7334 SERIES

PRECISION AC/DC RESISTANCE STANDARDS

Very High Stability Calibration Laboratory AC/DC Resistance Standards

7334 Air Model (Above) and 7334-TC (Temperature Compensated) (Below)

FEATURES

- Typical AC/DC Error <1.0 ppm at 1 kHz
- Stability < 2.5 ppm/Year
- Temperature Coefficient < 0.2 ppm/°C
- Oil or Air Baths not Required
- Resistance Range 1 Ω to 10 kΩ
- Either Binding Posts or optional BNC style Connectors are available
- Compact and Ruggedized
- Nominal Accuracy < 2 ppm
- Voltage Hysteresis < 0.1 ppm
- 17025 Report of Calibration Included
- Guard and Shield Compliant
- Operating Range 18 °C to 28 °C
- Special Values Available on Request

Guildline Instruments 7334 Series of AC/DC Air Resistance Standards are designed for high accuracy resistance calibration in air, without the need for stabilization in a temperature controlled bath.

They can be used as AC or DC working standards, or as highly reliable and rugged transfer standards. They are extremely useful as references for AC Temperature Bridges, for the calibration of resistance ranges of multi-function calibrators and high accuracy DVMs, as well as being used in more classical standards and calibration resistance measurements.

THE 7334 SERIES PRECISION RESISTANCE STANDARDS ARE TRUE AC/DC STANDARDS WITH ESSENTIALLY NO AC/DC ERROR UP TO1 KHZ, AND ARE AVAILABLE IN A WIDE RANGE OF STANDARD AND CUSTOM VALUES.

Hysteresis error is typically better than to 0.1 ppm when stressed at 3 times the maximum voltage, and less than 0.3 ppm over a temperature cycle between 0 °C & 40 °C.

Connections to these resistance standards are made via gold plated 5-way binding posts. In DC measurement, these gold plated binding posts yield the lowest thermal EMF when connected with gold, copper or silver. BNC connectors are also available upon request. The impedance of the resistor is expressed as:

$$Z(f) = R(f) \cdot (1+j2\pi f\tau)$$

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 energization. The 7334 standards have a very flat frequency response.

The resistive component is virtually independent of frequency, with typically less than 1.0 ppm of AC/DC difference between DC and 1000 Hz. The 7334 series of standards are almost purely resistive with a very small time constant. For example, the 7334-100Ω time constant is typically less than 10 ns.

7334 **Series** of Precision AC/DC Air Resistance Standards

The AC/DC difference is so insignificant that it is almost negligible, when compared to measurement noise. A user can confidently use the Guildline 7334 Series 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.

Special values such as 25 Ω, 300 Ω, 400 Ω and 2.9064 kΩ and others are available. Guildline also has an option to put the 7334 elements in an enclosed "Temperature Chamber (TC)" 6634A Style Case. The following 7334TC was built for Temperature Measurement and Source applications such as the calibration of Fluke Super Thermometers and for use with Wika/ASL AC Temperature Bridges. The 10 element sets in this unit are (2 x10 Ω), (2 x 25 Ω), (2 x100 Ω), (2 x300 Ω), and (2 x 400 Ω).

Model 7334-TC with 10 Custom Elements in a Temperature Controlled (TC) Enclosure

400 Ω Element

Note that these sets shown, when calibrated by an independent **National Measurement Institute (NMI),** were reported as "Element Value" White and "Element Value" Black. The results are very impressive as per the following Calibration Report.

Resistor	Current	Frequency	δ(f)	U(δ)
400 Ω white	1.5 mA	60 Hz	-0.3 μΩ/Ω	3.2 μΩ/Ω
		90 Hz	+0.2 μΩ/Ω	3.2 μΩ/Ω
400 Ω black	1.5 mA	60 Hz	+0.1 μΩ/Ω	3.2 μΩ/Ω
		90 Hz	-0.2 μΩ/Ω	3.2 μΩ/Ω

Definition of the calibrated quantity

The ac-dc difference of the magnitude of the impedance $\delta(f)$ is defined as

$$\delta(f) = \frac{|Z|_{ac} - R_{dc}}{R_{dc}}$$

where: $|Z|_{ac}$ is the magnitude of the impedance measured with ac current and
R_{dc} is the resistance measured with dc current.

Resistor	Current	Frequency	δ(f)	U(δ)
25 Ω white	6.3 mA	60 Hz	-0.4 μΩ/Ω	2.9 μΩ/Ω
		90 Hz	+0.2 μΩ/Ω	2.8 μΩ/Ω

Resistor	Current	Frequency	δ(f)	U(δ)
300 Ω white	1.8 mA	60 Hz	-0.3 μΩ/Ω	3.2 μΩ/Ω
		90 Hz	-0.1 μΩ/Ω	3.2 μΩ/Ω

Measurement uncertainties

The uncertainty $U(\delta)$ stated is the expanded measurement uncertainty obtained by multiplying the standard measurement uncertainty by the coverage factor $k = 2$. It has been determined in accordance with th "Guide to the Expression of Uncertainty in Measurement (GUM)". The value of the measurand then normally lies, with a probability of approximately 95 %, within the attributed coverage interval.

The Temperature Chamber (TC) allows the precision resistance standards to be enclosed in a highly stable environment for temperature and provides Electronic Magnetic Interference (EMI) protection. Each resistance element is isolated and has a 4-terminal connection at the back panel. The resistance elements are maintained at 30 ± 0.01 °C in this temperature stabilized chamber. A minimum of 4 elements to a maximum of 10 elements must be ordered in a temperature chamber configuration.

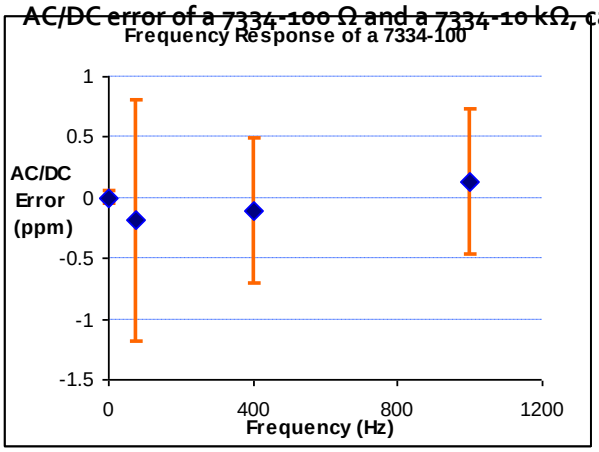
By placing the elements in a temperature controlled chamber, the temperature coefficient (affects due to Laboratory Environment) is reduced by a **factor of 40 times**. This means temperature is not an impact on measurements when used in any standard Metrology Laboratory running 23 °C ± 5 °C. For example, in Air, a 100 Ω element has a temperature coefficient of 0.2 ppm/°C (which is the best from any manufacturer), but placing the same element in the Temperature Chamber reduces this coefficient to 0.005 ppm/°C.

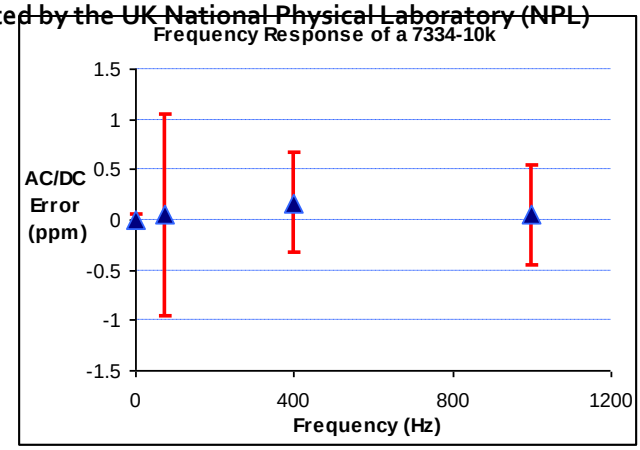
With Standard Models such as our 25 Ω model shown, you will find that these Resistance Standards are perfect for Temperature and Thermometry applications, and for AC and DC Thermometry Bridges.

The 7334 performance is exceptional! Even for elements in the Standard Air Enclosure, you will find that the results are impressive.

Examine the following graphs for a 7334-100 Ω and a 7334-10 kΩ Air Element that were calibrated at the National Physical Laboratory (NPL) in the UK. Both Air Standards show exceptional results.

AC/DC error of a 7334-100 Ω and a 7334-10 kΩ, calibrated by the UK National Physical Laboratory (NPL)





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							

Specifications							
Model (Nominal Ω)	Nominal Value (Ω)	Initial [1,2] Tolerance ± ppm	Stability 12 Months ± ppm	Typical AC/DC Difference @ 1kHz (± ppm)	Maximum Excitation Current (dc)	Temperature Coefficient [3] ± ppm/°C	
						Air	TC (Chamber)
7334-1	1	2	2.5	<3.0	316 mA	1	0.025
7334-2.5	2.5	2	2.5	<3.0	200 mA	1	0.025
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
7334-300	300	2	2.5	<1.0	19 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 Ohm to 1kOhm)							

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 under DC excitation, in air at 21, 23 and 25 °C referred to the unit of resistance as maintained by a NMI, and expressed as a total uncertainty with a coverage factor of k = 2. A traceable report of calibration stating the measured values and uncertainty is provided with each resistor.

Note 3: Temperature hysteresis: < 0.3 ppm between 0 °C and 40 °C and Voltage hysteresis: negligible to < 0.1 ppm. When placed inside an enclosed Temperature Chamber (7334TC), the temperature coefficient is reduced by a factor of x40 (eg 10 k would = 0.005 ppm/ °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 9334A, 9336, 9336, 6634A and 6636 Series of Standards.

Ordering Information	
7334-Value	Resistance Standard (List Ohmic Value) with Binding Posts
7334-Value/BNC	Resistance Standard (List Ohmic Value) with BNC Connectors
7334-TC/X	Resistance Standard (List Ohmic Values) in Temperature Chamber (X = number of decade elements installed, from 5 to 10 elements)
/CC	Certificate of Calibration Included
/RPT	Report of Calibration Included (Non-Accredited)
/RPT 17025	Report of Calibration NMI Accredited (Optional/Charge)
/TM7334	Technical Manual (included)
7334 Options	
7334-12	SCW lead pair with gold plated banana plugs, 1.5m in length
73340-2	Copper conductors and guard, trimmed ends, xm in length Teflon insulated lead with 4 stranded silver coated
73340-BNC	Teflon insulated lead with 4 stranded silver coated BNC connectors and guard, trimmed ends, 2m in length

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