



# OEM vs. Alternative Brake Discs: Lifetime cost analysis.

A KALMAR STUDY

## AUTHOR

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## EXECUTIVE SUMMARY.

This publication is part of a series of studies that report the results of technical research commissioned by Kalmar from the Laboratory of Automation and Hydraulics at Tampere University of Technology, analysing the lifetime cost difference between OEM (reference) spare parts and aftermarket (alternative) copies. The research findings indicate that in many areas there is not only a clear cost difference but also marked variation in quality and performance between the two types of spare parts.

For wet disc brakes that are typically used in heavy container handling equipment, it was found that alternative brake discs with a smaller outer diameter and wider grooves increase wear on the brake and shorten its life. Despite a price that is approximately 30 % lower than the OEM equivalent, due to its shorter service life the aftermarket disc is more expensive over the lifetime of the machine, assuming that the cost of the more frequent maintenance work and added machine downtime are factored into the calculation.



## Study background and scope.

In 2017, Kalmar commissioned three studies with Tampere University of Technology in Finland to evaluate the claim that even though OEM parts are generally priced higher than alternative parts, the OEM parts are still more economical over the lifetime of the equipment, when both purchase and replacement costs are factored into the calculation.

In the research summarised in this paper (brake discs), the study also encompasses specific cost calculations from the perspective of scheduled parts replacement as part of planned and correctly scheduled maintenance activities. With aftermarket spare parts that require more frequent changes due to their shorter product life, "second-order" service costs as well as the added downtime of the equipment during maintenance can have a significant financial impact on operations. However, this paper explicitly does not take into account potential "third-order" costs from e.g. equipment damage or injury if lower-performing aftermarket spare parts lead to system failure or safety incidents; or costs from unplanned maintenance or repairs arising for the same reasons. Equipment operators should certainly consider these factors in planning their maintenance strategy, but they are beyond the scope of this paper.

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# Overview of the study.

The study summarised in this paper by Tampere University of Technology focused on the expected longevity and performance of wet-system brake discs, which are typically used in demanding braking applications and heavy mobile equipment such as forklift trucks, container handlers and reachstackers. Wet brakes run in oil, which transfers the braking energy away from the discs and cools the brake system. Even though dry brakes can be easier and quicker to maintain, the wet disc brake system provides more stopping power and enables longer service intervals.

The most essential parts of a wet disc brake system that affect service life are the brake discs. This includes both the rotating friction discs and stationary discs. The research report evaluated the technical parameters of OEM vs. aftermarket friction discs and compared the service life and lifecycle costs of both types of discs.

## Technical analysis.

The service life of brake discs was analysed using the following key parameters:

- The outer diameter of the friction area (D) (Fig. 1)
- The width of grooves on the friction area (w) (Fig. 2)

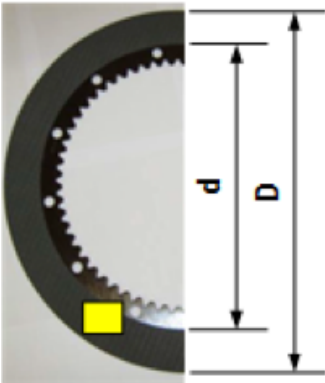


Fig. 1. The diameters of friction area. Area of Fig. 2 shown with yellow rectangle.

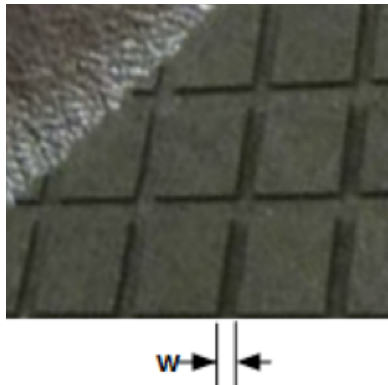


Fig. 2. Grooves on friction area and groove width (w).

**Table 1. Disc parameters and the values used in the analysis.**

Parameter	Reference disc	Alternative disc
Outer diameter of friction area (D) [mm]	456	440
Inner diameter of friction area (d) [mm]	360	360
Width of grooves (w) [mm]	1.5	2.0
Thickness of friction material [mm]	0.75	0.75
Spare part cost [€]	166	116

The alternative disc is approximately 30% cheaper than the OEM part. However, the alternative disc has both a narrower outer diameter and wider grooves, which would indicate that it would not last as long as the reference disc.

Due to these differences, the service life of the alternative disc has been reduced to 2.1 years versus the 3 years of the reference/OEM disc. On the assumption that 8 discs are required per machine and the lifetime of the machine is 9 years, we can calculate that:

- The reference disc would need to be changed 3 times
- The alternative disc would need to be changed 5 times

This gives a cumulative cost over 9 years of:

- Reference disc with 3 changes: 3,978 €
- Alternative disc with 5 changes: 3,951 €

On a straightforward part-for-part replacement cost basis, the reference and alternative discs are very close; however, taking into account the cost of five services versus three and the additional time that the machine will be off-line, the reference or OEM part is clearly the more economical option in this scenario.

## Further financial analysis / Savings calculation.

More detailed calculations were carried out to quantify the lifetime cost differential of using OEM vs. aftermarket brake discs. The calculations were based on the following parameters:

- A standard service cost of 70 € per hour
- Each machine is operating for 4,000 h/year
- It is assumed that a full set of disc brakes can be changed in one day (7 x 70 €) at the cost of 490 €
- The reference discs will need to be changed 3 times per year and the alternative discs 5 times per year

In this case, there is a significant impact on the simple part-for-part costs detailed above. Even though the disc brakes initially come out

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with a very similar lifetime cost over nine years, when the additional service costs are factored in, the gap widens significantly.

- Reference discs: Servicing and annual parts cost:  
 $3,978 \text{ €} + (490 \text{ €} \times 3) = 5,448 \text{ €}$
- Alternative discs: Servicing and annual parts cost:  
 $3,951 \text{ €} + (490 \text{ €} \times 5) = 6,401 \text{ €}$

This resulting in an annualised cost of:

- Reference discs 605.33€
- Alternative discs 711.22€

Over the lifetime of the machine, OEM/reference brake discs will provide savings of 15% compared to the alternative part, turning what may initially seem like a bargain into a sub-optimal purchase decision.

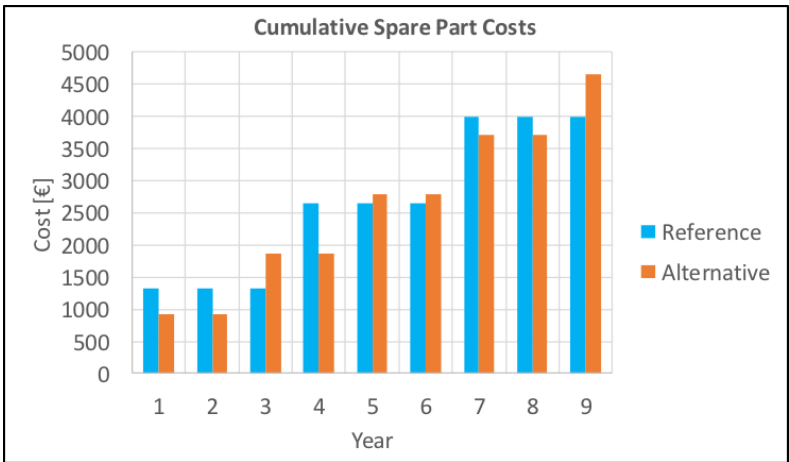


Fig. 3. Cumulative spare part costs of brake disc types 'Reference' and 'Alternative' for an equipment with 8 brake discs.

## Other considerations.

Oil-cooled brake discs are a safety-critical component in any type of heavy equipment. Correct and timely maintenance/replacement of brake discs and pads is essential to keep the braking system working properly. Worn brake discs can also adversely affect the handling and steering of the equipment.

This paper offers a limited analysis of the cost differential of OEM vs. alternative brake discs in certain scenarios under a specific set of assumptions about equipment lifetime and service intervals. No attempt has been made to analyse the wider impact that using lower-quality parts may have on operations, whether this impact is financial, operational or related to occupational safety considerations. Though such questions move from a straightforward cost-benefit calculation into the realm of risk management, prudent operators will consider questions such as whether poor braking performance can cause safety hazards, or what impact unplanned machine downtime will have on the entire operation.

## Summary of conclusions.

Based on the research summarised above, we can reasonably conclude that:

- There is more to consider than just the price of the spare part, and savings calculations need to be based on a realistic lifetime analysis that takes into account both service intervals and maintenance costs
- The performance of various parts can differ substantially from one vendor to another, depending greatly on the manufacturing and material choices of the component
- The quality and performance of the part will influence its longevity, which in turn will impact not only performance levels, but also the time and cost of service and maintenance
- Additional service and maintenance time not only costs more, but also adversely impacts the utilisation of the machine(s).

” Over the lifetime of the machine the OEM/reference brake discs will provide savings of 15% compared to the alternative part.

### ABOUT THE AUTHOR



#### STEPHAN JOHANSSON

Over 30 years experience within equipment sales and product management in the industry. Currently Stefan is Vice President for Kalmar Service Sales and Product management.

### SOURCE

Report of Tampere University of Technology, Laboratory of Automation and Hydraulics (AUT)

Technical Analysis of Spare Parts for Kalmar's Equipment - Brake Disc, 18.10.2017



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