

# Calculation of Load Bearing of ADIPRENE® Wheels

## Calculation of Load Bearing of ADIPRENE Wheels

It is usually considered that for continuous running at speeds up to 10 mph a 5% to 10% deflection is a safe range to prevent heat build-up and eventual tire blow-out.

### WHEEL CALCULATIONS

The deflection for a specific tire size under a known loading can be calculated from the following equation:

$$U = \left[ \frac{0.75 \times W \times (b - a)}{E \times S \times (8b)^{1/2}} \right]^{2/3}$$

U = Deflection in inches

W = Load in pounds

a = Inside radius of tire in inches

b = Outside radius of tire in inches

E = Compression Modulus of ADIPRENE grade – see Table I

S = Tire width in inches

Note: If calculation shows greater than 5-10% deflection then a harder grade of ADIPRENE with a higher E value must be used.

Urethane  
Prepolymers

# CALCULATION OF LOAD BEARING OF ADIPRENE WHEELS

## TIRE FOOTPRINT

The area in contact with ground (tire footprint) can be calculated from the following equation:

$$P = 2 \times S [b^2 - (b - U)^2]^{1/2}$$

P = Area of footprint in square inches

## TIRE STRESS

The stress on the tire for a specific grade of ADIPRENE at a given deflection can be calculated from the following equation:

$$L = \frac{W}{P}$$

## SAMPLE CALCULATIONS

Tire has outside diameter of 4.90 inches, b = 2.45

Tire has inside diameter of 3.85 inches, a = 1.93

Tire has width of 2.938 inches, S = 2.938

Tire thickness = 0.52 inches (b - a) - assume ADIPRENE L 167, from *Table I*

E = 7675 psi

Assume a load, W, of 2240 lbs.

$$U = \left[ \frac{0.75 \times 2240 (2.45 - 1.93)}{7675 \times 2.938 (8 \times 2.45)^{1/2}} \right]^{2/3} = \left[ \frac{1680(0.52)}{7675 \times 2.938(19.6)^{1/2}} \right]^{2/3}$$

$$U = \left[ \frac{873.6}{22549.15 \times (19.6) \cdot 50} \right]^{2/3} = \left[ \frac{873.6}{22549.15 \times 4.427} \right]^{2/3}$$

$$U = [.00875]^{2/3} \quad \text{or} \quad [.00875] \cdot 66667 = .04246$$

$$U = \underline{.04 \text{ ins. deflection}}$$

$$\% \text{ deflection} = \frac{U \times 100}{\text{Tire Thickness}} = \frac{.04 \times 100}{0.52} = 7.69\%$$

# CALCULATION OF LOAD BEARING OF ADIPRENE WHEELS

## FOOTPRINT 'P'

$$P = 2 \times 2.938 [2.45 \times 2.45 - (2.45 - .04)2]^{1/2}$$

$$P = 5.876 [6.0025 - 5.808]^{1/2}$$

$$P = 5.878 [0.1945]^{.5} = 5.878 \times .44102$$

$$P = \underline{2.59 \text{ sq. in.}}$$

## TIRE STRESS

$$L = \frac{W}{P} = \frac{2240}{2.59} = 865 \text{ psi}$$

Experiments were made to check the equations validity; results of one experiment are as follows:

ADIPRENE L 167 wheel on steel hub

Outside diameter = 4.900 inches

b = 2.450 inches

Inside diameter = 3.85 inches

a = 1.93 inches

Initial height mounted on test rig = 6.926 inches

Load applied = 2000 lbs.

Final height = 6.890 inches

Deflection = .036 inches

Compare .036 inches observed deflection with the theoretical .04 inches. As there were some inaccuracies with the experimental rig the observed deflection should have been higher and therefore an even closer agreement would have been obtained. A series of experiments were run using different grades of ADIPRENE with different tire thicknesses and widths, in all cases good agreement was shown between the predicted and observed deflections.

**Table I**

### Compression Modulus of ADIPRENE L Grades

POLYMER <sup>1</sup>	COMPRESSION MODULUS
ADIPRENE L 42	1,826 psi
ADIPRENE L 83	2,994 psi
ADIPRENE L 100	4,029 psi
ADIPRENE L 167	7,675 psi
ADIPRENE L 200	17,582 psi
ADIPRENE L 213	40,974 psi
ADIPRENE L 315	65,000 psi

<sup>1</sup> Curing agent in all cases was MBCA [4,4' methylene bis (2-chloroaniline)]