Zafety Lug Lock Turbine™ Q&A

1. What material these are made from?

Zafety Lug Lock Turbine™(ZLLT) is based on Zafety Lug Lock® (ZLL). ZLL parts need both strength and flexibility to provide the necessary retention capabilities. ZLL units are installed after the bolts and or nuts are fully torqued so it is a combination of strength and flexibility that we are looking for in the product, as well as its ability to perform despite the environmental factors of fluctuating temperature and humidity. The material must also be resistant to many chemicals found in the environment where it is to be used. For outdoor applications – UV protection is also required.

The composition of our Zafety Lug Lock® units is proprietary, it is a thermoplastic polyester resin that performs under the conditions noted below.

Our material meets or exceeds these specifications when developed into a part.

1. *A device that had sufficient strength to be installed on two lug nuts or bolts and sufficient elastic retention to keep it in place under the tremendous Centrifugal forces that it would be subjected to on a spinning wheel rim.*
2. *The device had to retain its strength and elasticity at temperatures of -40 degrees Centigrade (-40°F).*
3. *The device had to be fully functional at temperatures as high as +160 degrees Centigrade (+320°F).*
4. *The device had to retain its physical characteristics including color, properties and surface texture for at least 5 years (automotive part), (**for the wind turbine application the target is a 10-year lifespan for units being used in environmental conditions with a maximum temperature of 60 degrees C and no exposure to UV rays**).*
5. *The device had to be highly visible (automotive part) – for wind turbines, colour coding will indicate a precise location application.*
6. *The device had to be reusable. The goal was to make the device so it could be installed up to 10+ times without impairment to the device.*
7. *The device had to install manually with someone's fingertips to ensure secondary tooling would not be required.*
8. *The device had to have sufficient rigidity and tensile strength to prevent a lug nut or bolt from turning within it once it was installed.*
9. *The device needed to be inert or resistant to the chemicals it might be exposed to during use and these included:*

Road Salt	Liquid calcium chloride	Windshield washer alcohols
Hydraulic fluid	Transmission fluid	Gasoline
Locktite	Diesel fuel	Ethanol alcohol
Radiator fluid	Iron oxides	**For Wind turbines - CEPLATTYN BL – recent test by the raw material manufacturer confirmed no issues**

2. Do you have an average expected lifespan?

   We warranty ZLLT units for 5 years and we expect a 10-year lifespan. For exterior applications we have a 2-year warranty and a 5-year expected lifespan.

3. What prevents these things from flying off the lug nuts? Is it just friction?

   For the traditional Zafety Lug Lock® units there is a slight chamfer at the opening on the back of the unit so it can slide over the nut more easily and then it gets tighter the further that you push it down on the nut. Then it would be friction holding the unit – the plastic is soft enough to create enough resistance. For the wind turbine units – they are identical on both sides so there is no chamfer but again the units are snug and the plastic material is still soft enough to create enough resistance.

4. Do you have any test reports indicating the clamping force in a lugnut connection with and without the product?

   Lug nuts are clamped at different levels depending on the size of the lug nuts and the application. Lug nuts are tightened to the appropriate clamping pressure for the particular application and then Zafety Lug Lock® units are installed. The Zafety Lug Lock® units will retain the nut in the position that it was torqued to but the clamping pressure may change depending on environmental and physical conditions. We have done a number of third-party tests to ensure the Zafety Lug Lock® units will stop the nuts from rotating. They are all available to download from our website here https://zafetyluglock.com/about/

5. How much rotation does the device allow before "catching"? Or if it is already "caught" because it is such a tight fit, there should be some amount of flex in the material.

   There should not be any rotation - the nut is "caught" in the teeth when the ZLL unit is installed. The ZLL units are installed after the clamping pressure has been achieved. If there are significant temperature changes and vibration it may cause the nut to slip to the next set of teeth but since there are only vibration and some centrifugal forces to cause that to happen it would be a rare occurrence. The teeth are fairly large to prevent it.

   Note: if the nut is fully torqued and it is just through expansion, contraction and vibration that the nut is no longer tight and a re-torque check is done, the Zafety Lug Lock® unit will allow the nut to be tightened without removing it, as the edges of the nut will just be moving along one or two teeth at most to achieve the required clamping pressure again. The teeth of the Zafety Lug Lock® unit will maintain their integrity if the nut is turned relatively slowly using a manual torque wrench. Zafety Lug Lock® units must be installed after the nuts have been torqued to the desired clamping pressure, especially when using a pneumatic wrench.

6. What is your experience/testing/technical details with oil & grease resistance long term? I see mention on your website that the plastic is engineered with automotive products (fuel, fluids, etc.) in mind – could you give some more details on the plastic material and resistance to greases and oils in particular?

   Because Zafety Lug Lock® goes on the lug nuts of commercial truck and public and private transit vehicles the units are exposed to everything that might be found on the road and in automotive maintenance environments. These vehicles are also washed frequently with detergents to remove grease and grime (even blasted with water) and over the years go through many cycles of this. We have received may reports of companies using Zafety Lug Lock® units for more than five years and some as many as eight years, though we recommend in the automotive industry that they be replaced after five years. These environments would be much more demanding than the inside of a wind turbine. Our plastics engineer asked the raw material manufacturer to test the specific grease used inside the turbine, **CEPLATTYN BL**, to ensure there would not be any long-term impact on the plastic used for Zafety Lug Lock Turbine™ and they have confirmed that with a five-year warranty. A report from the lab that did the testing, confirmed that there were no significant impacts on the material.

7. I see on the website and recall from our discussions that we could perform torque checks with the ZLLTs still on if necessary. If we end up having to remove the ZLLTs, how many "cycles" of removal and reinstallation can they withstand?

   As mentioned above Zafety Lug Lock® are used on wheels – that must have brakes checked and tires replaced periodically and minimally Zafety Lug Lock® units would be removed and replaced likely 4-6 times per year if not more for garbage trucks and city transit buses. If they are removed properly by pulling up on the ends and reinstalled properly with no sharp objects in either case, the removal and reinstallation should not cause any damage to the units or the teeth. Even when doing a torque check the most the nut should be moving is one "tooth" if the nuts/bolts were properly torqued before the units were installed. This should not cause any damage to the units. Under these conditions companies/transit operators have been using the units 5-8 years. This would indicate the units can be installed and removed many times without damage. The Zafety Lug Lock Turbine™ units are typically not expected to be removed and reinstalled and/or certainly not with the frequency of a vehicle wheel but could be put though the cycle certainly quite a number of times without damaging the units..

8. Acceptable temperature ranges – I see that you mentioned on the website, testing between -40F and +320F specifically to test resistance to nut rotation. What are the

general temperatures that these can handle, and are they subject to any thermal fatigue/cracking over long periods of temperature swings?

2. The device had to retain its strength and elasticity at temperatures of -40 degrees Centigrade (-40°F).
3. The device had to be fully functional at temperatures as high as +160 degrees Centigrade (+320°F).
This was the original guidance that we had when choosing the material because in the city transit and garbage truck scenarios the frequent braking causes very high temperatures at the wheel end, so the Zafety Lug Lock® units have to continue to perform in these circumstances. We have also been supplying the mining industry in the far north as they have difficulty with the temperature swings on vehicles going in and out of the mine. They tell us that the units perform very well in freezing temperatures. Our clients are from around the world including Australia, where they experience very high temperatures and the product performs very well there.

9. You previously mentioned 5-year warranty and expected 10 years lifespans – could you give any details about life testing/experience and what failure modes you found as the ZLLs reach their end of life?

   We see that after five years in an automotive environment it is the UV exposure that begins to cause some deterioration – initially first noticeable with the colour fading and eventually deterioration of the plastic – the things to look for would be "rounded or frayed teeth (this is potentially also an indication of improper use if nuts are being torqued after install instead of before), edges of the "accordion" section starting to tear and the plastic looking less resilient. If the fit over the nuts is not as tight – it is an indication that the unit will not be working at its best and it is time to replace – that would be caused either by the rounding of the teeth or deterioration of the plastic.

   We have tested the final product in many scenarios, but the field testing that happens every day with our clients really is the assurance that the product works. We have many clients that have been using the product for over 10 years and believe that it has reduced wheel end costs and repairs and fewer out of service vehicles by preventing damage caused by loose nuts. Many also feel that it has minimized/eliminated the possibility that they will have a wheel-off.