



Australian Government
Department of Industry, Science,
Energy and Resources

National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

Certificate of Approval NMI 5/1/5A

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 International Model Diptronic 100AGB Liquid Level Measuring System

submitted by Liquip International Pty Ltd
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 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 to 5 approved – certificate issued | 29/01/09 |
| 1 | Pattern & variants 1 to 5 reviewed & updated – variant 6 approved – certificate issued | 16/12/13 |
| 2 | Pattern & variants 7 & 8 approved – certificate amended (submitter name) – certificate issued | 18/08/16 |
| 3 | Variant 9 provisionally approved – interim certificate issued | 02/05/17 |
| 4 | Variant 9 provisionally approved – certificate amended (validity date) – interim certificate issued | 12/05/17 |

Document History (cont...)

| Rev | Reason/Details | Date |
|-----|--|----------|
| 5 | Variant 10 & 11 approved – certificate issued | 9/02/18 |
| 6 | Variant 9 approved –certificate issued | 31/05/18 |
| 7 | Amend address – certificate issued | 25/11/20 |
| 8 | Added Provisional Test Procedure – certificate amended (valid until January 2022) – certificate issued | 11/06/21 |
| 9 | Extended validity of Test Procedure until June 2022 – certificate issued | 27/06/21 |
| 10 | Extended validity of Test Procedure until September 2022 – certificate issued | 25/06/22 |
| 11 | Extended validity of Test Procedure until 8 th November 2022 – certificate issued | 05/10/22 |
| 12 | Extended validity of Test Procedure until 8 th June 2023 – certificate issued | 10/11/22 |

CONDITIONS OF APPROVAL

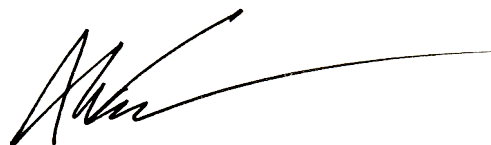
General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI 5/1/5A' 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 Certificates No S1/0/A or 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*.



Alex Winchester
A/g Manager
Policy and Regulatory Services

TECHNICAL SCHEDULE No 5/1/5A

1. Description of Pattern

approved on 29/01/09

The pattern is a Liquip International model Diptronic 100AGB static volume measuring system for road tankers (Figure 1). 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. May also be known as Liquip instruments (or components) of the same models.

1.1 Field of Operation

- The instrument may replace any other dipstick approved for a vehicle-mounted tanker
- The system is approved for deliveries not less than the minimum measured quantity (MMQ). The MMQ is to be displayed in the vicinity of the indicating device as determined (and marked) for each tank at verification/certification. Refer to '1.10 Markings and Notices' for the calculations to determine the MMQ.
- The system is approved for indicating the transfer of liquids (other than LPG) such as various grades of petrol which may include up to 10% ethanol ('E10') and various grades of pure biodiesel and biodiesel/distillate blends (to Australian government standard) either to the tank or from the tank.
- Ambient temperature range of -25°C to 55°C.
- Operating voltage range of 9 to 30 V DC.
- Accuracy Class 0.5.

Note: The Diptronic 100AGB system is a radar measuring device and is required to be calibrated and used with liquids of similar dielectric constant e.g. petrol, kerosene and distillate.

1.2 System Design

The Diptronic system is approved as substitute for a dipstick when fitted to a non-pressurised tank or compartment of a tank, of a capacity from 0.5 kilolitres to 105 kilolitres, fitted to or forming part of a vehicle, to measure the volume of the contents. Refer to General Certificate 9/0/B Vehicle Tanks of Capacities 0.5 to 105 kilolitres or similar for tank design requirements.

The Diptronic system (Figure 1) comprises a Liquip International model DIP200 calculator/indicator interfaced to not more than nine (9) Liquip International model DIP1xx (#) radar gauges (aka model 130-12) one for each tank/compartment.

(#) 'xx' may be any 2 digit number.

The system displays the minimum measured quantity for each tank defined by the quantity between the outlet valve of the tank (the transfer point) and the lowest level measured by the radar sensor. The instrument is calibrated to indicate the volume contained in the tank and in the pipe work leading to the transfer point – the point which defines the delivery/receipt of product.

Any hose/pipe work connected after the transfer point (bulk connector or hose reel model) must be completely drained when the system is used for making delivery and is kept full of liquid when the system is used for receiving product.

1.3 Calculator/Indicator

The Liquip International model DIP200 calculator/indicator (Figure 2) incorporates three LCD displays. The top left display indicates the compartment number, the top right display can be programmed to indicate either volume in litres or height in millimetres, and the bottom display indicates user information/prompts during the operation or calibration of the system.

During power-up of the calculator/indicator, the software version 01.00.xx is displayed on the user indicator. With the calculator/indicator set up to indicate volume in litres, the height of the liquid level can be displayed through the diagnostic mode by pressing the INC and OK buttons simultaneously.

1.4 Measurement Transducer

The measurement transducer is a Liquip International model DIP1xx (#) radar gauge (aka model 130-12) comprising the Diptronic headwork connected to a liquid level sensor in the form of a sensor rod mounted inside a tube with liquid entry holes at the bottom of the tube (Figure 3). The Diptronic headwork, which contains the radar electronics, is mounted on the top of the tank with the level sensor positioned vertically at the volumetric centre of the tank. The mounting bolts for the Diptronic headwork have provision for sealing the device in its prescribed calibration position. The level sensor is maintained in its vertical position with the bottom of the level sensor attached to the Liquip International model DIP 300 support bracket fixed to the bottom of the tank.

The level sensor has a top datum mark that can be used for checking the correct mounting position of the measuring transducer.

The level sensor can be from 0.6 to 2.5 m long to suit the tank size.

(#) 'xx' may be any 2 digit number.

1.5 Printer

An Epson model TM-295, 24V DC printer or any other equivalent (*) is connected to the model DIP200 calculator/indicator for printing the initial and final volume in the tank and for printing the calculated volume transferred.

(*) "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.

1.6 Installation

To ensure immunity from electromagnetic interference all cables are protected using ferrite beads and all devices are grounded.

1.7 Verification Provision

Provision is made for the application of a verification mark (refer to Figure 13)

1.8 Checking Facility

The system verifies data between the calculator/indicator and the probe by performing a checksum for every packet of data as per standard for HART protocol and the central processing unit raises an alarm if the probe does not respond.

1.9 Sealing Provision

Provision is made for the application of a verification mark.

Provision is made for the calibration buttons of the DIP200 to be sealed.

1.10 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 number | NMI 5/1/5A |
| Manufacturer's identification mark or trade mark | |
| Model number | |
| Serial number | |
| Year of manufacture | |
| Maximum temperature of the liquid T_{max} | °C |
| Minimum temperature of the liquid T_{min} | °C |
| Maximum volume (*) | Litres |
| Minimum volume (*) | Litres |
| Accuracy class | 0.5 |
| Environmental class | class |

(*) Determined at verification/certification.

In addition, the minimum measured quantity for each tank/compartment are indicated/marked.

The MMQ is to be displayed in the vicinity of the indicating device.

The MMQ must be specified for each compartment using the following calculations. This value is rounded up to the next multiple of 100 L and shall not exceed one quarter ($\frac{1}{4}$) of the compartment's nominal capacity.

MMQ calculation for **variants 1 to 5**:

MMQ = 200 x ("LITRES/mm" at the widest part of the tank)

Example: 2610L tank; 2.2L/mm widest; MMQ = 200*2.2 rounded up = 500L

MMQ calculation for **variant 9**:

MMQ = 80 x ("LITRES/mm" at the widest part of the tank)

Example: 2610L tank; 2.2L/mm widest; MMQ = 80*2.2 rounded up = 200L

2. Description of Variant 1

approved on 20/01/09

Certain other models of Diptronic liquid level measuring systems identified using the numbering system set out below:

The model number of the pattern is 100AGB; certain other models are approved having model numbers in the form '1xxxxx' as set out below:

| | |
|------------------------|----------------------|
| First digit | 1 |
| Second digit | any numeral, 0 to 9 |
| Third digit | any numeral, 0 to 9 |
| Fourth to sixth digits | any alpha characters |
| Suffix (optional) | any alpha character |

During power-up of the calculator/indicator, the software version, in the form 01.0x.xx is displayed on the user indicator.

3. Description of Variant 2

approved on 20/01/09

The Liquip International model Diptronic 1xxAGB static volume measuring system for road tankers, similar to the pattern, but now with software to allow communication with a process logic controller (PLC) and the system is designed to allow deliveries via a hose reel and nozzle (Figure 4). The system includes a diverting valve, a filter/strainer, a pump, a hose reel and a nozzle installed such that the pipe work is maintained full of liquid at all times. A diverting manifold valve is installed between the outlet of the tank and the filter/strainer to prevent deliveries whenever the tank is refilled with liquid. The nozzle is fitted with an anti-drain valve to maintain the system full of liquid and pressurised at not less than 55 kPa.

To ensure that the level of liquid does not fall below the minimum measuring level, either:

- (a) An internal float valve is installed in the supply tank (Figure 5a) that stops the delivery when minimum measuring level is reached; or

- (b) A liquid detector, such as the Liquip model FOB100 sensor connected to a Liquip MPP100 series monitor (Figure 5b), is installed and interfaced to stop the delivery when the product level approached the minimum measuring level of the electronic dipstick; or
- (c) The system is maintained full of liquid and protected from measuring air by the Diptronic itself which is programmed to signal low level to PLC which acts through relays closing valves and disengaging the hydraulic drive pump.

A three-way valve may be fitted situated between the pump and the hose reel (Figure 6) and used for bulk deliveries

4. Description of Variant 3

approved on 20/01/09

Similar to the pattern except that it is used for delivering fertiliser products, and has an additional tank with DIP1xx (aka 130-12) radar level gauge that is utilised for flushing at least 50 litres of water from the transfer point to the purchasers receiving tank. This ensures that the client has received the entire product purchased and contaminations will not occur between other fertiliser products.

A printer receipt is supplied indicating the volume of fertiliser product, and water delivered.

It shall not be possible to deliver fertiliser product unless there is sufficient water in compartment number 2 to flush the system. Refer to Figure 7 for a schematic diagram of a typical system.

5. Description of Variant 4

approved on 20/01/09

Similar to the pattern except that it is used for delivering cooking oils. The variant comprises a vehicle tank with three compartments, two for fresh cooking oils and the other for waste oil.

The system may have one model DIP200 calculator/indicator for either one or two DIP1xx (aka 130-12) measurement transducers (as described for the pattern).

Refer to Figure 8 for a schematic diagram of a typical system with a single calculator/indicator.

6. Description of Variant 5

approved on 20/01/09

With a compartment within a compartment (Figure 9) allowing bulk or smaller volumes to be delivered. The pumps and valves are controlled by PLC. The compartment has two discharge points, one for bulk deliveries and the other for smaller volume deliveries.

The smaller volume deliveries have the field of operation as the pattern except for the following:

Scale graduation = 0.1 L

The minimum measured quantity is = 20 L

7. Description of Variant 6 **approved on 16/12/13**

With the Liquip model DIP200 calculator/indicator described for the pattern replaced by a Liquip DFV1** calculator/indicator as described in the documentation of approval NMI S609, or other compatible (#) NMI-approved calculator/indicator.

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

8. Description of Variant 7 **approved on 18/08/16**

Liquip model DFV130-12 (aka DFV130/DFV150) Radar level gauge (measurement transducer) which has the same features and field of operation as the measurement transducer of the pattern DIP1xx (as described in clause **1.4 Measurement Transducer**) except that this model now operates within an environment temperature range of -10°C to 55°C (environment class N).

9. Description of Variant 8 **approved on 18/08/16**

The DreamTec model i-meter GPS tracking module (Figure 10) 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.

10. Description of Variant 9 **provisionally approved on 02/05/17**
approved on 31/05/18

The variant is able to deliver two different products e.g. product A or product B one at the time through a single pump having two hoses one for each product and a bulk outlet.

10.1 Calculator/Indicator

The Liquip International model DFV1xx calculator/indicator incorporates an LCD display with a resettable indicator. The calculator/indicator frequently queries each Diptronic probe for its product level and converts this to volume using tables established during calibration

- The transferred volume is based on the product level and pipework priming quantity*.
*priming quantity = the calibrated volume between compartment's manifold through pipework to air eliminator
- Displays the stable measured volume in each compartment, corresponding to the quantity between the outlet valve of the tank and the lowest level of the product measured.
- Sends control signals to the System Control Box(s)

10.2 System Control Box(s)

The System Control Box provides buttons for the operator to either select Product A or B and the compartment.

These buttons open specific valves corresponding to the selection.

10.3 Pump

A single pump is used. This is manually switched ON or OFF by the operator.

10.4 Air Eliminator

A TCS Model 730 Air Eliminator or 'Equivalent' (*) is fitted to keep the pipework full of liquid at all times and to vent air and vapour from the pipeline.

- (*) '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.

10.5 Sight Glass (Optional)

A Sight Glass may be fitted at the pump inlet for the operator to visually check the presence of product in the pipeline.

10.6 Two Hose Reels

Two Hose Reels are fitted. One Hose Reel is dedicated for Product A and the other for Product B.

10.7 Vacuum Breaker

A Vacuum Breaker is fitted to prevent negative pressure occurring in the pipeline and compartments.

10.8 Isolation Valves

A 3-Way Valve and/or Isolation Valves are fitted to ensure that the product selected is diverted to the correct hose reel. (Refer to Figure 11 Schematic Diagram).

11. Description of Variant 10

approved on 9/02/18

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 |

12. Description of Variant 11

approved on 9/02/18

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.

Provisional Test Procedure No 5/1/5A

The pattern and variants 1 to 5 and 9:

The vehicle tank shall comply with the requirements of the appropriate general certificate of approval (e.g. 9/0/B) in terms of:

- Rigidity
- Internal venting (excluding diptube)
- Sump
- Piping design
- Tank markings

The Diptronic headwork, which contains the radar electronics, is mounted on the top of the tank with the level sensor positioned vertically at the volumetric centre of the tank within 25 mm.

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.

The verification may be carried out by either delivering a traceable volume into the tank compartment, or alternatively by dispensing the liquid from the tank compartment via traceable volume measuring equipment.

Within the field of operation, the reference standards must be able to measure the volume at any level in the-tank compartment with sensitivity at least three times better than a volume equivalent to 1 mm change in liquid level.

For each tank, the calibration points shall include the minimum liquid level (rounded up to the nearest 10 L) and the maximum liquid level (rounded down to the nearest 10 L). These maximum and minimum volumes for each tank/compartment shall be indicated to the user as the operating range of the instrument.

The tank profile shall be determined at an appropriate number of intervals to ensure that for contents in the tank greater than $2 \times$ minimum measured quantity, the interpolated volume between any two adjacent calibration points is within $\pm 0.3\%$.

Additional tests for Variant 9:

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

The liquid measuring instrument shall be tested in accordance NITP 5.2 clause 4.6 with the following variations:

- Testing is not required at different flowrates.
- All test deliveries are to be at least equal to the greater of:
 - 1 minute delivery at the maximum achievable flowrate
 - $2 \times$ minimum measured quantity; or
 - 1500 scale intervals for system with a digital indicator.

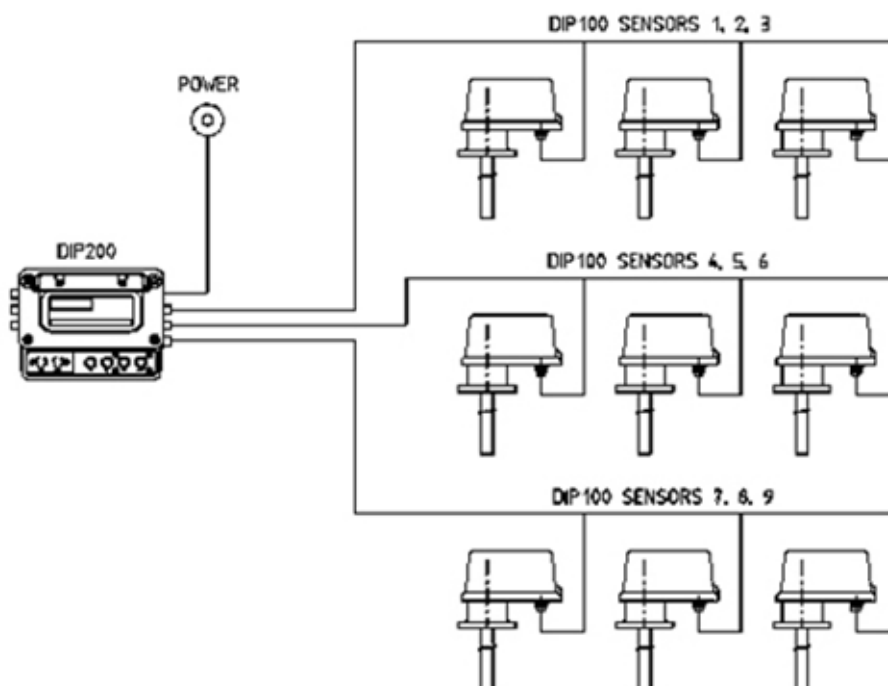
- Complete at least three deliveries across different measuring ranges of the compartment (Typically Top, middle and bottom). For example: 8100L down to 6600L, 5600L down to 4100L, and 2000L down to 500L.
- Complete at least one delivery for each of the following conditions:
 - Wet (full pipework and manifold) to dry (empty pipework and manifold).
 - Dry (empty pipework and manifold) to wet (full pipework and manifold).

Note 1: Use of a smaller prover is acceptable to conduct these tests (where a prover equal to or greater than the required delivery size is unavailable). In this case multiple deliveries into prover can be used provided the accuracy (uncertainty and variations) of the reference volume is no greater than one-third of the MPE.

Note 2: Where a delivery into a prover is completed without reaching the measurable scale of the prover, it is acceptable to use a second reference volume to facilitate a prover reading provided the accuracy (uncertainty and variations) of the reference volume is no greater than one-third of the MPE.

e.g. measure a volume from a master meter to top up and reach a readable level on the prover.

FIGURE 5/1/5A – 1



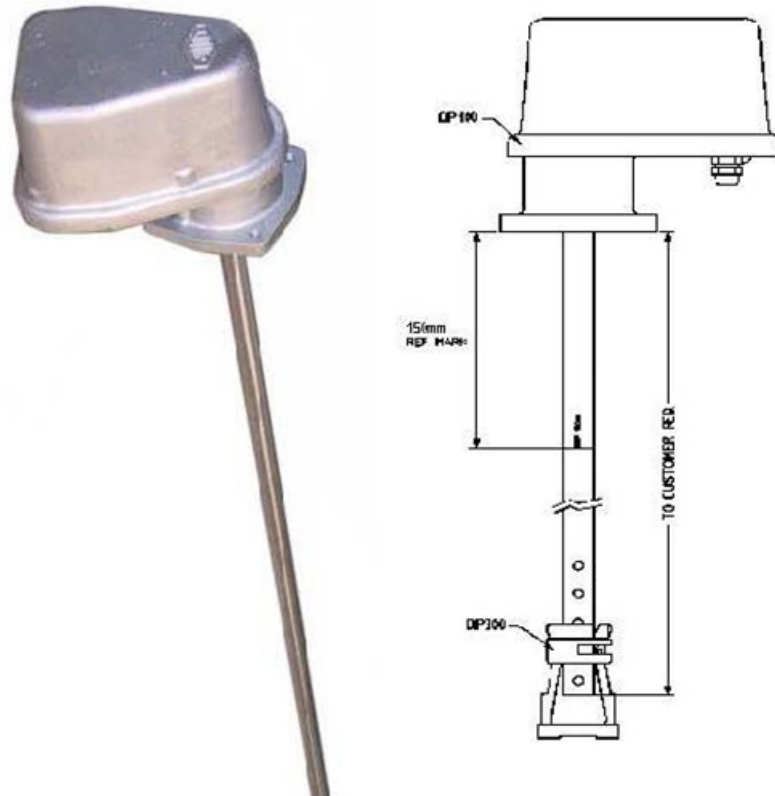
Liquip International Model Diptronic 100AGB Liquid Level Measuring System

FIGURE 5/1/5A – 2



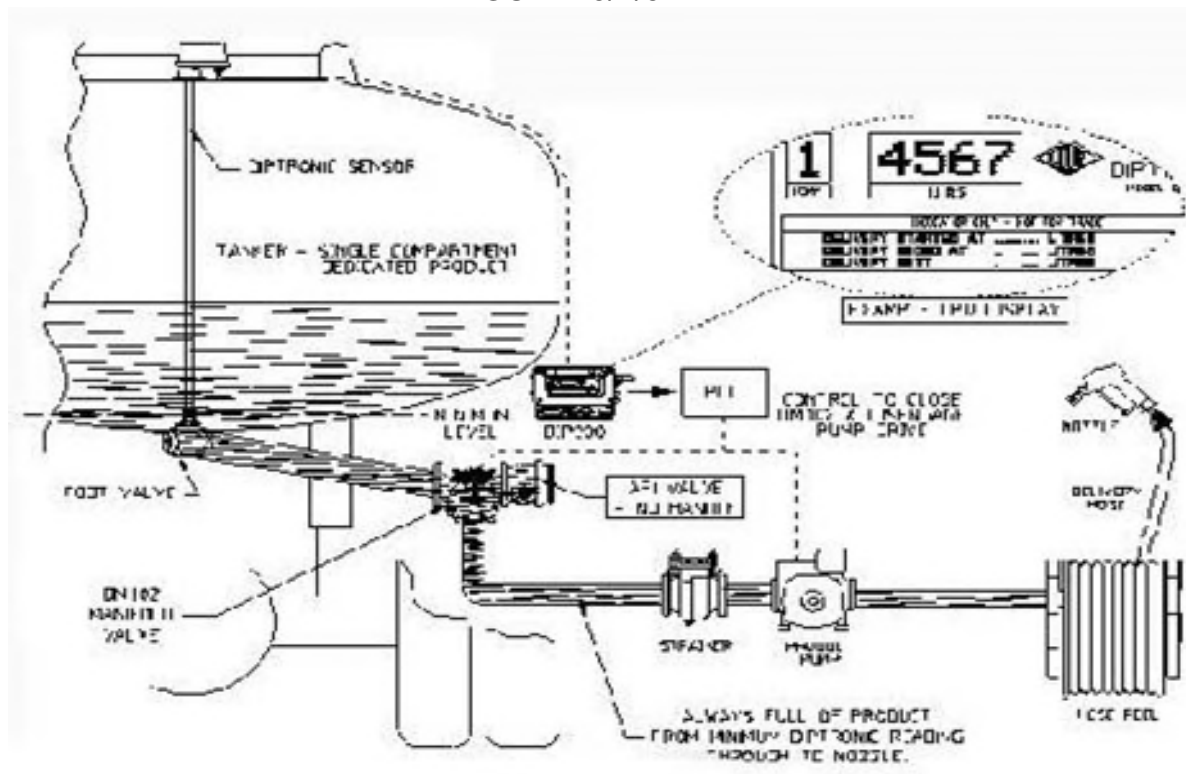
Liquip International Model DIP200 Calculator/Indicator

FIGURE 5/1/5A – 3



Model DIP1xx Radar Gauge

FIGURE 5/1/5A – 4



Interruptible Volume Measuring System – Variant 2

FIGURE 5/1/5A – 5

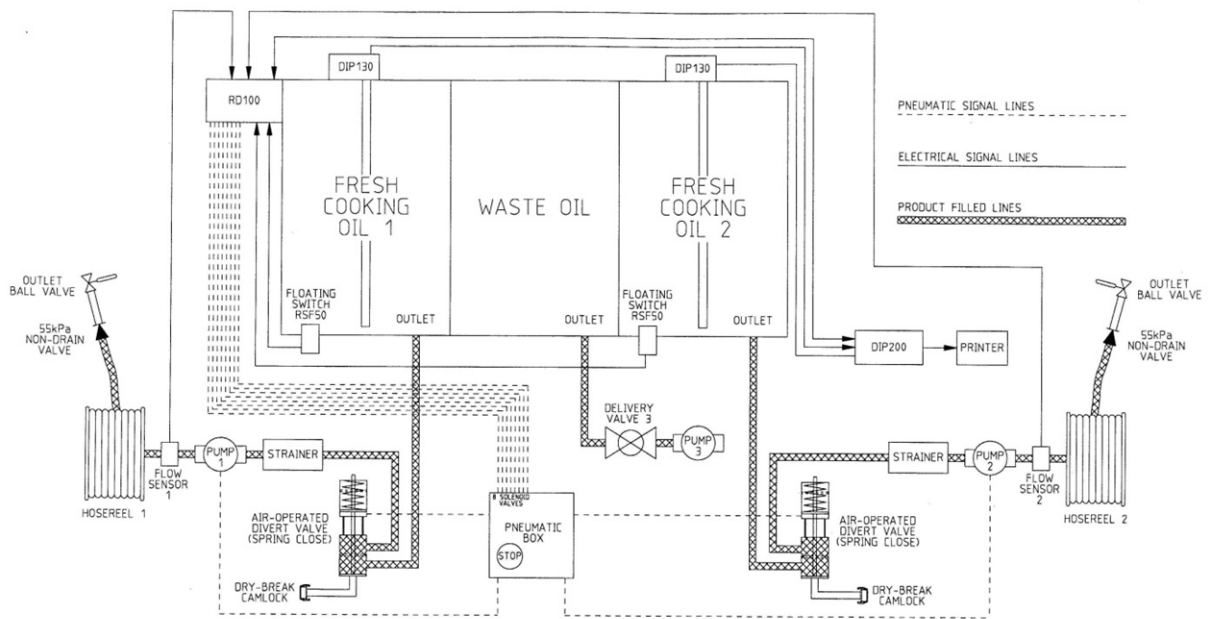


(a) Internal Float Valve



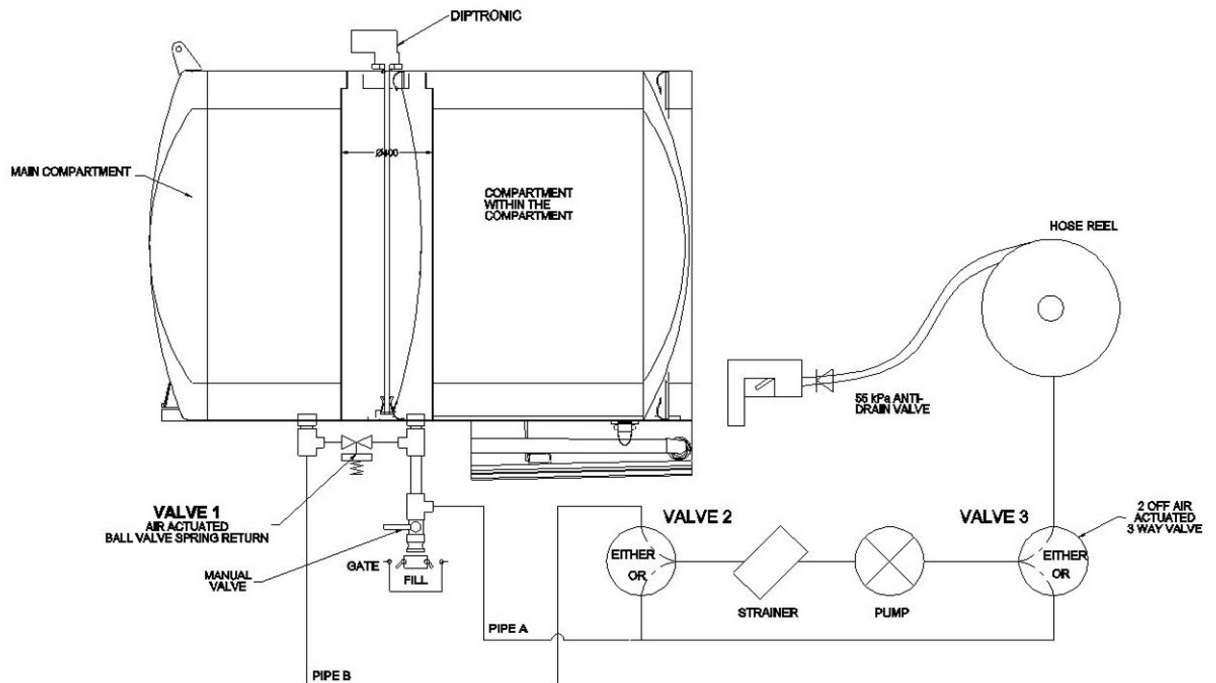
(b) MPP100 Series Monitor

FIGURE 5/1/5A – 8



Typical System for Cooking Oils – Variant 4

FIGURE 5/1/5A – 9



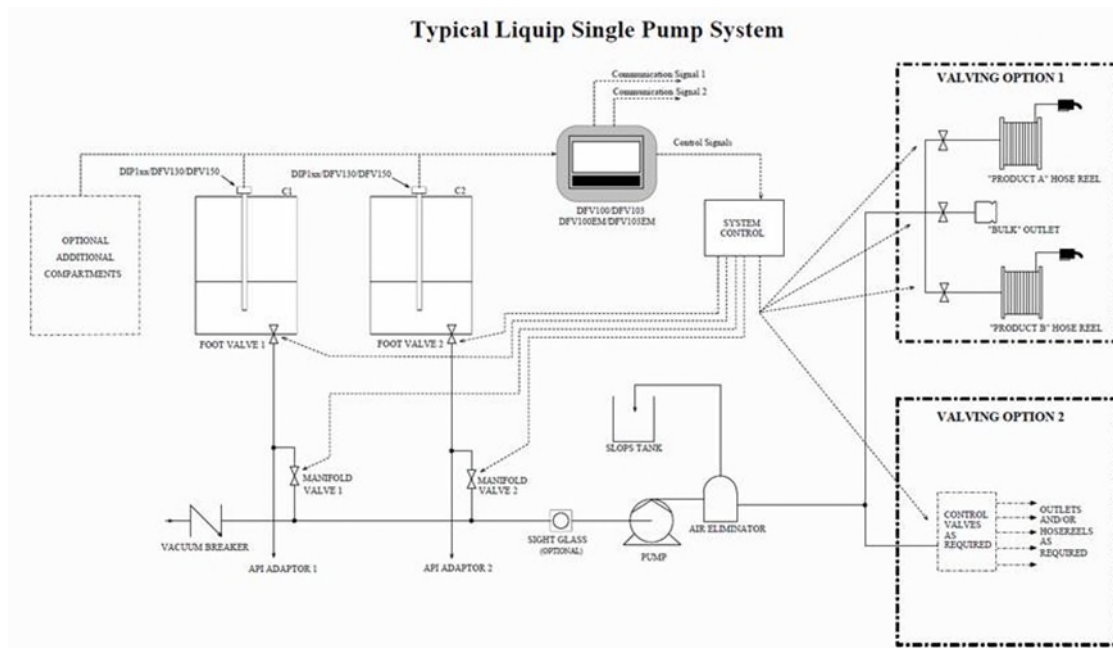
Compartment Within a Compartment System – Variant 5

FIGURE 5/1/5A – 10



DreamTec Model i-meter GPS Tracking Module – Variant 8

FIGURE 5/1/5A – 11



Schematic drawing of Variant 9

FIGURE 5/1/5A – 12



Microchip RN-240F Bluetooth module – Variant 12

FIGURE 5/1/5A – 13

160 OVERALL

LIQUIP INTERNATIONAL DIPTRONIC

TANK MANUFACTURER TANK NUMBER

NMI APPROVAL No: P5/1/5A PRODUCT

| COMPARTMENT | 1 | 2 | 3 | 4 | 5 | 6 |
|------------------------------|---|---|---|---|---|---|
| TOTAL CAPACITY litres | | | | | | |
| MAX. MEASURABLE LEVEL litres | | | | | | |
| MIN. MEASURABLE LEVEL litres | | | | | | |
| MIN. DELIVERY (MMQ) litres | | | | | | |
| 7332 | | | | | | |

70 OVERALL

2mm dia. Holes are drilled out as required for each calibrated compartment and fitted with lead seals through the appropriate hole. The seals are stamped with the verification Marks which includes the verifier's company ID, individual ID and date of verification.

~ End of Document ~