



BONATRANS

Resilient wheel Bonatrans

Main advantages

- High absorption of noise and vibrations
- Reduction of life-cycle costs
- Easy to fit and dismantle
- Extended life of wheel and rail
- Low weight

Silent transport for your city

More than 70% of all people in Europe live in urban areas. World-wide, the urban population represents roughly half of all world population and this share is steadily growing. Billions of people move daily in highly populated areas and transport considerably affects their living environment. Urban rail transport relieves cities of smog and exhaust fumes; however, it has often been linked with adverse effect of noise induced to a large extent by wheel-rail contact.

Bonatrans resilient wheels are an ideal solution for the problem of noise in urban and suburban transport. Their absorption of noise and vibrations is considerably higher in comparison to earlier resilient wheel designs. They can therefore considerably reduce noise of rail vehicles in operation - trams, metro carriages and others.





BONATRANS RELIABLE SOLUTION

Thousands of Bonatrans resilient wheels in operation improve living environment of people in many European and world cities.

Bonatrans reliable solution

Bonatrans resilient wheels have been developed with the aim not only to reduce noise and vibrations in service. Their design also substantially simplifies maintenance of such type of resilient wheel and enables considerable reduction of life cycle costs.

The scheme below outlines the design of Bonatrans resilient wheel:

The basic parts of the wheel are:

- Tyre (1)
- Rubber segments (2)
- Wheel centre (3)
- Clamping ring (4)
- Locking ring (5)

Earthing bridges (6) connect the tyre with the wheel centre at the wheel surface; however, they can be located also within the rubber segments.



The main advantage of this design is its simplicity, as it does not require any bolt connections and it enables simple and quick replacement of the tyre without necessity of a bogie being disassembled from the tram. In comparison to designs of other manufacturers that use bolt fixing of the tyre the Bonatrans design offers also bigger area of the wheel web available for mounting of other components (brake discs, drive pins etc.) This is especially advantageous in the case of wheels for low-floor trams where wheels are usually directly linked with motors (see the following picture).



Bonatrans resilient wheel for low-floor trams

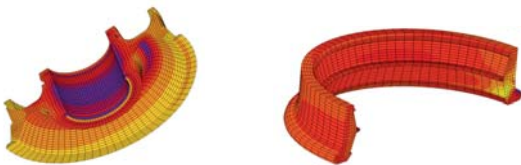
Main properties of Bonatrans resilient wheel

- Low overall weight
- Absorption of noise and vibrations
- Decreased wear of wheel and rail
- Minimized wear of wheel flange
- Reduced transversal deformation
- Easy to fit and dismantle (replacement of a tyre within 20 minutes)
- Low unsprung mass
- Simple assembly and dismantling equipment.

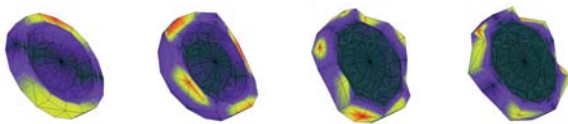
VERIFICATION OF UTILITY CHARACTERISTICS

Verification of wheel design

Finite Elements Method (FEM) is used during design of Bonatrans resilient wheels and for preliminary verification of design safety. Mechanical characteristics of wheel centre and tyre are examined through FEM.



Modal analysis is used for ascertainment and verification of wheel vibration characteristics. Vibration behaviour of the wheel can be objectively observed and measured with the assistance of the modal analysis. It can also be used for verification of the mathematical model so that load capacity of the particular design may be assessed.

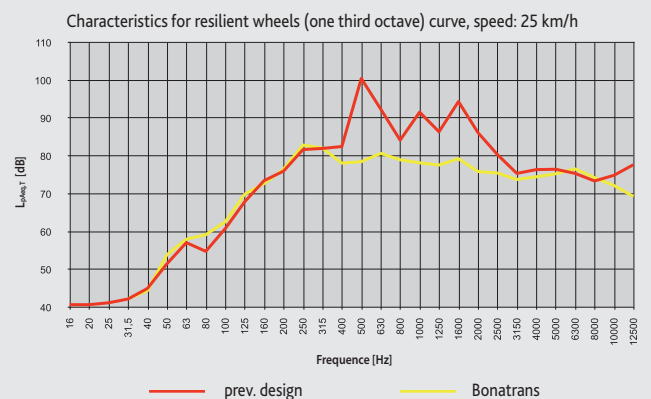
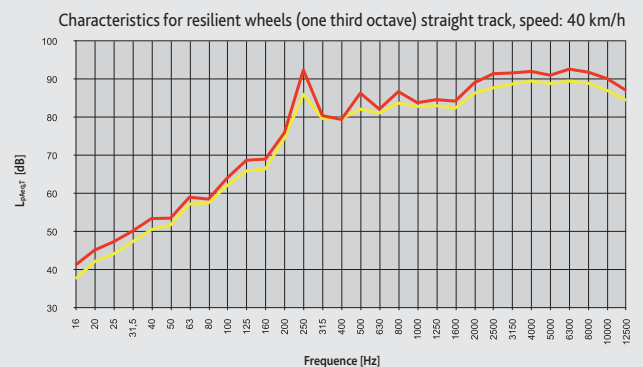


Verification of utility characteristics

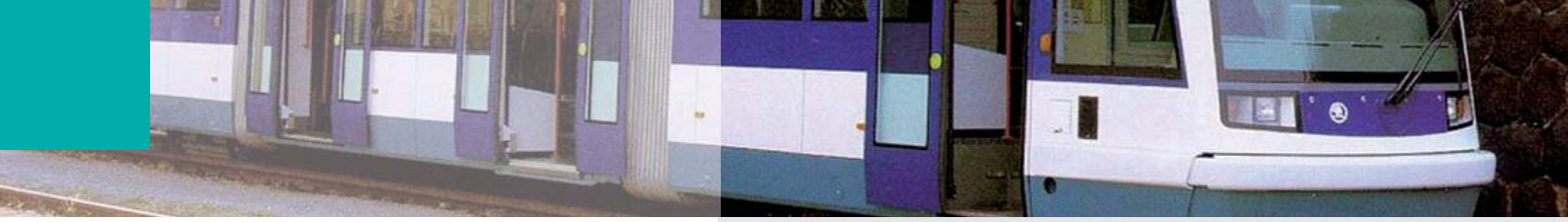
Bonatrans resilient wheels undergo a number of demanding tests. Wheels and their components are tested in external testing laboratories as well as in the accredited Bonatrans testing laboratory. The tests are focused on life-cycle of individual wheel parts (wheel centres, tyres and rubber), radial and axial wheel stiffness, resistance of the wheel against tyre slippage, fatigue characteristics of rubber segments, eventually also endurance of bonded joint (pin for transfer of torque). Utility characteristics of resilient wheels were also tested by municipal transport authorities



in a number of European cities. The tests evaluated life-cycle of the wheels (namely tyres and rubber segments) and noise emissions in the driver cabin, in passenger areas and also outside the tram. Test results were compared with an older design of rubber-sprung resilient wheel (TATRA design). The comparison results are shown in the following charts. As the comparison included two types of resilient wheels it can be anticipated that the noise reduction related to a completely undamped wheel will be even bigger.



	Straight track, v = 40 km/h		Curve r = 30m, v = 25 km/h	
	$L_{Aeq,T}$	$L_{pA,1/3} (f = 200-8000 \text{ Hz})$	$L_{Aeq,T}$	$L_{pA,1/3} (f = 200-8000 \text{ Hz})$
Previous design	102,3 dB	76,0 - 92,7 dB	102,9 dB	73,5 - 100,6 dB
Bonatrans design	96,5 dB	74,6 - 89,6 dB	91 dB	72,3 - 82,0 dB
Difference	5,8 dB	up to 6,4 dB per frequency	11,9 dB	up to 22 dB per frequency



Tyre and centre assembly and disassembly

Bonatrans resilient wheels are designed with the aim of minimising time for tyre replacement or wheel centre removal, limiting demands on machinery equipment and on service staff. Where the car body design enables access to the bogie the tyre can be replaced without disassembly of a bogie out of the vehicle.

Service experience has proved that the tyre can be replaced, without disassembly of a bogie out of the vehicle, within 20 minutes even in cases when the wheels have been run under extremely unfavourable weather conditions.



The wheel centre can also be disassembled without need for a wheel press; it can be done by means of the tool for tyre replacement. Wheel press is necessary for assembly of the wheel centre onto axle.

Tyre disassembly and assembly.

Further development

The Bonatrans resilient wheel family is continuously expanding for further use on other vehicle types.

Individual design alternatives are flexibly modified to meet various requirements for wheel diameter, tread profile, inter-connectivity dimensions, driving mode and other customer wishes. If necessary, the noise dampening effect can be enhanced through application of Bonatrans noise absorber on the resilient wheel.

We develop a resilient wheel with enhanced radial compliance that can, in addition to noise absorption, serve as primary suspension of the vehicle.

Reference

Bonatrans resilient wheels are intended for applications in all types of standard and low-floor trams, for suburban rail transport vehicles and metro vehicles. Bonatrans resilient wheels are installed in trams and other vehicles manufactured by Alstom, Siemens, Rotem, Vossloh, Škoda Transportation, Inekon Trams. BONATRANS resilient wheels are operated in Italy, Norway, Spain, Czech Republic, Slovakia, Poland, Hungary, Russia, and Ukraine and in other countries.

WE CREATE THE FUTURE

BONATRANS GROUP a.s.

Revoluční 1234

735 94 Bohumín

Czech Republic

T: +420 597 082 304

F: +420 597 082 805

E: info@bonatrans.cz

WWW.BONATRANS.CZ