for Liquid-measuring Systems

FIGURE S742 – 4

*Optional switch and lights not shown.

Smith Meter™ AccuLoad IV Model ALIV-N4 Controller for Liquid-measuring Systems (Variant 2)

Note: Mechanical sealing is achieved utilizing the lock hasps on the side of the enclosures

FIGURE S742 –5

Smith Meter™ AccuLoad IV Model ALIV-N4-MMI (foreground) and ALIV-FCM Controller for Liquid-measuring Systems (Variant 2)

Note: Mechanical sealing is achieved utilizing the lock hasps on the side of the enclosures

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