June 2024

data points

Data Points is a publication produced by the Wildland Fire Lessons Learned Center to highlight a collection of similar events or lessons signaling a need for specific action. Data Points is published on an "as needed" basis as the result of ongoing analysis.

Recurring Lesson: Torque to specifications, mark lug nut and stud. Inspect daily.

Over a 10-year span we have recorded 13 separate incidents of wheels nearly or completely separating from Type 6 engines due to problems related to lug nuts and studs.

Report	State	Year
Oklahoma Dual Wheels	OK	2016
Oregon Dual Wheels	OR	2017
Long Valley Fire	CA	2017
Mile 0 Rx Fire	OR	2017
Rocky Mountain Engine Lug 1	CO	2019
Rocky Mountain Engine Lug 2	CO	2019
Lug Nuts Loosening	SD	2020
Lug Nuts Sheared Off	NV	2020
Mark Twain NF Dual Wheels	MI	2020
Wyoming Dual Wheels	WY	2020
WWNF Dual Wheels	WA	2023
Kentucky Broken Wheel Studs	KY	2024
Blue Panther Rx Broken Wheel Studs	VA	2024

"I felt the rear of the engine sway. I looked quickly in my sideview mirror to see the outside dual pass the engine." Mark Twain NF Dual Wheels RLS

The Problem

Problems are traced to issues related to lug nut tightening. In most cases, lug nuts are overtightened which compromises the strength of the wheel studs (also called lugs), eventually resulting in broken wheel studs. In some cases, loose lug nuts are not noticed and simply rattle off.

Recommended Action

Use a system to mark lug nuts after each torque to factory setting. This can be achieved with specifically designed wheel nut indicators or other forms of colorful marking (paint marker, torque seal).
Cost: commercial indicators $1.50 a piece. Paint markers $3

Wheel Nut Indicators

Torque Seal Paint

Maintenance

Once lug nuts are torqued to factory setting and marked with a bright colored indicator, conduct daily checks to ensure no movement. Be sure to keep updated on any vehicle specific recall notifications – there have been several related to wheel studs.

Lug Nuts and Wheel Stud-Related Lessons

2024 – Blue Panther Prescribed Fire Broken Wheel Studs

The vehicle had a minor shake that was noticed about five minutes away from the destination. Soon after this shaking began, driving speeds were reduced to 35-40 mph, and an audible "clank" type noise was heard. This was believed to be a possible rock dislodged from the rear dual tires.

Within another minute or so, the vehicle lost both passenger-side rear wheels. The engine operator safely guided the apparatus off the road and on-to the shoulder. Studs on the wheel had sheared completely off.

Lesson: Consider the use of a Commercial Indicator.
The use of wheel nut indicators (see photo on right) would help to visually check that lug nuts are still properly torqued to the manufacture's specifications.

This is an efficient and effective method for identifying loose wheel nuts. This simple indicator is highly visible and simplifies daily inspections.

2024 – Kentucky Engine Broken Wheel Studs

The Fire Engine Operator noticed a small vibration in the vehicle, although he couldn't tell where it was coming from. Seconds later, he felt some major shaking from the vehicle and then felt the back-end drop. As the rotor hit the ground, the FEO saw the outside dual wheel release and cross to the opposite side of the road.

Lesson: Documenting inspections helps to identify developing safety concerns. By having done all the required inspections on the vehicle, the unit discovered this outcome was related to conditions outlined in the recall rather than any crew actions related to vehicle maintenance.

2021 – Overtightening Lug Nuts

When a lug nut is overtightened, it causes the shaft to stretch and elongate. After each successive overtightening, it then takes more torque to "tighten" the lug—causing further damage.

This causes a repetitive overtightening cycle that causes the lug(s) to fail by shearing, bending, or simply rattling loose. The lugs in the photos indicate significant stretching.

Lesson: Use only a torque wrench and torque to proper setting.