

## Force to Bend / Minimum Bend Radius

The amount of force required to bend a hose and the minimum bend radius are important factors in hose design and selection. The minimum bend radius is defined as the radius to which the hose can be bent in service without damaging or appreciably shortening the life of the product, and is measured to the inside of the curvature of the bend. The bend radius for a given application must be equal to or greater than the rated minimum bend radius. Bending the hose to a smaller bend radius than minimum may kink the hose and result in premature failure.

Perhaps more important in determining flexibility, the force-to-bend is defined as the amount of force required to induce bending around a specified radius. The less force that is required, the easier the product is to maneuver in the field. Different hose constructions may require significantly different forces to attain the same minimum bend radius. Generally, the preferred hose is the more flexible hose, provided all other properties are essentially equivalent.

## Oil and Fuel Resistance

Rubber compounds are available in different formulations, blends and grades. Compounds are selected by hose design engineers based on the intended application of the hose. For instance, a hose recommended for multipurpose applications that may include hydraulic or

lubrication oil service generally contains a lower grade of tube compound. Conversely, a hose recommended for a more rigorous application, such as highly refined fuel service, contains a higher grade of compound, often within the same compound family.

Rubber hose is used to convey petroleum products both in the crude and refined stages. The aromatic content of refined gasoline is often adjusted to control the octane rating. The presence of aromatic hydrocarbons in this fuel generally has a greater effect on rubber components than do aliphatic hydrocarbons. Aromatic materials in contact with rubber tend to soften it and reduce its physical properties. For long-lasting service, the purchaser of fuel hose should inform the hose manufacturer of the aromatic content of the fuel to be handled so that the proper tube compound can be recommended for the specific application.

The effect of oil on rubber depends on a number of factors that include the type of rubber compound, the composition of the oil, the temperature and duration of exposure. Rubber compounds can be classified to their degree of oil resistance based on their physical properties after exposure to a standard test fluid. In this ARPM classification, the rubber samples are immersed in IRM 903 oil at 212°F (100°C) for seventy hours. (See [ASTM Method D-471](#) for a detailed description of the oil and the testing procedure.) As a guide to users of hose in contact with oil, the oil resistance classes and a corresponding description are listed on the next page.

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### General Formula for Minimum Hose Length (given hose bend radius and degree of bend required)

$$\frac{\text{Angle of Bend}}{360^\circ} \times 2 \pi r = \text{Minimum length of hose to make bend.}$$

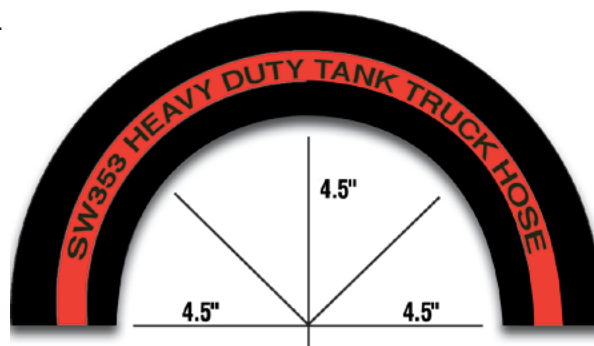
$r = \text{Given bend radius of hose.}$

**Example:** To make a 90° bend with 2" I.D. hose.  
Given  $r = 4.5$  inches.

$$\frac{90}{360} \times 2 \times 3.14 \times 4.5$$

$$.25 \times 2 \times 3.14 \times 4.5 = 7" \text{ (minimum length of hose to make bend without damage to hose)}$$

The bend radius for a given application must be equal to or greater than the rated minimum bend radius. Bending the hose to a smaller bend radius than minimum may kink the hose and result in premature failure.



The minimum bend radius is measured to the inside of the curvature.

### General Formula for Minimum Hose Length (allowing relief from couplings)

$$\text{Overall Length (OAL)} = (2 \times \text{Length of Coupling}) + (2 \times \text{Hose OD}) + (\text{Angle}/360) \times 2 \pi r$$