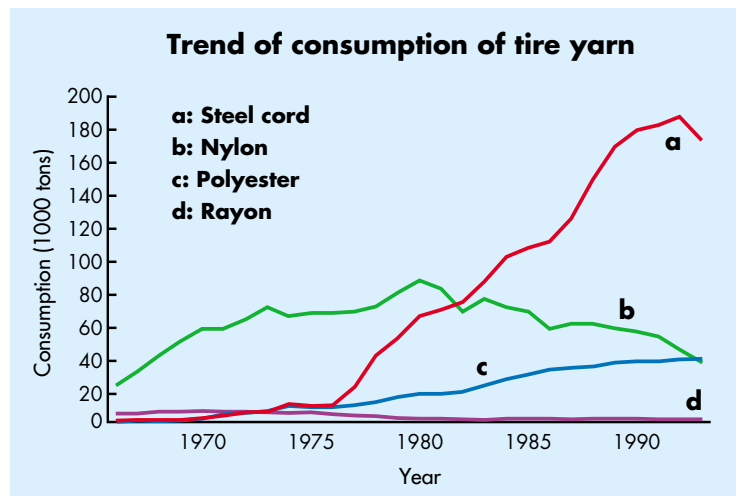


TOYO TIRE TALK

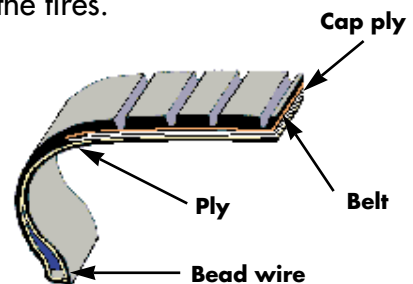
Subject: Tire Materials ... Steel Cords

Tire cords play an important role in the "reinforcement of rubber". They are an important factor in tire construction and have a major influence upon the tire's performance. The chart to the right shows the trends in tire cord material:- Organic fiber - Cotton, Rayon, Nylon and Polyester - were used for tire cord for some time. Within the last 25 years the increase in steel cord can be seen and this is due to the increase in Radial tire manufacture.



The steel cords are mainly used in the following parts of the tires.

- "Carcass" of LT/TB/OTR tires.
(In PC tires, Polyester is used in the majority of passenger tire carcasses.)
- "Belt" of PC/LT/TB/OTR tires.
- "Bead wire" of PC/LT/TB/OTR tires, which reinforces bead area.



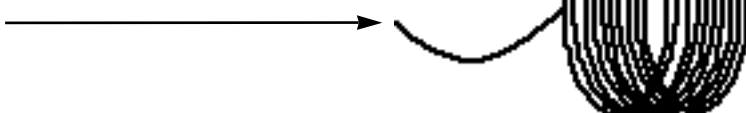
We would like to provide some basic knowledge of steel cords used in the "carcass" of LT/TB tires and "belt" of PC/LT/TB tires currently.

1) The Material of Steel Cords

In general, high level carbonaceous steel wire is used.

Carbon content: around 0.7%

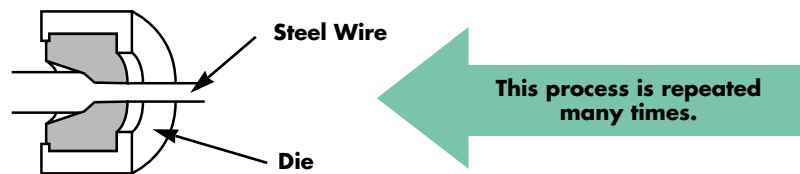
Diameter: 5.5m/m



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2) Manufacturing Method of Steel Cords

1. The manufacturing process runs high level carbonaceous steel wire through a die numerous times.

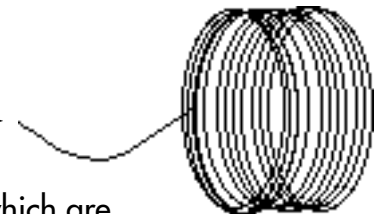


But in the middle of this process, the steel manufacturer has to carry out the following:-

- The heat treatment must be carried out once or twice because steel wire becomes hard by running it through the die.
- The plating with "brass" must be carried out so that the steel wire can easily adhere to rubber.

Brass plating: In general, Copper (Cu) and Zinc (Zn) are used.
The ratio is usually between 60:40 to 70:30

2. By repeatedly drawing the wire through the extruder die the wire finally reaches the correct diameter.
(Diameter: 0.2m/m - 0.38 m/m)



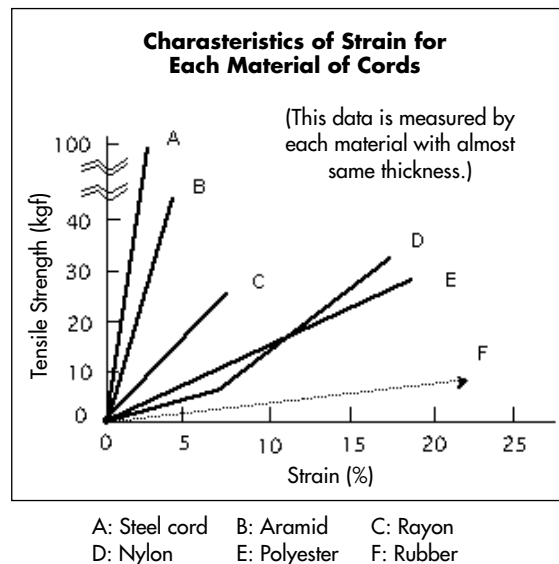
- The steel cords are made up of many filaments which are manufactured by the above-mentioned method.

3) Characteristics of Steel Cords

- a) Excellent tensile strength
- b) High modulus of elasticity per uniform section area

By utilizing the characteristics of steel cord, it is easy to see where it is suitable for certain tire categories, components and operating conditions.

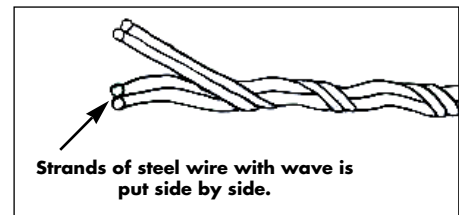
The next page shows the requirement performances of steel cords for each category and parts within the tire.



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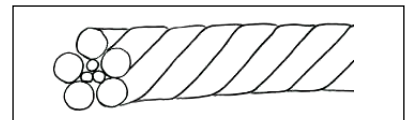
Characteristics of Steel Cord for Passenger Tire (Belt)

- 1) Diameter of filament is smaller.
 - ➔ This provides improve ride comfort and durability of belt.
- 2) Pitch of twist (turn/cm) is longer.
 - ➔ Durability (deflection) is not as important for the steel belt when compared with the carcass.



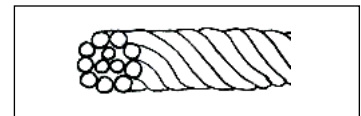
Characteristics of Steel Cord for Truck Tire (Belt)

- 1) Diameter of filament is bigger.
 - ➔ This is required to improve the strength of the belt. (More difficult to deflect the belt.)
- 2) Pitch of twist (turn/cm) is longer.
 - ➔ Durability (deflection) is not as important for belt by comparison to carcass.



Characteristics of Steel Cord for Truck Tire (Carcass)

- 1) Diameter of filament is smaller.
 - ➔ The purpose is to improve the durability of carcass. Additionally, strength for the carcass is improved by increasing the number of filaments.
- 2) Pitch of twist is shorter.
 - ➔ Durability is very important for carcass when compared to the belt wire.



As with most things in the world steel cord has its good and weak points. The most commonly known weak point of steel cord is "rust". Rust resistance can be improved by improving rubber penetration. We would like to show an example of this below.

(This is an extract from TBR Professional Talk.)

High-Tensile* Open Construction Carcass-Cord

Regular steel cord



Regular steel cord:

There is a very small opening between filaments.

Rubber penetration is poor.

1. Air or water enters easily ➔ Steel cord rust.
2. Steel cord to steel cord contact occurs. ➔ Fretting occurs.

Open-type steel cord



Open-type steel cord:

There is an opening between filaments.

Rubber penetration is good.

1. Air or water has difficulty entering ➔ Steel cord resists rust.
2. Steel cord maintains separation. ➔ Fretting is eliminated

*High-Tensile Steel Cord (High strength steel cord):

Carbon content of high level carbonaceous steel wire (steel cord material) is increased to about 0.8%. (Regular carbon contents is around 0.7%) This results in a High-Tensile Steel Cord with greatly improved strength as a result of the increasing carbon content.