

# Appendix

# **Analysis I Information**

## **GREENFLOORS BAMBOO FLOORS**

Most bamboo flooring is manufactured with adhesives that contain a urea formaldehyde resin. Lower priced bamboo flooring can have formaldehyde emissions around 0.237ppm. GreenFloors Premium bamboo flooring has one of the lowest formaldehyde emission levels in the industry at 0.0127 ppm. This exceeds European and American Indoor Air Quality recommendations. GreenFloors can also furnish formaldehyde-free bamboo for a minimal additional cost.

GreenFloors quality bamboo makes a beautiful, warm, environmentally friendly floor that can be enjoyed for many years. Since the manufacturing of bamboo flooring has so many variables, quality will vary between manufacturers. Our manufacturers use quality materials to make an excellent product. When buying bamboo flooring our first concern has always been quality. We can buy and sell bamboo flooring for less but we feel this would not serve our purpose in the long run. Because of this we can offer a life time structural warranty as well as a 15 years finished warranty.

### **Attributes That Make Bamboo Floors “Green”**

#### **Renewable**

##### **Rapidly Renewable**

One of bamboo's greatest benefits is the rate at which it renews itself. The three-to-five year harvest cycle makes bamboo a rapidly renewable material, which is generally defined as having a harvest rotation of 10 years or less. In contrast, most hardwood species used for flooring reach saleable size in 50 to 100 years.

Bamboo is a member of the grass family that "matures in three years, regenerates without need for replanting and requires minimal fertilization or pesticides."<sup>1</sup>

#### **Recycled Content**

##### **Recycled Content Product**

To be considered a recycled content material, the product should contain a certain amount of either post consumer or post-industrial waste material. This is generally presented as a percentage of the total weight. The LEED Rating System has used 20 percent post consumer and 40 percent post-industrial as minimum requirements for a product to be considered recycled content.

Some bamboo flooring products may be laminated over a core material made from medium density fiberboard (MDF), which generally contains some post-

industrial wood fiber. The OSB flooring product also contains post-industrial recycled bamboo. It may depending on the content percentage-be potentially considered a recycled-content material.

Some manufacturers also offer an engineered floor that utilizes a thin bamboo layer laminated over a non-bamboo material. One manufacturer now offers tongue-and-groove flooring made from bamboo-oriented strand board (OSB). This product is made using the post-industrial waste bamboo from floor manufacturing.

## **Toxicity**

Bamboo growing requires minimal fertilization or pesticides. According to the U.S. EPA, Americans spend nearly 90 percent of their time indoors. Therefore, evaluating how products impact IEQ is necessary. These impacts may include emissions of volatile organic compounds (VOC) and/or formaldehyde. Several factors should be considered when looking at the indoor environmental quality impacts of a material. For example, these may include ventilation rates of the space applied, decay rates for volatile components, and the overall emissions from other components.

Volatile Organic Compounds - At this time, little data is available relative to the emissions of VOC from bamboo flooring material.

Formaldehyde - Some bamboo flooring products are manufactured using formaldehyde-based adhesives, and formaldehyde emissions vary from brand to brand. Some brands claim the use of formaldehyde-free glues and finishes. Some manufacturers reported formaldehyde emissions at various ranges, from 16 ug/m<sup>3</sup> to 330 ug/m<sup>3</sup>. The California Office of Environmental Health Hazard Assessment has listed formaldehyde as a "chemical of special concern." The agency has published the reference exposure levels (RE L) for toxicity for both Chronic<sup>7</sup> (3 ug/m<sup>3</sup>) and Acute (94 ug/m<sup>3</sup> for 1 hour) exposures.

If you are considering bamboo flooring, inquire about VOC and formaldehyde emissions from the specific manufacturer or distributor. VOC and formaldehyde emissions should also be considered when choosing adhesives for glue-down installations, in the surface finishing material, and in the choice of sub floor materials.

## **Life Cycle**

Durable materials require less frequent replacement, generate less waste, and may also realize lower long-term costs. According to manufacturers, bamboo flooring should last a lifetime (30 to 50 years). The onetime costs of installing bamboo flooring should be less than the costs for multiple installations of less durable flooring options. Therefore, over the long-term, the consumer should save money. Replacing the flooring generates waste, so reducing the rate of replacement also reduces waste generation. Without a single standard measurement for durability, the only comparable data available at this time are the results from standard Janka-Ball Hardness tests (ASTM D1037). Bamboo

flooring ranges "from slightly lower than red oak (1290 PSI) to significantly harder- 1130 PSI to 1640 PSI,"<sup>5</sup> making it a relatively hard material.

Since most bamboo flooring can be refinished, it should have a longer life than less durable flooring options such as carpet and some resilient flooring. The following list is from the Residential Rehabilitation Inspection Guide of the U.S. Department of Housing and Urban Development.<sup>6</sup> Based on information provided by manufacturers and trade associations; it shows the life expectancy of several common flooring components used in residential applications: Oak or pine: lifetime. Slate flagstone: lifetime. Vinyl (sheet or tile) 20-30 years. Terrazzo: lifetime. Carpeting: 11 years. Marble: lifetime.

Since bamboo has a relative hardness comparable to oak, a very hard, durable wood, and exhibits similar properties to other wood floors, it is assumed to have a life expectancy comparable to wood flooring.

### **Installation**

Bamboo flooring can be used in most residential and commercial applications where carpet, wood, tile, or resilient flooring is used. Some applications may be inappropriate a-high moisture area, for example-so consumers should confirm with the supplier to make sure the application is appropriate.

Depending upon the product, installation may be glue-down or nail down. In engineered products, bamboo may be floated, and it can be used with concrete or wood sub floors.

### **Maintenance**

Manufacturers report that bamboo floors are maintained in the same manner as wood floors and can be refinished.

**Social Responsibility** Life-cycle analysis often includes examining environmental justice issues. Since most bamboo for flooring originates in the Asian Pacific Rim, the question of fair labor practices is a legitimate concern in the production and manufacture. To date, these practices have not been well documented. As a result, local product distributors may not have much direct control or be willing to say much about this issue.

#### **Manufacturer Processes**

Bamboo is harvested, sliced into strips, boiled in water with a preservative, and pressed flat. It is then laminated vertically or in three horizontal layers, and kiln-dried. Floors manufactured using the horizontal orientation may be prone to cupping, but this problem is eliminated when the center layer is oriented perpendicular to the top and bottom layers.

Some manufacturers also offer an engineered floor that utilizes a thin bamboo layer laminated over a non-bamboo material. One manufacturer now offers tongue-and-groove flooring made from bamboo-oriented strand board (OSB). This product is made using the post-industrial waste bamboo from floor manufacturing.

Bamboo flooring products are manufactured in varying dimensional tongue and groove strip sizes and lengths. These products are available either pre-finished or unfinished, and they are usually offered as either natural or amber colored. Costs range from \$4 to \$8 per square foot for higher quality products.

Distribution Methods

### **Transportation Issues**

Nearly all bamboo for flooring is grown and manufactured in the Pacific Rim, generally in China or Vietnam. Therefore, any life-cycle analysis of these products should take into account both energy consumption and air emissions resulting from the transportation requirements of bringing the bamboo to market.

Some green building rating systems or guidelines give preference to the use of materials that either originate or are manufactured locally, which is often defined as within a 500-mile radius from the project.

## **Marshfield Signature Series™**

### **Environmental Class™ Doors**

#### **Scientific Certified Systems (SCS) Certified Particleboard Core Doors**



Certified for recovered fiber content by Scientific Certification Systems (SCS), Marshfield's Environmental Class particleboard core is available as non-rated or 20-minute rated. SCS is an independent, third party certification agency that certifies recovered fiber content through detailed assessment of material acquisition records and manufacturing processes. SCS recovered fiber content certification means we:

- Have completed an intensive auditing process;
- Have documented the acquisition and use of recycled material, &
- Have independent certification that our product contains at least 40% recovered wood fiber.



*Photo Courtesy of  
AEGON EQUITY GROUP*

# Environmental Class™ Particleboard Core Doors (1)

*Positive Pressure with Concealed Intumescents (2) (3) (4) (5) - 20-MINUTE (EPC-20PP)*

**Product Features and Specifications**

**Interior Only (6)**

**Thickness**  
**Maximum Size**  
**Minimum Size**  
**Faces**  
**Crossbands**  
**Stiles**  
**Top and Bottom Rails**  
**Face Assembly Adhesive**  
**Core Assembly Adhesive**  
**Core**  
**Maximum Size of Lite Openings (11) (12)**  
**Other Detail Work (16)**  
**Factory Finish (17)**  
**Warranty**  
**Security Rating**  
**Acoustic Rating**

1-3/4"  
**ITS-WH & UL:** **Single:** 4/0 x 10/0      **Pair:** 8/0 x 9/0 (7)  
**Double Egress Pair:** 8/0 x 9/0 (7)  
 1/5-3/4 x 6/0  
 \*At least 40% of the door by weight is comprised of recovered materials as certified by Scientific Certification Systems (SCS).  
 • Wood Veneer (5-Ply)      • Decorative Laminate  
 • Medium-Density Overlay (MDO)      • Styled™ Door Face  
 Engineered fiber  
 1-3/8" concealed intumescent positive pressure stiles with veneer band or decorative laminate to match face  
 1-1/8" Mill Option (8) (9) (10)  
 Type I (waterproof)  
 Type II (water-resistant)  
 Scientific Certification Systems (SCS) certified particleboard core (which complies with ANSI A208.1 1-LD-2)  
**METAL VISION FRAMES or WOOD MOULDING (13):**  
**EPC-20PP:** 1/4" wired glass only:  
 Total area of openings not to exceed 1,296 sq. in. of visible glass or one continuous dimension of 36" W or 54" H  
**FIRE-TRIM (14) MOULDING:**  
**EPC-20PP:** 5/16" Firelite® Plus glass only:  
 Total area of openings not to exceed 1,296 sq. in. of visible glass or one continuous dimension of 36" W or 54" H  
**METAL VISION FRAMES:**  
**EPC-20PP:** 3/16" Firelite® NT glass only (15):  
 Total area of openings not to exceed 1,296 sq. in. of visible glass or one continuous dimension of 36" W or 54" H  
 • Fitting    • Machining    • Applied Mouldings    • Glazing  
 • Clear or stain with satin gloss Enviroclad UV™ finish  
 • Prime only  
 • Opaque with flat gloss topcoat  
 Full; life of original installation (6)  
 Class 40 (18), highest security rating possible  
 STC 31 (Inoperable)

- (1) This product has been certified by Scientific Certification Systems (SCS) and meets the criteria for recycled content. SCS is an independent, third party certification agency that certifies recycled material content via detailed assessment of material acquisition records and manufacturing processes. SCS recycled-content certification means Marshfield DoorSystems has completed an intensive auditing process, has documented the acquisition and use of recovered fiber material, and have independent certification that our product contains at least 40% recovered fiber content by weight.
- (2) Meets UBC 7-2 (97) Positive Pressure requirements.  
 (3) Frame mounted listed and approved gasket required for these doors to receive positive pressure S (smoke) label.  
 (4) Dutch doors are available.  
 (5) Transoms are not available.  
 (6) Use of Marshfield DoorSystems, Inc. doors in exterior applications is not recommended and not warranted.  
 (7) On pairs of doors, Pemko S77 gasket used with concealed intumescent stiles eliminates the need for metal edge and astragal (MEA). Pemko S77 gasket or MEA is required for pairs of doors to receive the positive pressure S (smoke) label.  
 (8) Wider top and bottom rails are available in dimensions of 2-1/2" and 3-7/8".

- (9) Bottom rails are 2 1/2" in doors requiring deep mortise machining for bottom seals.  
 (10) Laminated Strand Lumber (LSL) or hardwood at mill option.  
 (11) Marshfield DoorSystems, Inc. does not assume responsibility for choice of glazing materials used. Refer to Consumer Product Safety Commission 16 CFR 1201 CAT. II (1-1-97 Edition) to determine the need for safety-rated glazing.  
 (12) Minimum distance requirement is 5 1/2" from cutout to any edge and adjacent openings, including hardware cutouts.  
 (13) If 1/4" wired glass is used in doors that are shipping to Canada or anywhere that requires hose stream testing, Trim-Lite™ moulding is required.  
 (14) 5/16" Firelite® Plus glass required with Fire-Trim wood moulding.  
 (15) All Metal 115-I vision frame required.  
 (16) All fire-rated doors must be machined by Marshfield DoorSystems, Inc. or other approved fire door machiners. Factory machining of surface-mounted exit devices with face holes 1" and larger is offered.  
 (17) All colors may not be available.  
 (18) Per UBC standard 41-1 and ASTM F-476.



Note: Marshfield DoorSystems, Inc. doors are manufactured per the standards listed on this page. Specifications are subject to change without notice.



# **Analysis II Information**

Nodes Members Shells Areas Gen

Sections

Member	Section	Ig factor	d0	dL
1	W 14x99	0	0	0
2	W 14x99	0	0	0
3	W 14x99	0	0	0
4	W 14x61	0	0	0
5	W 14x61	0	0	0

Available sections

- UB
- UC
- W
- WT
- X2L
- W 14x61
- W 14x68
- W 14x74
- W 14x82
- W 14x90
- W 14x99
- W 14x109
- W 14x120

0.35 0.70 Ig=1



Cursor X





# RAM Advanse

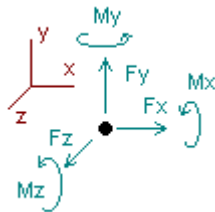
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## Analysis Results

### Translations

Node	Translations [in]			Rotations [Rad]		
	TX	TY	TZ	RX	RY	RZ
Condition <b>dl=Dead load</b>						
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00000	-0.11444	0.00000	0.00000	0.00000	0.00000
3	0.00000	-0.22301	0.00000	0.00000	0.00000	0.00000
4	0.00000	-0.28763	0.00000	0.00000	0.00000	0.00000
5	0.00000	-0.33558	0.00000	0.00000	0.00000	0.00000
6	0.00000	-0.34739	0.00000	0.00000	0.00000	0.00000

### Reactions



Direction of positive forces and moments

Node	Forces [Kip]			Moments [Kip*ft]		
	FX	FY	FZ	MX	MY	MZ
Condition <b>dl=Dead load</b>						
1	0.00000	521.20000	0.00000	0.00000	0.00000	0.00000
SUM	0.00000	521.20000	0.00000	0.00000	0.00000	0.00000

### Maximum forces at members

Condition : <b>dl=Dead load</b>						
	Axial [Kip]	Shear V2 [Kip]	Shear V3 [Kip]	Torsion [Kip*ft]	M22 [Kip*ft]	M33 [Kip*ft]
<b>MEMBER 1</b>						
Max	-414.30	0.00	0.00	0.00	0.00	0.00
Min	-521.20	0.00	0.00	0.00	0.00	0.00
<b>MEMBER 2</b>						
Max	-285.10	0.00	0.00	0.00	0.00	0.00
Min	-414.30	0.00	0.00	0.00	0.00	0.00
<b>MEMBER 3</b>						
Max	-159.20	0.00	0.00	0.00	0.00	0.00
Min	-285.10	0.00	0.00	0.00	0.00	0.00

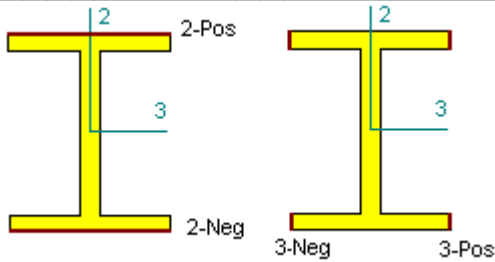
<b>MEMBER 4</b>						
Max	-36.40	0.00	0.00	0.00	0.00	0.00
Min	-159.20	0.00	0.00	0.00	0.00	0.00
<b>MEMBER 5</b>						
Max	0.00	0.00	0.00	0.00	0.00	0.00
Min	-36.40	0.00	0.00	0.00	0.00	0.00

### Maximum relative deflections

Remark.- Magnitude of deflections in absolute value.

CONDITION dl=Dead load						
Member	Defl. (2) [in]	@(%)	Defl. (3) [in]	@(%)		
1	0.00000 (< L/10000)	0.00000	0.00000 (< L/10000)	0.00000		
2	0.00000 (< L/10000)	0.00000	0.00000 (< L/10000)	0.00000		
3	0.00000 (< L/10000)	0.00000	0.00000 (< L/10000)	0.00000		
4	0.00000 (< L/10000)	0.00000	0.00000 (< L/10000)	0.00000		
5	0.00000 (< L/10000)	0.00000	0.00000 (< L/10000)	0.00000		

### Member stresses



Location of the fibers with maximum bending stresses

CONDITION dl=Dead load

Station	Axial [Kip/in <sup>2</sup> ]	Shear V2 [Kip/in <sup>2</sup> ]	Shear V3 [Kip/in <sup>2</sup> ]	Bending			
				2-Pos [Kip/in <sup>2</sup> ]	2-Neg [Kip/in <sup>2</sup> ]	3-Pos [Kip/in <sup>2</sup> ]	3-Neg [Kip/in <sup>2</sup> ]
<b>MEMBER 1</b>							
0%	-17.84	0.00	0.00	0.00	0.00	0.00	0.00
25%	-17.84	0.00	0.00	0.00	0.00	0.00	0.00
50%	-17.84	0.00	0.00	0.00	0.00	0.00	0.00
75%	-17.84	0.00	0.00	0.00	0.00	0.00	0.00
100%	-14.18	0.00	0.00	0.00	0.00	0.00	0.00
<b>MEMBER 2</b>							
0%	-14.18	0.00	0.00	0.00	0.00	0.00	0.00
25%	-14.18	0.00	0.00	0.00	0.00	0.00	0.00
50%	-14.18	0.00	0.00	0.00	0.00	0.00	0.00
75%	-14.18	0.00	0.00	0.00	0.00	0.00	0.00
100%	-9.76	0.00	0.00	0.00	0.00	0.00	0.00

**MEMBER 3**

0%	-9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25%	-9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50%	-9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75%	-9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	-5.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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**MEMBER 4**

0%	-8.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25%	-8.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50%	-8.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75%	-8.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	-2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00

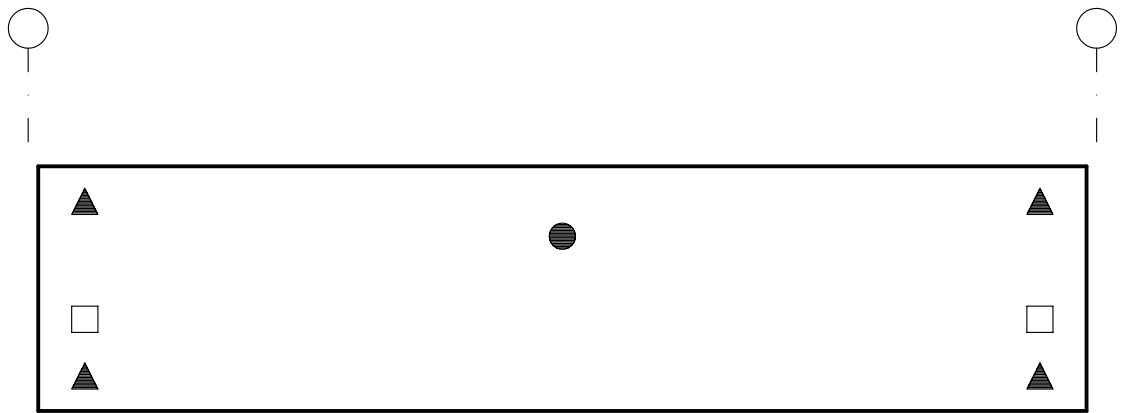
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**MEMBER 5**

0%	-2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25%	-2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50%	-2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75%	-2.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

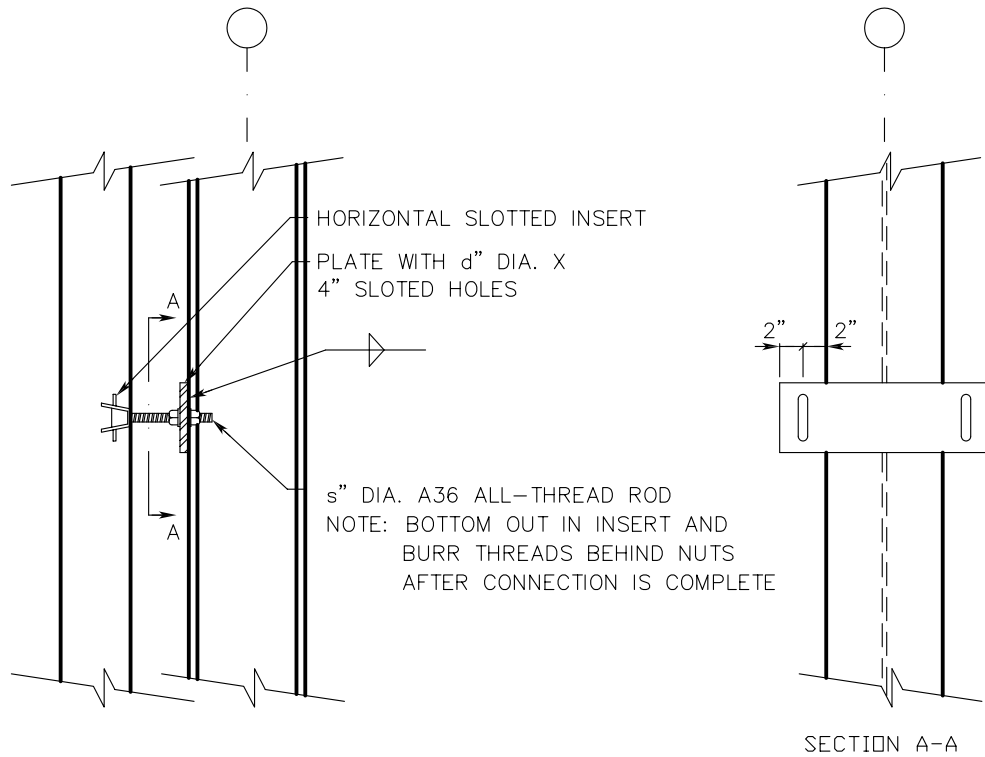
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## PANEL CONNECTION HORIZONTAL PANELS



- BEARING CONNECTION
- ▲ TIE-BACK CONNECTION
- SEISMIC CONNECTION

## PANEL CONNECTION COLUMN TIE-BACK



# **Analysis III Information**





2.4 x 1.9 x 0.8"  
(68 x 48 x 19 mm)

The HOBO RH/Temp is a 2-channel temperature and relative humidity data logger. It will measure and record up to 7,943 readings. Its reading rate is user selectable with sampling intervals being 0.5 seconds to 9 hours, recording times up to 1 year. Additional features include programmable start time/date, nonvolatile EEPROM memory which retains data even if battery fails and an extendable internal temperature sensor.

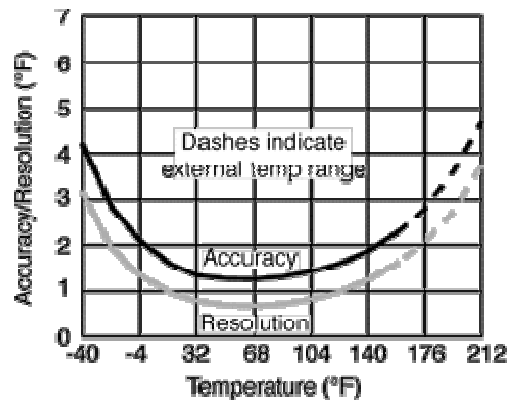
### Features and Specifications

- Capacity: 7943 measurements total
- User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to 1 year
- Readout and relaunch with optional [HOBO Shuttle](#)
- Internal temperature sensor on 4" wire can extend from case
- Precision components eliminate the need for user calibration
- Drop-proof to 5 feet
- Mounting kit included (hook/loop, magnet, and tape)
- Programmable start time/date
- Memory modes: stop when full, wrap-around when full
- Nonvolatile EEPROM memory retains data even if battery fails
- Blinking LED light confirms operation
- User-replaceable battery lasts 1 year
- Battery level indication at launch
- Operating range: -4°F to +158°F (-20°C to +70°C), 0 to 95% relative humidity, non-condensing, non-fogging (see RH sensor range below)
- Time accuracy: ±1 minute per week at +68°F (+20°C)
- Size/Weight: 2.4 x 1.9 x 0.8" (68 x 48 x 19 mm)/approx. 1 oz.(29 gms)
- Compliance certificate available

NIST-traceable temperature accuracy [certification](#) available

## Temperature (internal sensor)

- Range: -4°F to +158°F (-20°C to +70°C)
- Range for internal sensor when used outside of case:  
-40°F to +248°F (-40°C to +120°C)
- Accuracy:  $\pm 1.27^\circ\text{F}$  ( $\pm 0.7^\circ\text{C}$ ) at +70°F, see plot to the right
- Resolution:  $0.7^\circ\text{F}$  ( $0.4^\circ\text{C}$ ) at +70°F
- Response time still in air: 15 min. typical with sensor inside case; 1 min. typical with sensor outside case



## Relative humidity (user-replaceable RH sensor)

- Range: 25% to 95% RH at +80°F for intervals of  $\geq 10$  seconds, non-condensing and non-fogging, see plot to the right.
- Accuracy:  $\pm 5\%$
- Response time 10 min. typical in air
- Sensor operating environment: +41°F to +122°F (+5°C to +50°C) non-condensing and non-fogging

