Australian Government
Department of Industry, Innovation and Science

National Measurement Institute

Certificate of Approval

NMI 5/6B/209

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.

TCS Model 700-35-SPA Liquid-measuring System

submitted by Total Control Systems
2515 Charleston Place
Fort Wayne Indiana 46808
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 117-1, Measuring Systems for Liquids Other than Water, dated July 2004.

This approval becomes subject to review on 1/02/17, and then every 5 years thereafter.

DOCUMENT HISTORY

Rev	Reason/Details	Date
0	Pattern & variant 1 approved – interim certificate issued	30/01/07
1	Pattern & variant 1 – certificate issued	20/02/07
2	Variants 2 & 3 approved – interim certificate issued	20/06/07
3	Variants 2 & 3 approved – certificate issued	12/07/07
4	Variants 4 & 5 approved – interim certificate issued	12/12/07
5	Variants 4 & 5 approved – certificate issued	22/01/08
6	Variant 6 approved – certificate issued	27/10/08

Document History (cont…)

7	Pattern & variants 1 to 6 reviewed & updated – variant 7 approved – certificate issued	20/12/11
8	Variant 8 approved – certificate issued	27/07/12
9	Variant 9 approved – certificate issued	25/07/13
10	Variants 10 & 11 approved – certificate issued	29/09/14
11	Variants 12 & 13 approved – certificate issued	5/07/16

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with approval number 'NMI 5/6B/209' and only by persons authorised by the submittor.

Instruments incorporating a component purporting to comply with this approval shall be marked 'NMI 5/6B/209' 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 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*.

Dr A Rawlinson

TECHNICAL SCHEDULE No 5/6B/209

1. Description of Pattern approved on 30/01/07

A bulk flowmetering system incorporating a Total Control Systems (TCS) model 700-35-SPA (*) positive displacement flowmeter (Figure 1 and Table 1) for bulk metering of petroleum products other than LPG.

(*) The full model number of the meter is in the form '700-35-SPA-4-EI-A' – refer to Table 1.

1.1 Field of Operation

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

- Minimum measured quantity, V_{min} 100 L (#1)
- Maximum flow rate, Q_{max} 1135 L/min
- Minimum flow rate, Q_{min} 113 L/min
- Maximum pressure of the liquid, P_{min} 1050 kPa
- Minimum pressure of the liquid, P_{min} 140 kPa (#2)
- Dynamic viscosity 0.4 to 20 mPa.s (at 20°C) (#3)
- Liquid temperature range -10°C to 50°C
- Ambient temperature range -25°C to 55°C
- Accuracy Class 0.5

(#1) The calculator/indicator indicates the volume at least in 1 L increments.

(#2) As specified for the gas elimination device for effective operation.

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

1.2 Components of the Flowmetering System

(i) Tank

A supply tank, which may incorporate a detector for low liquid-level. The detector is used to prevent further deliveries when the low liquid-level is reached, and prevents air from entering the pipework.

(ii) Pump

A positive displacement, centrifugal or submersible turbine type pump may be used to provide flow through one or more flowmeters.

Systems fitted with a positive displacement pump shall include a gas elimination device capable of continuously separating any air/vapour entrained in the liquid upstream of the flowmeter.

A centrifugal type pump may only be installed below the liquid level of the supply tank and a submersible turbine type pump may be used either alone or supplying a centrifugal type pump positioned above or below the liquid level of the supply tank. These systems shall include a gas elimination device capable of removing any pockets of air/vapour that may form in the pipework upstream of the flowmeter.

In any case, for all combination of usage, the pump(s) shall be of sufficient capacity to ensure that each flowmeter can operate over its approved flow rate range.

(iii) Non-return Valve

A non-return valve is fitted between the pump and the flowmeter to prevent reverse flow and keep the pipework full of liquid at all times.

(iv) Gas Elimination Device (Figure 2)

The gas elimination device is a TCS model 740 strainer/air eliminator (or any other equivalent approved gas elimination device) fitted upstream of the flowmeter to prevent vapour entering the flowmeter.

For applications where the duration of the shut down period does not cause thermal contraction of the liquid and formation of pockets of gas upstream of the flowmeter, the gas elimination device may be modified for use as a strainer only, provided the supply tank incorporates a detector for low liquid-level.

Note: A TCS model 745 high capacity strainer/air eliminator may be used.

(v) Measurement Transducer

The measurement transducer is a TCS model 700-35-SPA-6-EI-A rotary motion positive displacement flowmeter (Figure 2) with a mechanical output shaft connected via 90° bevel gear to a micrometer type calibration adjustment mechanism with a slotted shaft into which the drive shaft of the pulse generator fits.

The calibrator has a thimble which can be rotated in the direction marked for increasing or decreasing the rotation rate of the drive shaft of the pulse generator. The amount by which the volume, displayed by the calculator/indicator, is increased or decreased is determined with reference to the scale divisions on the calibrator, marked 1%, 0.1% and 0.02%.

The calibration adjustment is carried out using the liquid which the flowmeter is intended to measure.

Provision is made for inserting a thermometer and fitting a pressure gauge for measuring the liquid temperature and pressure at the flowmeter during calibration.

(vi) Pulse Generator

An Acme model EPU 200 pulse generator, or any other compatible (#) NMI-approved pulse generator, is used. The EPU 200 is described in the documentation of approval NSC S189B**.**

(vii) Calculator/Indicator

A Liquip model EMH 500H calculator/indicator (Figure 2), or any other compatible (#) NMI-approved calculator/indicator, is used. The EMH 500H is described in the documentation of approval NMI S351A**.**

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

(viii) Transfer Device

The transfer device is located downstream of the flowmeter and clearly defines the start and stop of the measured quantity. The transfer device may be in the form of a breakaway coupling, a nozzle or a positive shut-off component, such as a manually or automatically operated flow control valve. Whatever the transfer device used, the pipework upstream of the transfer device shall be maintained full of liquid.

The system may have more than one transfer point however the pipework design is such that once the measurement starts the flow continues through the intended transfer point until delivery is finalised; there is no possibility for diverting the measured quantity other than through the intended transfer point.

1.3 Descriptive Markings

Each measuring system shall bear the following information, placed together either on the indicating device or on a data plate:

Pattern approval mark	NMI 5/6B/209
Manufacturer's identification mark or trade mark	…..
Meter model	…..
Serial number of the instrument	…..
Year of manufacture	…..
Maximum flow rate, Q_{max}	….. L/min
Minimum flow rate, Q_{min}	….. L/min
Maximum pressure of the liquid, P_{max}	….. kPa
Minimum pressure of the liquid, P_{min}	….. kPa
Type of the liquid for which the system is verified	..... (#)
Environmental class	class C

(#) This may be located separately, e.g. on a metal tag sealed to the instrument.

The minimum measured quantity *(V_{min})* is clearly visible on the indicating device, e.g. "Minimum Delivery 200 L".

1.4 Verification Provision

Provision is made for the application of a verification mark.

1.5 Sealing Provision

Provision is made for sealing access to the calibration mechanism. Refer also to approval for calculator/indicator for any additional sealing requirements.

2. Description of Variant 1 approved on 30/01/07

Using certain other Total Controls Systems (TCS) flowmeters as listed in Table 1.

TABLE 1

Flowmeter Model (*)	Minimum Flow (Q_{min}) (L/min)	Maximum Flow (Q_{max}) (L/min)	Minimum Delivery (L)	
700-15-SPA	22	220	25	
700-20-SPA	38	380	50	
700-25-SPA	57	570	50	
700-30-SPA	76	760	100	
700-35-SPA	**113**	**1135**	**100**	**(#)**
700-40-SPA	180	1800	200	
700-45-SPA	220	2200	200	

(*) The full model number of the meter is in the form '700-35-SPA-6-EI-A', as set out below:

'700' designates meter series.

'35' designates meter capacity.

'SPA' designates meter construction type, e.g. SP ('Standard Petroleum'), SPA ('Standard Petroleum Aviation', premium grade), SPD ('Standard Petroleum, Ductile iron'), or SSD ('Stainless Steel for Diesel exhaust fluid DF or AdBlue').

'6' designates meter accessory combinations fitted; may be any numeral '2' to '7'.

'EI' designates electronic indicator.

'A' designates air check valve fitted. 'Blank' if no air check valve is fitted.

(#) The pattern is shown in **bold** type.

For minimum deliveries less than 200 L the calculator/indicator displays the volume at least in increments of 0.1 L. For minimum deliveries equal to or greater than 200 L the calculator/indicator displays the volume in 1 L increments.

3. Description of Variant 2 approved on 20/06/07

As a mobile liquid-measuring system (excluding for aircraft refuelling) as shown in Figure 3, which is similar to the pattern except that:

- The system is fitted with any of the following Veeder-Root mechanical indicators (Figure 4), namely;
  - (i) model 788700-037 with 0.1 litre increments; or
  - (ii) model 788700-092 with 1 litre increments; or
  - (iii) model 789000-077 with integral printer and 1 litre increments; or
  - (iv) model 789000-733 with integral printer and 0.1 litre increments.

  The indicator may be fitted with a pre-set device and pre-set counter (Figure 4b) fitted between the calibration device and indicator.

The pre-set device is mechanically linked to a Total Control Systems model 750SP pre-set control valve. The required quantity is displayed on the pre-set counter and is set by using five push buttons; during operation, the display of the pre-set counter progressively returns to zero. A mechanical linkage within the pre-set device closes the pre-set valve in two stages to complete the delivery. The pre-set control valve, which may also be manually operated, is installed downstream of the meter.

For instruments fitted with a Veeder-Root mechanical indicator, the model number includes the code 'AL' instead of 'EI' (for 'electronic indicator') referred to in Table 1 of Technical Schedule No 5/6B/209.

- The system includes a pump, a pressure control valve (if necessary), and a valve fitted downstream of the pressure control valve to provide flow rate control. The valve is fitted with a mechanism to prevent setting flow rates below Q_{min}.
- Downstream of the flow rate control valve (Figure 5) is a flexible hose and hose reel. The transfer device is in the form of either a nozzle or a dry-break coupling at the end of the hose.

  Any nozzle used shall have an integral outlet control valve. If the nozzle is fitted with an integral anti-drain valve, the valve shall be immediately before the outlet control valve or a separate anti-drain valve may be fitted to the nozzle end of the hose. The anti-drain valve retaining pressure shall be not less than 55 kPa.

4. Description of Variant 3 approved on 20/06/07

As a drum-filling liquid-measuring system (Figure 6) which is similar to variant 2 except that:

- A pre-set device is always fitted.
- The transfer device is in the form of an outlet control valve, with integral anti-drain valve. The valve may be closed manually or by the pre-set counter. The outlet is either a drum-filling spear or a hose. If a spear is used, it is arranged to fully drain after each delivery so that the control valve is the transfer device.
- The system is arranged such that the meter operates at a constant flow rate (±5% of nominal) within the maximum and minimum flow rate range specified in Table 1.
- The pre-set amount is marked PRE-SET INDICATION NOT IN USE FOR TRADE.

5. Description of Variant 4 approved on 12/12/07

The pattern and variants for use to dispense various petrol/ethanol blends and pure ethanol ('E100').

6. Description of Variant 5 approved on 12/12/07

The pattern and variants constructed for use to dispense various grades of pure biodiesel and biodiesel/distillate blends (to Australian government standard).

7. Description of Variant 6 approved on 27/10/08

The pattern and variants for use to dispense lubricating oils having a dynamic viscosity in the range 20 to 1000 mPa.s.

In these applications the gas elimination device may be dispensed with however provision is made to prevent air entering the pipework, for example by incorporating a device that stops measurements when low liquid level in the supply tank is detected.

8. Description of Variant 7 approved on 20/12/11

The TCS model DMP100-*A* or RMP100-*A* (*) dual channel (overlapping) pulse generator (Figure 7a) is designed to produce pulses proportional to volume throughput, when fitted to any flowmeter listed elsewhere in this approval and interfaced with a compatible (#) NMI-approved calculator/indicator.

(*) The model DMP100-*A* is directly mounted on the flowmeter (Figure 7b) while the model RMP100-*A* is mounted remotely via a Veeder-Root mechanical indicator output shaft. The '*' characters in the model numbers refer to features which are not metrologically significant.

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

8.1 Field of Operation

• Pulses per shaft revolution	100 pulses/revolution/channel
• Maximum pulser shaft speed	2500 revolutions/minute
• Output pulses	Positive rectangular waveform
• Maximum pulse frequency	2000 Hz
• Power supply range	6 to 30 volts DC
• Environmental class	–25°C to 55°C
• Accuracy class	Class 0.3 (or larger)

9. Description of Variant 8 approved on 27/07/12

Any model flowmeter as listed in Table 1 now approved for use to dispense AdBlue fluid AUS32 (aqueous urea solution 32.5%) or Diesel Exhaust Fluid (DEF).

10. Description of Variant 9 approved on 25/07/13

The pattern and variants for use to dispense vegetables oils having a dynamic viscosity in the range 20 to 200 mPa.s.

In these applications the gas elimination device may be dispensed with however provision is made to prevent air entering the pipework, for example by incorporating a device that stops measurements when low liquid level in the supply tank is detected.

11. Description of Variant 10 approved on 29/09/14

All models listed in Table 1 for use with the following extended field of operation:

- Dynamic viscosity 0.4 to 1200 mPa.s (at 20°C) (#3)
- Liquid temperature range -30°C to 50°C

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

12. Description of Variant 11 approved on 29/09/14

The following additional model listed below

Flowmeter Model (*)	Minimum Flow (Q_{min}) (L/min)	Maximum Flow (Q_{max}) (L/min)	Minimum Delivery (L)
700-60-SPA	438	4540	1000
700-65-SPA	438	4540	1000

Refer to Table 1, Variant 1 for a description of model numbers

13. Description of Variant 12 approved on 5/07/16

All models listed in Table 1 for use with the following extended field of operation:

- Dynamic viscosity 1.4 to 740 mPa.s (at 20°C) (#3)
- Liquid temperature range -30°C to 50°C
- Ambient temperature range -40°C to 55°C

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

14. Description of Variant 13 approved on 5/07/16

As multiple inlet liquid-measuring systems as shown in Figures 8 and 9, having either a bulk discharge (camlock) outlet or a single or dual hose outlet.

TEST PROCEDURE No 5/6B/209

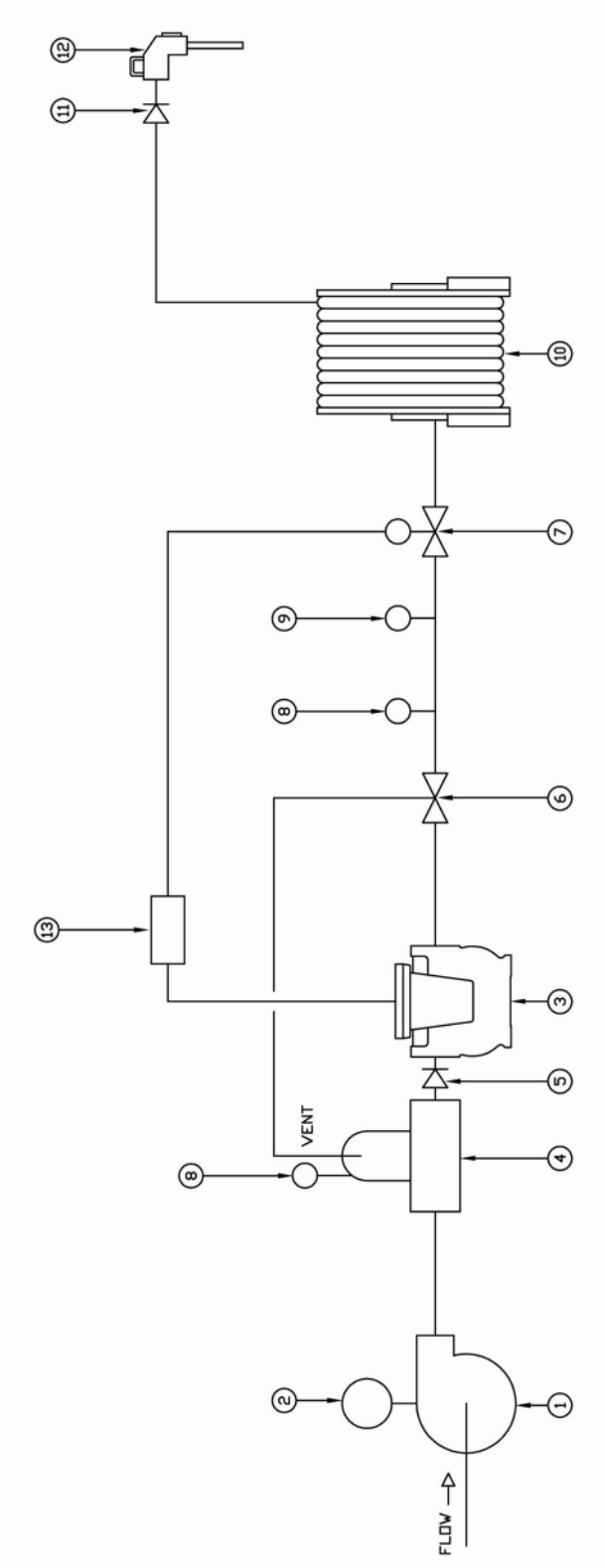
Instruments shall be tested in conjunction with any tests specified in the approval documentation for the instruments to which the pattern is connected, as appropriate, and in accordance with any relevant tests specified in the National Instrument Test Procedures. Tests should be conducted in conjunction with any tests specified in the approval documentation for any indicator/controller and/or any conversion device, etc. used.

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 5/6B/209 – 1

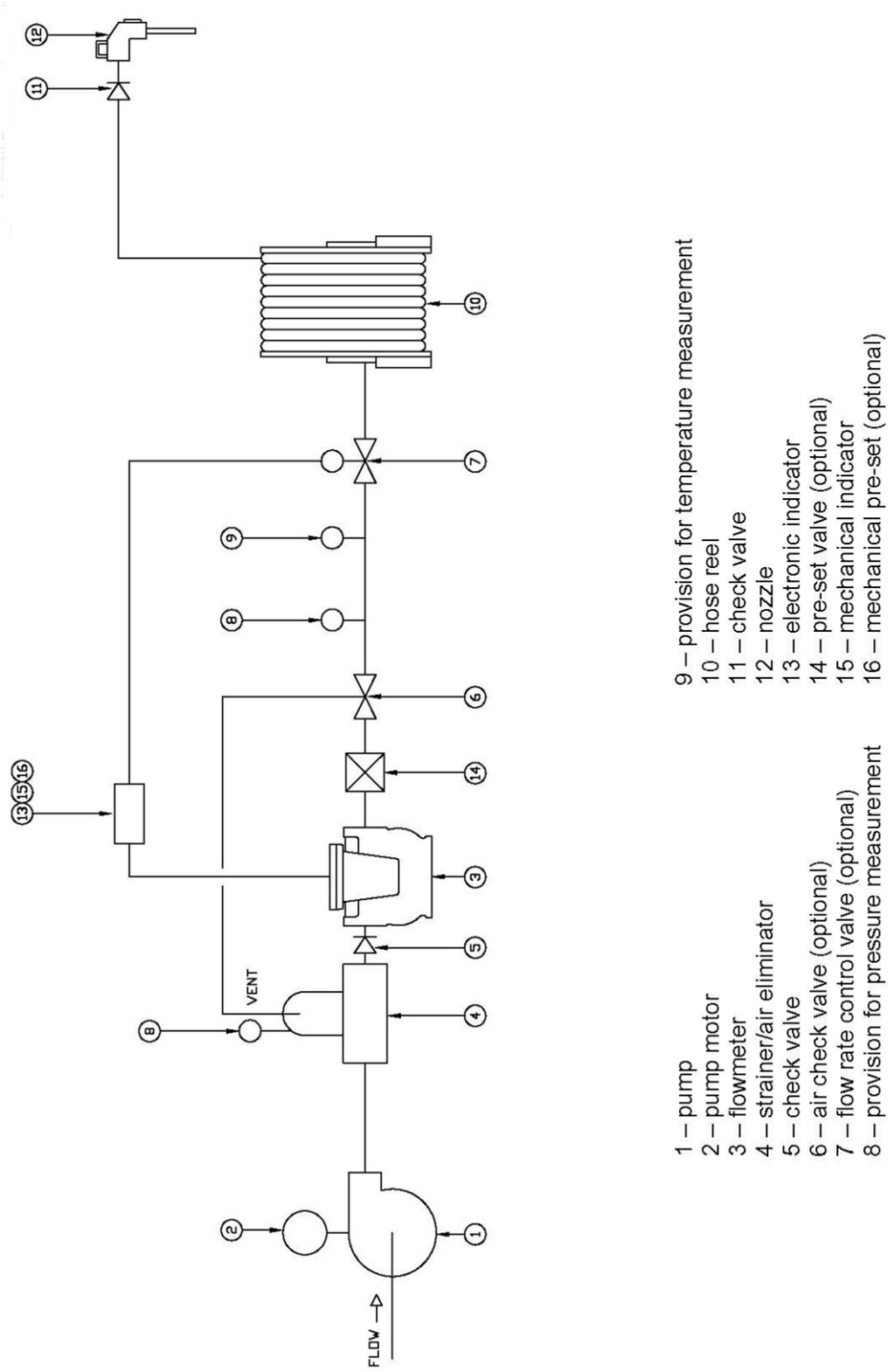


TCS Model 700-35-SPA Flowmetering System

FIGURE 5/6B/209 – 2

TCS Model 700-35-SPA-4-EL-A Flowmeter

FIGURE 5/6B/209 – 3



Typical TCS Mobile Liquid-measuring System

FIGURE 5/6B/209 – 4

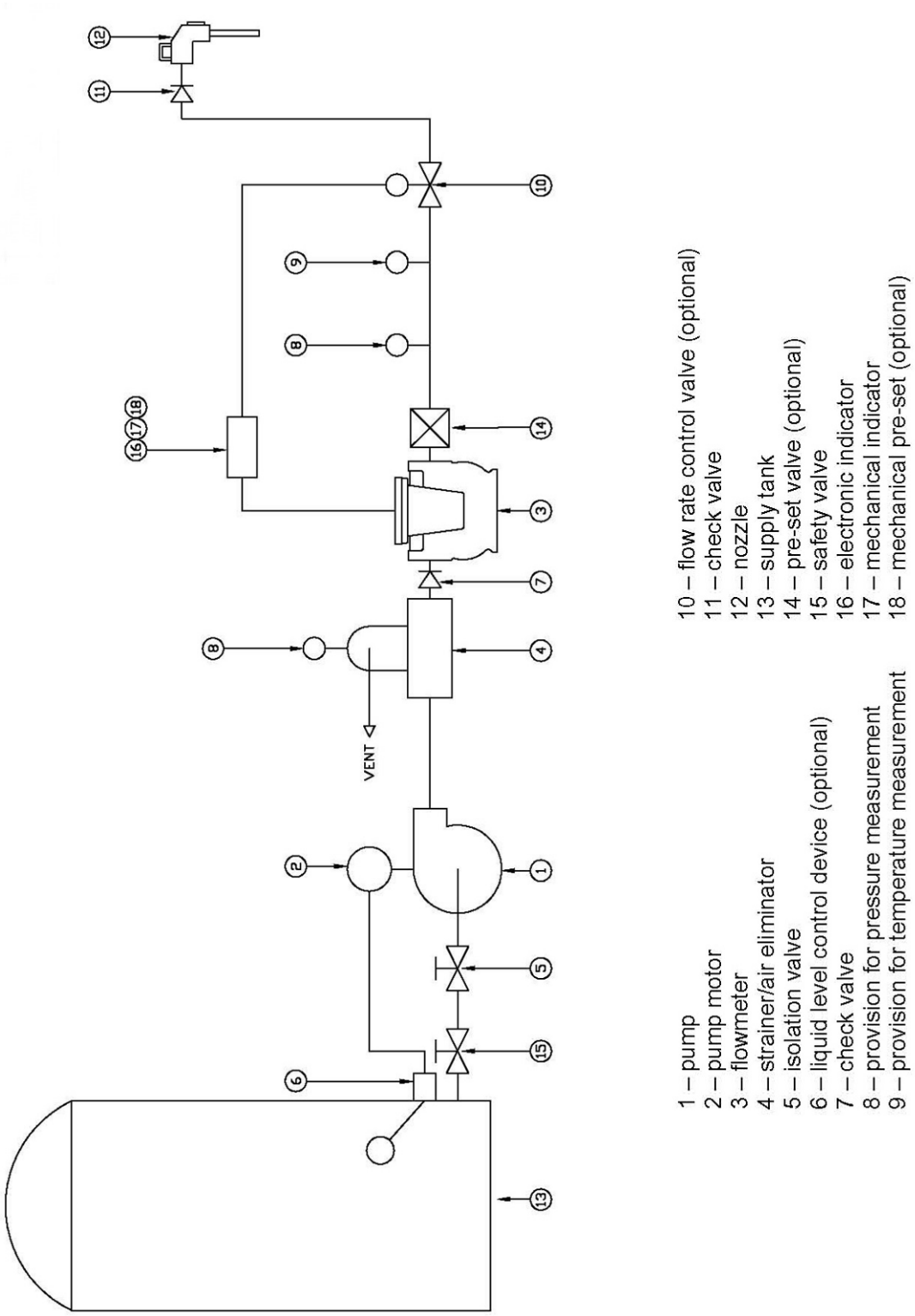
(a) Typical Veeder-Root 7800 Series Indicator and Printer

(b) Typical Veeder-Root 7800 Series Indicator and Pre-set Device

FIGURE 5/6B/209 – 5

Typical Flow Rate Control Valve

FIGURE 5/6B/209 – 6

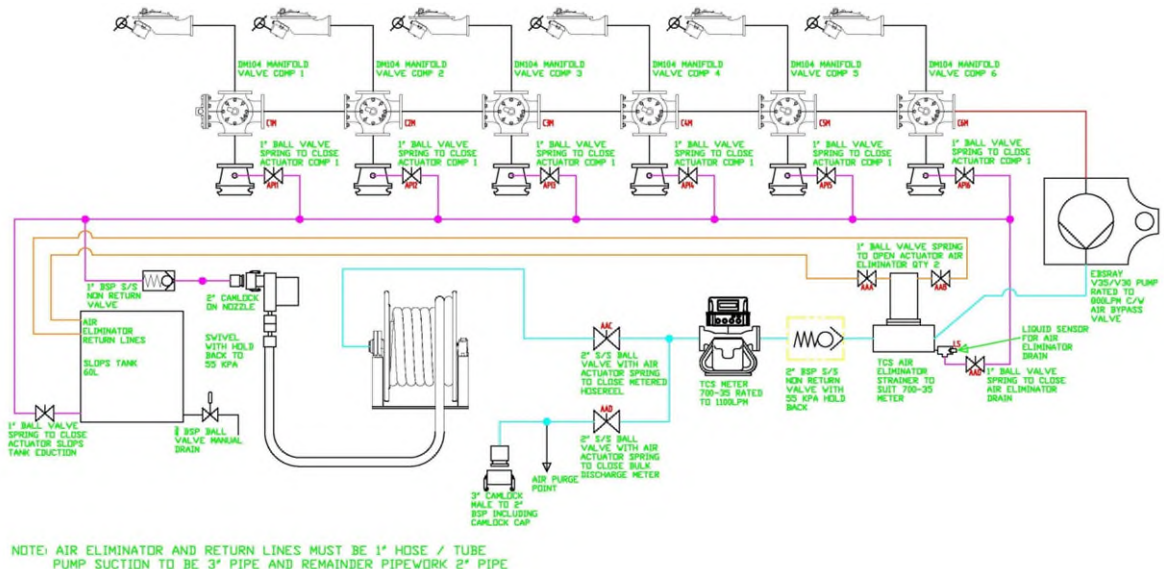


Typical TCS Drum-filling Liquid-measuring System

FIGURE 5/6B/209 – 7

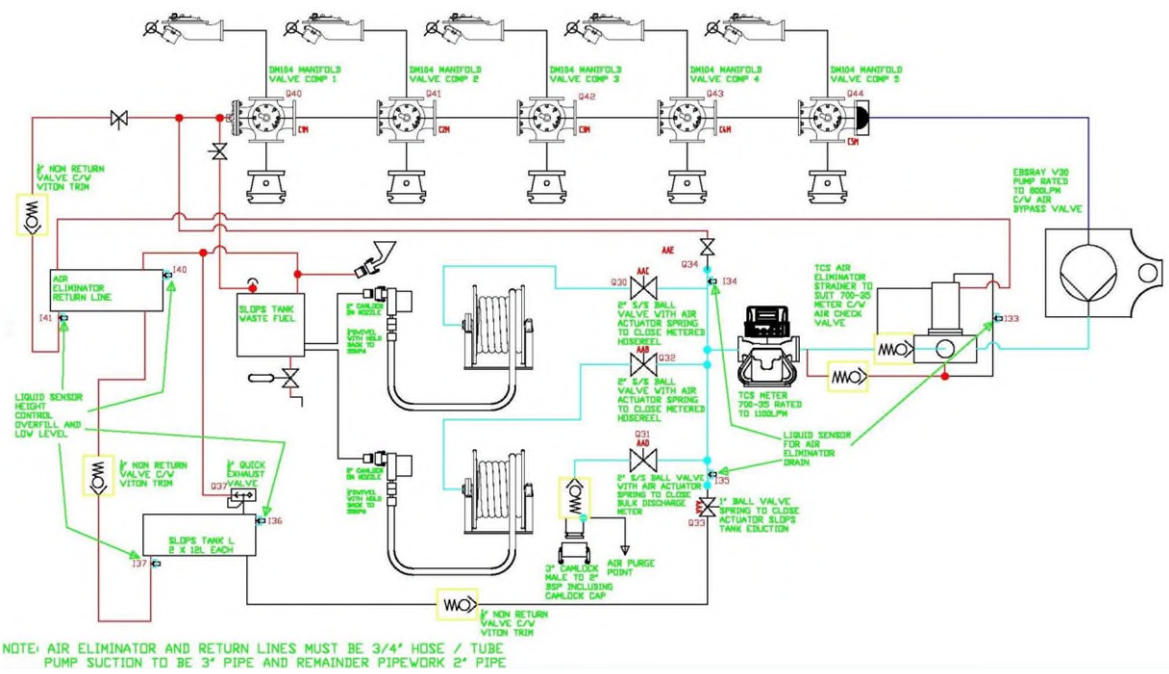
TCS Model DMP100-*A* Pulse Generator
Including a Typical Direct Mounting Arrangement

FIGURE 5/6B/209 – 8



A Multiple Inlet Liquid-measuring System Having Either a Bulk Discharge Outlet or a Dual Hose Outlet

FIGURE 5/6B/209 – 9



A Multiple Inlet Liquid-measuring System Having Either a Bulk Discharge Outlet or A Dual Hose Outlet

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