Rubena
AIR SPRINGS

AIR SPRINGS
& POWER ELEMENTS

ABOUT US

The rubber industry in Náchod has a long tradition that began back in 1908, when Josef Kudrnáč started producing rubber products. In 1923, Ing. Jaroslav Hakauf joined him, and together they began manufacturing technical rubber. Kudrnáč subsequently began producing bicycle tires, and in 1929 he made the first Czech car tire and inner tube. After World War II, the company was transformed into a national enterprise and renamed RUBENA. Over the years, the company underwent various reorganizations and mergers, until in 1996 RUBENA Náchod joined the ČGS a.s. group.

In 2016, the company was acquired by the Trelleborg holding, and in 2021 it was sold to the Czech investment group Kaprain, which focuses on industry and other sectors. Today, Rubena is a significant European manufacturer of bicycle tires and inner tubes, technical rubber, air suspension, and other rubber products.

SYSTEM CERTIFICATION ISO 9001 SGS

SYSTEM CERTIFICATION ISO 14001 SGS

SYSTEM CERTIFICATION ISO TS 16949 SGS

rubber compounds

1908
Josef Kudrnáč started production of lubricants, packings, and other rubber products

KUDRNÁČ

1934
Baťa
Tomáš Baťa started production of V-belts in Zlín.

1948
The company was renamed to Rubena and a new brand Barum was established (BAťa + RUbena + Mitas).

Barum

1996
Rubena
Rubena Náchod became part of the ČGS company based in Prague.

2016
Rubena became part of the Trelleborg Group under the name Trelleborg Bohemia.

TRELLEBORG

2021
Rubena
Separation from Hradec Králové, return into Czech ownership (Kaprain), and to the Rubena brand.

CONTENTS

GENERAL BASIC CHARACTERISTICS

AIR SPRINGS

Air springs use a specially designed rubber-textile vessel, in which a specific volume of compressed air is enclosed. This air serves as the supporting element of the entire system and can replace traditional steel springs or hydraulic systems.

The air spring itself consists of a multi-layered construction, made up of an inner rubber layer, a reinforcement layer of textile fibers, and a protective rubber cover forming the outer surface of the air spring. The internal compressed air provides elasticity to the system and ensures the damping of impacts and vibrations.

ADVANTAGES OF AIR SPRINGS

1. Smooth adjustment of stiffness and height
Air springs allow easy modification of stiffness and height simply by changing the internal pressure. This enables adaptation to different load types and ensures optimal driving characteristics.

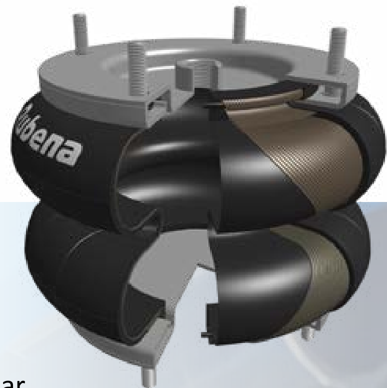
2. Maintenance of constant height
The system can maintain a constant ground clearance of the vehicle or machine regardless of uneven weight distribution. This improves overall stability and functionality of the structure.

3. Vibration isolation and component protection
Air springs effectively reduce the transmission of vibrations and shocks, increasing comfort and protecting sensitive components. This extends their lifespan and reduces the risk of damage.

4. Resistance to lateral loads and angular deflection
Thanks to the ability to partially absorb lateral forces and angular deflection, air springs operate reliably even in demanding conditions. Compared to traditional springs, they offer better stability and longer service life.


Air springs can be controlled by regulating the air pressure inside. Increasing the pressure leads to a more rigid response, while lowering the pressure results in softer suspension. Thanks to this property, it is possible to precisely adjust the desired height of a vehicle or machine and adapt to current operating conditions or load. Air springs therefore not only enhance ride comfort but also optimize the performance and stability of the entire suspended component or system.

An example of using air springs as pneumatic springs includes vehicle suspension, vibration and shock isolation in various production lines and industrial systems (e.g. forging hammers, presses, textile looms, conveyors), vibration isolation for test benches in laboratories and testing facilities, etc.



5. Low maintenance requirements

The absence of moving parts means minimal wear and eliminates the need for lubrication. This reduces maintenance costs and simplifies operation.

6. Space efficiency

The compact design allows use in limited spaces and ensures low compressed height. This makes air springs ideal for applications where space is restricted.

7. Wide range of applications

Air springs are used in the automotive industry, construction, and mechanical engineering. Their versatility and adaptability make them an effective solution for various applications.

FORCE ELEMENTS (ACTUATORS)

Air springs can be used not only for suspension but also as air actuators, which are widely used in industrial and mechanical applications where a simple, reliable, and flexible solution is needed for generating motion or transferring force. These actuators use compressed air as the medium for transmitting energy and force, allowing them to function without complex mechanical components such as pistons or rods found in conventional hydraulic or pneumatic cylinders.

PRINCIPLE OF OPERATION OF ACTUATORS

Air actuators operate on the principle of inflating and deflating the rubber-textile air spring with compressed air, which causes it to expand and subsequently generate force or motion. This enables linear movement without the need for internal moving parts that could wear out or be damaged. Thanks to this simple yet effective principle, air actuators perform reliably in harsh conditions such as environments with high levels of dust, debris, or moisture, where other types of actuators might fail.

ADVANTAGES OF AIR ACTUATORS

1. Low acquisition cost
Air actuators are generally more affordable than traditional hydraulic or pneumatic cylinders of equivalent capacity. This cost difference is especially significant for larger sizes and high-force capacities.

2. Durability and long service life
Due to the absence of internal pistons, rods, or seals, air actuators are less prone to damage. Their design ensures high wear resistance and long service life, even under intensive use.

3. Maintenance-free operation
Air springs require no lubrication or complex maintenance. This eliminates the need for regular inspections and reduces operating costs.

4. Frictionless operation
Thanks to the lack of frictional components, there is no internal friction, meaning the actuator responds to pressure changes instantly and without the risk of jamming.

5. Use of various media
Rubber-textile actuators can be filled not only with compressed air but also with other media such as nitrogen or water when using stainless steel metal components, increasing their versatility and application options.

Rubena

Air springs used as actuators represent a flexible, cost-effective, and reliable solution for many industrial applications. Thanks to their design and ability to withstand demanding environments, they are an ideal choice where durability, low maintenance costs, and operational flexibility are priorities. These types of actuators thus **facilitate** efficient transmission of force and motion with minimal operational complications.

Examples of air springs used as actuators include lifting pantographs or heavy platforms, car jacks, leveling systems for caravans and agricultural machinery, pressure elements in paper machine rollers, pressing elements, clutch and brake jaw actuators, and more.

6. Tolerance to lateral loads and angular motion

Depending on the type, air springs can absorb various lateral loads and operate even under angular deflection of up to 30 degrees without the need for complex joint connections or additional support elements.

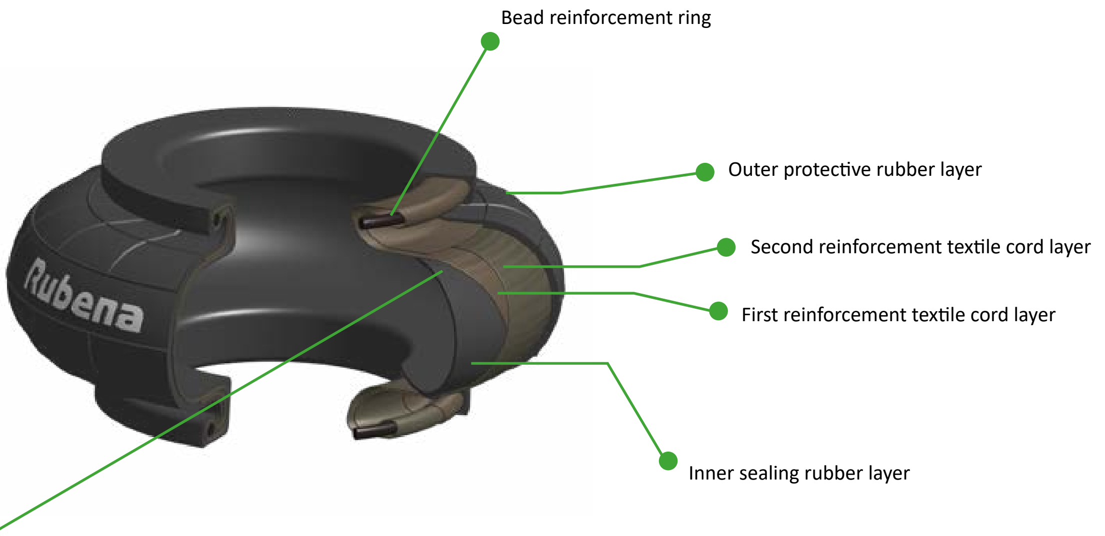
7. Compact design

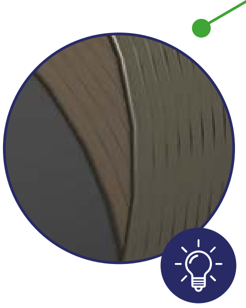
Actuators feature low initial height, enabling installation in space-limited applications.
For example, the smallest springs have a compressed height of just 50 mm.

STRUCTURE AND DESIGN

An air spring is a rubber-textile product composed of several essential layers. The wall of the air spring consists of two rubber foils (inner and outer) and typically two cord plies, which are crossed at a defined angle.

In the case of special applications, air springs with reinforced walls may be used, employing four cord plies (4PLY) instead of the standard two (2PLY). All these layers are permanently bonded together through vulcanization. Air springs can be manufactured in single-convolution (1 lobe), double-convolution (2 lobes), or triple-convolution (3 lobes) designs. For multi-convolution versions, the individual lobes must be separated by intermediate metal rings or vulcanized center rings. The upper and lower ends of the air spring, referred to as „end closures“ or „end caps,“ serve for attaching the metal parts during assembly and sealing of the air spring as a whole. The end caps are reinforced with bead rings in the case of a detachable version, or with steel cables in the case of a crimped version. Air springs can be made from various materials tailored to different environments and temperature ranges. Various materials are also used for clamping metal parts (e.g. standard steel, aluminum, stainless steel) and can be used and combined with different air spring materials.



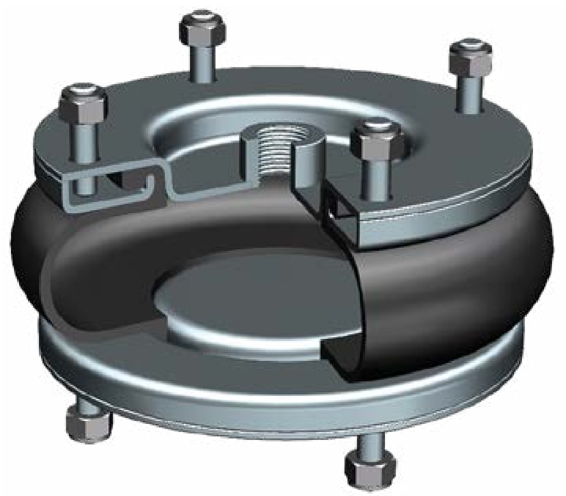


2PLY OR 4PLY

The main difference between two-ply (2PLY) and four-ply (4PLY) air springs lies in the wall design and reinforcement, which affects the load capacity, strength, and pressure limits of the air spring. Two-ply air springs offer greater flexibility and are more suitable for lighter applications, while four-ply versions are significantly stiffer and provide higher strength and load-bearing capacity for more demanding conditions. The choice of a specific design and dimension depends on the working conditions and duty cycle of the air spring – therefore, we always recommend consulting the manufacturer for appropriate selection.

DETACHABLE OR CRIMPED DESIGN

Detachable Design – sealing the air springs between a metal clamping flange and cover



- Enables easy installation and removal, allowing reuse of metal parts when replacing the air spring
- The sealing surface may be the internal conical section of the end cap (Dunlop series) or the top sealing surface with sealing ribs (Rubena series)
- The end cap of this design is reinforced with rubber heel O-rings in most cases
- Bolts of the clamping rings also serve as mounting elements in the application
- The possibility to use different types of flange materials (e.g. aluminum, standard steel, stainless steel)

Crimped design – non-detachable closure of air springs by crimping the end cap

- A cost-effective closure solution without the possibility of disassembly or reuse of metal parts
- The sealing surface is the top section of the end cap with specially designed sealing grooves
- The end cap of this type of air spring is reinforced with steel heel cables
- Mounting in the application is provided by internal crimped inserts with threads
- The standard material for crimped cover is surface-treated steel

AIR SPRING MATERIALS

Materials used for the production of air springs are developed to meet different temperature ranges or resistance to oils, petroleum products, and various chemicals. The base component of every developed compound is rubber, whose properties influence the core function and application range of the air spring. Rubena uses several types of rubber in compounds for manufacturing air springs, including:

- **SBR** *(styrene-butadiene rubber)*
- **ECO** *(epichlorohydrin rubber)*
- **CIIR** *(chlorobutyl rubber)*
- **CR** *(chloroprene rubber)*

OPERATING LIMITATIONS AND REQUIREMENTS

The working conditions for the use of air springs are defined for individual dimensions and variants using several key parameters:

Minimum operating height **(H_{min})** Maximum operating height **(H_{max})** Maximum operating pressure **(p_{max})**

The minimum and maximum operating heights differ across air spring types. The standard maximum operating pressure for most 2PLY air springs is p_{max} = 8 bar.

Special reinforced 4PLY variants may allow a higher maximum pressure, but the use of such air springs must always be consulted with the manufacturer.

Specific values for H_{max}, H_{min}, and p_{max} can be found in the datasheets for each dimension in our online catalog. These values must not be exceeded in application. Therefore, mechanical stops must be used at both Hmax and Hmin to limit operating height.

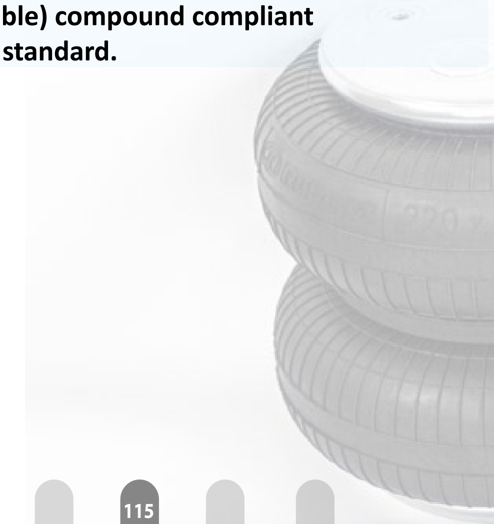
Due to the natural resistance of rubber to deformation, external force must be applied to reach H_{min}.

Other generally limiting factors may include allowable angular and lateral deflections, required installation clearance, minimum and maximum operating temperatures, resistance to petroleum and chemical products. These limitations are also detailed in the datasheets and online catalog.

MATERIALS AND THEIR OPERATING LIMITATIONS

Marking	Material	Key Properties and Application Scope
	SBR	Standard and most used material, suitable for general use
B B	CIIR	Suitable for higher temperatures, resistant to steam and acids*
E Ǝ	ECO/GECO	Suitable for extremely high temperatures, offering the best resistance to steam, acids, oils, and fuels.
N И	CR	Used in higher temperature environments, resistant to steam, acids, and oils*
EN 45545	CR (AF - Anti Fire)	Can be used at elevated temperatures, resistant to acids and oils*; **self-extinguishing (non-flammable) compound compliant with EN 45545 standard.**

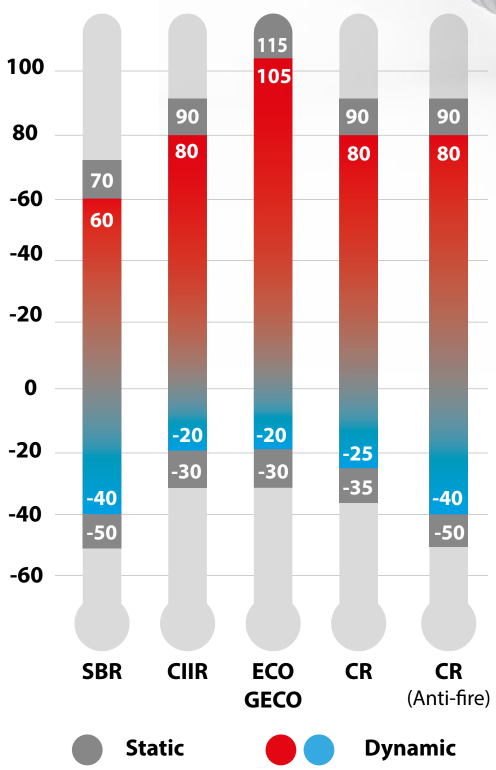
*Resistance depends on the specific type and concentration of acid/oil.
Specific applications of the rubber type should always be consulted with Rubena.



OPERATING TEMPERATURE RANGE

Material	Static application [°C]	Dynamic application [°C]
SBR	-50° to 70°	-40° to 60°
CIIR B B	-30° to 90°	-20° to 80°
ECO/GECO E Ǝ	-30° to 115°	-20° to 105°
CR N И	-35° to 90°	-25° to 80°
CR (AF - Anti Fire) EN 45545	-50° to 90°	-40° to 80°

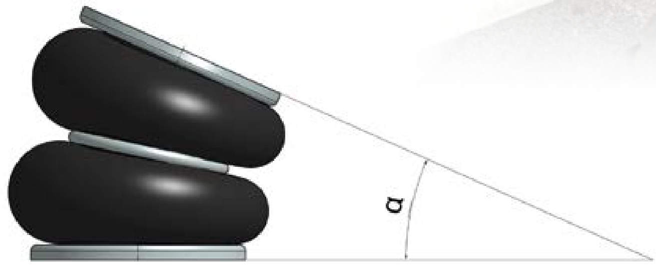
* Use of air springs in the extreme ends of the temperature range during dynamic application is not prohibited. However, operation in these gray zones may reduce the overall lifespan of the air spring.



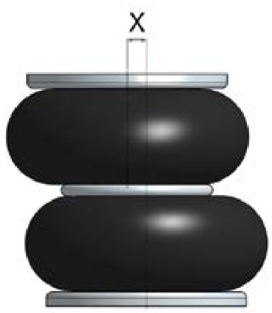
PERMISSIBLE ANGULAR AND LATERAL DEFLECTIONS

The specific values of permissible angular and lateral deflections vary depending on the type of bellow, i.e., they always depend on the dimension and the number of lobes.

ANGULAR DEFLECTION



LATERAL DEFLECTION



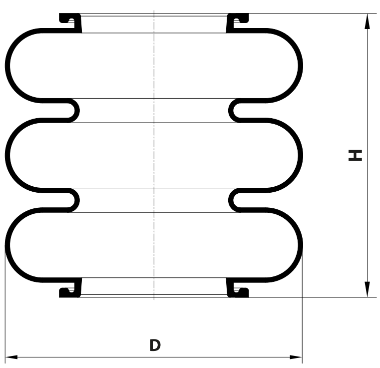
In general, it can be said that the range of permissible angular deflections is up to **α≈15°** and the range of lateral deflection is up to **x≈50 mm**.

It is always necessary to observe the maximum permissible range of working heights H_{min} to H_{max}, which must not be exceeded at any point of the deflected bellow.

PRODUCT OVERVIEW

AIR SPRINGS OF THE **RUBENA DESIGN LINE**

RUBENA design line	D	$D_{max.}$	H	$H_{stat.}$	$H_{min.}$	H_{max}	$p_{max.}$
Size x Lobe Count	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[MPa]
130 x 1	130	140	80	79	49	109	0,5
130 x 2	130	140	145	134	94	174	0,5
130 x 3	130	140	210	174	114	234	0,5
170 x 1	170	180	92	84	54	114	0,7
170 x 1E	170	200	127	129	54	149	0,7
170 x 2	170	180	162	139	79	199	0,7
170 x 2E	170	200	232	214	94	274	0,7
170 x 3	170	180	232	184	84	284	0,7
180 x 2	180	190	168	149	74	224	0,7
190 x 3	190	200	280	240	140	340	0,7
280 x 2	280	295	179	165	105	225	0,7
280 x 3	280	295	250	240	140	340	0,7
340 x 2	340	345	162	180	90	270	0,7
340 x 3	350	345	231	240	140	340	0,7
350 x 2	350	360	205	200	90	305	0,7
350 x 3	350	360	290	280	130	440	0,7
380 x 2T	380	400	230	230	150	310	1
380 x 3	380	395	244	271	147	347	0,7
410 x 2	410	420	206	205	130	280	0,7



D outer diameter of the air spring in mm (in mold)
$D_{max.}$ maximum diameter at H_{stat} and p_{max}
H height of the air spring in mold
H_{stat} static (mounting) height
H_{min} minimum height (without metal end fittings)
$H_{max.}$ maximum height (without metal end fittings)
$p_{max.}$ maximum operating pressure at H_{stat}

AIR SPRINGS OF **THE DUNLOP DESIGN LINE**

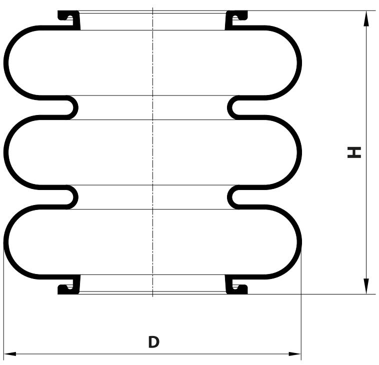
DUNLOP design line	D	D_{max}	H	$H_{stat.}$	H_{min}	H_{max}	p_{max}
Size x Lobe Count	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[MPa]
2 ¾“ x 1	70	80	41	36	26	46	0,8
2 ¾“ x 2	70	80	68	68	41	86	0,8
2 ¾“ x 3	70	80	95	91	56	116	0,8
4 ½“ x 1	114	125	50	53	38	78	0,8
4 ½“ x 2	114	125	90	88	53	138	0,8
4 ½“ x 3	114	125	130	133	88	188	0,8
4 ½“ x 3E	114	130	176	138	83	243	0,8
6“ x 1	152,5	168	70	73	44	99	0,8
6“ x 2	152,5	168	127	124	69	184	0,8
6“ x 3	152,5	168	184	174	89	272	0,8
8“ x 1	203,2	230	76	86	44	124	0,8
8“ x 2	203,2	230	140	144	69	244	0,8
8“ x 3	203,2	230	203	224	94	344	0,8
9 ¼“ x 2	235	260	140	154	69	259	0,8
10“ x 1	254	280	89	89	44	144	0,8
10“ x 2	254	280	165	154	69	294	0,8
10“ x 3	254	280	242	234	94	424	0,8
12“ x 1	304,8	330	89	89	44	144	0,8
12“ x 2	304,8	330	165	159	69	294	0,8
12“ x 2E	304	345	265	264	69	374	0,8
12“ x 3	304,8	330	242	244	94	424	0,8
14 ½“ x 1	368,3	395	102	99	44	169	0,8
14 ½“ x 2	368,3	395	191	189	69	334	0,8
14 ½“ x 3	368,3	395	279	279	99	474	0,8
16“ x 1	406,4	430	102	99	44	194	0,8
16“ x 2	406,4	430	191	189	69	384	0,8
16“ x 3	406,4	430	279	279	99	584	0,8
21 ½“ x 2	546,1	580	191	184	74	354	0,8

Aluminum clamping components: 2 ¾“; 4 ½“; 6“ and 21 ½“
Steel clamping components: 6” – 16”

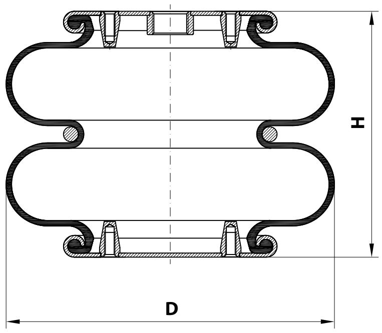
AIR SPRINGS OF **THE CRIMPED TYPE**

CRIMPED TYPE	D	$D_{max.}$	H	$H_{stat.}$	$H_{min.}$	H_{max}	$p_{max.}$
Size x Lobe Count	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[MPa]
220x2	220	230	200	210	75	270	0,8
220x2E	220	230	230	220	80	290	0,8
220x2EE	220	230	240	235	95	325	0,8
5“ x 1	127	137	78	84	50	105	0,8
5“ x 2	127	137	134	140	70	170	0,8
5“ x 3	127	137	190	196	90	230	0,8
6“ x 1	152	168	86	95	53	110	0,8
6“ x 2	152	168	148	155	75	195	0,8
6“ x 2E	152	162	180	145	75	230	0,8
6“ x 3	152	168	208	215	100	270	0,8
8“ x 1	203	230	97	105	55	150	0,8
8“ x 2	203	230	167	175	80	265	0,8
9 ½“ x 1	241	270	101	105	55	160	0,8
9 ½“ x 2	241	270	175	175	80	310	0,8
12“ x 1	304	330	110	110	60	165	0,8
12“ x 2	304	330	192	190	85	300	0,8
12“ x 3	304	330	275	265	120	435	0,8

DUNLOP design line



CRIMPED TYPE



D outer diameter of the air spring in mm (in mold)

$D_{max.}$ maximum diameter at **H_{stat}** and **p_{max}**

H height of the air spring in mold

H_{stat} static (mounting) height

H_{min} minimum height (without metal end fittings)

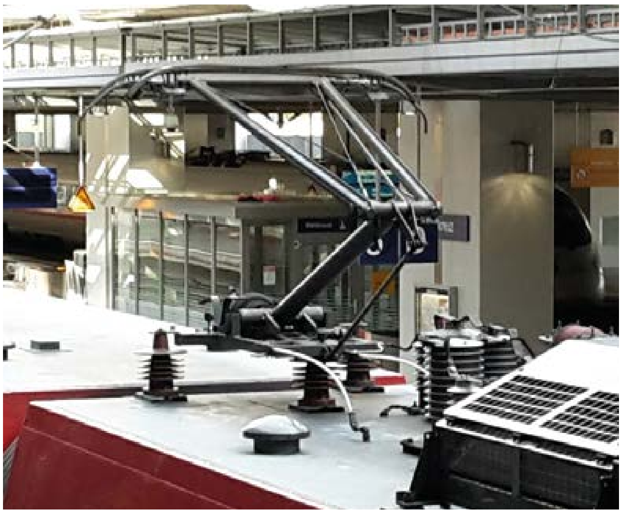
$H_{max.}$ maximum height (without metal end fittings)

$p_{max.}$ maximum operating pressure at **H_{stat}**

TOP APPLICATIONS

Rubber-textile bellows of a convoluted shape have a wide range of applications. Their main functional value lies especially in their ability to act as a spring or a force element – an actuator.
Below is an overview of the most popular ones:

RAISING PANTOGRAPHS WITH AIR ACTUATORS

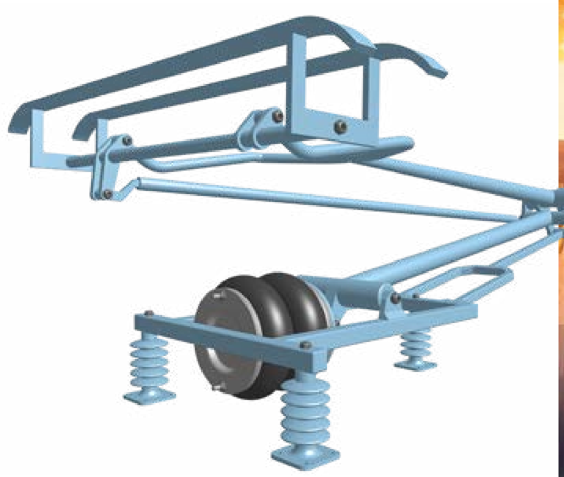


A world speed record was achieved using our actuator.

In recent years, this has become a very popular and widespread application. Moreover, in this field, Rubena is a very important player, and major companies in the industry use our bellows. A locomotive equipped with our actuator, has achieved a World Speed Record.

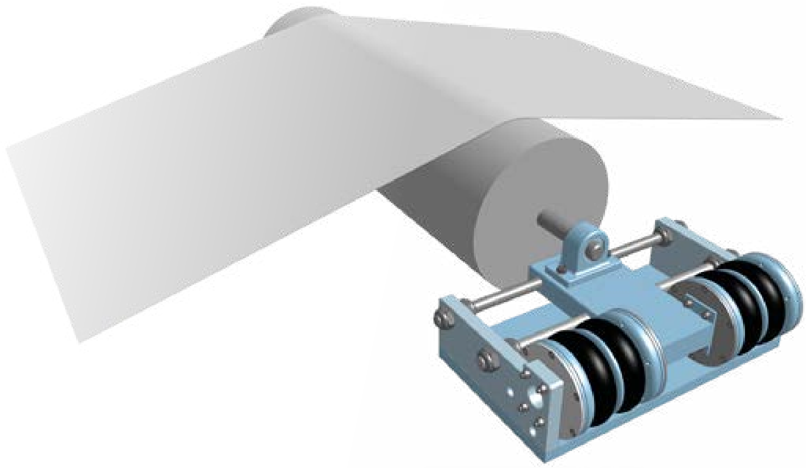
Generally, it involves raising a particular component with specific kinematics – in this case, a pantograph – while maintaining a defined contact pressure. All of this must function in environments ranging from freezing cold to direct exposure to intense sunlight, heat, and strong UV radiation.

We offer various types of bellows here, different closure variants, not only from compounds designed for demanding climatic conditions, but also tested in accordance with the EN 45545-2 standard.

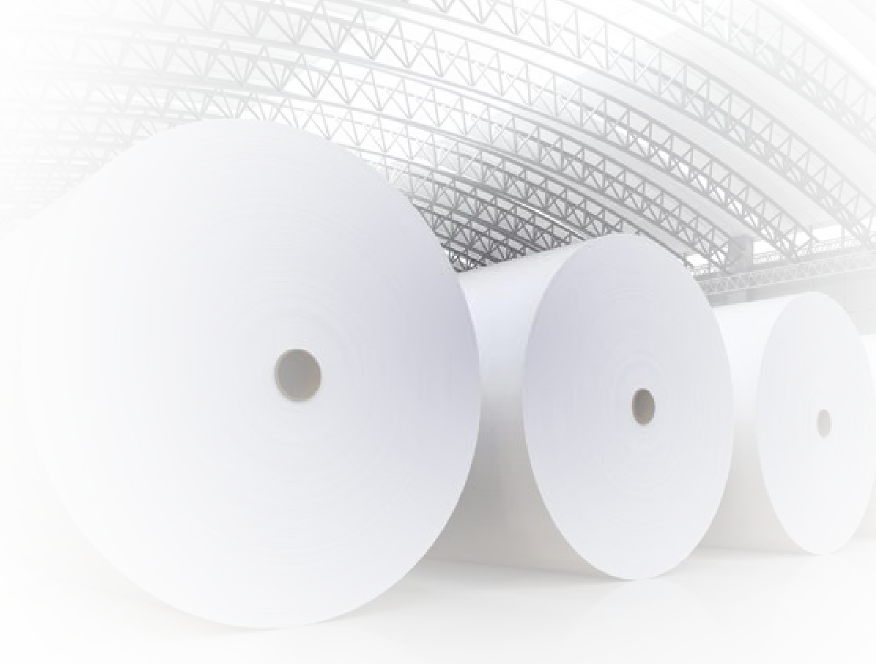


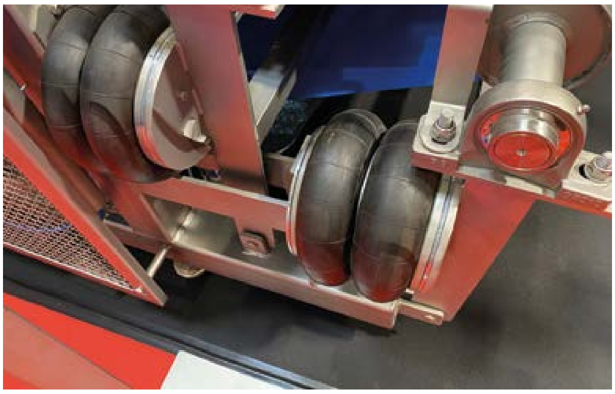
ELEMENT REGULATION ON PRODUCTION LINES

This is one of the fundamental applications of Rubena's air springs—specifically as force-generating actuators that can move a production line component along a predefined path, using only compressed air. Many manufacturers of production lines and industrial machinery—such as for paper, concrete elements, and food production—utilize this capability.



Moves the component using only compressed air.



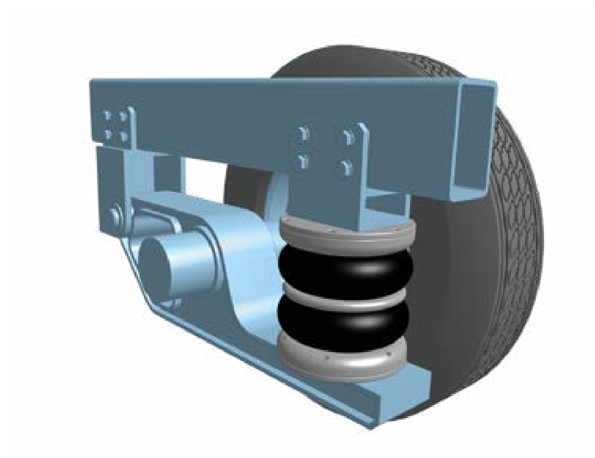


RETROFITTING OF COMMERCIAL VEHICLES, CAR SUSPENSION TUNING, CARAVAN LEVELING, AGRICULTURAL SPRAYERS, COMMAND CONTAINERS, ETC.

In these applications, the air spring serves both as a force element and a pneumatic spring. For commercial vehicles, it's mainly used to level the bed under uneven loads—effectively lifting the body via the air spring and stabilizing the vehicle to improve ride performance.

In the case of suspension tuning, the lifting principle is not just about practicality but more about performance versatility, allowing different ride profiles in various environments.

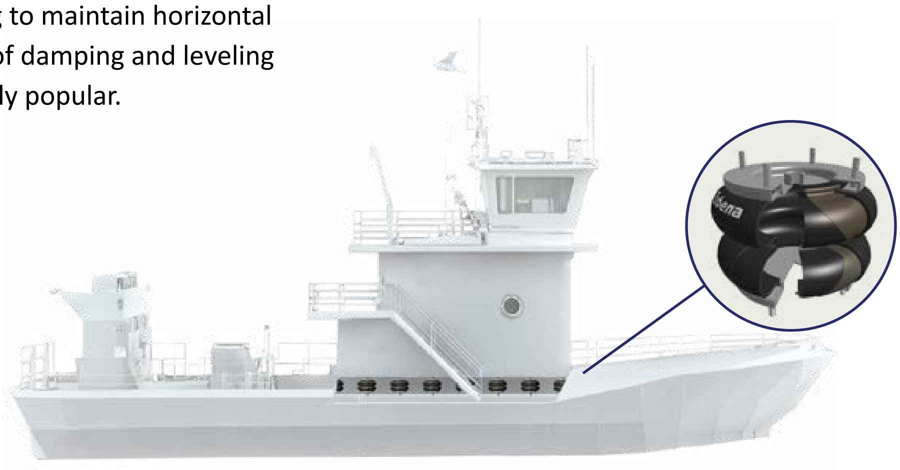
For caravans, height-adjustment ensures level parking for camping—so you can sleep comfortably, your shower drains properly, and your coffee stays put on the table. The same principle applies to command containers used in emergency or crisis situations.



Not just for practicality, but for enhancing vehicle performance across diverse driving conditions.

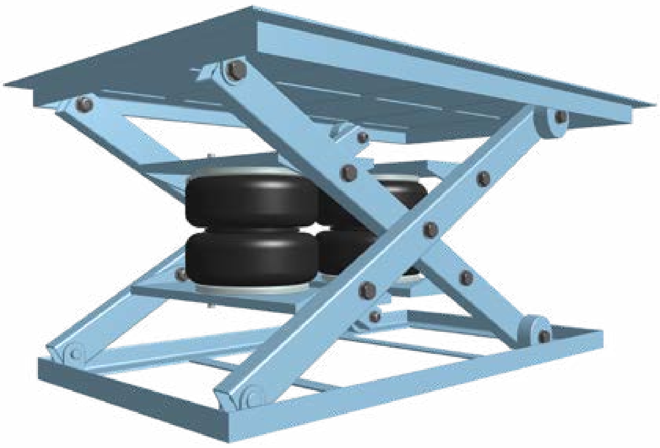
In spraying tractors, air springs provide height adjustment and tilting of the spray boom—both critical functions.

A relatively new application is in modern ship building, where air springs are used for continuous leveling, helping to maintain horizontal positioning. This type of damping and leveling is becoming increasingly popular.

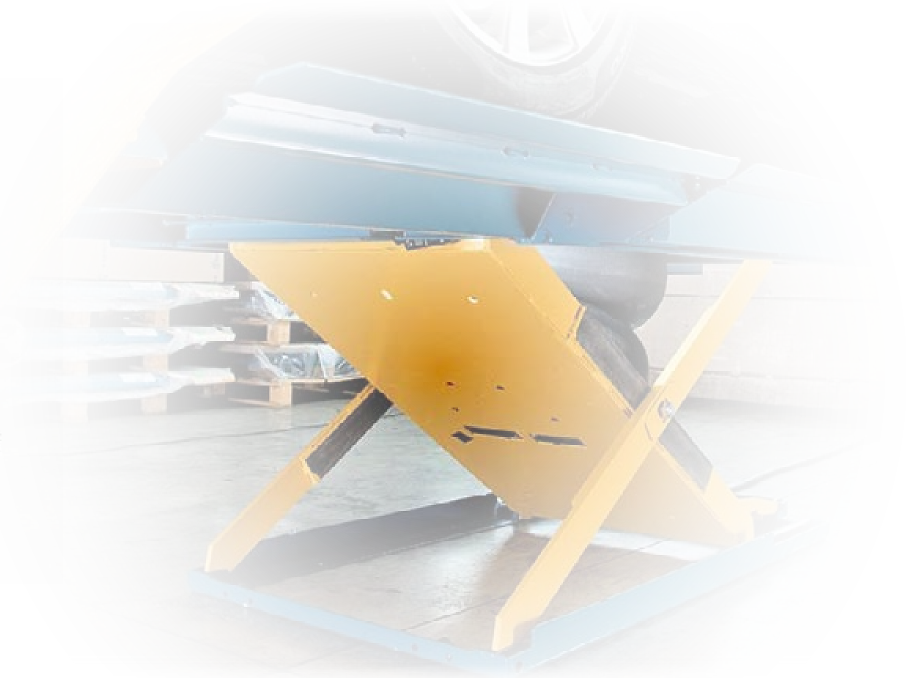


LIFTING SYSTEMS

Here, the air spring functions as a powerful actuator, capable of performing work over a defined stroke. This principle is applied in the design of simple air jacks, as well as in scissor lift systems, where the air spring acts as the main force generator.



As a force element, the bellow can be used to lift very heavy loads.



ELIMINATION OF VIBRATIONS AND SHOCKS IN VEHICLES, MACHINES, STRUCTURES, ETC.

Here, the function of the air damper is utilized. Applications range from automotive to industrial technologies or even entire buildings. In the automotive industry, it is especially popular as a damper for vibration elimination.

The bellow is used here as a vibration damper

Similarly, in certain industrial technologies. Whether it's massive forging hammers, presses, or testing facilities — or smaller material sorters and even smaller laboratory equipment. Recently, there have also been considerations of entire buildings mounted on a whole field of bellows. The purpose is clear: the elimination of external influences, such as traffic, and the ambition to better withstand earthquakes.

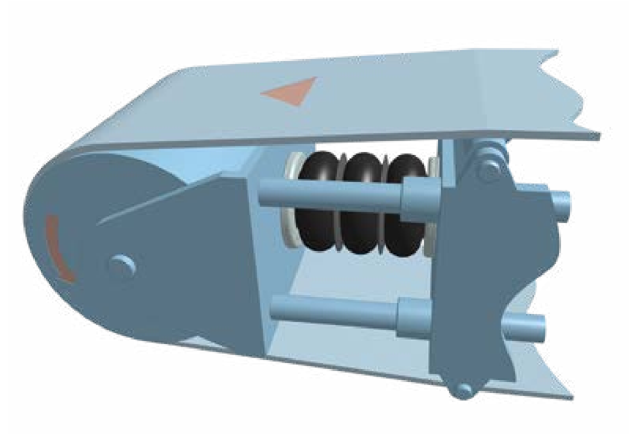
AGRICULTURE AND FORESTRY

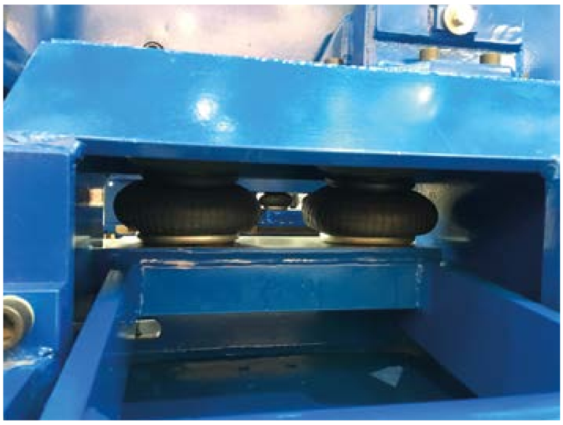
In the agricultural sector, applications are highly diverse. Both core functionalities of air springs are utilized—actuation and suspension. As a spring, air springs can compensate for deflections of cultivator blades, and also fine-tune their contact pressure by pressurizing the spring. As an actuator, the air spring can be used in forestry operations to adjust the diameter of blade opening of tree delimbing machines. Sprayer tractors represent another major category, where both properties—actuation and leveling—are important. Height adjustment or tilt correction of the spray boom is often critical. Manufacturers of modern tractors are increasingly using air springs to provide higher levels of comfort.

In the agricultural sector, both core functions—actuator and spring—are widely applied.

MINING AND CONSTRUCTION

The applications are similar to those in the agricultural sector, involving both primary functions – actuator and spring. For example, this includes vibratory material sorters, vibratory feeders, presses for concrete shaped components. The future may even lie in placing concrete house foundations on a series of bellows, serving as a highly effective isolation system against external influences such as traffic, and even with the ambition to better withstand earthquakes.





DEFENSE INDUSTRY

Recently, this chapter have primarily included applications in the defense industry – an unfortunate reality of today's world. The air bellow is used here mainly as a spring, implemented in combat vehicles or self-propelled howitzers. The springs not only significantly improve off--road capability and thus driving comfort – and consequently speed and mobility, which are crucial during combat operations – but especially in the case of howitzers, these bellows can absorb part of the energy from firing, which is a highly beneficial feature.

In general, new applications continue to emerge, as air bellows can play a general or highly specific role in new technologies.

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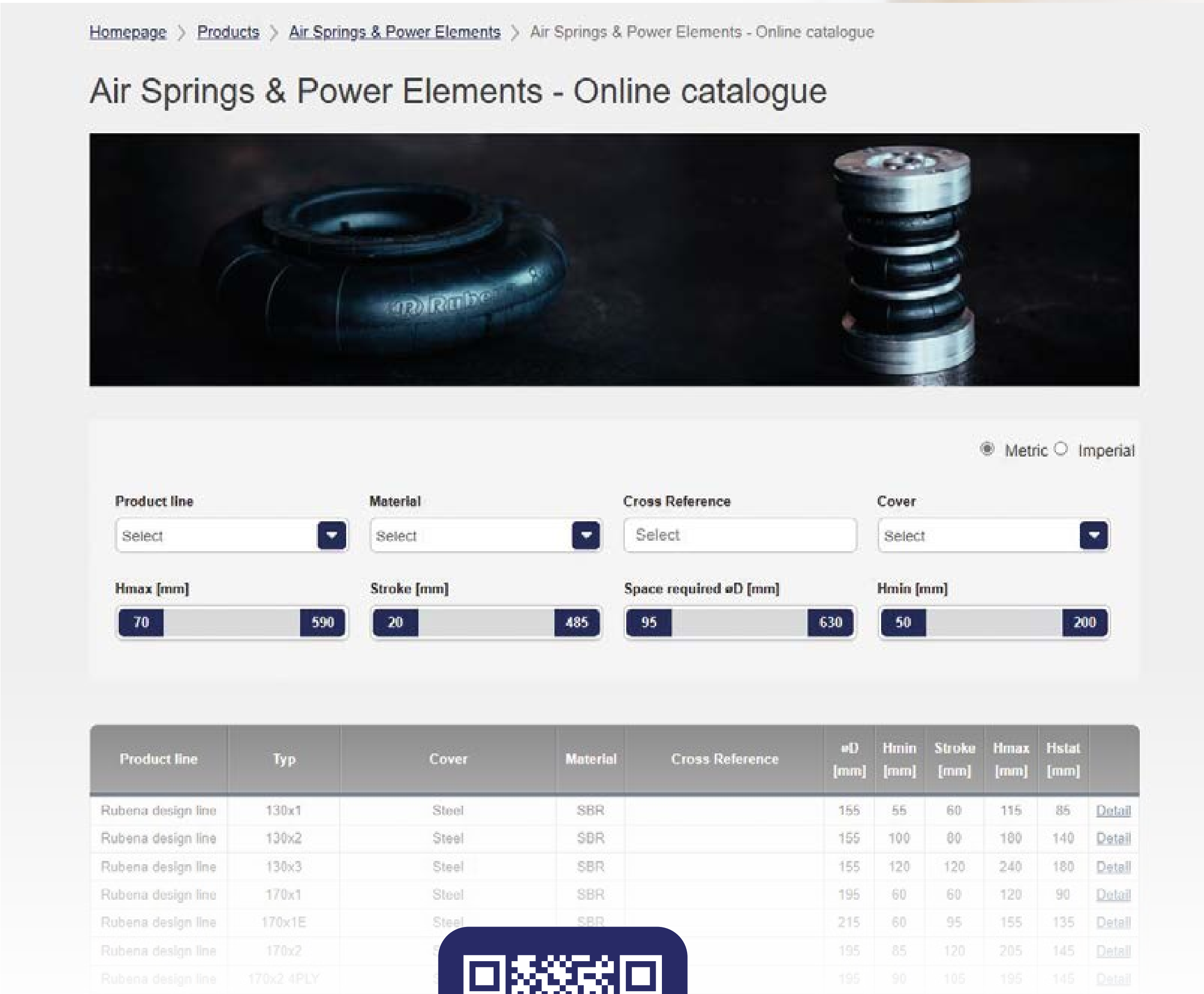
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Metric Imperial

Product line: Select
Material: Select
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Cover: Select

Hmax [mm]: 70 – 590
Stroke [mm]: 20 – 485
Space required øD [mm]: 95 – 630
Hmin [mm]: 50 – 200

Product line	Typ	Cover	Material	Cross Reference	øD [mm]	Hmin [mm]	Stroke [mm]	Hmax [mm]	Hstat [mm]	
Rubena design line	130x1	Steel	SBR		155	55	60	115	85	Detail
Rubena design line	130x2	Steel	SBR		155	100	80	180	140	Detail
Rubena design line	130x3	Steel	SBR		155	120	120	240	180	Detail
Rubena design line	170x1	Steel	SBR		195	60	60	120	90	Detail
Rubena design line	170x1E	Steel	SBR		215	60	95	155	135	Detail
Rubena design line	170x2	[illegible]	[illegible]		195	85	120	205	145	Detail
Rubena design line	170x2 4PLY	[illegible]	[illegible]		195	90	105	195	145	Detail

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