SPECIFICATION

FOR

WORKING STANDARDS

OF

CAPACITY

METAL & EPOXY COMPOSITE MATERIAL CONTENTS MEASURES

In accordance with section 5(5) of the Weights and Measures Act 1985, the Secretary of State hereby approves the material and form of working standards conforming to this specification for use when testing measuring instruments used for dispensing liquid fuel.

This specification replaces 7321(March 2002), (Sept 1995), SWM 264 (May 1970), WM 138 (Sept 1958), WM 287 (Sept 1976) and A.4 (May 1908) which are cancelled, but existing measures made to these specifications may continue to be used.

John Pain
National Measurement Office
Stanton Avenue
Teddington
Middlesex
TW11 0JZ

Department for Business, Innovation and Skills

SPECIFICATION FOR STANDARDS OF CAPACITY

METAL AND COMPOSITE MATERIAL CONTENTS MEASURES

NOMINAL CAPACITIES

1 The working standards shall have capacities as shown in Table 1.

MATERIAL

2 The measures shall be made of stainless steel or mild steel suitably treated to prevent corrosion. They may also be constructed from fibre reinforced epoxy composite material or other materials having an essential zero linear thermal expansion coefficient. Handles and other fittings may be of other appropriate materials.

GENERAL CONSTRUCTION

3 The measures shall have the following general features:

(a) a cylindrical body of height approximately the same as the diameter. It shall resist deformation when filled with water.

(b) a conical portion to facilitate pouring out and drainage.

(c) a neck to give the required sensitivity.

(d) a base designed to resist distortion when filled and to provide protection against damage in use. (See diagrams.)

(e) handles to facilitate carrying.

4 The measures shall be sufficiently strong and robust to withstand normal usage with a minimum material thickness of approximately 1 mm. Measures may have strengthening bands to minimise distortion when filled or being transported.

5 Measures shall not leak.

6 Measures shall have a smooth interior surface.

7 No air shall be trapped on filling and no liquid retained on emptying.

8 Measures may be of the brim type or line type.

9 Brim measures shall have:

(a) a smooth machined striking surface 50 mm internal diameter and at least 2.5 mm wide, perpendicular to the vertical axis of the measure and below the level of the collar;

(b) a collar to, to receive excess liquid, which enables a glass strike of at least 55 mm diameter, and at least 5 mm thick, to be slid across the striking surface.

(c) a drain cock which enables the complete drainage of liquid from the collar into a graduated glass container.

10 Measures may incorporate a calibrating unit (adjustment plunger) in the design, of up to ± 0.5% of the nominal value.

11 Means shall be provided to secure the calibration unit after adjustment. A protective cap or cover should be provided.

12 Line measures shall have graduated scales incorporated into the neck, adjacent to a vertical clear glass window or sight tube in the neck.

13 The scales may be adjustable and shall be capable of being locked and sealed in position. For additional security it is recommended the distance (in mm) be measured from the nominal mark on the scale to the top or bottom of the neck, the details being recorded on certificates or reports.

14 The internal neck diameter of line measures shall fall within the appropriate band given in Table 1.

15 The scale shall be of sufficient length to indicate the permitted limits of error for inspection.

16 Scale marks may be numbered in terms of millilitres (ml) or in terms of percentage of nominal volume.

INSCRIPTIONS

17 The following inscriptions shall be marked permanently, legibly and conspicuously on each measure:

The nominal capacity

In 20 °C

A serial number

The name of the local authority

Additionally the name or trade mark of the manufacturer may be marked on the measure.

APPENDIX 1

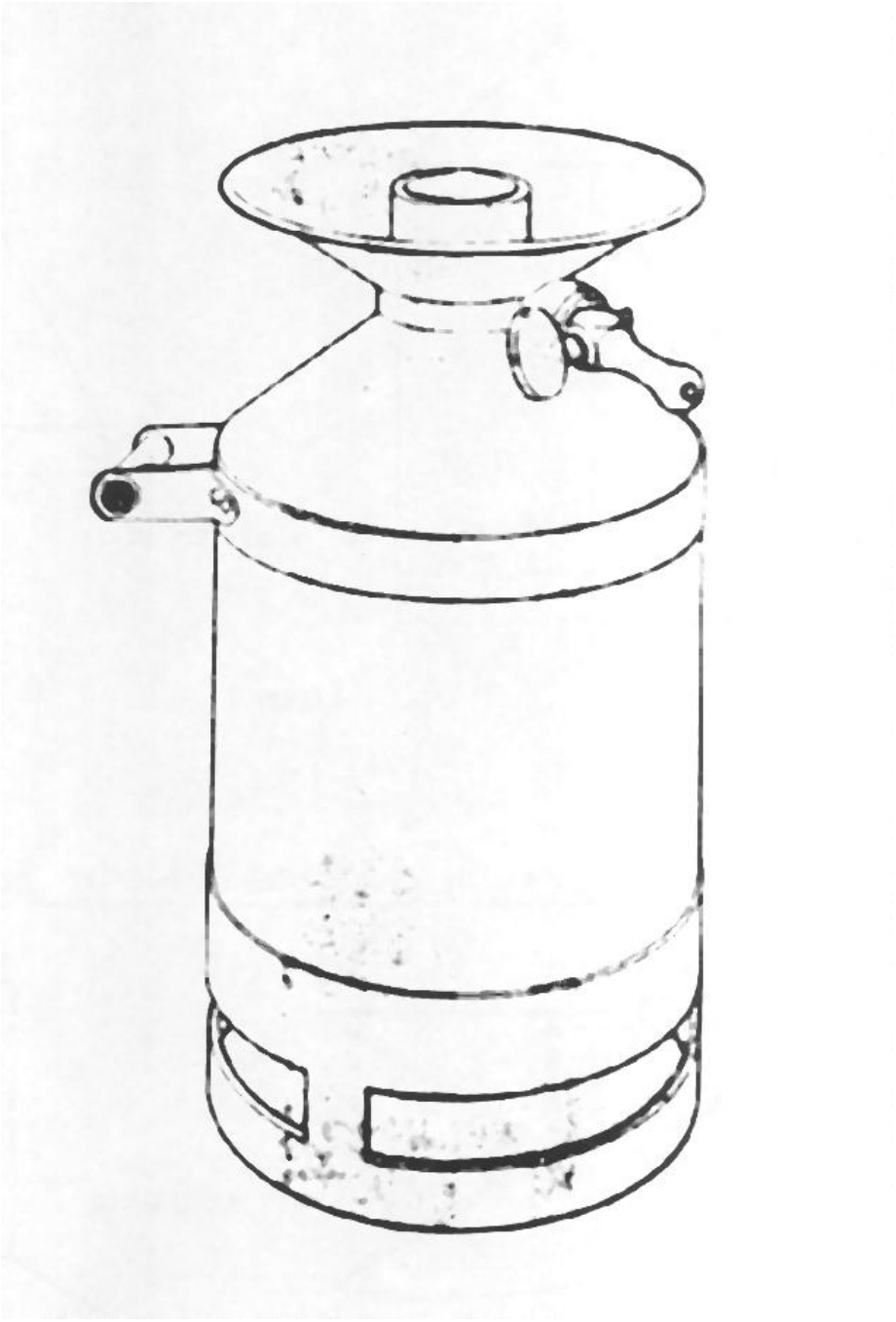
Notes for guidance in the use of contents measures

18 These measures shall be tested either by discharging water from an appropriate local standard or standards into a dry measure or by pouring water of a known temperature into the measure, determining the weight of the water on a suitable weighing machine and calculating therefrom the capacity.

19 Before being used to test a petrol pump these measures should be filled with petroleum spirit and allowed to drain for the specified drainage time after the main outflow has ceased.

TABLE 1

Capacity of measure	2 litres	5 litres	10 litres	20 litres
Permitted error of measure	± 2 ml	± 5 ml	± 10 ml	± 20 ml
Diameter of neck (line measures)	44 mm ± 4 mm	54 mm ± 4 mm	70 mm ± 4 mm	74 mm ± 4 mm
Diameter of neck (brim measures with strike)	50 mm	50 mm	50 mm	50 mm
Minimum capacity of collar (brim measures)	50 ml	75 ml	150 ml	300 ml
Maximum displacement of calibration unit (brim measures)	20 ml	50 ml	100 ml	200 ml
Drainage time	½ min	½ min	1 min	1 min



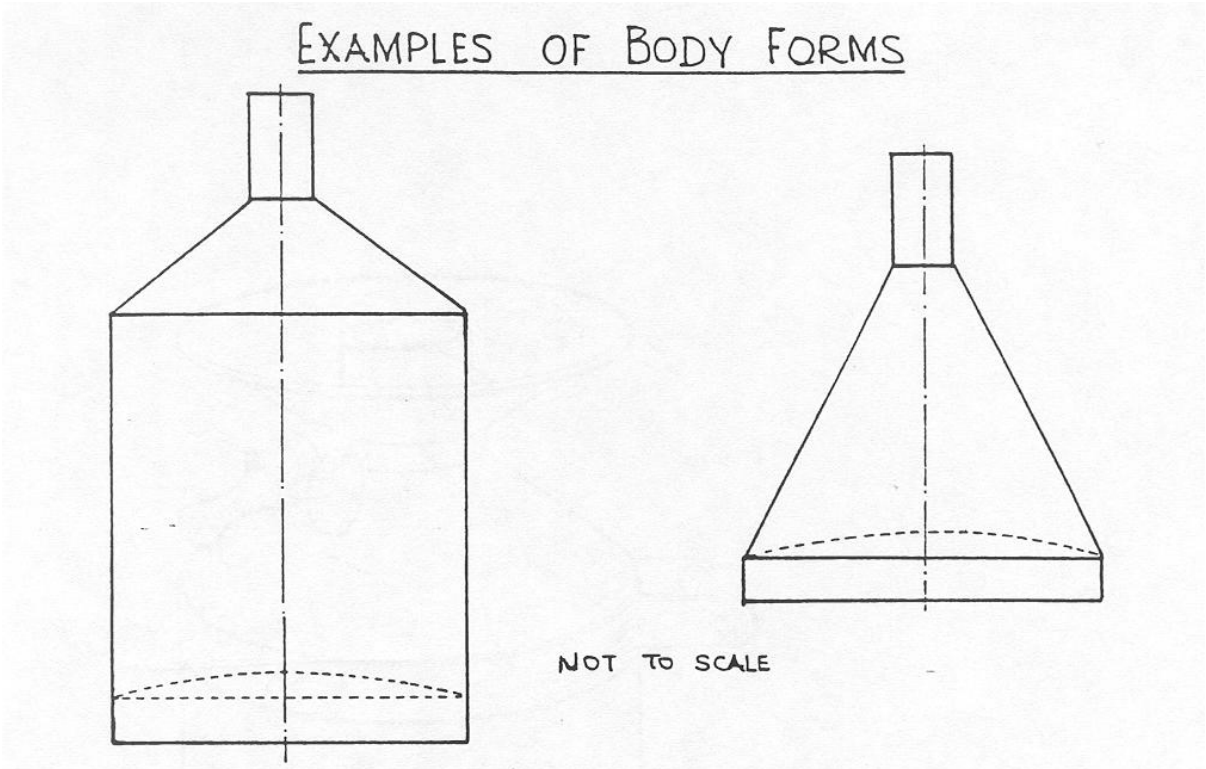


Figure 1

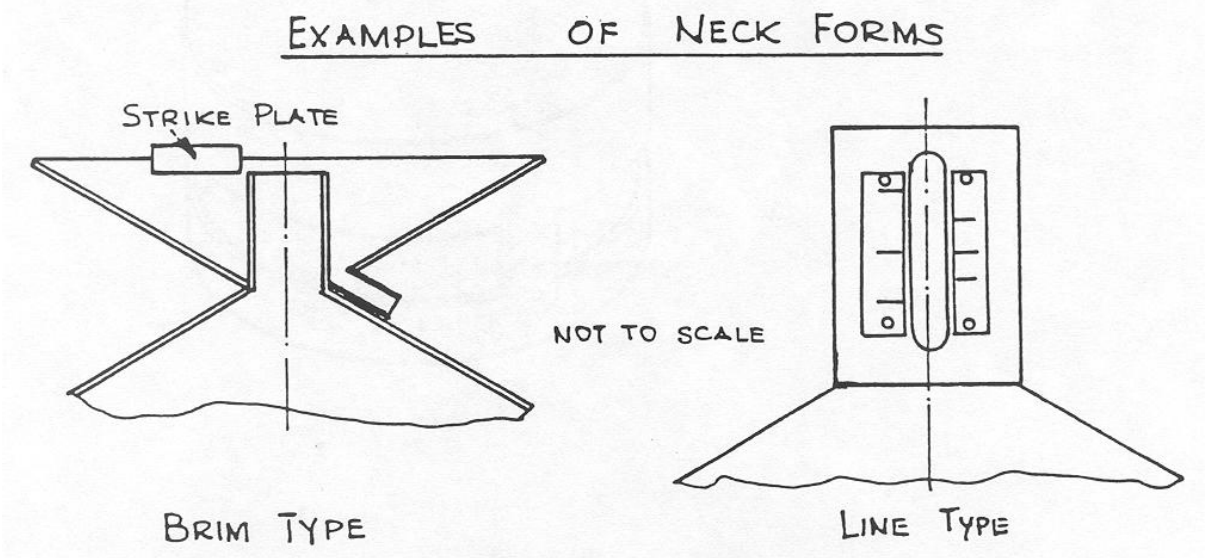


Figure 2

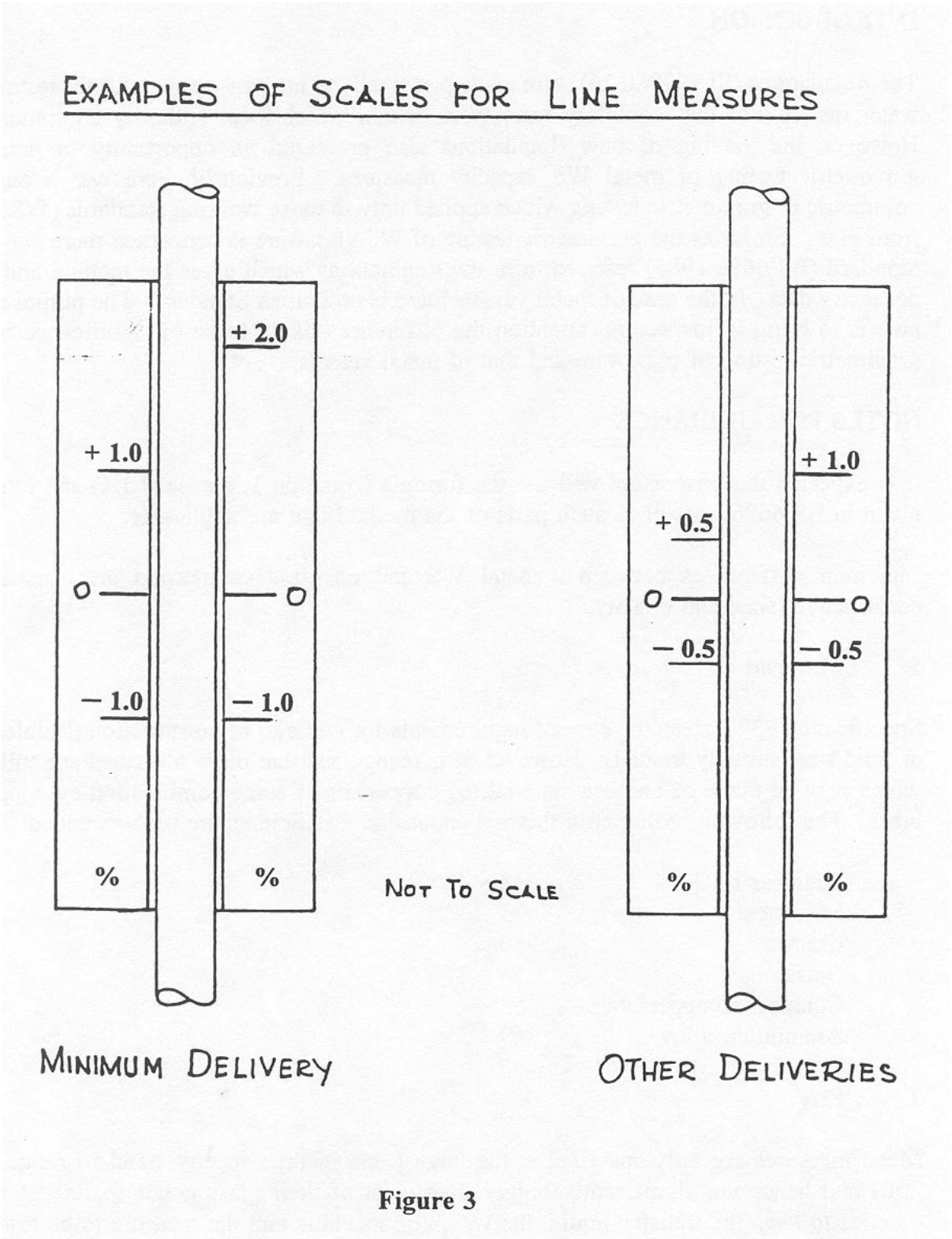

EXAMPLES OF SCALES FOR LINE MEASURES
+ 2.0
+ 1.0
0
0
− 1.0
− 1.0
%
%
NOT TO SCALE
+ 1.0
+ 0.5
0
0
− 0.5
− 0.5
%
%
MINIMUM DELIVERY
OTHER DELIVERIES

Figure 3

APPENDIX 2

GUIDANCE NOTES

GRAVIMETRIC TESTING OF WORKING STANDARD CAPACITY MEASURES

INTRODUCTION

The Regulations (SI 1990/2626) were made principally to introduce apparatus for testing cold-water meters into the regulatory framework within which local authority equipment falls. However, the making of new Regulations also presented an opportunity to permit the gravimetric testing of metal WS capacity measures. Previously there was a choice of volumetric or gravimetric testing which applied only to those working standards (WSs) made from glass. So far as the gravimetric testing of WS glassware is concerned there is a British Standard (BS 6696:1986) referred to in the Regulations which gives the method and all the necessary data. In the case of metal and composite material vessels there is no British Standard. The purpose of this note is to bring to inspector's attention the differences likely to be of significance between gravimetric testing of glassware and the vessels made of these different materials. The regulations refer to measures made from metal and glass, the references to 'metal' will include all other materials used for construction mentioned below.

NOTES FOR GUIDANCE

It is expected that inspectors will use the formula (equation 1, clause B.1.1) and other data given in BS 6696 as well as such parts of the method that are applicable.

The main differences between a metal WS and its glass counterpart are: material of construction, size, and opacity.

1 Material

Specification 7321 gives the current requirements for material of construction (stainless steel or mild steel suitably treated). However, it is recognised that some older / newer measures currently in use may be made of another material, eg copper, epoxy composite materials. The following volumetric thermal expansion coefficients are recommended:

Stainless steel	48×10^{-6}
Mild steel	33
Copper	50
Brass	54
Composite copper/brass	52
Aluminium alloy	69
Epoxy composite materials	0 (Assume '0' as actual figures may vary but remain small)

2 Size

Metal measures are only specified at the largest end of the capacity standard range (2L to 20L) and hence are significantly bigger than most of their glass counterparts. It is good practice to keep the transfer liquid, the weighing machine and the measure to be tested in a common thermally stable environment; this is easy to achieve with small glass measures. The large size, and weight, of metal measures may introduce a problem with availability of sufficient quantities of transfer liquid (distilled or de-ionised water) and availability in the "wet" laboratory of a suitable weighing machine. It is recommended that distilled water be used as a transfer liquid but where tap water, or other water of unknown composition, is used it will be necessary to determine the density. Since the fundamental relationship used is:

$$\text{volume} = \text{mass} / \text{density}$$

it follows that any uncertainty (eg systematic due to composition) in the water density will be thrown directly onto the calculated volume. The limits of error on metal capacity WSs are +/– 0.1% therefore it is recommended that the water density be known or determined to 0.02% or better. There are a variety of ways of determining the density of a liquid to this accuracy most of which can be found at: http://www.oiml.org/publications/G/G014-e87.pdf
Where the water used does not come from storage within the laboratory environment its temperature may be far from the standard temperature. In this case there will be errors introduced due to rapid temperature drift. Initially there could also be a significant difference between the temperature of the water and that of the standard under test. Where possible both the temperature of the water and that of the container should be monitored and a mass measurement only made when these temperatures are sensibly equal and relatively stable. The thermometers used must be calibrated and read to 1/4 degree Celsius or better.

The weighing machine used must have a performance which meets the discrimination threshold and repeatability requirements of the Regulations.

The exact procedure for testing will depend upon the use to which the standard is to be put. It is good metrological practice to calibrate a device in the way it is to be used. In the case of measures used with highly volatile liquids (eg petrol) this may be inconvenient and dangerous therefore it is recommended that such a standard be calibrated from dry as recommended in Specification 7321.

3 Opacity

A disadvantage of metal measures is that they are opaque. This means that the presence of dirt, corrosion etc on the inside surface is not readily visually detectable. Also any effects due to greasiness, eg the formation of bubbles on the walls which would produce errors due to incomplete filling, are not apparent. Small bubbles may also be present in the water supply particularly if the mains supply is used. It is left to Inspectors' judgement to decide whether a particular mains supply is suitable and to assess how quickly a measure is to be filled in order to minimise bubble formation. Filling through a tube reaching to the bottom of the vessel may help to reduce splash loading and bubble formation.