



Australian Government  
Department of Industry,  
Science and Resources

**National  
Measurement  
Institute**

36 Bradfield Road, West Lindfield NSW 2070

**Certificate of Approval  
NMI 9/2/7**

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 Vehicle Tank Static 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 80-1 Road and Rail Tankers with Level Gauging, Part 1 Metrological, dated May 2021.

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**

<b>Rev</b>	<b>Reason/Details</b>	<b>Date</b>
0	Pattern & variants approved – certificate issued	14/06/23
1	Provisional status removed – certificate issued	20/10/23

## CONDITIONS OF APPROVAL

### General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI 9/2/7' and only by persons authorised by the submitter.

Instruments purporting to comply with this approval and currently marked 'NMI 5/1/5A' may be re-marked 'NMI 9/2/7' but 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 S1/0B.

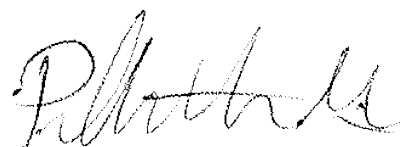
### Special Conditions of Approval (Vehicle Tanks – road and rail):

Static level gauging systems for vehicle tanks to measure and display a volume of liquid by measuring the level of liquid contained in a compartment of a vehicle tanker with respect to a fixed reference. The known dimensions of a compartment are used by the system to calculate the volume of liquid in the compartment from the height measured.

The system shall only be installed on a vehicle tanker that has been designed according to General Certificate 9/0/B *Vehicle Tanks of Capacities 0.5 to 105 kilolitres*, or other compatible (#) **NMI approved Vehicle Tank**.

- (#) '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 within the rated field of operation.

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



**Dr Phillip Mitchell**  
A/g Manager  
Policy and Regulatory Services

TECHNICAL SCHEDULE No 9/2/7

**1. Description of Pattern**

**approved on 14/06/23**

The pattern is a Liquip International model Diptronic 100AGB static level gauging system (Figure 1) for vehicle tanks, approved for measuring the quantity of liquid hydrocarbon products other than LPG in the compartments.

**1.1 Field of Operation**

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

- Minimum measured quantity,  $V_{min}$  ..... L (#1)
- Capacity of road tanker 0.5 m<sup>3</sup> to 50 m<sup>3</sup>
- Capacity of rail tanker 10 m<sup>3</sup> to 120 m<sup>3</sup>
- Inclination from horizontal  $\pm 2^\circ$
- Dynamic viscosity,  $\eta$  (at 20 °C) 0.4 to 20 mPa.s (#2)
- Liquid temperature range -10 °C to 50 °C
- Ambient temperature range -25 °C to 55 °C (\*)
- Voltage of road vehicle battery 12 or 24 V DC (nominal)
- Accuracy class for system Class 0.5
- Applications Road and rail tanker compartments

(#1) The minimum measured quantity ( $V_{min}$ ) **must be specified for each compartment** using the following calculations:

a) must be given by one of the following forms:

- $1 \times 10^n$ ,  $2 \times 10^n$  or  $5 \times 10^n$  litres where  $n$  is a whole number;
- entire multiples of 100 litres.

b) equal to or greater than the volume corresponding to 200 mm difference in liquid level at the section of the compartment with the smallest sensitivity (i.e., millimetres per litre).

c) not exceed one quarter ( $\frac{1}{4}$ ) of the nominal capacity of the compartment.

$V_{min}$  calculation:

$V_{min} = 200 \times$  (smallest sensitivity "LITRES/mm" generally at the widest part of the compartment)

Example: 2610 L tank; 2.2 L/mm widest;  $V_{min} = 200 \times 2.2 = 500$  L (rounded up)

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

The Diptronic 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.

(\*) Refer to the corresponding measurement transducer models for the appropriate environmental class. -25 °C to 55 °C for Environmental Class I, -10 °C to 55 °C for Environmental Class N.

Note: The instrument may replace any other level gauge approved for a vehicle-mounted tanker (e.g., manual dipstick).

**1.2 System Design**

This automatic tank level gauging system measures the liquid level in a horizontal tank (measuring vessel), with the gauge positioned within 25 mm of the centroid of

the compartment giving compensation for the angle of inclination, in longitudinal and lateral direction in respect of horizontal.

The system is intended for the volume measurement of liquid in a vehicle tank compartment. During normal operation, the volume is displayed on the calculator/indicator and is derived from the measured liquid level in the compartment. The external valve (API coupling or Manifold valve) is deemed to be the transfer point.

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 compartment of a tanker.

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

The system displays the minimum measurable level for each compartment defined by the quantity between the external valve (API coupling or Manifold valve) of the compartment (the transfer point) and the lowest level measured by the radar sensor. The instrument is calibrated to indicate the volume contained in the compartment 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 Components of the Measuring System

The system includes:

- **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 (however the millimetre display is not approved for trade use) 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.

- **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).

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

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.

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 m to 2.5 m long to suit the tank size.

- **Printer**

An Epson model TM-295, 24 V DC printer or any other equivalent (\*) is connected to the model DIP200/DFV1xx 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.

- **Installation**

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

#### **1.4 Verification Provision**

Provision is made for the application of a verification mark (refer to Figure 12).

For systems installed on a vehicle tank having multiple compartments, each compartment is to be verified separately. Provision is made for the verification mark to identify and be associated with the compartment that has been verified.

#### **1.5 Checking Facility**

The system verifies data between the calculator/indicator and the sensor 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.

#### **1.6 Sealing Provision**

Provision is made for the DIP200/DFV1xx to be sealed by sealing bolts and wires outside the gauge, and the calibration Button on the DIP200/DFV1xx to be sealed (Figure 2).

## 1.7 Descriptive Markings and Notices

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

Pattern approval number	NMI No 9/2/7
Manufacturer's identification mark or trade mark	.....
Model number	.....
Serial number	.....
Year of manufacture	.....
Liquid temperature range	... to ...°C
Total capacity of compartment, $V_{max}$	..... Litres
Minimum measured quantity, $V_{min}$	..... Litres
Minimum Measurable level	..... Litres (^)
Accuracy class	class 0.5

(^) the volume quantity for each tank defined by the quantity between the (the transfer point) and the lowest level measured by the radar sensor

In addition, tanks and compartments shall comply with any relevant requirements given in NITP 9 *National Instrument Test Procedures for Vehicle Tanks* in regard to markings, numbering and notices. The minimum measured quantity for each compartment are indicated/marked.

The  $V_{min}$  is to be displayed in the vicinity of the indicating device.

## 2. Description of Variant 1

**approved on 14/06/23**

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 14/06/23**

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, 4 and 6 for a schematic diagram of a typical system.

**4. Description of Variant 3** **approved on 14/06/23**

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.

**5. Description of Variant 4** **approved on 14/06/23**

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 5** **approved on 14/06/23**

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 6** **approved on 14/06/23**

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 **1.3 Components of the Measuring System, Measurement Transducer**) except that this model now operates within an environmental temperature range of -10 °C to 55 °C (Environmental Class N).

**9. Description of Variant 7** **approved on 14/06/23**

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**

**approved on 14/06/23**

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

**11. Description of Variant 9**

**approved on 14/06/23**

A Microchip RN-240F Bluetooth module (Figure 11) 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.



## TEST PROCEDURE No 9/2/7

Verification shall only be performed on the complete measuring system.

Assess the design of the vehicle tank and compartment is in accordance with procedures given in the NMI documents NITP 9 *National Instrument Test Procedures for Vehicle Tanks* and General Certificate 9/0/B *Vehicle Tanks of Capacities 0.5 to 105 kilolitres*.

The measuring system 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 (MPE), for the transferred volumes are:

1. For transferred volumes ( $V$ ) equal to or greater than the minimum measured quantity ( $V_{min}$ ) and up to twice the minimum measured quantity, the minimum specified volume deviation ( $E_{min}$ )

The minimum specified volume deviation is twice the absolute value of the maximum permissible error for the minimum measured quantity of the compartment

$$\text{i.e: } E_{min} = V_{min} \times 2 \times (0.5 / 100)$$

2. For transferred volumes greater than twice the minimum measured quantity,  $\pm 0.5\%$

Note: For calculating errors, the transferred volumes are determined using the static volume measurements indicated by the instrument before and after a delivery, which is compared with the transferred reference volume measured using suitable traceable reference standard(s) of measurement.

### **Accuracy test:**

The test shall be carried out with the tank in normal position with an inclination of no greater than  $\pm 0.2^\circ$  from the horizontal.

The measuring system shall be verified at an appropriate number of volume levels across the full measuring range of the level sensor, that ensure for any combination of liquid levels in the compartment, the deliveries to or from the compartment greater than the minimum measured quantity are within the MPE for that delivery.

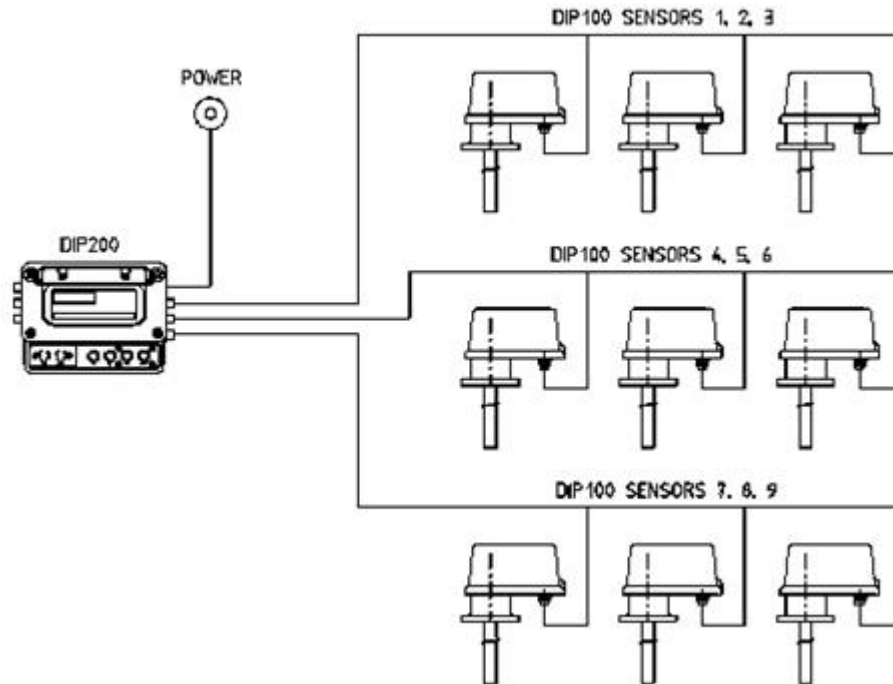
The verification may be carried out by either delivering a traceable volume into the tank compartment, or alternatively by dispensing the liquid from the tank compartment via traceable volume measuring equipment.

The accuracy of reference volume needs to be equal to or better than 3 times than the MPE for the delivery volume being tested.

Selected volume levels shall include multiple levels across the most sensitive part of the tank/compartment.

The errors of all transferred volumes between any combination of measured levels that correspond to a volume greater than or equal to the minimum measured quantity shall be calculated. The error of each calculated transfer volume shall be within the maximum permissible errors given above.

FIGURE 9/2/7 – 1

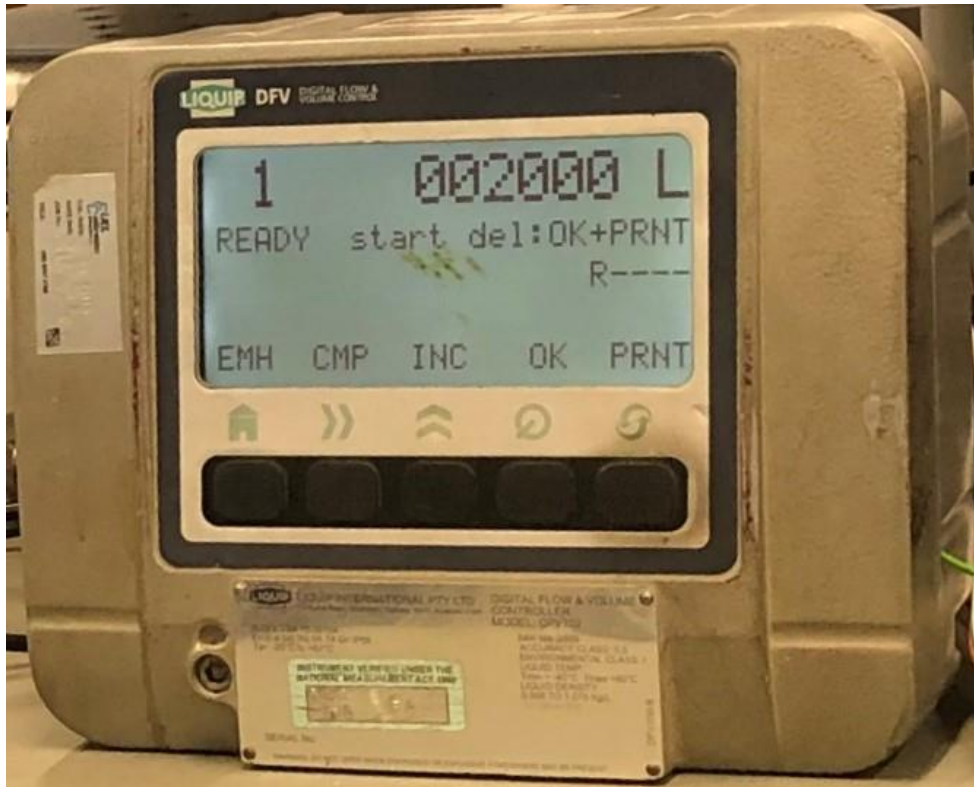


Liquip International Model Diptronic 100AGB Liquid Level Measuring System

FIGURE 9/2/7 – 2



Liquip International Model DIP200 Calculator/Indicator

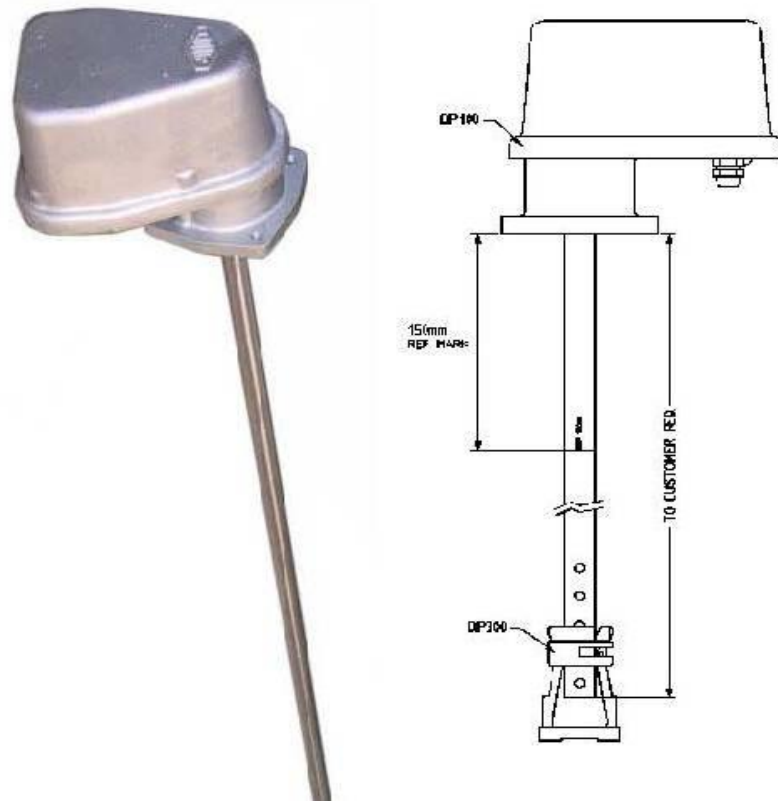


Liquip International Model DFV1\*\* Calculator/Indicator



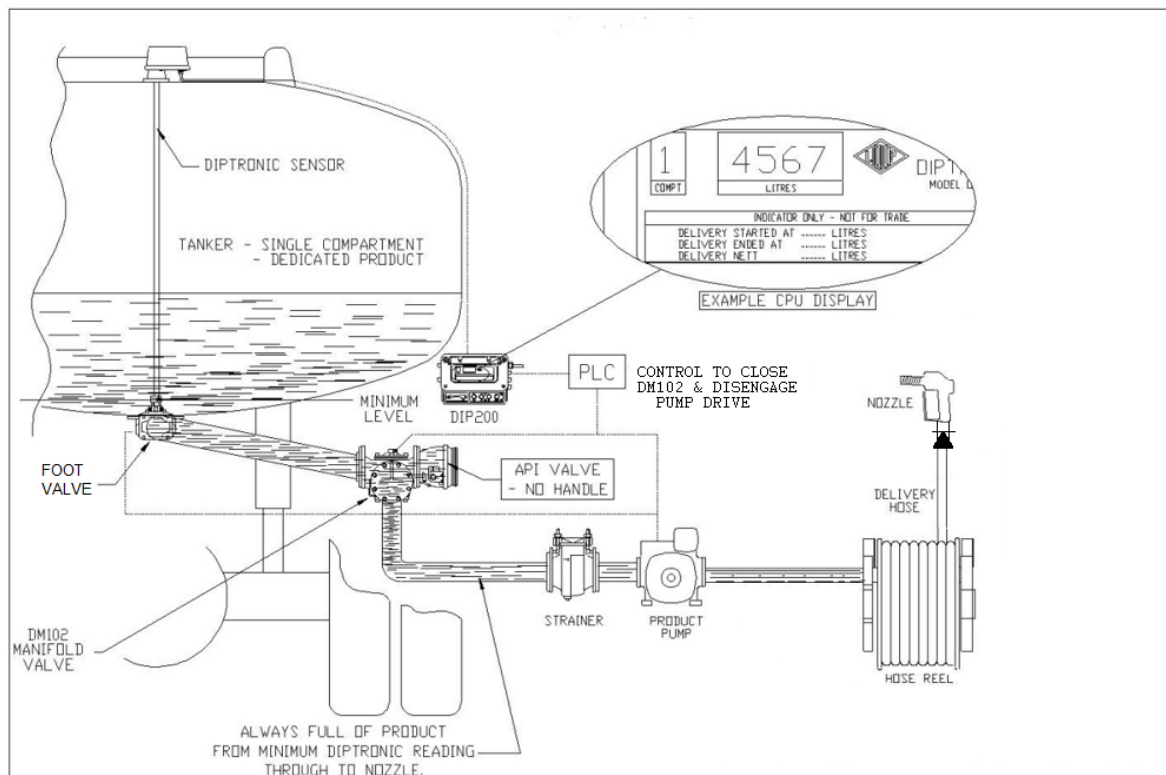
Typical Sealing of the DFV1\*\* Cal Button to a Cover-mounting Screw (not shown)

FIGURE 9/2/7 – 3



Model DIP1xx Radar Gauge

FIGURE 9/2/7 – 4



Interruptible Volume Measuring System – Variant 2

FIGURE 9/2/7 – 5

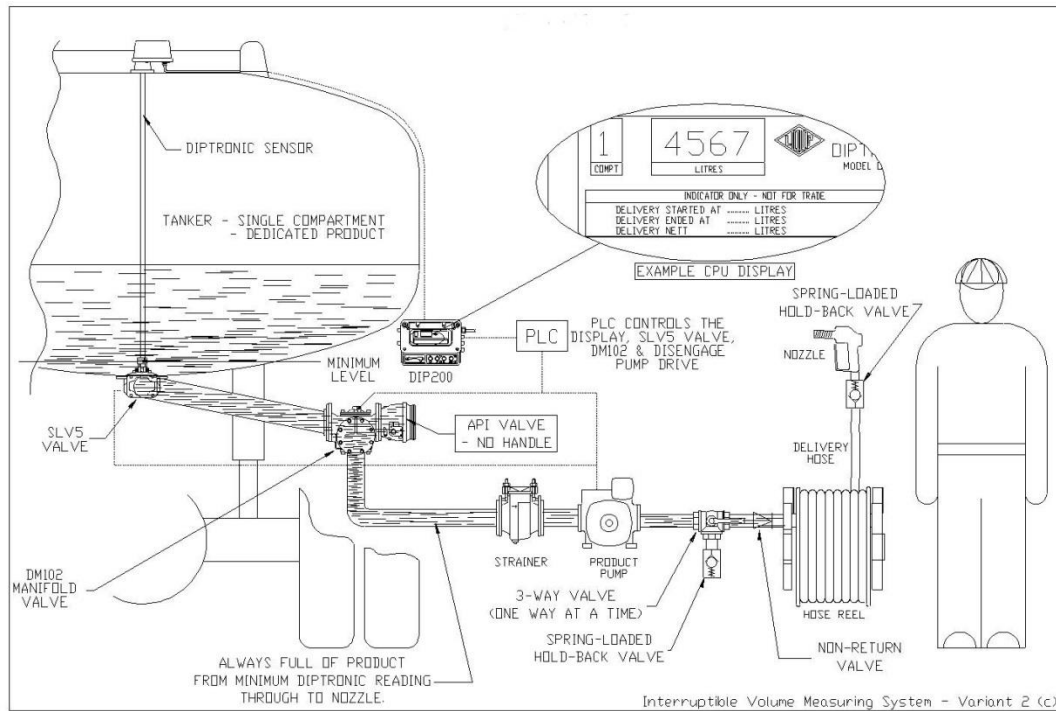


(a) Internal Float Valve



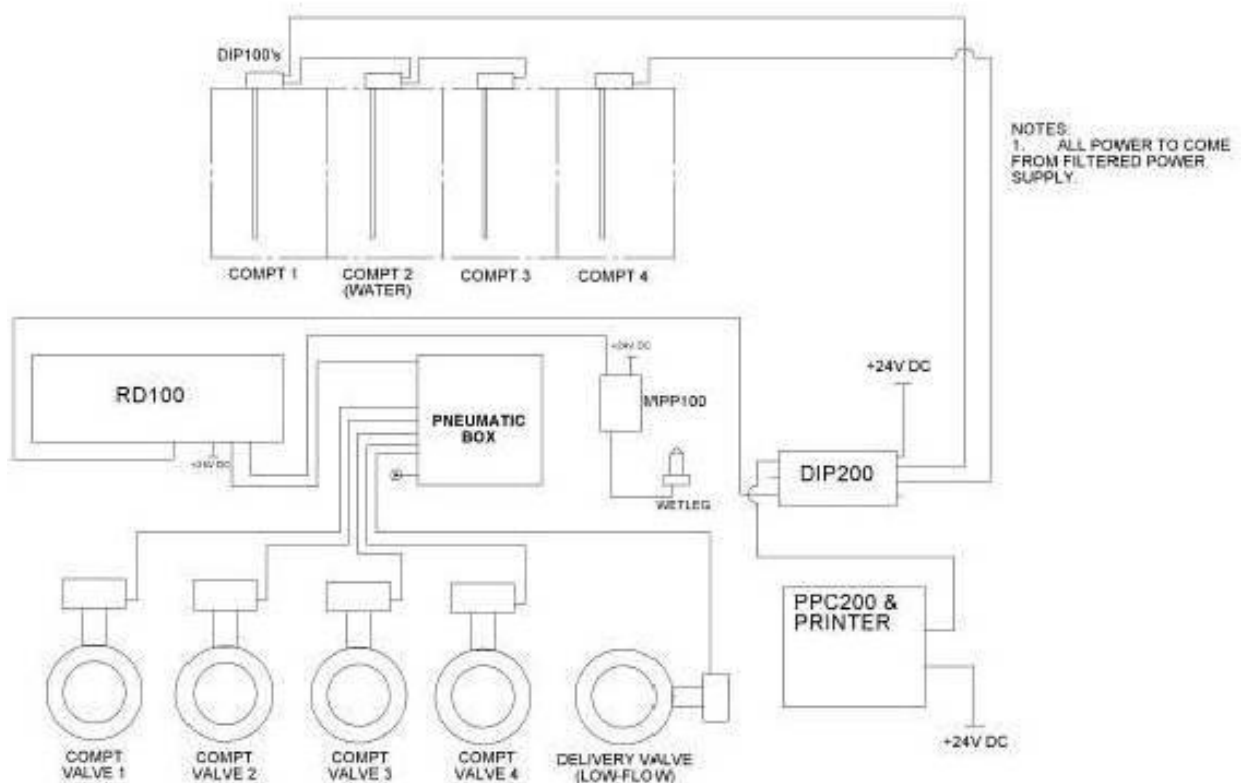
(b) MPP100 Series Monitor

FIGURE 9/2/7 – 6



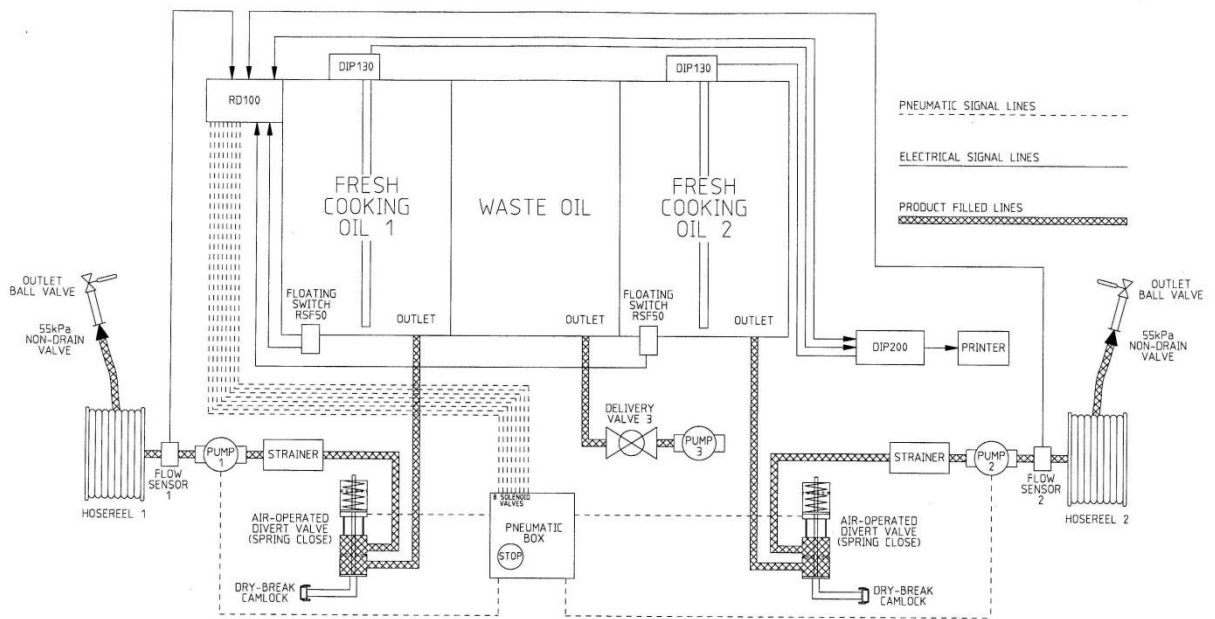
Typical System with Three-way Valve – Variant 2

FIGURE 9/2/7 – 7



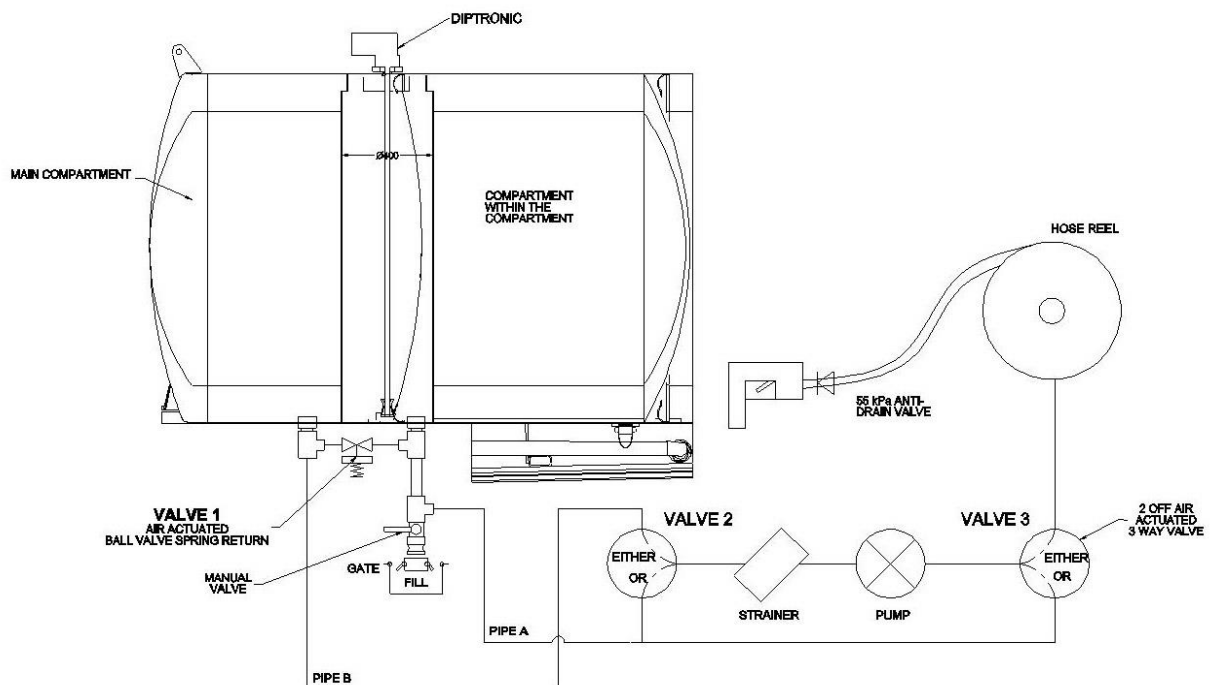
Typical System for Fertiliser – Variant 2

FIGURE 9/2/7 – 8



Typical System for Cooking Oils – Variant 3

FIGURE 9/2/7 – 9



Compartment Within a Compartment System – Variant 4

FIGURE 9/2/7 – 10



DreamTec Model i-meter GPS Tracking Module – Variant 8

FIGURE 9/2/7 – 11



Microchip RN-240F Bluetooth module – Variant 12



FIGURE 9/2/7 – 12

<b>LIQUIP INTERNATIONAL DIPTRONIC</b>						
TANK MANUFACTURER <input style="width: 150px;" type="text"/>			TANK NUMBER <input style="width: 150px;" type="text"/>			
NMI APPROVAL No: 9/2/7			PRODUCT <input style="width: 100px;" type="text"/>			
FRONT OF TANK			REAR OF TANK			
COMPARTMENT	1	2	3	4	5	6
TOTAL CAPACITY litres						
MAX. MEASURABLE LEVEL litres						
MIN. MEASURABLE LEVEL litres						
MIN. DELIVERY (MMQ) litres						
7332	○	○	○	○	○	○

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 ~