Bogie subsystems
Wheel flange lubrication

Extract from the Railway technical handbook, volume 1, chapter 9, page 176 to 181
Wheel flange lubrication

Wheel flange and top-of-rail lubrication have become an important and two-fold strategy for operators and rail vehicle maintenance. These systems substantially contribute to reducing wear, friction and noise. Intelligent lubrication systems can support the operators in achieving higher profitability through less wear and, as a consequence, reduced maintenance costs and higher fleet availability. Active noise emission reduction through additional application of customized lubrication solutions results in increased environmental awareness by passengers and residents alike. Accurate application of biodegradable lubricants and intelligent control of the lubricant application process are reducing environmental pollution to a minimum and providing highly improved lubrication practices compared to those of two decades ago.
Wheel flange capabilities
The Association of American Railroads (AAR) estimated that the wear and friction occurring in the wheel/rail interface of trains due to ineffective lubrication costs US Railways in excess of 2 billion USD each year. Continuous monitoring of rolling stock equipment and analysis of wear data will be keys for decision-making to reduce maintenance costs and achieve operational excellence.

Wheel flange lubrication contributes not only to the friction properties of directly lubricated wheels, but also to following un-lubricated wheelsets of passenger coaches or freight cars. Moreover, rail vehicles left completely un-lubricated bear a risk of derailment. The interaction of a rail vehicle with its infrastructure is a key fundamental aspect of a railway system.

The highly stressed wheel/rail interface is a key cost driver for rail operators: on one hand, there is the wheelset performance and maintenance costs, and, on the other hand, upon track deterioration, maintenance and renewal. Friction occurs on all wheel flange contacts of a train and has impact on every journey, every day. Vehicle and track maintenance intervals are strongly determined by this wear process and highly influence the life-cycle cost of the vehicle and the rail infrastructure. Considerable energy and material cost savings can be achieved by reducing the friction to a necessary minimum [36, 37].

SKF EasyRail system solutions
The SKF EasyRail on-board wheel flange lubrication system helps to reduce friction and wheel wear significantly and contribute to lower operating cost. Vehicle operators can reduce energy and material consumption and take advantage of improved vehicle life cycle cost by operating environmentally sustainable lubrication equipment. On-board systems have proven to be the most flexible and effective applications for railway operators due to their variable setting options.

The lubricant, sprayed on the wheel flanges of the first or second axle in the direction of travel, is transferred to the rail face, thus lubricating the following wheel flanges. On average, spraying volume is only 0.03 to 0.05 cm³ per 250 m. Optimally configured wheel flange lubrication systems could supply lubricant to as many as 250 wheelsets.

SKF wheel flange lubrication systems, available under the brand SKF EasyRail, cover the complete range of on-board flange lubrication technology and can be configured for single and dual-line applications.

SKF EasyRail single line solution principle

SKF EasyRail Compact system for tram applications
SKF EasyRail Compact
SKF EasyRail Compact single-line systems operate through homogenous lubricant metering. The dosage is already defined at the pump unit and compressed air is used as transport medium to move the lubricant via a flow divider towards the spraying nozzles from where the lubricant is evenly distributed on the wheel flange. Thus, only one line, carrying both the lubricant and compressed air at the same time, is installed. The air/lubricant mixture in the flow divider is split up into equal parts when the flow conditions prevailing in the outlet branches are similar. The steady supply of compressed air needs to be ensured. This is a simple configuration that means less installation time and expense. In many cases, it is possible to install the wheel flange lubrication system on low-floor vehicles without having to dismantle the panelling.

The SKF EasyRail Compact system consists of a piston pump with a lubrication reservoir, a flow divider and the respective spray nozzles. All moving parts are included in the lubrication module consisting of a piston pump with reservoir. This means the components are highly accessible and easy to service or replace.

Moreover, neither the flow divider nor the spray nozzles have any moving parts, which considerably reduces maintenance time and expense.

SKF EasyRail High Pressure
SKF EasyRail High Pressure is a dual-line lubrication system that is mainly used on large locomotives and high-speed trains. It is used as well for other applications that require a lubricant reservoir larger than 7 litres for maintenance reasons. The maximum distance between the pump unit and spray nozzle is 10 m. The pump feeds the lubricant via the grease control valve. From the grease control valve, the lubricant is directed to the spray nozzles for lubricant application in the appropriate direction of travel. The spray nozzles supply lubricant to the wheel flanges on the leading axle.

The lubricant is metered with a system pressure of up to 100 bars inside the spray nozzles in volumes of typically 0,03 or 0,05 cm³/spray and sprayed onto the wheel flanges. The high system pressure enables operations even under extreme operating climate conditions, like low temperatures (down to -40 °C) using appropriate lubricants. The system can be customized for bi-directional operations.
SKF EasyRail Low Pressure

SKF EasyRail Low Pressure is a dual-line lubrication system that is mainly used for application on multiple units and smaller locomotives with a maximum distance of up to 5 m between the lubricant reservoir and the spray nozzles. The pressurized reservoir has been customized to capacities of 4, 5 and 6 litres.

The continuous compressed air supply for the pressure reservoir is enabled when the rail vehicle is in motion. The lubricant is fed to the spray nozzles and is constantly available in the form of a column. The metering of the lubricant takes place in the spray nozzles. The spray nozzles are actuated by compressed air, and the compressed air is controlled by a valve block. The grease reservoir is depressurized when the rail vehicle is shut down. The system can be customized for bi-directional operations.

SKF EasyRail Track

SKF EasyRail Track is a dual-line lubrication system to be installed as an on-board unit on vehicles in revenue service to minimize squealing noises on inner-city lines or residential areas. This top-of-rail lubrication system applies a specially configured lubricant on top of the rail and significantly decreases the noise level below the maximum noise level allowed by regulations. This solution can replace fixed lubrication installations or special purpose vehicles to lubricate the network. The lubrication module consisting of a piston pump with reservoir, plus the peripheral components for the compressed air supply can be installed as one unit in a cabinet or as separate subunits to enable customized fittings on the vehicle. This means the key components can be kept highly accessible and easy to service or replace.
SKF EasyRail benefits

- noticeable reduction of downtime and increased operational reliability and availability
- maintenance optimized system configuration, therefore improved LCC values
- reduction of impact on the environment through use of rapidly biodegradable greases
- reduced noise levels, therefore increased public acceptance
- increased safety through reduced risk of derailment by so-called wheel “climbing”

SKF EasyRail Airless

The SKF EasyRail Airless is a single-line lubrication system mainly used for mass transit vehicles without its own compressed air supply on-board. Light rail vehicles and tramcars are typically “all electric cars” that are not equipped with an air brake system, because braking is done by electric motors, electric brake solenoids (operating magnets) and electric rail brakes.

This very compact system is easy to install on newly built rolling stock as well as for retrofit programmes. The electromagnetic powered pump unit is fed with lubricant from a tailor-made reservoir and supplies the lubricant to a heated integrated metering chamber from where the lubricant is pressed to the attached spray nozzles. The system actuates after an electromagnetic impulse. The two nozzles lubricate the outer and inner wheel flange. The reservoir for the lubricant can be mounted either onto the bogie or the vehicle body.

The SKF EasyRail Airless unit can be controlled by the SKF EasyRail controller LCG2, which helps to minimize the lubricant consumption. It activates the lubrication system when the vehicle is running through curves. In addition, distance- or time-dependent lubrication modes can be combined with the curve-dependent one.

The main advantage of the SKF EasyRail Airless lubrication system is the application of a very compact wheel flange lubrication system without the necessity to mount air compressors and reservoirs. It reduces the air consumption to zero and reduces the lubrication unit weight by more than 90%. The integrated heating system enables the operation of the lubrication unit even under challenging climate conditions.

Electro magnetic SKF EasyRail Airless pump with nozzles

SKF EasyRail Airless single-line lubrication system

mainly used for mass transit vehicles without its own compressed air supply on-board
Intelligent lubrication control by EasyRail LCG2

The SKF EasyRail LCG2 lubrication control system detects rail curves and initiates lubrication. This sensor can be applied to all wheel flange lubrication systems. It offers a comprehensive range of functions and benefits. It is used to control wheel flange lubrication systems for optimizing the sprayed lubricant quantity. Two spray nozzles are actuated, the lubrication taking place in curve-, time- or distance-dependent mode. Lubrication is triggered after a certain number of previously specified pulses are received.

A combination of two operating modes can be programmed. The parameters for the different operating modes are currently set at an 8-position dual in-line package (DIP) switch. Future developments aim to change parameters only via an interface on a regular computer to enhance customer value and operator convenience.

In the case of curve-dependent lubrication, it is possible to specify whether lubrication is to take place on both sides or only on the respective outside curve, depending on the direction of travel.

Curves are detected via an integrated gyroscopic sensor with adjustable sensitivity, which starts lubrication while a train enters a curve.

Maintenance and operational impacts

The service life of wheelsets and tracks can be considerably extended, provided they are lubricated properly. Intervals of up to 300 000 km before wheelset re-profiling or 1 500 000 km before wheelset replacement, are no longer a distant target for railway operators. The cost saving potential for this major maintenance cost block and the return on investment in a wheel flange lubrication system can be achieved within a short time. Additionally, the savings resulting from longer rail track life, especially in curves, have to be considered, thanks to the systems' high reliability, combined with significant technical developments in control and monitoring techniques.

Lubricants

The lubricant quality has a decisive impact on the effectiveness of the lubrication applied to the wheel-rail interface. Ultimately, it determines the friction, wear and noise level. In the past few years, attempts have been made to achieve optimal surface smoothness and minimal wear with the help of increasingly higher percentages of solid additives.

SKF lubrication products for wheel flange lubrication:

- EasyRail Oil
- EasyRail Grease

These lubrication products enhance the performance of the lubrication units and achieve optimal results under various operating conditions.

Applications

SKF EasyRail wheel flange lubrication systems have a long record of excellent performance and reliability. Leading railway rolling stock suppliers like Alstom, AnsaldoBreda, Bombardier, Siemens and Stadler equip vehicles for major train operators with EasyRail systems. These systems are used by Deutsche Bahn, Trenitalia, Danish State Railway DSB, Norwegian State Railway NSB, Berliner Verkehrsbetriebe BVG, Hamburger Hochbahn AG, Erfurter Verkehrsbetriebe AG, Metro Hong Kong, Japan Railways Cargo, etc.
The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

References