

# Mercury™ 1500V Vacuum Rated Digital Output Encoders

## Factory Set Resolution to 0.50µm

Reflective Linear and Rotary Vacuum Encoders Systems

### Typical Vacuum Encoder System

Sensor the size of a Dime

Wall

Vacuum

Customer Controller

### Resolution

Factory Set:  
x4, x8, x20, or x40

Linear: 5µm, 2.5µm, 1.0µm, or 0.50µm

Rotary: 6,600 to 655,000 CPR

### Accuracy

Linear: ± 1µm available  
± 3µm to ± 5µm standard

Rotary: Up to ± 2.1 arc-sec

### Output

A-quad-B and Digital Index Window

### Vacuum

10<sup>-8</sup> Torr

The Mercury 1500V Digital Output Vacuum Encoder is a cost-effective solution with high immunity to EMI noise and all digital outputs straight from the sensor.

### Imagine what you can do with this!

The Mercury 1500V Digital Output Vacuum Encoder delivers unmatched performance at a lower cost for your vacuum application. With all digital signals directly from the sensor the M1500V has high immunity to EMI noise and includes a 5m vacuum-rated cable. The sensor is vented and constructed with vacuum compatible materials rated up to 10<sup>-8</sup> Torr and is designed for a 48 hour bake out at 150° C. The tiny sensor is easy to align and fits into very tight spaces and works in both linear and rotary applications. Color coded bare leads are provided for customer termination.

### Standard features

- Digital A-quad-B output and Index window
- Vacuum rating: 10<sup>-8</sup> Torr ; bake out - 48 hours at 150° C (non-operating)
- Smallest sensor with ultra-low Z height
- Factory set interpolation x4, x8, x20, x40 for resolutions of 5µm to 0.50µm (linear); 6,600 CPR to 655,000 CPR (rotary)
- Bi-directional index signal
- Index mark at the center or end of the glass scale (linear)
- 5m vacuum cable with flying leads
- Alignment Tool enables fast set up (see pg 2)

### Table of Contents

<b>System &amp; Sensor</b>	<b>pg . 2-6</b>
<b>Scales</b>	<b>pg. 7-8</b>
<b>Ordering Information</b>	<b>pg. 9</b>

### Optional Features & Accessories

- SmartPrecision Alignment Tool

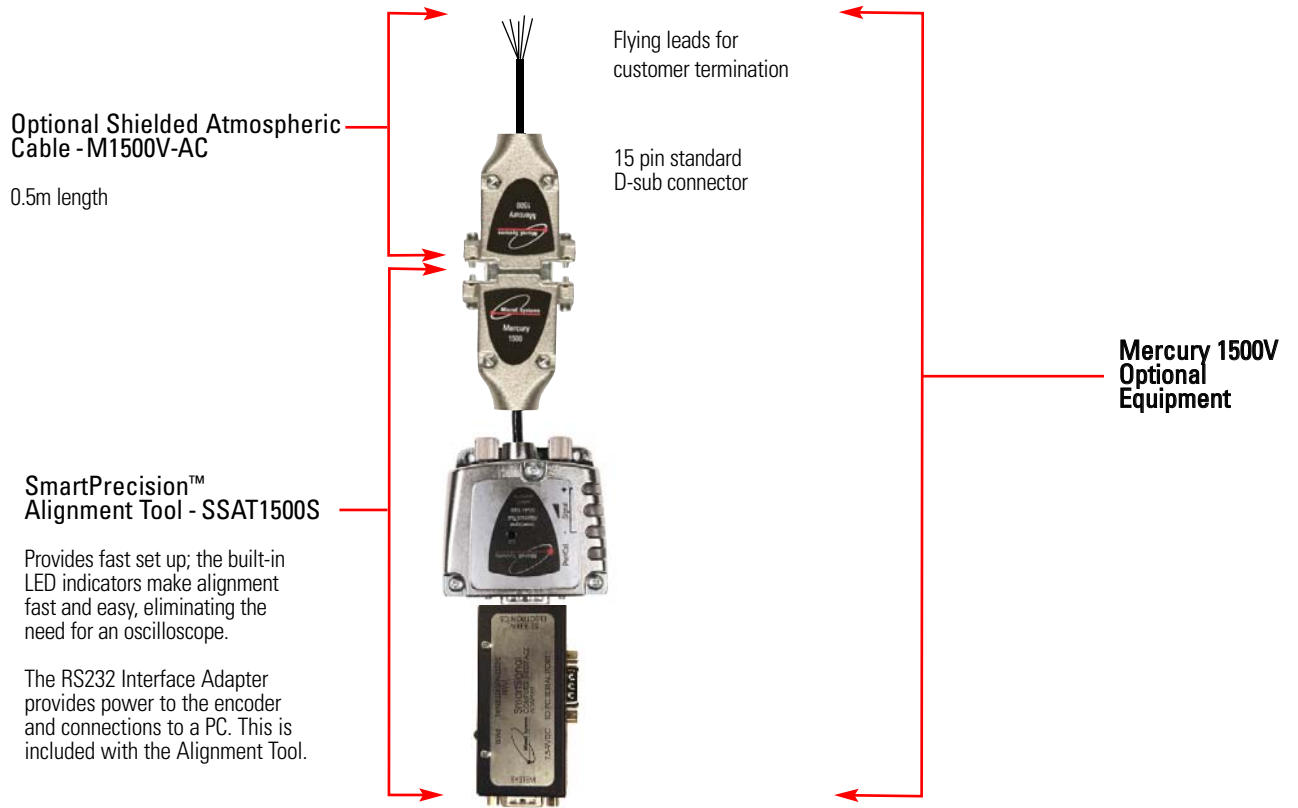
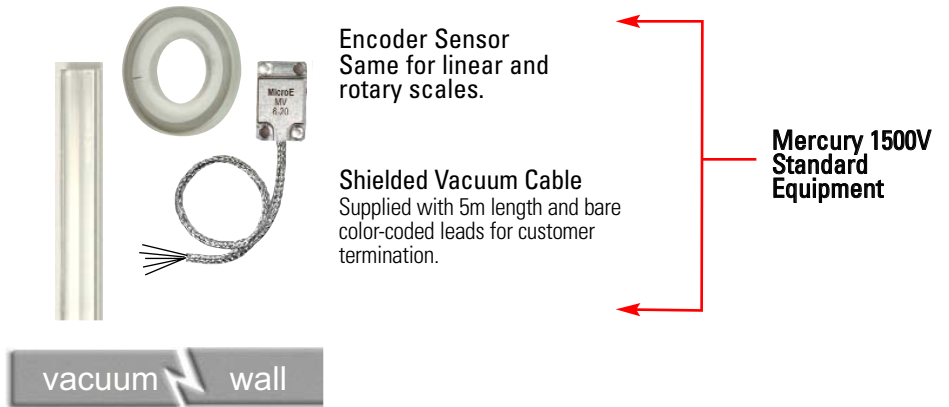


- 0.5m, atmospheric, double shielded cable with 15 pin D-sub connector
- Glass scale length or diameter:  
Linear lengths from 5mm to 2m  
Rotary diameters from 12mm to 108mm
- Vacuum-rated cable length of 5m or custom
- SmartPrecision Software for set up and monitoring



# System Configurations

## Standard and Optional Equipment



## Optional Software

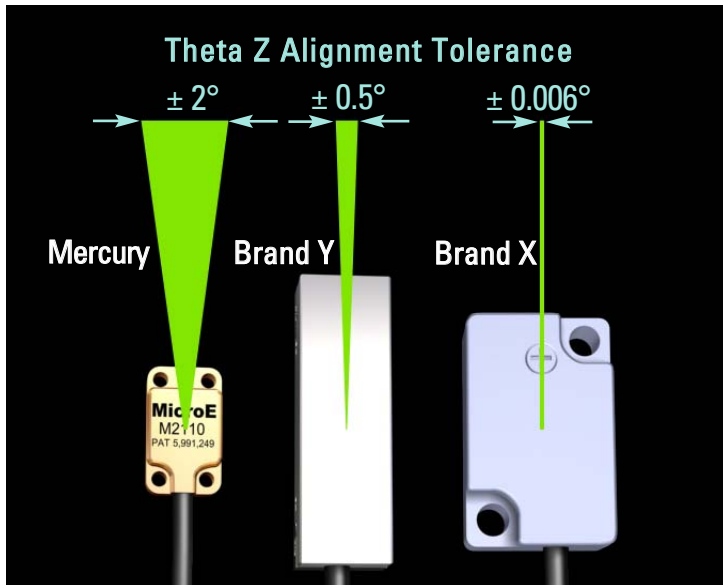
### SmartPrecision™ Software



Optional software lets you view signal strength, Lissajous plots, position data and diagnostics.

# Broader Alignment Tolerances, Increased Standoff Clearance, Smallest Sensor and More

## Why Mercury Encoders Make It Easier To Design High Performance Into Your Equipment



### Eliminate the Frustration of Touchy Encoder Alignment

#### Mercury Solves this Problem for Good

Fussy alignment is no longer a concern. With Mercury's patented PurePrecision™ optics, advanced SmartPrecision™ electronics and LED alignment indicators, you can push the sensor against your reference surface, tighten the screws and you're finished. Try that with brand X or Y.

This performance is possible thanks to relaxed alignment tolerances, particularly in the theta Z axis. Mercury offers a ±2° sweet spot— that's a 300% improvement over the best competitive encoder. And that will result in dramatic savings in manufacturing costs.

No other commercially available encoder is easier to align, easier to use, or easier to integrate into your designs.

### Alignment Tolerance Comparison\*\*

	Mercury*	Brand X	Brand Y	Mercury vs. Best Competitor
Z Standoff	± 0.15mm	± 0.1mm	± 0.1mm	Mercury is 50% better
Y	± 0.20mm for linear ± 0.10mm for rotary ≥19mm dia.	± 0.1mm	unspecified	Mercury is 100% better
theta X	± 1.0°	unspecified	± 1.0°	
theta Y	± 2.0°	± 0.1°	± 1.0°	Mercury is 100% better
theta Z	± 2.0°	± 0.006°	± 0.5°	Mercury is 300% better

\*Measured at a constant temperature for one axis at a time with all other axes at their ideal positions.

\*\*Based on published specifications

### Mercury Can Reduce System Size and Cost

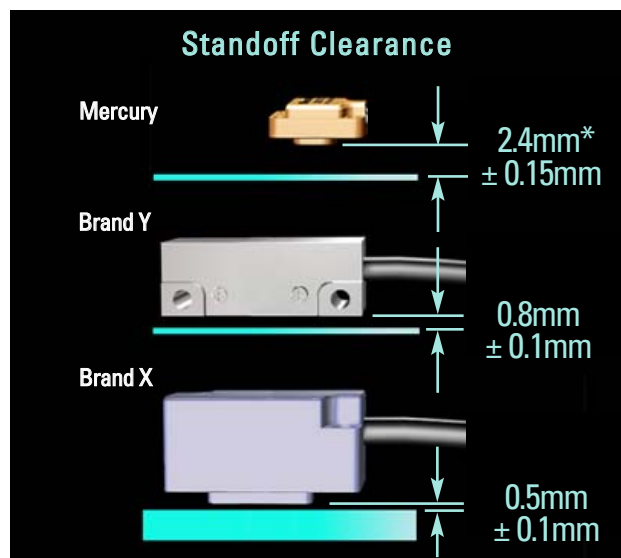
Mercury's sensor height is 44% shorter than competitive encoders, making it easy to fit into your design. This reduction can also cut total system weight and cost by allowing the use of smaller motors and stages. Safe system operation is also enhanced thanks to Mercury's generous standoff clearance— 200% greater than other encoders. And its standoff tolerance is 50% greater than the best alternative.

This significantly relaxes mechanical system tolerances, while reducing system costs.

### Mechanical Dimension Comparison\*\*

	Mercury	Brand X	Brand Y	Mercury vs. Best Competitor
Sensor Z height	8.4mm	23mm	15mm	44% better
Standoff clearance	2.4mm	0.5mm	0.8mm	200% better
Standoff tolerance	± 0.15mm	± 0.1mm	± 0.1mm	50% better
System height	11.7mm	28.5mm	15.8mm	26% better

\*\*Based on published specifications



\* Dimensions shown illustrate encoder system standoff clearance; see Mercury Encoder Interface Drawings for correct design reference surfaces.

# System Specifications

## Resolution and Maximum Speed

Mercury 1500 systems have factory set interpolation: x4, x8, x20, x40. Below is the table of available resolutions.

### Linear - 20µm grating pitch

Interpolation	Resolution	Maximum Speed
x4	5.000µm/count	7200mm/s
x8	2.500µm/count	7200mm/s
x20	1.000µm/count	7200mm/s
x40	0.500µm/count	7200mm/s

### Rotary - 20µm grating pitch

Rotary Glass Scale Diameter      Fundamental Resolution      Interpolation  
Below is a table of the available resolutions.

Rotary Glass Scale Diameter	Fundamental Resolution	Interpolation	x4	x8	x20	x40
0.472" [12.00mm]	1650 CPR					
		interpolated resolution (CPR)	6,600	13,200	33,000	66,000
		interpolated resolution (arc-sec/count)*	196.4	98.2	39.2	19.64
		interpolated resolution (µrad/count)*	952	476	190.3	95.2
		maximum speed (RPM)	13090	13090	13090	13090
0.750" [19.05mm]	2500 CPR					
		interpolated resolution (CPR)	10,000	20,000	50,000	100,000
		interpolated resolution (arc-sec/count)*	129.6	64.8	25.9	12.96
		interpolated resolution (µrad/count)*	628	314	125.6	62.8
		maximum speed (RPM)	8640	8640	8640	8640
1.250" [31.75mm]	4096 CPR					
		interpolated resolution (CPR)	16,384	32,768	81,920	163,840
		interpolated resolution (arc-sec/count)*	79.1	39.6	15.82	7.91
		interpolated resolution (µrad/count)*	383	191.7	76.6	38.3
		maximum speed (RPM)	5273	5273	5273	5273
2.250" [57.15mm]	8192 CPR					
		interpolated resolution (CPR)	32,768	65,536	163,840	327,680
		interpolated resolution (arc-sec/count)*	39.6	19.78	7.92	3.96
		interpolated resolution (µrad/count)*	191.7	95.8	38.3	19.17
		maximum speed (RPM)	2637	2637	2637	2637
4.250" [107.95mm]	16384 CPR					
		interpolated resolution (CPR)	65,536	131,072	327,680	655,360
		interpolated resolution (arc-sec/count)*	19.78	9.89	3.96	1.978
		interpolated resolution (µrad/count)*	95.8	47.9	19.16	9.58
		maximum speed (RPM)	1318	1318	1318	1318

\* Resolution values shown are approximate. To calculate exact resolution values, convert from CPR (Counts Per Revolution) to the desired units.

Note: Specifications assume XOR function which is available in all standard controllers.

All Specifications are subject to change. All data is accurate to the best of our knowledge. MicroE Systems is not responsible for errors.

# System Specifications

## System

Grating Period 20 $\mu$ m

System Resolution 5 $\mu$ m, 2.5 $\mu$ m, 1.00 $\mu$ m, or 0.50 $\mu$ m (linear)

Linear Accuracy\* Better than  $\pm 1\mu$ m\*\* available; contact MicroE  
Better than  $\pm 3\mu$ m\*\* up to 130mm,  $\pm 5\mu$ m from 155mm to 1m,  
 $\pm 5\mu$ m per meter from 1m to 2m

\*Maximum peak to peak error over the specified movement when compared to a NIST-traceable laser interferometer standard, used at room temperature and with MicroE interpolation electronics.

\*\*Or +/- one quadrature count, whichever error value is greater.

Rotary Accuracy*	Scale O.D.	Microradians**	Arc-Seconds**
	12.00mm	$\pm 100$	$\pm 21$
	19.05mm	$\pm 63$	$\pm 13$
	31.75mm	$\pm 38$	$\pm 7.8$
	57.15mm	$\pm 19$	$\pm 3.9$
	107.95mm	$\pm 10$	$\pm 2.1$

\*Based on ideal scale mounting concentricity

\*\*Or +/- one quadrature count, whichever error value is greater.

## Sensor Size

W:	12.70mm	0.500"
L:	20.57mm	0.810"
H:	8.38mm	0.330"

## Operating and Electrical Specifications

Vacuum  $10^{-8}$  Torr, negligible outgassing

Bake Out Up to 150°C; up to 48 hours, non-operating

Power Supply 5VDC  $\pm 5\%$  @ 60mA

Temperature

Operating: Sensor: 0 to 70°C

Storage: -20 to 70°C

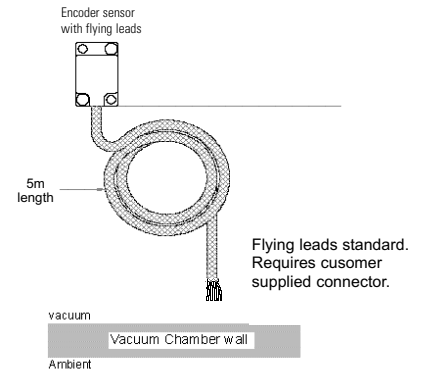
Humidity: 10 - 90% RH non-condensing

Shock: 1500G 0.5 ms half sine

Sensor Weight: 2.7g ( Sensor without cable )

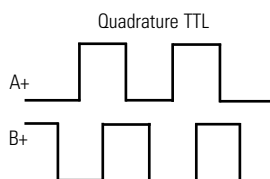
Cable: The 5m vacuum-compatible cable is EMI shielded and comes standard with color coded bare leads for customer termination within the vacuum bulkhead. Custom cable lengths and connectors are available.

## Vacuum Encoder System

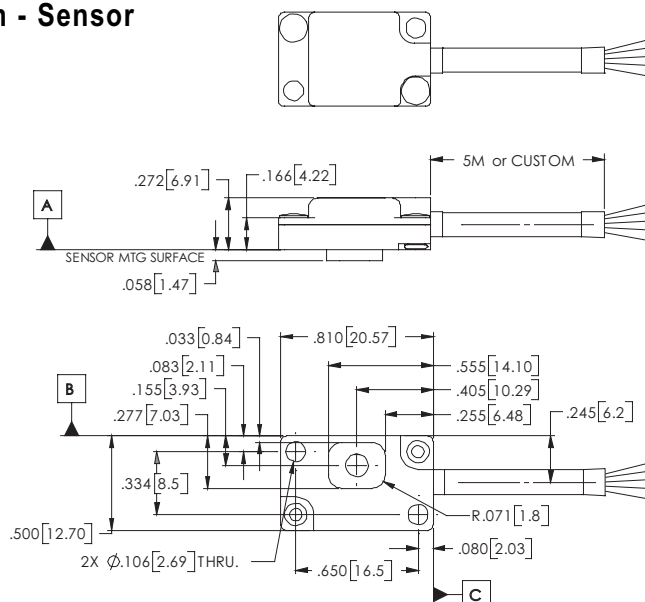
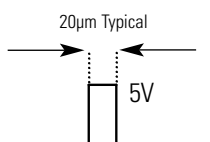


## Mechanical and Electrical Information - Sensor

### Output Signals



### Index Window



## Mechanical and Electrical Information

### Mercury™ 1500V Flying Leads Color Code Signal Chart

Sensor Wires

COLOR	FUNCTION
Orange	A - quadrature
Brown	A + quadrature
Yellow	Sine+***
Green	Cosine+***
White	B- quadrature
Grey	B+ quadrature
Red	+5VDC
Black	Ground
Violet	Index Window+
Blue	Index Window-

\*\*\* Analog outputs are for sensor alignment only and are nominally 0.85Vpp with 1.7V offset.

### SmartPrecision Alignment Tool, Model SSAT1500S, Pin Assignments

15-pin Standard Female D-sub connector

PIN	FUNCTION
1	
2	
3	
4	A - quadrature
5	A + quadrature
6	
7	Sine+***
8	Cosine+***
9	B- quadrature
10	B+ quadrature
11	
12	+5VDC
13	Ground
14	Index Window+
15	Index Window-

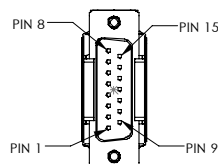
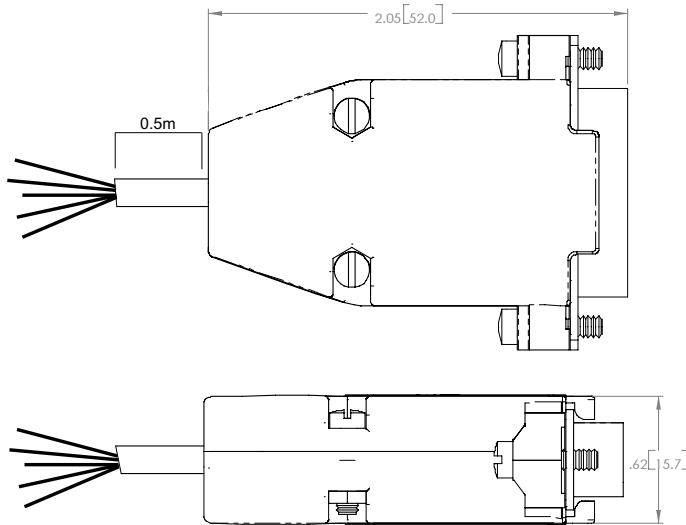
\*\*\* Analog outputs are for sensor alignment only and are nominally 0.85Vpp with 1.7V offset.

### Atmospheric Cable, Model M1500-AC

M1500V-AC can be ordered for use with M1550V units (one M1500V-AC per encoder) or for use with SSAT1500S.

Flying Leads

COLOR	FUNCTION
Orange	A - quadrature
Brown	A + quadrature
Yellow	Sine+***
Green	Cosine+***
White	B- quadrature
Grey	B+ quadrature
Red	+5VDC
Black	Ground
Violet	Index Window+
Blue	Index Window-



15-pin Standard Male D-sub connector

PIN	FUNCTION
1	
2	
3	
4	A - quadrature
5	A + quadrature
6	
7	Sine+***
8	Cosine+***
9	B- quadrature
10	B+ quadrature
11	
12	+5VDC
13	Ground
14	Index Window+
15	Index Window-

\*\*\* Analog outputs are for sensor alignment only and are nominally 0.85Vpp with 1.7V offset.

# Scale Specifications

## Standard and Customized Scales

MicroE Systems offers a wide array of chrome on glass scales for the highest accuracy and best thermal stability. Easy to install, standard linear and rotary scales meet most application requirements. Customized linear, rotary, and rotary segment scales are available where needed. All scales include an optical index. Mercury's glass scales save time by eliminating motion system calibrations or linearity corrections required by other encoders, and provide better thermal stability than metal tape scales.

### Options include:

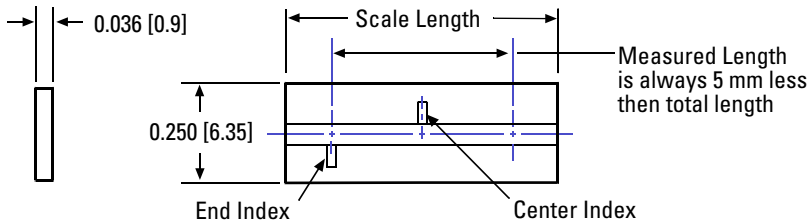
- *Standard linear*: 18mm - 2m
- *Standard rotary*: 12mm - 107.95mm diameter, with or without hubs
- *Custom linear\**: special lengths, widths, thickness, index mark locations and special low CTE materials
- *Custom rotary\**: special ID's, OD's (up to 304.8mm), index mark outside the main track and special low CTE materials
- *Mounting of hubs for rotary scales*: MicroE Systems can mount and align standard, custom, or customer-supplied hubs
- *Rotary segments\**: any angle range; wide range of radius values

\*Custom scales or rotary segments are available in OEM quantities. Contact your local MicroE Systems sales office.

## Standard Short Linear Scales

### 130mm and Shorter

Key: inches[mm]



### Specifications

Accuracy	±3µm standard ±1µm available
Material	Soda lime glass
Typical CTE	8ppm/°C
Index	Center or End

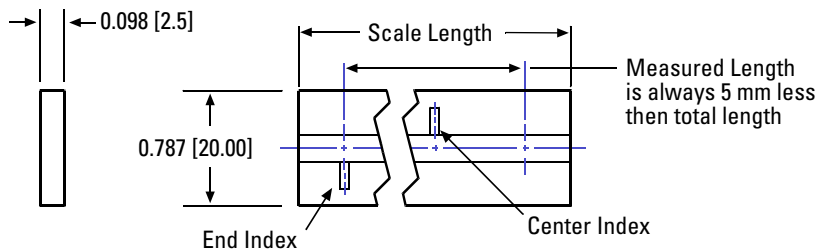
Model	L18	L30	L55	L80	L105	L130
Scale Length	0.709 [18]	1.181 [30]	2.165 [55]	3.150 [80]	4.134 [105]	5.118 [130]
Measured Length	0.512 [13]	0.984 [25]	1.969 [50]	2.953 [75]	3.937 [100]	4.921 [125]

Custom scales available

## Standard Long Linear Scales

### 155mm and Longer

Key: inches[mm]



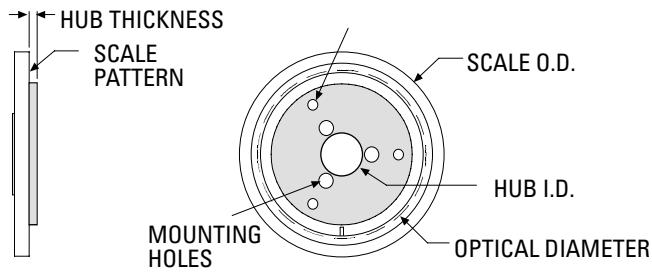
### Specifications

Accuracy	±5 µm <1m ±5 µm/m >1m
Material	Soda lime glass
Typical CTE	8ppm/°C
Index	Center or End

Model	L155	L225	L325	L425	L525	L1025	L2025
Scale length	6.102 [155]	8.858 [225]	12.795 [325]	16.732 [425]	20.669 [525]	40.354 [1025]	79.724 [2025]
Measured length	5.906 [150]	8.661 [220]	12.598 [320]	16.535 [420]	20.472 [520]	40.157 [1020]	79.528 [2020]

Custom scales available

## Standard Rotary Scales



### Specifications

Material	Soda lime glass
Typical CTE	8ppm/°C

Key: inches[mm]

Model No.	Scale Outer Diameter	Scale Inner Diameter	Optical Diameter	Hub Inner Diameter +0.0005/-0.0000	Hub Thickness	Fundamental CPR
R1206	0.472 [12.00]	0.250 [6.35]	0.413 [10.50]	0.1253 [3.18]	0.040 [1.02]	1650
R1910	0.750 [19.05]	0.375 [9.52]	0.627 [15.92]	0.1253 [3.183]	0.040 [1.02]	2500
R3213	1.250 [31.75]	0.500 [12.70]	1.027 [26.08]	0.2503 [6.358]	0.050 [1.27]	4096
R5725	2.250 [57.15]	1.000 [25.40]	2.053 [52.15]	0.5003 [12.708]	0.060 [1.52]	8192
R10851	4.250 [107.95]	2.000 [50.80]	4.106 [104.30]	1.0003 [25.408]	0.080 [2.03]	16384

Custom scales available



# How to Order Mercury 1500V Encoder Systems

To specify your Mercury encoder with the desired scale, level of interpolation, cable length and software, consult the chart below to create the correct part number for your order. Call MicroE Systems' Rapid Customer Response team for more information [781] 266-5700.

Example (Linear Encoder): M1550V-8-L55-C1 Example (Rotary Encoder): M1550V-40-R1910-HA

<u>M1550V</u>	–	<u>Interpolation</u>	–	<u>Scale Model</u>	–	<u>Scale Mounting</u>
		4 = 4x		Lxxx or Rxxxx		For linear scales:
		8 = 8x				C1 = 3 scale clamps*
		20 = 20x				C2 = 10 scale clamps**
		40 = 40x				

Hubs for Rotary Scales:  
 NH = Without Hub  
 HE = for R1206  
 HA = for R1910  
 HB = for R3213  
 HC = for R5725  
 HD = for R10851

\* 3 clamps for linear scales up to 130mm  
 \*\* 10 clamps for linear scales 155mm or longer

All Specifications are subject to change. All data is accurate to the best of our knowledge. MicroE Systems is not responsible for errors.

Note: Scale mounting clamps are not vacuum rated.

## How to Order Atmospheric Cable

M1500V-AC can be ordered for use with M1550V units (one M1500V-AC per encoder) or for use with SSAT1500S.

M1500V-AC

Atmospheric cable, 0.5m long, flying leads/15-pin standard D-sub connector

## How to Order SmartPrecision Alignment Tool

Example: Alignment Tool for Mercury 1500V encoder, 120 VAC = SSAT1500S-120

NOTE:  
 The M1500V-AC Atmospheric cable is recommended when purchasing an SSAT1500S Alignment Tool.

SSAT1500S – Voltage

120 = 120 VAC, 60Hz US Std. 2-prong plug  
 220 = 220 VAC, 50Hz European Std. 2-prong plug

## How to Order SmartPrecision Software

Optional for SSAT1500 Alignment Tool

SmartPrecision Software

SSWA-AT = SmartPrecision software on CD

All Specifications are subject to change. All data is accurate to the best of our knowledge. MicroE Systems is not responsible for errors.

