Terminals: Two gold-plated GR874® locking connectors, easily adapted to other common connector types (on air-bath version, connectors can be moved to rear).

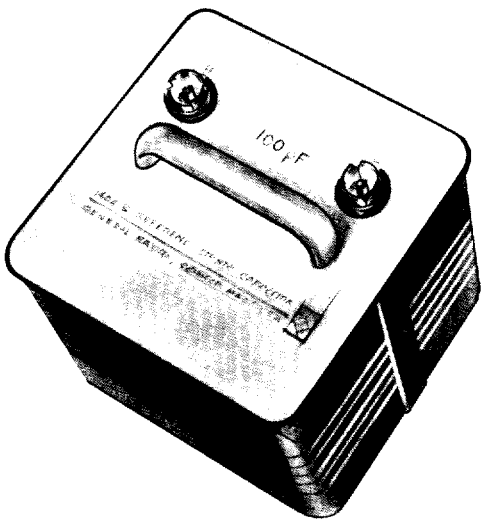
Available: GR874 ADAPTORS, 874-R22LA PATCH CORDS.

General: Fused-silica dielectric; plated substrate is hermetically sealed in a dry-nitrogen-filled stainless-steel case. Connections to the air-bath version can be made to the front or the rear as your application dictates. A 12-volt input is provided to maintain a constant air-bath temperature even while the unit is in transit.

Power (Air-bath version only): 100 to 120 or 200 to 240 V, 50 to 60 Hz, 5 W; 12 V at 0.4 A for dc operation, battery connectors provided on rear.

Mechanical: DIMENSIONS (wxhxd): Air-bath version 8.42x 8.72x16 in. (214x222x407 mm); oil-bath version, 3.5x11.1x 1.86 in. (89x283x48 mm). WEIGHT: Air-bath version (single value), 23 lb (11 kg) net, 32 lb (15 kg) shipping; (two values), 25 lb (12 kg) net, 34 lb (16 kg) shipping; oil-bath version, 3 lb (1.4 kg) net, 7 lb (3.2 kg) shipping.

Description	Catalog Number
Reference Standard Capacitor, air bath	
1408, 10 pF	**1408-9700**
1408, 10/10 pF	**1408-9702**
1408, 100 pF	**1408-9703**
1408, 100/100 pF	**1408-9705**
1408, 10/100 pF	**1408-9706**
Reference Standard Capacitor, oil bath	
1408-A, 10 pF	**1408-9701**
1408-B, 100 pF	**1408-9704**



1404 Reference Standard Capacitor

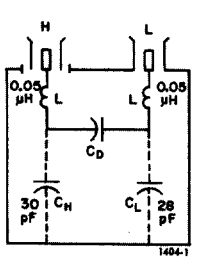
- **10, 100, 1000 pF**
- **20 ppm/year stability**
- **3-terminal, coaxial connections**
- **hermetically sealed in dry nitrogen**

These capacitors have been designed as primary reference standards of capacitance with which working standards can be compared. The 1615-A Capacitance Bridge is particularly well suited for this purpose and can be conveniently used to calibrate accurately a wide range of working standards in terms of a 1404 Reference Standard Capacitor. A single 1000- or 100-picofarad standard is also the only standard necessary to calibrate the bridge itself.

In combination with an accurately known external resistor, this capacitor becomes a standard of dissipation factor.

All critical parts of the plate assembly are made of Invar for stability and low temperature coefficient. After heat cycling and adjustment, the assembly is mounted in a heavy brass container, which, after evacuation, is filled with dry nitrogen under pressure slightly above atmospheric and sealed. The container is mounted on an aluminum panel and protected by an outer aluminum case. Each capacitor is subjected to a series of temperature cycles to determine hysteresis and temperature coefficients and to stabilize the capacitance.

Two locking GR874® coaxial connectors are used as terminals. The outer shell of one is connected to the case, but the outer shell of the other is left unconnected to permit the capacitor to be used with an external resistor as a dissipation-factor standard.



Equivalent circuit showing direct capacitance, C_D, and average values of residual inductance, L, and terminal capacitances, C_H and C_L. C_D = 1000 pF for 1404-A, 100 pF for 1404-B, and 10 pF for 1404-C.

SPECIFICATIONS

Calibration: A certificate of calibration is supplied with each capacitor, giving the measured direct capacitance at 1 kHz and at 23° ±1°C. The measured value is obtained by a comparison to a precision better than ±1 ppm with working standards whose absolute values are known to an accuracy of ±5 ppm, determined and maintained in terms of reference standards periodically measured by the National Bureau of Standards.

Adjustment Accuracy: The capacitance is adjusted before calibration with an accuracy of ±5 ppm to a capacitance about 5 ppm above the nominal value relative to the capacitance unit maintained by the General Radio reference standards.

Stability: Long-term drift is less than 20 parts per million per year. Maximum change with orientation is 10 ppm and is completely reversible.

Temperature Coefficient of Capacitance: 2 ± 2 ppm/°C for 1404-A and -B, 5 ± 2 ppm/°C for 1404-C, from −20°C to +65°C. A measured value with an accuracy of ±1 ppm/°C is given on the certificate.

Temperature Cycling: For temperature cycling over range from −20°C to +65°C, hysteresis (retraceable) is less than 20 ppm at 23°C.

Dissipation Factor: Less than 10^{-5} at 1 kHz.

Residual Impedances: See equivalent circuit for typical values of internal series inductances and terminal capacitances.

Max Voltage: 750 V.

Terminals: Two locking GR874 coaxial connectors; easily convertible to other types of connectors by attachment of locking adaptors. Outer shell of one connector is ungrounded to permit capacitor to be used with external resistor as a dissipation-factor standard.

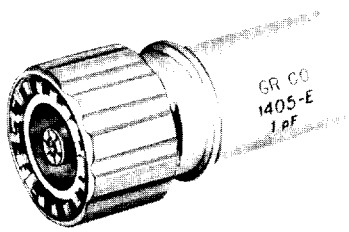
Required: For connection to 1615-A Capacitance Bridge, 2 Type 874-R20A or 874-R22LA Patch Cords.

Mechanical: Lab-bench cabinet. DIMENSIONS (wxhxd): 6.75x 6.63x8 in. (172x169x204 mm). WEIGHT: 8.5 lb (3.9 kg) net, 14 lb (6.4 kg) shipping.

Description	Catalog Number
Reference Standard Capacitor	
1404-A, 1000 pF ◈	**1404-9701**
1404-B, 100 pF	**1404-9702**
1404-C, 10 pF	**1404-9703**

1405 Coaxial Capacitance Standards

- **1 and 10 pF**
- **rf standards**
- **GR900® connectors**



Extending the available values of rf capacitance downward, the 1405 standards permit impedance-measuring instruments to be calibrated at even higher frequencies accurately and with traceability to the National Bureau of Standards.

Accuracy is stated two ways. The first refers to nominal capacitance and includes initial adjustment, aging, and other effects. The second refers to the individual calibration and certificate.

SPECIFICATIONS

Calibration: A certificate of calibration is supplied with each unit, giving the measured capacitance at 1 kHz and at a specified temperature and relative humidity. The measured capacitance is the capacitance at the reference plane of the GR900 connector. This value is obtained by comparison, to a precision better than ±0.002 pF, with working standards whose absolute values are known to an accuracy typically ±0.02%, determined and maintained in terms of reference standards periodically calibrated by the National Bureau of Standards.

		1405-B, 10 pF	1405-E, 1 pF
Accuracy at 23°C		±0.2% (0.02 pF)	±0.5% (0.005 pF)
Calibration Accuracy		±0.04%	±0.2%
Stability	vs temperature, 10-70°C	−0.004%/°C	−0.01%/°C
	vs humidity, <90% RH	——	+0.005%/% RH
	vs aging	<0.1%/yr	<0.3%/yr
Frequency	0.1% C increase	40 MHz	120 MHz
	10% C increase	0.4 GHz	1.7 GHz
Residuals	D at 1 kHz, <50% RH	$<150 \times 10^{-6}$	$<100 \times 10^{-6}$
	insulation R	$>10^{12}$ Ω at 23°C and <50% RH	
	equivalent L	1.6 nH at <250 MHz	1.8 nH at <500 MHz
Peak Volts		1 kV	3 kV

Available: ADAPTORS 1615-P2 for calibrating with GR 1615 bridge and 900-Q9 for connecting standard to ¼-inch x 28 threaded stud (GR 938 Binding Post) or tapped hole.

Terminal: GR900 precision coaxial connector.

Mechanical: DIMENSIONS (dia x h): 1.06x2.32 in. (27x59 mm). WEIGHT: 4 oz (103 g) net, 5 oz (142 g) shipping.

Description	Catalog Number
Coaxial Capacitance Standards	
1405-B, 10 pF	**1405-9703**
1405-E, 1 pF	**1405-9700**

◈ Federal stock numbers are listed before the Index.