

# Nitrogen Inflation for Truck Tires

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## Nitrogen Inflation

- Nitrogen Inflation has been used for aircraft tires and many large off road tires for many years. It is required on aircraft tires on braked wheels of all aircraft over 75,000 lbs takeoff weight.
- Nitrogen Inflation is widely used in racing car tires.
- Is Nitrogen Inflation Beneficial for highway truck tires?

### Inflation Pressure Loss of Tires in Service

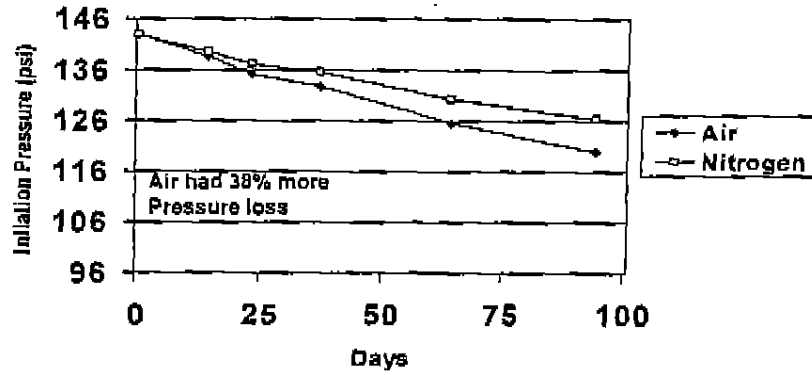
- In a small controlled test of tires in regular service an equal number were inflated with nitrogen and with air.
- Records were kept for nine months of service.
  - The air inflated tires lost an average of 2.7 psi per month
  - The nitrogen inflated tires lost an average of 0.7 psi per month

### Pressure Loss

- It is clear that Nitrogen Inflation retains inflation pressure in truck tires better than Air Inflation.

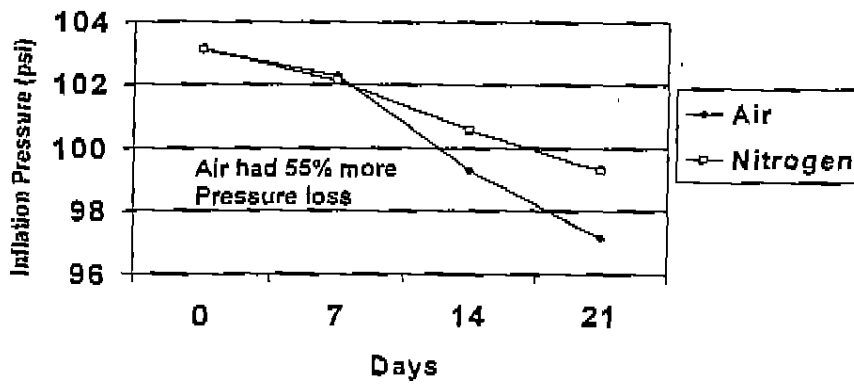
# Static Inflation Pressure Loss

## 11R22.5 Tire in Lab



# Dynamic Inflation Pressure Loss

## 11R22.5 Tire in Lab



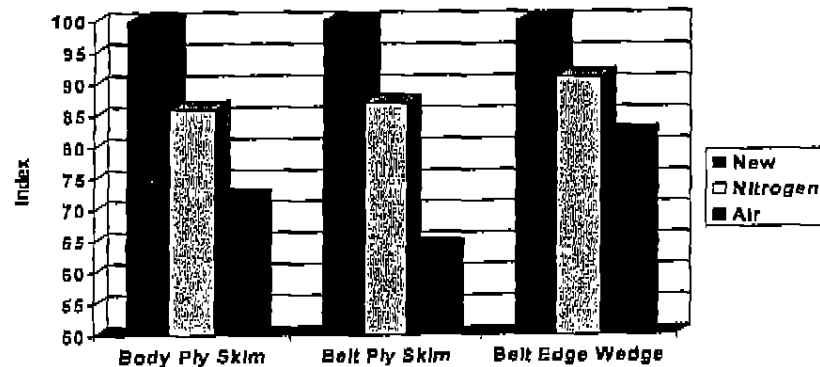
## Oxidation of Tire Components

- Oxidation of rubber compounds is a big enemy of Truck Tire Durability.
- Nitrogen Inflation does reduce the oxidation degradation of rubber components in Truck Tires.

## Compound Physical Properties

12R22.5 After 59,925 km Highway Use

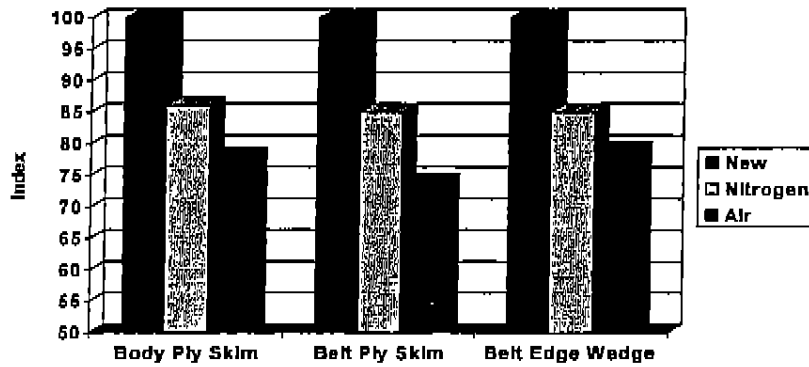
Tensel at Break



## Compound Physical Properties

### 12R22.5 After 59,925 km Highway Use

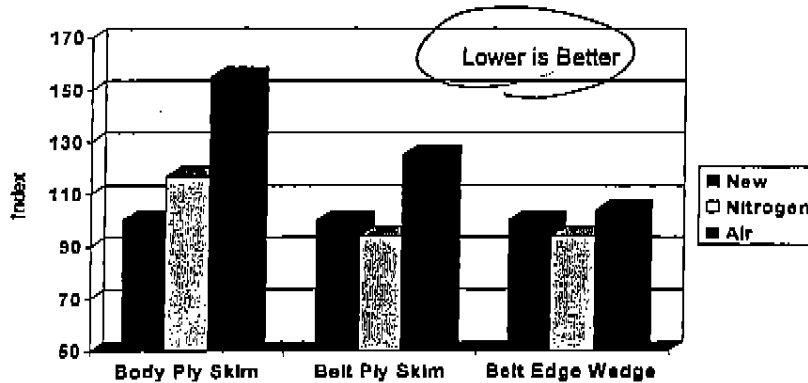
#### Elongation at Break



## Compound Physical Properties

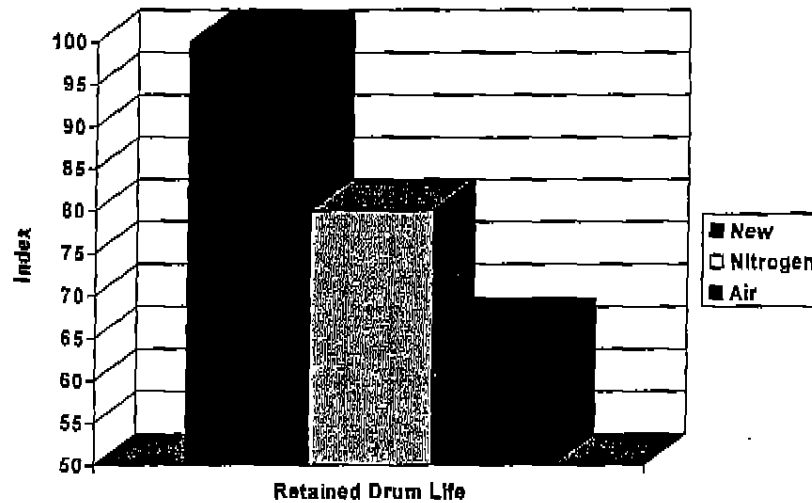
### 12R22.5 After 59,925 km Highway

#### 100% Modulus



## Retrained Bead Fatigue Drum Life

12R22.5 After 59,925 km Highway Use



## Compound Physical Properties

- It is clear that Nitrogen Inflation does reduce the loss of compound physical properties in truck tires compared to air inflation.
- This reduction in physical property loss does result in better retained drum life for used tires.

## Tire Pressure Buildup In Service

- It is claimed that there is less pressure buildup with Nitrogen Inflation than air inflation.
- *The major reason for this is that Nitrogen Inflation is with dry Nitrogen. Air inflation usually contains water and water vapor. Sometimes, a lot of water.*
- The presence of even a very slight amount of liquid water in the tire will effect the buildup of pressure in the tire as the temperature of the contained air increases.

### Effect of Water Vapor Pressure (liquid water in the tire) On Pressure Build up in a Tire

Contain ed Air	Base Inflation = 24 psi				Base Inflation = 100 psi			
	Dry Nitrogen	Wet Air (Liquid Water in Tire)	Difference		Dry Nitrogen	Wet Air (Liquid Water in Tire)	Difference	
	Pressure (psi)	Pressure (psi)	psi	% Change	Pressure (psi)	Pressure (psi)	psi	% Change
75	24.00	24.00	0.00	0	100.00	100.00	0.00	0
80	24.73	24.83	0.10	27.16%	102.17	102.38	0.20	9.18%
90	26.46	26.80	0.34	25.18%	104.33	104.87	0.54	7.82%
100	28.19	28.79	0.60	27.10%	106.50	107.08	0.58	8.14%
110	29.92	27.84	0.91	31.38%	108.66	109.58	0.92	16.88%
120	27.66	28.88	1.24	38.80%	110.83	112.18	1.34	12.38%
130	29.39	30.34	1.00	42.43%	112.99	114.88	1.88	14.32%
140	29.11	31.84	2.53	48.38%	115.18	117.68	2.53	16.66%
150	28.86	32.22	3.37	57.88%	117.32	120.76	3.37	18.45%
160	30.38	34.97	4.39	68.21%	119.49	123.88	4.39	22.54%
170	31.31	38.87	6.66	77.80%	121.65	127.32	5.68	28.15%
180	32.04	38.21	7.17	88.24%	123.82	129.89	7.17	30.11%
190	32.77	41.78	8.92	102.66%	125.98	136.07	9.92	34.71%
200	33.50	44.88	11.18	117.78%	128.18	138.54	11.18	39.73%

## Tire Pressure Buildup In Service

- Since Nitrogen Inflation results in dry inflation, the pressure buildup in service from temperature increase is smaller than wet air inflation.
- For racing tire usage this pressure increase is very significant. Low inflation pressures and very high tire temperatures make dry Nitrogen inflation critical.
- For truck tires, this inflation pressure buildup difference is not very important. With higher initial inflation pressures the percentage of change is smaller and any additional pressure increase reduces the deflection and lowers running temperatures.

## Tire Pressure Buildup In Service

- The pressure buildup also works in reverse. Assume you inflate a truck tires to 100 psi at 95°F ambient temperature and then drive to a location at 35°F ambient temperature.
- With wet air inflation, the tire would now be at 94 psi cold inflation.
- With dry Nitrogen Inflation, the tire would now be at 95 psi cold inflation.
- That is a difference of only 1 psi. A very small difference, but in the right direction.



## Nitrogen Inflation

- It is claimed in many brochures that Nitrogen Inflation results in lower tire running temperatures.
- We believe that the only reason that tires with Nitrogen Inflation would have reduced running temperatures is that the inflation pressure is maintained better than with air inflation. Higher inflation pressure results in reduced deflection and lower running temperatures.
- Good inflation pressure maintenance with air should give the same results.

## Nitrogen Inflation

- It is claimed in many brochures that Nitrogen Inflation provides longer tread wear life.
- We believe that the main reason that tires with Nitrogen Inflation would have better wear life is that the inflation pressure is maintained better with nitrogen than with air inflation. Higher inflation pressure results in reduced deflection, lower running temperatures, and generally better wear life.

## Nitrogen Inflation

- It is claimed that tires with Nitrogen Inflation have a greatly reduced risk of a tire explosion from ignition of internal gases.
- By reducing the percentage of oxygen from 21% to 1% or 5% in the tire, the chance of an explosion is greatly reduced.
- The conditions that cause an explosion are very rare in truck tires. Unless a flammable substance is accidentally introduced into the tire, the flammable substance must come from within the tire. This would happen only at very high temperatures where out gassing of flammable vapors from rubber components could occur. Excessive brake heat is the most probable cause.
- That is why the FAA requires Nitrogen Inflation of aircraft tires on braked wheels of all aircraft over 75,000 lbs take off weight.
- The usual method of inflating aircraft tires with nitrogen is by using Nitrogen gas cylinders. These are very high pressure cylinders and should never be used without a pressure regulator to limit maximum pressure. Serious accidents have occurred when using unregulated nitrogen cylinders.

## Nitrogen Inflation

- It is claimed that Nitrogen Inflation reduces the oxidation of wheels.
- With less oxygen present in the tire, there will be less oxidation of the wheels.
- Maybe even more important is the fact that the inflation gas is dry. The lack of water and water vapor greatly reduces the oxidation process of steel.

TOTAL of 13 PAGES

## Nitrogen Inflation

- That brings us to a major point about water and water vapor in the tire.
- Water vapor does permeate the inner liner and go into the steel cords of the tire. Water inside the tire is destructive to the long term performance of steel cord radial truck tires.
- The fact that Nitrogen Inflation provides dry inflation is a major advantage for long term tire performance.



## Nitrogen Inflation

- So far, we have verified many advantages of Nitrogen Inflation, with no negative performance attributes.
- The only negative we see is the added cost.
- Can the added cost be justified by improved performance such as:
  - Fewer road failures and less downtime
  - Additional retreads
    - Especially in fleets with high brake heat conditions like City Bus Service and Waste Collection Service
      - This brake heat often hardens the bead area and leads to non-retreadable casings due to torn bead toes or distorted beads.
  - Better wear life and fuel economy from better inflation retention

## Nitrogen Inflation

- All factors would indicate that these items should show improvement, but solid data to prove this is hard to come by.
- Most data is testimonial or antidotal in nature.
- To answer these question, carefully structured evaluations are needed to determine if the improvements are significant enough to show up in the bottom line of tire costs. These evaluations need to be large enough to randomize normal variation and long enough to include retread history.