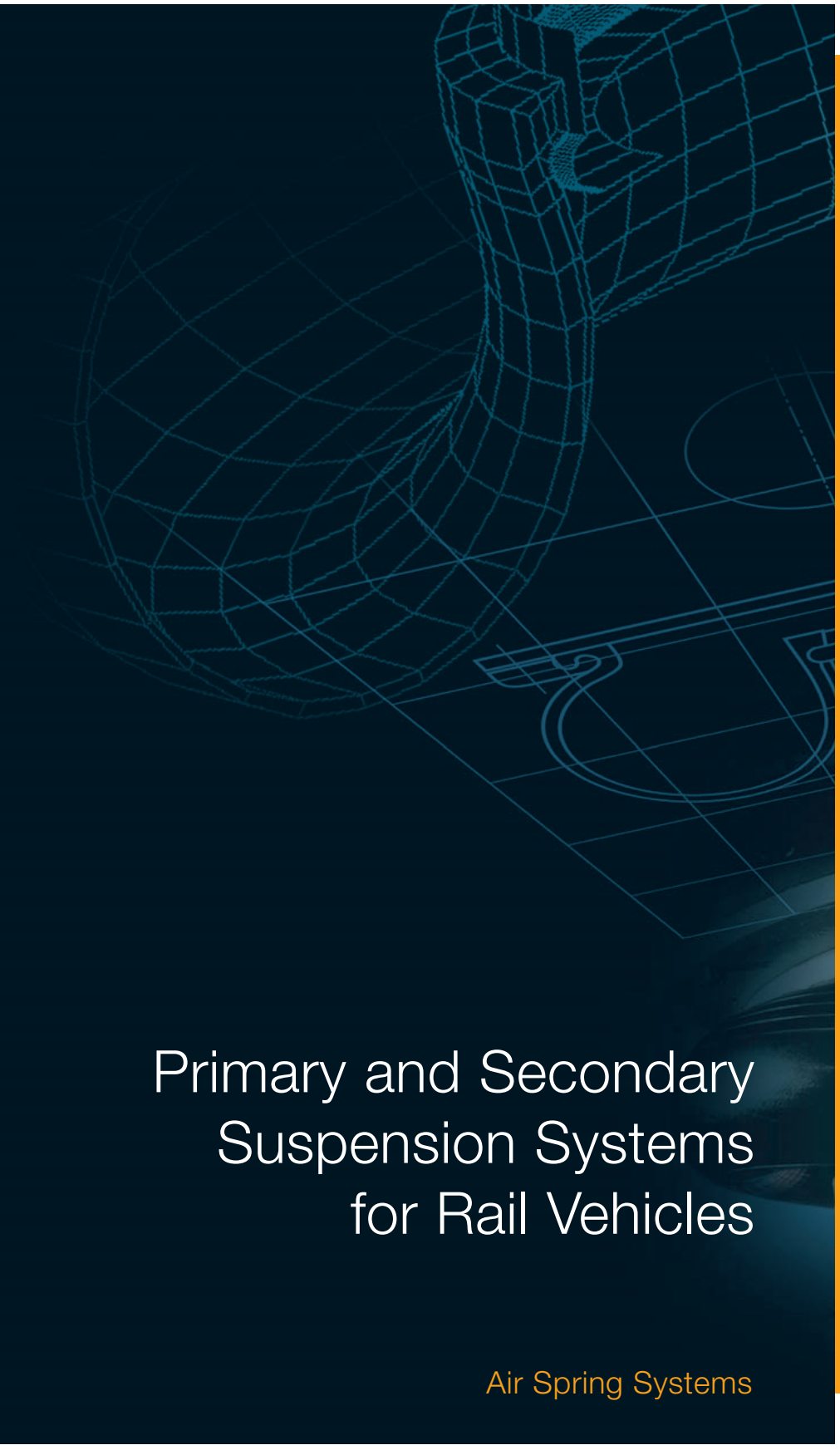


Primary and Secondary Suspension Systems for Rail Vehicles

Air Spring Systems

Continental CONTITECH

ContiTech Railway Engineering

Comprehensive suspension expertise for modern running gear

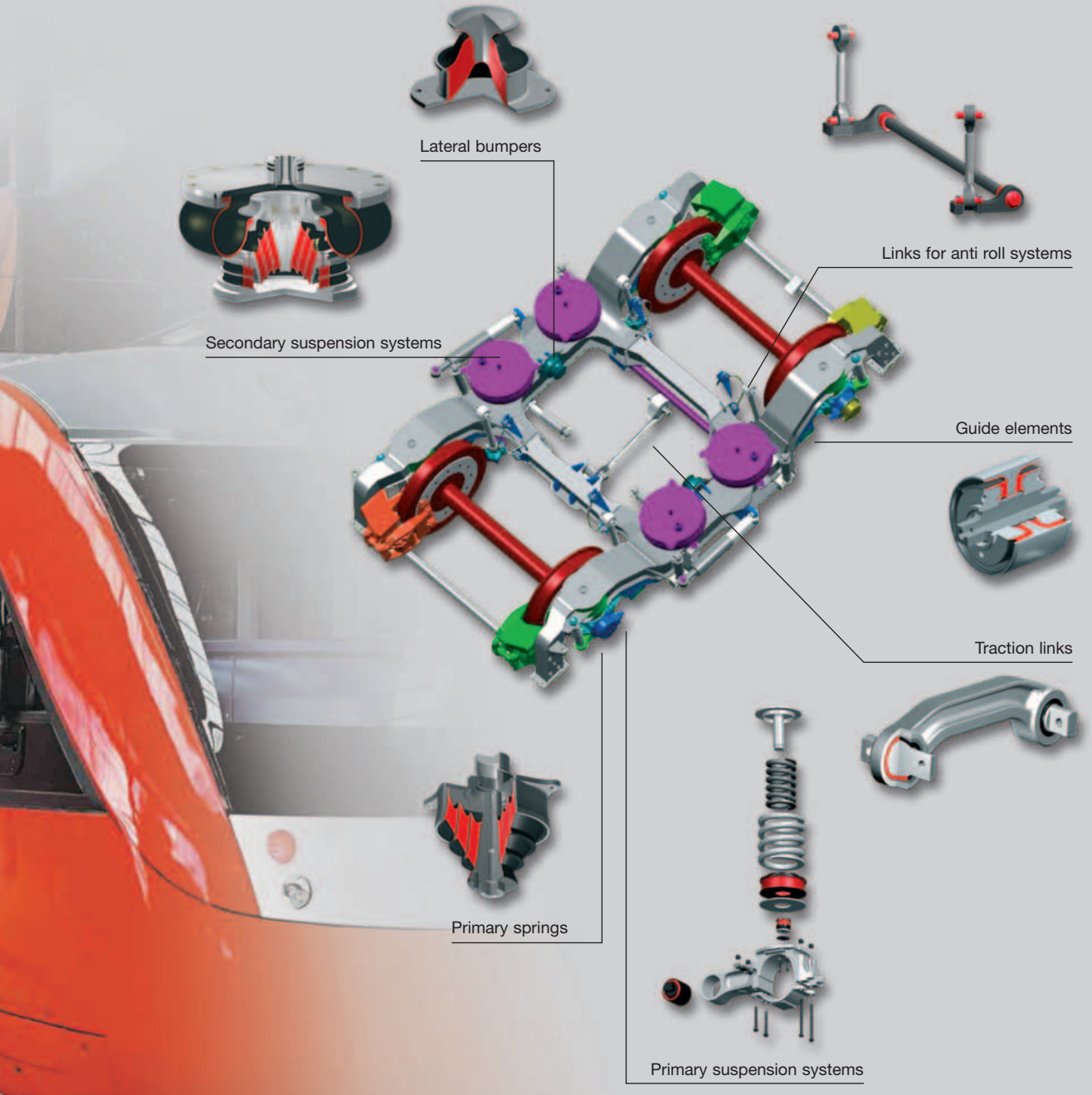
ContiTech Phoenix
...united for excellence

Double tracking support
Primary and secondary suspension

Innovative solutions for all types of modern rail vehicles in local and mainline service – including high-speed trains – are our specialty. As a development partner and OEM, we develop complete primary and secondary suspension concepts and system solutions.

Elastomer suspension elements and air spring systems make it possible for rail vehicles to meet rigorous demands in terms of safety and comfort, speed, noise control and cost-effective passenger transport.

Picture source: Siemens

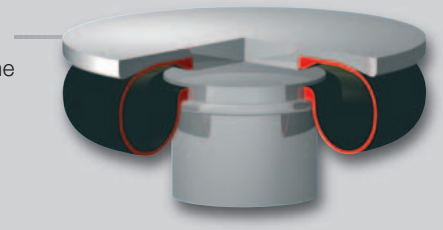


Air springs

Application examples, technical specifications

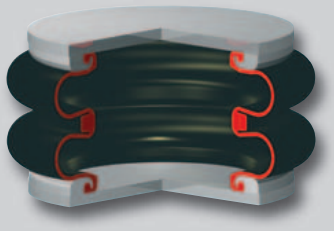
Rolling lobe air spring

Ideally suited for tram and low-floor bogies with extreme spatial limitations.



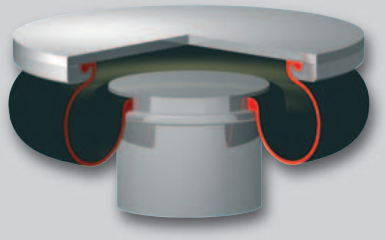
Double convoluted air spring

High-lift capability is a key feature of this spring.



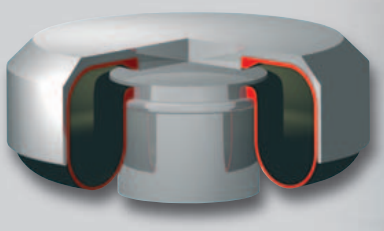
Convoluted air spring

Extra-high lateral deformability renders this spring ideal for bolsterless bogies as well as modern bogies used on high-speed trains and in urban and Metro systems.



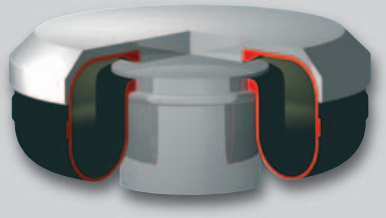
Guided rolling lobe air spring

External guide ensures higher load-bearing capacity than with a non-guided air spring and effectively protects spring from ambient influences (vandalism); spring well suited for tram and low-floor bogies with extreme spatial limitations.



Belted air spring

Higher load-bearing capacity than conventional air springs; intended mainly for bolster bogies.



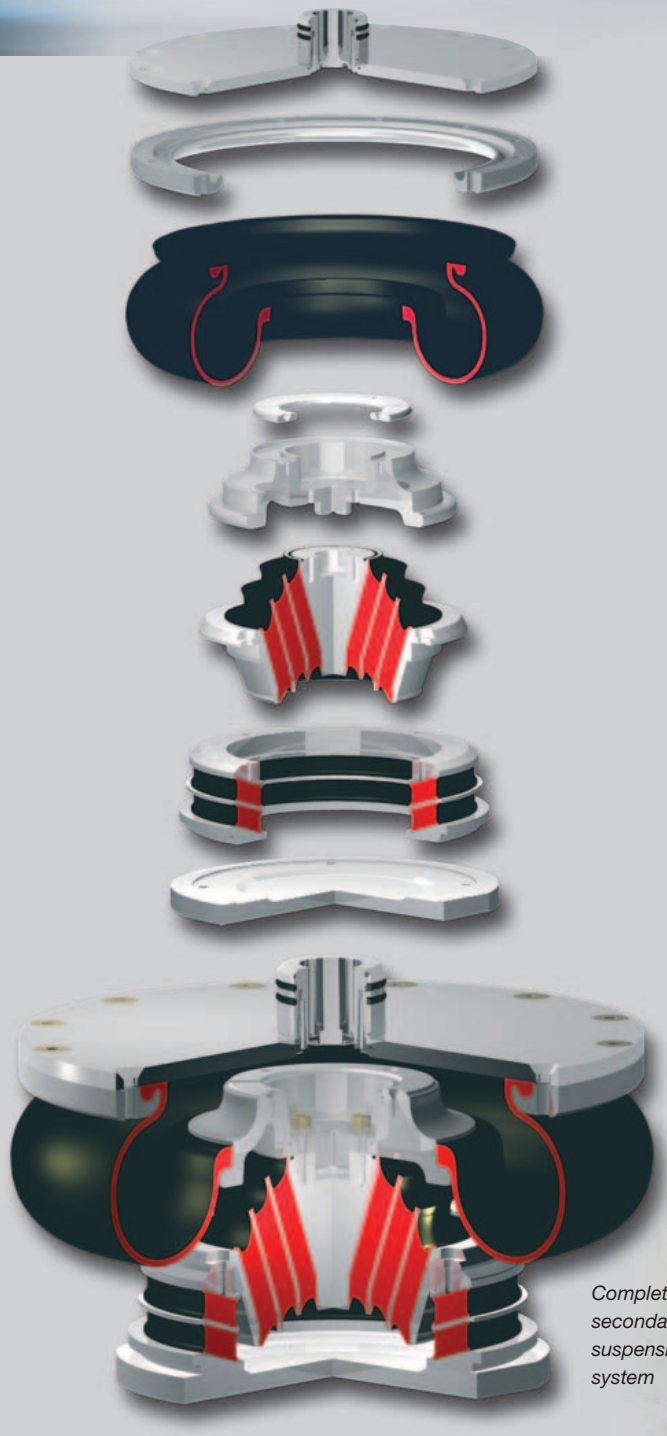
Air springs for use in secondary suspension modules (examples from our product portfolio)

Air spring	Load range F_z kN	Max. lateral deflection ΔS_y mm	Lateral stiffness at 5 bar[1] $C_{lateral}$ N/mm	Vertical stiffness at 5 bar[1]/ additional volume $C_{vertical}$ N/mm/l	Load-bearing capacity at 5 bar F_z kN	System diameter at 5 bar Ø mm
840 N1	20 – 65	40	275	550 / 0	55	450
843 N10	25 – 80	40	75	800 / 0	65	490
7090N10	30 – 80	110	140	600 / 0	65	540
7010N10	30 – 100	80	335	1050 / 0	75	545
7050N10	40 – 120	120	150	475 / 0	100	720
684 N10	40 – 130	120	150	460 / 0	110	745
743 N100	50 – 140	50	280	1230 / 0	115	625
7140N10	50 – 140	120	160	865 / 0	110	700
747 N100	50 – 150	50	410	1800 / 0	130	650
1Ao 50 a	20 – 60	± 50	60	180 /40	49	470
1Ao 55 a	30 – 70	± 80	165	940 / 0	68	535
1Ao 70 a	30 – 80	± 100	165	840 / 0	68	540
1A0 90 b	45 – 130	± 110	145	975 / 0	107	680
1Ao 103	45 – 125	± 110	170	535 / 0	105	735
1Ao 112 - 1	50 – 140	± 110	155	870 / 0	126	760
1 G 130 a	50 – 140	± 50	355	1080 / 0	126	665
2 B 22 R-1	12.5 – 45	± 20	15	225 / 0	28	330

[1] Amplitude ±10 mm

Secondary suspension systems

Application examples, technical specifications



Complete secondary suspension system

Function

Secondary suspension systems are located between the bogie and the carbody. They are used to bear the carbody and allow the bogie to rotate when the rail vehicle negotiates bends.

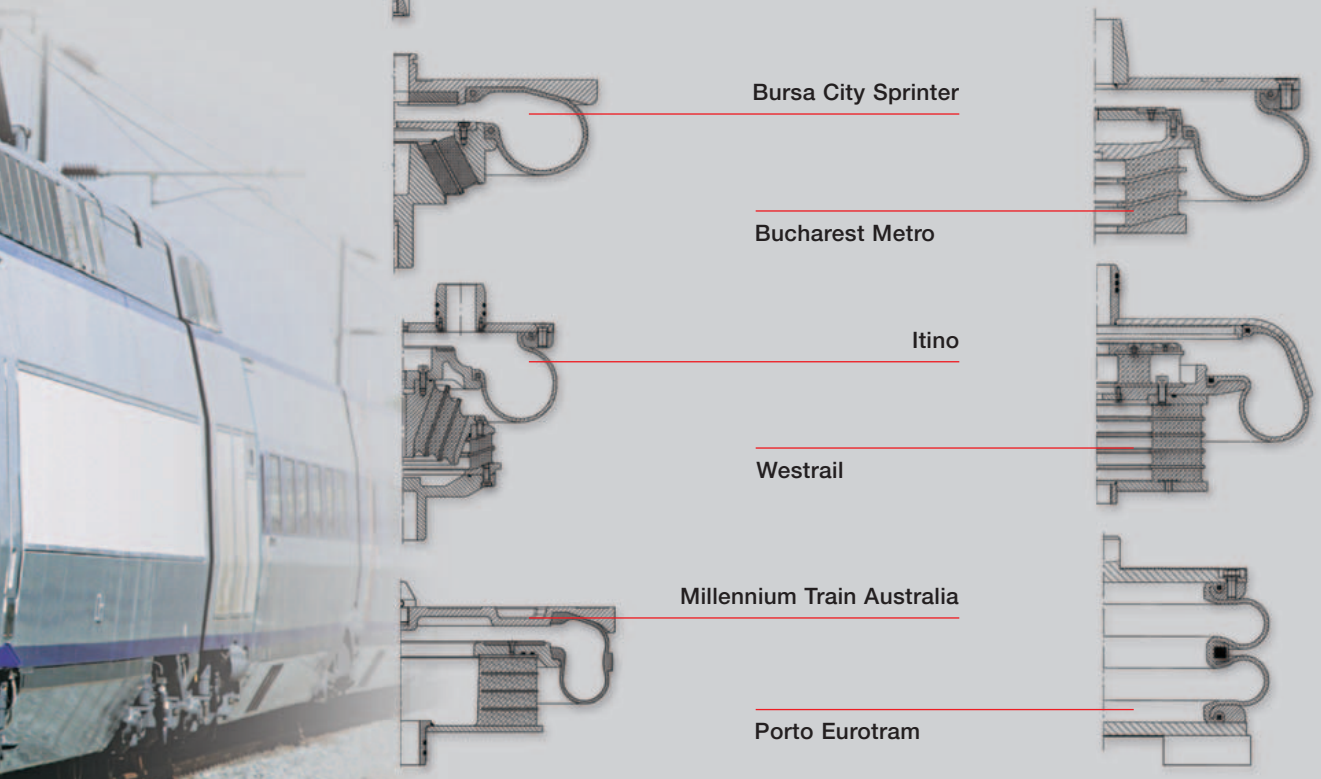
Advantage

- Increase in ride comfort thanks to pneumatic suspension irrespective of the load conditions
- Reduction in structure-borne noise transmission from the bogie to the carbody
- Adjustment of the vehicle height at different loads
- Stabilisation of running dynamics

Air spring systems for use in secondary suspension modules (examples from our product portfolio)

Air spring system	Load range F_z kN	Max. lateral deflection ΔS_y mm	Lateral stiffness at 5 bar[1] $C_{lateral}$ N/mm	Vertical stiffness at 5 bar[1]/ additional volume $C_{vertical}$ N/mm/l	Load-bearing capacity at 5 bar F_z kN	System diameter at 5 bar Ø mm
840 N1	25 – 55	± 40	270	530 / 0	50	450
7010N10	30 – 100	± 90	185	385 /50	70	550
743 N10	60 – 115	± 110	170	400 /50	110	630
7050N100	110 – 140	± 130	150	440 / 0	100	715
732 N100	90 – 170	± 125	200	430 /50	150	810
770 N100	150 – 240	± 35	335	1100 /40	200	815
SEK 330	12.5 – 45	± 20	15	225 / 0	28	330
SEK 440	35 – 65	± 80	135	544 / 0	50	440
SEK 540	37 – 81	± 35	170	500 /20	66	525
SEK 670	50 – 130	± 120	140	350 /100	111	680
SEK 700	80 – 120	± 80	250	530 /55	130	690
SEK 760	80 – 150	± 150	160	470 /40	130	780

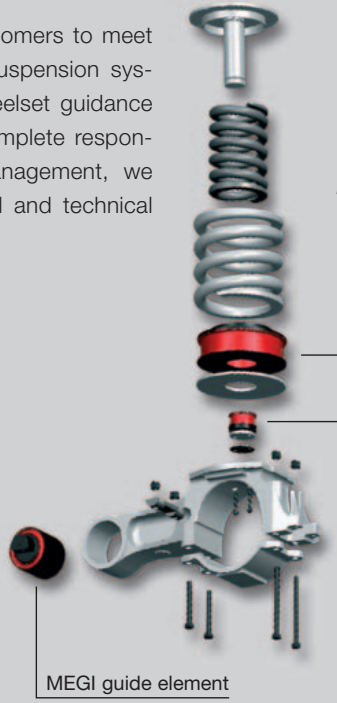
[1] Amplitude ± 10 mm



MEGI® primary suspension systems

For bogies in modern rail vehicles

Developed in collaboration with the customers to meet specific requirements, MEGI® primary suspension systems aptly tackle the complexity of wheelset guidance and bogie suspension. By assuming complete responsibility for engineering and project management, we are able to achieve economic, logistical and technical synergies.



The interaction of individual components is optimised to ensure that the system performs reliably and safely over its entire lifetime.

MEGI® system components

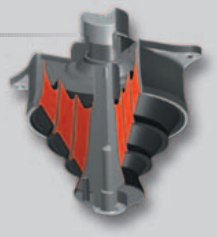
For guiding, suspension and damping tasks

MEGI® elements greatly enhance the comfort and safety of rail vehicles.

MEGI® guide elements

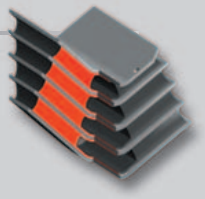
play a key role in guiding the wheelset. As system components they can also be used to transmit loads in the traction link and anti roll system as well as in the driveline suspensions

MEGI® conical springs



permit a large variation in adjustable vertical and horizontal stiffness within a confined space. They often eliminate the need for any auxiliary damper.

MEGI® chevrons

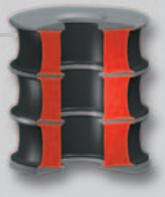


are optimally suited for primary spring modules with a large degree of variation in vertical and horizontal stiffness. They often eliminate the need for other dampers.

MEGI® auxiliary springs

reduce structure-borne sound and vibrations in primary and secondary spring modules when used in combination with a coil spring (i.e. MEGI layer spring).

MEGI® layer springs



ensure maintenance-free bearing of primary and secondary suspension systems.

MEGI® = METALLGUMMI®
MEGI and METALLGUMMI are registered trademarks.

MEGI® primary springs

Conical springs and chevrons for use in the primary suspension system

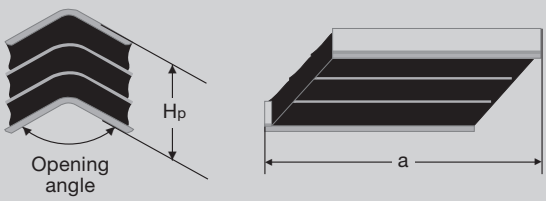
Conical springs (examples from our production portfolio)

Component Conical spring no.	External diameter D_a mm	Unloaded height H mm	Load range F_z kN	Vertical stiffness in load range C_z N/mm	Average lateral stiffness in load range C_x N/mm	 C_y N/mm
746 120	158	140	10 – 24	1200	2000	2000
746 128	158	140	13 – 26	1200	4000	4000
746 165 S1	160	190	9 – 22	870	4500	4500
746 166	155	196,5	9 – 22	780	2500	2500
746 129	256	251.5	20 – 33	600	3200	3200
746 142	256	249	16 – 24	535	3500	3500
746 125	160	178	6 – 15	410	600	1600
746 150	280	225	15 – 30	610	2200	2200
746 138	200	214	20 – 28	1470	3800	3800
746 159	272	260	25 – 34	640	2300	2300
210 170	160	190	10 – 20	880	2100	2100
210 095 A	200	241	18 – 30	660	4400	1150
210 095 B	200	230	25 – 40	1150	3700	3700
210 095 D	200	233	14 – 19	990	4600	4600
210 129	220	200	18 – 29	650	4150	4150
100 933 B	270	284	20 – 50	1200	3800	3800
100 933 F	270	185	to 120	12000	–	–
100 933 G	270	284	10 – 35	560	2750	2750
210 166	274	327	20 – 30	500	2900	900
230 303	310	290	15 – 43	600	3000	3000

The maximum (static) loads are matched to the specified stiffnesses and the maximum permissible deflection for the respective component. The stiffness – and thus the maximum permissible load – can be modified within certain limits by varying the Shore hardness of the rubber compound used. Our product development staff will be happy to answer any queries in this regard.

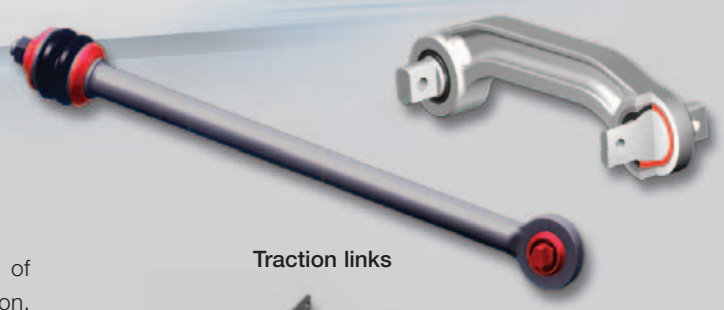
Chevrons (examples from our production portfolio)

Component Chevron no.	Spring length a mm	Spring height (parallel) H_p mm	Load range F_z kN	Vertical stiffness in load range C_z N/mm	Average lateral stiffness in load range C_x N/mm	 C_y N/mm	Opening angle °	Mounting angle °
732 061	329	81.8	to 50	1545	16500	2600	120	12
732 073	307	80.5	to 70	2210	23000	3700	120	12
732 097 S40	263	81.8	to 33	950	8200	1450	120	11
732 135 S3	345	129.9	to 115	2500	60000	6200	120	12
732 140 S15	258	81.8	to 62	2150	16400	5200	120	12
732 148 S13	336.5	120	to 58	1200	7700	3750	106	11
732 149 S2	311	120	to 58	1200	8300	5000	106	11
732 150 S4	311	120	to 81	1695	17400	5200	106	11
732 151	208	78	to 40	1300	16400	2700	120	10
732 281 S5	377	96.5	to 72	2000	24100	3400	120	10



MEGI® auxiliary systems and elements

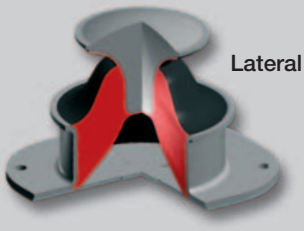
For customised solutions



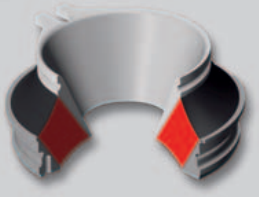
Traction links

Maximum reliability for specific tasks

MEGI® auxiliary systems fulfil the complex tasks of transmitting loads and controlling noise and vibration. These customised solutions are developed in close collaboration with the customer on the basis of clearly defined specifications. By adopting a holistic approach and assuming complete responsibility for engineering and project management, we are able to achieve economic, technical and logistical synergies.



Lateral bumper



Coupling articulation

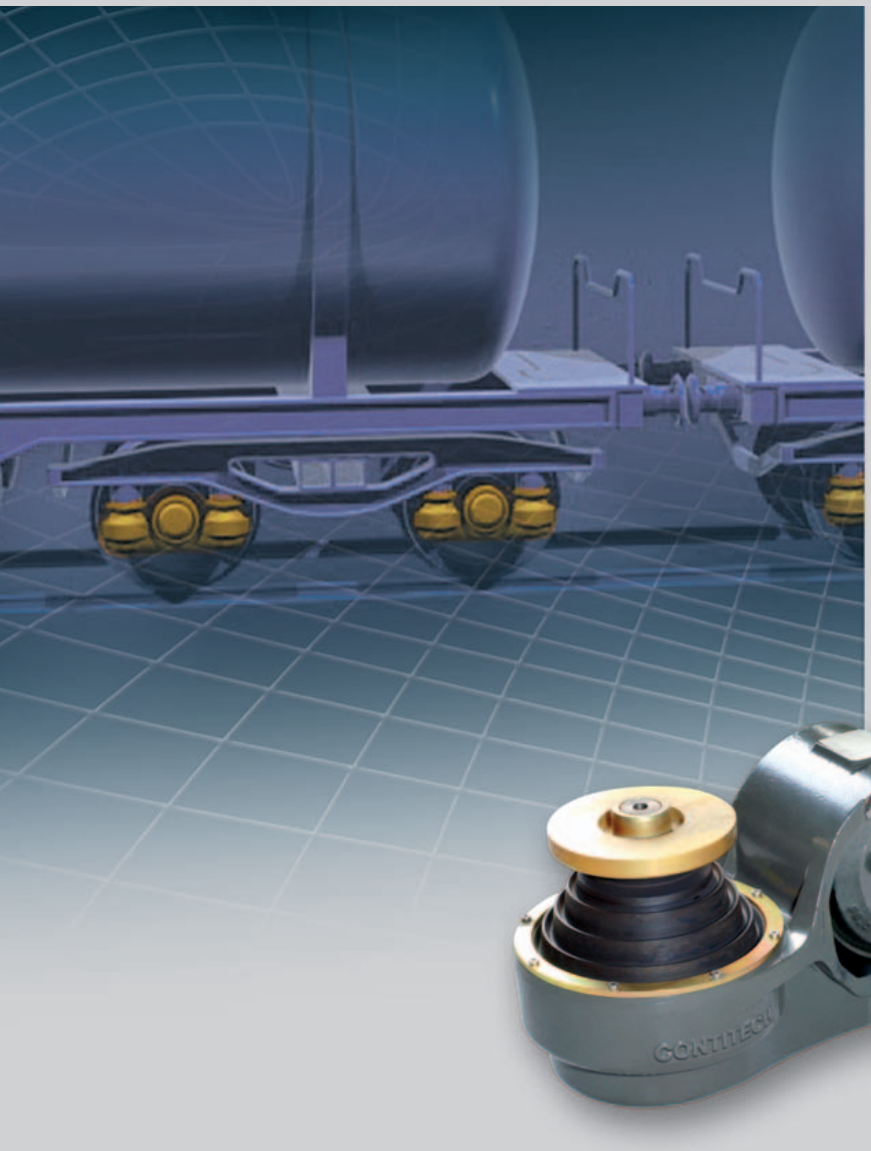
Wheelset spring

Link with bushes for anti roll system

Gigabox

The completely new bearing and suspension concept

GIGABOX – This new system with integral rubber spring provides rail vehicles hydraulic damping and wheel guidance.
The GIGABOX was developed jointly by the SKF Group, based in Gothenburg, Sweden, and the ContiTech Group, based in Hanover, Germany.

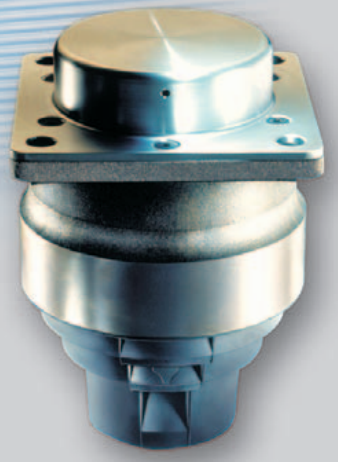


Features of the GIGABOX system:

- Extended maintenance intervals of 1 million km, corresponding to 1 gigametre – a revolutionary improvement that translates into a set maximum service interval of 10 years, or more than twice that of conventional systems.
- Smoother running gear operation, and thus reduced wear to the overall rail vehicle system (wheels, bogies, carbody) and track (rails, sleepers and ballast).
- Replacement of wearing parts by rubber guides, with the hydraulic damper permitting amplitude-independent vibration attenuation and wear-free operation.
- Far fewer component parts.
- Less wear and tear on cargo – especially important for sensitive freight.
- Significant reduction in operating noise
- Less screeching of wheels when cornering and less wear thanks to self-adjusting wheels.
- Energy-optimised goods transport thanks to smoother running.

Hydraulic springs

The primary suspension system for every specification



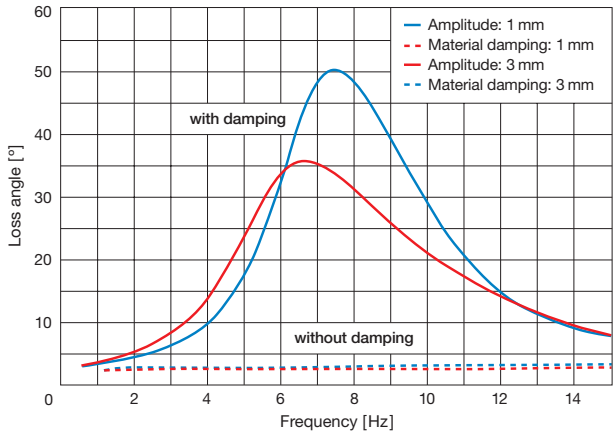
Damping in a nutshell

This special axle spring system damps vibrations and reduces noise. It is comprised of a load-bearing SCHWINGMETALL® conical spring that allows for comfortable spring properties, with large spring travel in a vertical direction. A self-contained hydraulic system is incorporated into the conical spring to damp vibrations. It can be adjusted to certain frequency ranges by means of a throttle function. This eliminates the need for a separate damper. The multifunctional system does not contain any moving seals, so it is absolutely wear- and maintenance-free throughout the required service life for axle springs.

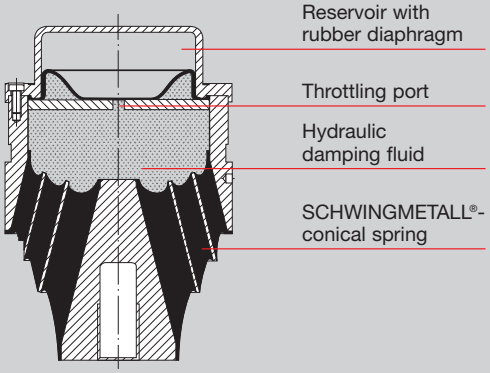
Benefits

Multidirectional spring suspension, hydraulic damping of vertical vibrations, and the added wheelset guidance afforded by co-ordinated longitudinal and transverse stiffness make SCHWINGMETALL® hydraulic springs far superior to conventional springs. Compact and light, they are easy to retrofit and can even be used to upgrade older rolling stock to comply with modern comfort and environmental demands.

Loss angle as a function of frequency, with and without damping, at different amplitudes



The hydraulic spring ensures excellent noise control in the frequency range above maximum damping.



SCHWINGMETALL®
is a registered trademark
of ContiTech AG

Calculation and design

For lifetime-optimised products

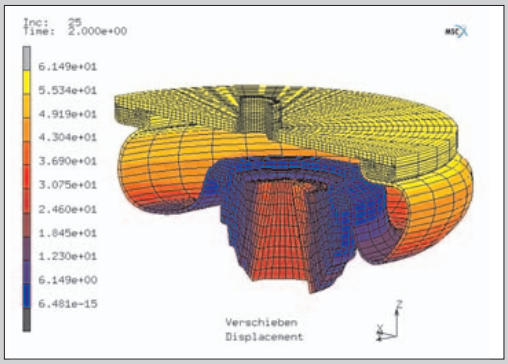
We have many years of experience in developing elastomer components and complex rail vehicle suspension systems. Customised processes serve to reduce development costs and times. The result is a lifetime-optimised product.

Estimating service life

Service life estimation is a vital tool in evaluating elastomer and air spring systems. Among other things, the specially developed lifetime analysis process employed pinpoints where maximum damage occurs. The component can then be lifetime-optimised already in the design phase.

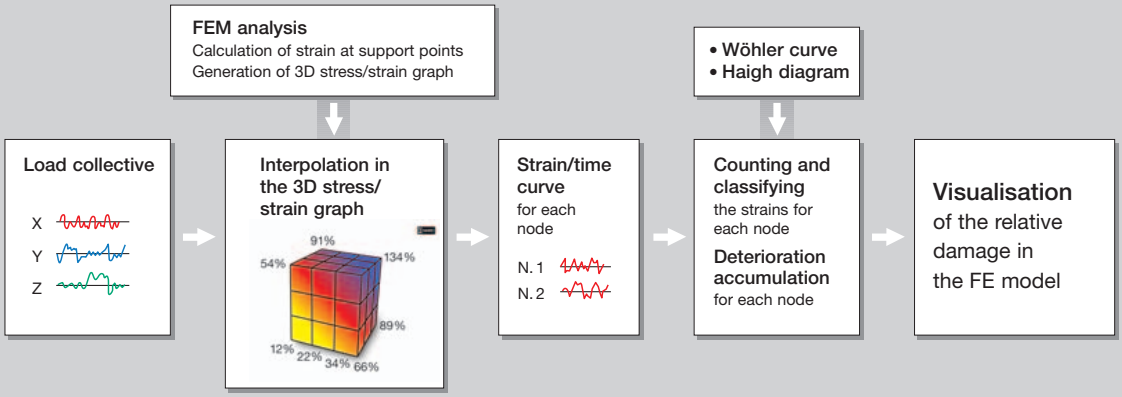
Finite element method (FEM)

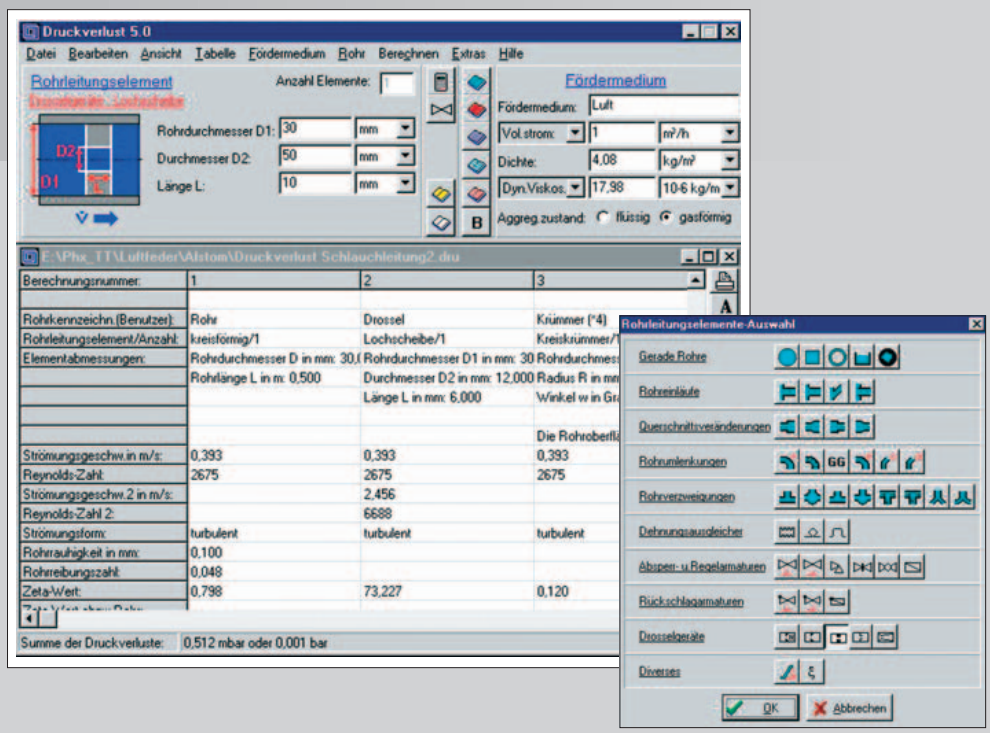
For over ten years now we have been using the finite element method in designing elastomer components and air spring systems. This simulation method is used already in the concept phase to analyse the component's mechanical properties so that important performance features can be identified and the exact article dimensions specified at a very early stage in the development process. Both metal and elastomer components are analysed. Detailed studies specifically focussed on defining optimum article geometry are followed up by service life estimations. Design of the air spring bellows also encompasses determination of the optimum fabric liner design. Complete-system simulations allow for early analysis of how the different components interact.



FEM analysis of a secondary suspension system

Procedure for estimating service life





Determination of performance parameters

In addition to FEM we use the “Airspring Addi Vol” analysis program developed in-house for the design of secondary suspension modules. With this software it is possible to determine the effect on stiffness and loss angle exerted by the following parameters

- geometric tube values (tube geometry, see graph above)
- throttle influence (throttle index, “zeta value”)
- additional volume
- amplitude
- frequency

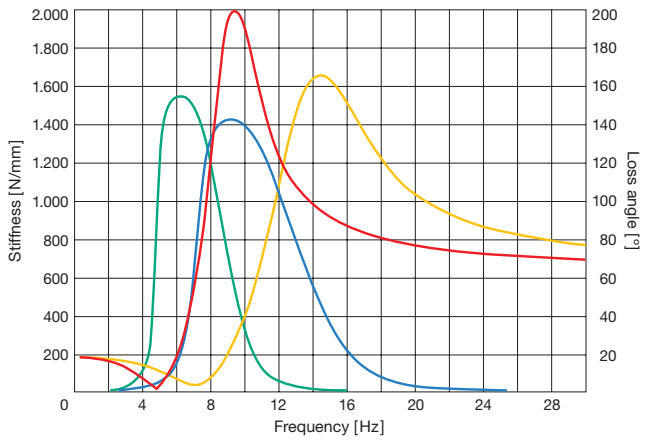
The results enable us to design our secondary suspension systems for maximum safety and comfort and to determine the size of the additional volume.

The input parameters

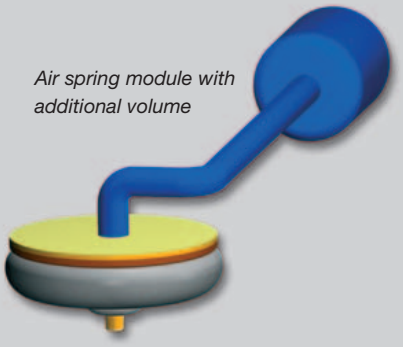
- effective area
- change in effective area and volume as a function of spring travel
- isentropic exponent
- “tube values”

are determined using in-house software (see graph on right) or with the aid of FEM. Comprehensive tests are conducted to verify and validate the results of these analyses.

Airspring 5 bar



Impact of length of tube to additional volume on stiffness and loss angle



Air spring module with additional volume

Testing and R&D

Test centre sets benchmarks in modern air spring technology

There's no compromising rail travel safety. The real-life suitability of our products is verified at our main Hanover test centre – the world's most extensive testing facility of its kind. Testing equipment includes single and multi-axle test rigs (used in varying combinations) and dynamics, bursting-pressure and assembly-specific test rigs. We simulate and analyse all load conditions arising during operation. This expedites not only our own product development but our customers' development processes as well.

Characteristic curve tests and destructive testing provide information on product properties. Our products are subjected to extreme loads – including accelerated tests – to determine their service life. Test-track runs are used to verify various properties such as suspension characteristics and the functionality of the sensor systems.

This testing technology is emblematic for our attention to quality. It ensures the excellent reliability and performance of our suspension system.

Quality and environmental management

Certifications

On track worldwide

In urban and mainline systems

We have been involved in the technological development of rail systems and vehicles for 50 years. During this time, we have repeatedly created innovative products that have modernised – and sometimes even revolutionised – rail transportation. The first air suspension system for high-speed trains is just one example of this.

We have expanded our product range and opened up markets on an ongoing basis. Today's urban, main line and high-speed trains would be inconceivable without the extreme safety and ride comfort provided by our suspension systems.

France – AGC Regional Express

Denmark – double-decker train

Shanghai – Pearlline (Metro)

Bangkok – Metro

Paris/Cologne – Thalys

Global presence

ContiTech Railway Engineering

Companies in the business unit
ContiTech service worldwide

Australia – Millennium Train

ContiTech
Specialist in rubber and plastics technology

www.contitech.de

Air Spring Systems

www.contitech.de/luftfedersysteme

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  Chungcheongnam-do
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  Derkovits út 37
  H-4401 Nyíregyháza
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  Fax +36 42315512

Certification in the ContiTech Air Spring Systems business unit

Management system

certified by DQS according to
DIN EN ISO 9001
FSO/TS 16949
VDA 6.1
Reg. No.:2286-QS/248

Umweltmanagementsystem
Dr. Kühnemann und Partner Institut für Umwelttechnik
Zertifiziert nach DIN EN ISO 14001
Reg.-Nr. 06-9053-06-01

EN ISO 14001

ContiTech service worldwide

- ContiTech
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