Automobile Tires and Go-Kart Track Safety Barriers

By Peter F. Olesen. P.E.

Since 1990, our firm has designed well over 150 existing concession go-kart tracks throughout the United States (currently 30 states), Brunei, Canada, Mexico and Vietnam. Used automobile tires in conjunction with a vertical steel barrier rail and a barrier curb backing have been the safety barrier of choice on every one. This system cushions the kart impacts against the rails by permitting potential compression of over twenty inches, horizontally. It eliminates the sudden impact of striking a rigid barrier, greatly reducing the "G" forces transmitted to the drivers and the karts themselves. The controlled compression and pressure to return to the tires original shape redirects most of the karts striking the rail back onto the track in the direction they were traveling.

To-date this writer, a professional engineer in Illinois and other states has continued to design track safety barriers using automobile tires as the energy attenuator in the barrier system because of their ability to take continual compression on kart impact and directing the barrier rail back to its original alignment.

To date there have been literally hundreds of attempts to create a superior and safer system than a properly designed steel barrier rail/automobile tire/barrier curb backing. None have proven to be the equal, in this writer's professional opinion. Guest and staff safety must always be the determining factor. Therefore until if and when some future concept proves equal or superior, we shall continue to utilize the steel plate/automobile tire/curb backing system.

When designing a steel barrier rail/automobile tire/barrier curb system there are a number of issues that should be considered.

To effectively function as a barrier that absorbs impact and redirects many karts back along the path they were travelling, the tires must all be of the same diameter and tread width in order to function as designed. [There are hundreds of tire designs that may all have the same labeled diameter and tread widths that may actually vary by more than one inch]. The desire is that when all the tires are fastened in position they present a straight rail alignment, without kinks, compressed or stretched tires.

It goes without saying that the barrier will be constructed with used tires. As such there will be a wide variety of used tires in any purchases made. After drilling the tires and prior to beginning installation, stack tires having roughly the same outside diameter together. Tires that vary by more than one inch in diameter should be stacked separately. In all likelihood you are going to have a number of stacks that have varying diameters. Use each stack in a continuous run adjacent to each other in order to maintain straight barrier rail alignments and enabling the tires to be basically unscratched or compressed. This enables the barrier to provide the maximum compression and may well extend the individual tire’s effective life. When finishing one stack, select the next stack with the closest similar diameters. Using this concept on both edges of the track will result in a uniform track width, visually, although there may be slight variations in exact widths, this won’t have any effect on the karts on the track and should not be visible to people looking at or driving on the track.

Not all tires are suitable for use in the barrier assembly. The tires must have a tread width of at least 8 inches or more to permit them to take the impacts on a straight line rather than collapsing along the top and providing an angled barrier face that permits the kart to ride up and over the barrier. They should all have the same relative overall diameter and preferably have at least 6 ply sidewalls to provide the relative stiffness required to rebound effectively back to the original shape after impact.

They must be automobile tires, as truck tire and airplane tires have far more sidewall plies resulting in them being far too stiff to function properly. There is also a problem with tires having too few sidewall plies. Tires such as used Goodyear NASCAR tires with raised yellow lettering are very impressive, but they only have two ply sidewalls. This means they will collapse too easily on hard impacts and don't always spring back to their original. They work reasonably well on tracks where the karts are un-bodied and lighter in weight and speeds are kept below 20 mph. When considering NASCAR tires, keep in mind, bodied gasoline powered, bodied karts and electric (battery powered) karts are heavier and have much higher impacts.

Truck tires and airplane tires have far too many sidewall plies, rendering them far too stiff to function as energy attenuators for impacts as light as go-karts.

The steel safety rail must be of a width and thickness to effectively function as part of the system. The width of the rail must be wide enough to effectively match against the go-kart bumpers. Most go-kart bumpers clear the pavement by two inches or slightly more and range up to a top height of 6 to 8 inches above the pavement with composite bumper rails. Using this as a guide, assuming ½ inch thick rail skid plates, and an 8 inch wide steel rail, is a reasonable choice. Narrower rails would be subject to the potential of karts riding up and over the barriers or the rail kinking on impact.

An additional benefit to using the 8 inch wide barrier rail is the fact that the added weight serves to hold the barrier system down on heavy impacts rather than permitting karts to be forced beneath the rail, with the potential of kart riders being injured by the rail. The weight of the barrier system should be heavy enough to effectively hold the barrier assembly in place to prevent karts from driving beneath the assembly on impact.

Beginning with our original track designs we developed a drain hole system to be drilled in the tire sidewall making contact with the pavement surface to eliminate water being retained in the tires after rainfall. The primary reason for the design was to eliminate the potential for mosquitoes breeding in standing water inside the tires.

As the tires are bolted to the back face of the barrier rail and on the opposite side to the barrier curb, this requires drilling holes through the tire tread, 180 degrees apart. At the same time we call for a four hole drain hole drainage pattern (one inch minimum diameter) drilled in the tire sidewall that will be facing the pavement surface. Two holes will be drilled along the same alignment as the anchor bolt holes and the other two at right angles to the first two. This four hole pattern provides drain holes at the low points regardless of the cross slope or profile grade, whether the track cross section slopes up or down, and whether the track profile is up or down.

At such time as individual tires may be degraded by UV and weather conditions, maintenance programs will replace them with new units and the replaced tires recycled in the same manner as they would have been had they not have been used for the barrier system. It is an environmentally responsible use of an existing material. By using the drainage hole system described we are also being environmentally responsible by preventing water accumulation in the tire casings, eliminating mosquito breeding grounds.

Other designers and track builders have used various systems for draining the tires. The most common method being slashing the casing sidewalls on the downward face rather than drilling the holes. While this works to some extent, there have been cases where the slashes have actually sealed up, thus resulting in water collecting inside the tires. Drainage through slashes in the tire is far slower than open holes even when they work. We feel they don't provide the same degree or uniformity of energy absorption. As long as the slashes or cuts are at the low points of the tire, they should drain.

We will continue to utilize used tire casings as long as they are available, unless somewhere in the future a superior (safer) replacement design is developed. This system combines the extended useful life of the tires for many years beyond their intended automotive use, with the creation of what has proven throughout the industry to be what we feel is still the safest go-kart track barrier system.

This writer is aware of two instances where EPA regulators (California and Illinois) have decided that the use of automobile tires for go-kart tracks should be regulated and that special permits be required that include identification of the source of the tires and even a certification by a professional Engineer that the use is proper. Hopefully these were isolated instances and that the EPA regulators will come to their senses or be overruled. The reality is that automobile tires currently provide the safest form of energy attenuation for go-kart track barriers and prolong the service life of used tires for many years and ultimately become a renewable material.

Peter is a registered professional engineer in numerous states and the President of Entertainment Concepts, Inc. (formerly Peter F. Olesen and Associates, Inc.) a firm with more than 33 years of experience in the design of family entertainment centers, both outdoor and indoor, stand alone go-kart tracks and miniature golf courses, bumper boat ponds and related attractions. The firm has been at the forefront of go-kart, miniature golf course and bumper boat pond design, having brought about many innovations in safety, geometrics, design and construction methods that are now widely emulated throughout the industry. The firm has performed more than 500 projects in 43 states, Angola, Brunei, Canada (Alberta, British Columbia, Ontario and Quebec), Cuba (Guantanamo Bay), Kazakhstan, Mexico, Puerto Rico, Saudi Arabia and Vietnam. These projects span feasibility, concept development, master plans, final design and construction engineering. He is a member of the faculty of Foundations Entertainment University (43 seminars, to-date), has presented seminars and participated in round table panel discussions at the International Association of Amusement Parks and Attractions' Attractions Expo, FunExpo, Kart Expo and Leisure Expo as well presenting go-kart safety seminars for the State of Ohio. He has, and continues to write articles for industry magazines and internet newsletters.
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