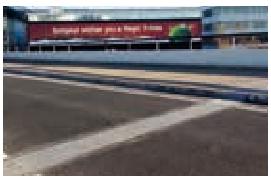
Expansion joints

mageba flexible plug expansion joint – the new generation

POLYFLEX®Advanced PU

highest traffic comfort, wear-resistant, watertight





mageba
Switzerland
www.mageba.ch

Product Characteristics

Principle

With the new POLYFLEX®Advanced PU Flexible Plug Expansion Joint System, we are able to achieve a complete new standard in terms of quality and working life.

In comparison to other expansion joint designs, flexible plug expansion joints offer large advantages: Unsurpassable roll-over comfort, no noise admission higher than on the adjacent asphalt, watertight, installable in sections (e. g. lane-by-lane) etc.

The traditional materials on bituminous basis, unfortunately show essential disadvantages. Soft materials with low reaction forces have no sufficient stability and deform plastically at high temperatures and traffic loads (especially braking). By contrast, hard material has high reaction forces and during winter debonding from surfacing leads to leakages.

Varying quality due to proper mixture and temperature during installation (at appr. 180 °C) and limitation to small movements also frequently cause problems. The elasto-plastic behaviour of the bituminous mixtures cause a permanent load (e. g. ballast gravel) that sinks into the material. For this reason, conventional bituminous plug joints are not suitable for railway bridges with ballast bed, whereas the POLYFLEX® System is.

With the new, flexible PU material – developed in cooperation with leading chemical industries – and our specific joint design, the above-mentioned problems have been solved.

For the design of integral bridges, it is a unique solution for a link to the adjacent surfacing to stay free of cracks.

Characteristics

We use a durable fully elastic material with an enormous tear resistance and low reaction forces. Integrated perforated steel angles all around covered by PU-material grant for safe flanks to the connecting structure, free from braking and reaction forces.

The new material has an exceptional long-life span, is resistant to environmental influences as well as chemicals and is completely wear-resistant. Its working life is substantially higher than the working life of materials used for roadway surfaces.

The original PU-material has a long tradition of use as waterproofing for roofs and has been constantly improved over the years. The elongation at break shows tested values of 650 %, which makes the material a perfect choice for the use in expansion joint systems.

Nearly every joint shape (upstands, skew-, T- and X- joints) can be casted. The 2-component material is mixed in complete packing units at ambient temperature, thus mixing failures on-site cannot occur. Processing is possible at temperatures between 5 °C and 35 °C, virtually independent of humidity. The joint can be driven over after a few hours. Full functionality of the joint is given in a temperature range between – 50 °C and + 70 °C, which is a major improvement compared to bituminous plug joints.

The flexible plug expansion joint system, POLYFLEX®Advanced PU, is a complete new development based on elastic polymeres and a further development of the traditional asphaltic plug joint, whereby disadvantages of the traditional bituminous plug joints (e. g. debonding, plastic deformations, rutting, overload due to standing traffic at crossings etc.) can be eliminated with the new material.

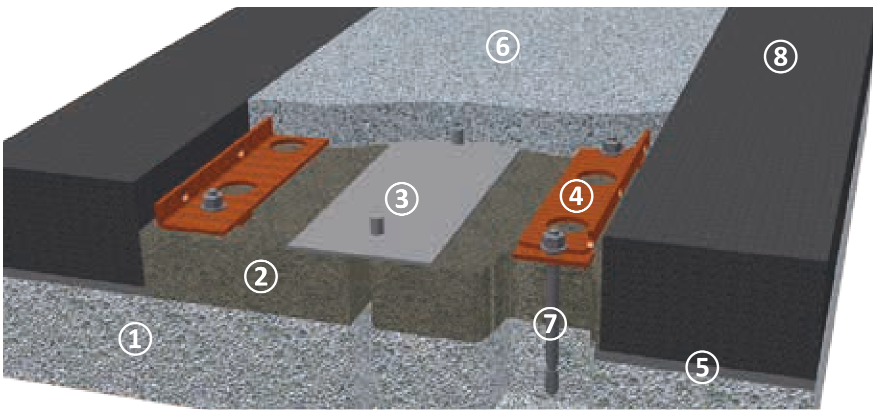
An essential advantage of the POLYFLEX®Advanced PU expansion joint system is the individual adaption of each joint to the requirements of the bridge. For example, thickness and width of the joint are set to the specific customer requirements in order to find an economic dimension without limitations to standard dimensions.

Total movements of up to 100 mm were realized in different projects spread over several countries and are in successful operation since 2007.

Manufacturing technology at latest state of the art, a highly qualified staff and a quality management according to EN ISO 9001:2008 allows us to ask you to rely on our capabilities to accomplish your projects.

Highlights – Scope of application

- bridges for public transport (road and railway bridges)
- architectural and industrial structures
- railway stations
- parking decks
- airport buildings, hangars and runways
- pharmaceutical industries for sterile joints
- chemical industries, where resistance to alkaline and acids is required
- clinics, hospitals and laboratories
- food processing industries
- as replacement for traditional steel joints
- for sliding floors in heavy load industries
- many further application fields



1 Abutment
2 Polymer concrete bedding
3 Cover plate
4 Perforated steel angle
5 Bridge sealing
6 POLYFLEX®Advanced PU-flexible material
7 Anchoring
8 Surfacing made of asphalt or concrete

Client Benefits

Advantages & properties

- exceptional long working life, longer than adjacent surfaces,
- highest traffic comfort,
- no noise from crossing traffic due to surface without gaps,
- watertight,
- maintenance free (continuous cleaning as with traditional steel joints is not required),
- suitable for new structures and refurbishments,
- quickly installed with smallest traffic restrictions lane-by-lane, trafficable after a few hours (overnight installation),
- installation within a wide temperature range (+ 5 °C to +35 °C),
- wear-resistant, no mechanical wear parts,
- no rutting, high resistance to abrasion (e. g. braking lanes, mountain areas etc.),
- damages in the joint can be easily repaired by re-activation of the PU material (e. g. scratches from snow-ploughs etc.),
- no recess for anchorage necessary in structural concrete,
- surfacing (asphalt or concrete) can be applied continuously before joint installation,
- any horizontal bend in joint direction possible,
- any curb / sidewalk detail possible,
- no noise transmission to adjacent structural parts,
- not susceptible to vibrations,
- low reaction forces,
- cold processing and easy material handling with preset mixing ratio, thus no mixing defects
- resistant to environmental influences and chemicals,
- resistant to alkaline, acids, chlorides etc.,
- free of germs and fungus,
- colour grey (matches surface of carriageway) – individual colour on request

Former disturbing joints in walking areas of airports or railway stations can be replaced now with perfect smooth surfaces.

Damage repair & partial installations

Road maintenance vehicles like, snow-ploughs, or traffic accidents may damage expansion joints which may cause high repair costs.

Local damages of the POLYFLEX®Advanced PU joint material are repaired easily by cutting out the affected areas from the surface followed by chemical re-activation of the cured PU material.

Then the damaged areas can be filled up with new PU material and the surface dressing, if any, can be applied to the refurbished areas.

A similar procedure of chemically reactivating cured material is done at partial installations, e. g. if a lane-by-lane installation is necessary.

Examples

Standard road ①

POLYFLEX®Advanced PU joint for road bridges with continuously applied surfacing before joint installation. Useable for new bridges with high loads and large movements, as integral bridge joint filler or for refurbishment.

Standard light load ②

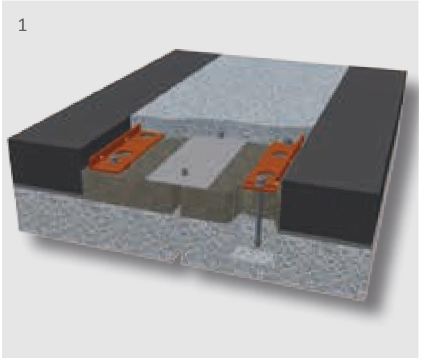
This POLYFLEX®Advanced PU joint design with reduced width and small perforated steel angles is used for light loads (e. g. railway bridges, park decks, airport or railway station joints, shop buildings, industrial plants).

Intersections ③

Intersection of POLYFLEX®Advanced PU joints, such as T-crossing or X-crossing in any shape and angle, is possible. For such cases, please contact our experts.

Vertical joints ④

POLYFLEX®Advanced PU material allows the design of vertical joints, too, with no limit to inclination and width. Butt joints to horizontal joints can be casted in any shape easily.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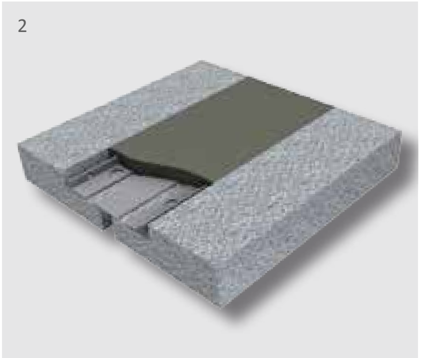
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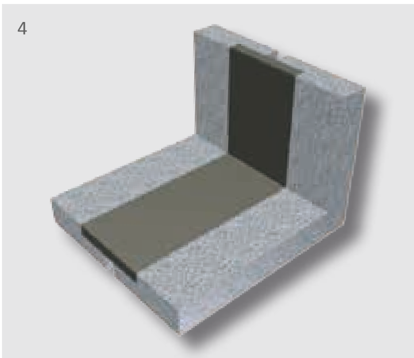
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Design Details & Movement Capacity

Design principles

The POLYFLEX®Advanced PU filling material shows excellent adhesion to the supporting structure as well as to the adjacent surfacing and is, therefore, capable of transferring horizontal loads safely into the structure.

Additionally perforated steel angles, which are fully embedded into the joint material, are bolted to the structure and can transfer even highest loads (e. g. from heavy vehicles braking on the joint at downward slopes).

These steel angles also support the adjacent surfacing in a way that the asphalt can not be depressed into the sides of the joint material.

We strongly recommend the use of additional transition strips or support ribs to secure the strength of adjacent bituminous surfacing areas.

A cover plate bridges the structural gap and is designed to withstand all traffic loads while stabilizing elements within the joint material restrain vertical displacements to limited values. These values are derived from the „ETAG032 – Guideline for European Technical Approvals of Expansion Joints for Road Bridges“ and grant for traffic safety as well as for a perfect roll-over comfort.

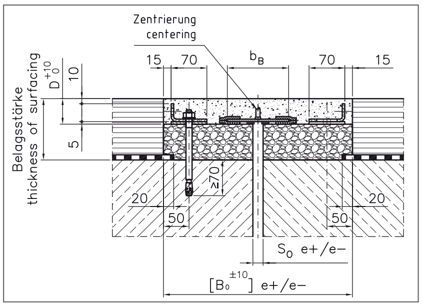
The waterproofing membrane of the structure is integrated into the joint filling material or the polymer concrete bedding material for the substructure to render the whole system watertight.

Dimensions

The tables below shows examples of joint dimensions for basic design stage. For final design, width and height of the joint are individually determined according to real movements. All joint types can accommodate a vertical movement of at least ± 10 mm for exchange of bridge bearings.

System types PA 15 to PA 40 (without stabilizing elements)

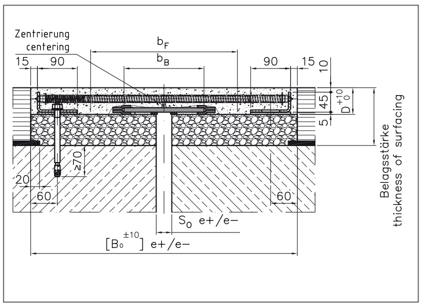
	PA 15 [mm]		PA 20 [mm]		PA 30 [mm]		PA 40 [mm]	
total movement e	15		20		30		40	
movement tension e^+	10		13		20		26	
movement compression e^-	5		7		10		14	
thickness D	50		50		50		50	
joint width in middle position B_0	290	330	290	330	330	360	360	390
gap at middle position S_0	10-20	21-60	12-17	18-57	15-50	51-80	19-44	45-74
bridging element width b_B	80	120	120		120	150	120	150
steel angle	70 x 35 x 6							



System types PA 50 to PA 135 (with stabilizing elements)

	PA 50 [mm]			PA 60 [mm]			PA 75 [mm]			PA 80 [mm]			PA 90 [mm]		PA 100 [mm]		PA 110 [mm]		PA 120 [mm]	PA 130 [mm]	PA 135 [mm]
total movement e	50			60			75			80			90		100		110		120	130	135
movement tension e^+	33			40			50			53			60		66		74		80	86	90
movement compression e^-	17			20			25			27			30		34		36		40	44	45
thickness D	60			60			60			60			60		60		60		60	60	60
joint width in middle position B_0	430	460	520	450	480	540	600			650			700		750		800		900	950	1000
gap at middle position S_0	22-67	68-97	98-157	25-60	61-90	91-150	30-50	51-80	81-140	32-47	48-77	78-137	35-70	71-130	39-64	65-124	41-56	57-116	45-110	49-104	50-100
bridging element width b_B	150	180	240	150	180	240	150	180	240	150	180	240	180	240	180	240	180	240	240	240	240
sliding sheet width b_F	–			–			350			400			450		500		550		650	700	850
steel angle	90 x 45 x 6																				
stabilizing element distance eS	200			200			200			200			150		150		150		150	150	150

Note: Achievable movements in Serviceability Limit State (SLS) observing maximum permissible vertical deflections. At Ultimate Limit State (ULS) significantly larger movements can be accommodated. Please contact our experts for further details. For refurbishments, the actual width of the structural gap shall be considered for detail design of joint.



Testing and Verification

Wheel tracking comparison test

A wheel tracking test according to EN 12697-22 was performed by the Testing Institute MAPAG in August 2009. Testing was done on two different flexible plug joint systems with the following results:

Estimation of working life:	
conventional asphaltic plug expansion joints (picture 1)	0
BT 16 HS LKS (common asphaltic surfacing)	1
POLYFLEX®Advanced PU (picture 2)	**≥ 2**

This means in practice that the expected working life for POLYFLEX®Advanced PU flexible plug expansion joints will be more than 2 times higher than the working life of the adjacent surfacing.

Mechanical resistance and resistance to fatigue

At the testing facility of Technical University of Munich, Germany (Prüfamt für Verkehrswegebau, TU München) tests of mechanical resistance and resistance to fatigue according to ETAG 032-3, Annex 3-M were carried out on two test specimens of a PA 75 POLYFLEX®Advanced PU expansion joint.

These tests included:

- test method a) „resistance to vertical static load and recovery after unloading“ and
- test method b) „resistance to repeated vertical dynamic load“.

Test method a) was carried out at an ambient temperature of +23 °C ± 2 °C using a mean contact pressure of 0,94 MPa applied with a vertical force of 150 kN through a load distribution pad of 400 x 400 mm simulating the wheel print defined in ETAG 032-1, Annex G. The specimen further showed an opening position of 100 % of the declared value for the tested type PA75.

After applying the load for 5 minutes elastic deformations and recovery during the following hour were recorded. The recordings showed a highest value for elastic deformation of 0,5 mm directly after unloading and a full recovery after one hour.

The test was then carried out again after cutting the load distribution pad in two halves resulting in a halved wheel print of 400 x 200 mm and a doubled mean contact pressure of 1,87 MPa. Even under these extremely overrated testing conditions the highest elastic deformation was only 1,4 mm and the remaining deformation after one hour was only 0,5 mm directly under the load distribution pad.

Test method b) was a „classic“ roll-over test carried out at an inner specimen temperature of +45 °C using standard twin tyres 7.50R15. The tyres were vertically loaded with 45 kN and inflated with a pressure of 10 bar resulting in a contact pressure of approximately 1,0 MPa which is more than twice the value of 0,46 MPa as required in ETAG 032-3. The roll-over speed was chosen to 0,2 m/s and a lateral shifting of wheel tracks in a range of ± 2 cm was simulated. The specimen was showing an opening position of 60 % of the declared value for the tested type. Then 3.000 overrolling cycles were carried out followed by another 30 cycles with a simulated braking force of 10 % of the vertical load. The number of load cycles was 50 % higher than the required 2.000 cycles according to ETAG 032-3.

The surface profile was recorded after every 500 cycles to show possible effects of wheel tracking, but the elastic deformations were negligibly small and no remaining wheel tracking was recorded!

1 Traditional bituminous plug joint after 100 load cycles at 60 °C
2 POLYFLEX®Advanced PU expansion joint after 30.000 load cycles at 60 °C
3 Resistance to vertical static load and recovery after unloading
4 Resistance to repeated vertical dynamic load

Testing and Verification

Movement capacity test & material characteristics test

At the Federal Institute for Materials Research and Testing (BAM) in Berlin, Germany movement capacity tests according to ETAG 032-3, Annex 3-N have been carried out on a test sample of a PA50 POLYFLEX® Advanded PU expansion joint.

During test method a) „Movement capacity under slow occurring movements“, the temperature of the specimen was controlled according to the applied movements. Therefore, the maximum tension of 33 mm was applied at –40 °C and the maximum compression of 17 mm at +60 °C.

Reaction forces resulting from the applied movements were recorded as well as the surface profiles at extreme positions. At maximum tension and a temperature of –40 °C the system showed reaction forces of approximately 50 kN per running meter of joint while the maximum vertical displacement under maximum compression at +60 °C was only 6 mm.

Test method b) „Movement capacity under fast occurring movements“ was run with 7,5 Mio. load cycles at 15 °C and additional 180 000 cycles at –40 °C. A dynamic amplitude of + 1mm and a frequency of 5 Hz was chosen for this test.

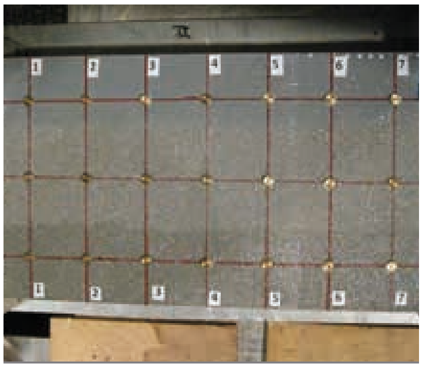
Further tests have been successfully completed including artificial weathering, artifical ageing, spectroscopy analysis, thermal analysis, hardness testing, tensile testing, dynamic-mechanical analysis and bonding tests.

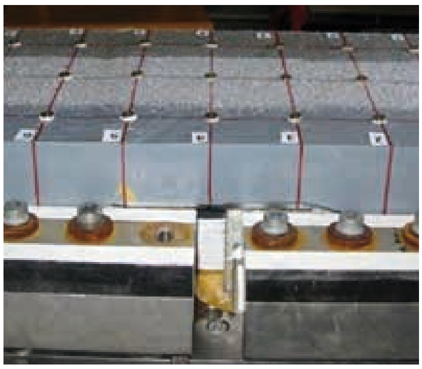
All determined test results are far better than comparable values of traditional bituminous plug expansion joints what again underlines the extraordinary capabilities of the new POLYFLEX®Advanced PU expansion joint system.

In July 2012, we received the European Technical Approval – ETA 12 / 0260 – for the product system POLYFLEX®Advanced PU.

This European technical approval is issued by the „Österreichisches Institut für Bautechnik“ in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, modified by the Council Directive 93/68/EEC of 22 July 1993;
- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC.





Movement capacity tests POLYFLEX®Advanced PU

Materials & Installation

Material description

POLYFLEX®Advanced PU is an elastic, solvent-free 2-component grout system developed for the application in flexible plug expansion joint systems.

The polymer concrete recommended for the support is a cold processed grout system adopted to the POLYFLEX®Advanced PU joint in terms of workability and endurance.

Technical data of PU material*)

density	g/cm³	1,05
hardness shore A according to DIN 53505	Shore A	approx. 65
tensile strength according to DIN 53504	N/mm²	14
elongation at break according to DIN 53504	%	650
tear strength according to DIN 53515	N/mm²	20
processing time („pot life“)		
at 10 °C	min.	40
at 20 °C	min.	30
at 30 °C	min.	20
trafficability		
at 10 °C	h	max. 48
at 20 °C	h	max. 24
full cure		
at 10 °C	d	5
at 20 °C	d	4
recommended substrate temperatures	°C	min. 5
	°C	max. 35
recommended relative humidity	%	max. 90

*) *indications only.*

1 Marking and cutting of the continuously applied surfacing
2 Removal of asphalt and cutting of support ribs
3 Cleaning, sandblasting and application of primer
4 Creating polymer-concrete base
5 Installation of steel angles and coverplate
6 Filling with POLYFLEX®Advanced PU material
7 Finished expansion joint

Quality & Support

Consulting

To determine the proper joint width and details under consideration of all technical and economic aspects as well as to calculate the optimum and most cost-effective application, we offer further technical support. Please contact us.

POLYFLEX®Advanced PU flexible plug expansion joints are either installed by our own staff or by customer, who are specially trained and certified by us. Supervision of installation works can also be done by our experts upon request.

A valid ISO 9001 certification, 100 % factory production control and continuous third party quality control by a German governmental body, the Material Testing Institute of the University in Stuttgart (MPA) ensure both the high quality level of products and manufacturing facilities.

Installation

For new structures, the bituminous surfacing shall be made in advance. For concrete surfacing and at edge beams adequate recesses shall be provided.

If the joint is installed upon a concrete support, the minimal nominal compressive strength shall be 25 N/mm².

To ensure watertightness of the whole system, waterproofing membrane shall be applied up to the bridge gap. During installation of the POLYFLEX®Advanced PU joint, the waterproofing is cut and integrated into the PU material or the polymer concrete substructure.

Customer support

Our product specialists will be pleased to advise you in the selection of the optimal solution for your project and to provide you with a quotation.

On our website, **www.mageba.ch**, you will find further product information, including reference lists and tender documentation.

1 Bridge Krapina, Croatia
Equipped with POLYFLEX®Advanced PU expansion joints type PA 100

2 Airport Schipol, Netherlands
Equipped with POLYFLEX®Advanced PU expansion joints type PA 30

Reference projects – POLYFLEX®Advanced PU


Wiedehopfweg (DE)


Hornbridge Kitzbühl (AT)


Bridge over the Ybbs (AT)

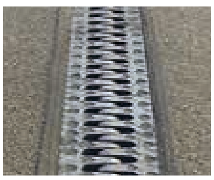

Neudrossenfeld A 70 (DE)


Kastelbell (IT)

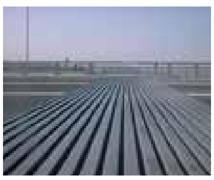

Bridge Grbavica (BA)

mageba expansion joint types


Single gap joints


Cantilever finger joints


Sliding finger joints


Modular expansion joints

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