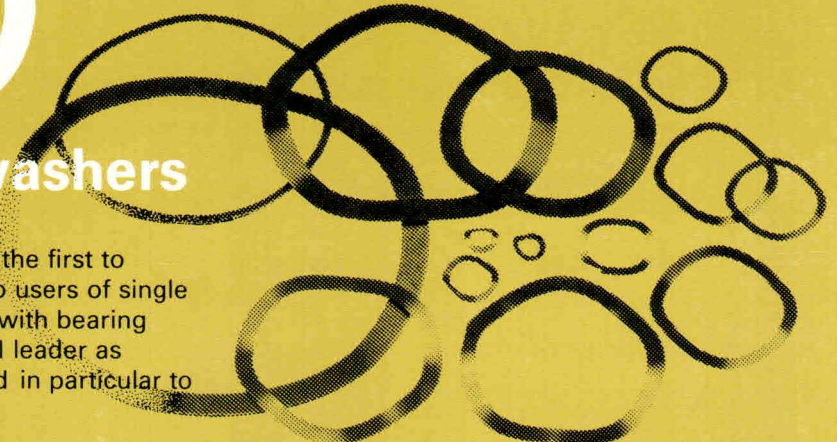




## pre-load waved washers

for standard single row ball journal bearings

George Emmott (Pawsons) were one of the first to introduce spring steel waved washers to users of single row ball bearings. Research and liaison with bearing manufacturers has kept Emmotts a World leader as suppliers to International Companies and in particular to electric motor manufacturers.



silence is golden



### Applications

The drawing shows the waved washer in position and compressed between the outer ring of the ball bearing and the spigot of the end cover. The pressure is transmitted through the balls onto the inner ring allowing the balls to revolve smoothly, for quiet running and extended life.

### Range of sizes & materials

This brochure omits certain sizes which are no longer in demand. Dies and tools have been retained for these obsolete sizes to be made as 'Specials'.

The schedules in this brochure list sizes of waved washer which have been designed to suit all popular sizes of single row ball bearings. Emmotts can and do make to customers specification regarding dimensions, pre-load and type of steel or non-ferrous alloy. Pre-loads are within 10% of the listed figures.

**Other applications.** EMO waved washers are being used increasingly for non-bearing applications, the Automotive industry being one example. All sizes and any number of specials can be supplied as split washers and are being used in electrical connectors which call for non-magnetic steel. Where unusual and very accurate spring loading is required - try Emmotts.

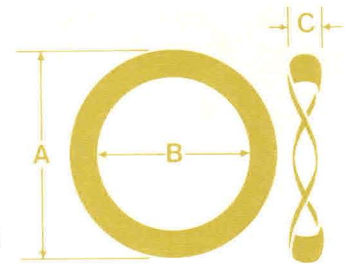
**Quality and Reliability.** When you fit an EMO waved washer you need not replace it during the life of the bearing.

### EMO-X high pre-load series

This series provides up to three times the pre-load of the standard EMO range and is described on page 3. Designers have found that in some circumstances even better results are obtained with more pressure on the outer ring and prefer this to the use of multiple washer assemblies. Emmotts' EMO-X have more waves (up to 6 if required) but retain the same dimensions when compressed.



# METRIC SERIES

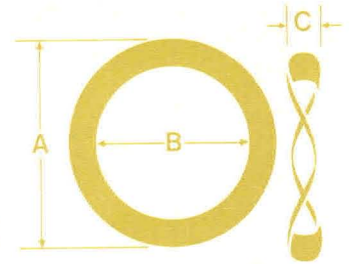


## pre-load waved washers for standard single row ball journal bearings

EMO ref	Housing Dia. millimetres	Diameter when flat		Free height millimetres	Load when compressed to 1.5 mm.		Rolling bearing designation Nos. & customer reference
		A millimetres	B millimetres		Kilos	Newtons	
EPL 1	10	9.5	4.5	1.5	1.5	* 15	623
EPL 2	13	12.5	7.5	1.5	2.0	* 19	624
EPL 4	16	15.5	10.5	1.5	2.0	* 19	634
EPL 5	16	15.5	10.5	1.5	2.5	* 24	625, E5
EPL 8	19	18.5	13.0	2.0	3.0	* 29	626, 635, 607
EPL10	21	20.5	15.0	2.0	3.0	* 29	E6
EPL12	22	21.5	16.0	2.0	3.5	* 34	608, 627, E7
EPL13	24	23.5	17.0	3.0	3.5	34	609, E8
EPL15	26	25.5	19.0	3.0	4.0	39	629
EPL16	26	25.5	19.0	3.0	4.5	44	629, 6000
EPL17	28	27.5	21.0	3.0	4.0	39	E9
EPL19	28	27.5	21.0	3.0	5.5	54	E10, 6001
EPL20	30	29.5	23.0	3.5	4.5	44	6200, E13
EPL22	32	31.5	25.0	3.5	4.5	44	98200
EPL24	32	31.5	25.0	3.5	5.5	54	6201, E11, E12
EPL25	32	31.5	25.0	3.5	7.0	68	6002
EPL28	35	34.5	28.0	3.5	7.0	68	6300, 6202, E14, E15
EPL29	35	34.5	28.0	3.5	8.0	78	6003
EPL30	37	36.5	30.0	4.0	5.5	54	6301
EPL31	37	36.5	30.0	4.0	7.0	68	98202
EPL32	38	37.5	31.0	4.0	7.5	73	E16
EPL34	40	39.5	33.0	4.0	8.0	78	6203, E18, E19
EPL37	42	41.5	33.5	5.0	7.0	68	6302
EPL38	42	41.5	33.5	5.0	9.0	88	6004
EPL39	44	43.5	35.5	5.0	8.0	78	E17
EPL40	47	46.5	38.5	5.0	8.0	78	6303
EPL41	47	46.5	38.5	5.0	9.0	88	6204, E20
EPL42	47	46.5	38.5	5.0	11.5	113	6005
EPL43	52	51.5	42.0	5.5	9.0	88	6304
EPL44	52	51.5	42.0	5.5	11.5	113	6205
EPL45	55	54.5	43.5	5.5	13.5	132	6006
EPL46	62	61.5	50.5	5.5	8.0	78	6403
EPL47	62	61.5	50.5	5.5	11.5	113	6305
EPL48	62	61.5	50.5	5.5	13.5	133	6206, 6007
EPL50	68	67.5	55.0	6.5	18.0	176	6008, 7008
EPL51	70	69.5	57.0	6.5	16.0	157	98207
EPL53	72	71.5	59.0	6.5	13.5	133	6404, 6306
EPL54	72	71.5	59.0	6.5	16.0	157	6207
EPL55	75	74.5	62.0	7.0	20.5	201	6009
EPL57	80	79.5	63.5	7.0	16.0	157	6405, 6307
EPL58	80	79.5	63.5	7.0	18.0	176	6208, 6010
EPL60	85	84.5	67.0	8.0	20.5	201	6209
EPL61	90	89.5	72.0	8.0	13.5	133	6406
EPL62	90	89.5	72.0	8.0	18.0	176	6308, 6210
EPL64	90	89.5	72.0	8.0	25.0	245	6011
EPL65	95	94.5	75.5	8.5	27.0	264	6012
EPL67	100	99.5	80.5	8.5	20.5	201	6407, 6211, 6309, 6013
EPL70	105	104.5	84.5	8.5	27.0	264	
EPL72	110	109.5	90.5	9.5	23.0	225	6408, 6212, 6310, 6014
EPL75	115	114.5	95.5	9.5	28.5	279	6015
EPL77	117	116.5	97.5	9.5	25.0	245	
EPL79	120	119.5	100.5	9.5	25.0	245	6311, 6213
EPL82	125	124.5	105.5	9.5	32.0	313	6214, 6016
EPL84	127	126.5	107.5	9.5	27.0	264	



## METRIC SERIES



### pre-load waved washers for standard single row ball journal bearings

EMO ref	Housing Dia. millimetres	Diameter when flat A B millimetres		Free height millimetres	Load when compressed to 1.5 mm. Kilos Newtons		Rolling bearing designation Nos. & customer reference
		A	B		Kilos	Newtons	
EPL 86	130	129.5	110.5	9.5	27.0	264	6410, 6312
EPL 87	130	129.5	110.5	9.5	34.0	333	6215, 6017
EPL 89	135	134.5	114.0	11.0	36.5	358	
EPL 90	137	136.5	116.0	11.0	29.5	289	
EPL 92	140	139.5	119.0	11.0	29.5	289	6411, 6018, 6313, 6216
EPL 96	145	144.5	124.0	11.0	43.0	421	6019
EPL 99	150	140.5	129.0	11.0	27.0	26	6412, 6217, 6314, 6020
EPL103	157	156.5	136.0	12.0	34.0	332	
EPL105	160	159.5	139.0	12.0	34.0	333	6413, 6218, 6315, 6021
EPL109	170	169.5	149.0	12.0	36.5	358	6316, 6022, 6219
EPL113	180	179.5	159.0	12.0	38.5	377	6414, 6220, 6317, 6024
EPL118	190	189.5	167.0	12.0	41.0	** 402	6318, 6415, 6221
EPL122	200	199.5	177.0	12.0	43.0	** 421	6416, 6222, 6319
EPL124	210	209.5	185.5	12.5	38.5	** 377	6417, 6223
EPL127	215	214.5	190.5	12.5	45.5	** 446	6320, 6224
EPL129	220	219.5	195.5	12.5	72.5	** 710	
EPL131	225	224.5	200.5	12.5	47.5	** 465	6321, 6418
EPL132	230	229.5	205.5	12.5	59.0	** 578	6226
EPL134	240	239.5	214.0	14.5	50.0	** 490	6322
EPL136	250	249.5	224.0	14.5	63.5	** 622	6228, 6323
EPL138	260	259.5	234.0	14.5	54.5	** 534	6324, 6228
EPL140	270	269.5	242.5	15.0	68.0	** 666	6230
EPL141	280	279.5	252.5	15.0	59.0	** 578	6326

\* Note — Washers sizes EPL1 to EPL13 give stated loads when compressed to 1.0mm.

\*\* Note — The loads stated are to suit makers recommended heights.

Most washers can be made in alternative thickness steel and to give higher or lower loads. When much higher loads are required, refer to the schedule of EMO-X four wave washers as printed below.

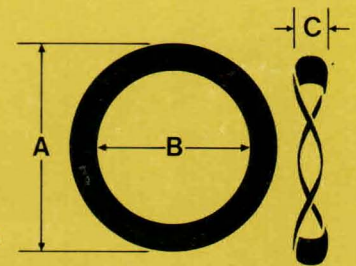
### EMO-X high pre-load series

This series provides up to three times the pre-load of the EPL range. Designers have found that in some circumstances, even better results are obtained by increasing the pressure on the outer ring of the rolling bearing. This is preferable to the use of multiple washer assemblies. EMO-X washers generally have four waves, or up to six for the larger sizes when much greater force is required. They all have the same dimensions as the EPL range when flat.

EMO ref	Housing Dia. millimetres	Diameter when flat A B millimetres		Free height millimetres	Load when compressed to 1.5 mm. Kilos Newtons		Rolling bearing designation Nos. & customer reference
		A	B		Kilos	Newtons	
EMO-X16	26	25.5	19.0	2.0	9.0	88	629, 600
EMO-X19	28	27.5	21.0	2.0	11.0	108	6001, E10
EMO-X24	32	31.5	25.0	2.5	11.0	108	6201, E11, E12
EMO-X28	35	34.5	28.0	2.5	14.0	137	6300, 6202, E14, E15
EMO-X34	40	39.5	33.0	3.0	15.0	147	6203, E18, E19
EMO-X37	42	41.5	33.5	3.5	18.0	176	6302, 7302
EMO-X41	47	46.5	38.5	3.5	24.0	235	6204, E20
EMO-X44	52	51.5	42.0	4.0	34.0	333	6205
EMO-X48	62	61.5	50.5	4.0	40.0	392	6206, 6007
EMO-X54	72	71.5	59.0	5.5	42.0	411	6207
EMO-X58	80	79.5	63.5	6.0	55.0	539	6208, 6010
EMO-X62	90	89.5	72.0	6.5	60.0	588	6308, 6210
EMO-X67	100	99.5	80.5	7.0	62.0	607	6407, 6211, 6306, 6013
EMO-X72	110	109.5	90.5	7.0	70.0	686	6408, 6212, 6310, 6014
EMO-X86	130	129.5	110.5	7.0	85.0	833	6410, 6312



## INCH SERIES



Pre-load waved washers  
for standard single row ball journal bearings

EMO ref	Housing Dia. inches	Diameter when flat		Free height inches	Load when compressed to 0.063 inches		Rolling bearing designation Nos. & customer reference
		A inches	B inches		Kilos	Newtons	
PLW1	0.375	0.36	0.23	0.06	1.4	14	EEO compressed to 0.031
PLW2	0.500	0.48	0.30	0.06	2.3	22	EE1 compressed to 0.031
PLW3	0.750	0.73	0.51	0.08	2.7	26	EE2
PLW4	0.875	0.86	0.64	0.08	4.5	44	EE3
PLW5	1.125	1.11	0.86	0.11	5.9	58	EE4
PLW6	1.313	1.30	1.05	0.13	2.7	26	MJ $\frac{1}{4}$
PLW7	1.313	1.30	1.05	0.13	5.9	58	LJ $\frac{1}{2}$
PLW8	1.375	1.36	1.11	0.13	7.3	71	EE5
PLW9	1.500	1.48	1.23	0.16	4.5	44	MJ $\frac{3}{8}$
PLW10	1.563	1.55	1.30	0.16	7.3	71	LJ $\frac{5}{8}$
PLW12	1.625	1.61	1.30	0.16	8.6	84	EE6, MJ $\frac{1}{2}$
PLW13	1.750	1.73	1.42	0.19	8.6	84	EE7
PLW14	1.813	1.80	1.48	0.19	7.3	71	MJ $\frac{5}{8}$
PLW15	1.875	1.86	1.55	0.19	8.6	84	EE8, LJ1 $\frac{1}{4}$
PLW17	2.000	1.98	1.61	0.22	8.6	84	MJ $\frac{3}{4}$
PLW18	2.000	1.98	1.61	0.22	10.0	98	EE9, LJ $\frac{3}{8}$
PLW20	2.125	2.11	1.67	0.22	13.0	127	EE10
PLW22	2.250	2.23	1.80	0.22	11.0	108	LJ1, MJ $\frac{3}{8}$
PLW23	2.250	2.23	1.80	0.22	14.0	137	EE11
PLW24	2.500	2.48	2.05	0.22	11.0	108	MJ1
PLW26	2.500	2.48	2.05	0.22	16.0	156	EE12, LJ1 $\frac{1}{8}$
PLW28	2.690	2.67	2.17	0.25	17.0	166	XLJ1 $\frac{1}{2}$
PLW30	2.813	2.80	2.30	0.25	13.0	127	MJ1 $\frac{1}{8}$
PLW31	2.875	2.86	2.36	0.25	18.0	176	XLJ1 $\frac{1}{8}$
PLW32	3.000	2.98	2.48	0.28	16.0	156	LJ1 $\frac{3}{8}$ , XLJ1 $\frac{3}{4}$
PLW34	3.125	3.11	2.48	0.28	14.0	137	MJ1 $\frac{1}{4}$
PLW36	3.250	3.23	2.61	0.28	17.0	166	LT1 $\frac{1}{2}$
PLW37	3.313	3.30	2.67	0.31	23.0	225	XLJ2
PLW38	3.500	3.48	2.80	0.31	16.0	156	MJ1 $\frac{3}{8}$ , LJ1 $\frac{1}{8}$
PLW40	3.563	3.55	2.80	0.31	26.0	254	XLJ2 $\frac{1}{4}$
PLW41	3.750	3.73	2.98	0.34	17.0	166	MJ1 $\frac{1}{2}$ , LJ1 $\frac{3}{4}$
PLW44	4.000	3.98	3.23	0.34	18.0	186	MJ1 $\frac{1}{8}$ , LJ1 $\frac{1}{8}$
PLW46	4.000	3.98	3.23	0.34	23.0	225	LJ2
PLW48	4.250	4.23	3.48	0.34	20.0	196	MJ1 $\frac{3}{4}$
PLW57	5.250	5.23	4.42	0.44	32.0	313	LJ2 $\frac{3}{4}$

Standard "inch" size waved washers are available up to 12 inches diameter as well as "specials" to customers dimensions. Larger sizes generally have more than three waves.

## CALL EMMOTTS FOR SPRINGS

Emmotts make all types of spring to customer specification - in any quantities at commercial prices.

### CALL EMMOTTS FOR FLAT SPRINGS & PRESSINGS

Emmotts shape, set and form spring steel, mild and stainless as well as non-ferrous. Engineers help develop applications. Prototypes made by toolmakers.

### CALL EMMOTTS FOR CONSTANT FORCE SPRINGS

EMO-force springs made in carbon and stainless from 0.10mm to 0.70mm thick and up to 150mm wide in lengths to suit customers. Ideal for fast closing air dampers, counterbalancing and brush assemblies.

### CALL EMMOTTS FOR CLOCK TYPE SPRINGS

Release stored energy for up to 30 days. Countless uses including Defence Navigational Instrument (illustrated), wind-up toys and non-electric door bells.

### CALL EMMOTTS FOR POWER SPRINGS

Made up to one metre in diameter or down to 15mm (when used for torsion). Applications include retracting hoses and cables and commutator brush gear.

### CALL EMMOTTS FOR TENSION AND COMPRESSION SPRINGS

Compression springs from 30mm bar to 26 swg wire. Carbon steel, music wire stainless, non-ferrous. Tension springs to almost any length used as driving bands. Hand finishing for intricate designs and ends.

— in fact call Emmotts - we try to solve spring problems.

**GEORGE EMMOTT (Pawsons) Limited**

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