POLICY			
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File name:	LM-P-009-02-10- Revised requirements for temp sensors and verification procedure for meters		

1. Scope

Revised requirements for temperature sensors and verification procedure for meters with electronic temperature conversion devices with gross and net indications

2. Reference documents

SANS 1698
Trade Metrology Regulations Part ll, Regulation 74

3. Policy

BACKGROUND

In light of information gained over the past year it appears that temperature probes fitted to meter installations for product volume conversion to 20 ºC are sometimes of a low accuracy class and could potentially cause errors greater than the combined maximum permissible error (MPE) for the meter system (errors of over 4 ºC have been found). The current requirement for an ice test to detect this problem was designed for mechanical temperature compensators (which have a virtually linear error curve) no longer serves the purpose as most electronic sensors are fairly accurate near 0 ºC.

The current ice test requirement is enforced in terms of Regulation 74 (7) h) of Part 2 of the Trade Metrology Regulations which reads as follows “Where a meter is provided with a temperature compensating device, such device shall be tested for efficiency”. The following new requirements will also be enforced in terms of this Regulation.

3.1 NEW REQUIREMENTS

In light of the problem mentioned in the first paragraph and advances in technology, it has been decided to revise the requirement for an ice test to verify accuracy in the case of a meter with electronic calculator, indicator and conversion device and that also has a gross (uncompensated) indication. This will mean that the standard accuracy test of converting the test measure volume to volume at 20 ºC and comparing it to the net meter reading will also fall away.

NOTES:

1) The above only applies to meters of the type described above and meters with mechanical temperature conversion (compensation) devices will be tested according to current requirements. Electronic meters without a gross reading will also still need an ice test to confirm correct software version for conversion to 20 ºC.
2) The above does not apply to meters with temperature sensors used solely for accuracy corrections or density determinations e.g. mass flow meters with no temperature conversion facilities when indication is by volume.

Requirements for the accuracy of temperature sensors are as prescribed hereunder and will be formalised as a condition of approval in approval documentation in terms of Sections 18 2) and 3) of the Trade Metrology Act.

3.2 REQUIREMENTS FOR TEMPERATURE SENSORS

For temperature conversion OIML R 117 allows for an error, over the whole range of indication of the temperature, of 0,3 ºC for a meter with a MPE of 0,3% and 0,5 ºC for meters with a MPE of 0.5% and

above. This means that with our current MPE of 0,25 % the temperature sensed and indicated by meter should not have an error greater than 0,3 ºC.

However, we intend to move to an MPE of 0,5 % with the adoption of OIML R117 and the following requirements are therefore specified for temperature sensors:

3.2.1 A sensor fitted to an installation for the purpose of temperature conversion to 20 ºC shall be of an accuracy class that will ensure a maximum permissible error over its range of 0,5 ºC with a linearity deviation of not more than 0,5 ºC. This applies to new installations and all replacement sensors fitted to currently verified meters.

3.2.2 Accuracy class A or equivalent sensors shall be used. The accuracy class of the sensor shall be a condition of approval and shall be included in the pattern description as well as the manner in which the class shall be marked so that it is easily legible.

3.2.3 The installation of temperature sensors shall be such that they may be removed without disconnection from any electronic circuitry. It will be acceptable for temperature sensors, built into the measurement transducer and not removable without disconnection, to be removed according to manufacturers specifications for the prescribed tests. Should a measurement transducer have a built in temperature sensor that can not easily be removed during verification the requirements in the first paragraph of clause 4 will be applied. As tampering or replacement of sensors could affect the metrological integrity of the meter, sensors shall be sealed in position at the time of verification of the meter so that the sensor can not be removed or be disconnected from the electronic circuitry without rendering the meter unverified.

4 VERIFICATION TEST METHODS

The following tests apply to all meters with electronic calculators, indicators and conversion devices and that also have a gross (uncompensated) indication. Should a measurement transducer have a built in temperature sensor that can not easily be removed during verification, alternative methods of verifying accuracy of temperature conversion shall be agreed at the time of type approval and be included in the certificate of approval as a condition of approval.

4.1 Accuracy of measurement test

This follows the normal steps for meters without conversion devices as the gross meter reading is used. This means that the accuracy of conversion at all test temperatures (each flow rate) will not be verified during accuracy tests and the temperature sensor will need separate verification. The accuracy of measurement of the meter (before temperature conversion) shall be verified as follows:

4.1.1 Set up test measure and wet as normal.

4.1.2 Insert standard thermometer into meter thermometer well or, if one is not provided, remove meter temperature probe and insert standard thermometer into the well.

NOTE: If the thermometer well is not vertical to allow insertion of temperature transfer liquid e.g. glycerine, some other transfer method should be used e.g. tin foil.

4.1.3 Determine the density of the product at 20 ºC and ensure that it is correctly entered in the meter conversion device.

NOTE: The correct density in the meter will only be required during the conversion accuracy test but it should be entered at this stage to avoid changing parameters during the test.

4.1.4 Complete test sheet 38 (for meters without temperature compensation) (see annex A) with the meter details and density of the product at 20 ºC as determined in 4.1.3.

4.1.5 Carry out the normal runs while monitoring the meter temperature during each run to determine the average for the run.

4.1.6 Complete test sheet 38 to correct the measure reading for thermal expansion of the shell and convert to product temperature at the time of measurement by the meter (difference between meter and test measure temperatures).

4.1.7 Compare the corrected measure reading to the gross meter reading and calculate the measurement error for each test run.

4.2 Accuracy of temperature sensor test

This test shall be carried out at the time of all verifications (Initial [when new], Subsequent [in use] and after repair). It shall also be carried out on electronic meters that do not have gross indications i.e. where the tests in 4.1 and 4.3 can not be used and they are tested by means of the ice test and comparing the measure volume converted to volume at 20 ºC with the net meter reading during the accuracy of measurement test.

The following procedure shall be used:

Remove the meter temperature sensor (if not already done for the basic accuracy test) and verify it against a calibrated standard thermometer, with a resolution of not greater than 0,2 ºC, at a low temperature of below 5 ºC, at ambient water temperature and at a high temperature of above 40 ºC. Taking the error on the standard thermometer into consideration verify that any error on the meter temperature indication does not exceed 0,5 ºC. Record the results on the form provided in annex B.

Should the meter be used for artificially heated products this test shall be carried out at below 15 ºC, the maximum temperature to which the liquid is normally heated and a temperature approximately halfway in between 15 ºC and the maximum.

NOTE: It is imperative that the meter temperature sensor (probe) and the standard thermometer are next to one another (touching) and do not touch the side of the receptacle containing the water (ice, ambient or hot). Sufficient time must be allowed for the electronic temperature sensor to stabilise at the test temperature.

Verification of correct software for conversion to 20 ºC

This test need only be carried out at the time of initial verification or when software is changed after initial verification.

The following procedure shall be used:

When the temperature sensor and standard thermometer are stabilised at the low temperature of below 5 ºC in 4.2, reset the meter to zero and deliver at least 500 L of product. Using the test sheet in annex C, convert the gross volume indicated by the meter to net volume at 20ºC by means of the temperature indicated by the standard thermometer and the applicable correction factor from IP Petroleum Measurement Table B. Verify that the calculated volume does not differ from the indicated net volume by more than 0,25%.

For artificially heated liquids this test shall be carried out at the maximum temperature test in 4.2.

NOTE: Ensure that the density of the product at 20 ºC is correctly set in the meter conversion device.

Record keeping

The completed test sheets in annex A, annex B and annex C shall be kept as data records. The verification status (new, repaired or in use) shall be clearly documented as per SANS 10378.

IMPLEMENTATION POLICY

These requirements and procedures shall come into effect on 1 January 2006. From this date the following time schedule and provisions shall apply.

The new verification procedures shall be incorporated into quality systems and applied (including any training that may be required by verification officers) within a period of 90 days.

For a period of 15 months a meter having a temperature reading verified and found to be outside the prescribed tolerance of 0,5 ºC due to an inaccurate temperature sensor, may be verified if the error at below 5 ºC is within the tolerance of 0,5 ºC i.e. it would still pass the traditional ice test.

Such verification is restricted to a maximum period of 30 days within which the inaccurate temperature sensor shall be replaced. At the time of replacement the requirements of sub – clauses 3.1, 3.2 and 3.3 shall be met and the test in 4.2 carried out whereafter a verification officer shall issue a supplementary certificate according to the requirements of his/her quality system.

The 15 month period (12 months after actual implementation) will allow for all meters to be verified and faulty sensors replaced.

After the 15 month period meters found to have an inaccurate temperature reading shall be rejected until repaired as per the requirements of Sections 13A and 25 of the Trade Metrology Act.

The changes in procedure do not affect the registration of verification officers and they must still be registered to verify temperature compensated meters and know how to complete the relevant test sheets.

Annex A
Test Sheet SA 38

TEST SHEET: SA38

TEST SHEET FOR METERS (WITHOUT A TEMPERATURE COMPENSATOR) TESTED AGAINST AN OPEN TEST MEASURE

METER MODEL:		PRODUCT:			
SERIAL NUMBER:		OBSERVED DENSITY:			
MAX. RATE OF FLOW: (MARKED)		OBSERVED TEMPERATURE:			
DATE:		DENSITY AT 20℃:			
RATE OF FLOW OF TEST					
1. Test measure reading					
2. Test measure temperature (average) when reading is taken					
3. Item 1 corrected for thermal expansion of shell: Item 1 [1 + (Item 2 – 20℃) x coefficient of expans ion of the material]					
4. Factor for conversion of volume at test measure temperature to 20℃ (Selected from TABLE B)					
5. Meter temperature during test run					
6. Factor for conversion of volume at meter temperature to temperature at 20℃ (Selected from TABLE B)					
7. Item 3 converted to volume at meter temp: Item 3 x Item 4 / Item 6					
8. Meter counter reading					
9. Meter error (Item 7 – Item 8)					
10. Percentage meter error: Item 9 x 100 / Item 8					
REMARKS:…… ……					
TESTED BY:		DATE:			

Annex B
Record of accuracy test for meter temperature sensing device

Meter S/No:		**Product:**			
Prescribed test	**Actual temp used**	**Temp on Standard**	**Error on Standard**	**Temp on Meter**	**Temp error on meter**
Low temp (below 5 ºC)					
Ambient temp (Water temp)					
High temp (above 40 ºC)					
Remarks:					
Tested By:		Date:			

Annex C
Test sheet to verify accuracy of conversion devices

Meter S/No:	**Product:**
1. Density of product at 20 ºC from IP Table A using observed density at ambient temperature	
2. Gross indication on meter register	
3. Temperature of cold water	
4. Factor for volume conversion from cold temperature to 20 ºC from IP Table B using density of product determined in Item 1	
5. Item 2 converted to volume at 20 ºC Item 2 X Item 4	
6. Net indication on meter register	
7. Conversion error Item 5 – Item 6	
8. Percentage conversion error Item 7 X 100 Item 6	
Remarks:	
Tested By:	Date: