POLICY			
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1. Scope

Description of requirements and procedures for compact provers to be used as verification standards.

2. Reference documents

Trade Metrology Act
SANS1698

3. Policy

A. BASIC REQUIREMENTS

Compact provers shall only be used to verify meters with electronic correction devices and indicators and if fitted, electronic conversion devices, where calibration factors are directly entered into the instrument software. Basic requirements are set out in SANS 1698:1998 and are supplemented by the following:

Design and accuracy of Compact Provers and auxiliary equipment

General requirements: General design requirements are given in clauses 3.5 and 3.7 of SANS 1698 as applicable.

Standard temperature: The standard temperature for all calculations shall be 20 ºC and all quantities indicated (including printed documents) shall be in SI units acceptable in South Africa.

Non-petroleum products: Where products that are not compatible with the characteristics of petroleum products are tested, software shall be programmed with relevant applicable data such as coefficient of expansion and compressibility of the product to ensure accurate correction to standard conditions.

Affects of pressure and temperature on the accuracy of provers: Clause 3.5.5 is applicable and proof must be supplied that the prover is not affected by more than 0,025% by variations in pressure and temperature within the stated working ranges of the prover or corrections shall be made during verification testing. Proof could be in the form of authentic test results published by the manufacturer or other documentation acceptable to the Director. If corrections for temperature or pressure must be made, proof of the accuracy (validation) of these corrections must also be supplied. Correction factors must be related to a standard reference temperature or pressure, as applicable, for which the prover is designed. Where the pressure difference from atmospheric pressure during a verification test could affect results by more than 0,025%, corrections for the compressibility of the test liquid shall be made.

Rated (marked) operating ranges: Verification test procedures shall state that the prover may not be used outside its rated (marked) operating ranges for temperature and pressure. Thermometers and pressure gauges used to make corrections or ensure that the prover remains within rated operating conditions shall comply with clause 3.7 of SANS 1698.

Prevention of gas intake: To ensure that no gas is present in the system during use at least a sight glass shall be fitted in the pipe work of the prover. The prover and pipe work shall be designed in such a way as to prevent air pockets, which could introduce errors, from being formed. If necessary means shall be provided for releasing trapped air before verification commences. During calibration of the prover, precautions shall be taken to ensure that no air or gas is present in the test liquid supply.

Prevention of effect of flow disturbances: The inlet piping of the prover shall be of such design that any flow disturbance does not affect the accuracy of the prover. Where inconsistent results are obtained due to flow profile disturbance a section of straight pipe with a length of 10 pipe diameters or some other means of flow straightening may need to be installed upstream of the prover to correct any flow profile disturbance.

Control of flow: There shall be a dedicated quick action valve, fitted in the prover system downstream of the prover, for starting and ending the flow and controlling flow rates. In cases where a prover is fitted upstream of the meter being verified this valve shall be downstream of the meter being verified. A staged shut off valve on the meter being verified is not acceptable and should be left fully open during calibration.

Strainer: A suitable strainer shall be fitted upstream of the prover in such a manner that it does not affect the accuracy of the prover.

Number of pulses to be collected: Sufficient pulses shall be collected during a single pass of the prover to ensure accurate determination of calibration factors. The use of the prover will be restricted to the verification of meters that generate the following number of pulses for a delivered volume equal to the volume of the prover.

- Prover without pulse interpolation: 10 000 pulses
- Prover with pulse interpolation: 500 pulses

Repeatability of determined calibration factors: During use, sufficient passes shall be made to ensure accurate determination of calibration factors and factors shall be determined at least three times to determine repeatability. Precaution shall be taken to discard factors that have a repeatability range so great that there is a risk that the meter being verified may exceed maximum permissible errors (i.e. the difference between the highest and lowest factor determined for the flow rate could have an effect greater than 0,125% of the measured volume as measured by the meter under test). It will be preferable if the acceptable range is software controlled to automatically discard factors that are not considered sufficiently repeatable. Provers shall not be used on meters where pulses are not sufficiently evenly spaced to give repeatable results.

Markings: In addition to the applicable markings required by Clause 5.3 of SANS 1698, any other markings decided on during the evaluation shall be marked on the prover.

Calibration of Compact Provers

The accuracy of the cylinder shall be calibrated by a SANAS accredited laboratory according to a method prescribed for the particular prover that is acceptable to the Director and is within the accredited test methods of the laboratory. Auxiliary measuring equipment for pressure, temperature, time and frequency shall be calibrated by a SANAS accredited laboratory according to the accredited test methods of the laboratory and errors taken into consideration as necessary. Calibration periods shall be 12 months but consideration could be given to extending these if calibration history indicates a longer period is acceptable. See Clauses 4.1, 6.1.1 and 6.2.3.1 of SANS 1698.

Other tests such as leak detection to determine slippage past internal components shall be conducted by the user at least every 12 months.

Should any component critical to the accuracy of the prover be replaced the system shall be validated to ensure accuracy has not been affected. Any replacement components shall be original manufacturer supplied or specified components.

B. APPROVAL REQUIREMENTS FOR COMPACT PROVERS

Compact Provers do not require formal approval in terms of the Trade Metrology Act but must be evaluated against these requirements and SANS 1698 to ensure accuracy (see SANS 1698 clause 3.5.7).

The quality system calibration procedure and the procedure for use of the prover as a verification standard (verification procedure), shall be submitted to the Director for evaluation and formal approval.

Evaluation will be done according to tests determined by the Director and will include at least a verification test on a meter after calibration factors, as determined by the prover, have been entered.

The evaluation of the verification test procedure will be conducted on an actual trade use meter.

C. PROCEDURES FOR USE OF COMPACT PROVERS WHEN VERIFYING TRADE USE METERS

The normal tests for trade use meters shall be carried out and covered by the verification test procedures. The following requirements shall also be addressed in the verification test procedure.

1. All hose connections between the meter being verified and the prover shall be non-expandable. If a vacuum breaker is present it shall be effectively sealed or removed to prevent air entering the piping between the prover and meter.

2. Ensure that any pressure loss over the prover does not reduce the flow rate of the system being verified.

3. Ensure that the product return line after the prover does not cause excessive pressures that will increase the normal operating pressure in the meter being verified or prover or cause a reduced maximum flow rate. It will be preferable to discharge measured product into an intermediate tank rather than a bulk storage tank.

4. All valves between the meter being verified and the prover shall remain fully open during the test. If applicable, test the action of automatic shut off mechanisms prior to the accuracy tests and then programme them with a volume greater than the test volume so that they remain fully open during accuracy tests.

5. Flow shall be started and ended and the flow rate controlled by using the dedicated quick action valve positioned downstream of the prover. If the prover is fitted upstream of the meter being verified then the control valve shall be downstream of the meter being verified. Manipulation of pump pressure shall not be used to control the rate of flow.

6. Before testing commences visually inspect the required gas eliminator or gas prevention system on the meter system being verified. Ensure that it is complete, appears serviceable and that gas release valves are adequately vented. If there is any suspicion that the gas eliminator or gas prevention system is unserviceable, repair or abort the verification.

7. A prover shall not be used to verify meters on bulk delivery vehicles or portable tanks where a drain test of the gas eliminator or gas prevention system is required.

8. Before starting a verification test run, pass a sufficient volume of product through the system and prover to equalise pressures and temperature in the piping.

9. During a test run ensure that the rated operating conditions of the prover are not exceeded. If the meter being verified is situated some distance from the prover and there is a possibility that temperature of the product may differ between the prover and meter then the affect on the volume of the product will need to be determined to comply with clause 3.5.6 of SANS 1698.

10. During each verification test run monitor the sight glass at the prover to ensure that there is no gas present in the product.

11. Precaution shall be taken to ensure that meters being verified generate at least the following number of pulses for a delivered volume equal to the volume of the prover.
    (a) Prover without pulse interpolation: 10 000 pulses
    (b) Prover with pulse interpolation: 500 pulses

12. Precaution shall be taken to discard factors that have a repeatability range so great that there is a risk that the meter being verified may exceed maximum permissible errors (i.e. the difference between the highest and lowest factor determined for the flow rate could have an effect greater than 0,125% of the measured volume as measured by the meter under test). The test procedure shall indicate when calibration factors are not sufficiently repeatable. Abort the verification if calibration factors are not sufficiently repeatable.

13. If the trade use meter being verified is fitted with a temperature compensator normal tests approved in the quality system procedure for verification by means of an open measure shall also be carried out.

    An acceptable method is as follows:

    a) <u>Compulsory at all verifications:</u>
    Remove the meter temperature sensor 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.
    NOTE: Sufficient time must be allowed for the electronic temperature sensor to stabilise at the test temperature.

    b) <u>For initial verification and when software is changed after initial verification to ensure that correct conversion tables are entered:</u>
    When the temperature sensor and standard thermometer are stabilised at the low temperature in a) reset the meter to zero and deliver at least 500 L of product. Using the temperature indicated by the <u>standard thermometer</u> and the applicable correction factor from IP Petroleum Measurement Table B, convert the gross volume indicated by the meter to volume at 20 ºC. Verify that the calculated volume does not differ from the indicated net volume by more than 0,25%. A suitable test sheet is attached as annex A

Annex A

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 error $\frac{\text{Item 7 X 100}}{\text{Item 6}}$	