

Star Spring Washers for Axial Preloading



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RINGSPANN-Star Spring Washers

An Important Aid to Better Bearing Location

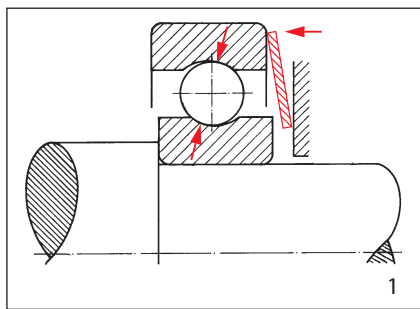
Description

RINGSPANN Star Spring Washers are particularly light spring elements with linear or not-linear spring characteristic. They are suitable for application as pressure elements in precision machines, phonographic and film instruments, as pressure springs for taking up free movement, and for reducing noise in ball bearings.

Service Life

Ball bearings give longer service if the inner and outer rings are pre-loaded axially. This fact has been known for a long time, e.g. with internal grinder spindles and has been described and proved by bearing experts*. This axial preloading by RINGSPANN Star Spring Washers eliminates radial play in the ball bearings. This effects a better distribution of the radial load to be transmitted onto the bearing rings and therefore increases the length of service life of the bearing.

*) Dr. R. Kamps, „Lager- u. Schmiertechnik, insbesondere von Verbrennungsmaschinen“ (VDI-Verlag)



Silent Running

High speed machines, particularly small electric motors, create special problems for the designer regarding silent running. Extensive trials in this field have shown, that in the main, noise originates in the ball bearings, and that the application of the exact amount of axial pressure suitable for each job reducing noise effectively.

Protection of Bearings subject to vibration when non-rotating

The spring axial location also eliminates damage as a result of vibration in non-rotating bearings. This type of damage is well known in electric motors for auxiliary drives in ships and vehicles. If the auxiliary drives is stationary, the rotor can vibrate in the bearing, due to the vibration of the ship or vehicle. In these conditions the balls beat in the races of the bearing rings and cause wear. This is why leading manufacturers use only ball bearings, the radial play of which is removed by Star Spring Washers, so preventing any vibration of the rotor. The reason for damage is then completely eliminated.

Conditions for most favourable effect

The effect of axial pre-loading depends on certain conditions:

- The axial pressure must be applied to the whole outer race.
- The axial pre-loading must be done with a load suitably adapted to the size of the bearing.
- Axial variations and length tolerances within the components of the machine should have only the very slightest effect on the applied spring force.

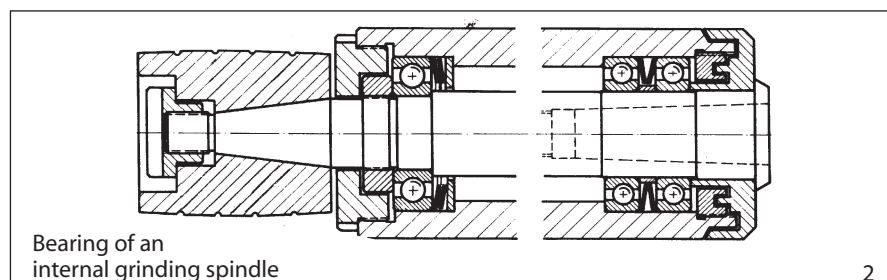
Features of the RINGSPANN Star Spring Washers

- Their spring load corresponds with the optimum values of the relevant bearing sizes.
- Because of the large axial variations of the spring it is often possible to achieve the desired effect with a single star spring washer.
- The very large axial movement of the spring guarantees that considerable axial variations and length tolerances can be accommodated without much deviation from the nominal value of the axial force of the star spring washer.

Notes on installation

Generally it will be found most suitable for the Star Spring Washer to work on the outer ring of the ball bearing. The Star Spring Washer outside diameters given in the following table correspond therefore with the ball bearing outside diameters. The RINGSPANN design with slots and dished shape guarantees even axial pressure on the whole outer race.

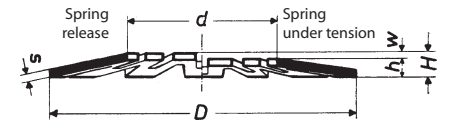
If an axial pressure is applied to the shaft in one direction only, the Star Spring Washer must be mounted in such a way that there is no axial pressure on it (Figure 2). If the axial pressures vary or are in both directions, a Star Spring Washer has to be mounted both sides of the ball bearings. In this case and in any doubtful cases we will be pleased to submit an installation proposal.



Bearing of an internal grinding spindle

RINGSPANN-Star Spring Washers

Specification Table for Standard RINGSPANN Star Spring Washers



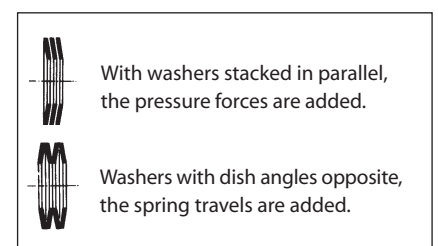
For ball bearing					Article number	Star Spring Washers			Height released H mm	Height under pressure h mm	Tolerance for h mm	Spring travel w mm	Pressure F N	Spring const. c N/mm
D	d	s	H	D		d	s							
634	E 3	E 4	E 5	624	1051.012.001	12,7	5,3	0,3	1,1	0,7	± 0,15	0,4	14	35
				625	1051.015.001	15,7	7,5	0,3	1,1	0,7	± 0,15	0,4	9	23
635				626	1051.018.001	18,7	7,5	0,3	1,4	0,7	± 0,15	0,7	10	14
635				607	1051.018.002	18,7	9,2	0,3	1,2	0,7	± 0,15	0,5	11	22
	E 6				1051.020.001	20,7	10,5	0,3	1,3	0,7	± 0,15	0,6	7	12
627	E 7			608	1051.021.001	21,7	11	0,5	1,6	0,9	± 0,15	0,7	34	49
	E 8			609	1051.023.001	23,7	11	0,5	1,8	1,0	± 0,2	0,8	33	41
629			6000		1051.025.001	25,7	11	0,5	2,0	1,0	± 0,2	1,0	31	31
629			6000		1051.025.002	25,7	13,5	0,5	1,7	1,0	± 0,2	0,7	30	43
16100	E 9	E 10		6001	1051.027.001	27,7	15	0,65	1,9	1,1	± 0,2	0,8	52	65
16101	E 13			6200	1051.029.001	29,7	15	0,66	2,1	1,1	± 0,2	1,0	38	38
	E 11	E 12		6201	1051.031.001	31,7	15	0,65	2,3	1,1	± 0,2	1,2	46	38
16002			6002	6201	1051.031.002	31,7	18	0,65	2,0	1,1	± 0,2	0,9	36	40
16003	E 14	E 15	6003	6202	1051.034.001	34,7	20	0,9	2,4	1,4	± 0,2	1,0	89	89
				6300	1051.036.001	36,7	20	0,9	2,6	1,4	± 0,2	1,2	92	77
	E 16				1051.037.001	37,7	20	0,9	2,7	1,4	± 0,2	1,3	84	65
	E 19	L 17a	Bo 15	6203	1051.039.001	39,7	20	0,9	2,9	1,4	± 0,2	1,5	81	54
	E 19			6203	1051.039.002	39,7	23	0,9	2,6	1,4	± 0,2	1,2	103	86
16004			6004	6302	1051.041.001	41,7	27	0,9	2,4	1,4	± 0,2	1,0	76	76
		EA 17	Bo 17		1051.043.001	43,5	27	0,9	2,6	1,4	± 0,2	1,2	68	57
16005	E 20	L 20	6005	6204	1051.046.001	46,5	27	0,9	2,9	1,4	± 0,2	1,5	74	49
16005			6005		1051.046.002	46,5	30	0,9	2,6	1,4	± 0,2	1,2	72	60
	M 20	L 25	6205	6304	1051.051.001	51,5	35	0,9	2,6	1,4	± 0,2	1,2	61	51
16006		6006			1051.054.001	54,5	35	1,15	3,1	1,7	± 0,25	1,4	98	70
16007	L 30	6007	6206	6305	1051.061.001	61	40	1,15	3,3	1,7	± 0,25	1,6	110	69
16008		6008			1051.067.001	67	45	1,15	3,4	1,7	± 0,25	1,7	90	53
			6207	6306	1051.071.001	71	45	1,15	3,8	1,7	± 0,25	2,1	110	52
16009		6009			1051.074.001	74	50	1,15	3,6	1,7	± 0,25	1,9	130	68
16010		6010	6208	6307	1052.079.001	79	58	1,15	3,3	1,7	± 0,25	1,6	290	—*)
		6209	6308	6405	1052.084.001	84	63	1,15	3,3	1,7	± 0,25	1,6	320	—
16011		6011	6210	6308	1052.089.001	89	63	1,15	3,8	1,7	± 0,25	2,1	290	—
16012		6012			1052.094.001	94	68	1,15	3,8	1,9	± 0,4	1,9	260	—
16013		6013	6211	6309	1052.099.001	99	73	1,15	3,8	1,9	± 0,4	1,9	280	—
16014		6014	6212	6310	1052.109.001	109	78	1,15	4,2	2,0	± 0,4	2,2	180	—
16015		6015			1052.114.001	114	83	1,15	4,2	2,0	± 0,4	2,2	200	—
			6213	6311	1052.119.001	119	88	1,15	4,2	2,0	± 0,4	2,2	270	—
16016		6016	6214		1052.124.001	124	93	1,15	4,2	2,0	± 0,4	2,2	250	—
16017		6017	6215	6312	1052.129.001	129	98	1,15	4,2	2,0	± 0,4	2,2	250	—
16018		6018	6216	6313	1052.139.001	139	98	1,25	5,3	2,3	± 0,5	3,0	330	—
16019		6019			1052.144.001	144	103	1,25	5,3	2,3	± 0,5	3,0	330	—
16020		6020	6217	6314	1052.149.001	149	108	1,25	5,3	2,3	± 0,5	3,0	370	—
16021		6021	6218	6315	1052.158.001	158	118	1,5	5,5	2,5	± 0,5	3,0	410	—
16022		6022	6219	6316	1052.168.001	168	123	1,5	6	2,7	± 0,5	3,3	470	—
16024		6024	6220	6317	1052.178.001	178	133	1,5	6	2,7	± 0,5	3,3	600	—
			6221	6318	1052.188.001	188	138	2	7	3,3	± 0,5	3,7	520	—
16026		6026	6222	6319	1052.198.001	198	143	2	7,5	3,3	± 0,5	4,2	660	—
16028		6028			1052.208.001	208	163	2	6,2	3,0	± 0,5	3,2	1160	—
			6224	6320	1052.213.001	213	168	2	6,4	3,1	± 0,5	3,3	1120	—
16030		6030		6321	1052.223.001	223	183	2	6,1	3,0	± 0,5	3,1	1200	—
			6226		1052.228.001	228	188	2	6,2	3,0	± 0,5	3,2	1160	—
16032		6032		6322	1052.238.001	238	198	2	6,4	3,1	± 0,5	3,3	1120	—
			6228		1052.248.001	248	211	2	6,2	3,0	± 0,5	3,2	1160	—
16034		6034		6324	1052.258.001	258	223	2	6,2	3,0	± 0,5	3,2	1180	—

*) These and the following sizes have a non-linear spring characteristic.

Explanation concerning the table

Apart from the listed ball bearing series the Star Spring Washers can also be used for series 32, 33, 42, 72 and 73. Pressure P is attained at height h. The spring constant c, i.e. the pressure increase per mm spring travel can only be given up to size 74 x 50 x 1,15. With larger Star Spring

Washers the spring characteristic is not linear but diminishing. With tolerances of the installation height h the pressure F therefore changes even less than with smaller washers. Up to size 129 x 88 x 1,15 the springs can be supplied plated against corrosion.

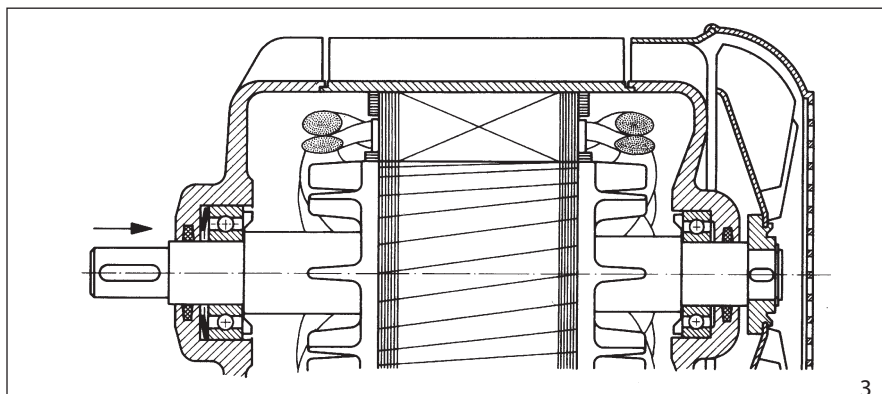


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Application Examples

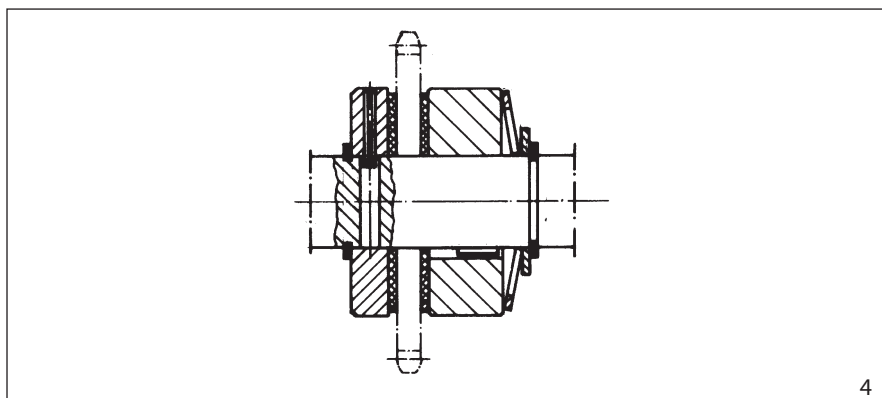
Pressure and adjusting spring for ball bearing

Silent running is a particular requirement for electric motors. For this purpose a RINGSPANN Star Spring Washer acts to pre-load the outer race of the bearing as illustrated.



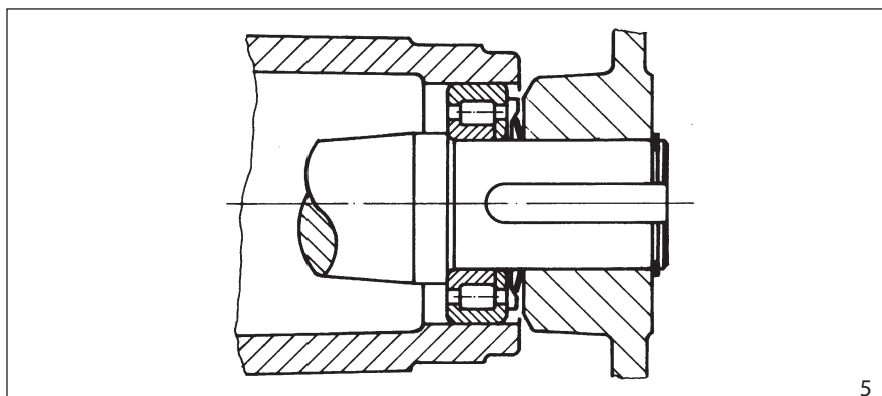
Friction hub

Here a RINGSPANN Star Spring Washer is used for transmitting low torques. The exact setting of the pressure force is effected by the intermediate discs arranged between the star spring washer and the circlip.



RINGSPANN Star Spring Washers for accommodating length tolerances

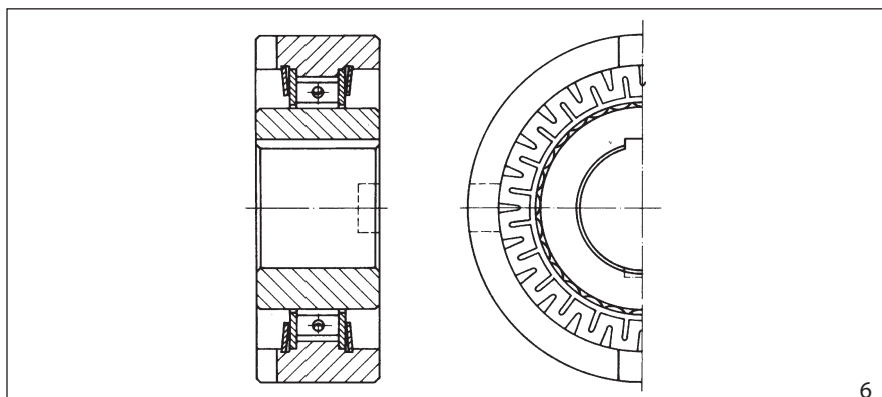
As shown in this example the RINGSPANN Star Spring Washer fitted between output shaft and NILOS sealing ring makes it possible to accommodate wide axial tolerances.



Locating of guide discs

This example shows guide discs being pressed against a freewheel wedgepiece set, with the RINGSPANN Star Spring Washers being used as a simple and cost effective method of holding the guide discs in position.

In this case the Star Spring Washer takes on a dual function of circlip and pressure disc.



RINGSPANN GmbH

Schaberweg 30-34
61348 Bad Homburg

Telefon +49 6172 275-0
Telefax +49 6172 275-275

internet: <http://www.ringspann.com>
e-mail: mailbox@ringspann.com