

TOYO TIRE TALK

Subject: PCR TIRE DESIGN COMPARISON

PCR tires are used under many various conditions and are required to perform well in all of them. There are currently many types of PCR tires and they can be basically classified into three categories.

- General Use PCR — **Standard** Tire, in a word
- PCR with excellent driving performance — High Performance(**HP**), Ultra HP(**UHP**) Tire
- PCR for Winter Weather — Winter tire including **Lamellen** Tire and **Studless** Tire



As we have discussed in previous Toyo Tire Talks a tire is constructed of many types of rubber and cords. Moreover, each tire type has many differences in design factors such as pattern, construction and material.

In this chapter, we'll explain about the difference in design factors which have a major influence on the characteristics of each type of tire.

1. Tread Rubber
2. Tread Pattern
3. Tire Construction

Our explanation in this chapter is general method of tire design. In practice, there are many different cases on actual tire.

Characteristics of Each Tire

- STANDARD Tire
This category of tire has well balanced basic performance
- UHP TIRE
This category is designed mainly for high-performance cars, so it's important they perform well providing driving stability on wet and dry roads.
- STUDLESS TIRE
These tires are used on winter roads, so it's important they perform well on snow and ice surfaces.

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1. Tread Rubber

	STANDARD	UHP	STUDLESS
Hardness	Criterion	Softer	More Soft
Heat Generation	Criterion	Higher	Higher
Wear Resistance	Criterion	worse	worse
Hysteresis Loss*	Criterion	Higher	Higher

*:When rubber is repeatedly deforming and recovering, it has some difference between providing and giving back energy. Generally, this is called 'Hysteresis Loss'.

In the case of UHP tires, softer and higher heat generating tread rubber is necessary to provide improved grip on dry and wet surfaces. In case of STANDARD tires, better wear resistance and low hysteresis loss is for longer wear life and low fuel consumption. In case of studless, the tread rubber is softer than UHP. But the purpose of using softer rubber is different from UHP. It is to provide a better grip on ice surfaces.

2. Tread Pattern

	STANDARD	UHP	STUDLESS	
Void Ratio	Criterion	Smaller	Slightly Smaller	 bigger void ratio
Uni- directional	Not Apply	Mostly Apply	Sometime Apply	 non-directional uni-directional
Block Size	Criterion	Bigger	Slightly Bigger	 bigger block
Sipe Density	Criterion	less	more	 more sipes

In case of UHP, uni-directional patterns are mostly applied since this design provides better water drainage. This allows for improved wet performance without making the void ratio big (this provides a larger contact area). Smaller void ratio is better for dry grip.

In case of studless, the pattern with many sipes is designed for obtaining better traction on ice surfaces.

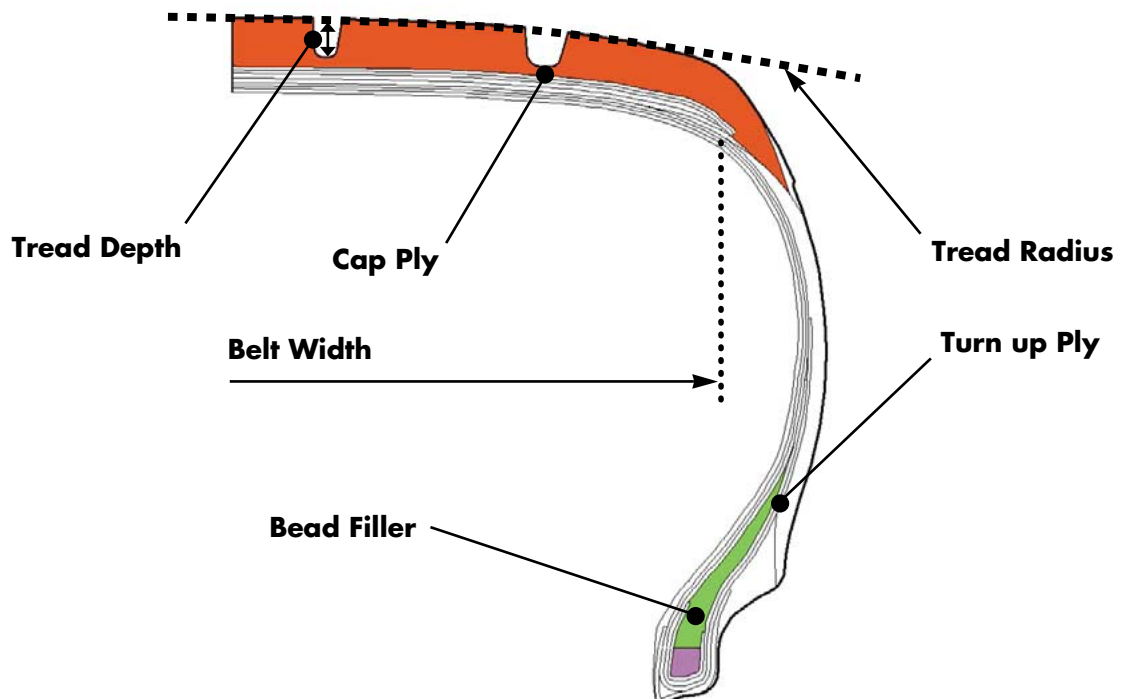
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3. Tire Construction

	STANDARD	UHP	STUDLESS
Side* ¹ Stiffness	Criterion	Stiffer	Equivalent
Tread Radius	Criterion	Larger	Equivalent or Slightly Larger
Cap Ply	Basically Not Apply* ²	Mostly Apply	Not Apply
Tread Depth	Criterion	Shallower	Deeper
Belt Width	Criterion	Wider	Equivalent

*1: In this time, Stiffer side means designing high turn up ply and/or bead filler.

*2: Sometime apply as occasion demands



In case of UHP, a stiffer sidewall is designed to provide for better handling stability. The wider belt and cap ply is for high speed durability.