Australian Government
Department of Industry, Science and Resources

National Measurement Institute

36 Bradfield Road, West Lindfield NSW 2070

Supplementary Certificate of Approval

NMI S700

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.

Total Control Systems Model TCS 3000 Calculator/Indicator for Liquid-measuring Systems

submitted by Murray Equipment, Inc.
2515 Charleston Place
Fort Wayne
IN 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 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 approved – certificate issued	21/08/15
1	Variant 1 approved – certificate issued	27/10/16
2	Variant 2 & 3 approved – certificate issued	04/08/22
3	Variant 4 approved – certificate issued	11/11/25

CONDITIONS OF APPROVAL

General

Instruments purporting to comply with this approval shall be marked with pattern approval number 'NMI S700' and only by persons authorised by the submittor.

Instruments incorporating a component purporting to comply with this approval shall be marked 'NMI S700' 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 S700

1. Description of Pattern approved on 21/08/15

The pattern is a Total Control Systems model TCS 3000 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 vehicle-mounted flowmeters.

(#) '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:

- Input pulse rate — less than 5000 Hz/channel
- Input voltage ranges:
  - for the calculator/indicator — 12 V DC to 24 DC
  - for the internal pulse generator — 5 V DC
  - for the printer — 12 to 24 V DC
- Liquid temperature range — –40ºC to 90ºC
- Environment temperature ranges:
  - for the calculator/indicator — –25ºC to 55ºC
  - for printers — –10ºC to 40ºC
- Non-linearity correction facility
- Density range for volume conversion to 15ºC:
  - for generalised products — 0.670 kg/L to 1.070 kg/L
- Accuracy classes — 0.3, 0.5 or 1.0

1.2 Indicator

The model TCS 3000 (Figure 1) uses software version V10.04.14.xx (*) and includes an alphanumeric liquid crystal display with the following maximum volume display:

99 999.9 L when the resolution is set to 0.1
9 999 999 L when the resolution is set to 1

The accumulated total is displayed up to 99 999 999 L before rolling over to 0. The total can be reset to zero via the calibration mode.

(*) The software version can be shown by simultaneously pressing the SHIFT button and the Mode button then going into System Menu, then Systems report, then Version Info.

1.3 Features

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

The instrument can display the temperature of the liquid, the set density, and the volume at 15ºC.

It can also store up to 20 separate k-factors for different products. Selection of different products (k-factors) cannot be used simultaneously with flow rate correction mentioned above.

1.4 Pulse Generator

The calculator/indicator is interfaced to a TCS model DMP100-*A* or RMP100-*A* (**) or other compatible (#) NMI-approved dual channel (overlapping) pulse generator designed to produce pulses proportional to volume throughput, when fitted to any compatible (#) flowmeter.

(**) The model DMP100-*A* (Figure 2) is directly mounted on the flowmeter 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.

1.4.1 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	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	Same as calculator/indicator

1.5 Calibration

The Total Control Systems model TCS 3000 calculator/indicator is configured for a single k-factor to define the relationship between the volume throughput and the pulses generated by the measurement transducer.

1.6 Checking Facilities

The instrument incorporates the following checking facilities:

- A segment check is performed on the display only at power up. An easily accessible power switch is located on the vehicle to enable the checking of the segments before each delivery, should this be required.
- 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 the indication reaches 90% of the maximum indication the displayed figure starts flashing and shutdown of the solenoid valves is commenced to prevent the indication from rolling over to zero.
- When configured for use with a printer, the TCS 3000 checks for the presence and correct operation of the printer.

1.7 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.

1.8 Volume Conversion for Temperature Facility

An electronic volume conversion for temperature facility is used to convert the measured volume to volume at 15ºC. Activation of the volume conversion feature is indicated by the □ symbol in the top left corner of the display and is activated via the management mode for the approved products. The conversion is based on ASTMIP-API Petroleum Measurement Table 54B for Generalised Petroleum Products.

The density is either fixed via the calibration mode or is available for adjustment under the 'Weights and Measures' menu, under Product Parameters/Modify Parameters/<ass Density, prior to measurements taking place. In such applications, temperature measurement is required which can be displayed by the model TCS 3000.

For temperature measurement, an n RdF Type 23A-T01-2.5-X4-A0-60 4-wire RTD probe, which has a resistance of 100 ohms at 0ºC, or any other compatible (#) temperature probe with similar characteristics, can be used.

When displaying the volume at 15ºC, the TCS 3000 is connected to an Epson model TM-295 printer (Figure 3) or to any other equivalent (*) printer.

If the nature of the measured volume is entered into 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.

1.9 Verification Provision

Provision is made for the application of a verification mark.

1.10 Sealing Provision

Access to the calibration parameters is via the calibration ('W&M') switch covered by a screw affixing the cover of the indicator (Figure 4), which has provision to be sealed using a wire lead seal, or similar.

1.11 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 S700	
Year of manufacture	.....	
Accuracy class	0.3, 0.5 or 1.0	
Environmental class	I or C	(#1)
Liquid temperature range	.....ºC to .....ºC	(#2)

(#1) Environmental class for printers is class B

(#2) Required when the volume conversion for temperature facility is activated

For applications other than LPG, when the volume conversion facility is activated, the indicator reading face shall display or be marked 'Litres at 15ºC' or 'Volume at 15ºC'.

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

2. Description of Variant 1 approved on 27/10/16

With the pattern now using version V10.09.14.xx or version V10.14.15.xx software, rather than the version listed in clause **1.2 Indicator**.

3. Description of Variant 2 approved on 04/08/22

With the system now operating version V30.05.00.

The software updates the conversion tables described in **1.8 Volume Conversion for Temperature Facility** with the conversion based on *ASTM-IP- API Petroleum Measurement* Table 54D for Lube Oils and Table 54E for LPG, where the density is set for the product for which the instrument is verified.

3.1 Field of Operation

The field of operation of the variant is determined by the following characteristics:

- Liquid temperature range -46ºC to 90ºC
- Density range for volume conversion to 15ºC
  - for generalised products 0.670 kg/L to 1.070 kg/L
  - for LPG 0.490 kg/L to 0.685 kg/L

4. Description of Variant 3 approved on 04/08/22

With the system now operating version V30.05.01. The software updates the linux based operating system but does not change any metrologically significant features.

5. Description of Variant 4 approved on 11/11/25

The Total Control Systems model TCS 3000 EX calculator/indicator which is similar to the pattern, but which has an explosion proof enclosure (Figure 5). The system is now operating on firmware version V30.05.04.The updated software does not change any metrologically significant features.

Access to the calibration parameters is via the calibration ('W&M') switch covered by a screw affixing the cover of the indicator (Figure 6), which has provision to be sealed using a wire lead seal, or similar.

TEST PROCEDURE

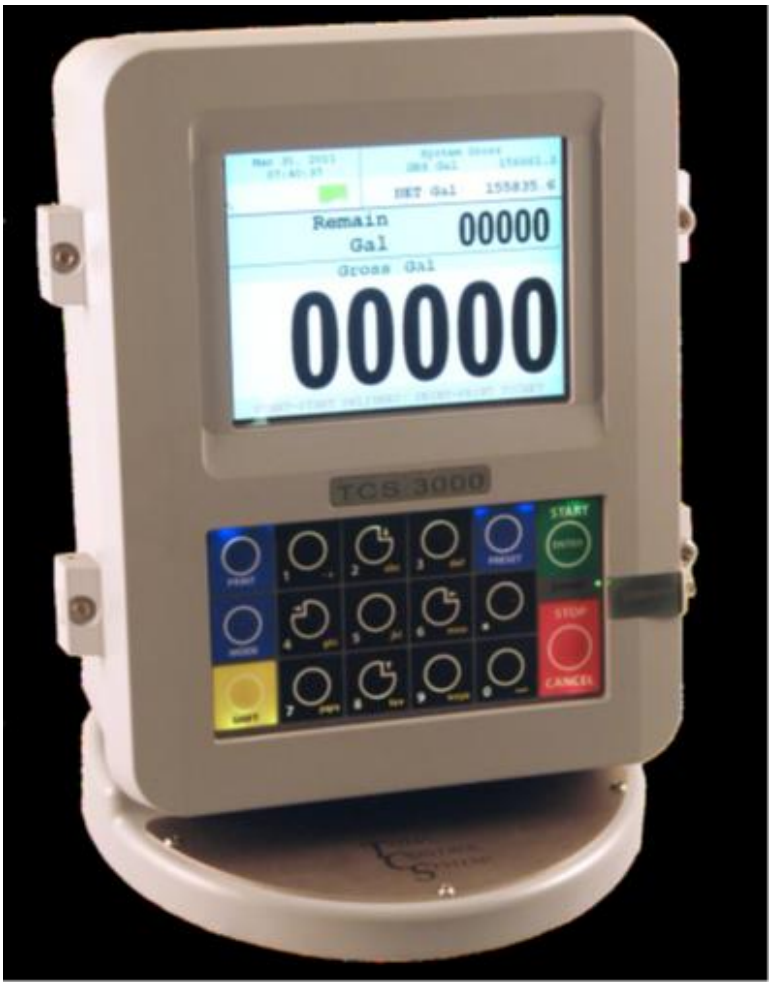
Instruments shall be tested in accordance with any relevant tests specified in the National Instrument Test Procedures.

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

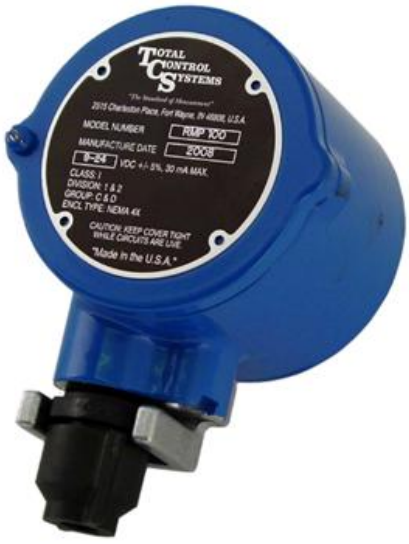
The maximum permissible errors those applicable to the fuel dispensers to which the instrument approved herein is fitted, as stated in the approval documentation for the fuel dispensers or in the *National Trade Measurement Regulations 2009*.

FIGURE S700 – 1



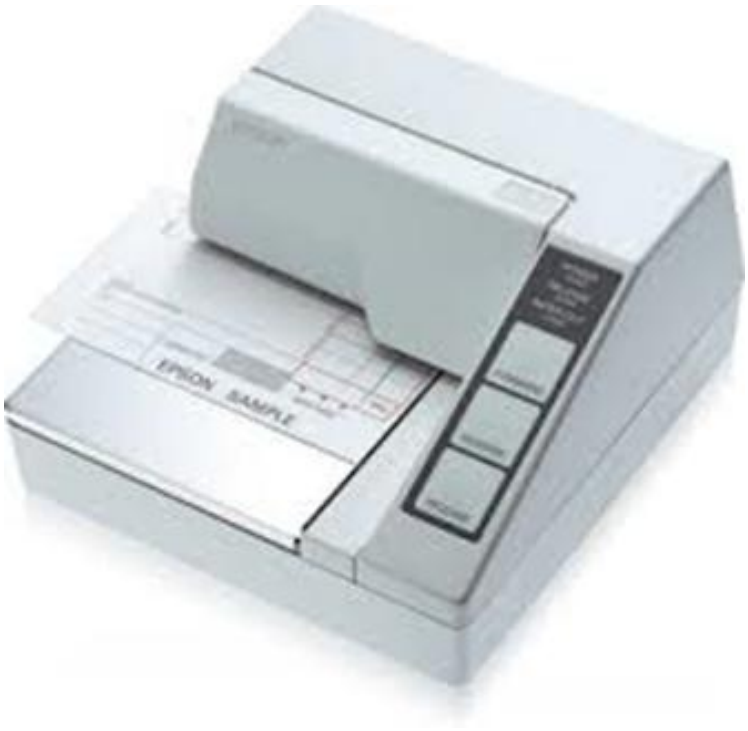
Total Control Systems Model TCS 3000 Calculator/Indicator

FIGURE S700 – 2



TCS Model DMP100-*A* Pulse Generator

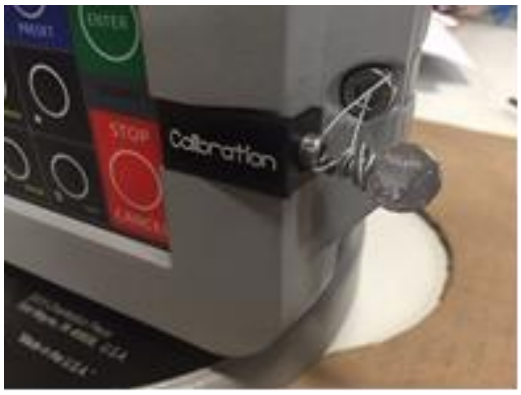
FIGURE S700 – 3



Epson Model TM-295 Printer

FIGURE S700 – 4

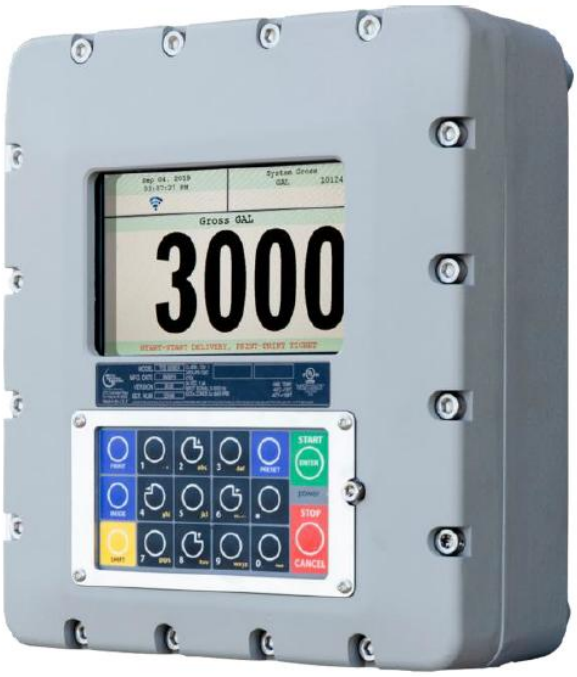
(a) Unsealed



(b) Sealed

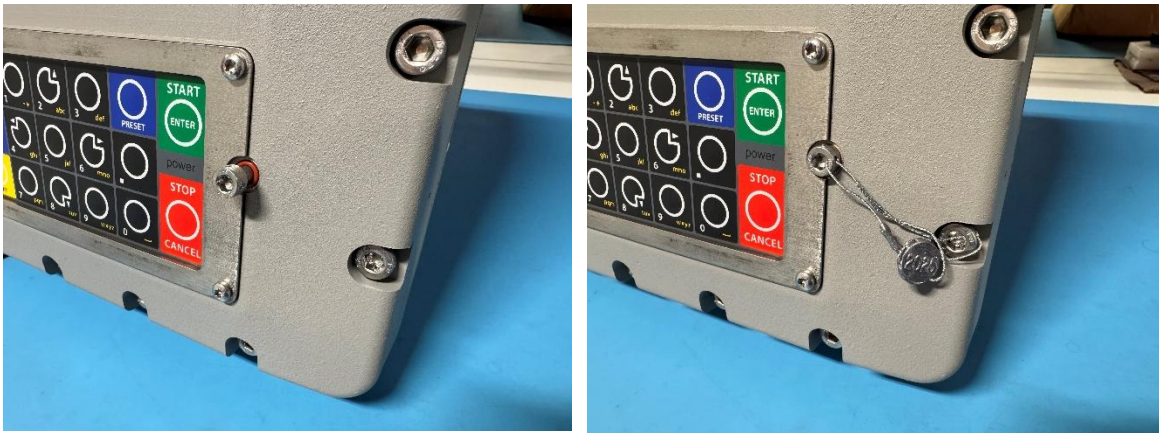
Access to Calibration ('W&M') Switch Including Typical Sealing

FIGURE S700 – 5



Total Control Systems Model TCS 3000 EX Calculator/Indicator (Variant 4)

FIGURE S700 – 6



(a) Unsealed (b) Sealed

Access to Calibration ('W&M') Switch Including Typical Sealing (Variant 4)

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