Method For Calculating An Estimated Weight-Per-Foot of Solid-Wall Plastic Pipe

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Foreword

METHOD FOR CALCULATING

AN ESTIMATED WEIGHT-PER-FOOT OF SOLID-WALL PLASTIC PIPE

This report was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute, Inc. (PPI). The members have shown their interest in quality products by assisting independent standard-making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

The purpose of this technical report is to provide engineers, users, contractors, code officials, and other interested parties with a standard method for calculating an estimated, nominal weight-per-foot of solid wall plastic pipe. This method uses nominal average outside diameter and average wall thickness dimensions. Depending on the pipe manufacturing standard and production equipment used, the actual pipe weight may vary from the weight-per-foot determined by using this method. This Technical Report does not establish specifications, or standards, for pipe weight-per-foot. It is intended to provide general information for use in estimating pipe weight-per-foot. The pipe manufacturer should be consulted for their estimated pipe weight-per-foot.

PPI has prepared this report as a service to the industry. The information in this report is offered in good faith and believed to be accurate at the time of its preparation, but is offered "as is" without any express or implied warranty, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Additional information may be needed in some areas, especially with regard to unusual or special applications. Consult the manufacturer or material supplier for more detailed information. A listing of member manufacturers is available from PPI. PPI does not endorse the proprietary products or processes of any manufacturer, and assumes no responsibility for compliance with applicable laws and regulations.

PPI intends to revise this report from time to time, in response to comments and suggestions from users of the report. Please send suggestions of improvements to:

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METHOD FOR CALCULATING AN ESTIMATED

WEIGHT-PER-FOOT for SOLID-WALL PLASTIC PIPE

1.0 INTRODUCTION

This Technical Report 7 describes a method for estimating the weight-per-foot for solid wall plastic pipe and tubing. This report does not set specifications, or standards, for product weights.

The estimated value can vary from production pipe weight per foot because actual product will vary from the average dimension and density values assumed within the method.

2.0 SIGNIFICANCE

2.1 TR-7 provides a standard method for calculating an estimated weight-per-foot of plastic pipe and tubing. The estimated weight-per-foot may be useful for project design, sales, shipping, and handling purposes Use of this method provides information that is meaningful in commercial practice, benefiting both the consumer and the plastic pipe industry.

2.2 The TR-7 method uses the density, in gm/cm^3 at 73ºFof the plastic pipe material compound, an average pipe outside diameter, an average pipe wall thickness, all in inches, to estimate pipe weight in pounds per foot. Depending upon the industry specification, pipe and tubing dimensions can vary; therefore, the user is strongly cautioned to obtain and review the pertinent product specifications. The pipe or tubing manufacturer should be consulted for the density of its plastic pipe compound (virgin resin plus pigment). In lieu of specific data, the density may be determined by testing per ASTM D792 or ASTM D1505.

3.0 DEFINITIONS

3.1 Weight-Per Foot (W) - The solid wall pipe or tubing weight-per-foot, in pounds per foot, calculated using the material density, the average inside or outside diameter, and the average wall thickness, and rounded to three decimals for tubing and two decimal places for pipe.

3.2 Specific Gravity (SG_{23}) - The specific gravity of the pigmented plastic pipe material compound at 23^{o}C, rounded to three decimal places. Note: Do not use the SG of the un- pigmented base resin. [The density at 23ºC of the pigmented plastic pipe compound in grams per cubic centimeters divided by the density at 23ºC of water at 1.0 grams per cubic centimeter equals the specific gravity, which is dimensionless.]

3.3 Average Outside Diameter (OD) ,or Average Inside Diameter (ID) : The outside diameter or inside diameter value, in inches rounded to three decimal places, obtained from the applicable pipe standard, plus, if applicable, half of the total diameter tolerance.
If the diameter is specified as a minimum (maximum) value plus (or minus) a total tolerance, the average diameter is the minimum (maximum) value plus (or minus) half the total tolerance. If the diameter is specified as a value with a plus-or-minus tolerance, the average diameter is the specified value.

3.4 Average Wall Thickness (t) : The wall thickness value, in inches rounded to three decimal places, obtained from the applicable pipe standard, plus, if applicable, half the total wall thickness tolerance. If the wall thickness is specified as a minimum value plus a total tolerance, the average wall thickness equals the sum of the minimum value plus half the total tolerance. If the wall thickness is specified as a value with a plus-or-minus tolerance, the average wall thickness is the specified value.

Note : For large diameter extruded thermoplastic pipe, some specifications require a minimum wall thickness and a maximum percent eccentricity, but do not specify a maximum wall thickness. For convenience, 106% of the minimum wall thickness is used as an average wall thickness in this method. However, the actual average wall thickness can be greater. For example, if the thinnest wall measured is 2% greater than the specified minimum wall thickness, +12% eccentricity would allow the maximum wall thickness to be 14% above minimum wall thickness. For this example, the resultant average wall thickness value calculates to be 107% of the minimum wall thickness.

4.0 FORMULAE

4.1 Formulae for estimating the nominal weight-per-foot of solid wall plastic pipe, in pounds per foot, are given as follows; the derivation is presented in the Appendix:

$$W = SG_{23} \times (OD^2 - ID^2) \times 0.34049 \qquad \text{Eq. \#1}$$

4.2 When the pipe dimensions are designated by outside diameter and wall thickness, equation #1 simplifies to:

$$W = SG_{23} \times (OD - t_{avg}) \times t_{avg} \times 1.36196 \qquad \text{Eq. \#2}$$

4.3 When the tube or pipe dimensions are designated by inside diameter and wall thickness, equation #1 simplifies to:

$$W = SG_{23} \times (ID + t_{avg}) \times t_{avg} \times 1.36196 \qquad \text{Eq. \#3}$$

5.0 Example Calculation:

5.1 Calculate the weight per foot of High Density Polyethylene Pipe with an average outside diameter of 2.375 inches of DR 11 with a wall tolerance of +12%, with Specific Gravity, at 23ºC, of 0.955 .

5.1.1 Determine the average wall thickness, t_{avg} :

$t_{min} = OD_{nominal} / DR = 2.375/11 = 0.216$ inches

$t_{avg} = t_{min} \times (1 + (0.12/2) = t_{min} \times 1.06 = 0.216" \times 1.06 = 0.229$ inches

5.1.2 Determine the average weight per foot :

$W = 0.955 \times (2.375 – 0.229) \times 0.229 \times 1.36196 = 0.639$ lbs/ft

6.0 Report

6.1 The report should include the following :

(a) Complete identification of the material from which the pipe is made.

(b) The Specific Gravity at 73ºF (23ºC), of the material, to three decimal places (i.e.: 0.955).

(c) The dimensions and tolerances of the pipe, and the standard or specification from which these dimensions and tolerances were taken.

(d) The Weight-per-Foot, rounded to at least two decimal places.
(Note: For tubing diameters, rounding to three or more places is advisable.)

Appendix

Derivation of Weight-per-Foot Formula

These formulae use English units of inches, pounds, and feet.

$$W = SG_{23} \times Pi/4 \times (OD^2 - ID^2) \times 1 \text{ foot} \times 12 \text{ in/ft} \times 62.4 \text{lb/ft}^3 \times (1 / 1728 \text{ in}^3/\text{ft}^3)$$

$$W = SG_{23} \times (OD^2 - ID^2) \times 0.34049 = \underline{\hspace{2cm}} \text{ lbs / ft.}$$

Note : $(OD^2 - ID^2) = 4 \times (OD - t_{avg}) \times t_{avg}$

Therefore

$$\boxed{W = SG_{23} \times (OD - t_{avg}) \times t_{avg} \times 1.36196 = \underline{\hspace{2cm}} \text{ lbs / ft.}}$$