



Pro-Ring Manhole Adjustment System 100 Year Accelerated Aging Evaluation

Made with

ARPRO®

Expanded Polypropylene (EPP)

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Pro-Ring 100 Year Accelerated Aging Evaluation

Product Details

Material: 100% Expanded Polypropylene (EPP)

Color: Black

Density: 120 kg/m³ (7.5 lb/ft³)

Mfg. Location: Butler, PA, USA

Model: 36" x 6" size used for study

ANGLE RING >
For slope adjustments

FINISH RING >
For finite adjustments

GRADE RING >
For gross adjustments



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Product
Usage



Pro-Ring 100 Year Accelerated Aging Evaluation

Close-up
of Pro-Ring
Surface

(new product before aging)



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Accelerated Aging Equivalent Plot for Expanded Polypropylene (EPP)

Accelerated aging of polymers (time versus temperature), showing the time (in weeks) equivalent to 1 year of room-temperature aging when a polymer is heat-aged at a selected temperature (°C). Using (Q10+Δ10°C) reaction-rate constant, assuming a room temperature of 22°C.

Simplified Protocol for Accelerated Aging (using the "10-degree rule") was developed around the collision theory based Arrhenius model.

Ref: ASTM D3045; Standard Practice for Heat Aging of Plastics Without Load

For accelerated aging and ambient temperatures selected, the relationship of oven test time to shelf-life time is as follows:

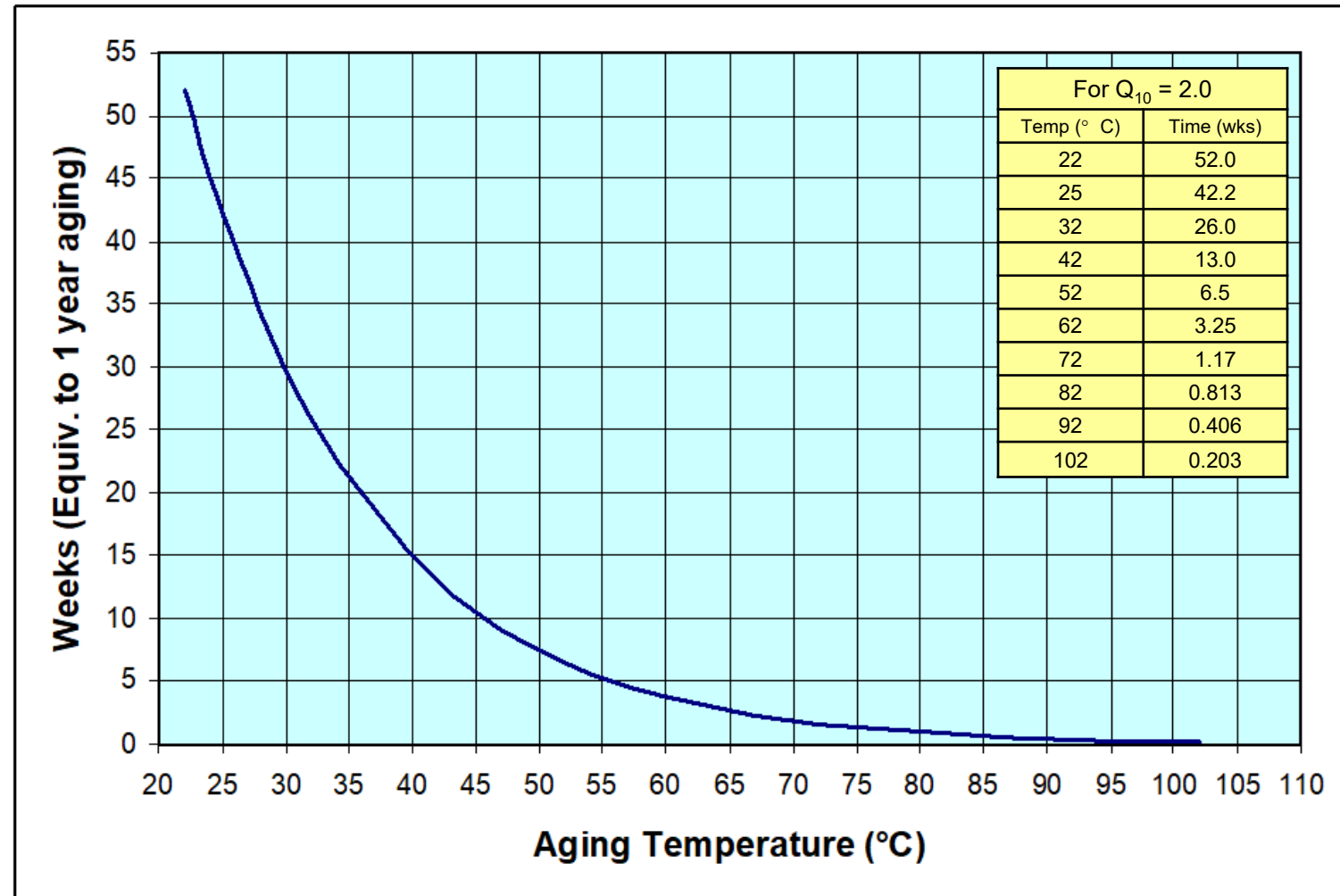
$$\text{Time}_{\text{TI}} = \text{Time}_{\text{RT}} / Q_{10}^{(T_1 - T_{\text{RT}}) / 10}$$

Where:

T_1 = oven aging temperature

T_{RT} = room temperature (ambient/storage)

Q_{10} = reaction-rate coefficient



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Accelerated Aging Calculation for Exposure Time at Temperature

$$\text{TIME}_{\text{TI}} = \text{TIME}_{\text{RT}} / Q_{10}^{(T_1 - T_{\text{RT}}) / 10}$$

$$\text{TIME}_{\text{TI}} = 5200 \text{ weeks} / 2^{(80 - 20) / 10} = 5200 / 64 = 81.25 \text{ weeks}$$

Total Exposure Time for 100 year aging = 81.25 weeks (569 days)

Oven Temperature: 80°C (176°F)

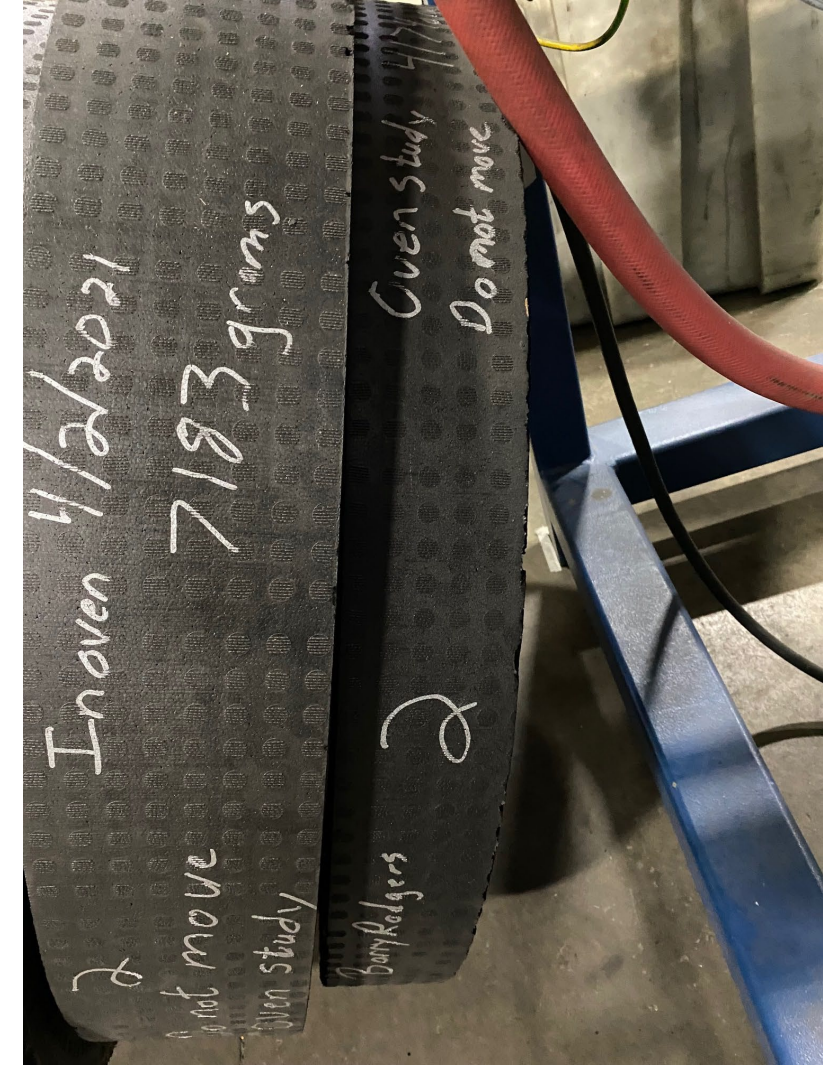
Conditions: Base supported without load

Date into Oven: 02 APRIL 2021

Date out of Oven: 24 OCTOBER 2022

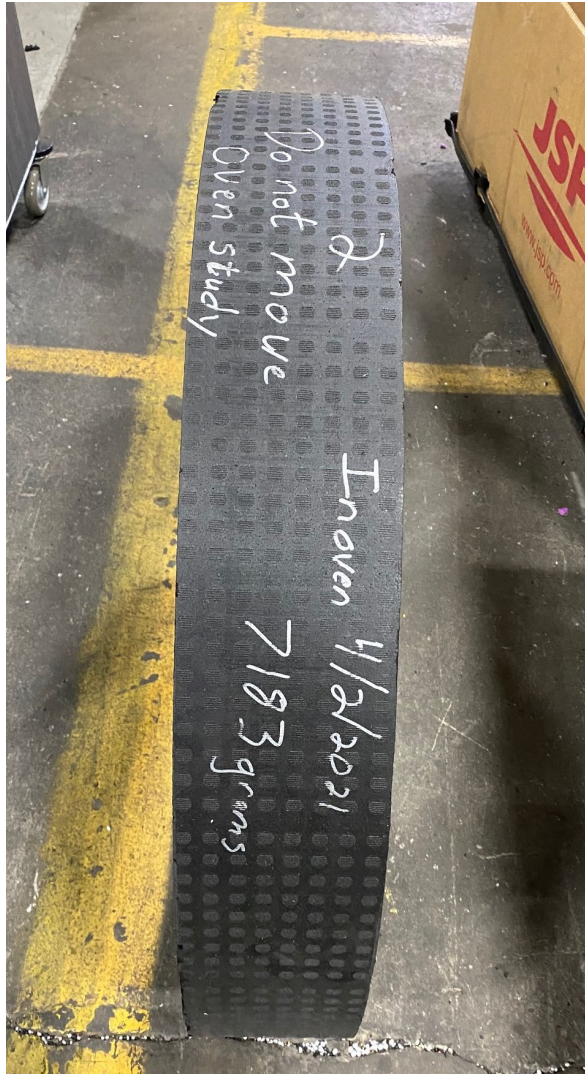
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Post-Aging Pictures



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Post-Aging Pictures



Pro-Ring 100 Year Accelerated Aging Evaluation

Properties Evaluated Post-Oven Aging

1. Visual
2. Density/Weight
3. Dimensional
4. Compression Strength
5. Tensile Strength

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Visual Evaluation

See pictures on pages 7 & 8 for Post-Aged samples

Observations:

- No color change.
- No change in surface finish.
- Slight powdering on surface, but very superficial <0.5 mm (<0.02”) depth.
- Slight deterioration along perimeter of part, but limited to edges.
- Slight embrittlement along perimeter of part, but limited to edges.
- No changes in shape or size. No dimensional change or shrinkage.

Result: Meets 100 year performance requirement

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Weight/Density Evaluation

Pre-Aging Weight: 7.183 kg

Part Volume: 60.28 liters

Actual Density: 119.2 kg/m³ (Target Density: 120.0 kg/m³ ± 10%)

Post-Aging Weight: 7.157 kg

Part Volume: 60.28 liters

Difference = 26 grams; (< 0.4%)

Actual Density: 118.73 kg/m³ (Target Density: 120.0 kg/m³ ± 10%)

Result: Meets 100 year performance requirement

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Dimensional Evaluation

Pre-Aging Diameter: 912.9 mm (Target Diameter: 914.4 mm \pm 7.5 mm)

Post-Aging Diameter: 913.6 mm (Target Diameter: 914.4 mm \pm 7.5 mm)
Difference = +0.7 mm (< 0.1%)

Result: Meets 100 year performance requirement

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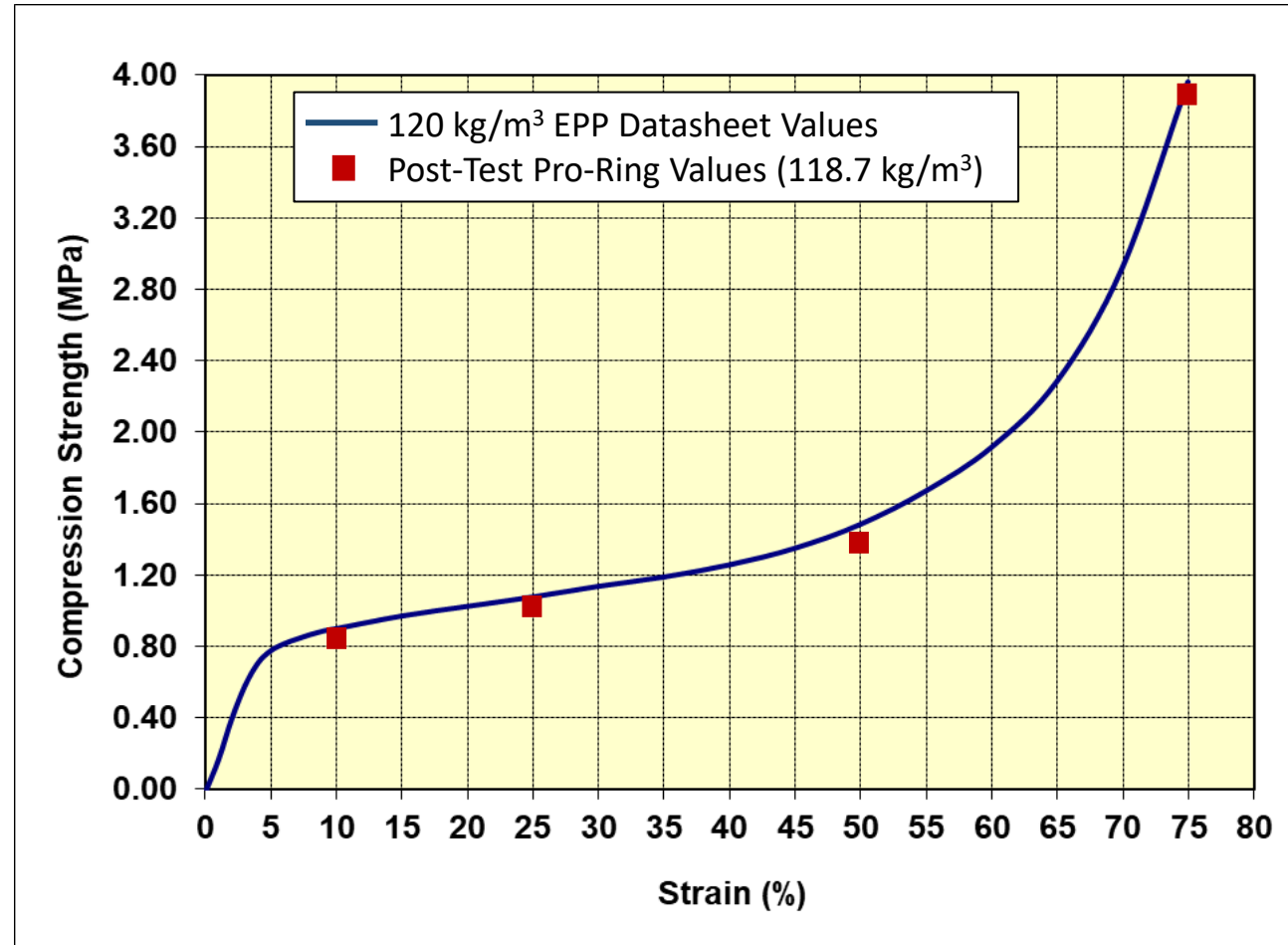
Compression Strength

Compression Strength values measured at 25%, 50% and 75% Strain per ISO 844*.

All values within 10% of pre-aging datasheet values.

Result: Meets 100 year performance requirement.

**Note: Sample size n=3. Average reported.*



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Tensile Strength

Tensile Strength values measured per ISO 1798*.

Target value: 1.33 MPa
Measured Value: 1.24 MPa
Change: <7.0%

All values within 10% of pre-aging datasheet values.

Result: Meets 100 year performance requirement.

**Note: Sample size n=3. Average reported.*

