

Wheel end security - wheel to hub



Technical Advisory Procedure



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This Technical Advisory Procedure is published by the Australian Trucking Association Ltd (ATA) to assist the road transport industry to improve commercial vehicle wheel end security. It is not, nor is it intended to be, complete or without exceptions.

The Technical Advisory Procedure is a guide only, and its use is entirely voluntary. Recommendations or procedures may not be suitable for or applicable to all operators. Operators should consider their own circumstances, practices and procedures when using this Technical Advisory Procedure.

Operators must comply with the Australian Design Rules (ADRs), the Australian Vehicle Standards Regulations, roadworthiness guidelines and any specific information and instructions provided by manufacturers in relation to the vehicle systems and components.

No endorsement of products or services is made or intended. Brand names, where used in this Technical Advisory Procedure, are for illustrative purposes only.

Suggestions or comments about this Technical Advisory Procedure are welcome. Please write to the Industry Technical Council, Australian Trucking Association, Minter Ellison Building, 25 National Circuit, Forrest ACT 2603.

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Introduction

This Technical Advisory Procedure (TAP) has been developed by the ATA Industry Technical Council (ITC) to provide operators with key information about commercial vehicle wheel end security to reduce the incidence of commercial vehicle wheel offs. This TAP focuses on the wheel to hub security, but of equal importance, is the security of the wheel hub to the axle.

A wheel off can be defined as the separation of a tyre and rim assembly from a vehicle due to the failure of component performance. This failure can be due to component fatigue, installation techniques, maintenance procedures and/or lack of follow up procedures.

Wheel offs cause downtime and equipment damage, Of far more importance, they may cause personal injury or a fatality.

This document sets out to industry best practice techniques about wheel installation and maintenance procedures to ensure optimum component performance. This will be achieved by the cooperation of the service providers, operators and drivers. This document does not override manufacturer's specifications and directions.

To aid in correctly performing installation and maintenance procedures, this document discusses the types of wheels commonly dealt with in the road transport industry, vehicle jacking and wheel removal techniques.

The installation procedures for these common types of wheels and their components are divided into individual sections for the service provider, including maintenance providers, contractors, etc and the driver plus roadside requirement.

Service providers and drivers should comply with company procedures to ensure the best levels of practice are maintained. This is achieved using documented policies such as Service Level Agreements.

The routine of the physical checking of wheel assembly components during pre-trip and en-route driver inspections is crucial to ensuring wheel assembly integrity within the transport industry. The methods of performing these inspections are outlined.

Notes:

This TAP is a general recommendation and it is offered up where the preferred source of reference information, the original equipment manufacturers (OEMs), is not available. **OEM information always takes precedence over general advisories, such as this TAP.**

Definition of commercial vehicle for the purposes of this TAP is a vehicle covered by the Heavy Vehicle National Law where it has a legal mass greater than 4.5 tonne for a truck or trailer.

1. Types of wheel systems

Understanding the type of wheel assembly is crucial to performing the correct procedure at service or inspection. There are four basic types of wheel mounting systems used in the Australian market.

- 1.1. Hub-piloted disc wheel system, typically ISO.
- 1.2. Stud-piloted disc wheel system, typically SAE/DIN.
- 1.3. Demountable (spider) wheel system, typically spoke wheel.
- 1.4. Japanese two piece wheel nut system with stud piloted disc wheels.

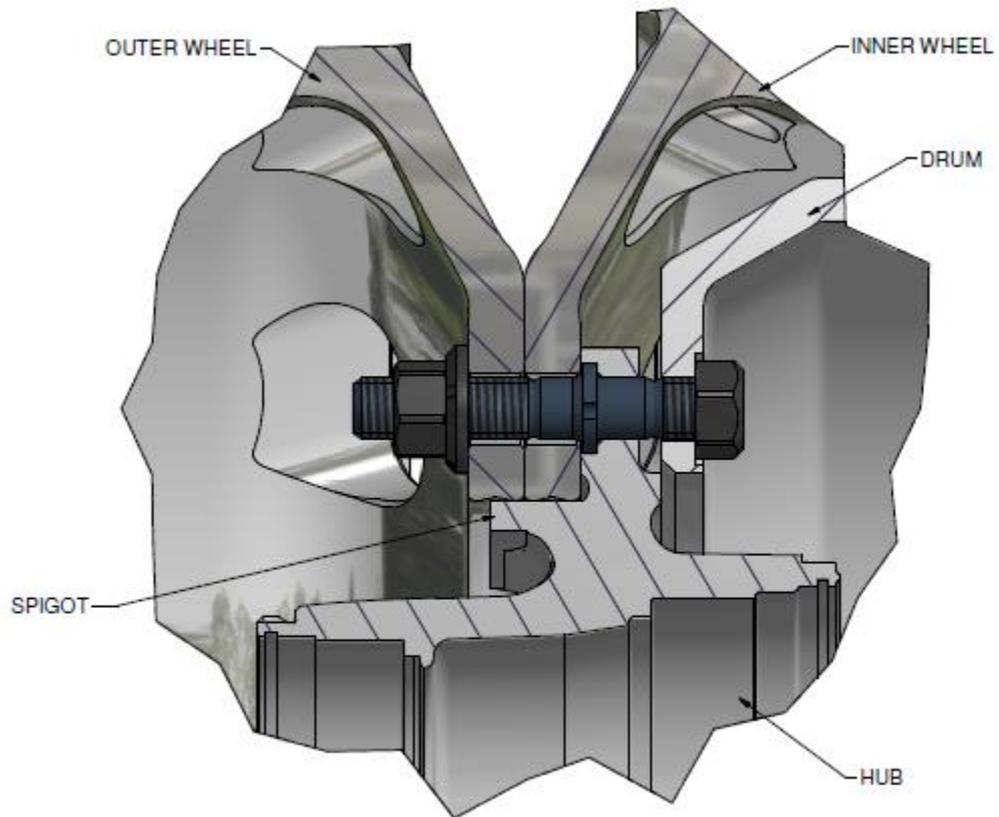
The following nut, wheel and hub images were provided by



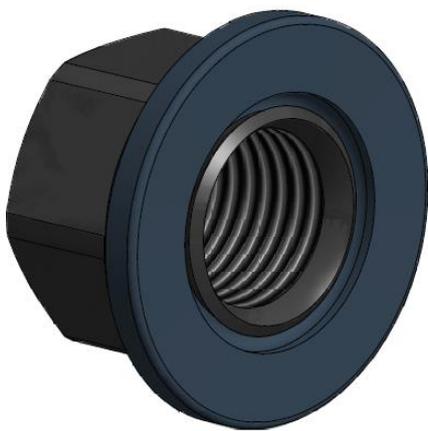
1.1. Hub-piloted disc wheel system

Features:

- Wheels are centred on the hub-pilot.
- Hub-piloted wheels use flange nuts.
- Bolt holes in wheel are non-chamfered.
- Only one nut is required per stud for dual assemblies.



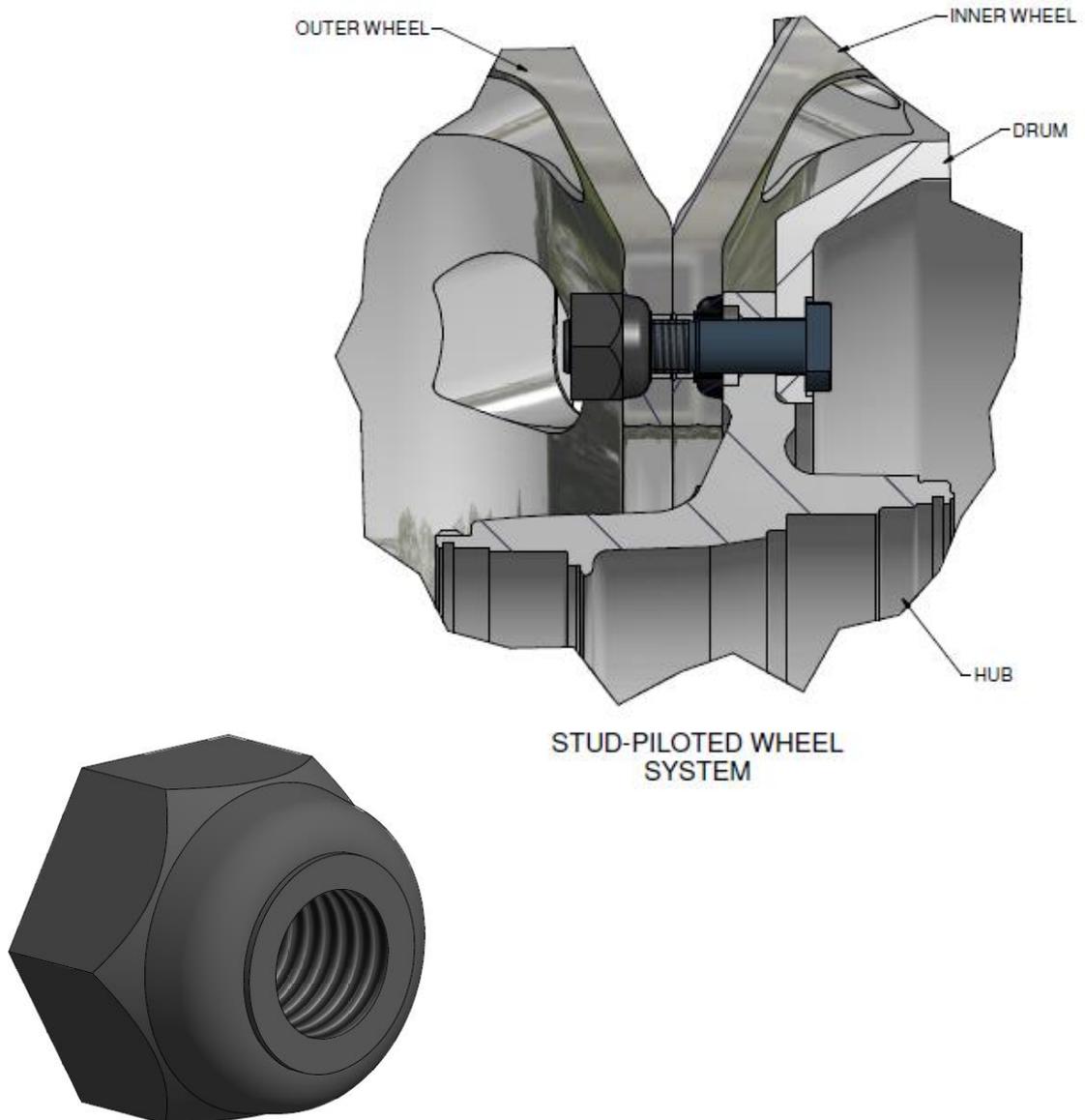
HUB-PILOTED WHEEL SYSTEM



1.2. Stud-piloted disc wheel system

Features:

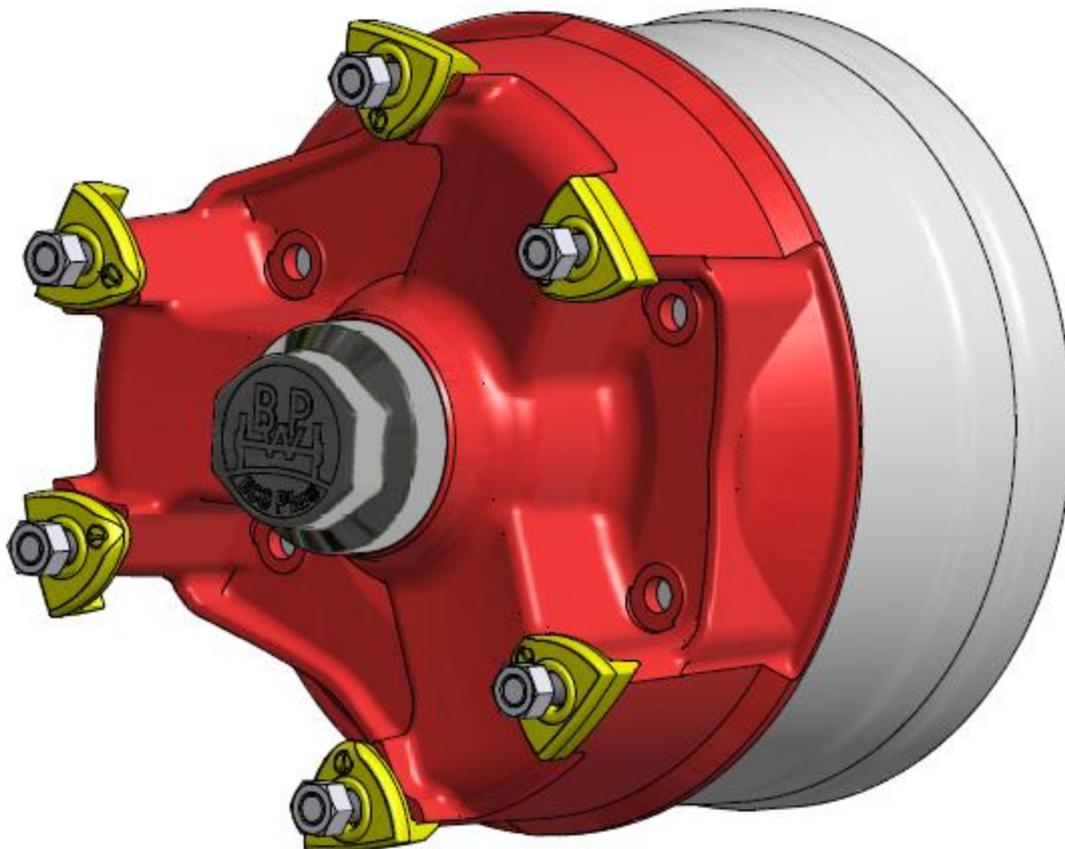
- Wheels are centred on the studs.
- Stud piloted wheels use ball seated nuts.
- Inner cap nuts are required to locate inner dual wheels.
- Bolt holes are chamfered.



1.3. Demountable (spider) rim

Features:

- A wheel with no centre disc or nave, more appropriately known as a rim.
- Relies on rim clamps (wedges) to secure the wheel to a cast spoke.
- Rim clamps are fastened by hex nuts.
- Dual assemblies are separated by a spacer band.



1.4. Japanese two piece wheel nut system with stud piloted disc wheels

The Japanese two piece wheel nut system is typically used on light and medium trucks with dual wheel installation along with left and right handed threaded wheel end hardware.

Where this system is being used, every stud and nut will be stamped with either an "R" or "L", even on the front axle. The right hand (driver's side) components will be identified with an "R" and left hand (passenger side) ones with an "L". This prevents loose nuts from loosening further as the unit is driven.

Warning check wheel studs and wheel nuts for

- Cracks or other damage
- Stud elongation or excessive rust
- Crush, thinned or seized threads

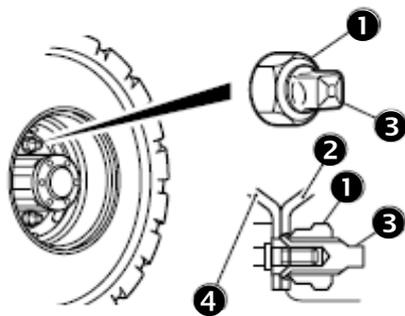


Figure 1: two piece wheel nut system

Dual wheel installation with double-nuts

First loosen the outer wheel nuts (1) and remove the outer tyre (2), then lower the jack, loosen inner wheel nuts (3) by using the square socket end of the wheel nut wrench, and jack up the vehicle again to remove the inner tyre (4).

Do not paint disk wheel mounting surfaces (1), dual wheel mating surfaces (2), wheel nut seating surfaces, and wheel hub mounting surfaces (3)

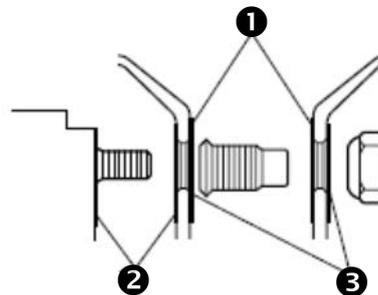
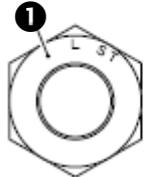


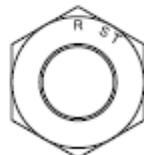
Figure 2: components of the assembly

Front Wheels

Left



Right



Left and right hand threads are used to ensure loose nuts, don't loosen further as the vehicle is driven down the road. This will occur with right hand threaded component on left hand side.

Rear wheels



Note: (1) LH front wheel nut, (2) LH outer rear wheel nut and (3) inner rear wheel nut

Figure 3 left/right handed threads identification

Images Source:- Fuso Trucks Australia.

2. Wheel and tyre assembly service procedures

Proper safety procedures are important when fitting or remove wheel assemblies!

Throughout all stages of wheel removal and fitting, it is important that all components are visually inspected during the process to check for damage or contaminants.

This includes checking for:

- Cracks, fractures or damage in wheels, mounting assemblies and components.
- Excessive corrosion or foreign material build up.
- Damaged threads or nuts.
- Damaged seating surfaces.

All suspect parts should be reported immediately. Damaged wheels, nuts or hub, or related components should not be used. Relevant parties should be notified of any damage.

2.1. Vehicle jacking

The following procedures are a guide to the safe handling, removal and refitting of wheel assemblies from heavy vehicles.

Procedure:

- Position vehicle in a clear area, safe from traffic and on a level surface suitable for jacking.
- Apply park brake.
- When changing wheels on road verges, always use safety warning equipment.
- Take into account issues including other vehicles and people, the vehicle condition, available tools, prevailing environment.
- Ensure the vehicle is adequately secured by use of chocks.
- Position jack under vehicle in a suitable location.
Refer to vehicle manufacturer's recommendations on jack placement.
- Raise jack until wheel is clear of the ground. The use of axle stands is recommended.
- It is advisable to deflate the tyre to be serviced before removal.
- In a dual tyre/wheel situation, the second/inside tyre should be inspected for signs of damage, and deflated before removal if damaged.
- Examine the wheel and determine type - each type of wheel system requires individual service techniques.
- Once initial assessment, preparation and precautions are completed, continue the task depending on the type of wheel system in use as outlined on the following page.

2.2. Wheel removal

When removing any type of tyre and wheel assembly from a vehicle (single or dual assemblies), it is crucial that the integrity of the assembly be known.

If there is evidence or suspicion that a tyre has been running at a pressure less than 80% of the pressure recommended for that vehicle either underinflated, overloaded situation or in a damaged state, then the air pressure must be released fully from that tyre before it is removed from the vehicle. If this tyre is fitted in dual fitment with another, then both tyres must be fully deflated before removal.

If removing multi-piece rims, the tyre/s must be fully deflated before removal from the vehicle. Both tyres of a dual assembly must be deflated before removal of one or both wheels. Multi-piece rim assemblies consist of more than one part, usually two pieces (rim base and rim side) or three pieces (rim base, side ring, and lock ring) for use with tube type tyres.

For dual assemblies, remove inner valve extension if fitted. This applies to all wheel system types.

2.2.1. Removing hub-piloted disc wheel system

- Remove all wheel nuts taking care not to damage the thread on the studs.
- Remove the wheel from the vehicle avoiding contact between the wheel and the studs.
- Apply correct manual handling techniques.
- If a wheel has become stuck onto a hub assembly, use a rubber mallet and strike the inner rim flange to assist in removal. Do not apply heat to the assembly at any stage to assist removal.

2.2.2. Removing stud-piloted disc wheel system

- Remove outer wheel nuts (outer cap nuts) taking care not to damage the thread on the studs or inner cap nuts (dual assemblies).
- Remove the outer wheel using correct manual handling techniques.
- Remove inner cap nuts (dual assembly) taking care not to damage threads.
- Remove the inner wheel using correct manual handling techniques.

2.2.3. Removing demountable (spider) rim system

CAUTION: There is potential for serious injury from dislodging wedges.

- Loosen the hex nuts until they are no longer in contact with the rim clamps (wedges).
- Ensure that the hex nuts remain fully on the threads of the studs.
- Tap the rim clamps (wedges) with a hammer until loose.

CAUTION: Stand to side of assembly out of possible trajectory of wedges.

- Wheel nuts can now be fully removed once wedges are dislodged.
- Remove the outer wheel using correct manual handling techniques.
- Remove the spacer band from the cast spoke using a side to side pulling motion.
- Remove the inner wheel using correct manual handling techniques.

2.3. Wheel installation procedures

This section is divided into two sections:

2.3.1. Wheel installation procedures - service provider, including maintenance providers, contractors, etc, and

2.3.2. Wheel installation procedures - driver and roadside requirement.

CAUTION:

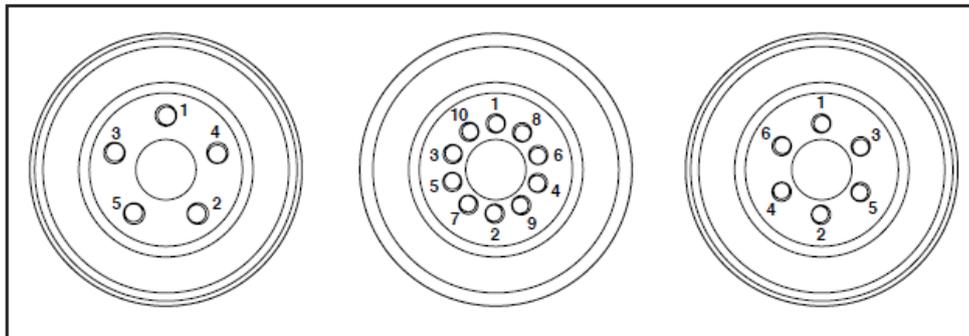
Incorrect use of impact wrenches (rattle guns) can lead to component damage including thread damage and mating surface damage. Over tensioning wheel nuts can lead to component failure.

Care is needed to ensure an impact wrench is not used to tighten wheel nuts to levels approaching 75% of the recommended torque settings.

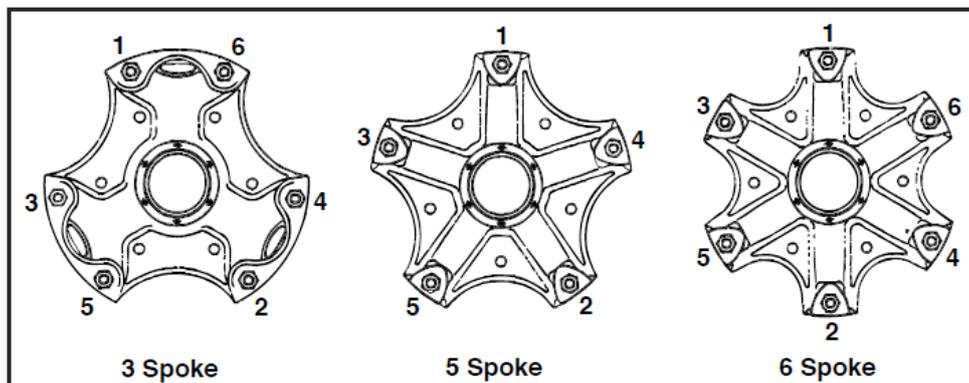
Equipment should be calibrated and serviced regularly.

Tensioning Sequences

Disc Wheels



Demountable (Spider) Wheels



2.3.1. Wheel installation procedures - service provider, including maintenance providers, contractors, etc

Ensure correct tyre inflation pressure has been achieved. This must be compliant with tyre and rim specifications and not exceed max allowable tolerances or recommendations for the rim or tyre.

Important: never mix the type of wheels used in a disc wheel system.

That is

- Never use a stud-piloted wheel on a vehicle with a hub-piloted system.
- Never use a hub-piloted wheel on a vehicle with a stud-piloted system.

Mixing wheel types may result in component damage, loss of wheel nut tension and wheel loss.

Damaged wheels, nuts or hub/drum components should not be re-used. They should be replaced.

It is important to use the correct type of nut for the disc wheel system.

That is

- Flange nuts for hub-piloted wheels.
- Ball seated nuts for stud-piloted wheels.

It is important that the person installing the wheel and tyre assembly performs a visual inspection of all componentry to check for mechanical adversity. This would include such things as worn threads, damaged mountings, cracks, etc.

Wheel nut torquing with brakes off

It is recommended that the wheel nut tightening procedure for vehicles with drum brakes should be undertaken with the brakes off. Brake drums can distort when the brakes are applied and torquing the wheel nuts in this condition could lead to a distortion of the drum and brake shuddering.

To prevent wheel rotation during torquing, the wheel end should be lowered to the ground to provide enough friction with the road to allow it to be correctly tensioned or suitable torquing equipment could be used.

Normal workshop practices should be carried out before any work is undertaken - the vehicle should be park on suitable surface and chocked to prevent it moving.

Lubrication

On most threads and friction surfaces (eg between ISO nut and its integrated washer), will require a **small amount of lubrication** to ensure the torque applied to the wheel nut, actually applies the appropriate clamping force on the rim to hub.

Products such as CRC are not lubricants, but rather water displacement agents and should not be used for lubrication. Grease is equally inappropriate as even if tightened to the specified torques, greased wheel nuts can loosen.

A light grade of oil, from air tool oil to car engine oil, should be used applied across the threads and appropriate surfaces.

Over lubrication

Lubricating threads against a manufacturers' recommendation and over lubricating threads, can lead to over tensioning and failure of the retention system. At the time of publication Fuso Trucks, BPW Transpec axles and selected Hendrickson axles are the only known suppliers who do not recommend the use of lubrication on the stud and nut threads. UD Trucks advises not to use grease on the threads, particularly anything containing molybdenum. If uncertain, please refer to the supplier.

Light and medium duty trucks often do suffer from over torqueing issues due to their significantly lower torque requirements and the industry's over use of rattle guns.

The concern regarding lubrication and over lubrication is valid. The torque applied to a bolt's joint is typically upwards of 70% friction, the addition and type of lubrication can significantly increase the clamping force applied to the assembly. But the presence of increased friction due to contaminated parts (rust, dirt, paint etc.) or deformed parts will have a negative effect on clamp load achieved.

Clamp load joints must never under perform during service as wheel offs could result. Higher clamp loads, due to over lubrication, may result in clamp loads well above the design service loads. If yielding does occur during tightening, parts will permanently deform. Despite the deformation, the joint will continue to meet the clamp load requirements and will function as intended. Eventually successive yielding events will cause the stud to fracture during torqueing, this will be a highly evident failure as the required tensioning torque will not be achieved.

If there is a concern that an over torqueing situation has taken place and stretching has occurred, the stud should be replaced or at least checked via a stud thread tester and replaced, if required.

A more concerning situation is low clamp load where an assembly is potentially exposed to fatigue loading and therefore has potential to fail during service. This sort of failure is not visible to a tyre fitter or driver and as such can progress unseen, possibly leading to failure and a wheel off event.

In summary, applying lubrication sparingly will produce a better outcome in the absence of definitive information. Higher clamping loads from over lubrication are more likely to lead to low severity, highly visible failures, such as a snapped stud as opposed to a much more serious wheel off event in operation or service.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers.
- The external or internal workshop should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

2.3.1.A. Installing hub-piloted disc wheel systems

Procedure

- Ensure all hub/drum mounting faces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure wheel mounting surfaces are clean.
- Clean all studs and threads to eliminate foreign material that may affect the correct function of the nuts.
- Ensure multi-piece flange nuts turn smoothly on their flanges.
- Lightly lubricate between the nut and flange and to the threads only if required.
- Do not allow lubricant to contact the mounting faces of the hub/drum or wheel.
- Mount the wheel on the hub using correct manual handling techniques.
- Ensure a flush fit between the mounting faces of the hub/drum and wheel.
- Take care not to damage threads whilst mounting the wheel.
- For dual assemblies, mount the second wheel on the hub using correct manual handling techniques.
- Install flange nuts finger tight at the 12 o'clock and then at the 6 o'clock positions. The remaining nuts may then also be fitted finger tight.
- Using the correct tightening sequence, apply an adequate amount of tension to the wheel nuts to effectively seat the wheel onto the hub.
- Care is needed to ensure an impact wrench is only used to tighten wheel nuts to levels approaching the 75% recommended torque settings.
- Check the assembly for correct fitment.
- Using a torque wrench, complete final tensioning of the wheel nuts to the recommended manufacturer specifications using the correct tightening sequence. See section 6 for a listing of generic wheel nut tightening torque tables or preferably, the attached supplement with manufacturer specific wheel nut tightening torques. Manufacturers' torques and procedures will always take precedence over this guide.
- Notification must be made to the vehicle operator/driver that work has been completed. See the notification of service procedures section.

2.3.1.B. Installing stud-piloted disc wheel systems

Procedure:

- Ensure all hub/drum mounting faces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure wheel mounting surfaces are clean.
- Clean all stud and threads to eliminate foreign material that may affect the correct function of the nuts.
- Check around the ball seats of the wheel for burrs and remove with a file.
- Mount the wheel on the hub using correct manual handling techniques.
- Ensure a flush fit between the mounting faces of the hub/drum and wheel.
- Do not lubricate chamfered bolt holes or ball seated nuts. Carefully apply lubrication sparingly to the stud and nut threads only if required.
- Take care not to damage threads whilst mounting the wheel.
- Position the wheel to allow a ball seated nut to be finger tightened.
Repeat this process for the remaining nuts to ensure the wheel is positioned uniformly and flush against the hub/drum.
- Using the correct tightening sequence, apply an adequate amount of tension (75% of the recommended tightening torque) to the wheel nuts to effectively seat the wheel onto the hub.
- Check the assembly for correct fitment.
- Using a torque wrench, complete the tensioning of the wheel nuts to the recommended manufacturer specifications using the correct tightening sequence.
- For dual assemblies, mount the outer wheel over the inner nuts using correct manual handling techniques.
- Position the wheel to allow a ball seated nut to be finger tightened.
Repeat this process for the remaining nuts to ensure the wheel is positioned uniformly and flush against the outer face of the inside wheel.
- Using the correct tightening sequence, apply an adequate amount of tension (75% of the recommended tightening torque) to the wheel nuts to effectively seat the wheel against the inner wheel.
- Care is needed to ensure an impact wrench is not used to tighten wheel nuts to levels approaching the recommended torque settings.
- Check the assembly for correct fitment.
- Using a torque wrench, complete final tensioning of the wheel nuts to the recommended manufacturer specifications using the correct tightening sequence.
See section 6 for a listing of generic wheel nut tightening torque tables or preferably, the attached supplement with manufacturer specific wheel nut tightening torques. Manufacturers' torques and procedures will always take precedence over this guide.
- Notification must be made to the vehicle operator/driver that work has been completed. See the notification of service procedures section.

2.3.1.C. Installing demountable (spider) wheel systems

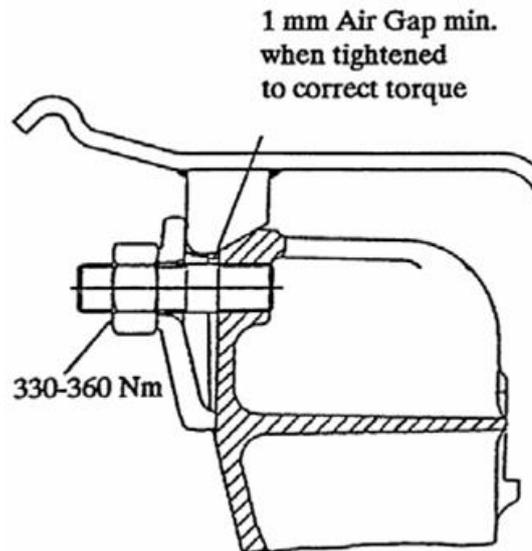
Procedure:

- Ensure all rim clamps (wedges) and cast spoke mounting surfaces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure wheel mounting surfaces and spacer bands are clean.
- Clean all stud and threads to eliminate foreign material that may affect the correct function of the nuts.
- Mount the wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- For single wheel assemblies, secure the rim clamps (wedges) into position. Ensure that the rim clamps are correct for the rim style.
- Using the correct tightening sequence, apply an adequate amount of tension to the hex wheel nuts to effectively seat the wheel onto the cast spoke mounting surfaces. This must be done in a gradual and even manner to ensure the wheel remains properly aligned on the cast spokes. Care is needed to ensure an impact wrench is not used to tighten wheel nuts to levels approaching 75% of the recommended torque settings.
- Using a torque wrench, complete the tensioning of the wheel nuts to the recommended manufacturer specifications using the correct tightening sequence.
- For dual assemblies, mount the inner wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- Then place the spacer band over the cast spoke using an even pressure on both sides. Ensure that the spacer band is of the correct width for the assembly. Refer to manufacturers specifications.
- The spacer should sit against the inner rim and fit snugly over the cast spokes.
- Mount the outer wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- Secure the rim clamps (wedges) into position. Ensure that the rim clamps are correct for the rim style.
- Using the correct tightening sequence, apply an adequate amount of tension to the hex wheel nuts to effectively seat the wheel onto the cast spoke mounting surfaces. This must be done in a gradual and even manner to ensure that the wheels and spacer band remain properly aligned on the cast spokes.
- Care is needed to ensure an impact wrench is not used to tighten wheel nuts to levels approaching the recommended torque settings.
- Using a torque wrench, complete the tensioning of the wheel nuts to the recommended manufacturer specifications using the correct tightening sequence. See section 6 for a listing of generic wheel nut tightening torque tables or preferably, the attached supplement with manufacturer specific wheel nut tightening torques. Manufacturers' torques and procedures will always take precedence over this guide.
- Notification must be made to the vehicle operator/driver that work has been completed. See the notification of service procedures section.

Demountable (spider) wheel installation quality check

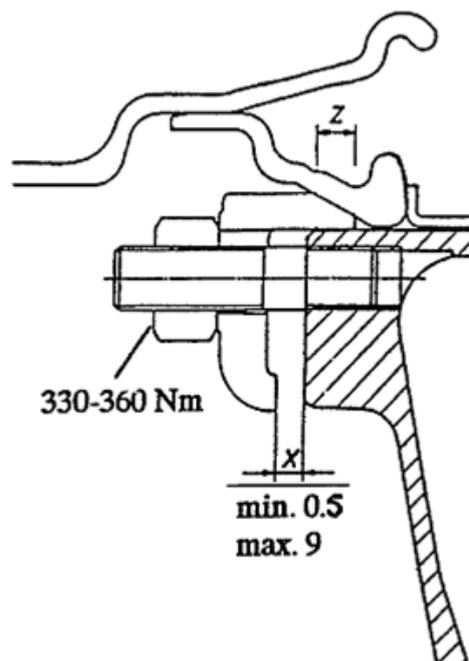
Steer axle installation example

Ensure, after the wheel assembly has been correctly torqued, that the rim has about 1 mm air gap/clearance to each of the wheel studs. Refer to the following diagram.



Typical twin tyre/rim installation example

Ensure, after the wheel assembly has been correctly torqued, that the wedge/cleat does not bottom out on the hub with between 0.5 mm to a maximum of a 9 mm air gap / clearance. Refer to the following diagram.



2.3.2 Wheel installation procedures - driver (roadside requirement)

Ensure correct tyre inflation pressure has been achieved. This must be compliant with tyre and rim specifications plus not exceed max allowable tolerances or recommendations for the rim or tyre.

Important: never mix the type of wheels used in a disc wheel system.

That is

- Never use a stud-piloted wheel on a vehicle with a hub-piloted system.
- Never use a hub-piloted wheel on a vehicle with a stud-piloted system.

Mixing wheel types may result in component damage, loss of wheel nut tension and wheel loss.

Damaged wheels, nuts or hub/drum components should not be used. They should be replaced.

It is important to use the correct type of nut for the disc wheel system.

That is

- Flange nuts for hub-piloted wheels
- Ball seated nuts for stud-piloted wheels.

It is important that the person installing the wheel and tyre assembly performs a visual inspection of all componentry to check for component integrity. This would include such things as worn threads, damaged mountings, cracks etc.

Wheel nut torqueing with brakes off

It is recommended that the wheel tightening procedure for vehicles with drum brakes should be undertaken with the brakes off. Brake drums can distort when the brakes are applied and torqueing the wheel nuts in this condition could lead to a distortion of the drum and brake shuddering.

To prevent wheel rotation during torqueing, the wheel end should be lowered to the ground to provide enough friction with the road to allow it to be correctly tensioned or suitable torqueing equipment could be used.

Normal workshop practices should be carried out before any work is undertaken - the vehicle should be park on suitable surface and chocked to prevent it moving.

Lubrication

On most threads and friction surfaces (eg between ISO nut and its integrated washer), will require a **small amount of lubrication** to ensure the torque applied to the wheel nut, actually applies the appropriate clamping force across the rim to the hub.

Products such as CRC are not lubricants, but rather water displacement agents and should not be used for lubrication. Grease is equally inappropriate as even if tightened to the specified torques, greased wheel nuts can loosen.

A light grade of oil, from air tool oil to car engine oil, should be used applied across the threads and appropriate surfaces.

Over lubrication

Lubricating threads against a manufacturers' recommendation and over lubricating threads, can lead to over tensioning and failure of the retention system. At the time of publication Fuso Trucks, BPW Transpec axles and selected Hendrickson axles are the only known suppliers who do not recommend the use of lubrication on the stud and nut threads. UD Trucks advises not to use grease on the threads, particularly anything containing molybdenum. If uncertain, please refer to the supplier.

Light and medium duty trucks often do suffer from over torqueing issues due to their significantly lower torque requirements and the industry's over use of rattle guns.

The concern regarding lubrication and over lubrication is valid. The torque applied to a bolt's joint is typically upwards of 70% friction, the addition and type of lubrication can significantly increase the clamping force applied to the assembly. But the presence of increased friction due to contaminated parts (rust, dirt, paint etc.) or deformed parts will have a negative effect on clamp load achieved.

Clamp load joints must never under perform during service as wheel offs could result. Higher clamp loads, due to over lubrication, may result in clamp loads well above the design service loads. If yielding does occur during tightening, parts will permanently deform. Despite the deformation, the joint will continue to meet the clamp load requirements and will function as intended. Eventually successive yielding events will cause the stud to fracture during torqueing, this will be a highly evident failure as the required tensioning torque will not be achieved.

If there is a concern that an over torqueing situation has taken place and stretching has occurred, the stud should be replaced or at least checked via a stud thread tester and replaced, if required.

A more concerning situation is low clamp load where an assembly is potentially exposed to fatigue loading and therefore has potential to fail during service. This sort of failure is not visible to a tyre fitter or driver and as such can progress unseen, possibly leading to failure and a wheel off event.

In summary, applying lubrication sparingly will produce a better outcome in the absence of definitive information. Higher clamping loads from over lubrication are more likely to lead to low severity, highly visible failures, such as a snapped stud as opposed to a much more serious wheel off event in operation or service.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers.
- The external or internal workshop should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

2.3.2.A. Installing hub-piloted disc wheel systems

Procedure:

- Ensure all hub/drum mounting faces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure that the wheel mounting surfaces are clean.
- Clean all studs and threads to eliminate foreign material that may affect the correct function of the nuts.
- Ensure multi-piece flange nuts turn smoothly on their flanges.
- Lightly lubricate between the nut and flange, and on the outer end of the stud threads.
- Mount the wheel on the hub using correct manual handling techniques.
- Ensure a flush fit between the mounting faces of the hub/drum and wheel.
- Take care not to damage threads whilst mounting the wheel.
- For dual assemblies, mount the second wheel on the hub using correct manual handling techniques.
- Install flange nuts finger tight at the 12 o'clock and then at the 6 o'clock positions. The remaining nuts may then also be fitted finger tight.
- Using the correct tightening sequence, apply an adequate amount of tension (75% of the recommended tightening torque) to the wheel nuts to effectively seat the wheel onto the hub.
- Check the assembly for correct fitment.
- Using an appropriate wheel brace length (see section 7), tighten the wheel nuts to the manufacturer's recommended specifications using the correct tightening sequence. See section 6 for a listing of generic wheel nut tightening torque tables or preferably the attached supplement with the manufacturer specific wheel nut tightening torques. The manufacturer's torques and procedures will always take precedence over this guide.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers.
- The external or internal workshop should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

2.3.2.B. Installing stud-piloted disc wheel system

Procedure:

- Ensure all hub/drum mounting faces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure wheel mounting surfaces are clean.
- Clean all stud and threads to eliminate foreign material that may affect the correct function of the nuts.
- Check around the ball seats of the wheel for burrs, and remove with a file.
- Mount the wheel on the hub using correct manual handling techniques.
- Ensure a flush fit between the mounting faces of the hub/drum and wheel.
- Do not lubricate chamfered bolt holes or ball seated nuts. Lubrication should be limited and applied carefully, to threads only if required.
- Take care not to damage threads whilst mounting the wheel.
- Position the wheel to allow a ball seated nut to be finger tightened. Repeat this process for the remaining nuts to ensure the wheel is positioned uniformly and flush against the hub/drum.
- Using the correct tightening sequence, apply an adequate amount of tension (75% of the recommended tightening torque) to the wheel nuts to effectively seat the wheel onto the hub.
- Check the assembly for correct fitment.
- Using an appropriate wheel brace length (see section 6), tighten the wheel nuts to recommended manufacturer specifications using the correct tightening sequence. (See section 6 for mounting torque tables and supplement)
- For dual assemblies, mount the outer wheel over the inner nuts using correct manual handling techniques.
- Position the wheel to allow a ball seated nut to be finger tightened. Repeat this process for the remaining nuts to ensure the wheel is positioned uniformly and flush against the outer face of the inside wheel.
- Using the correct tightening sequence, apply an adequate amount of tension to the wheel nuts to effectively seat the wheel against the inner wheel.
- Check the assembly for correct fitment.
- Using an appropriate wheel brace length (see section 7), tighten the wheel nuts to manufacturer's recommended specifications using the correct tightening sequence. See section 6 for a listing of generic wheel nut tightening torque tables or preferably the attached supplement with the manufacturer specific wheel nut tightening torques. The manufacturer's torques and procedures will always take precedence over this guide.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers.
- The external or internal workshop should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

2.3.2.C. Installing demountable (spider) wheel system

Procedure:

- Ensure all rim clamps (wedges) and cast spoke mounting surfaces are clean and allow a flush fit with the mounting surface of the wheel. This is critical in attaining a secure fit.
- Ensure wheel mounting surfaces and spacer bands are clean.
- Clean all stud and threads to eliminate foreign material that may affect the correct function of the nuts.
- Mount the wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- For single wheel assemblies, secure the rim clamps (wedges) into position.
- Using the correct tightening sequence, apply a firm amount of tension to the hex wheel nuts to adequately seat the wheel onto the cast spoke mounting surfaces. This must be done in a gradual and even manner to ensure the wheel remains properly aligned on the cast spokes.
- Using an appropriate wheel brace length (see section 6), tighten the wheel nuts to recommended manufacturer specifications using the correct tightening sequence. See Section 6 for mounting torque tables and supplement.
- For dual assemblies, mount the inner wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- Then place the spacer band over the cast spoke using an even pressure on both sides.
- The spacer should sit against the inner rim and fit snugly over the cast spokes.
- Mount the outer wheel on the cast spokes, positioning the location indicators between the spokes, using correct manual handling techniques.
- Take care not to damage threads whilst mounting the wheel.
- Secure the rim clamps (wedges) into position.
- Using the correct tightening sequence, apply an adequate amount of tension (75% of the recommended tightening torque) to the hex wheel nuts to effectively seat the wheel onto the cast spoke mounting surfaces. This must be done in a gradual and even manner to ensure that the wheels and spacer band remain properly aligned on the cast spokes.
- Using an appropriate wheel brace length (see section 7), tighten the wheel nuts to recommended manufacturer specifications using the correct tightening sequence. See section 6 for a listing of generic wheel nut tightening torque tables or preferably the attached supplement with the manufacturer specific wheel nut tightening torques. The manufacturer's torques and procedures will always take precedence over this guide.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers.
- The external or internal workshop should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

2.4. New wheel nut torquing procedure, torque-angle format

Some trucks and trailers, particular the newer European models, may have the wheel tightening specification provided in a torque-angle format. The benefits of a torque-angle specification is a more consistent clamping force being applied to the wheel.

Compared to normal torque specifications, it is also much less sensitive to factors such as friction, surface conditions and component quality. However, the downsides are additional process complexity and an unknown final level of torque required from the operator. A high friction joint will require more torque to achieve the given angle, conversely a low friction joint will require less torque.

Typically, a torque-angle tightening specification will be provided as a seating (or snug) torque, followed by an additional angle component. For example 200 Nm + 90 degrees, and a tolerance is also typically given for both the seating torque and the applied angle.

Torque-angle tightening procedure

Note:- Manufacturer's recommendations will always take precedence.

- Inspection, cleaning and placement of the wheel are carried out as per normal.
- The nuts are tightened to the seating torque using a tension wrench in a normal torquing sequence, as per normal torque joints for a given wheel type.
An impact wrench or similar may be used prior to the tension wrench, but only if does not exceed 75% of the recommended seating tightening torque. As a guide, the tension wrench should turn the nut the last quarter of a turn to the seating torque, this will ensure more consistent clamping and prevent over tightening. If the nut does not rotate a quarter of a turn, loosen all nuts and start the procedure over from the beginning.
- Once all nuts have had the seating torque applied, the angle can be applied. Using a wrench with a protractor or angle gauge, tighten all nuts individually, using the same torquing sequence as used for the seating torque, until the required angle has been achieved.

Note:- that the torque required to obtain the angle is not important and may vary considerably between wheel to wheel and stud to stud. This is not a concern provided the seating torque and angle have been applied correctly.

Checking / follow up.

- Every time a wheel is fitted to a vehicle, the wheel nut tension should be checked after 50-100km of driving. This is a common recommended practice of all suppliers. The checking torque when applied in the tightening direction to a satisfactory joint should not result in any nut movement. If a nut does move with the checking torque the joint was insufficient, loosen all nuts, check the assembly for any faults and if ok retorque from the beginning of the procedure.
- The external or internal workshops should advise the driver of the truck of the need to check the wheel nut torque after 50-100km. It is the responsibility of the workshop to alert the driver/s of the work performed and the need to recheck wheel nut tension to the prescribed torque. This can be done as per section 3: notification of service procedures.

Note the checking torque given is only a minimum torque value; the actual value for a given nut may be much higher depending on friction and condition of parts. For this reason the checking torque value should not be used to tighten loose nuts. Checking torque is only to be used to check after the correct seating torque and angle torquing have been applied when in service or annually.

3. Notification of service procedures

It is the responsibility of a service provider to alert the operator/driver of a vehicle that recent service has been performed on particular wheel assemblies of a vehicle.

This alert must be clearly visible to the driver after service completion.

Outside of the routine pre-trip tyre and wheel inspection carried out by a driver, it is imperative that the driver be aware that recent service has been performed. This service includes notification of any tyre and rim assembly removed and/or fitted by:

- Original equipment suppliers.
- A tyre workshop, either at store, on-site or roadside.
- A mechanical workshop.
- Any other maintenance provider.

The alert notification shall be displayed prominently to the driver of the vehicle and correctly identify the location of work performed on the vehicle. These may include but not limited to:

- Attachment to the rear view mirror.
- Attachment to the steering wheel.
- Clearly displayed at dashboard instrument panel.
- Clearly marking the tyre and wheel assemblies involved (with tyre crayon or tag).
- Attachment to trailer airlines.

And may also include as additional notification:

- Notification to fleet operations staff.

It is important that the assemblies are clearly marked in a manner that enables easy identification and that is resistant to the effects of weather. This need is highlighted in the case of removal of wheel assemblies being performed on a piece of equipment that is not currently attached to a prime mover or host vehicle.

This will enable the correct practice of rechecking wheel nut tensions of wheel assemblies after a service provider has performed service on a vehicle.

Sample driver and vehicle information wheel off warning label.

ATTENTION DRIVER **BORAL**

1 This vehicle has had a wheel removed and replaced as indicated below

Fleet No. Service Provider

Date Technician

2 Wheel nut indicators to be monitored between 50 km & 100 km.

Trailer 2	Trailer 1	Drive	Steer
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3 Wheel nuts must be retensioned at the end of the first shift

Wheelnuts retensioned by

Date

BT NSW - W05 - 2010 - V1

4. Physical checking of wheel assembly components

This section covers 4.1. general maintenance, and 4.2. rechecking of recently serviced assemblies as routine inspections to be carried out by the driver of a vehicle at times specific to the task.

4.1. General maintenance.

It is the responsibility of the professional driver to carry out a pre-trip vehicle inspection prior to commencing a shift or trip.

In order to identify notifications from service providers of recent wheel maintenance, a driver should undertake a visual inspection of all wheel assemblies prior to initiating a shift or designated period of travel. This should be integrated into the primary pre-trip inspection routine.

During general maintenance pre-trip inspections, drivers should inspect for...

- Broken or missing wheels studs or nuts.
- Missing valve caps and missing inner valve extensions.
- Damaged or cracked wheel components (wheels, nuts, washers etc).
- Flat or damaged tyres.
- Mismatched tyres.
- Inflation of tyres.

Important: The responsibility for wheel assembly security is effective immediately the driver takes control of the vehicle.

4.2. Rechecking recently serviced assemblies

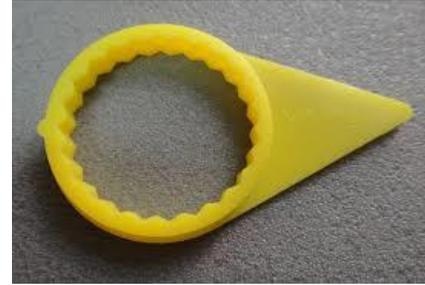
The following is an outline of checking procedures for wheel assemblies following service, to be performed by drivers.

- The driver must conduct a physical check of wheel assemblies during the pre-trip inspection prior to commencing a shift.
- The driver must then conduct a physical check of the wheel assemblies at an interval between 50-100km from the commencement of the shift. This inspection should be documented in the vehicle log.
- A physical check of wheel assemblies involves the use of an appropriate torque wrench to effectively determine the security of wheel fasteners. If this is not possible, refer to section 6 to develop an estimated torque tightening methodology.
- In the event of loose wheel nuts, the assembly should be secured and monitored. It is then a priority that the wheel assembly is correctly retensioned as soon as practical. It is vital that this occurrence (loose wheel nuts) be reported immediately to fleet management or recorded in the vehicle log.
- Missing wheel fasteners should be reported immediately.

5. Wheel nut indicators

Wheel nut indicators are growing in popularity as a cheap, simple and effective method to monitor nuts.

They come in many forms and functions but will not negate the need to periodically check the nut tension. Their functions will vary, but could include:



- To primarily provide a clear visual indication of nut movement.
- Provide a wheel nut retaining function to reduce wheel nut loosening and reduce the likelihood of wheel nuts from completely backing off the wheel hub.
- Provide an indication of wheel overheating which is otherwise difficult to detect, usually as a result of brakes sticking or problems with the bearings, through the use of specific product material melting points.
- Provide a clear visual commitment to roadworthiness and professionalism to other road users, customers, health and safety, road and transportation departments.

6. Mounting torque tightening tables - general

Important: The information contained in these tables is a guide only.

Where possible the recommended torque levels as stated by the manufacturer for a particular vehicle should be used. These can be found in the attached supplement. If there is any doubt, clarify the requirements with the supplier of the equipment.

Recommended mounting torque for disc wheels.

Mounting type	Nut/stud thread	Torque level ¹ .	
		Nm	ft-lb
Hub piloted with flange nut	$\frac{11}{16}$ " - 16	410-540	300-400
	M20 x 1.5	380-450	280-330
	M22 x 1.5	610-680	450-500
	$\frac{7}{8}$ " - 16	610-680	450-500

Mounting type	Nut/stud thread	Torque level ² .	
		Nm	ft-lb
Stud-piloted, double cap nut standard type (7/8" ball seat radius)	$\frac{3}{4}$ " - 16	610-680	450-500
	$1 \frac{1}{8}$ " - 16	610-680	450-500
Stud-piloted, double cap nut heavy duty type (1-3/16" ball seat radius)	1 - 12	1,020-1,220	750-900
	$1 \frac{1}{8}$ " - 16	1,020-1,220	750-900
	$1 \frac{5}{16}$ " - 12	1,020-1,220	750-900

Recommended mounting torque for spoke wheel/demountable rims

Mounting type	Nut/stud thread	Torque level ¹ .	
		Nm	ft-lb
Spoke wheel/demountable rims	$\frac{5}{8}$ " - 11	220-270	160-200
	$\frac{3}{4}$ " - 10	270-350	200-260

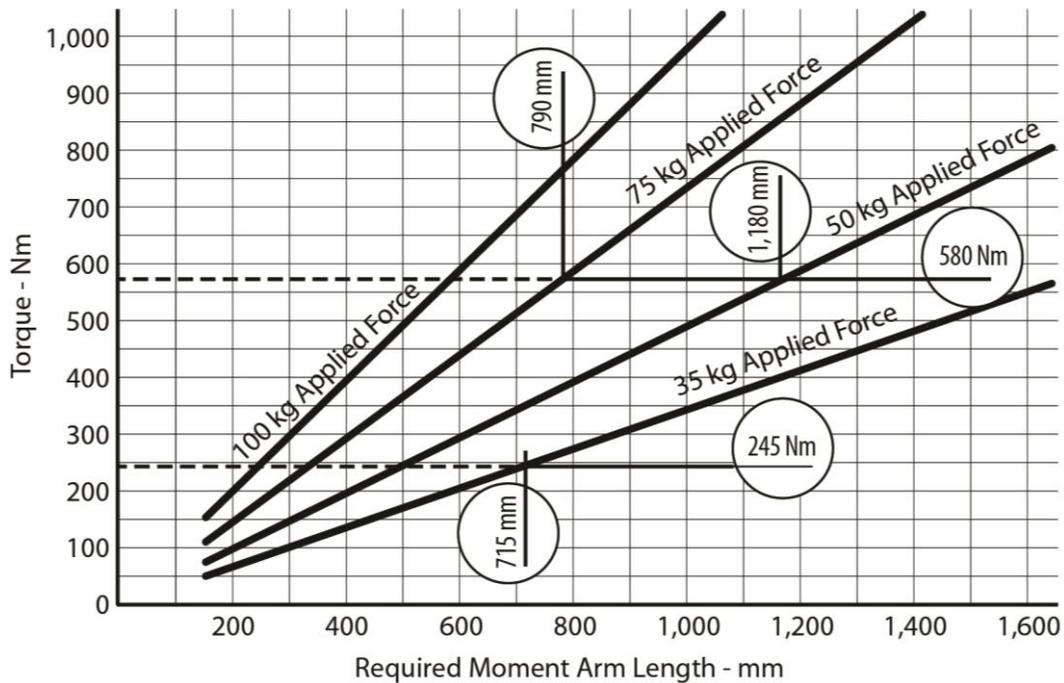
Note:

1. Stud thread lubricated with light machine oil.
2. Stud thread lubricated with light machine oil. Ensure that nut cone is DRY.

7. Estimating tightening torque in the field

To assist drivers in the field when changing wheels, a graph has been prepared to assist in achieving wheel nut tensions closely approximated to what is required in accordance with manufacturers' recommendations, see the supplement.

The following chart is designed to assist with estimating the tightening torques based on the lever arm (bar) and body mass.

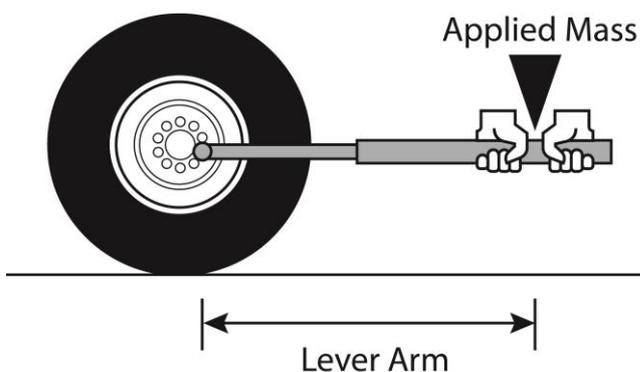


Graph 1: Approximating tightening torques.

Graph was prepared and formatted by ITC TAP Working Group – 2008.

Infield procedure for applying the torque tightening settings

1. To determine the maximum available lever arm (bar).
2. Identify required tightening torque from manufacturers' recommendations.
3. Draw horizontal line at the approximated torque on graph 1 above.
4. Follow approximated torque across graph to applied force line, the body mass you can apply to the bar. (eg: 580 Nm say 75 kg applied force line)



5. Where the line intersects force the line, draw vertical line to determine lever arm length (eg: require lever is 790 mm, this must be less than the available level arm)

6. Torque wheel nuts in the order previously noted in this TAP. Ensure the bar (level arm) is horizontal, otherwise the torque will be reduced.

TAP development process, history and validation

The TAP development process

The ITC will approve the need for the creation of a new TAP or the triennial routine review of an existing TAP. The nominated editor(s), who are listed below, with support of the ITC and specialist industry technical members as required, will agree on the TAP content with approval by a majority vote of ITC members. A suitably qualified and experience ATA appointed peer reviewer will further review the publication and if necessary, recommended changes. These changes will then be reviewed and approved again by a majority vote of ITC members before the document is released.

Document version control

Edition	Date	Nature of change / comment	Editor(s)
First	2008	Initial release	David Coonan, ATA National Manage - Policy
Second	Oct 2015	Significant review with expanded torque tables	Chris Loose, ATA, Senior Advisor Engineering
Third	Feb 2016	Additional information added including details on Japanese dual wheel nut system, over lubrication issue of threads leading to stretching and torquing wheel nuts with the brakes off.	Chris Loose, ATA, Senior Advisor Engineering

The next is expected on or before February 2019.

Drafting committee, third edition

Member	Organisation	Title	Qualification
Chris Loose	ATA	Senior Advisor Engineering	Engineer

Peer review

Edition	Date	Peer Reviewer	Organisation / Qualifications
Third	2016	Peter Jones	Goodyear, Customer Engineer, BEng



About the ATA Industry Technical Council:

The Industry Technical Council (ITC) is a standing committee of the Australian Trucking Association (ATA). The ITC's mission is to improve trucking equipment, its maintenance and maintenance management. The ITC was established in 1995.

As a group, the ITC provides the ATA with robust professional advice on technical matters to help underpin the ATA's evidence based policymaking. It is concerned with lifting technical and maintenance standards, improving the operational safety of the heavy vehicle sector, and the development of guidelines and standards for technical matters.

ITC performs a unique service in the Australian trucking industry by bringing operators, suppliers, engineers and other specialists together in a long-term discussion forum. Its members provide expert and independent advice in the field to inform the work of the ITC. The outcomes from ITC benefit all ITC stakeholders and the heavy vehicle industry at large.

The ITC operates under the Australian Trucking Association's Council, which formulates industry policy for implementation by the organisation.

Joining ITC:

We welcome applications to join the ITC. For further information, please call the ATA (02) 6253 6900

email ata@truck.net.au

or download information from the ATA website www.truck.net.au follow the links under the members tab to join here.

A. Supplement with detailed manufacturers' tightening torques

Wheel end security TAP supplement - traditional torquing methodology

Manufacturers' truck torque tightening table - 2008.

This supplement provides model specific information, which is not provided in the body of the wheel end security TAP. This original table was published 2008 in the first edition of this TAP and is believed to be accurate for the models listed. If there is any doubt, clarify the requirements with the supplier of the equipment.

Manufacturer - Style	Size	Nm	ft-lb
DaimlerChrysler, disc wheels with spherical spring washer	18 mm	250	185
DaimlerChrysler, disc wheels with spherical spring washer	20 mm	300	220
DaimlerChrysler, disc wheels with spherical spring washer	22 mm	450	330
DaimlerChrysler, ISO style - nut with flat washer	18 mm	400	295
DaimlerChrysler, ISO style - nut with flat washer	22 mm	600	445
DaimlerChrysler, spider (trilex)	18 mm	200	145
DaimlerChrysler, spider (trilex)	20 mm	300	220
DaimlerChrysler, spider (trilex)	22 mm	350	260
Isuzu, ISO 10 Stud.	-	640	470
Isuzu, SAE style - front NKR	-	167	123
Isuzu, SAE style - rear NHR & NKR	-	294	217
Isuzu, all other SAE style	-	441	325
IVECO, Daily 40C14; 50C17; & 65C17	-	290-350	210-260
IVECO, Daily 35S14	-	160	-
IVECO, EuroCargo 60-80	-	335-410	250-300
IVECO, EuroCargo 80-130	-	440-540	330-400
IVECO, EuroCargo 150-260	-	565-690	420-500
IVECO, EuroCargo with factory tag axle	-	550-600	410-440
MAN, hub centring	18 mm x 1.5	390	288
MAN, hub centring	20 mm x 1.5	475	350
MAN, hub centring	22 mm x 1.5	575	424
MAN, spider	16 mm x 1.5	285	210
MAN, spider	20 mm x 1.5	340	177
MAN, stud centring	18 mm x 1.5	285	210
MAN, stud centring	20 mm x 1.5	390	288
MAN, stud centring	22 mm x 1.5	475	350
MAN, trilex mounting plate	22 mm x 1.5	575	424
Mitsubishi, ISO style:	22 mm x 1.5	625-735	460-540
Mitsubishi, SAE style:	14 mm x 1.5	130-160	96-188
Mitsubishi, SAE style:	16 mm x 1.5	185-225	136-167
Mitsubishi, SAE style: (matching nut)	19 mm x 1.5	440-540	324-398
Mitsubishi, SAE style: (matching nut) FK Series	20 mm x 1.5	370-410	273-302
Mitsubishi, SAE style: (matching nut) FM Series	20 mm x 1.5	400-440	295-325
Mitsubishi, spider (trilex)	18 mm x 1.5	265-295	195-218
UD Nissan Diesel, ISO 10 stud	-	640	470
UD Nissan Diesel, SAE style 10 Stud - steer and drive	-	415-475	305-350
UD Nissan Diesel, SAE style 6 & 8 Stud - steer and drive	-	370-420	270-310

Notes:

1. DaimlerChrysler - specify that vehicles should not be jacked from under the differential housing (especially for hub reduction).
2. Trilex is the adaptor system used by European and Japanese manufacturers to allow the use spider rims with disc hubs.

B. Wheel end security TAP supplement - traditional torquing methodology

Manufacturers' truck torque tightening table - 2015.

This supplement provides model specific information, which is not provided in the body of the wheel end security TAP. This additional table was published in 2015 in the second edition of this TAP and is believed to be accurate for the models listed. If there is any doubt, clarify the requirements with the supplier of the equipment.

This supplement was updated with the support of

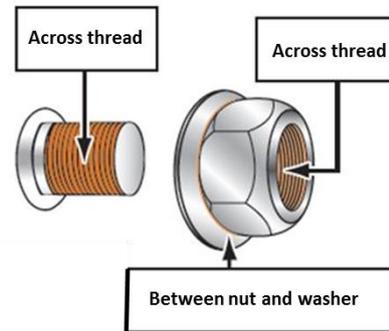


Reminder of key steps in fitting a wheel. Check the body of this TAP for full details:-

- 1) Ensure all threads and surfaces are clean and dry.
- 2) Sparingly apply oil as lubricate to the threads and surfaces as noted below and as required by manufacturer.

Areas for hub-pilot disc wheel systems

- 3) Use a calibrated torque wrench to apply the final torque, not a rattle gun.
- 4) Re-torque wheel nuts after driving 50 to 100 kilometres.



Note : ♦ Fuso Trucks does not endorse the use of any lubricant on the threads of the stud or nut. UD Trucks does not recommend the use of grease, particularly grease containing molybdenum.

Brand	Model, wheel or location method	Stud size (mm)	Nut torque specification (Nm)	Nut torque tolerance (Nm)
Caterpillar CT610/630LS	Hub piloted	$\frac{11}{16}$ "	510	± 35
	Hub piloted	M22	644	± 35
DAF CF75 / CF85	Stud piloted	M20	370	± 30
	Hub piloted	M20	485	± 35
	Trilex / demountable	-	335	± 35
	Hub piloted	M22	700	Not available
Dennis Eagle	Hub piloted	M22	680	± 35
Fuso / Mitsubishi ♦	Canter 17.5" rim / 225 PCD	-	490	± 35
	Fighter 17.5" rim / 225 PCD	-	475	± 25
	Fighter 19.5" rim / 285 PCD	-	575	± 25
	Fighter and heavies 22.5" rim / 335 PCD	-	580	± 20
Freightliner	Alloy / 22.5" rim	$\frac{3}{4}$ " or $1 \frac{1}{8}$ "	610	± 70
	Steel / 22.5" rim	$\frac{3}{4}$ " or $1 \frac{1}{8}$ "	645	± 35
	Demountable	$\frac{3}{4}$ "	285	± 15
	Demountable / 11.75" x 22.5" rim	$1 \frac{1}{8}$ "	335	± 15

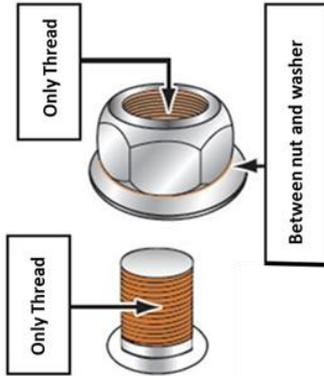
Brand	Model, wheel or location method	Stud size (mm)	Nut torque specification (Nm)	Nut torque tolerance (Nm)
Hino	300 and 500 series / 17.5" rim	-	440	± 40
	500 and 700 series / 19.5" rim	-	575	± 25
	RH & LH threaded nuts/studs for duals	-	525	± 25
	Ranger and coach 22.5" rim / 335 PCD	-	575	± 25
Iveco	Daily 4x4 / 17.5" rim	-	340	± 25
	ACCO / Demountable	$\frac{5}{8}$ "	227	± 10
	Local production / Demountable	$\frac{3}{4}$ "	250	± 10
	ACCO / 22.5" rim / 285 PCD	M22	645	± 35
	EuroCargo ML110-ML120 / 19.5" rim	M20	490	± 50
	EuroCargo ML120-160 / 19.5" rim	M20	610	± 30
	EuroCargo ML180-ML225 / 22.5" rim	M22	625	± 75
	Local production / Hub pilot / 22.5" rim / 335 PCD	M22	645	± 35
	Stralis / hub piloted / 22.5" rim / 335 PCD	M22	600	Not available
Isuzu	Stud piloted with NPR / 17.5" rim or NQR / 19.5" rim	Ft & Rr M20 inner with rear M30 outer	500	± 50
	NQR / Stud pilot / 19.5" rim	M20	475	± 25
	FRR 500 and 600 / stud piloted / 17.5" rim	Ft & Rr M24 inner with rear M30 outer	475	± 25
	FSS and FTS / stud piloted / 22.5" rim	As above	575	± 25
	Stud piloted / 19.5" rim	M20	475	± 25
	Hub piloted / 19.5" rim	M22	575	± 25
	Hub and stud piloted / 22.5" rim	M22	575	± 25

Brand	Model, wheel or location method	Stud size (mm)	Nut torque specification (Nm)	Nut torque tolerance (Nm)
Kenworth	Demountable	$\frac{3}{4}$ "	340	± 10
	Hub piloted / 22.5" rim	M22	640	± 30
Mack	Hub piloted / 22.5" rim	-	610	Not available
MAN	Trilex / demountable	M16 x 2.0	285	Not available
	Trilex mounting plate	M22 x 1.5	575	Not available
	Stud piloted	M18	285	Not available
	Stud piloted	M20	390	Not available
	Stud piloted	M22	475	Not available
	Hub piloted – 6 stud	M18	390	± 20
	Hub piloted, 8/10 stud	M20	475	± 25
	Hub piloted	M22	575	± 25
Mercedes-Benz	Stud piloted	M18	250	Not available
	Stud piloted	M20	300	Not available
	Stud piloted	M22	450	Not available
	Hub piloted	M18	400	Not available
	Hub piloted	M20	500	Not available
	Hub piloted	M22	600	Not available
Nissan UD ♦	MKB / MKC / stud piloted	-	405	± 25
	LKC / stud piloted	-	575	± 25
	Hub piloted / 335 PCD	-	575	± 25
Scania	Trilex / demountable	-	350	Not available
	Hub piloted / 22.5" rim / 335 PCD	-	650	Not available
Volvo	Demountable single with 8.25" x 22.5" rim	-	360	± 40
	Demountable dual wheels	-	330	± 30
	Hub piloted / 22.5" rim / 335 PCD	8 stud M20	450	± 45
	Hub piloted / 22.5" rim / 335 PCD	10 stud M22	Refer to separate table on the following page for details for the requirements on the torque angle format.	
WesternStar	Hub piloted / steel rim	M22 or $1\frac{1}{8}$ "	645	± 35
	Hub piloted / alloy rim	$1\frac{1}{8}$ "	610	± 70
	Demountable	$\frac{5}{8}$ "	225	± 10
	Demountable	$\frac{3}{4}$ "	340	± 10

C. Wheel end security TAP supplement – new torque-angle torquing format

Manufacturers' truck torque tightening table - 2015.

Note in service minimum checking torque of wheel nuts after 50-100 km with this format should not tighten the wheel nut, if it does, the procedure for the whole wheel end assembly needs to be repeated. Refer to section 2.4 of this TAP for further details.



Reminder of key steps in fitting a wheel. Check the body of this TAP for full details:-

- 1) Ensure all threads and surfaces are clean and dry.
- 2) Sparing apply oil as a lubricate to the threads and surfaces, as illustrated.
- 3) Use a calibrated torque wrench with angle indicator to finalise the tension, not a rattle gun.
- 4) Using the in service minimum checking torque value to confirm the wheel nuts are tensioned correctly, after driving 50 to 100 kilometres. This should not tighten the wheel nuts.

Truck	Wheel / Stud / Nut						
	Wheel location method	Stud size (mm)	Seating torque specification (Nm)	Seating torque tolerance (Nm)	Nut Angle specification (deg)	Nut Angle tolerance (deg)	In service minimum checking torque (Nm)
Volvo FM/FH16	Hub piloted	M22	200	± 8	90°	± 10°	670 ± 30
		M22	200	± 8	90°	± 10°	670 ± 30

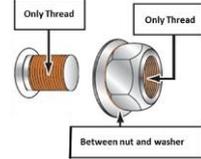
D. Wheel end security TAP supplement - traditional torquing methodology

Manufacturers' trailer torque tightening table - 2015.

It is important to identify the manufacturer of the hub / wheel assemblies on the trailer to be worked upon. BPW Transpec have a "BPW" logo on the hubcap, Hendrickson can be identified with an "H" on the hubcap, York axles have "YORK" on the hubcap and K Hitch have a "KH" logo on the hubcap.

Reminder of key steps in fitting a wheel. Check the body of this TAP for full details:-

- 1) Ensure all threads and surfaces are clean and dry.
- 2) Sparingly apply oil as lubricate to the surfaces noted, if appropriate.
- 3) Use a calibrated torque wrench to apply the final torque, not a rattle gun.
- 4) Re-torque wheel nuts after driving 50 to 100 kilometres.



Note : ♦ These suppliers do not recommend the use of any lubricate on the threads of either studs or nuts.

Trailer brand	Wheel location method	Stud size (mm)	Nut torque specification (Nm)	Nut torque tolerance (Nm)
Hendrickson Trailer Parts ♦	Hub piloted	$\frac{11}{16}$ "	475	± 50
	Hub piloted	M20	415	± 30
	Hub piloted	M22	645	± 30
	Hub piloted	M24	770	± 25
	Stud piloted	$\frac{3}{4}$ "	645	± 20
	Stud piloted	$1 \frac{1}{8}$ "	645	± 30
	Stud piloted (HD)	$\frac{15}{16}$ "	1,120	± 100
	Stud piloted (HD)	$1 \frac{1}{8}$ "	1,120	± 100
	Stud piloted (HD)	$1 \frac{5}{16}$ "	1,120	± 100
York Trailer Parts	-	ISO M22	575	± 25
	-	ISO M24	675	± 25
	-	$\frac{7}{8}$ "	505	± 30
	-	DIN M22	530	± 10
	-	Japan M20	420	± 20
	-	Japan M24	700	± 50
	Demountable	$\frac{3}{4}$ "	230	± 30
	BPW Transpec ♦	Demountable	$\frac{3}{4}$ "	345
Stud piloted		M20	380	± 20
Stud piloted		M22 x 1.5	510	± 25
Stud piloted		M22 x 2.0	460	± 25
Hub piloted		M18	350	± 20
Hub piloted		M20	480	± 25
Hub piloted		M22	630	± 30
Hub piloted		M24 x 1.5	860	± 40
Fuwa / K Hitch	Demountable ♦	$\frac{3}{4}$ "	310	± 30
	Hub piloted	M12	130	± 5
	Hub piloted	M20	410	± 20
	Hub piloted	M22	645	± 30
	Hub piloted	M24	760	± 40
SAF-Holland	Hub piloted	M22	630	± 30