Australian Government
National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Cancellation

Certificate of Approval

No 10/2/1

Issued by the Chief Metrologist under Regulation 60
of the
National Measurement Regulations 1999

This is to certify that the approval for use for trade granted in respect of the

Wheaton (Anhydrous Ammonia) Flowmeter with Neptune 38 mm Meter

submitted by Wheaton Australia Pty Ltd,
4 Stanton Road,
Seven Hills New South Wales 2147

has been cancelled in respect of new instruments as from 1 April 2011.

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

NATIONAL STANDARDS COMMISSION

CERTIFICATE OF APPROVAL No 10/2/1

This is to certify that the patterns of the

Wheaton (Anhydrous Ammonia) Flowmeter with Neptune 38 mm Meter

submitted by Wheaton Australia Pty Ltd,
4 Stanton Road,
Seven Hills, New South Wales, 2147,

have been approved under the Weights and Measures (Patterns of Instruments) Regulations as being suitable for use for trade.

Date of Approval: 28 November 1978

The patterns are described in Technical Schedule No 10/2/1 and in drawings and specifications lodged with the Commission.

The approval is subject to review on or after 1 October 1980.

All instruments conforming to this approval shall be marked with the approval number "NSC No 10/2/1".

Approval is granted on condition that:

1. The maximum flow rate of the instrument is a flow rate between 115 and 225 litres per minute; the minimum flow rate is 20% of the maximum flow rate achievable with that instrument.

2. The liquid measured is anhydrous ammonia of density 618 kg/m^3 at 15°C, at a temperature in the range of 0°C to 45°C.

3. The pump motor is started before the hose is connected to the purchaser's storage tank.

4. The pump suction operates under a positive liquid head.

5. Instruments complying with this approval are subject to a service period of six months.

The approval relates only to the metrological performance of the

metering system; inspectors are advised that the system must comply with the requirements of other statutory authorities relating to safety, handling, storage and transportation of anhydrous ammonia.

Signed

Executive Officer

NATIONAL STANDARDS COMMISSION

TECHNICAL SCHEDULE No 10/2/1

Pattern: Wheaton (Anhydrous Ammonia) Flowmeter with Neptune 38 mm Meter

Submittor: Wheaton Australia Pty Ltd,
4 Stanton Road,
Seven Hills, New South Wales, 2147.

Date of Approval: 28 November 1978

Description:

The pattern (Figure 1) is a vehicle-mounted or fixed-installation flowmeter for the delivery of anhydrous ammonia of density 618 kg/m^3 at 15° C at temperatures between 0 and 45° C, at a maximum flow rate of 225 litres per minute. The flowmeter comprises:

1. Pump — positive displacement pump with an external by-pass connected to the supply tank in order to minimise vapour formation. It is mounted on the assembly at a point lower than the minimum height of liquid in the supply tank. The supply pipe from the tank to the pump slopes downward to the pump.

2. Gas purger — Neptune 38 mm — incorporating an inlet non-return valve, strainer and float chamber (Figure 2). The gas purger is vented through a non-return valve and a pipe of bore not less than 20 mm to the supply tank. If a stop valve (Y) is fitted to the vent pipe, it shall be interlocked with a second stop valve (X), so that when a delivery is taking place the vent line is open (Figure 1). A thermometer pocket is situated in the strainer cover.

3. Meter — Neptune 38 mm Type 4DA (Figure 2).

4. Temperature compensator — Neptune Type 1 Style 22 — attached to the top of the meter (Figures 2, 3 and 4).

   The expansion and contraction of the temperature-sensing capsule in a pocket of liquid above the meter with changes in the temperature of the liquid are transmitted by means of a pin-and-lever system to a variable-ratio drive which changes the coupling

ratio between the meter and indicator so that the indicated volume is the equivalent volume at a temperature of 15°C. A screw fitted to the bottom of the lever permits adjustment of the compensator.

Provision is made for a Veeder-Root VR 1141 non-resettable counter to be fitted to the compensator (Figure 3), to indicate the uncompensated meter output; that is, it records the number of revolutions of the input shaft of the variable-ratio drive.

A thermometer pocket is situated in the side of the compensator housing.

5. Indicator — Neptune Type 443 (Figure 2) — a zero-start indicator and ticket printer. The ticket printer has 1 litre increments and the indicator first element has ten scale marks numbered from 0 to 9. The aperture through which this element is viewed is widened in the direction of travel.

6. Differential valve — Neptune 38 mm (Figures 1 and 2). A spring-loaded diaphragm-operated valve maintains pressure in the metering chamber to prevent the formation of gas. A pressure-equalising pipe is connected from the differential valve through an excess-flow valve (which has no bleed hole) to the supply tank, either directly or through the gas-discharge pipe from the gas-purger vent.

7. Pipe connection from the differential valve to the hose reel. This pipe is fitted with an excess-flow valve, a stop valve, a pressure gauge, and two relief valves (Figure 1).

8. Hose reel — incorporating up to 20 metres of high-pressure hose of bore not exceeding 25 mm.

9. Swivel hose coupling — may be fitted between the hose and the stop valve.

10. Stop valve — fitted on the end of the delivery hose.

11. Marking — an instrument data plate sealed to the instrument by a lead-plug seal is marked:

    (a) "approved for anhydrous ammonia";

    (b) "minimum delivery 675 litres".

12. Sealing — a sealing wire, the ends of which terminate in a plug seal over a set screw, passes through a drilled set screw retaining the top cover on the indicator, a drilled lug on the face of the indicator, and drilled set screws securing the indicator to the temperature compensator, securing the cover over the compensator adjustment, and securing the compensator to the meter.

The approval includes the flowmeter with a Neptune Type 441 zero-start indicator with a scale interval of 1 litre; the first element has ten scale marks numbered from 0 to 9. The aperture through which the first element is viewed is widened in the direction of travel (Figure 5).

Test Procedures:

The instrument should be tested with anhydrous ammonia. Tables 1 and 2 list the density and the factor for volume reduction to 15°C for various temperatures of anhydrous ammonia.

During verification testing, a vapour-return line should not be connected to the proving measure.

Three alternative verification methods for this instrument are available; any one may be selected, and the quantities delivered may be measured either gravimetrically, volumetrically, or by master meter.

1. Replacement of metering assembly

A two-stage verification involving at each verification:

(a) the replacement of the metering assembly, that is, the meter, temperature compensator and indicator, with a metering assembly that has been checked by the Weights and Measures Authority either at the manufacturer's premises or in a laboratory; followed by

(b) an overall test of the combined meter and temperature-compensator at the temperature of the anhydrous ammonia. The overall test should include not less than two tests at full flow rate and two tests at 20% of full flow rate. (During each test the flow rate will reduce due to pressure build-up in the proving measure.)

2. Six-monthly verification

A winter-summer six-monthly verification period with one verification

in the hotter period of each year and a second verification in the cooler period of each year. The tests to be applied at each verification would include not less than two tests of the delivered volume at full flow rate and two tests at 20% of full flow rate. (During each test the flow rate will reduce, due to pressure build-up in the proving measure.)

3. Performance tests

A complete determination of the overall system performance by separate determinations of the meter and temperature-compensator errors at an anhydrous ammonia temperature of less than 10°C or more than 20°C. The meter and the temperature-compensator error may be determined directly by isolating the temperature compensator (select uncompensated position, that is, 1 : 1 ratio) while determining the meter error, and then checking that the ratio of the variable-ratio drive in the temperature compensator is correct for the temperature of the anhydrous ammonia. As an alternative, either of these separate errors may be determined indirectly by an overall check of the system errors, a determination of either separate error, and a simple subtraction.

The meter-errors check should include not less than three tests of the delivered volume at full flow rate and three tests at 20% of full flow rate. (During each test the flow rate will reduce due to pressure build-up in the proving measure.)

The temperature-compensator error check should include not less than two tests at any flow rate with the anhydrous ammonia being circulated back to the supply tank. It will necessitate fitting a Veeder-Root 1141 counter to record the number of revolutions of the input shaft of the temperature compensator, and setting the gear ratio in the indicator to 1 : 1 so that the indicator records the number of revolutions of the output shaft of the temperature compensator.

The overall system performance test is as for 2, except that not less than three tests should be done at each flow rate.

4. Maximum permissible errors at verification

(a) With the temperature compensator deactivated:

the maximum permissible error, over a 5 : 1 flow range, on a system calibrated at maximum flow rate, is ± 1,0% with the liquid at any temperature between 5° and 40°C.

(b) With the temperature compensator activated:

the maximum permissible error specified is increased by 0,2% + 0,02% per ^{o}C difference from 15^{o}C.

TABLE 1 — ANHYDROUS AMMONIA
Density in kg/m³

Observed Temperature °C	0	0,2	0,4	0,6	0,8
0	638,6	638,2	638,0	637,8	637,5
1	637,2	636,9	636,7	636,4	636,1
2	635,8	635,6	635,3	635,0	634,7
3	634,5	634,2	633,9	633,6	633,4
4	633,1	632,8	632,5	632,2	632,0
5	631,7	631,4	631,1	630,9	630,6
6	630,3	630,0	629,7	629,5	629,2
7	628,9	628,6	628,3	628,1	627,8
8	627,5	627,2	626,9	626,7	626,4
9	626,1	625,8	625,5	625,2	625,0
10	624,7	624,4	624,1	623,8	623,6
11	623,3	623,0	622,7	622,4	622,1
12	621,8	621,6	621,3	621,1	620,7
13	620,4	620,1	619,8	619,6	619,3
14	619,0	618,7	618,4	618,1	617,8
15	617,5	617,3	617,0	616,7	616,4
16	616,1	615,8	615,5	615,2	614,9
17	614,6	614,4	614,1	613,8	613,5
18	613,2	612,9	612,6	612,3	612,0
19	611,7	611,4	611,1	610,9	610,6
20	610,3	610,0	609,7	609,4	609,1
21	608,8	608,5	608,2	607,9	607,6
22	607,3	607,0	606,7	606,4	606,1
23	605,8	605,5	605,2	604,9	604,6
24	604,3	604,0	603,7	603,4	603,1
25	602,8	602,5	602,2	601,9	601,6
26	601,3	601,0	600,7	600,4	600,1
27	599,8	599,5	599,2	598,9	598,6
28	598,3	598,0	597,7	597,4	597,1
29	596,8	596,5	596,2	595,8	595,5
30	595,2	594,9	594,6	594,3	594,0
31	593,7	593,4	593,1	592,8	592,5
32	592,1	591,8	591,5	591,2	590,9
33	590,6	590,3	590,0	589,6	589,3
34	589,0	588,7	588,4	588,1	587,8
35	587,5	587,1	586,8	586,5	586,2
36	585,9	585,6	585,2	584,9	584,6

.../Cont'd over

TABLE 1 (Cont'd)

Observed Temperature °C	0	0,2	0,4	0,6	0,8
37	584,3	584,0	583,7	583,3	583,0
38	582,7	582,4	582,1	581,7	581,4
39	581,1	580,8	580,4	580,1	579,8
40	579,5	579,2	578,8	578,5	578,2
41	577,9	577,5	577,2	576,9	576,6
42	576,2	575,9	575,6	575,3	574,9
43	574,6	574,3	573,9	573,6	573,3
44	573,0	572,6	572,3	572,0	571,6
45	571,3				

NOTE: The tabulated values were calculated from the equation for the specific volume of saturated liquid ammonia:

$$\mu = \frac{4283,0 + 813,055\sqrt{133 - \theta} - 8,2861\,(133 - \theta)}{1 + 0,424805\sqrt{133 - \theta} + 0,015938\,(133 - \theta)}$$

where μ is expressed in m^3/kg and θ in °C, and is based upon Scientific Papers No 420 dated 15 October 1921 of the USA Bureau of Standards.

TABLE 2 — ANHYDROUS AMMONIA
Factor for Reducing Volume to 15°C

Observed Temperature °C	0	0,2	0,4	0,6	0,8
0	1,0341	1,0336	1,0332	1,0327	1,0323
1	1,0318	1,0314	1,0309	1,0305	1,0301
2	1,0296	1,0292	1,0287	1,0283	1,0278
3	1,0274	1,0269	1,0265	1,0260	1,0256
4	1,0252	1,0247	1,0243	1,0238	1,0234
5	1,0229	1,0225	1,0220	1,0216	1,0211
6	1,0207	1,0202	1,0197	1,0193	1,0188
7	1,0184	1,0179	1,0175	1,0170	1,0166
8	1,0161	1,0157	1,0152	1,0148	1,0143
9	1,0138	1,0134	1,0129	1,0125	1,0120
10	1,0116	1,0111	1,0106	1,0102	1,0097
11	1,0093	1,0088	1,0083	1,0079	1,0074
12	1,0070	1,0065	1,0060	1,0056	1,0051
13	1,0047	1,0042	1,0037	1,0033	1,0028
14	1,0023	1,0019	1,0014	1,0009	1,0005
15	1,0000	0,9995	0,9991	0,9986	0,9981
16	0,9977	0,9972	0,9967	0,9963	0,9958
17	0,9953	0,9948	0,9944	0,9939	0,9934
18	0,9930	0,9925	0,9920	0,9915	0,9911
19	0,9906	0,9901	0,9896	0,9892	0,9887
20	0,9882	0,9877	0,9873	0,9868	0,9863
21	0,9858	0,9853	0,9849	0,9844	0,9839
22	0,9834	0,9829	0,9825	0,9820	0,9815
23	0,9810	0,9805	0,9801	0,9796	0,9791
24	0,9786	0,9781	0,9776	0,9771	0,9767
25	0,9762	0,9757	0,9752	0,9747	0,9742
26	0,9737	0,9732	0,9728	0,9723	0,9718
27	0,9713	0,9708	0,9703	0,9698	0,9693
28	0,9688	0,9683	0,9678	0,9673	0,9669
29	0,9664	0,9659	0,9654	0,9649	0,9644
30	0,9639	0,9634	0,9629	0,9624	0,9619
31	0,9614	0,9609	0,9604	0,9599	0,9594
32	0,9589	0,9584	0,9579	0,9574	0,9569
33	0,9564	0,9558	0,9553	0,9548	0,9543
34	0,9538	0,9533	0,9528	0,9523	0,9518
35	0,9513	0,9508	0,9503	0,9497	0,9492
36	0,9487	0,9482	0,9478	0,9472	0,9467
37	0,9462	0,9456	0,9451	0,9446	0,9441

.../Cont'd over

TABLE 2 (Cont'd)

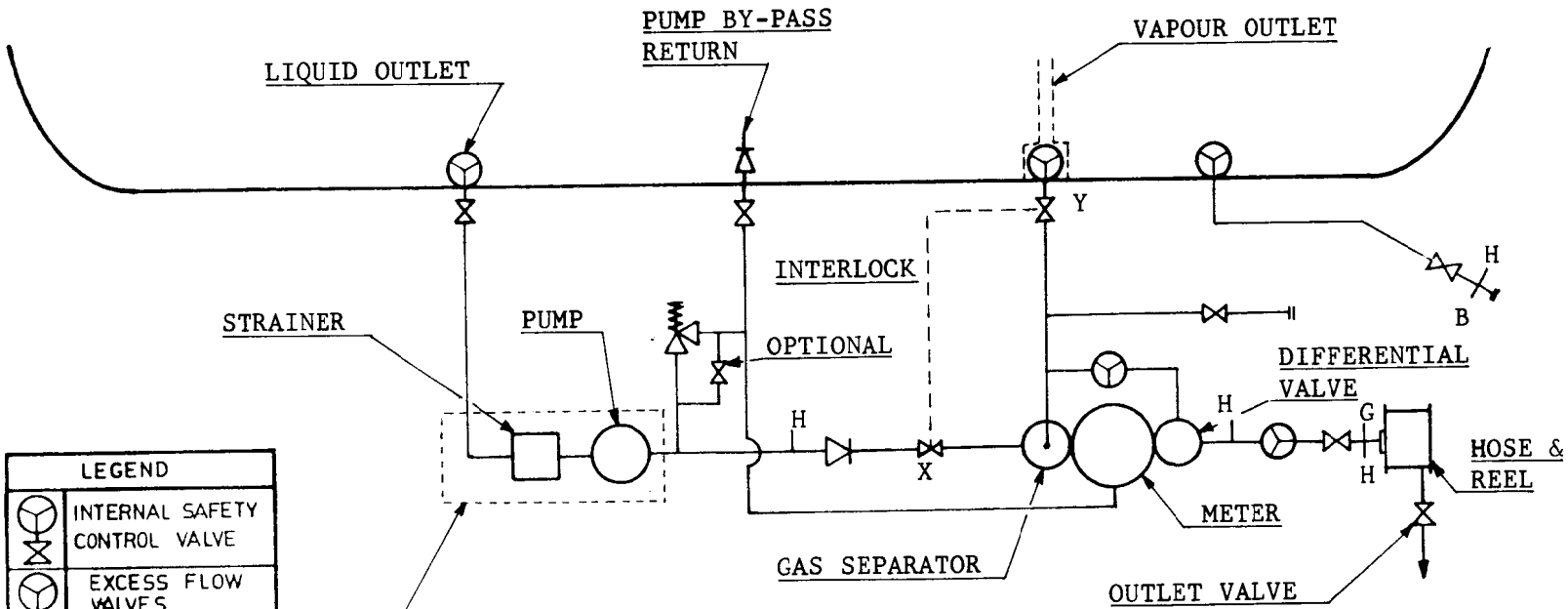
Observed Temperature °C	0	0,2	0,4	0,6	0,8
38	0,9436	0,9431	0,9425	0,9420	0,9415
39	0,9410	0,9405	0,9399	0,9394	0,9389
40	0,9384	0,9378	0,9373	0,9368	0,9363
41	0,9357	0,9352	0,9347	0,9342	0,9336
42	0,9331	0,9326	0,9320	0,9315	0,9310
43	0,9305	0,9299	0,9294	0,9289	0,9283
44	0,9278	0,9273	0,9267	0,9262	0,9256
45	0,9251				

NOTE: The tabulated values were calculated from the equation for the specific volume of saturated liquid ammonia:

$$\mu = \frac{4283,0 + 813,055\sqrt{133 - \theta} - 8,2861\,(133 - \theta)}{1 + 0,424805\sqrt{133 - \theta} + 0,015938\,(133 - \theta)}$$

where μ is expressed in m^3/kg and θ in °C, and is based upon Scientific Papers No 420 dated 15 October 1921 of the USA Bureau of Standards.

FIGURE 10/2/1 - 1



LEGEND	
	INTERNAL SAFETY CONTROL VALVE
	EXCESS FLOW VALVES
	CHECK VALVES
	VALVES
B	BLEEDERS
G	PRESSURE GAUGES
H	HYDROSTATIC RELIEF VALVES

NOTE

ADDITIONAL VALVES MAY MAKE PROVISION FOR:

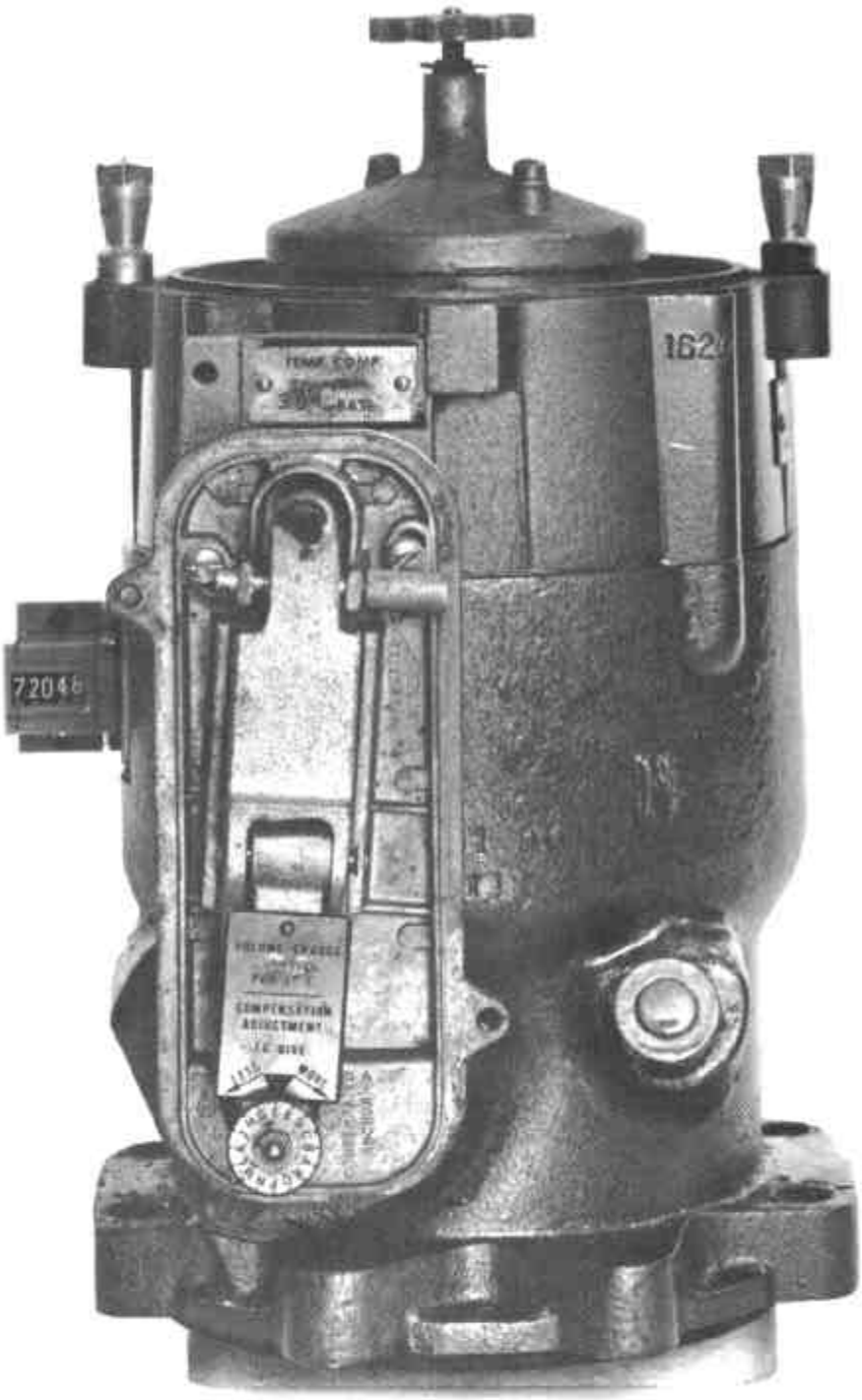
1. GRAVITY FEED OR PUMPED UNMETERED DELIVERIES
2. FILLING OF THE SUPPLY TANK
3. SUPPLY OF L.P.G. FROM OTHER TANKS

Wheacon Anhydrous Ammonia Flowmeter — Hydraulic Diagram

Neptune 38 mm Meter, with Gas Purger, Temperature Compensator, Indicator Type 443 and Differential Valve

11/6/79

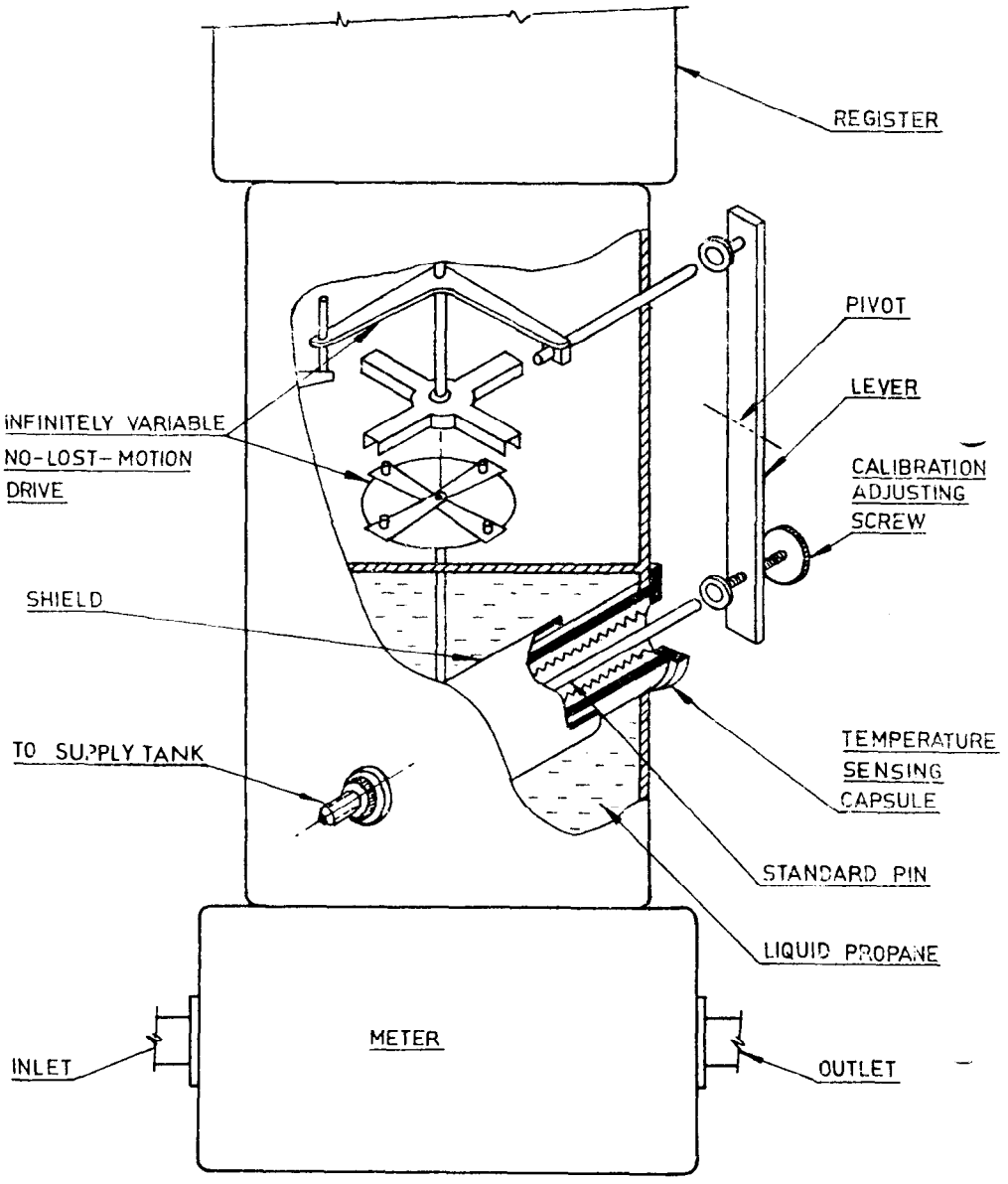
FIGURE 10/2/1 - 3



Temperature Compensator with VR 1141 Counter and
with Calibration Cover Removed

11/6/79

FIGURE 10/2/1 - 4



Temperature Compensator, showing Principle of Operation

11/6/79

FIGURE 10/2/1 - 5

Neptune Type 441 Indicator

11/6/79