

SPECIFICATION FOR WATER METERS AND SPARE PARTS

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SPECIFICATION FOR VOLUMETRIC DISPLACEMENT TYPE WATER METERS AND SPARE PARTS

1. SCOPE:-

This specification applies to water meters for the measurement of cold potable water supplied to the domestic premises in Sri Lanka. It deals with the metrological and technical requirements of volumetric type domestic meters.

2. GENERAL

2.1 Technical Capabilities

The Products offered shall conform to specifications stipulated under this contract.

The manufacturer shall submit all technical literature and any other technical reports containing information with regard to design, manufacture and characteristics of water meters.

2.2 Relevant Standard

The meters shall comply with ISO 4064:2014 or OIML R 49-2:2013

3. TECHNICAL REQUIREMENTS

3.1 Definitions

3.1.1 Flow Rate (Q)

$Q=dV/dt$ where V is actual volume and t is time taken for this volume to pass through the meter.

3.1.2 Actual Volume (Va)

Total Volume of water passing through the meter, disregarding time taken.

Notes: this is measurand. The actual volume is calculated from a reference volume as determined by a suitable measurement standard taking into account differences in metering conditions, as appropriate.

3.1.3 Indicated Volume (V_i)

Volume of water indicated by the meter, corresponding to the actual volume.

3.1.4 Maximum Permissible Error (MPE)

Extreme value of measurement error, with respect to a known reference quantity value permitted by specifications or regulations of given meter.

3.1.5 Rated Operation Condition (ROC)

Operating condition requiring fulfillment during measurement in order that a meter perform as designed.

Note: The rated operating conditions specify intervals for the flow rate and for the influence quantities for which the errors of indication are required to be within the maximum permissible errors.

3.1.6 Limiting Conditions (LC)

Extreme conditions including flow rate, temperature, pressure, humidity and electromagnetic interference (EMI) that a water meter is required to withstand without damage, and without degradation of its error of indication. when it is subsequently operated within its ROC.

3.1.7 Intrinsic Error

Error of a meter determined under reference conditions

3.1.8 Fault

Difference between the error of indication and the intrinsic error of a meter.

3.1.9 Permanent Flow Rate (Q_3)

Highest flow rate within ROC at which a water meter is required to operate in satisfactory manner within maximum permissible error.

3.1.10 Overload Flow Rate (Q_4)

Highest flow rate at which a water meter is required to operate for a short period of time within its MPE, whilst maintaining its metrological performances when it is subsequently operated within its ROC.

3.1.11 Minimum Flow rate (Q_1)

Lowest flow rate at which the water meter is required to operate within the MPE.

3.1.12 Transitional Flow Rate (Q_2)

Flow rate which occurs between the permanent flow rate (Q_3), and minimum flow rate (Q_1) that divides the flow rate range into two zones the “the lower zone” and the “upper zone”, each characterized by its own MPE.

3.1.13 Minimum Admissible Working temperature (mAT)

Minimum temperature that a water meter can withstand permanently at a given internal pressure without deterioration of its metrological performances.

3.1.14 Minimum Admissible Working temperature (MAT)

Maximum temperature that a water meter can withstand permanently at a given internal pressure, without deterioration of its metrological performances.

3.1.15 Minimum admissible working pressure (mAP)

Minimum pressure that a water meter can withstand permanently within ROC, without deterioration of its metrological performances.

3.1.16 Maximum Admissible working pressure (MAP)

Maximum pressure that a water meter can withstand permanently within ROC, without deterioration of its metrological performances.

3.1.17 Working Temperature (T_w)

Average water temperature in the pipe, measured upstream and downstream of the water meter.

3.1.18 Nominal Diameter (DN)

Alphanumeric designation of size for components of a pipe work system, which is used for reference purpose.

Note: it comprises the letters DN followed by a dimensionless whole number that is indirectly related to the physical size in mm of the bore, or outside diameter of the end connection.

3.1.19 Pressure Loss

Head loss at a given flow rate caused by the presence of the meter in the pipe line.

3.2 Operating conditions

Domestic meters shall be suitable in every respect for operation under following operating conditions

Temperature

The working temperature range shall be suitable for a country with following conditions:

- a. Annual average ambient temperature = 30⁰C
- b. Maximum ambient temperature = 40⁰C

Working Pressure

Meters shall function on a normal pressure of 3m H₂O for the forward flow. The water meters must be able to withstand constantly a continuous working pressure of 10 bar without defects in its functioning, leakage, seepage through the walls or permanent deformation.

Humidity & Immersion

A meter shall be suitable for installation in a pit or basement which may be subjected to flooding. Therefore, meters and their fittings shall be capable of operating normally even when submerged to a depth of 1m.

Installation & Position

Domestic meters shall be suitable for installation in vertical, horizontal and inclined positions without loss of its required accuracy and counter shall be so positioned that it shall be easy to read in vertical or horizontal or inclined positions.

3.3 Meter type

All domestic water meters and spare parts to be supplied under this contract shall be of volumetric type with threaded End connections.

3.4 Meter Size and overall dimensions

For each meter size there is a corresponding set of overall dimensions and the dimensions are given in table 01 in appendix B (see also figure 01 of appendix A)

$H_1 + H_2$, L , $W_1 + W_2$ define the height, length and width respectively of a cuboid within which the water meter can be contained (the cover being at right angles to its closed position)

Dimensions of H_1 , H_2 , L , W_1 , W_2 are given in appendix b table 01.

Dimension L for 15mm shall be 165, 134, or 115 mm. without any preference to any Figure

3.5 Threaded Connections

All meters supplied shall have male threaded end connection and shall be provided with pipe connecting unions threaded to respective BSP Size, DN 15.

Union nut shall have provision for sealing the water meter and end connectors with metallic wires. The diameter of the sealing hole of the union nut and the meter shall be 2.5 mm, Union barrel shall be so designed that it can be tightened with a standard spanner.

Two minimum values 'a' and 'b' are specified in table in appendix B. Dimensions "a" and "b" are as per the figure 02 shown in appendix A.

3.6 Metrological requirements

Water meters are designated according to the permanent flowrate (Q_3) in cubic meter per hour and ratio of (Q_3) to the minimum flow rate (Q_1)

Meter Size (Nominal Diameter)(mm)	15
Permanent flow rate (Q_3) (m ³ /hr)	1.6
Measuring Range (Q_3 / Q_1)	100
Minimum Flow rate(Q_1) (l/hr)	16
Overload Flow (Q_4) (m ³ /hr)	2
Transitional Flow (Q_2) (l/hr)	25.6

3.7 Maximum Permissible Error

3.7.1 MPE Lower Flow range

The maximum permissible error, positive or negative, on volumes delivered at flow rates between the minimum flow rate (Q_1) and transition flow rate (Q_2) is $\pm 5\%$ for water having a temperature within ROC. (Accuracy class 2)

3.7.2 MPE upper Flow range

The maximum permissible error, positive or negative, on volumes delivered at flow rate between the transitional flow rate (Q_2) and the overload flow rate (Q_4) is $\pm 2\%$. (Accuracy class 2)

3.8 Materials and Construction

3.8.1 General

The water meters must be manufactured from materials of adequate strength and durability for the purpose for which it is intended. Namely internal and or external installation on domestic premises in tropical countries like Sri Lanka.

The meters must also be manufactured from materials which are resistant to or are protected against normal internal and external corrosion. However, the body of the meter shall be manufactured out of Brass.

The meter body shall be rigid and resistant to deformation that could impair the function of the moving parts.

When used under the conditions for which they are designed, materials in contact with or likely to come into contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

The indicating device of the water meter shall be protected by a transparent window (glass or other material). Further Protection shall be provided by a suitable cover.

3.8.2 Strainer

All volumetric type meters shall be provided with an internal strainer.

3.8.3 Pressure Loss

The pressure loss through the water meters at Q3 permanent flow rate shall not be greater than 0.63 bar when measured with non – return valve installed

3.8.4 Indication Devices

The meter shall incorporate an indicating device which must give an indication of the volume flow expressed in cubic meters. The device shall consist of a row of a minimum of four in line consecutive digits and can be of mechanical type.

(e.g. a series of numbered cylindrical drums). This device shall be clearly labeled "m³".

Sub multiple of a cubic meter shall be shown by further in line digits. The discrimination of this subsidiary indicating device shall be to 0.1 liters indicated digitally or by graduations of a movable scale.

The cubic meter and its multiples shall be indicated in black and its sub-multiples in red. The actual or apparent height of the digits shall not be less than 4 mm.

The advance of any digit must be completed while the digit of the immediately next lower value describes the last tenth of its travel. The numbers on the drums must be displaced upwards.

3.8.5 Anti-Tamper Facilities

Revenue meters of all types are subject to fraud and tampering. The anti-tamper facilities and construction of the meter shall deter attempts at tampering and indicate whether tampering has occurred.

Lead and wire seals shall be used to give local indications of meter removal or dismantling.

3.8.6 Non-Return Valve

An internal non-return valve which cannot be removed without tampering shall be incorporated within the meter body to prevent the contamination of distribution system and to avoid loss of revenue from the back flow from end users.

3.8.7 External Magnetic Interferences

If the drive between the metering rotor and the counter is magnetic, then it shall be unaffected by external magnetic interference.

Meters with magnetic drive between the metering rotor and the counter shall not be accepted and shall be rejected.

3.8.8 Marks & Inscriptions

The water meter must carry embossed on the body during casting of the body while manufacturing on its body, excluding the cover, in an unambiguous, indelible and clearly legible form the following information.

- a. The model number & name or the trade mark of the manufacturer.
- b. The permanent flow rate, size in DN and pressure loss in bars.
- c. The year of manufacture and serial Number.
- d. An arrow indicating the direction of flow.
- e. The letters "NWS&DB" of height not less than 05 mm shall be engraved into the metal body of the water meter.
- f. Metrological Class (Measuring Range)

4. SPARE PARTS

The bidder shall provide, with his tender a complete itemized priced list of spare parts recommended for 5 years operation. The lot of spare parts quoted shall include the following spare parts among others recommended by the manufacturer.

1. Combine counter and reduction gear assembly.
2. Working chamber complete with Top plate assembly.
3. Ramp assembly.
4. Non return valve.
5. All "O" rings, seals, washers and circlips etc.
6. Lid
7. Hinge pin

5. SAMPLES

5.1 Submission of Samples

Every tenderer shall submit 07 (seven) samples meters of 15mm volumetric type complete with end connections and washers for inspection and testing by National Water Supply & Drainage Board.

All samples shall be well packed, sealed and labeled to facilitate identification.

The samples shall truly represent the meters offered to be supplied under this contract in every aspect. No samples will be returned and the cost of providing samples shall be borne by the tenderers.

Out of the 07 samples submitted 05 samples will be subjected to the tests at NWSDB as described in the document and the remaining 02 will be stored by NWSDB for future reference.

05 samples out of the submitted 07 nos. shall be selected randomly for testing in the presence of the tenderers and those 05 shall be the final selection for testing and the remaining 02 shall be reserved for future reference.

5.2 Non Submission of Samples

The bids that are not accompanied with the required no. of samples will be treated as substantially non-responsive.

5.3 Testing of Samples

All sample meters will be tested to evaluate meter performance on the NWS&DB water meter test benches at NWS&DB Workshops.

All tenderers will be notified of the dates and times scheduled for testing samples and tenderer or his authorized representative will be allowed to witness these tests. No change in time schedule will be allowed.

All sample meters will be opened in the presence of bidders or their representatives before the commencement of the testing.

All sample meters will be tested with the non-return valve in position and any method for testing samples without non-return valves will not be accepted.

Following tests will be carried out to evaluate meter performance.

1. % Error Tests at Q_1 , Q_2 , and Q_3

% Error at all the above flow rates shall be within maximum permissible errors specified.

2. Non return valve function test

Non return valve shall withstand a maximum of 1 bar pressure applied on it without showing any leakage.

3. Magnetic Influence

All meters with magnetic drives shall not be influenced by a magnet.

4. Pressure Tests

Meters shall be able to withstand a working pressure of 10 bar without defects in its functioning, leakage or seepage through walls and water pressure class of the meter shall be MAP 10

5. Pressure Loss

Pressure loss through a meter at Q_3 Permanent flow rate shall not exceed 0.63 bar with the non – return valve installed.

6. Measurement of Overall Dimensions.

Overall measurement of the sample meters will be measured.

6. EVALUATION OF WATER METER PERFORMANCES

The test results obtained from above tests will be final and following criteria will be applied to evaluate meter performance.

6.1 Criteria For Evaluation

- a) All performance tests will carry equal weightage of 1.
- b) A minimum of 4 out of 5 sample meters shall pass all tests and sample lots meeting this criteria shall be considered for evaluation and those failing shall be rejected.

A meter determined as passed, shall have passed all tests shown below.

Test	Weightage allocated per pass per sample	Sample size	Weightage for 2 nd level of screening according to para 6.1 b
1.%Error Tests			
1.1 Q1 Test	1	5	4
1.2 Q2 Test	1	5	4
1.3 Q3 Test	1	5	4
2. Non Return Valve Test	1	5	4
3. Magnetic Influence Test	1	5	4
4. Pressure test	1	5	4
5. Minimum overall performance requirement			24

Note

In addition to the above, average pressure loss per meter at Q₃ flow rate & overall dimensions of the meters offered shall comply with the following.

e. Pressure loss

Total pressure loss of 5 meters in series will be measured at flow rate of Q_3 . The average pressure loss per meter at Q_3 shall be calculated and this figure shall not exceed 0.63 bar with the non – return valve installed. Samples not conforming to above will be rejected.

f. Overall Dimensions

In addition to the above, overall dimensions of the meters offered shall conform with the values given in the table in appendix b.

7. DURABILITY TEST

7.1 The supplier shall submit a copy of the Endurance Test Certificates for each size of the models of the water meters offered for this tender with the bid. The test should have been done for 03 Nos. meters of the models offered, less than 03 years before the closing date.

Endurance Test Certificates should have been obtained from one of the designated independent testing agencies described I to IV below and the reports shall be from such independent agency.

- I. Test shall be carried out by one of the Independent Inspection Agency complying with the acceptance requirement for their laboratories given in clause 7.2 of the specification.
 - i. Crown Agents
 - ii. Lloyds Register
 - iii. Bureau Veritas
 - iv. Societe Generale de Surveillance S.A
- II. Test shall be carried out by one of the Independent Testing Agencies which is accredited to perform this test and shall be a member of the International Accreditation Forum (IAF) complying with the acceptance requirement for their laboratories given in clause 7.2 of the specification. A certified copy of the membership which authorizes the agency to perform relevant test shall be attached with the bid document. The test certificate shall be issued by the Independent Inspection and Testing Agency.
- III. Test shall be carried out in a accredited Laboratory which is accredited to perform this test by International Laboratory Accreditation Cooperation

(ILAC) complying with the acceptance requirement for Laboratories given in Clause 7.2 of the Specification. A certified copy of the which authorizes the lab to perform this test shall be attached with the bid document.

- IV. In case the tests are carried out at the manufacturer's facilities, tests shall be witnessed by one of the designated inspecting agencies complying with the acceptance requirement for Laboratories given in Clause 7.2 of the Specification in the tender document and the reports shall be by the said agency. If the test shall not be witnessed by one of the designated inspection agencies, it shall be witnessed by an accredited inspection and testing agency which shall be a member of International Accreditation Forum (IAF) or accredited laboratory which is a member of International Laboratory Accreditation Corporation (ILAC) and shall fulfill the acceptance criteria of Laboratories for endurance testing as specified in clause 7.2.

Three meters exactly identical in description, specifications etc. to the meters being offered shall be subjected to the following tests and test reports shall be submitted along with the offer. Offers not accompanying the said reports shall be considered as substantially non – responsive.

Full contact details of the laboratory must be accompanied with the bid.

Endurance test should be carried out according to Section 7.11.3, Continuous Flow Test and 7.11.2 Discontinuous Flow Test of ISO 4064-2:2014 (E) and acceptance criteria shall be class 2 or OIML R 49-2:2013(E) for class 2 accuracy.

The report contents shall include all details/requirements in the above sections (7.11.2 & 7.11.3 of both the above standards) as a minimum.

Meters shall remain within the maximum permissible error ranges/deviations as specified before and after carrying out the tests for accuracy class 2 meters in the above two standards.

A. Endurance test

Accuracy of the meters shall be measured at the given flow rates during normal operation, during operation after discontinuous endurance test and during operation after continuous endurance test.

- I. measure the percentage accuracy of flow measurement at the following flow rates
 - 2000 l/hr.
 - 1600 l/hr.
 - 25.6 l/hr.
 - 16.0 l/hr.
- II. Measure the percentage accuracy of flow measurement at the same flow rates after discontinuous endurance test*.

III. Measure the percentage accuracy of flow measurement at the same flow rates after continuous endurance test*.

* (discontinuous type test shall be 100,000 interruptions, 15 sec. duration pauses, 15 sec. duration operation at 1600 l/hr, Continuous type test shall be with operation at 2000 l/hr. flow rate for 100 hrs for accuracy class 2)

Meters shall remain within the maximum permissible error ranges as given in the standards ISO 4064 -1 – 2014 (E) or OIMLR 49-1 2013(E) before & after carrying out all the tests described here.

Failure to comply with this requirement shall lead to the rejection of the offered meters.

7.2 Acceptance criteria of laboratories for endurance testing

7.2.1 The following laboratories shall qualify:

- 1) National Measurement Institute (National Metrology Laboratory) of the country of the laboratory.
or
- 2) An ISO/IEC 17025 accredited metrology /measurement institute authorized by the National Measurement Institute (National Metrology Laboratory) of the country of the laboratory, as dissemination of the National Standards of the country.

Accreditation schedule shall include water meter testing according to ISO 4064-2014(E) or OIMLR 49-2 2013(E) requirements.

- 3) Independent third party “Industrial Calibration/Test Laboratory” where the reference standards have been calibrated by an Accredited Calibration Laboratory, authorized by the National Measurement Institute (National Metrology Institute) of the country.

7.2.2 Qualification

- 1) Laboratory shall be a third party, independent laboratory
- 2) Certificates shall comply with the details/ reporting requirements of ISO 4064-3:2014 (E) OIMLR 49-2 2013(E) as a minimum.
- 3) Certificate shall be issued directly from a third party, independent laboratory, printed on paper with laboratory /company markings of the laboratory and seal/ signature on every page of the report.
- 4) Copies of an Accreditation certificate shall be submitted with the bid, in case of laboratories (2) of Cl. 7.2.1.

Copies of relevant pages of accreditation schedule showing the inclusion of water meter testing according to ISO 4064-2014 (E) or OIMLR 49-2 2013(E) shall be submitted with the bid.

- 5) All pages of copies of submitted certificates (endurance, accreditation etc.) shall be certified as true with seal and signature of the bidder.
- 6) Report shall include all details/requirements stipulated in the sections 7.11.2 & 7.11.3 of ISO 4064-2:2014 (E) or OIMLR 49-2 2013(E).
- 7) Accreditation Quality Assurance Certification of the laboratory shall be based on the requirement of Uncertainty of Measurement of the actual volume to be according to cl. 7.4.2.2.6.1 of OIMLR 49-2 2013(E).

If needed, NWSDB, Procurement Committees and TEC etc. shall require bidders to substantiate the above with supporting certificates/ documents whenever the bidders are notified.

8. TECHNICAL LITERATURE

8.1 Tender Drawings

The Bidder shall submit together with his tender a drawing or drawings showing the salient features of the meters, the materials used, methods of manufacture and tolerances allowed and other details to enable determination and assessment of the meters.

The Bidder shall supply a calibration curve (flow rate against % error) for each size and type of meter offered.

8.2 Services Manuals

The successful Bidder shall submit 3 copies of the Service Manuals for each type of meter to NWS&DB at the time delivery of meters.

The manuals shall contain complete list with number, name, drawing of spare parts, information, tools and equipment necessary for dismantling each item for repairing or replacing parts, maintenance instructions including charts showing lubrication, if required, and checking, calibration, testing and procedures.

9. INSPECTION & TESTING AT MANUFACTURE'S WORKS BEFORE SHIPMENT AND PRE – SHIPMENT APPROVAL

Selected samples using random tables according to ISO 2859 – 1:1999 (E) and ISO 3951 : 1989 (E) from the particular lot to be supplied under this contract shall be inspected and tested for conformity to specifications, prior to shipment at the bidders own cost by one of the inspecting agencies stated in the clause 8.5 of the General Conditions of Contract. Bidder shall indicate the name of the inspection agency selected with the bid.

Number of samples to be tested according to sampling procedure described in clause 13, inspection of delivery lots.

It is mandatory to include the complete meter numbers for all meters of the sample in the test certificates submitted.

Tests to be carried out are as follows,

1. Q₁ - min. flow
2. Q₂ - transitional flow
3. Q₃. - Permanent flow
4. Pressure test (acc. to the pressure rating in cl.4.2.10 of ISO 4064-1-2014(E) or OIMLR 49-1 2013(E).
5. Non return valve test.
6. Pressure loss test (acc. to the figures in cl. 6.5 of ISO 4064-1-2014(E)or OIMLR 49-1 2013(E).
7. Overall dimensions & thread dimensions
8. Magnetic test (if applicable)

Pre – shipment approval :

Tenderer shall submit the above test certificates from the inspection agencies for the samples selected according to the procedure given for testing at site at NWSDB to be supplied to NWSDB for approval and only upon such approval by the Purchaser that the manufacturer shall be allowed to ship the relevant lot.

Non approval of the above certificates by Purchaser shall cause the relevant lot being rejected and not being shipped to Sri Lanka.

10. APPROVAL

Approval by the Purchaser to ship the Water Meters or acceptance of the design or drawings by NWS&DB shall in no way relieve the supplier of any of his obligations or liabilities with regard to the design, materials used, workmanship and the proper execution of the contract.

11. GUARANTEE

All meters shall be guaranteed for performance and accuracy by the contractor for a period of 36 months from the date of delivery in respect of conformation with the specifications and defects in materials and workmanship.

The Supplier shall warrant to the Purchaser that the meters supplied under this contract will comply strictly with the Contract and shall be first class in every case and shall be free from defects. The Supplier further warrants to the Purchaser that all meters and their accessories furnished by the Supplier under this contract will be new, merchantable of the most suitable grade, and fit for their intended purposes.

Any part of the meters supplied under this contract, which fails or does not give satisfactory performance during this period of warranty, shall be replaced within 15 days from the date the Contractors has been notified to do so.

All expenses involved in this connection shall be borne by the Contractors who should take this into consideration when tendering.

12. PACKING

Each water meter and its accessories namely a set of seals and 02 Nos. end connections (Union nut + Threaded branch) shall be packed in box. These units shall then be packaged or otherwise enclosed or protected for overseas shipment, handling & storage in tropical climate. Suitable special provision shall be made to avoid damage resulting from handling by all carriers. All packages shall be clearly marked for identification including indication of upper side of packages.

Each meter of same size shall be marked with a unique serial number and then packed according to ascending order of such serial numbers. Starting Serial No., Last serial No and No. of meters in the each package shall then be marked on the package boxes.

13. INSPECTION OF DELIVERY LOTS

Delivery lots handed over to the main stores according to the delivery schedule in the tender document will be subjected to an Inspection procedure as described below, which has been formulated by NWSDB using data tables etc. from ISO 2859 – 1:1999(E) and ISO 3951:1989(E).

Delivery lots failing the inspection procedure shall be wholly rejected without any payment for such meters and the tenderer shall take over and remove the whole lot from the NWSDB premises.

In the case of non – acceptance of a lot, the entire lot and any other remaining lot(s), if any, shall be cancelled and no payment whatsoever regarding any lot(s) cancelled in such a manner shall be made.

Inspection Procedure

Sample size selection from the lot delivered:

Sample size code letter shall be selected from Table 1 – Sample Size Code Letters in Appendix d depending on the Lot size and General Inspection Level I.

Then the Table 2 – A – Single Sampling Plans for Normal Inspection (Master Table) in Appendix e shall be employed for sample size determination and allowable failure percentage.

Following are the inspection levels used by NWSDB.

Acceptance Quality Limit – 2.5

Single sample

Normal Inspection

From the above data, sample size shall be obtained from Table 2 – A in Appendix e. Subsequently, a sample of the above size is selected from among the lot using standard Random Tables.

Each meter in the sample shall be subjected to the following parameters & features.

1. Q_1
2. Q_2
3. Q_3
4. Pressure Test(No leak – pass, any leak fail)
5. Magnetic Test(Response to the magnet – fail, No – response – pass)
6. Non – return valve test(function – pass, not function – fail)
7. Pressure loss test
8. Overall dimensions & thread dimensions

Any Meter failing in any of the above eight tests shall be considered as rejected.