Model 7334 Series

AC/DC Precision Resistance Standards

Operator Manual

OM7334-D2-00
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Table of Contents

List Of Figures

List Of Tables

1.0 INTRODUCTION

This manual provides an overview of the 7334 Series of Air Resistance Standards and also contains the necessary information required to perform a calibration or verification test. General product information, description of case styles and performance specifications are also included.

This manual applies to all models of the 7334 Series of Resistance Standards unless otherwise noted. This includes custom values that are ordered.

The phone number in the USA and Canada to obtain Product Support, Calibration Service or Replacment Parts is (800) 310-8104.

To Contact Guildline Instruments, the following information is provided.

USA and Canada Telephone: (613) 283-3000
USA and Canada Fax: 1-613-283-6082

Outside US and Canada Telephone: + [0] [1] 613 283-3000
Outside US and Canada Fax: + [0] [1] 613 283-6082

You can also contact Guildline Instruments Limted via their Email or Websites.

Email is: sales@guildline.com
Website is: www.guildline.com

1.1 Unpacking and Inspection

Every care is taken in the choice of packing material to ensure that your equipment will reach you in perfect condition. If the equipment has been subject to excessive handling in transit, there will probably be visible external damage to the shipping carton.

In the event of damage, the shipping container and cushioning material should be kept for the carrier's inspection.

Carefully unpack the equipment and check for external damage to the standard. If the shipping container and packing material are undamaged, they should be retained for use in return shipments. If damage is found notify the carrier and Guildline immediately.

1.2 Warranty

Guildline Instruments warrants its products to be free of defects in manufacture and normal operation for a period of two (2) years from the date of purchase, except as otherwise specified. This warranty applies only in the country of original purchase and only to the original purchaser, who is also the end user. Equipment, which is defective or fails within the warranty period, will be repaired or replaced at our factory without charge at the discretion of Guildline Instruments.

In addition, standards and systems manufactured by Guildline Instruments are warranted to be free of defects in overall system operation for a period of two (2) years from the date of receipt by the original purchaser.

Third party system components purchased by Guildline carry the warranty of the original equipment manufacturer and will be accepted for claim by Guildline Instruments at our factory only after warranty authorization by the original manufacturer.

Limitation of Warranty

Warranty coverage does not apply to equipment which has failed due to misuse, neglect, accident or abnormal conditions of operation or if modifications or repairs have been made without prior written authorization of Guildline instruments.

Temperature probes are not warranted against failure due to mechanical shock.
Fuses, lamps and non-rechargeable batteries are not warranted against breakage.

Damage in Shipment to Orignal Purchase

Instrument(s) should be thoroughly inspected immediately on receipt for visible damage. Any damage should be reported to the carrier and further inspection and operational tests should be carried out if appropriate to determine if there is internal damage. Contact Guildline Instruments before returning for repair. The Customer or purchaser must complete all final claims with the carrier.

Regular charges will apply to non-warranty service. External service charges and expenses will be billed at cost plus handling. To Obtain Warranty or Calibration and Repair Service.

Call for a Return Material Autorization (RMA) number. RMA's are required for all Warranty Returns and/or Calibration and Repair Service Requests. Telephone, Fax and email addresses to contact Guildline are provided in a previous section of this Manual.

Guildline Instruments will pay for all warranty costs including shipping from Guildline to the original shipment point. However, if the instrument is purchased within one country and shipped to another, Guildline will only pay for shipping to the original ship to country or customer point. The customer is responsible for paying for the shipping costs to return an item to Guildline.

USA Warranty Return Address.

USA Customers should use the following address to return instruments for warranty service or calibration support.

Guildline Instruments Limited
C/O AN Deringer
835 Commerce Park Drive
Ogdensburg, NY 13669

Mark on the outside of the box:
RMA # _____
Model #_____
Serial #_____
The Statement: "Canadian manufactured goods being returned for repair."

For all other countries, including Canada please ship to:

Guildline Instruments Limited
21 Gilroy Street, PO Box 99
Smiths Falls, ON K7A 4S9

Mark on the outside of the box:
RMA # _____
Model #_____
Serial #_____
The Statement: "Canadian manufactured goods being returned for repair."

1.3 Safety Information

These Standards can be used with Equipment capable of voltages up to 32 V. The operator should be aware of the environment in which these standards are used.

WARNING: Use caution when working with voltages above 30 V ac rms, 42 V ac peak, or 42 V dc. These voltages pose a shock hazard.

The 7334 Resistance Standards are designed to work within specifications at 1 mW to 10 mW of power with a maximum of 100 mW of power and 32 Vdc or less. Applying more than the recommended power or voltage will damage the unit and voids the warranty.

Do not use the Resistance Standard in wet environments.

Never use the Resistance Standard with the cover removed or the case open.

When making electrical connections, connect the common test lead before connecting the live test lead; when disconnecting, disconnect the live test lead before disconnecting the common test lead.

Inspect the Resistance Standard for damage such as cracked connectors prior to use. If unit has a burned smell or smoke is visible during use, discontinue use immediately.

If test equipment used with Resistance standards overloads or trips, this could be a sign that the resistance standard requires repair..

Inspect all test leads used with the Resistance Standard for damaged insulation or exposed metal. Check all test leads for continuity.

Ensure all test leads are correctly connected prior to applying current or voltage.

Do not use resistance standards around explosive gas, vapor or dust.

2.0 7334 SERIES STANDARD SPECIFICATIONS

2.1 7334 Model Series Uncertainty Specifications

Table 2-1 shows the specificatons for the 7334 series. For custom models, please consult your calibration certificate to determine stabilities and maximum limits.

Table 2-1 : 7334 Model Series Uncertainty Specifications

7334 SPECIFICATIONS							
Model (Nominal Ω)	Nominal Value (Ω)	Initial [1,2] Tolerance ± μΩ/Ω	Stability[3] *2.1.1.1.1.1.1.1*	Typical AC/DC Difference @ 1kHz (±μΩ/Ω)	Maximum Excitation Current (dc)	Temperature Coefficient [4] ± μΩ/Ω / °C	
						Air	TC (Chamber)
7334-1	1	2	2.5	<3.0	316 mA	0.2	0.005
7334-2.5	2.5	2	2.5	<3.0	200 mA	0.2	0.005
7334-10	10	2	2.5	<1.0	100 mA	0.2	0.005
7334-25	25	2	2.5	<1.0	64 mA	0.2	0.005
7334-100	100	2	2.5	<1.0	32 mA	0.2	0.005
7334-400	400	2	2.5	<1.0	16 mA	0.2	0.005
7334-1k	1k	2	2.5	<1.0	10 mA	0.2	0.005
7334-10k	10k	2	2	<1.0	3.2 mA	0.2	0.005
Special Values Available on Request (in the range of 1 Ω to 10 kΩ)							

Note 1: Nominal initial tolerance is defined as the maximum variation of resistance mean values as initially adjusted at the point of sale.

Note 2: Calibrated in air at 23 °C traceable to the SI unit of electric resistance, calibration uncertainties expanded and expressed at the 95 % level of confidence. An ISO/IEC 17025 accredited certificate and report of calibration stating the calibrated value and estimated uncertainty is provided with each resistor.

Note3: Initial 12-month drift is for after the first year of ownership. The initial 12-month drift is higher due to stabilization of elements.

Note 4: Temperature hysteresis: < 0.3 μΩ/Ω between 0 °C and 40 °C and Voltage hysteresis: negligible to < 0.1 μΩ / V. When placed inside an enclosed Temperature Chamber (7334TC), the temperature coefficient is reduced by a factor of x 40 (eg 10 kΩ would = 0.005 μΩ/Ω / °C).

For AC/DC Oil Based Resistance Standards please refer to Guildline's 7330 Resistance Standards. For DC Resistance Standards, please refer to the Guildline 9330A, 9334A, 9336, 9337, 6634A and 6636 Series of Standards.

2.2 General Specifications

7334 AND 7334-TC GENERAL SPECIFICATIONS								
Environmental	Temperature				Humidity			
Operating	18 °C to 28 °C				<70% RH non-condensing			
Storage	-20 °C to 60 °C				15% to 80% RH			
Dimensions	Height		Width		Length		Weight	
	mm	Inches	mm	Inches	mm	Inches	kg	lbs
Air (All Values)	88	3.8	124	4.9	79	3.1	0.6	1.4
Temperature Chamber (TC) Model	132	5.2	440	17.4	503	19.8	11	24
Power (TC Model Only)	VAC: 100, 120, 220, 240V ± 10%, Frequency: 50/60 Hz ± 10%, 15 VA Maximum							

3.0 OVERVIEW

3.1 General

The Guildline Model 7334 series of Resistance Standards are designed as very stable calibration laboratory standards for high accuracy resistance calibration in air, between 1 Ω and 10 kΩ, without the need for stabilization in a temperature controlled bath (see Figure 3-1). If necessary, the ambient temperature adjacent to the enclosure may be monitored, and a correction factor applied to the value of the resistance. These standards are designed for use in AC applications as well as DC.

Figure 3-1: 7334 Series

The 7334 Resistance Standards are very accurate (i.e. low uncertainty) air resistannce standards. During manufacturing, the temperature coefficients are verified by using a primary level Direct Current Comparator Bridge and an air or oil bath. This ensures that the resistance standard meets the published temperature coefficient specification over the standards recommended range. For example at 10 kΩ, with a wide laboratory environment of 23 °C ± 3 °C, the worse case effect due to temperature will be a remarkable 0.2 ppm!

The 7334 Series can be used as working standards, or highly reliable and rugged transportable transfer standards. They are extremely useful for the calibration of the resistance ranges of multi-function calibrators and high accuracy digital multimeters, as well as for use in more classical standards and calibration laboratory applications where the need for high accuracy resistance values are required.

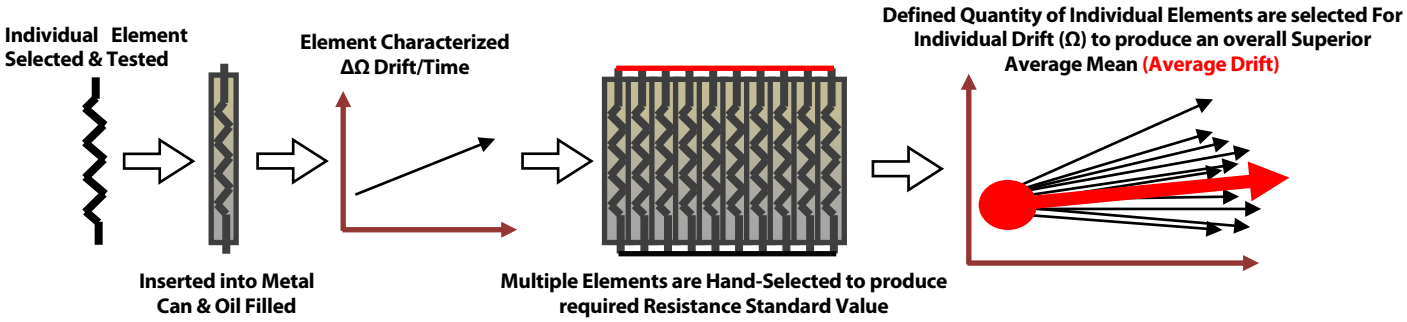
Models are also available to verify Temperature Measurement instruments such as Super Thermometers. Special Standard values such as 25 Ω and 400 Ω are available for precision thermometry applications.

The design of Guildline's 7334 Series Resistance Standards is based on over 69 years of innovation, design knowledge, and manufacturing experience in building resistance standards. Guildline resistance standards are made with multiple elements in parallel or series rather than using a single element as per competitive products.

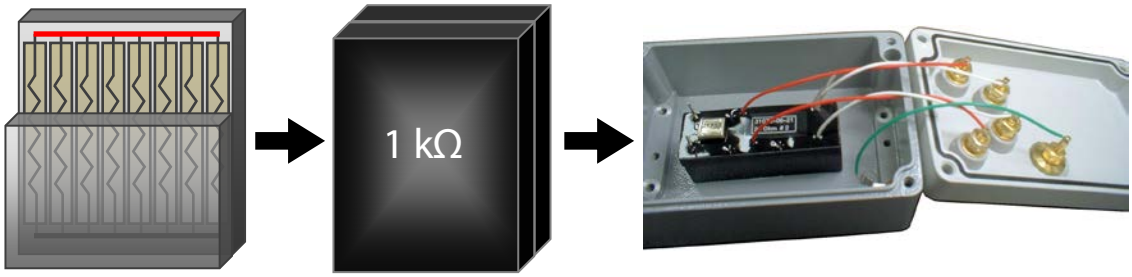
This approach lowers the drift that is seen with a single element and reduces the internal noise generated inside the reference resistor. The result is industry leading annual drift rates.

The design starts with every resistance element going through an exacting process that ensures quality and long term stability. This process is diagrammed as shown:

Figure 3-2: Resistance Element Build Up



The multiple elements are sealed in epoxy for protection against humidity, are bonded to a thermal block, and are placed into the provided EMI shielded outer case with high quality terminals attached.



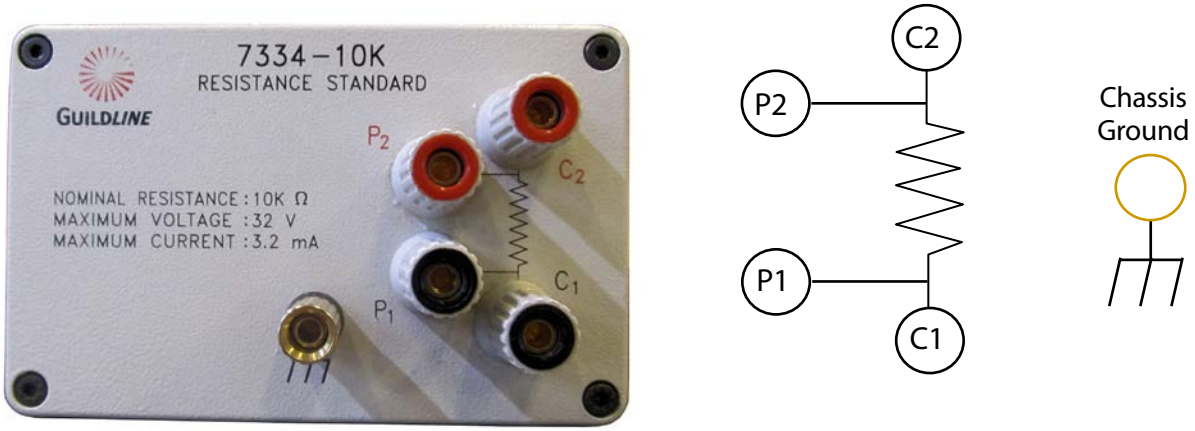
Guildline standards are the best by design and by manufacture. One key advantage of Guildline Resistance Standards is that each Resistance Value is made up from multiple resistance elements, not just a single element which is the technique used by most manufacturers.

3.2 Series Design Layouts

3.2.1 1 Ω to 10 kΩ Standard Values

The resistor elements are securely mounted to the inside of a hermetically sealed aluminum enclosure. Five binding post connections on the top of the resistance standard are provided (refer to Figure 3-3). The C1 and C2 connections are used to apply the test current or voltage to the resistor. The P1 and P2 connections are used to measure the voltage drop and thus the resistance. The fifth connection is for chassis ground.

Figure 3-3: 7334 Series from 1 Ω to 10 kΩ



3.3 Custom Values

Any custom value is available upon request. For custom values, to determine the uncertainy, contact Guildline Instruments. Actual uncertainties and measurements will be listed on the ISO/IEC 17025 Calibration Certificate.

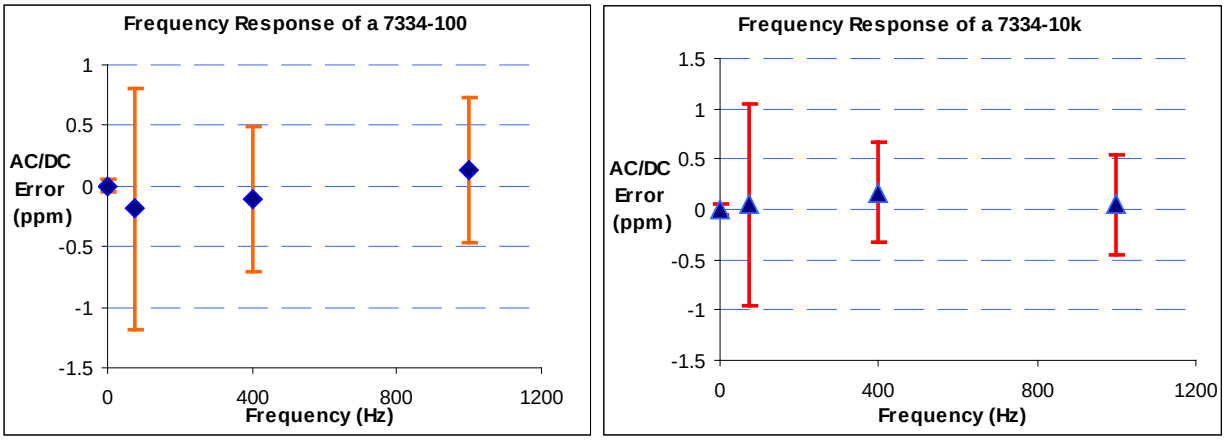
3.4 AC Characteristics

The impedance of the resistor is expressed as:

$$\mathbf{Z(f) = R(f) \cdot (1+}j\mathbf{\cdot\, 2\pi f\tau)}$$

Where *R(f)* is the real part of the impedance, *f* is the frequency in Hz and τ is the time constant of the standard. Parameter R(0) is the resistance measured with DC energisation. The 7334 standards have very flat frequency response. The resistive component is virtually independent of frequency, with far less than 0.8 ppm of AC/DC difference between DC and 1000 Hz (1 kHz). The 7334 series of standards are almost purely resistive with very small time constant. For a 7334-100Ω, the time constant is typically less than 10 ns.

Figure 3-4: AC/DC error of a 7334-100Ω and a 7334-10kΩ
Calibrated by UK National Physical Laboratory (NPL)



The AC/DC difference is so insignificant that it is almost negligible, when compared to measurement noise. A user can confidently use the Guildline model 7334 for DC resistance calibration, as a reference with an AC temperature bridge, as an AC impedance standard, or elsewhere in AC/DC metrology that calls for a stable, precision standard.

4.0 CALIBRATION AND PERFORMANCE VERIFICATION

4.1 Introduction

The following section describes the calibration and performance verification procedures for the 7334 Series of Resistance Standards. It is recommended that Resistance Standards be calibrated at 10 mW of power or less. The listed points in Table 4-1 are for 10 mW of Power for most values.

4.2 Calibration Overview

This calibration procedure covers the entire range of the 7334 Series of Resistance Standards. Resistance values in the range 1 Ω to 10 kΩ with currents less than 145 mA. Values in this range are calibrated in controlled air environment at 23 °C. These values are in a DCC Bridge current mode of operation.

4.3 Calibration Interval and Performance

It is recommended that the 7334 series be calibrated or verified on the manufacturer's recommended 12 month interval. As with all resistance standards it is highly recommended that past history be used to determine drift rates. Generally, resistance standards will drift in value more significantly in the first 12 months. After the initial 12 months, drift rates typically become smaller for all models.

It is highly recommended that each 7334 Series be calibrated within a highly controlled temperature environment.

Each 7334 is manufacturered to provide some of the best (i.e. lowest) uncertainies when compared to other commercially available resistance standards. After recalibration the user should determine the Resistance Calibration Uncertainties by applying an uncertainty calculation that includes: uncertainties for drift, standards and equipment used; the calibration and laboratory enviroment; and other uncertainties appplicable to that calibration.

Guildline offers ISO/IEC 17025 Accredited DC Resistance Calibration Services from its Smiths Falls, Canada Location. We can provide very good turn-around times with some of the lowest uncertainties available today. 7334 Users may find the use of Guildline Calibration Services an excellent convience as well as a great alternative to maintaining their own calibration facilities to support these standards. US customers can ship to a US address and Guildline makes all of the arrangements for shipping to and from Canada and for inport and export.

4.4 Calibration Temperature Point

The 7334 Series of Resistance Standards are normally calibrated at 23°C. The Guildline Instruments 5032 Temperature Air Bath (shown to the right) is recommended to provide the best calibration environment for "air-style" Resistance Standards. This Standard Laboratory Grade Air Bath maintains the temperature environment around the resistance standard to ± 0.03°C of set point and also provides a highly desirable RF and EMI Shielded environment.

The calibration currents or voltages points for each standard value is listed in Table 4-1.

Additional Temperature Points such as 21°C and 25°C can be achieved using the model 5032.

5032 Programmable Temperature Air Bath Shown

4.5 Equipment and Standards Required for Calibration

The following Resistance Standards and Test Equipment are required for calibration.

4.5.1 Normal Ohms Calibration Standards (1 Ω to 10 kΩ)

Note: Normal Ohms Resistance – 4-Wire resistances in the range 1 Ω to 10 kΩ with currents less than 145 mA. Values in this range are calibrated in a controlled temperature air environment at 23 °C.

Use Standards:

Complete 6625A Resistance Measurement System (See Below for Alternative Acceptable Equipment Models).

5032 Laboratory Grade Temperature Air Bath

(a) 5032 Series Laboratory Grade Temperature Air Bath

(b) Direct Current Comparator Resistance Bridge (Acceptable Models)

Guildline Instruments 6622A Series DCC Resistance Bridge
Guildline Instruments 6675 or 6675A Series DCC Resistance Bridge
Guildline Instruments Model 9975A Resistance Bridge

(c) Laboratory Grade Primary Resistance Standard (Acceptable Models)

Guildline Instruments 6634A Temperature Stabilized Resistance Standard
Guildline Instruments 6634TS Traveling Standard (Temperature Stabilized)

Guildline Instruments 7334 Standards maintained in a Guildline 5030 Air Bath

Guildline Instruments 7330 Oil Standards maintained in a Guildline Oil or Fluid Bath

(d) Low Thermal Lead Sets or Low Thermal Wire (Acceptable Models)

Guildine 6675A-12 : Precision Lead Set For Resistance Bridge
SCW-30:18AWG : 18 Guage Low Thermal Wire

(e) Optional (For Automation and Connections)

Guildline 6664B/C 4-Wire, 8 or16 Channel Low Thermal Scanner (For Automation)
Guildline Bridgeworks Software
Digital Thermometer (Acceptable Guildline Models 9535, 9540A, 9540B, 9540 or 5150)

Or (Alternative Standards)

4.6 Routine Calibration

This routine calibration procedure describes the calibration currents and/or voltges required for the 7334 Resistance Standards. The procedure is intended to be used as a reference for qualified metrology personnel who have a primary level standards laboratory with equipment available to support an instrument of this level of standards accuracy.

Qualified personnel means that the technician or metrologist performing the calibration has the necessary level and understanding on Direct Current Comparator Resistance Measurements and full understanding of the DCC Bridge operation's and will take precautions to avoid introducing errors from sources such as guard errors, thermal emfs, temperature and or EMI errors, connector and lead errors, and other sources of measurement errors. The procedure assumes operators will make adequate allowance for equipment stabilization and measurement settling times.

For the best uncertainties with least influence on the measurements, it is recommended that the procedure use automation technologies such as Bridgeworks Software, IEEE Control and a 6664B/C Low Thermal Scanner.

Calibration Notes For All Models

Always check availability of equipment and standards prior to starting the calibration If the required equipment is not available, do not proceed with the calibration.

Ensure all equipment used is within the calibration validity interval.

Before beginning the calibration, inspect the UUT and all leads for damage and cleanliness. If the UUT is not in suitable condition for calibration, please clean or repair before proceeding.

Most of Table 4-1 recommended calibration points are for 10 mW of Power. For higher values (when Bridge is used in Voltage Mode), points listed may be less than 1 mW due to limitations of the Bridge and/or usage factors. While Table 4-1 lists recommeded calibration points, actual calibration points should include consideration for the intended and/or application of the resistance standards.

Table 4-1 : List of Recommended Test Currents or Voltages For Resistance Values

7334 Model/Value	Recommended Current	Foot Note	Comments
7334-1	100 mAdc	1	
7334-2.5	65 mAdc	1	
7334-10	31.6 mAdc	1	
7334-25	20 mAdc	1	
7334-100	10 mAdc	1	
7334-400	5 mAdc	1	
7334-1k	3.16 mAdc	1	
7334-10k	1 mAdc	1	

1 – Can use any of the recommended Bridges

2 – Optional Calibration Points (if listed) can be used in place of the standard calibration point or added to the standard point for calibraiton.

4.7 Calibration Procedure

(a) Place 7334 into 5032 Temperature Stabilized Air Chamber.

(b) Setup DCC for appropriate measurement (refer to Standards Manuals used).

(c) Set chamber temperature to 23 °C and allow to stabilize a minimum of 12 hours.

(d) While Stabilizing record last calibration date and values as listed in Table 4-2.

(e) While Resistor is stabilizing, set bridge to appropriate settings as refered to in the operators manual for the DCC Bridge that is being used.

(f) After equipment, and readings have stabilized, record the resistance in Table 4-2 reading for temperature of 23 °C in the column for Temp Value.

(g) When all readings are recorded, go to Data Evaluation and Uncertainty Calculation.

Note: Measurement Tips.

Consider the following when setting up the measurement

Verify that the maximum voltage or current applied in the measurement will not exceed the specs for the UUT or the STD. In no case should you exceed 100 mW of applied power.

Verify the reversal rate is appropriated for the measurement and the uncertainty desired.

Ensure that you know whether the measurement you are reading on the Bridge is either a ratio or actual ohms value.

If using a PC, verify that the number of samples and logging delay are appropriate.

If using a PC set the environmental parameters in BridgeWorks .

Verify guard and ground connections (see 6622A Manual).

If using a Scanner, ensure that the proper channels for Rx and Rs are selected.

Table 4-2 : Calibration Data Worksheet

7334 Model ►		Serial Number ►	
		LAST CALIBRATION	**CURRENT CALIBRATION**
Calibration Dates ►			
Applied Current (Table 2) ►			
Current (I^2R)	Calculated Power ►		

		LAST CALIBRATION	**CURRENT CALIBRATION**
Actual Readings	Temp Value 23 °C ►		

Drift Specifcation From Table 1 ►		_____ μΩ/Ω_____	◄ Note Time Frame(1 Year/6 Months Etc)
Calculated[1]	Drift @ 23 °C ►	μΩ/Ω	

Note 1 – To Calculate Drift Specifications using the following formula:

For Drift @ 23 °C (In μΩ/Ω) Calculate Change (μΩ/Ω) Using formula:

((Current Cal $_{\text{Temp Value 23 °C}}$ – Last Cal $_{\text{Temp Value 23 °C}}$)/Last Cal $_{\text{Temp Value 23 °C}}$)*1E^6

5.0 MAINTENANCE

Maintenance of the resistor consists only of routinely inspecting the unit for physical damage and cleanliness. These should be cleaned with isopropanol and a soft brush or cloth. Special care should be taken to ensure that the terminal connectors are clean and are not cracked or damaged.

5.1 Replaceable Parts

The following tables list the replaceable parts. **Note that once a part has been replaced, the unit may be required to be recalibrated.**

To Contact Guildline Instruments, the following information is provided.

USA and Canada Telephone: (613) 283-3000
USA and Canada Fax: 1-613-283-6082

Outside US and Canada Telephone: +[1] 613 283-3000
Outside US and Canada Fax: [1] +613 283-6082

You can also contact Guildline Instruments Limted via their Email or Websites.

Email is: sales@guildline.com
Website is: www.guildlinecom

5.1.1 Common Parts (All Models)

Part Number (GPN#)	Description
813-31082	Case Screws
925-23468	Desiccant
841-04000	Split Lock Washer
19746-01-01	Terminal Washer
30175-01-15	Insulator Top Post
30176-01-15	Insulator Bottom Post
018-02200	Rubber Feet

5.1.2 Terminals

Part Number (GPN#)	Description
010-24073	Binding Post (Red)
010-24074	Binding Post (Black)
010-21519	Ground Terminal (Gold)