

## Calculation of Burst Yield and Collapse Yield for Round Tubing

### Burst Yield

We assume no external pressure for the calculation of burst yield. If we denote axial stress as  $\sigma_a$ , hoop stress  $\sigma_h$  and radial stress  $\sigma_r$ , then from thick-walled analytical results:

$$\sigma_a = \frac{F}{\frac{\pi}{4} (OD^2 - ID^2)} \quad (1)$$

$$\sigma_h = p_i \frac{(OD^2 + ID^2)}{(OD^2 - ID^2)} \quad (2)$$

$$\sigma_r = p_i \quad (3)$$

Where  $p_i$  is the internal pressure,  $F$  is the tension force (weight here),  $ID$  is the tubing inner diameter and  $OD$  is the outer diameter. Substituting (1) - (3) into the following Von Mises criterion

$$(\sigma_a - \sigma_h)^2 + (\sigma_h - \sigma_r)^2 + (\sigma_r - \sigma_a)^2 = 2S_y^2 \quad (4)$$

we get:

$$p_i = \frac{1}{2(B^2 + B + 1)} \left( \sigma_a = (B - 1) \pm \sqrt{\sigma_a^2 (B - 1)^2 + 4(B^2 + B + 1)(S_y^2 - \sigma_a^2)} \right) \quad (5)$$

Where  $B = (OD^2 + ID^2) / (OD^2 - ID^2)$ ,  $S_y$  is the yield strength. We should ignore the negative sign in (5) because it is physically insignificant. So, from the positive root, we can get the burst yield equation.

$$p_i^{burst} = \frac{1}{2(B^2 + B + 1)} \left( \sigma_a = (B - 1) \pm \sqrt{\sigma_a^2 (B - 1)^2 + 4(B^2 + B + 1)(S_y^2 - \sigma_a^2)} \right) \quad (6)$$

Figure 1 shows the burst yield for a tubing with  $OD = 2.375"$ ,  $WT = 0.175"$  (using its minimum value of  $0.167"$ ) and 70,000 psi yield strength.

# Calculation of Burst Yield and Collapse Yield for Round Tubing

## Collapse Yield

We assume no internal pressure. Denote the external pressure as  $p_o$ . The axial stress is the same as that given by (1). The radial pressure at the inner surface is zero.

$$\sigma_r = 0 \tag{7}$$

From analytical calculations, we get hoop stress

$$\sigma_b = -2p_o \frac{OD^2}{OD^2 - ID^2} \tag{8}$$

Substituting (1), (7) and (8) into (4), we get

$$p_o = \frac{-\sigma_a \pm \sqrt{4S_y^2 - 3\sigma_{a2}}}{2C} \tag{9}$$

where  $C = 2 OD^2 / (OD^2 - ID^2)$ . The negative sign is physically insignificant. The positive root is the collapse yield solution. Because conventionally collapse pressure is negative, we add a negative sign before the positive root. So,

$$p_o^{collapse} = \frac{-\sigma_a \pm \sqrt{4S_y^2 - 3\sigma_{a2}}}{2C} \tag{10}$$

the collapse curve based on (10) is shown in Figure 1.

## Burst and Collapse Curve

To make the whole curve look better, we take the physically insignificant root from the burst result (equation 5) to add a third curve to figure 1.

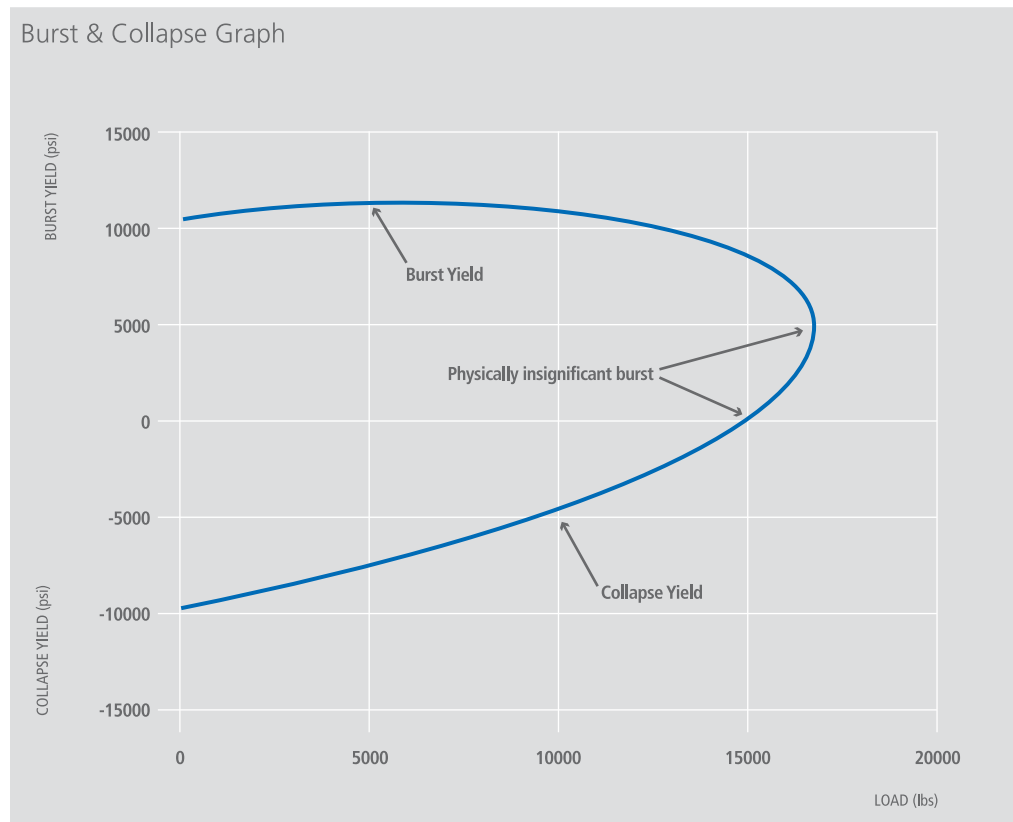
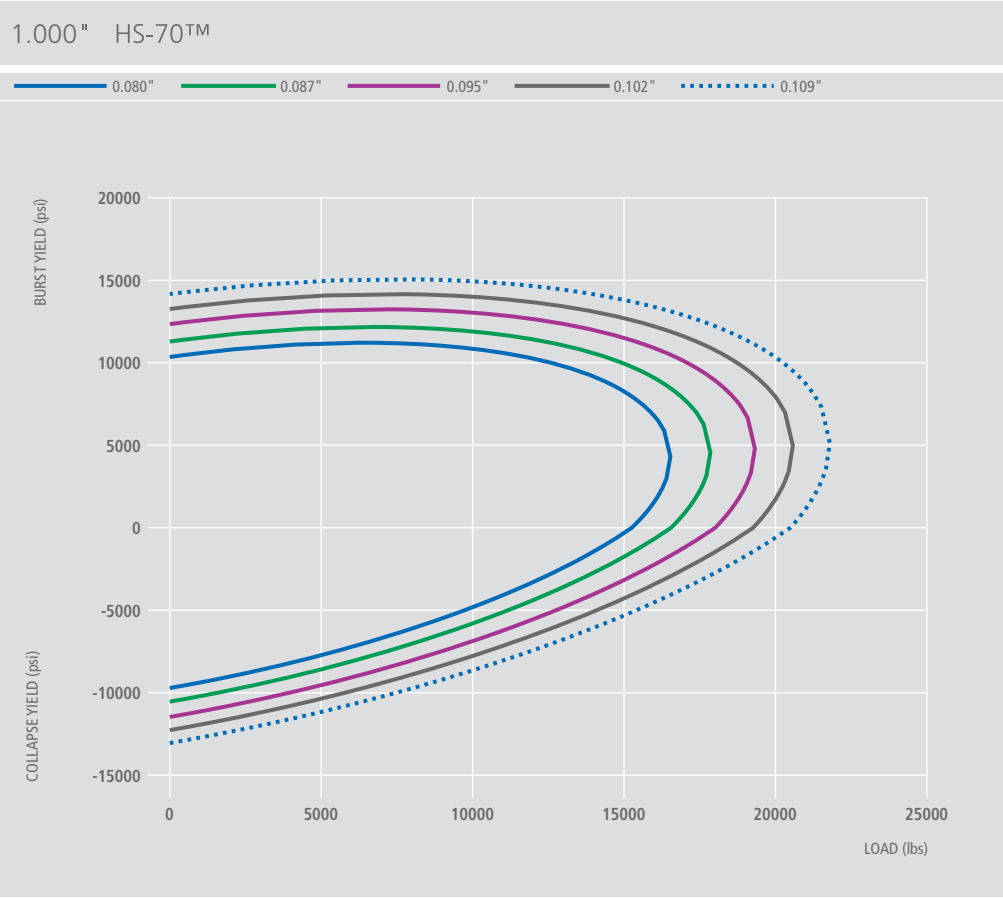
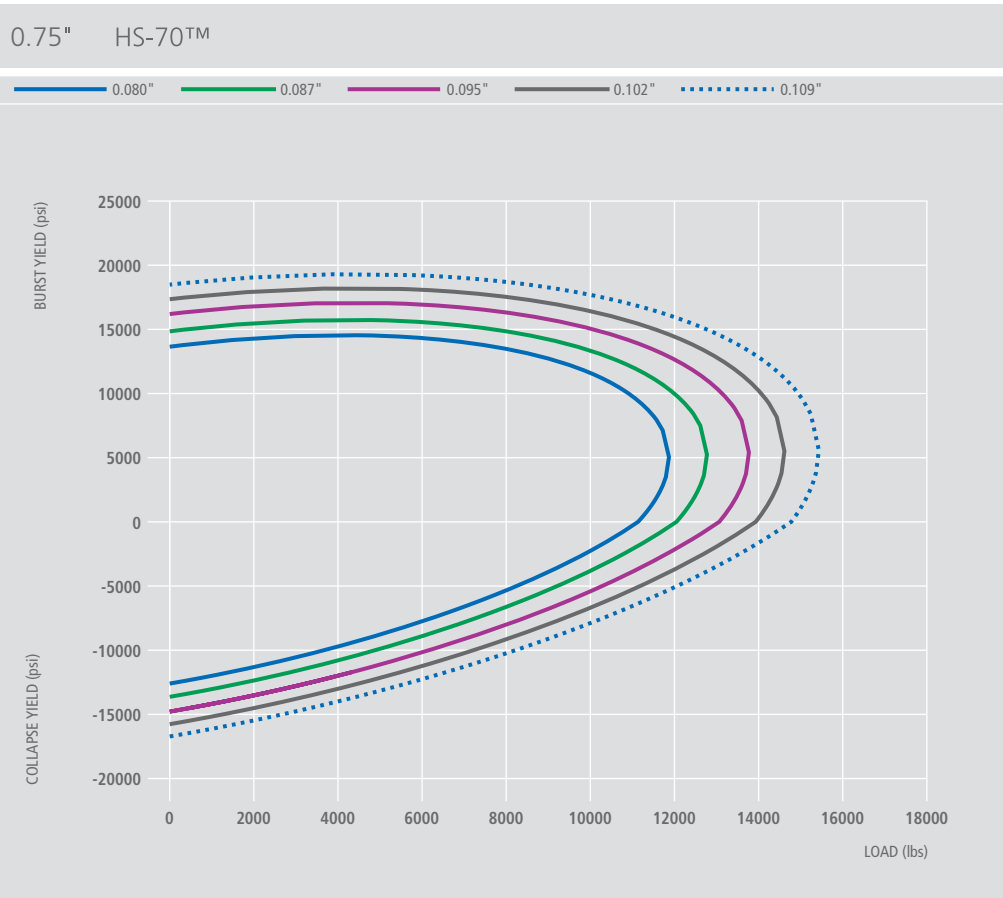


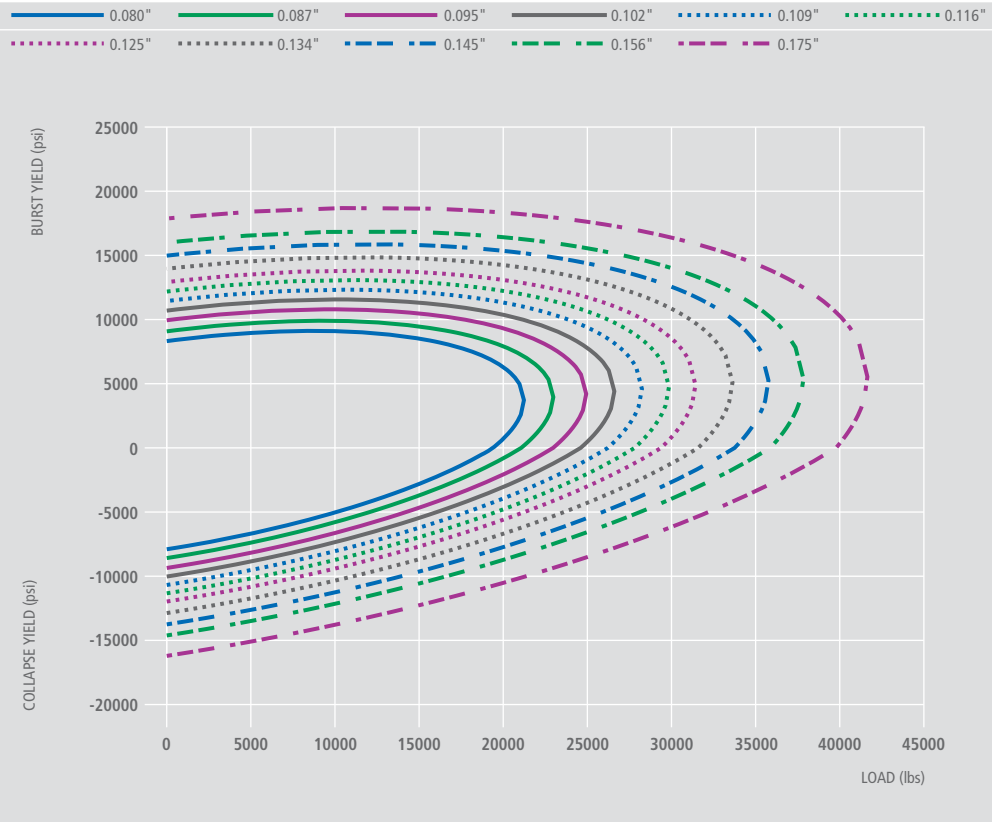
Figure 1. Burst yield and collapse yield curve.

# Pressure capacity curves

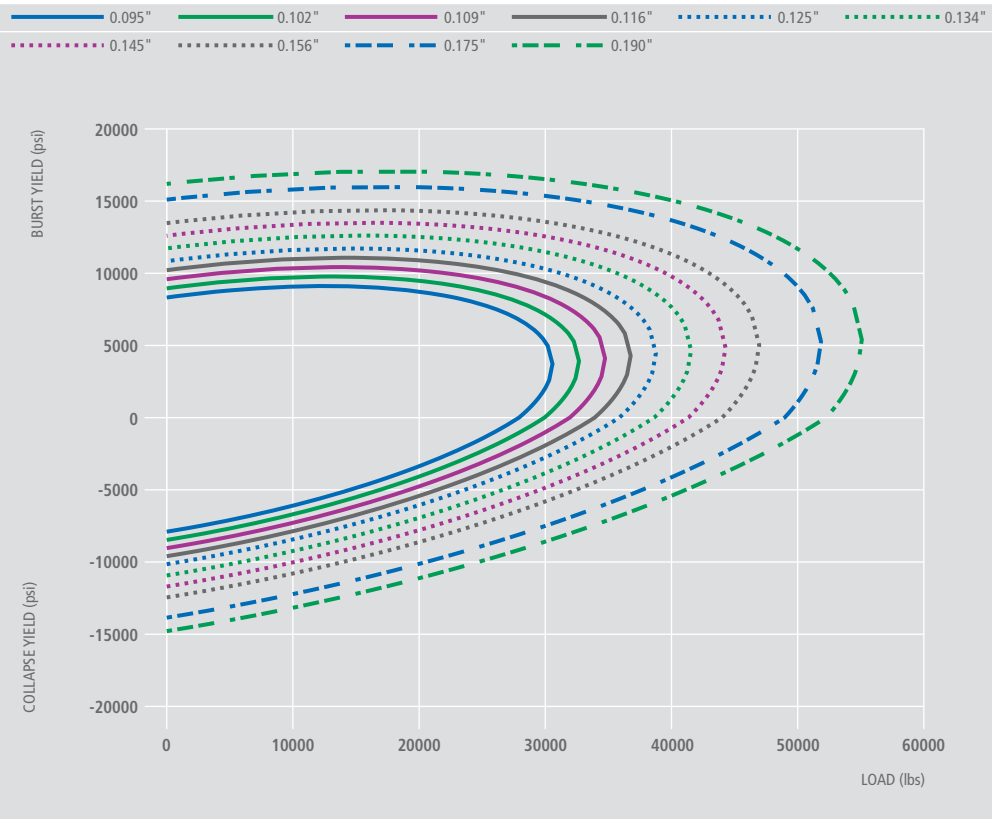


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 70,000 psi yield strength.

1.250" HS-70™

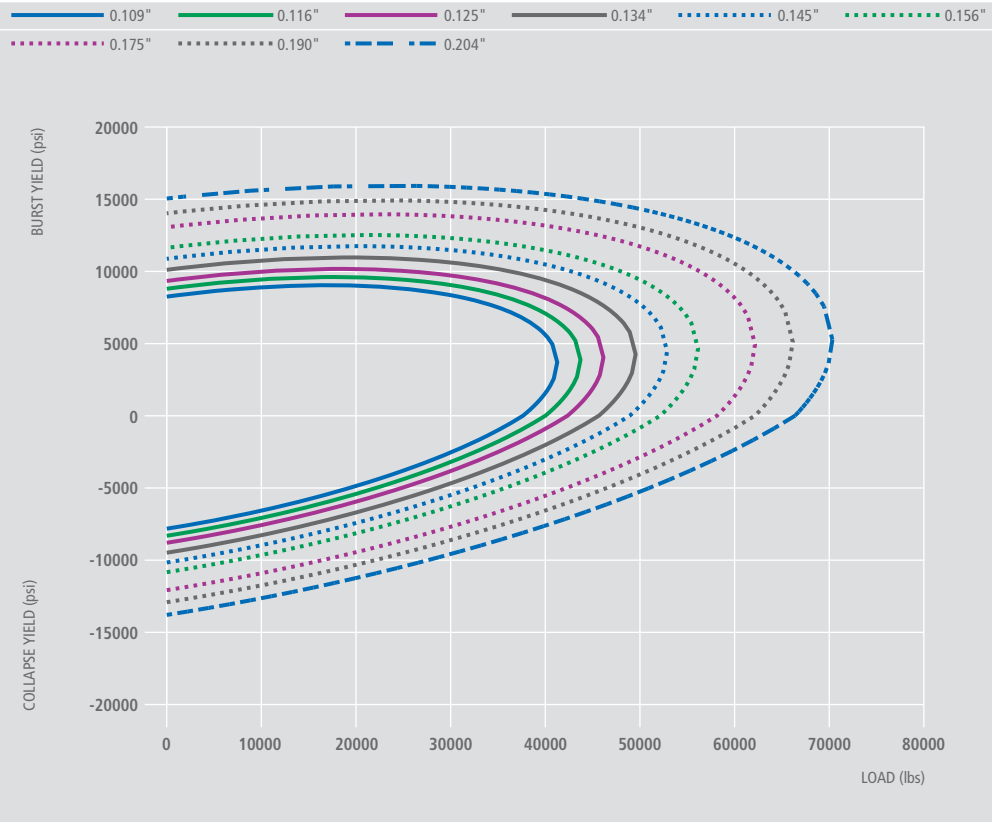


1.500" HS-70™

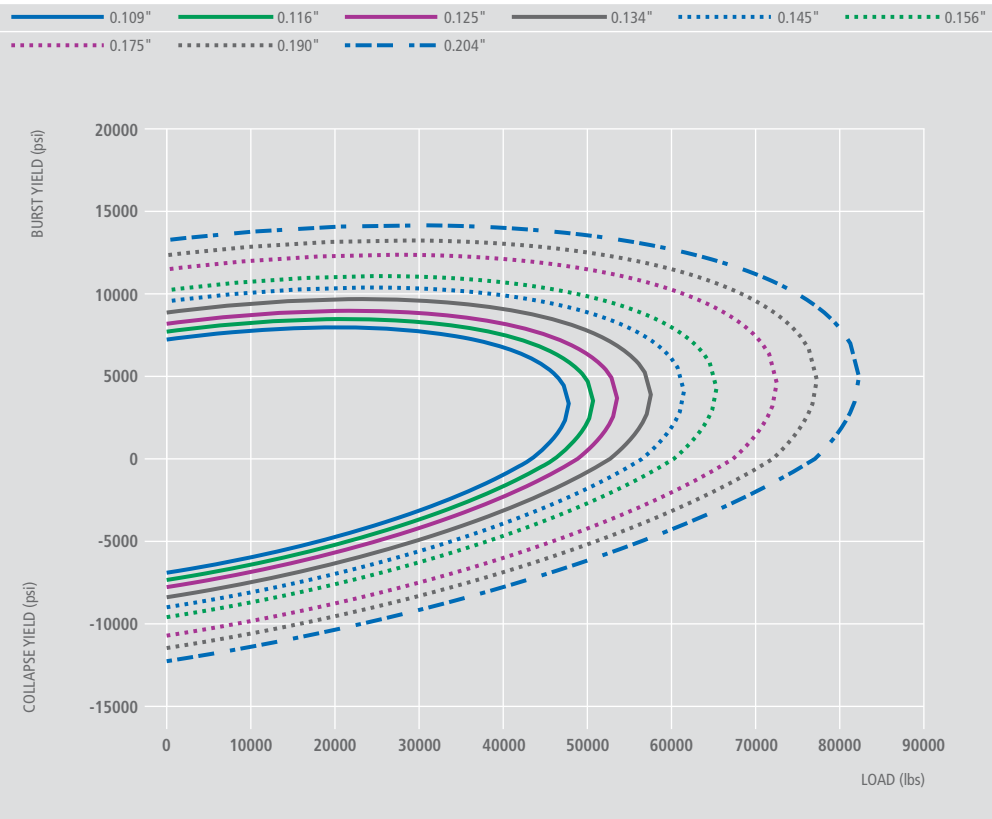


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 70,000 psi yield strength.

1.750" HS-70™

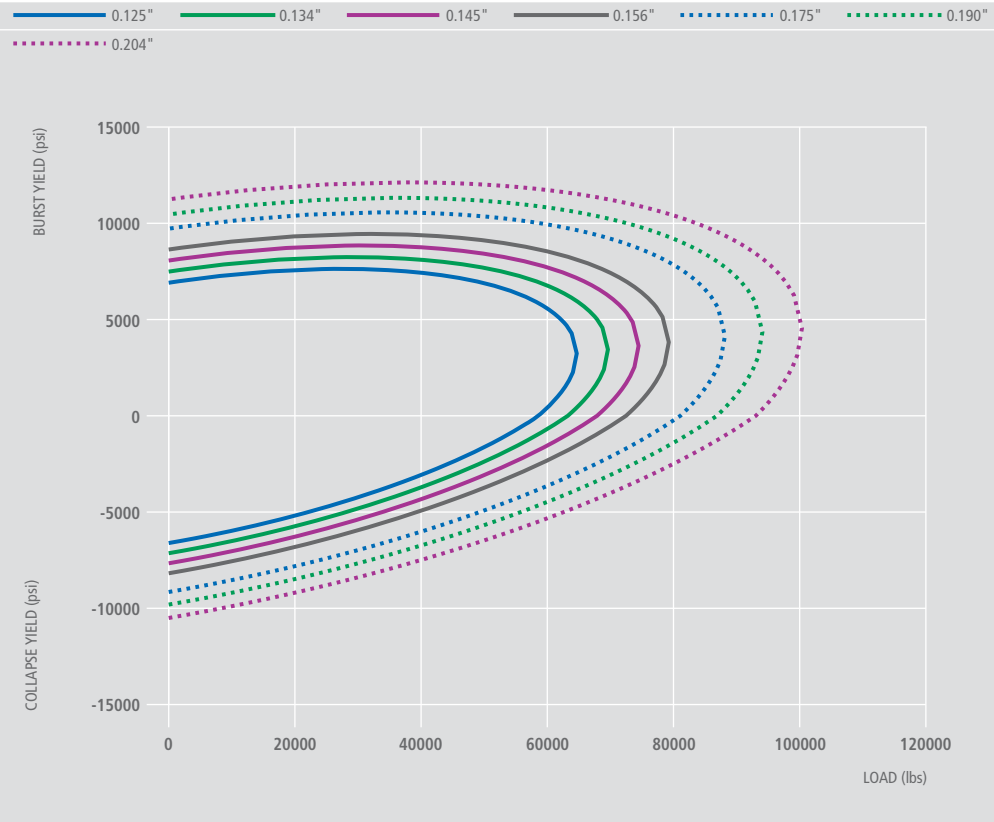


2.000" HS-70™

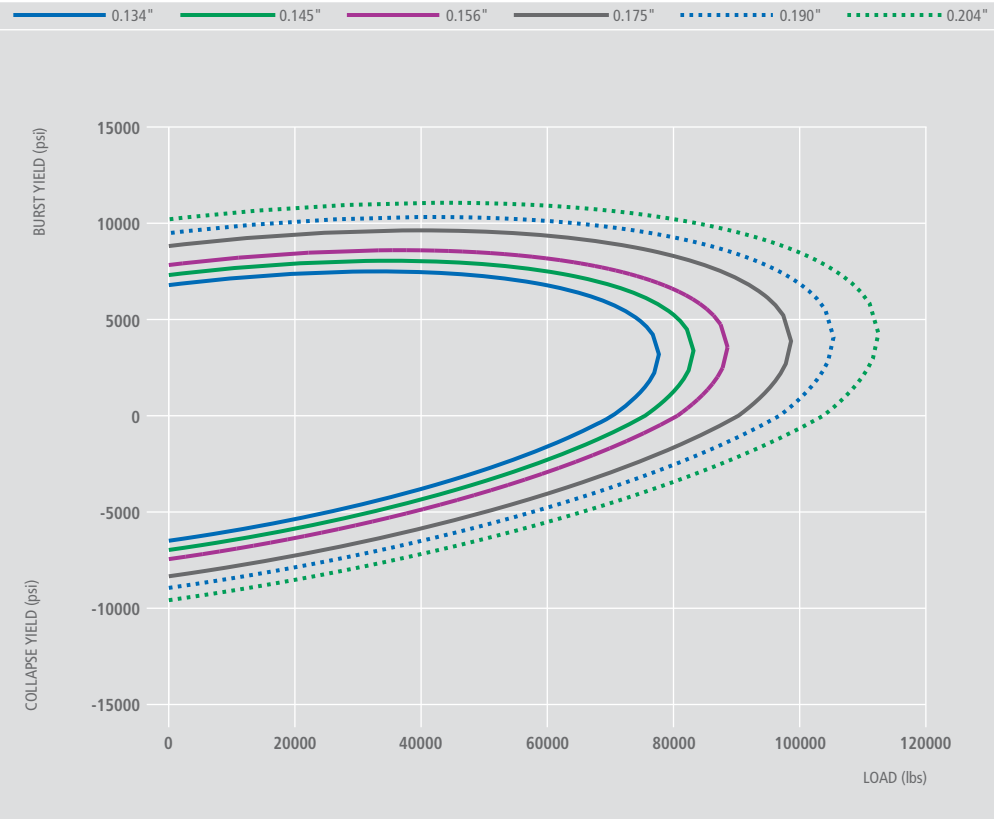


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 70,000 psi yield strength.

2.375" HS-70™

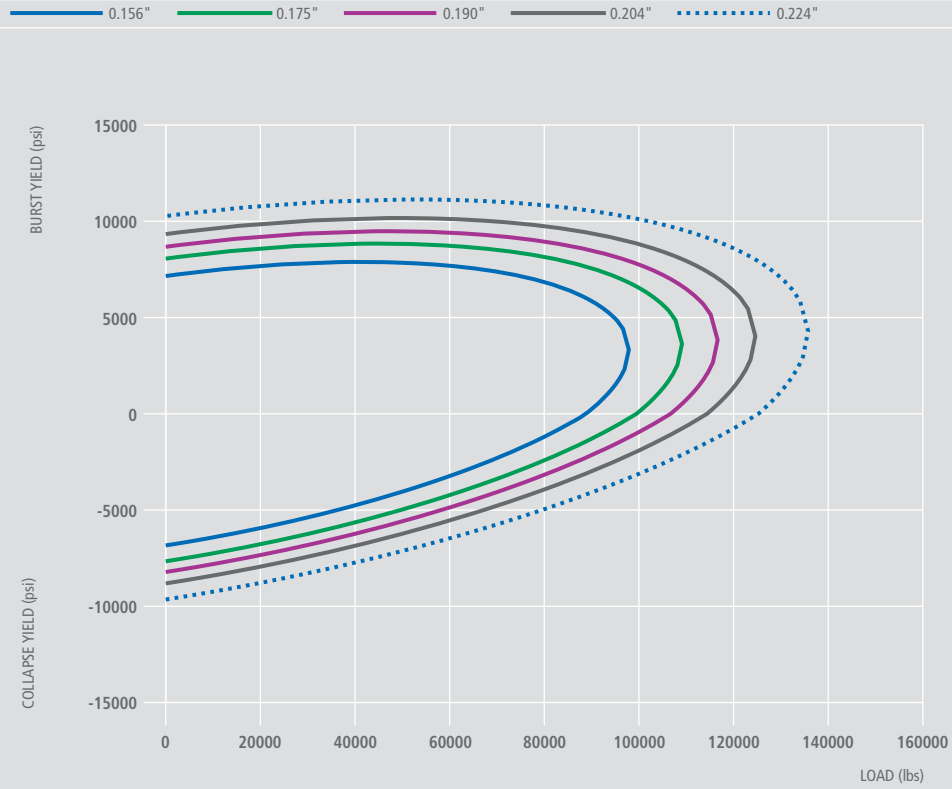


2.625" HS-70™

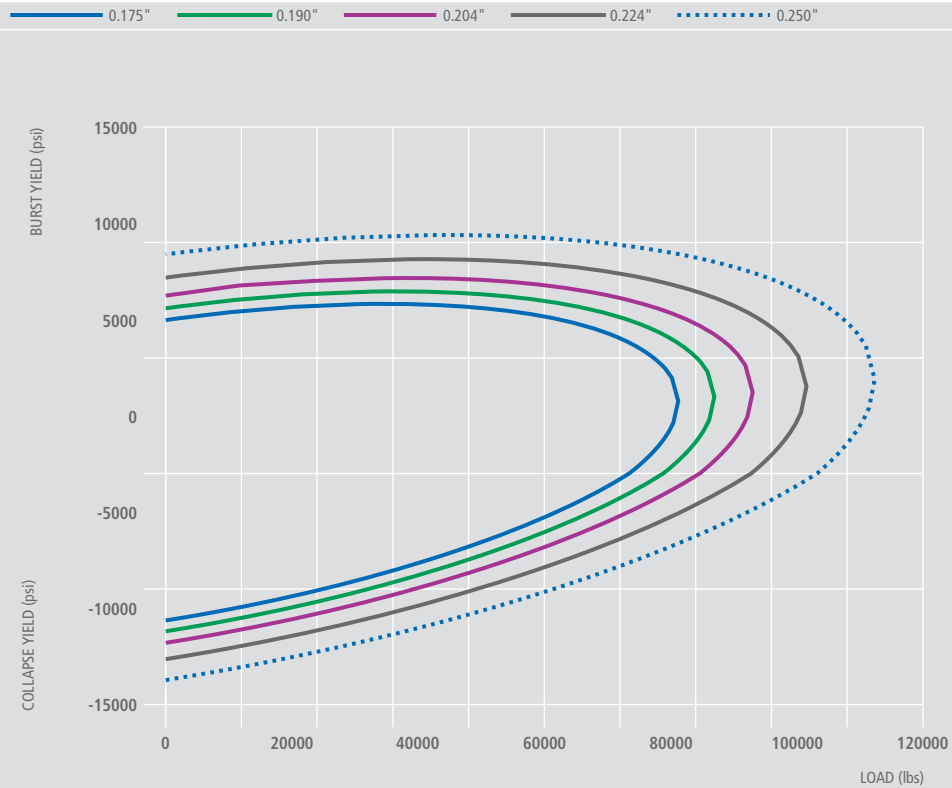


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 70,000 psi yield strength.

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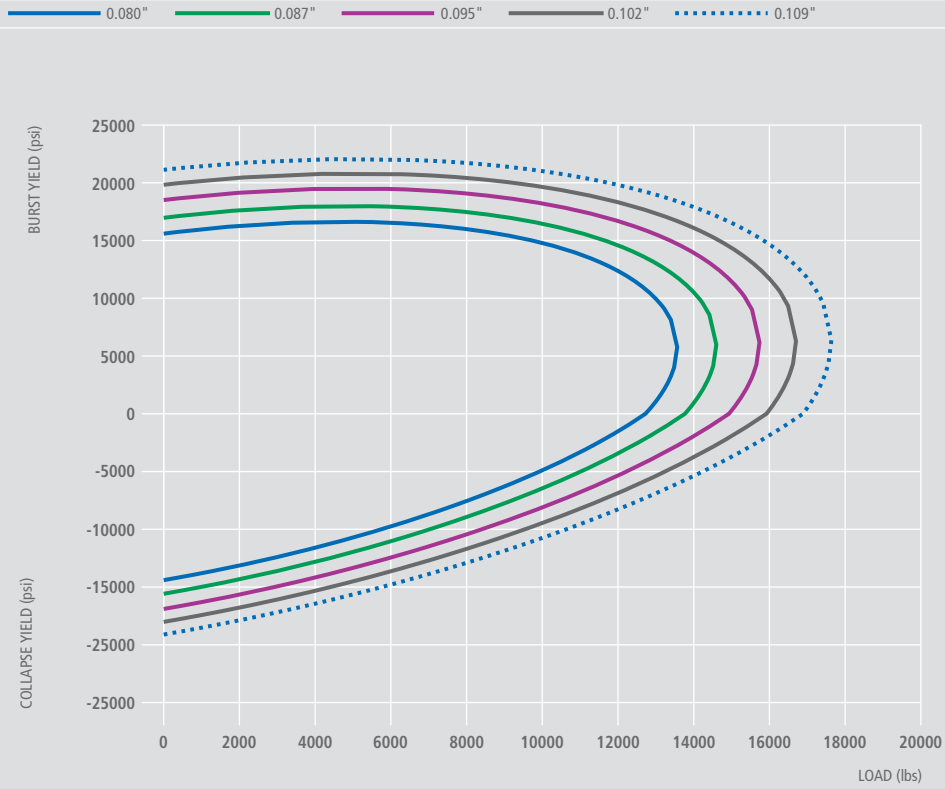


### 3.500" HS-70™

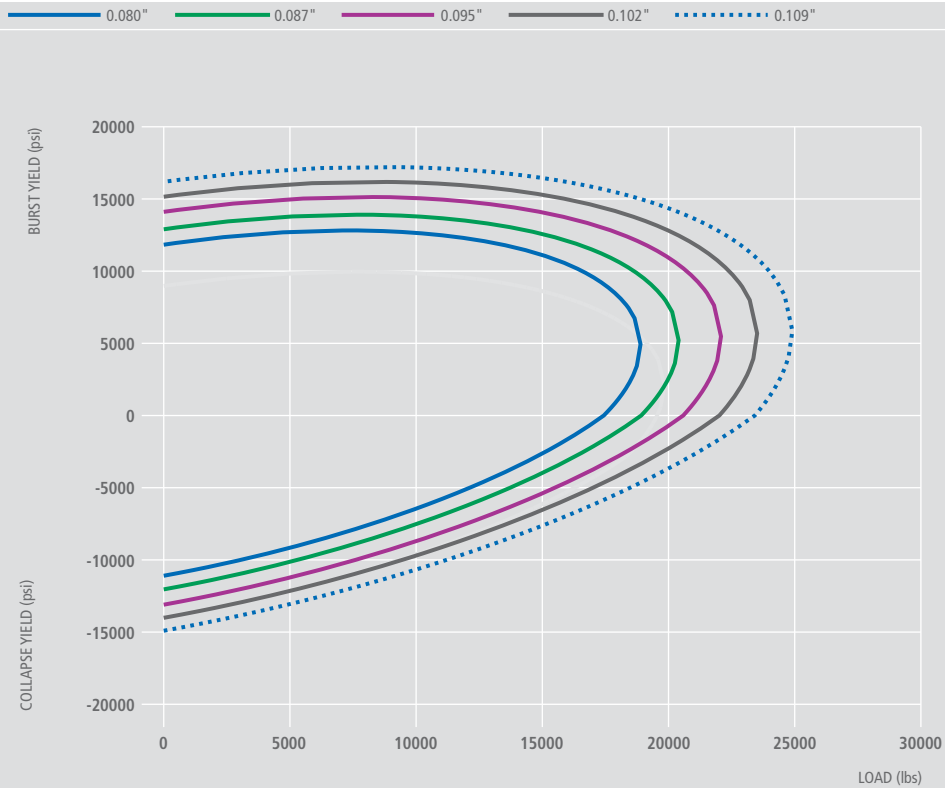


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 70,000 psi yield strength.

0.75" HS-80™

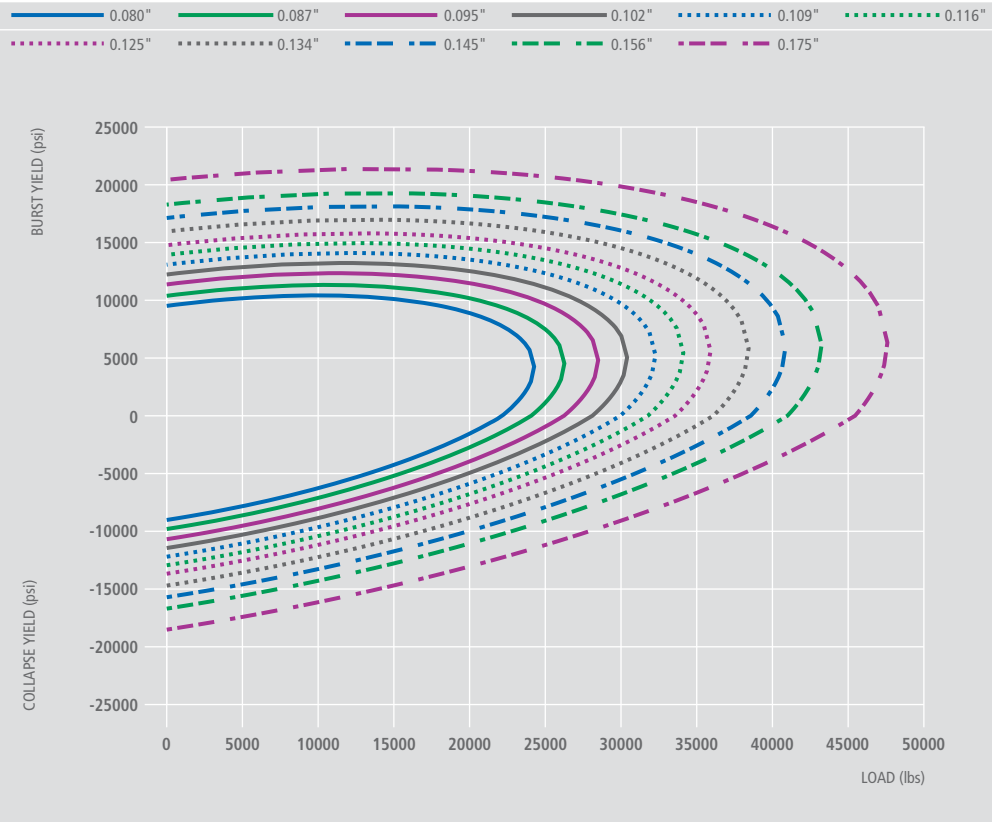


1.000" HS-80™

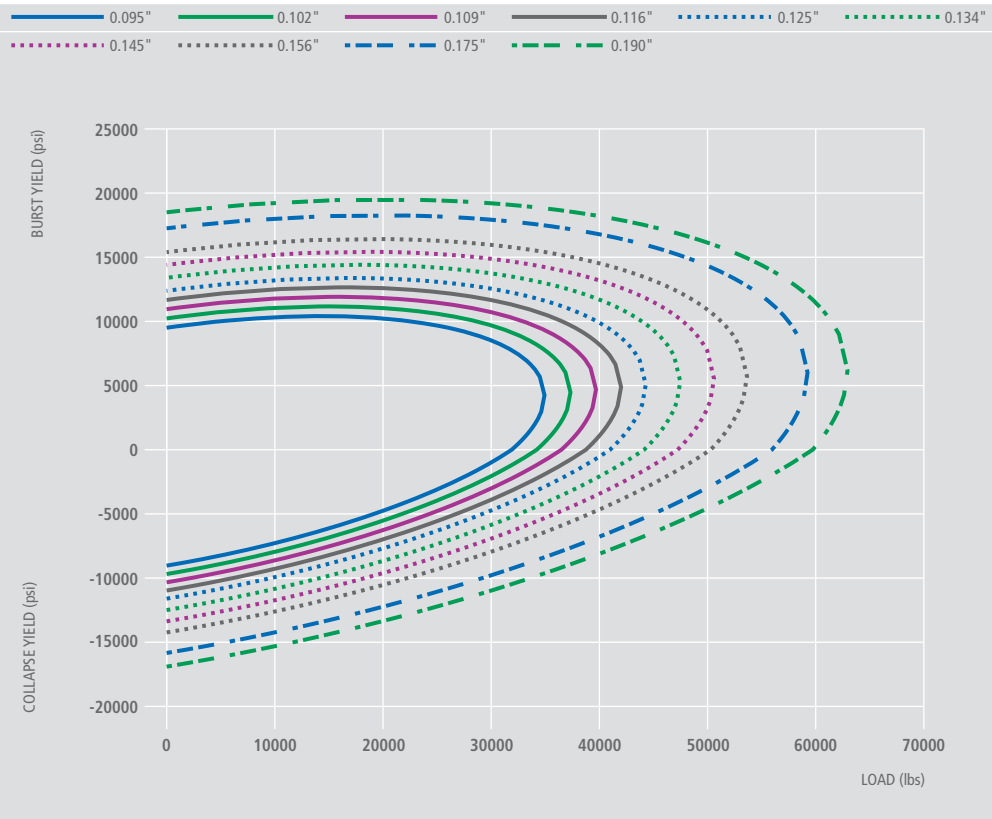


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 80,000 psi yield strength.

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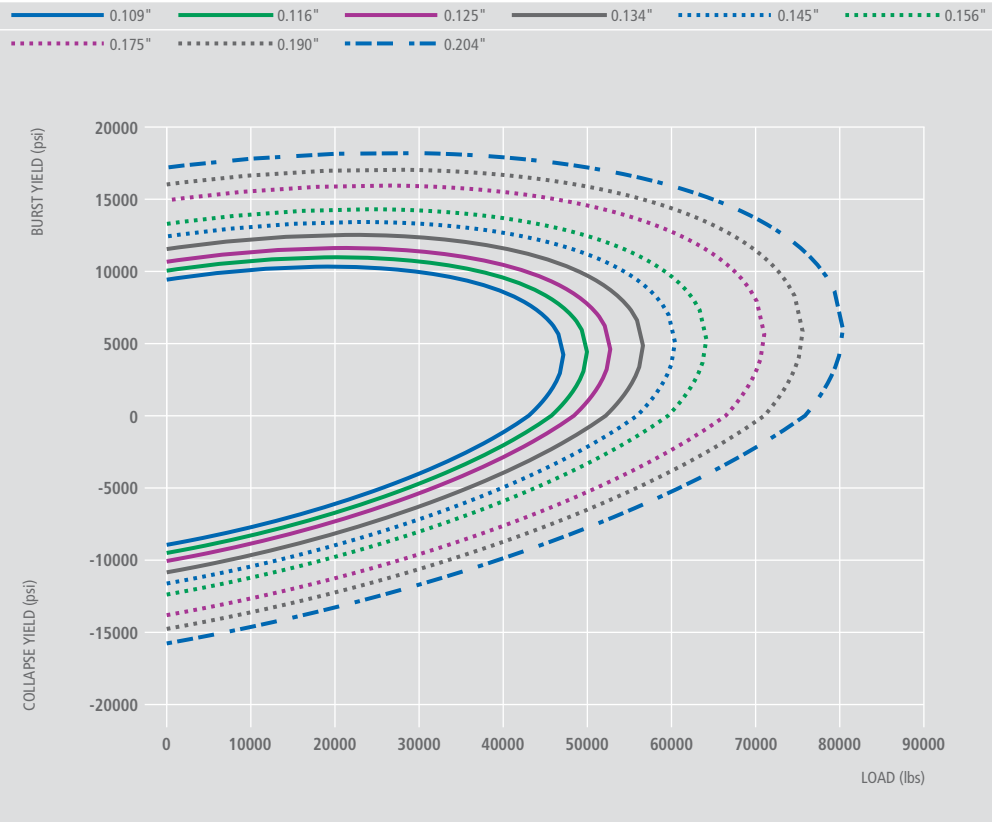


### 1.500" HS-80™

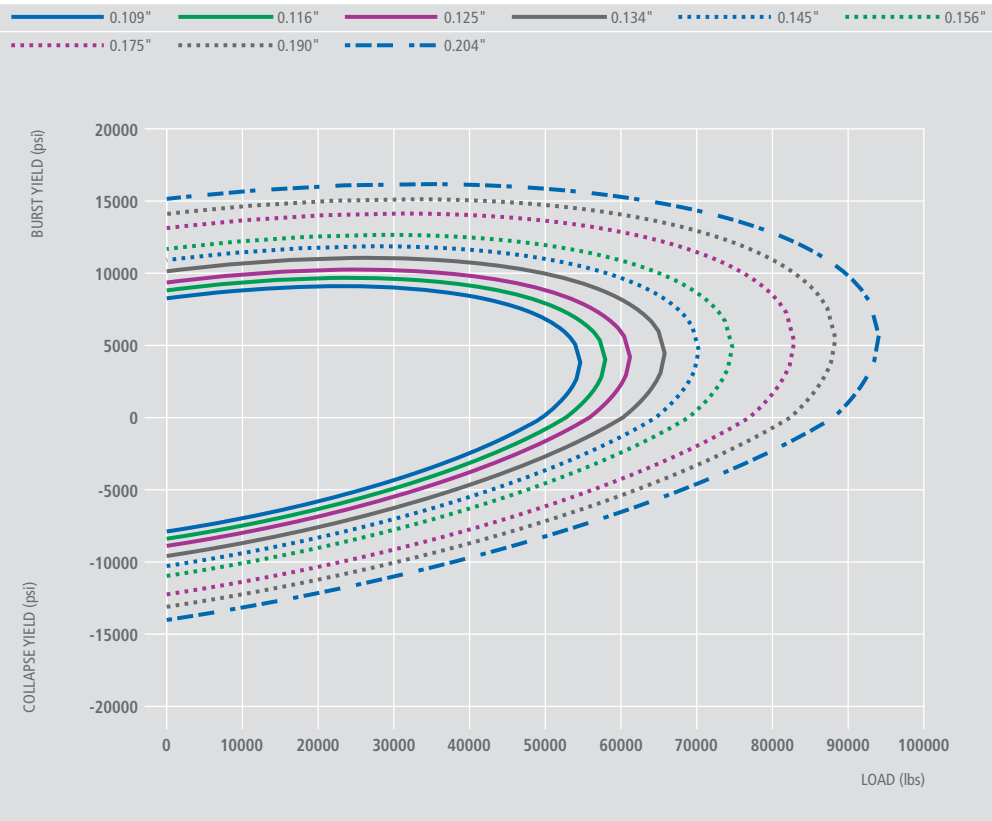


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 80,000 psi yield strength.

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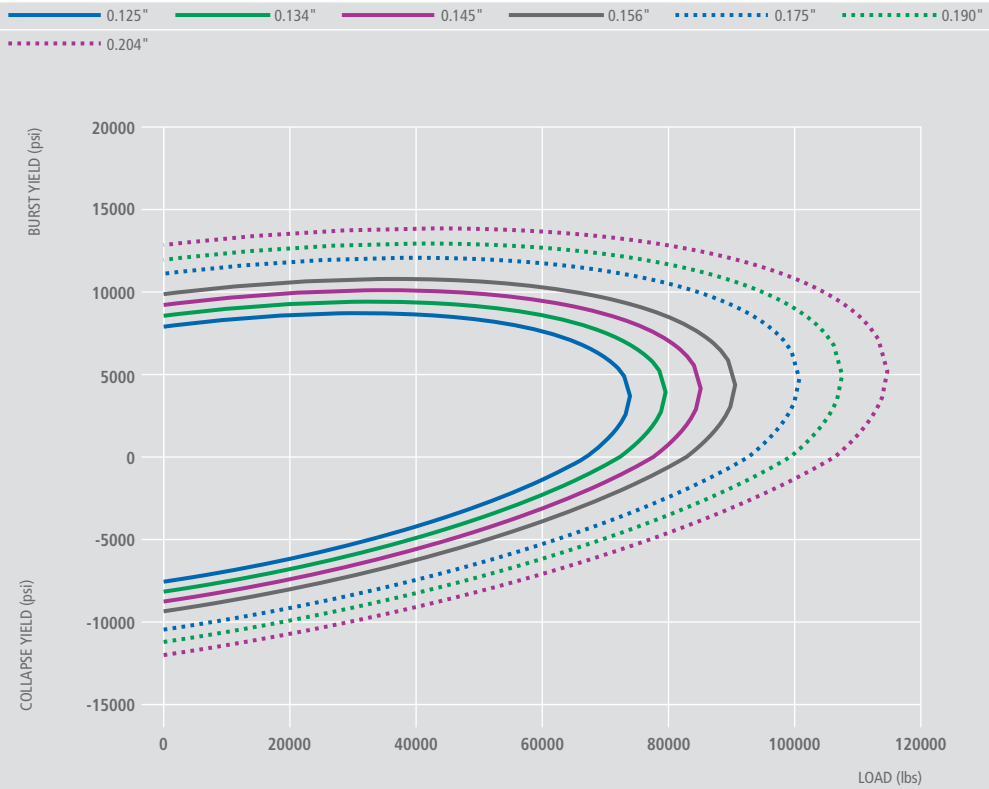


### 2.000" HS-80™

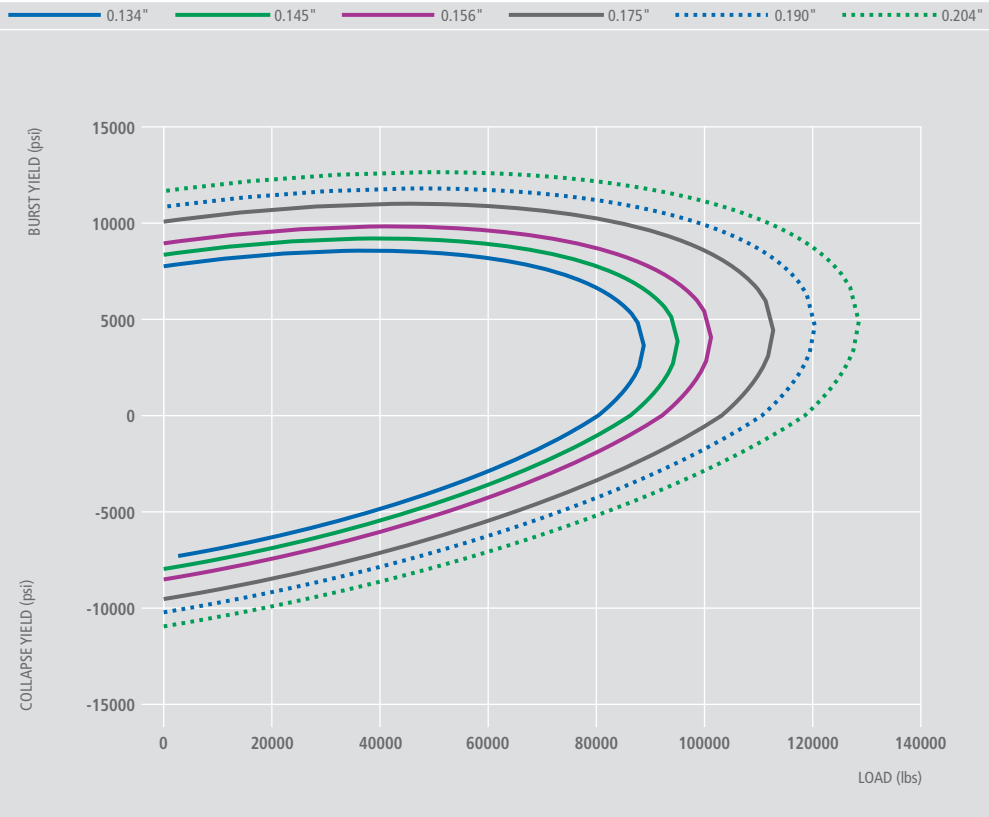


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 80,000 psi yield strength.

2.375" HS-80™

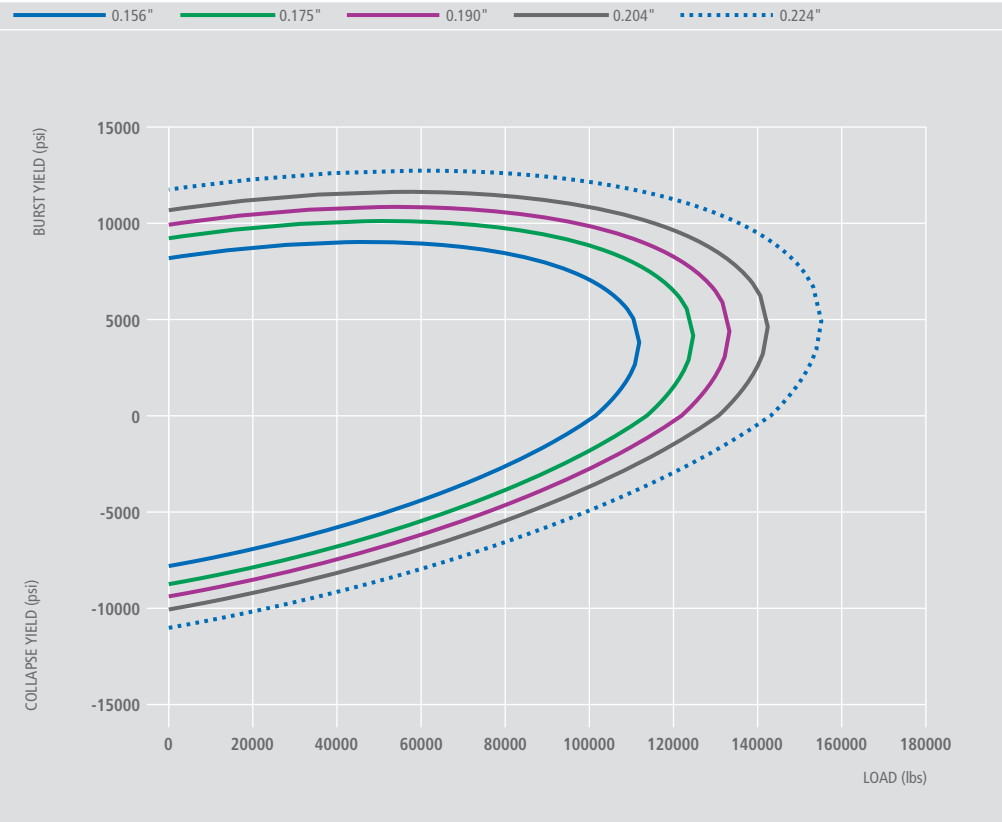


2.625" HS-80™

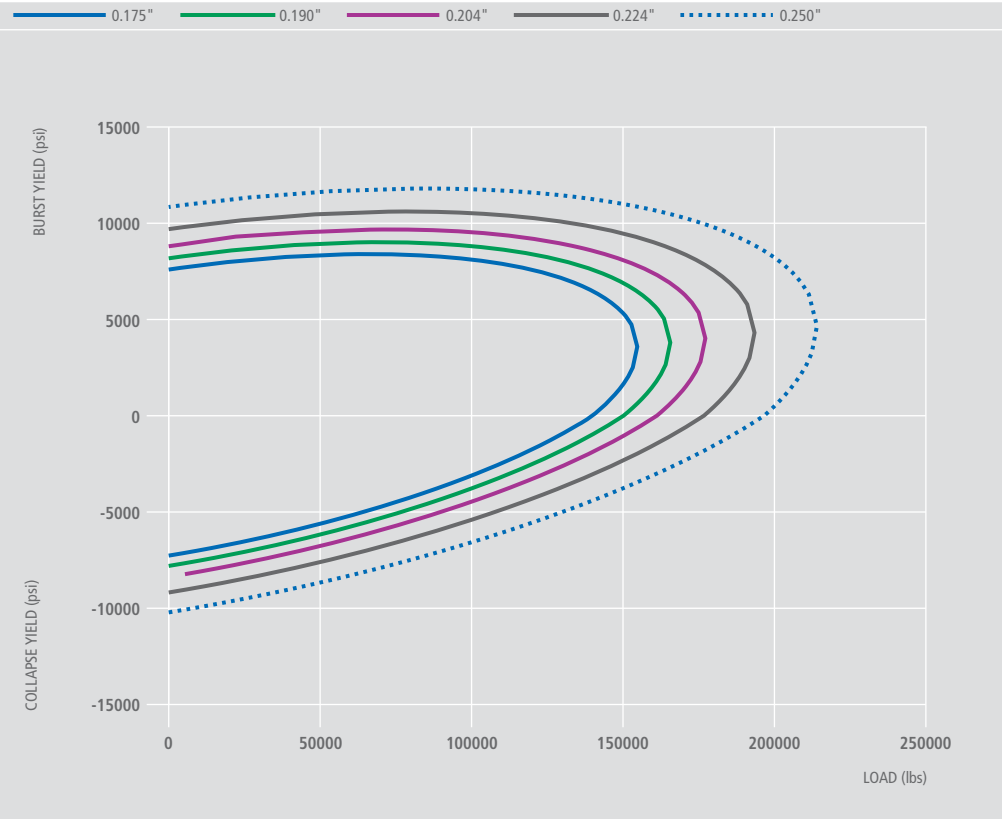


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 80,000 psi yield strength.

### 2.875" HS-80™

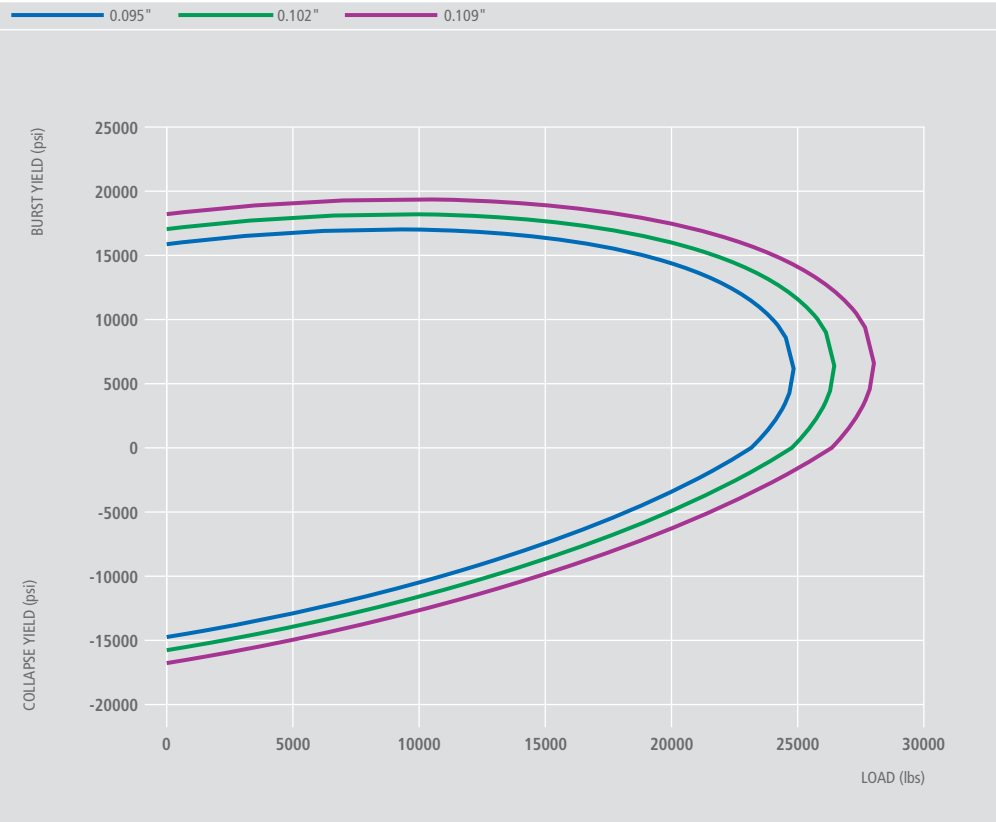


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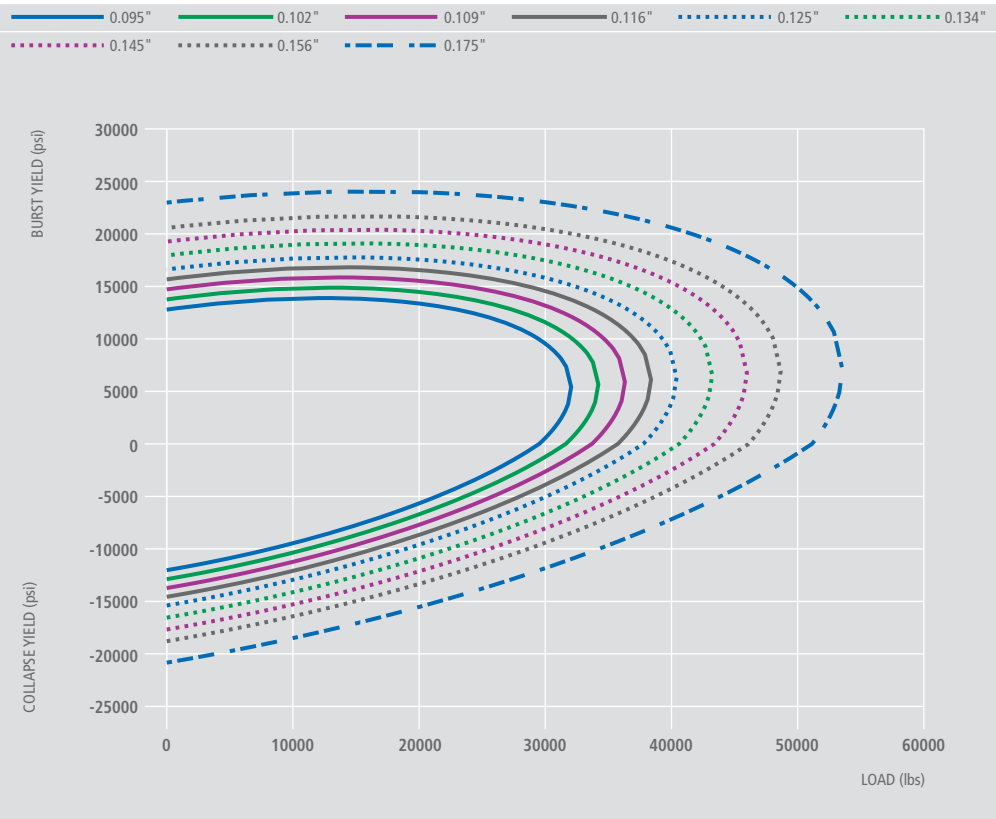


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 80,000 psi yield strength.

### 1.000" HS-90™

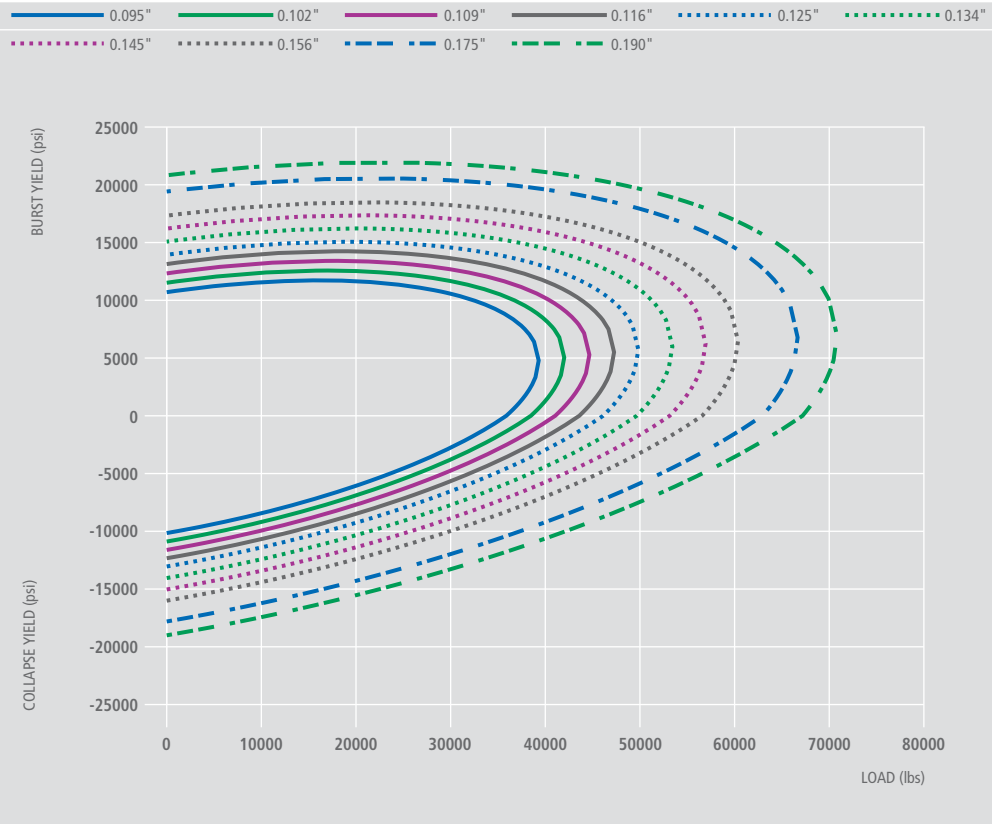


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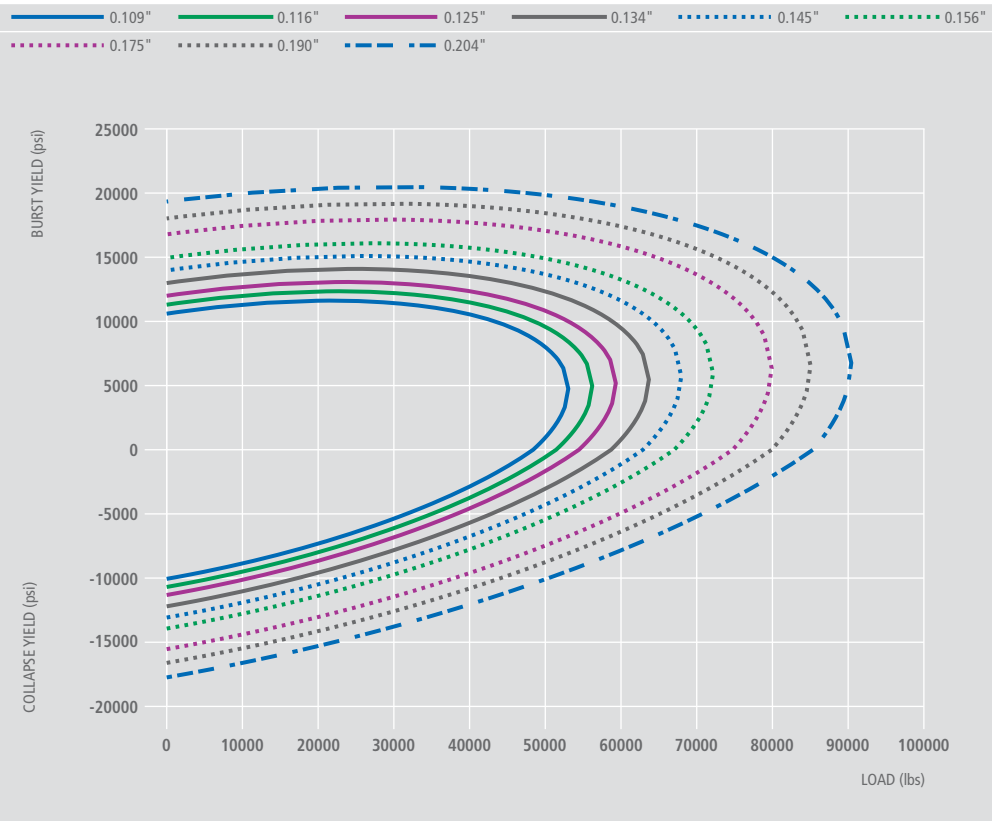


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### 1.500" HS-90™

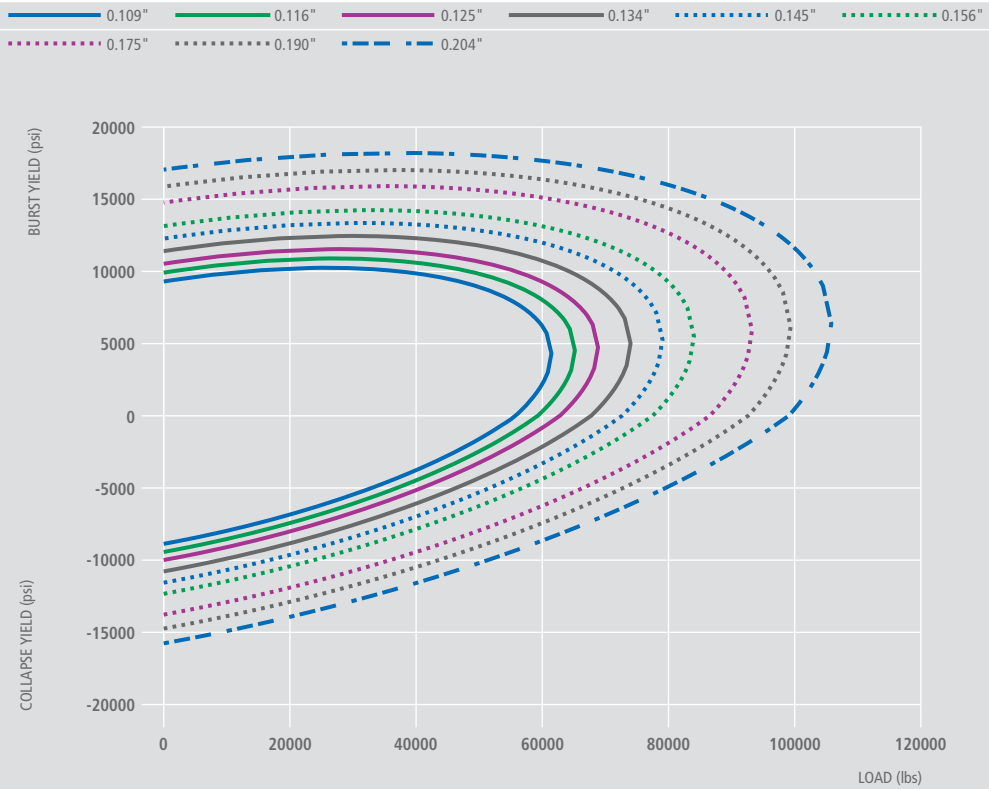


### 1.750" HS-90™

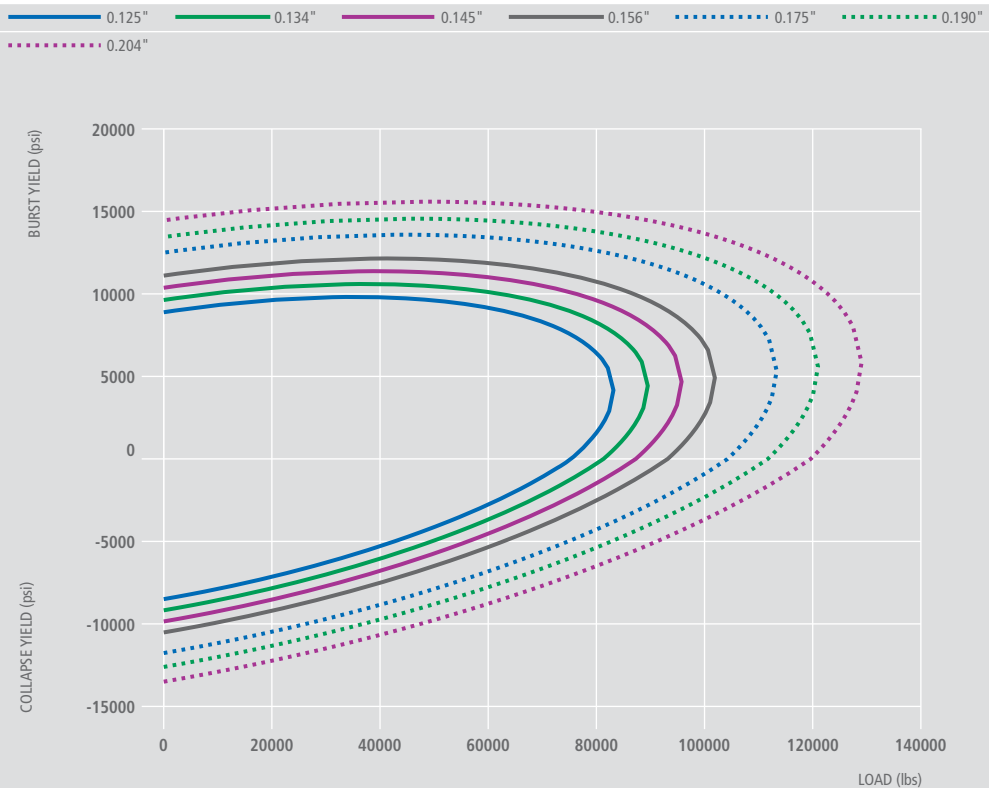


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## 2.000" HS-90™

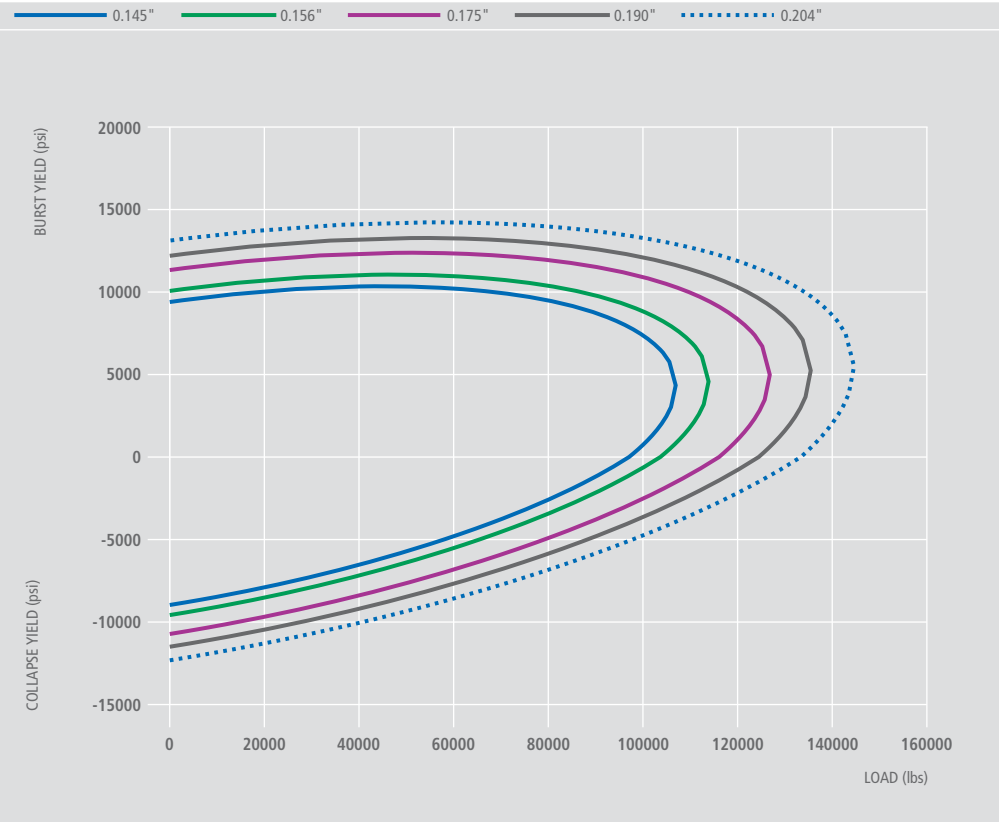


## 2.375" HS-90™

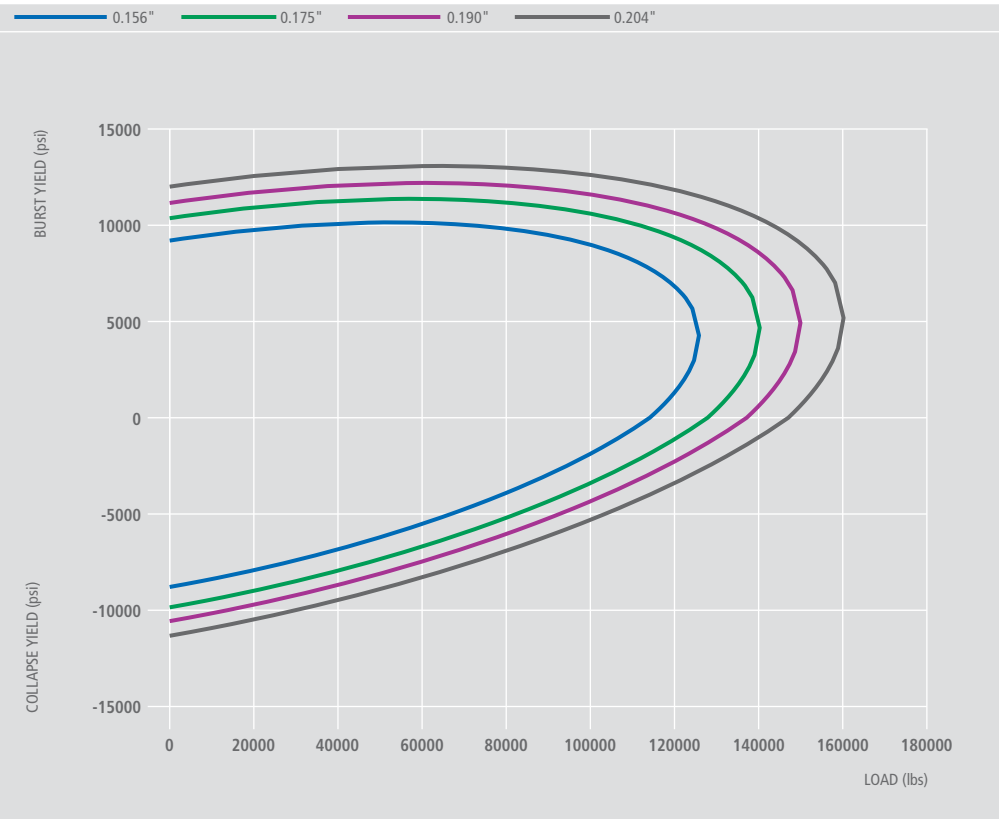


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 90,000 psi yield strength.

## 2.625" HS-90™

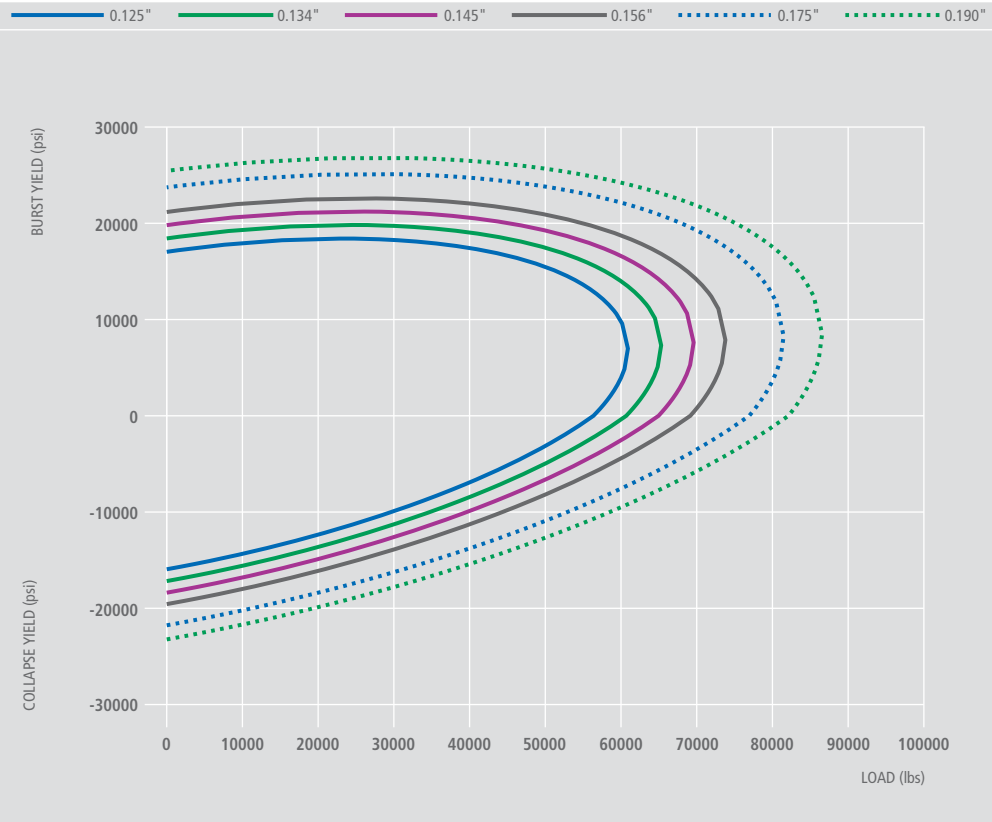


## 2.875" HS-90™

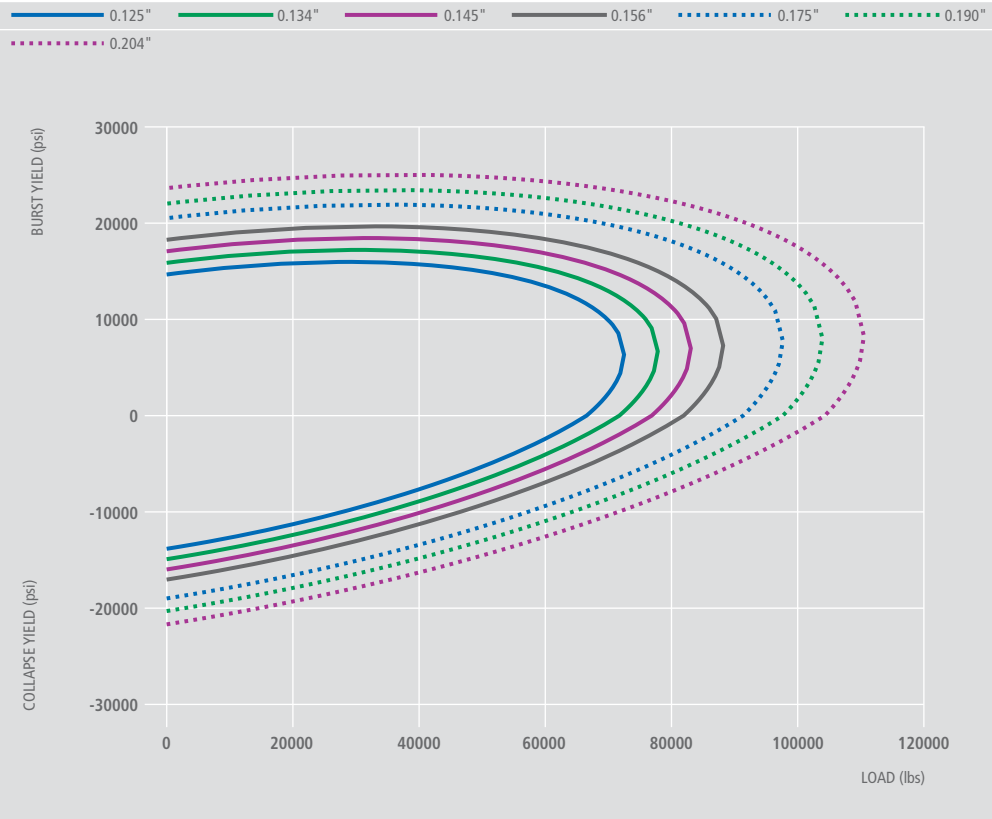


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 90,000 psi yield strength.

### 1.500" HS-110™

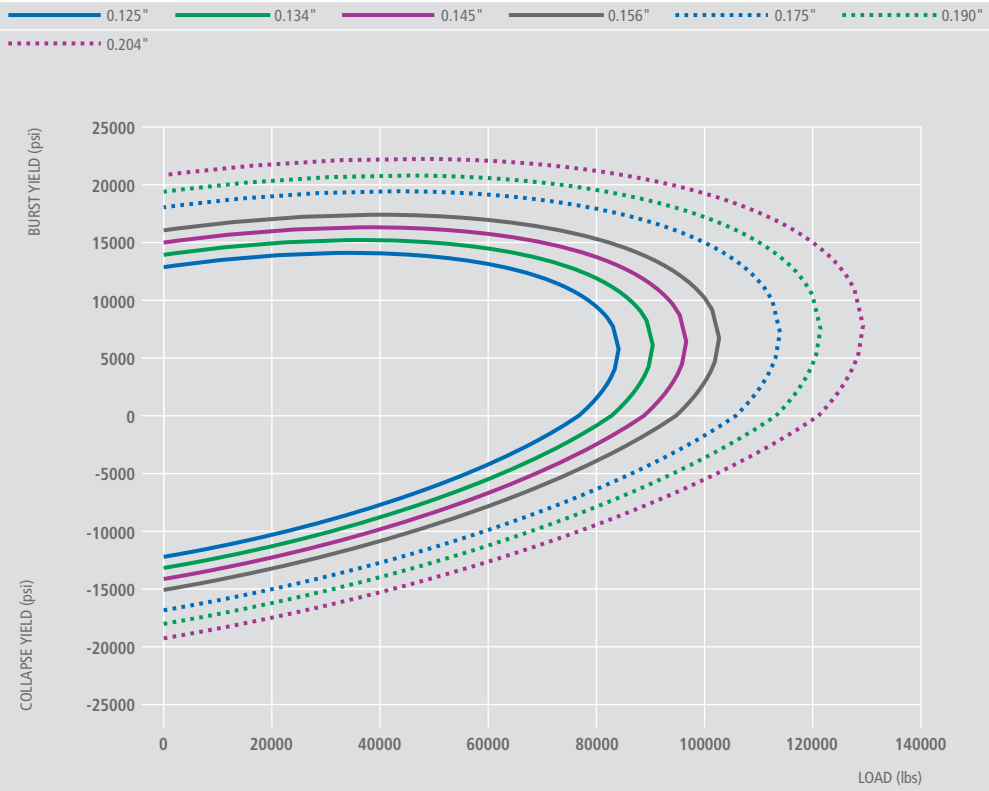


### 1.750" HS-110™

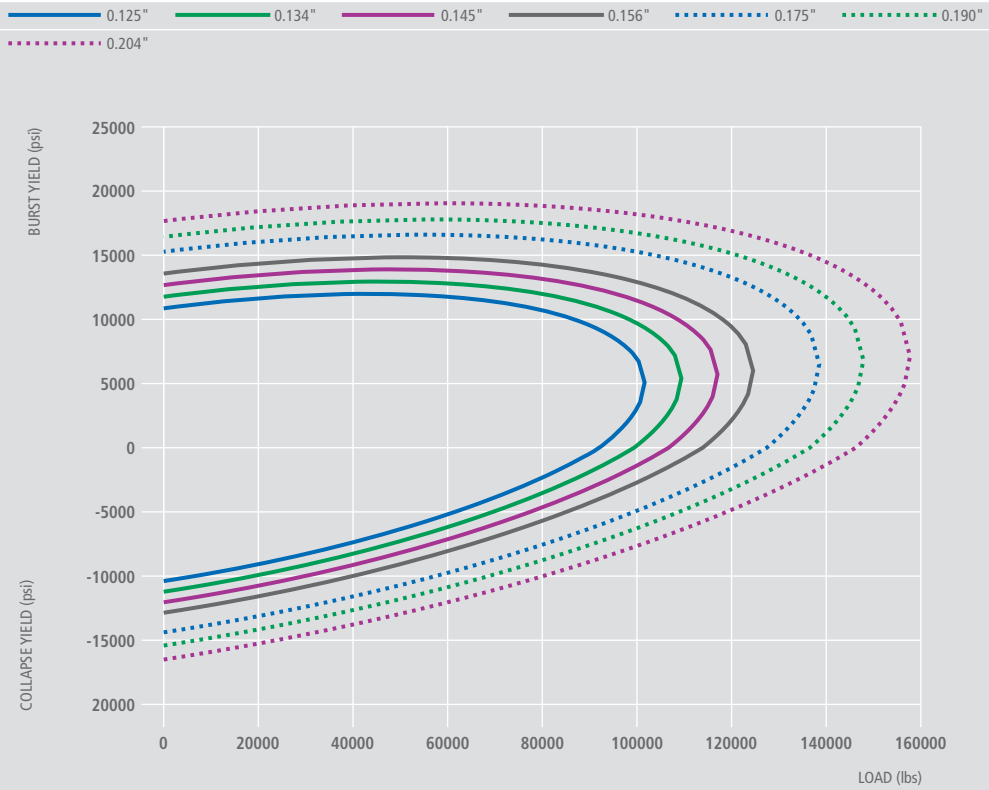


Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 110,000 psi yield strength.

## 2.000" HS-110™

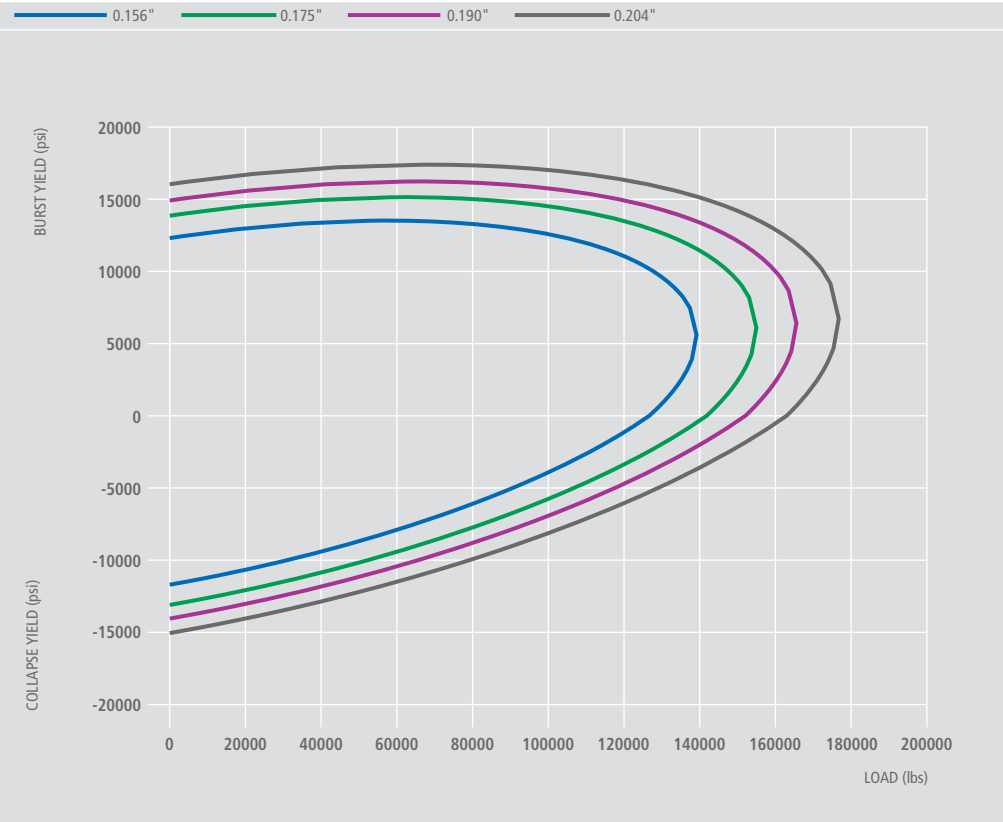


## 2.375" HS-110™



Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 110,000 psi yield strength.

# 2.625" HS-110™



Burst and Collapse yield calculated using the minimum wall thickness for the nominal wall thickness shown and 110,000 psi yield strength.