LOOSE SHAFT NUT

What is loose shaft nut failure?

In turbocharger assemblies, the shaft nut plays a crucial role in securely holding the compressor wheel and other rotor group parts onto the shaft. The tightening of the shaft nut must follow precise procedures and settings to ensure proper functionality. Generally, shaft nuts have a left-hand thread, but in cases where the rotor parts have reverse rotation, a right-hand thread is used. They are sometimes referred to as 'locknuts' or 'impeller locknuts'.



Turbochargers are precision engineered and designed to operate at incredibly high speeds, reaching up to 360,000 rpm. They also experience extreme temperatures up to 850°C in diesel applications and 1050°C in petrol applications. Operating under such extreme conditions many failures can occur, often leading to misdiagnosis. If there is any resistance or locking up within the rotor, the centrifugal force/inertia can cause the shaft nut to become loose.

The consequences of a loose shaft nut can be catastrophic, potentially resulting in severe damage to the compressor wheel within seconds of the turbocharger starting operation. To assist in identifying these failures during repairs, it is important to understand the causes and signs of damage associated with aloose shaft nut.

How are the shaft nuts are secured?

At Melett's UK based CHRA assembly and turbo production facility, there are strict guidelines and procedures for the shaft nut tightening operation. Each model has its own specified torque setting and instructions to be carried out by our experienced CHRA assembly team

Our tightening procedure is:

1. **Apply the required setting torque**
2. **Loosen the shaft nut**
3. **Tighten up to the specified torque. This could be a final torque or a pre-torque with an added angle to create the correct amount of tension between the shaft nut and the shaft**

With this tightening procedure and extensive operator training, here at Melett we have made a loose shaft nut a highly unlikely cause of turbo failure.

Causes of loose shaft nuts:

Understanding the underlying causes of loose shaft nuts in turbocharger assemblies is crucial for preventing potential failures and ensuring the longevity of the system. Several factors can contribute to the loosening of the shaft nut, and being aware of these causes can help identify and address issues before they escalate.

Here are the key factors that can lead to a loose shaft nut:

- Overspeeding causes excessive radial expansion of the impeller wheel, simultaneously shortens its length. This relaxes the tension on the shaft, and the shaft nut begins to loosen. View our overspeeding help guide for more details.
- Scoring to bearings, potentially caused by oil contamination or another failure mode, allows the impeller wheel to rub and 'stall' against the housing, eventually loosening the shaft nut. View our oil contamination help guide for more details.
- Foreign object damage to the compressor and/or turbine wheel puts the turbo out of balance. This allows it to rub against the housing, loosening the shaft nut. View our foreign object damage help guide for more details.
- Thread direction mismatch. In the vast majority of turbochargers, the shaft nut thread direction is opposite to the direction of rotation on the shaft. If the compressor wheel rotates clockwise, the shaft nut threads should be left-handed - if this is not the case the nut has the potential to become loose during operation.
- A blockage in the oil feed pipe can cause the bearing system to 'grab' onto the shaft, preventing it from rotating, this in turn, causes the shaft nut to loosen. View our insufficient lubrication help guide for more details.

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Signs of loose shaft nuts:

It is crucial to be able to identify the signs that may indicate a loose shaft nut in a turbocharger assembly. Detecting these signs early can help prevent further damage and potential failure.

Here are some common indicators:

- Noise from the turbo during operation: A loose shaft nut can cause abnormal noises, such as rattling or whining sounds, coming from the turbocharger while it is in operation.
- Loss of performance: A loose shaft nut can result in a decrease in turbocharger performance like reduction in power, slower acceleration, or a decrease in overall engine performance.
- Chipping to the compressor blades: The compressor blades can sustain damage if the shaft nut becomes loose and fell into compressor wheel inducer.
- Pitting around the compressor inlet: Appears as small, localised surface damage caused by completely loose shaft nut.
- Pitting on the compressor blades: In addition to chipping, pitting may also occur directly on the compressor blades themselves.
- Burst wheel: In severe cases, a loose shaft nut can lead to the complete failure of the compressor wheel, when excessive stress surpasses the compressor wheel's strength, causing it to reach its breaking point.



Chipping to the compressor blades



Pitting on the compressor blades



Complete component failure

Preventing turbo failure caused by loose shaft nuts:

- Preventing failure from a loose shaft nut is not straight forward. The only way to prevent issues is to keep the engine in good condition and correctly install the turbocharger.
- Always change the oil and filter when fitting a turbocharger, using the correct grade specified by the vehicle manufacturer.
- Use the correct torque settings on the shaft nut.

TECH TIP - In the majority of cases, a loose shaft nut is not the primary case of turbocharger failure. Always diagnose the root cause of the failure. If the original cause of failure was overspeeding, oil contamination or foreign object damage, and it does not get diagnosed correctly when you refit the turbocharger, it will fail.If the shaft nut is missing from the CHRA, it is imperative that you check all connecting parts for the missing shaft nut and debris, to prevent a secondary turbocharger failure.

For further information on this or other topics, visit www.melett.com/technical / technicalsupport@melett.com

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