

# WHEEL LOSS

**A Risk No One Can Run!**



Québec    

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## Foreword

This manual is intended to raise the awareness of heavy vehicle owners, professional wheel installers, drivers and maintenance staff about the importance of proper wheel installation and securing for safe travel.

This is not a text of law. For any questions of a legal nature, please refer to the *Highway Safety Code* and attendant regulations. The information contained in this manual is provided for reference purposes only and does not bind the Société de l'assurance automobile du Québec (SAAQ).

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# INTRODUCTION

## **Wheel Loss: A Risk No One Can Run!**

Having wheels come off a vehicle is generally caused by poor assembly, badly adjusted or improperly lubricated bearings, or the result of inadequate maintenance or inspection. This manual summarizes safe practices for the installation and proper maintenance of stud-piloted disc wheels with ball seat mounting, hub-piloted disc wheels and spoke wheels. It gives specific advice on securing wheels, safety rules and tightening procedures to keep the wheels in place, based on the type of mounting system and type of wheel used.



# 1

## RESPONSIBILITIES

**Taking preventive action is the only way to avoid wheels coming off a vehicle. The vehicle owner, the professional wheel installer, the driver or the person designated by the operator to perform the circle check and the person in charge of the preventive maintenance check all have a preventative role to play:**

**The owner** must make sure that the person who installs the wheels or maintains the wheel bearings on his or her vehicle has the skills and know-how to do that type of work.

**The professional installer**, by reason of his or her skills in the field, must strictly observe installation standards and keep abreast of the latest developments so that the vehicle will be safe for both the driver and the other road users.

**The driver or the person designated by the operator** is responsible for having performed a circle check and filling out a circle check report, as specified in the *Regulation respecting safety standards for road vehicles*, within the previous 24 hours. During the trip, e.g. before getting back on the road after a rest or a stop at a restaurant, the driver is also responsible for carrying out the necessary verifications in order to keep the circle check report up to date. The driver is the person closest to the vehicle and is responsible for ensuring his or her own safety as well as the safety of others. Any anomalies detected regarding the wheels or bearings must be noted and repaired before getting back on the road or continuing the trip.

**The person in charge of preventive maintenance** must ensure that the carrier's preventive maintenance program contains a section on the installation, inspection, maintenance and repair of wheels and bearings.



## 2 GENERAL PRINCIPLES

### Each person in charge must, if applicable:

- Preferably use a torque wrench to tighten the nuts to the recommended torque level

#### OR

use an impact wrench equipped with a torque stick, the length of which corresponds to the wheel manufacturer's recommended torque level.

- When using an impact wrench that is not fitted with a torque stick to tighten the nuts, make sure it is properly adjusted so that the torque values will be within the recommended limits. Nut tightening must be finished off with a torque wrench. Too much torque (creep\*) can be as dangerous as too little.
- Calibrate torque wrenches at least once a year. Some brands of torque wrenches have not been calibrated by the manufacturer prior to purchase; these must be calibrated before use.
- Be attentive to the fact that when a reconditioned disc wheel is used, the layers of protective paint can amount to 0.304 mm (0.012 in) thick. When the drum heats up, this paint disappears, resulting in loosening of the wheel.
  - All traces of paint must be removed from the contact surfaces prior to tightening. Wheels must be reconditioned according to the manufacturer's specifications.
- Check the torque level on wheels after the first 80 to 160 km of use following installation.

\* **Creep:** Deformation of a metal subjected to very heavy loads.

- Keep the wheels clean so as to more easily detect cracks, oil leaks, loose nuts or any other damage.
- Be attentive to the slightest oil leak, which points to a damaged hub ring seal or that a wheel bearing is about to slip out of its cup. Do not hesitate to raise a suspect wheel to examine the bearings. If the lubricant is leaking, this situation must be corrected as quickly as possible.
- Check the wheels as soon as possible after an unusual manoeuvre, such as sudden braking, to make sure no nut, stud or wheel has been damaged.
- Wheels can be loosened in a sharp turn involving contact with a curb or the edge of a sidewalk. In such cases, the wheels in question must be inspected immediately.

# 3 THE SAFE WAY TO CHANGE A WHEEL ON A HEAVY VEHICLE

★ Points marked with a star are required only when a wheel is changed on the road.

✖ Points marked with an X apply only to a spoke wheel.

## 3.1 Preparation

The driver must:

- ★ 1. Bring the vehicle to a stop at a safe place (rest stop, garage) on a solid, horizontal surface capable of supporting the weight of the load.
- 2. Apply the parking brake.
- 3. Make sure the transmission is in first gear.
- ★ 4. Switch on the hazard lights.
- ★ 5. Establish a safety perimeter by using reflective devices or other emergency equipment specified in the *Regulation respecting safety standards for road vehicles* as follows:
  - on a road with two-way traffic, the reflective devices or other emergency equipment must be placed on the traffic side of the roadway: the first two at 3 m and 30 m behind the vehicle, and a third at 30 m ahead of the vehicle;
  - on a divided highway, the reflective devices must be placed on the roadway, 3, 30 and 60 m behind the vehicle (facing oncoming traffic).
- 6. Place chocks under the wheels.
- 7. Install the jack at the recommended location.

8. Loosen the nuts by 1/2 to no more than 1 turn.
9. Jack up the vehicle so that the tire on the wheel to be replaced no longer touches the roadway.
- ✖ 10. Loosen the nuts without removing them (risk of rim clamps flying off).
- ✖ 11. Use a hammer to dislodge the rim clamps.
12. Remove the nuts:
  - ✖ – the rim clamps.
13. Remove the outside wheel:
  - ✖ – the rim spacer (if necessary);
  - the inner wheel (if necessary).

## 3.2 Verification

- For stud-piloted disc wheels, see Section 4.1.
- For hub-piloted disc wheels, see Section 5.1.
- For spoke wheels, see Section 6.1.

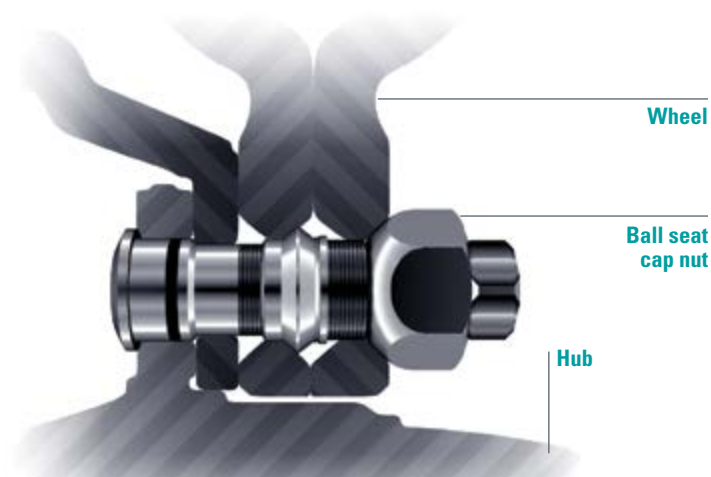
## 3.3 Mounting

The driver must:

1. Place the inner wheel back in the same location as prior to removal, if possible.
2. Make sure the valve stem is properly centred.
- ✖ 3. Reinstall the spacer between the wheels (dual assembly).
4. Reinstall the outer wheel and centre the valve (dual assembly).
5. Tighten the nuts slightly (preliminary tightening to around 67.8 Nm (50 ft-lb)).
6. Make sure the wheel chocks are in place and the transmission is in first gear.
- ✖ 7. Tighten the nuts according to the procedure described in Section 6.2.
- ✖ 8. Release the parking brake.
9. Tighten the wheels according to the procedure described in Sections 4.2 and 5.2.
- ✖ 10. Check the wheel alignment according to the procedure described in Section 6.3.
- ✖ 11. Apply the parking brake.
12. Lower the wheel to the ground and check the final torque.
13. Remove the jack, the chocks and the reflectors.
14. Check the nuts again after travelling between 80 and 160 kilometres.



# 4 STUD-PILOTED DISC WHEELS WITH BALL SEAT MOUNTING



## 4.1 Verification

**N. B.** Follow the wheel manufacturer's instructions if they are different from the instructions provided below.

You must:

- Make sure the contact surfaces between the wheel and the drum are clean before mounting a wheel.
- Check the stud holes for cracks or wear (oval-shaped holes).
- Check both sides of the disc to make sure there is no crack or warp.
- Inspect the entire wheel to make sure there is no crack, gouge or air leak.
- Make sure the threads on the studs and nuts are clean and free of any defects.

- Check for any signs of rust or dirt around a nut, which usually indicates it has become loosened.

**Important:** Installing a stud-piloted wheel on a hub-piloted assembly or vice versa can be dangerous.

## 4.2 Torquing

| Ball Seat<br>Cap Nuts         | Diameter                                             | Number<br>of Threads | Recommended<br>Dry Torque Level     |
|-------------------------------|------------------------------------------------------|----------------------|-------------------------------------|
| Standard<br>22 mm<br>(7/8 in) | 19 <b>or</b> 29 mm<br>(3/4 in <b>or</b><br>1 1/8 in) | 16/in                | 610 to 678 Nm<br>(450 to 500 ft-lb) |

**Important** (aluminum wheels only):  
If a thread lubricant is used, reduce torque  
to 475 to 542 Nm (350 to 400 ft-lb).

**Remember:** For this type of mounting, the threads are  
right-handed on the right side of the vehicle and  
left-handed on the left side of the vehicle. The  
stud standout should be stamped L  
for LEFT and R for RIGHT.

**N.B.:** This type of mounting requires an inner cap nut to centre and hold the inner wheel on a dual assembly and a ball seated cap nut to secure the outer wheel (Illustrations 1 and 2).

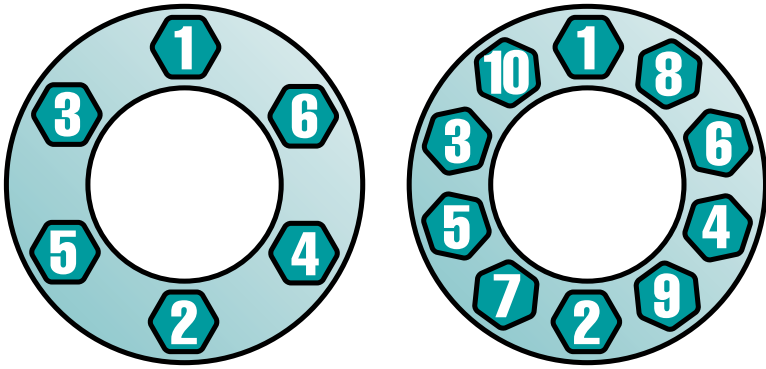
**You must:**

1. Tighten the inner cap nut (Illustration 1) to a torque level of 67.8 Nm (50 ft-lb) using the proper sequence (Illustration 3).
2. Tighten the nuts gradually to the recommended torque level.
3. Tighten the outer nut (Illustration 2) to a torque level of 67.8 Nm (50 ft-lb) using the proper sequence (Illustration 3).
4. Tighten the nuts gradually to the recommended torque level.



**Illustration 1**  
**Inner cap nut**

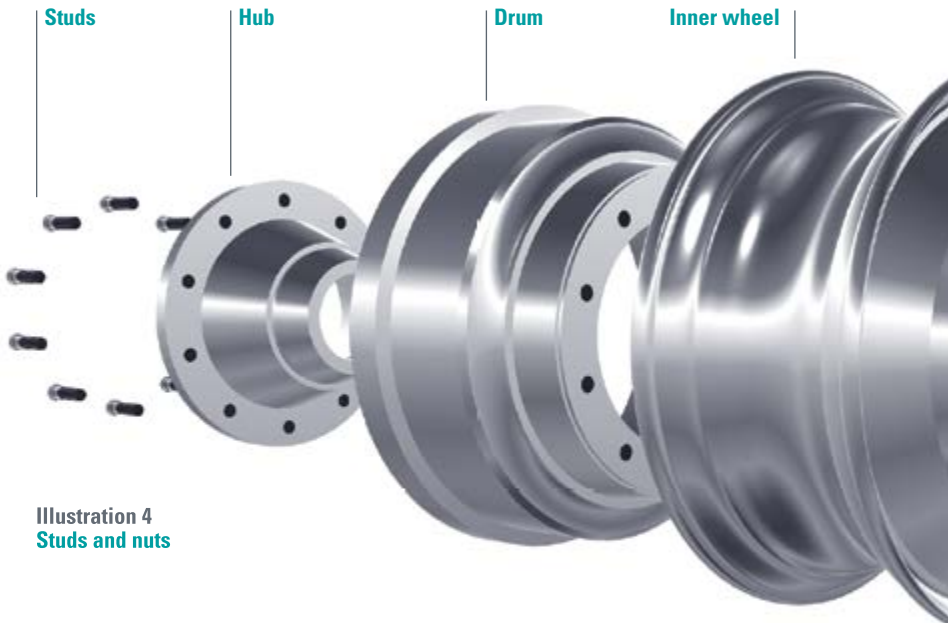
**Illustration 2**  
**Outer cap nut**



**Illustration 3**  
**Torque sequence for wheel with 6 or 10 studs**

Do not apply any lubricant to the cap nut, the contact surface of the nut or the threads. Lubricated surfaces can result in excessive tightening, which causes stretching and rupture of the studs.

Nuts that are not tightened to the correct torque cause the wheels to loosen, premature wear or damage to the ball seats and the wheels coming off.



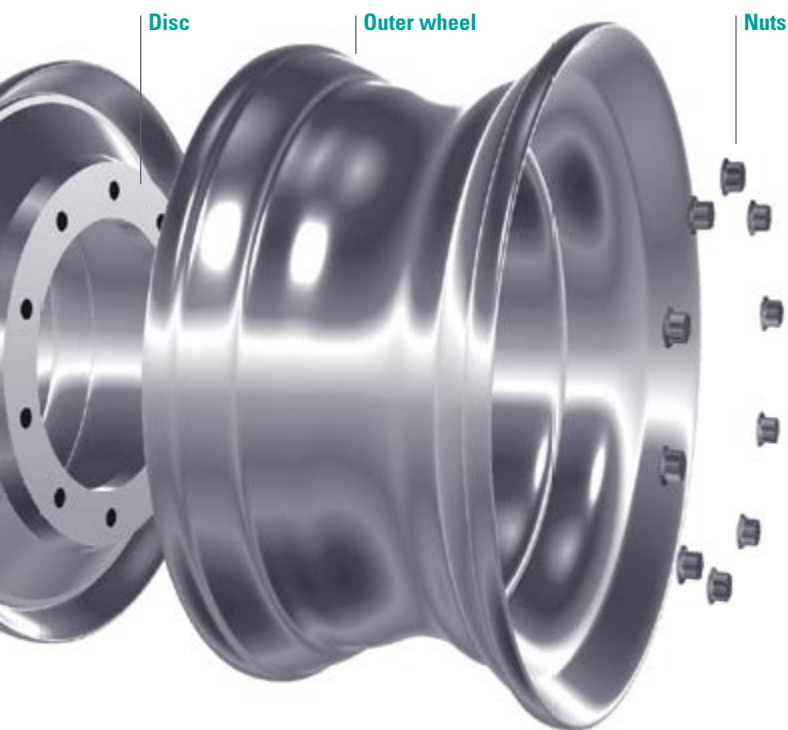
**Illustration 4**  
**Studs and nuts**

### Important:

- On a dual stud-piloted wheel assembly, the outer wheel nuts must be loosened slightly and the inner wheel tightened to the recommended torque level.
- Then, tighten the outer wheel following the proper torque sequence (Illustration 3).

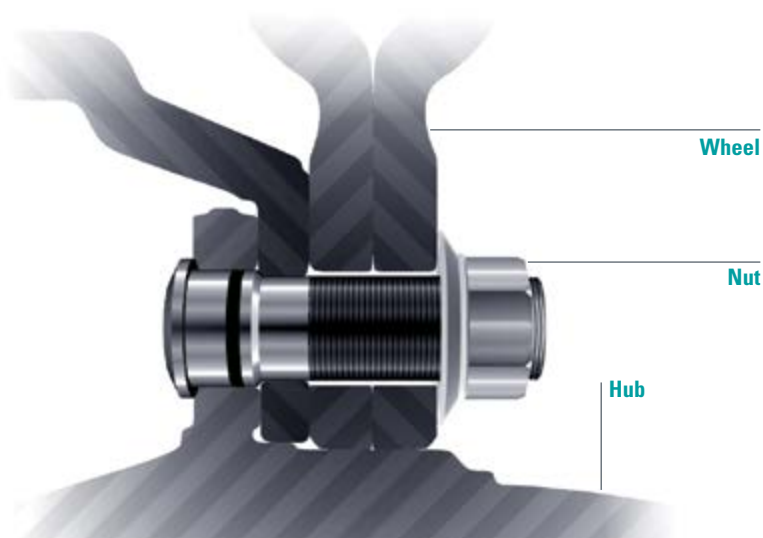
**N. B.:** When changing a stud on a 10-stud assembly (Illustration 4) is required, adjacent studs must also be replaced. In cases where the assembly has fewer than 10 studs, all of them must be replaced at once since the remainder have been subjected to greater stress by bearing the entire load and could be in a state of extreme metal fatigue (creep\*).

\* **Creep:** Deformation of a metal subjected to very heavy loads.





# 5 HUB-PILOTED DISC WHEELS



## 5.1 Verification

**N. B.:** Follow the wheel manufacturer's instructions if they are different from the instructions provided below.

For all of the parts, you must:

- Make sure the contact surfaces between the wheel and the drum are clean before mounting a wheel.
- Check the stud holes for cracks or wear (oval-shaped holes).
- Check both sides of the disc to make sure there is no crack or warp.
- Inspect the entire wheel to make sure there is no crack, gouge or air leak.

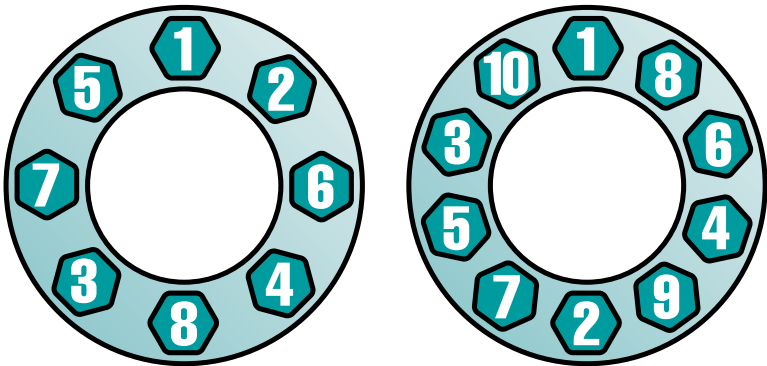
- Make sure the threads on the studs and nuts are clean and free of any defects.
- Check for any signs of rust or dirt around a nut, which usually indicates it has become loosened.

**Remember:** Installing a hub-piloted wheel on a stud-piloted assembly or vice versa can be dangerous.

## 5.2 Torquing

| Wrench Size         | Diameter | Number of Threads | Recommended Dry Torque Level        |
|---------------------|----------|-------------------|-------------------------------------|
| 33 mm<br>(1 1/2 in) | M22      | 1.5               | 610 to 678 Nm<br>(450 to 500 ft-lb) |

**Important** (aluminum wheels only):  
If a thread lubricant is used, reduce torque to 475 to 542 Nm (350 to 400 ft-lb).

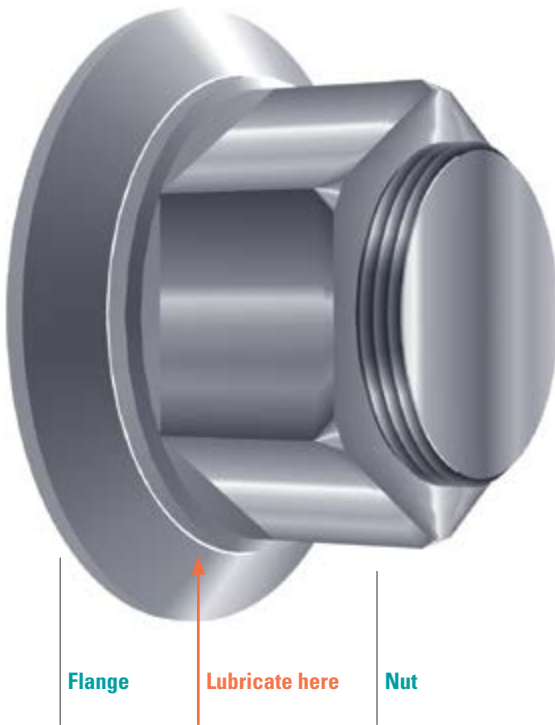


**Illustration 5**  
Torque sequence for wheel with 8 or 10 studs

You must:

1. Use a torque wrench to tighten the nuts evenly in the proper sequence (Illustration 5).
2. Tighten the nuts to a torque level of 67.8 Nm (50 ft-lb).
3. Tighten the nuts gradually to the recommended torque level.

**Note:** All threads are right-handed.



**Illustration 6**  
**Two-piece flange nut**

4. Lubricate with a few drops of oil where indicated on the type of nut shown in Illustration 6.

**N.B.:** When changing a stud on a 10-stud assembly (Illustration 4) is required, adjacent studs must also be replaced. In cases where the assembly has fewer than 10 studs, all of them must be replaced at once since the remainder have been subjected to greater stress by bearing the entire load and could be in a state of extreme metal fatigue (creep\*).

\* **Creep:** Deformation of a metal subjected to very heavy loads.

# 6 SPOKE WHEELS

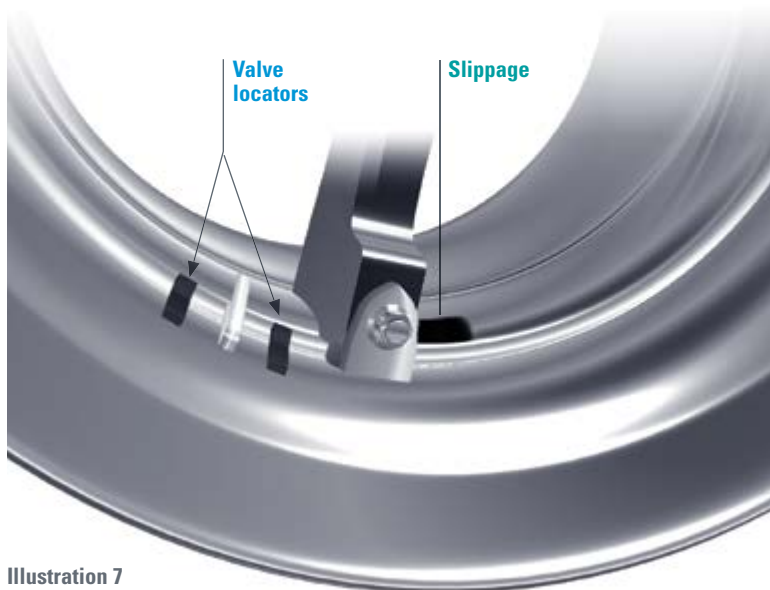


## 6.1 Verification

**N. B.:** Follow the wheel manufacturer's instructions if they are different from the instructions provided below.

■ For all of the parts, you must:

1. Examine the rim mounting surfaces to make sure there is no:
  - dirt or foreign body;
  - defect or wear pattern (wheel slippage or other) (Illustration 7);
  - burr or foreign body (file smooth if necessary).
2. Check for cracked or broken spokes.
3. Replace the rim spacer if it is crushed, dented or broken.
4. Make sure the threads (studs and nuts) are clean and free of any defects.
5. Examine the rim clamps to make sure they are in good condition.
6. Make sure the valve locators are in the proper position and in good condition (Illustration 7).



**Illustration 7**  
**Valve locators and slippage**

## 6.2 Torquing

| Diameter          | Number of Threads | Recommended Dry Torque Level        |
|-------------------|-------------------|-------------------------------------|
| 16 mm<br>(5/8 in) | 11/in             | 217 to 271 Nm<br>(160 to 200 ft-lb) |
| 19 mm<br>(3/4 in) | 10/in             | 271 to 353 Nm<br>(200 to 260 ft-lb) |

You must use a torque wrench and tighten the rim clamps evenly in the proper sequence (Illustration 8).

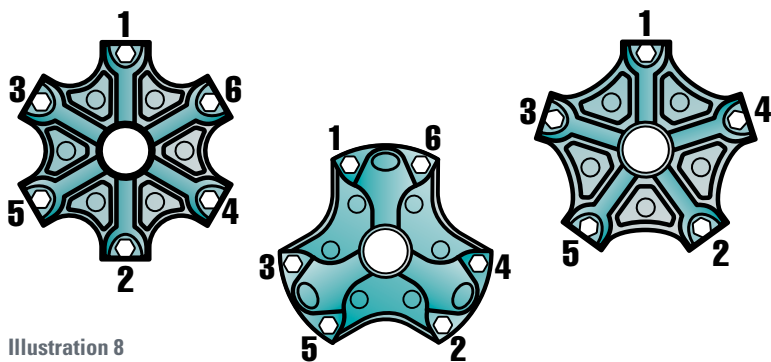


Illustration 8  
Torque sequences

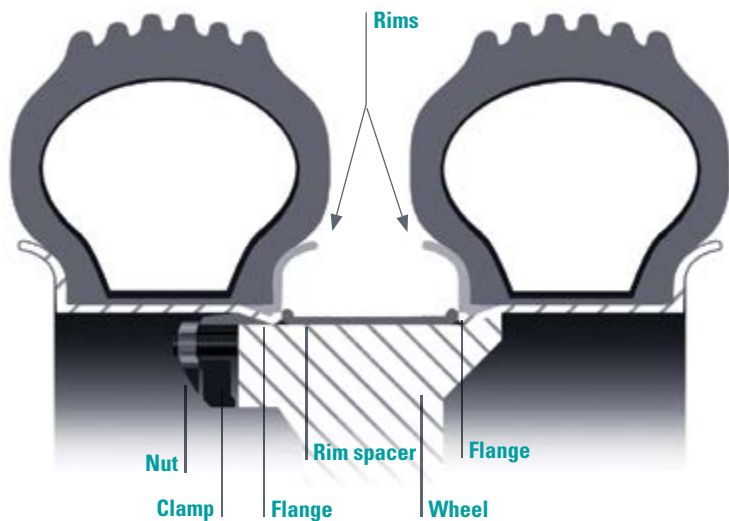
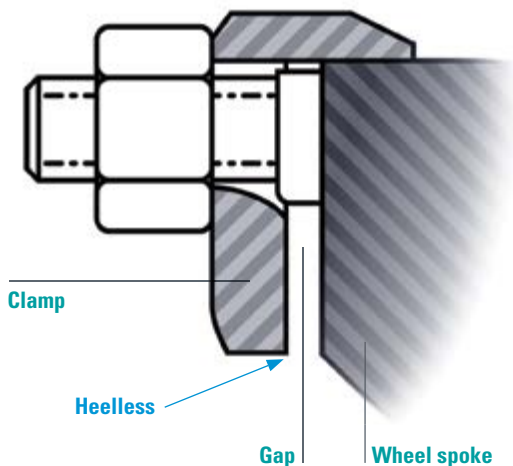


Illustration 9  
Clamp and rim spacer

**Important:** Do not tighten the rim clamps excessively. Overtorquing can deform the rim spacer and damage the back flange (Illustration 9).

**Heelless rim clamps:** when a heelless rim clamp is tightened to the specified torque level, it must not touch the spoke (Illustration 10a).



**Illustration 10a**  
**Heelless rim clamps**

**Heel-type clamps:** when the heel of clamp comes into contact with the spoke (Illustration 10b), you must have reached 80% of the maximum specified torque level.

Note that a gap of 6.3 mm (1/4 in) between the heel and the spoke is acceptable but not mandatory.

If the gap is greater than 6.3 mm (1/4 in) after the recommended maximum torque level is reached, check to make sure you are using the correct spacer or rim clamp.

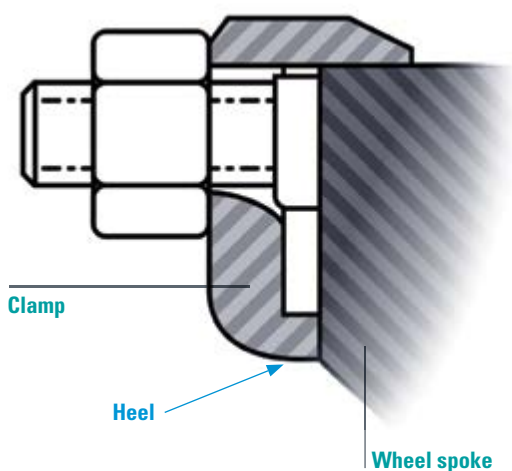


Illustration 10b  
Heel-type clamps

## 6.3 Rim alignment check

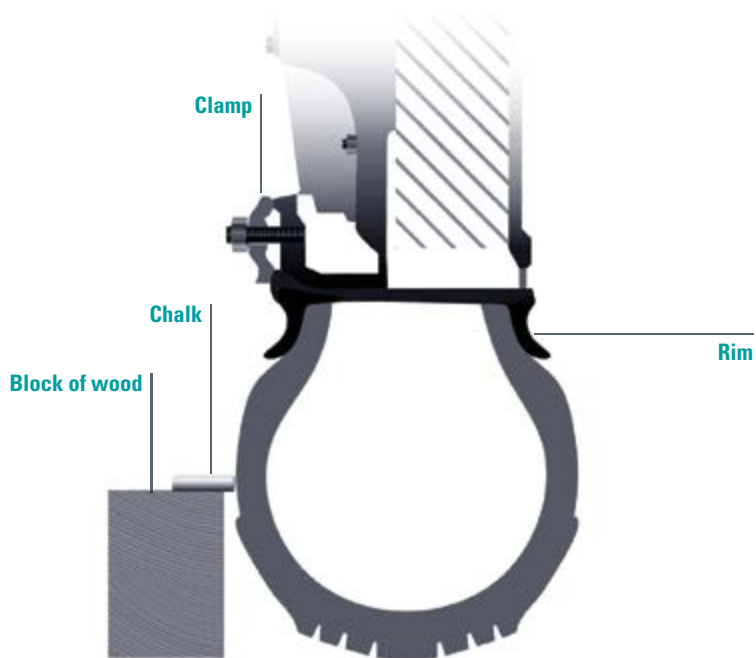


Illustration 11  
Installation for rim alignment check

Proceed as follows:

- Place a block of wood at 12 mm (1/2 in) from the tire;
- Rotate the wheel slowly to check for and measure any deviation;
- Correct any deviation over 1.6 mm (1/16 in) on a front wheel and 3 mm (1/8 in) on a rear wheel.

## 6.4 Correction of excessive rim deviation

You must:

- Rotate the wheel slowly and bring the chalk close to the tire (Illustration 11). When the chalk leaves a mark on the tire, this indicates the maximum deviation.
- Slightly loosen the nuts opposite the reference mark left by the chalk.
- Tighten the nuts facing this reference mark as well as the adjacent nuts without exceeding the maximum torque level.
- Check for deviation again. If there has been no change, look for deformed, crushed or broken parts, or any other defect.
- Tighten and repeat the operation if necessary.

**Note:** Deviation that is difficult to correct could point to a damaged component, in which case the entire assembly must be checked again.

## 7 TIGHTENING ON THE ROAD

Tightening wheels without the use of a torque wrench is considered a temporary solution, which should be repeated every 80 to 160 km of use, until the wheels can be properly tightened with a torque wrench according to the method indicated on page 11.

A good habit to get into is to ask the person torquing the wheels on your vehicle to write down the torque level on the invoice as well as the date on which the wrench was last calibrated.



# 8 THOUGHTS ON THE SUBJECT OF WHEEL BEARINGS\*

According to the results of an investigation ordered in September 1995 by the State of Maryland, the lack of proper lubrication for wheel bearings was among the main causes of wheel loss accidents.

What occurs is that the bearings overheat due to a lack of lubricant. Without proper lubrication, tiny pieces of metal wear off the bearings and fall into the lubricating fluid and serve as a grinding compound for the bearing mechanism. Once the mechanism is weakened, the lack of support for the hub/wheel/drum assembly eventually results in wheel separation.

There can be no doubt: drivers and maintenance personnel must pay more attention to the inspection and maintenance of wheel assemblies.

- At what intervals must bearings be replaced when grease is used?
- At what intervals should the lubricant level be checked if oil is used?
- At what intervals must the wheels be raised and rotated to check for noise (cracked bearings) or excessive play (improperly adjusted bearings)?
- Has the driver been shown how to check the hub temperature when they inspect the tires on the vehicle as part of the circle check? If not, you should do so.

**Happy trails!**

\* See the brochure titled *Wheel Loss Due to Faulty Bearings*, available on the SAAQ website at [saaq.gouv.qc.ca](http://saaq.gouv.qc.ca).



## ENGLISH-FRENCH GLOSSARY

- **back flange**: embase arrière
- **ball seat cap nut**: écrou conique
- **buckle**: voile
- **clamp**: crapaud (étrier)
- **drum**: tambour
- **dual wheel**: roue jumelée
- **hub**: moyeu
- **impact wrench**: outil pneumatique à percussion
- **inner cap nut**: écrou interne
- **nut**: écrou
- **oil seal**: joint d'étanchéité
- **outer cap nut**: écrou externe
- **parking brake**: frein de stationnement
- **rim spacer**: entretoise
- **spoke wheel**: roue moulée
- **stud**: goujon
- **thread**: filet
- **torque sequence**: séquence de serrage
- **torque wrench**: clé dynamométrique
- **torque**: couple
- **two-piece flange nut**: écrou à rebord à deux pièces
- **valve**: valve
- **valve locator**: butée de protection de la valve
- **wheel bearing**: roulement de roue
- **wheel**: roue
  - **hub-piloted wheel**: roue à disque avec centrage par moyeu
  - **stud-piloted wheel**: roue à disque avec avec système de serrage par goujons

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*Société de l'assurance  
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