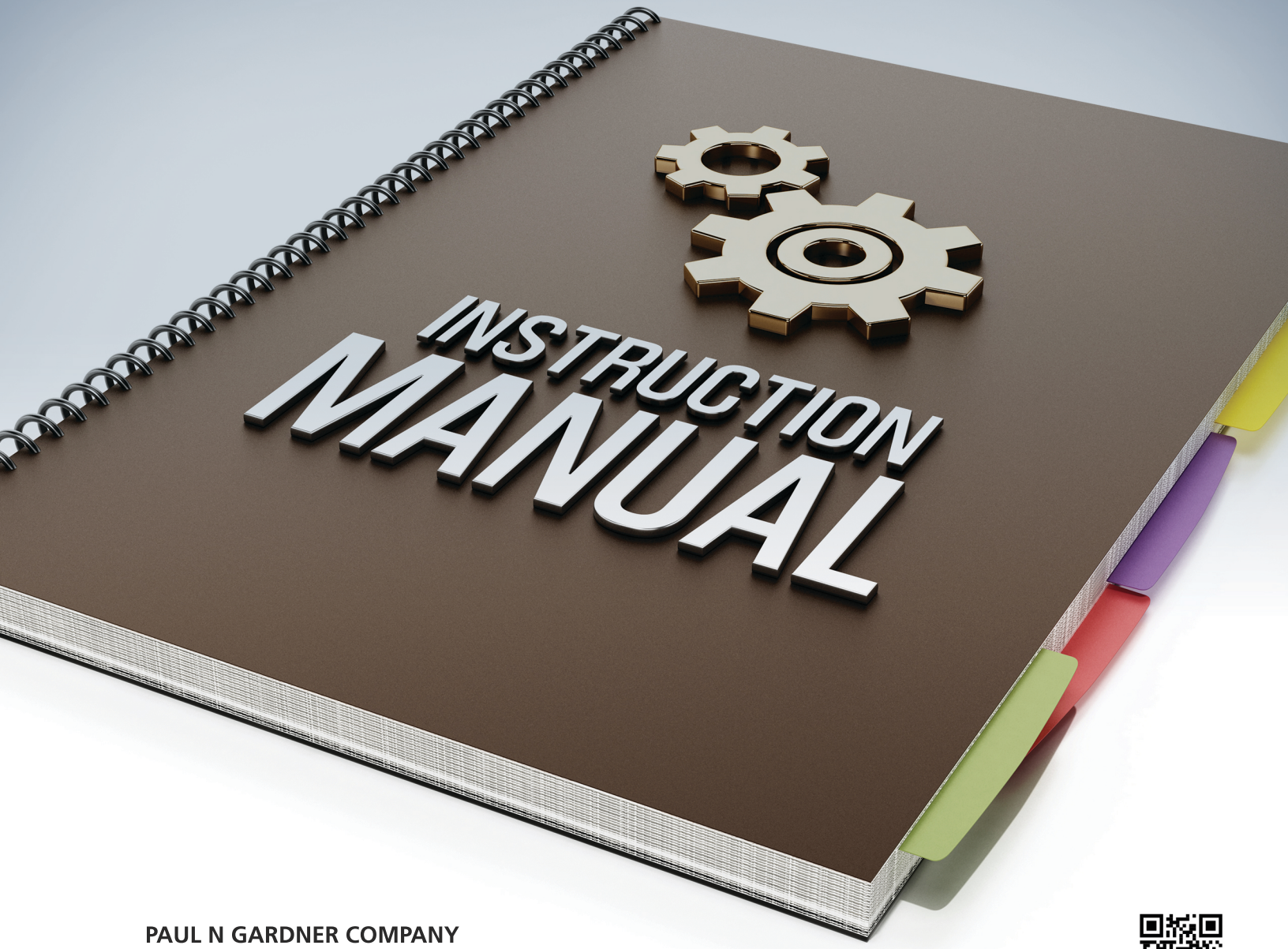

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INSTRUCTIONS

GARDCO DISTRIBUTED PRODUCTS

GARDCO®

WEIGHT PER GALLON DENSITY CUPS

STAINLESS STEEL SERIES 300

Made in the U.S.A. by Paul N. Gardner Company

Meets or exceeds: ISO 2811; DIN 53 2217; ASTM D1475

- Meet ASTM Methods of Test
- Qualify Under ANSI/NCSL Z540-1 as Applicable
- Conform to ISO 9000 when ordered with Calibration Certification
- Stainless Steel 300

Weight per Gallon Cups are used to quickly and accurately determine the weight per gallon, and also the specific gravity of paints, lacquer, pastes, semi-pastes, and other liquid or semi-liquid materials.

Until the middle of 1989, GARDCO weight per gallon cups were fabricated using Series 300 Stainless Steel for the sidewall and the easier machined but less corrosion resistant Series 400 Stainless Steel for the base and cover. Now, with the installation of state-of-the-art computer controlled metal cutting machinery, these cups are machined from Series 300 Stainless Steel solid bar stock.

FEATURES

- All surfaces are produced to a surface finish better than 32 RMS.
- Internal corners are rounded to a radius of no less than 0.188."
- Volume tolerance is within ± 0.5% of correct theoretical value.
- Volume certification qualifying under ANSI/NCSL Z540-1, as applicable, and conforming to ISO/IEC 17025 is available.
- Tare weights are Series 300 Stainless Steel, adjusted to within 0.2 gram of cup weight and sized for air cushioning when dropped into the cup for storage.

As a quality control check, errors in composition of a paint will usually be indicated by variations in the pycnometer value. In normal use in the Paint Industry, many specifications will allow a tolerance of about 0.2 pounds per gallon. Any deviation that is larger than this would make the paint suspect regarding the proper amount of ingredients in the batch.

DENSITY

GENERAL DIRECTIONS FOR USE

To check the actual capacity of your cup proceed as follows:

1. Determine the weight of a clean density cup in grams. As an alternative, the cup may be supplied with an accurate tare weight for use with two-pan laboratory balances. Note: Do not interchange tare weights between cups as each cup and tare weight is matched.
2. Remove cover of specific gravity cup and fill to within 1.7mm of rim with material to be tested.
3. Carefully replace cover so that the air and excess material is expelled through vent.
4. Wipe over cover to remove surplus and reweigh. By subtracting the original weight of the density cup, the weight of the contents will be found. If a tare weight was used at the start, the balance will show the weight of the contents. Clean thoroughly immediately after use.
5. By comparing a water sample at a temperature listed in the chart below verification of cup accuracy can be determined.

Temperature		Standard Grams	Mini Grams	British/100cc Grams	50cc Grams
C	F				
21	69.8	83.284	8.328		
22	71.6	83.266	8.327	99.998	49.999
23	73.4	83.246	8.325	99.975	49.987
24	75.2	83.226	8.323	99.950	49.975
25	77.0	83.205	8.321	99.925	49.962
26	78.8	83.183	8.319	99.899	49.949
27	80.6	83.161	8.316		

CUP FACTOR

Comparative results on different materials measured in the same cup are accurate to within the limits of accuracy of the balances used. Comparative results between cups may be somewhat improved by determining a cup factor as follows: Divide 83.205 by gram weight of water at 25°C (77°F). Example: if the cup actually holds only 83.000 grams, divide 83.205 by 83.000 which equals 1.0025. Multiply all cup readings by this factor of 1.0025. In the same manner if the cup holds 83.400 (grams) divide 83.205 by 83.400 which equals 0.9977. Multiply all readings by this factor of 0.9977.

CARE OF STAINLESS STEEL CUPS

There are numerous grades of Stainless Steel and all of them will corrode under adverse environmental conditions. A common type of Stainless Steel is the 300 Series which is most usually produced in sheets for forming into vats, kettles and the like. This series is highly resistant to corrosion under normal use conditions. It is very difficult, however, to machine this type where close tolerance and smoothness of finish are requirements.

Prior to the middle of 1989, Gardco weight per gallon cups were fabricated, using Series 300 Stainless Steel for the sidewall and the more easily machined, but less corrosion resistant, Series 400 Stainless Steel for the base and cover. Since then, with the installation of state of the art computer controlled metal cutting machinery, all Gardco weight per gallon cups are machined from Series 300 Stainless Steel solid bar stock.

With the exception of a daily cleaning, Gardco weight per gallon cups are essentially maintenance free If it is expected that a cup will be stored for an extended period of time, it is recommended that it be given a light coating of protective oil. With only these precautions, the cup should provide long and satisfactory service and retain its original attractive appearance.

REFERENCES

The information contained herein, or supplied by us or on our behalf in any other manner, is based on data obtained by our own research and is considered accurate. However, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA, THE RESULTS TO BE OBTAINED FROM THE USE THEREOF. This information is furnished upon the condition that the person receiving it shall make his own tests to determine the suitability thereof for his particular purpose. 13th Edition Paint Testing Manual by Gardner/Sward, Part 3, Physical Properties Chapter 3.1, Sect. 3.1.3 Weight Per Gallon. (A.S.T.M., 1916 Race St., Phila., PA 19103). FTMS 141c, Method 4183 "Specific Gravity of Solvents and Thinners". FTMS 141c, Method 4184.1 "Weight Per Gallon". ASTM D333 "Testing Clear Lacquers and Lacquer Enamels". ASTM D1475 "Density of Paint, Varnish, Lacquer and Related Products". ASTM D2205 "Traffic Paints, Recommended Practices for Testing". ASTM D2614 "Hiding Power of Chromatic Paints". ASTM D 2805 "Hiding Power of Paints". ASTM D 244 "Emulsified Asphalts", ASTM D1875 "Density of Adhesives in Fluid Form", ASTM D1875 "Standard Test Method for Density of Adhesives in Fluid Form".

U.S. STANDARD - WEIGHT PER GALLON DENSITY CUPS

STAINLESS STEEL SERIES 300

TECHNICAL DATA

Capacity: Accommodates 83.205 grams of water at 77.0° F (25.0°C)
Weight: Cup with Cover, approximately 130 grams.
Accuracy: ±0.5%

Relationships:
Pounds per U.S. Gallon = Gram Weight of U.S. Standard Cup Contents x 0.1000
Specific gravity = Gram Weight of Cup Contents x 0.01202
Measurements are normally made at a temperature of 77.0°F (25.0°C).

U.S. Standard Weight Per Gallon Density Cups
WG-SS-83.2 .... US Standard 83.2cc Weight Per Gallon Cup with Cover
WG-SS-83.2/T.. US Standard 83.2cc with Tare Weight to match weight of cup with Cover

MINI - WEIGHT PER GALLON DENSITY CUP

STAINLESS STEEL SERIES 300

TECHNICAL DATA

Capacity: Accommodates 8.3205 grams of water at 77.0° F (25.0°C)
Weight: Cup with Cover, approximately 56 grams.
Accuracy: ±1.2%

Relationships:
Pounds per U.S. Gallon = Gram Weight of Mini Cup Contents
Specific gravity = Gram Weight of Cup Contents x 0.1202
Measurements are normally made at a temperature of 77.0°F (25.0°C)

Mini Weight Per Gallon Density Cups
WG-SS-8.32 .... Mini 8.32cc Weight Per Gallon Cup with Cover

ISO DENSITY CUP S
WEIGHT PER GALLON DENSITY CUP

STAINLESS STEEL SERIES 300

- Made from corrosion resistant steel
- Compliant with ISO 2811 and DIN 53217 methods or ASTM D333, D1475, D2805
- Precisely made for maximum accuracy

TECHNICAL DATA

Volume: 50 ml
Weight: 0.23 kg (0.5 lbs)

ISO Density Cup S
1142..... 50cc ISO Density Cup S Weight Per Gallon Cup with Cover

BRITISH STANDARD
WEIGHT PER GALLON DENSITY CUP

STAINLESS STEEL SERIES 300

100cc British Standard Weight Per Gallon Cup with cover

TECHNICAL DATA

Capacity: 100cc accommodates 99.705 grams of water at 77.0° F (25.0°C)
Weight: Cup with Cover, approximately 143 grams.
Accuracy: ±0.5%

Relationships:

Pounds per British (Imperial) Gallon = Gram Weight of British Standard Cup Contents x 0.1
Specific gravity = Gram Weight of Cup Contents x 0.01001.
Measurements are normally made at a temperature of 77.0°F (25.0°C)

British Standard Weight Per Gallon Density Cups

WG-SS-100 ..... 100cc British Standard Weight Per Gallon Cup with Cover
WG-SS-100/T..... 100cc British Standard Weight Per Gallon Cup with Cover
with Matched Tare Weight

TARELITE - WEIGHT PER GALLON DENSITY CUP

ALUMINUM SERIES

Machined from solid stock, this extremely lightweight cup (less than 45 grams) is formed from high-tensile aluminum 6000 series alloy which combined with alodined coating provides great strength with lightness. Even when filled with a heavy pigment paint the total weight is well within the capacity of a 250 gram laboratory balance.

TECHNICAL DATA

Cup	Capacity	Accuracy	Approximate Weight
British Standard	100cc	± 1%	44g
U.S. Standard	83.2	± 1%	47g
50cc	50cc	± 2%	31g

U.S. Standard Weight per Gallon Cup:
Pounds per U.S. Gallon = Gram Weight of Cup Contents x 0.10000
Specific gravity = Gram Weight of Cup Contents x 0.01202

British Standard (100cc) Weight per Gallon Cup:
Pounds per British Gallon = Gram Weight of Cup Contents x 0.1000
Specific Gravity = Gram Weight of Cup Contents x 0.01001
Grams per liter = Weight of contents (in grams) x 10
Kilograms per Liter = Weight of contents (in grams) ÷ 100

(50cc) Weight per Gallon Cup:
Pounds per British Gallon = Gram Weight of Cup Contents x 0.2
Specific Gravity = Gram Weight of Cup Contents x 0.02
Grams per liter = Weight of contents (in grams) x 20
Kilograms per Liter = Weight of contents (in grams) ÷ 50

Tarelite Weight Per Gallon Density Cups
WG-AL-83.2..... U.S. Standard (83.2cc) Weight Per Gallon Cup with Cover
WG-AL-100..... British Standard (100cc) Weight Per Gallon Cup with Cover
WG-AL-50..... British Standard (50cc) Weight Per Gallon Cup with Cover

Although Paul N. Gardner Company, Inc. has attempted to provide accurate information, the Paul N. Gardner Company, assumes no responsibility for the accuracy of the information.

DETERMINING DENSITY OF VISCOUS MATERIALS

written by Maynard R. Euverard
(former Consultant to Paul N. Gardner Company)

Density (weight per unit volume) is one of the most important physical properties of coating materials and other liquids and semiliquids. Density is important because it is a first-line indication of the ratios of components that make up a material. Many materials are formulated and produced by weight and sold by volume.

Accurately determining the density of nonviscous liquids is usually straightforward, involving weighing a standard volume of the material. These nonviscous materials do not entrap air; the air rises and breaks free at the surface. However, if the material is viscous, the arrived-at density can be inaccurate. Viscous materials can entrap air, causing false volume readings.

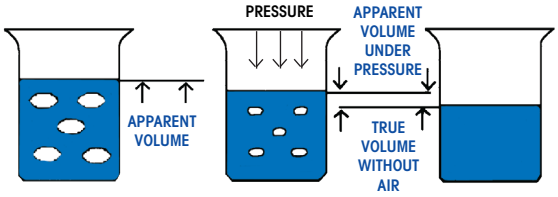

Figure 1
This drawing illustrates how entrapped air can give false volume (and density) readings for a viscous material even when compressing the material.

The false apparent volume of a viscous material containing entrapped air is depicted in Figure 1. If pressure is exerted onto the material, the apparent volume will decrease due to compression of the entrapped air. The material's true volume would be without the entrapped air.

The density in pounds per gallon of nonviscous materials can be found readily using a standard "weight-per-gallon cup" and a scale capable of reading to the nearest tenth gram. The most widely accepted such cup accommodates a weight of distilled water at 77°F of 83.2 g. To convert the gram weight of the cup's contents to pounds per gallon, it is necessary only to divide by 10 (move the decimal one place to the left). This is because the absolute density of water at 77°F is 8.32 lb/gal.

Diluting and mixing

The accurate volume determination of a viscous material with entrapped air can be determined by a method that involves diluting and mixing a sample of the material with an acceptable diluent (thinner). This diluting and mixing frees the viscous material sample of entrapped air. A standard weight-per-gallon cup can be filled with the diluted and mixed material and weighed (Figure 2).

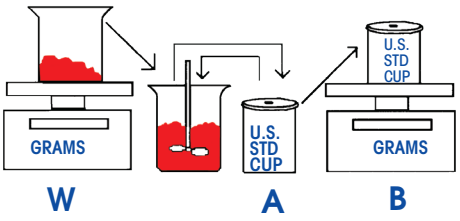

Figure 2
The procedure to determine the density of a viscous material with entrapped air is illustrated in these drawings. Mixing a diluent (A) with a sample of the viscous material (W) frees the entrapped air. The weight-per-gallon cup (B) contains a level-full amount of the diluent-viscous material mixture.

DENSITY

The true weight per gallon of the viscous material without entrapped air can then be calculated from the formula below.

$$X = \frac{W \times B}{W + A - (10 \times B)}$$

X is the unknown lb/gal density of the viscous material.
W is the measured gram weight of the viscous material sample.
A is the gram weight of the diluent from a full weight-per-gallon cup.
B is the lb/gal of the mixture of unknown material and diluent of a full weight-per-gallon cup.
10 is the multiplier to convert "B" into gram weight of a filled weight-per-gallon cup of the viscous material.

Proof of the formula is as follows:

$$\text{lb/gal} = \frac{\text{grams} \times \text{lb/gal}}{\text{grams} + \text{grams} - (K \times \text{lb/gal})}$$

lb/gal = grams/10 This is the cup conversion factor.
Substituting the conversion factor in the original formula:

$$\text{grams/10} = \frac{(\text{grams} \times \text{grams/10})}{\text{grams} + \text{grams} - K \times \text{grams/10}}$$

K is the conversion factor equal to 10.
Substituting 10 for K:

$$\text{grams/10} = \frac{\text{grams} \times \text{grams/10}}{\text{grams} + \text{grams} - \text{grams}}$$

grams/10 = grams/10
1 = 1

The method has been confirmed in the laboratory by using two materials of widely different densities. The amount of the unknown material (W) was varied greatly. The calculated weight per gallon (X) throughout the range of 25 to 125 grams of the unknown was always within 0.5% of the known true value.

The weight-per-gallon cups are available in corrosion-resistant materials. One such cup (Figure 3) is produced with a sidewall of series 316 stainless steel and a machined bottom and closely fitting lid of series 416 stainless steel. A radiused area where the bottom is secured to the sidewall provides ease of cleaning. The lid is formed with a small opening to permit discharge of excess material to ensure exact specified volume of the cup contents. The cups are warranted to be within 0.5% of specified volume. Cups are available that qualify for volume certification under MIL-STD-45662 and exceed the requirements of ASTM methods.

Cups of other volumes are available, including a "mini" cup that is one-tenth the U.S. standard cup. Another cup readily converts pounds and imperial gallons. These cups can also be used in this indirect computational method of measurement provided the correct multiplier is used in the equation for "B".

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