SELFOIL®

Self-Lubricating Sintered Bearings and Air Silencers

STANDARD DIMENSIONS

AMES®

SUMMARY

SELF-LUBRICATING SINTERED BRONZE BEARINGS

The first products made by AMES at the beginning of the 1950's were self-lubricating sintered bronze bearings. Thus, the quality and rigorous standards of their manufacture are backed by more than fifty years of experience.

Continuous improvements in the manufacturing process, the application of modern research techniques in the field of tribology and lubricants and the mastery of bronze metallurgy mean that SELFOIL bearings are among the most sought after in the worldwide market.

This publication is designed to help project engineers and users to utilize Sintered Bronze Self-Lubricating Bearings properly and obtain the best possible results in the process.

WHY SELFOIL?

AMES supplies its customers with a product that has been manufactured with the most modern techniques existing today in the field of sintered metal technology.

SELFOIL ® Bearings are:

Safe:
• Elimination of the risk of seizure.
• Permanent lubrication film.
• Quiet operations.
• Low friction coefficient.

Economical
• Elimination of lubricators.
• Maintenance-free.
• Permanently in stock.
• Wide distribution network in Europe.

Technologically advanced:
• Very high precision.
• Loads up to 10 MPa (100 Kg/cm^2).
• Speeds up to 30,000 r.p.m.
• Temperatures from -20°C to +120°C.

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1   SELFOIL Self-lubricating Sintered Bronze Bearings.
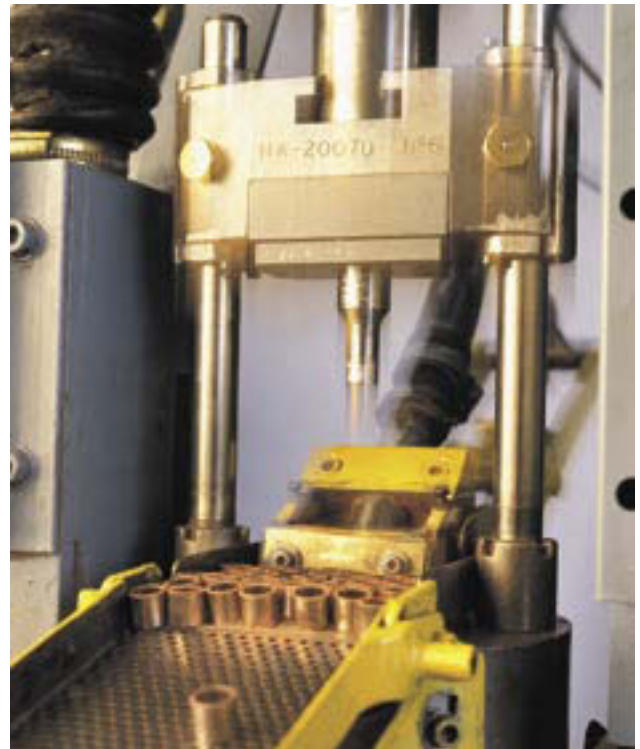
2   Calibration.

3   All the SELFOIL Bearings are delivered in plastic bags

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4 *Compacting*

5 *Sintering.*

6 *Impregnation.*

Standard sizes of Self-Lubricating Sintered Bronze Bearings pe

Type A. Cylindrical

d = inner Ø		D = outer Ø		Lengths L (Tolerance js13)	Parts p/bag
2	+12 / +2	5	+31 / +19	2 - 3	25
3	+12 / +2	6	+31 / +19	4 - 5 - 6 - 10	25
4	+16 / +4	6	+31 / +19	5 - 8 - 10	25
4	+16 / +4	7	+38 / +23	4 - 8 - 12	25
4	+16 / +4	8	+38 / +23	4 - 5 - 6 - 8 - 10 - 12	25
5	+16 / +4	8	+38 / +23	5 - 8 - 10 - 12 - 15 - 16	25
5	+16 / +4	9	+38 / +23	4 - 5 - 8	25
5	+16 / +4	10	+38 / +23	5 - 6 - 8 - 10 - 12 - 15	25
6	+16 / +4	9	+38 / +23	4 - 6 - 10 - 12 - 16	25
6	+16 / +4	10	+38 / +23	4 - 5 - 6 - 10 - 12 - 15 - 16	25
6	+16 / +4	12	+46 / +28	5 - 6 - 8 - 10 - 12 - 15 - 16	25
7	+20 / +5	10	+38 / +23	5 - 8 - 10	25
8	+20 / +5	10	+38 / +23	6 - 10 - 15	25
8	+20 / +5	11	+46 / +28	6 - 8 - 12 - 16 - 20	25
8	+20 / +5	12	+46 / +28	6 - 8 - 10 - 12 - 15 - 16 - 20	25
8	+20 / +5	14	+46 / +28	8 - 10 - 12 - 15 - 16 - 20	25
9	+20 / +5	12	+46 / +28	6 - 10 - 14	25
9	+20 / +5	14	+46 / +28	10 - 12 - 15 - 20	25
10	+20 / +5	13	+46 / +28	10 - 12 - 15 - 16 - 20 - 25	25
10	+20 / +5	14	+46 / +28	8 - 10 - 16 - 20 - 25	25
10	+20 / +5	15	+46 / +28	10 - 12 - 15 - 16 - 20 - 25	10
10	+20 / +5	16	+46 / +28	8 - 10 - 12 - 15 - 16 - 20 - 25	10
10	+20 / +5	18	+46 / +28	10 - 12 - 15 - 20 - 25	10
12	+24 / +6	14	+46 / +28	10 - 12 - 15 - 20	10
12	+24 / +6	15	+46 / +28	10 - 12 - 15 - 16 - 20 - 25	10
12	+24 / +6	16	+46 / +28	8 - 10 - 12 - 15 - 16 - 20 - 25	10
12	+24 / +6	17	+46 / +28	12 - 15 - 16 - 20 - 25	10
12	+24 / +6	18	+46 / +28	8 - 10 - 12 - 15 - 16 - 20 - 25 - 30	10
12	+24 / +6	20	+56 / +35	12 - 15 - 20 - 25 - 30	10
14	+24 / +6	18	+46 / +28	10 - 14 - 15 - 18 - 20 - 22 - 25 - 28	10
14	+24 / +6	20	+56 / +35	10 - 12 - 14 - 15 - 18 - 20 - 22 - 25 - 28 - 30	10
14	+24 / +6	22	+56 / +35	15 - 20 - 25 - 30	10
15	+24 / +6	18	+46 / +28	15 - 20 - 25 - 30	10
15	+24 / +6	19	+56 / +35	10 - 15 - 16 - 20 - 25 - 32	10
15	+24 / +6	20	+56 / +35	10 - 12 - 15 - 20 - 25 - 30	10
15	+24 / +6	21	+56 / +35	10 - 15 - 16 - 20 - 25 - 32	10
15	+24 / +6	22	+56 / +35	15 - 16 - 20 - 25 - 30	10
16	+24 / +6	20	+56 / +35	12 - 15 - 16 - 20 - 25 - 30 - 32	10
16	+24 / +6	22	+56 / +35	12 - 15 - 16 - 20 - 25 - 30 - 32 - 35	10
17	+24 / +6	22	+56 / +35	15 - 20 - 25 - 30 - 35	10
18	+24 / +6	22	+56 / +35	12 - 15 - 18 - 20 - 22 - 25 - 28 - 30 - 36	10
18	+24 / +6	24	+56 / +35	12 - 18 - 22 - 28 - 30 - 36	10
18	+24 / +6	25	+56 / +35	16 - 18 - 20 - 22 - 25 - 28 - 30 - 35 - 36	10
20	+28 / +7	24	+56 / +35	16 - 20 - 25 - 32	10

d = inner Ø		D = outer Ø
20	+28 / +7	25
20	+28 / +7	26
20	+28 / +7	27
20	+28 / +7	28
20	+28 / +7	30
22	+28 / +7	27
22	+28 / +7	28
22	+28 / +7	29
25	+28 / +7	30
25	+28 / +7	32
25	+28 / +7	35
28	+28 / +7	32
28	+28 / +7	33
28	+28 / +7	35
28	+28 / +7	36
30	+28 / +7	35
30	+28 / +7	38
30	+28 / +7	40
32	+34 / +9	38
32	+34 / +9	40
35	+34 / +9	40
35	+34 / +9	41
35	+34 / +9	44
35	+34 / +9	45
36	+34 / +9	42
36	+34 / +9	45
38	+34 / +9	44
40	+34 / +9	45
40	+34 / +9	46
40	+34 / +9	50
45	+34 / +9	51
45	+34 / +9	55
45	+34 / +9	56
45	+34 / +9	60
50	+34 / +9	56
50	+34 / +9	60
55	+40 / +10	65
60	+40 / +10	70
60	+40 / +10	72
60	+40 / +10	80
63	+40 / +10	70
70	+40 / +10	80
80	+66 / +12	100
100	+66 / +12	120

Type A. Cylindrical

er / uter Ø	Lengths — L (Tolerance js13)	Parts p/bag
+ 56 / + 35	15 - 16 - 20 - 25 - 30 - 32 - 35	10
+ 56 / + 35	15 - 16 - 20 - 25 - 30 - 32 - 35 - 40	10
+ 56 / + 35	16 - 20 - 25 - 32	10
+ 56 / + 35	16 - 20 - 25 - 30 - 32 - 35 - 40	10
+ 56 / + 35	20 - 25 - 30 - 35 - 40	10
+ 56 / + 35	15 - 18 - 20 - 22 - 25 - 28 - 30 - 35 - 36 - 40	10
+ 56 / + 35	18 - 20 - 22 - 25 - 28 - 30 - 35 - 36 - 40	10
+ 56 / + 35	18 - 22 - 28 - 36	10
+ 56 / + 35	20 - 25 - 30 - 32 - 35 - 40	10
+ 68 / + 43	20 - 25 - 30 - 32 - 35 - 40 - 45	10
+ 68 / + 43	25 - 30 - 35 - 40 - 45 - 50	5
+ 68 / + 43	20 - 22 - 25 - 28 - 32 - 36 - 40	5
+ 68 / + 43	20 - 22 - 25 - 28 - 32 - 36 - 40 - 45	5
+ 68 / + 43	25 - 30 - 35 - 40 - 45 - 50	5
+ 68 / + 43	22 - 28 - 36 - 45	5
+ 68 / + 43	20 - 25 - 30 - 35 - 40 - 45 - 50	5
+ 68 / + 43	20 - 24 - 25 - 30 - 35 - 38 - 40 - 45 - 50	5
+ 68 / + 43	20 - 25 - 30 - 35 - 40 - 45 - 50	5
+ 68 / + 43	20 - 25 - 32 - 40 - 50	5
+ 68 / + 43	20 - 25 - 30 - 32 - 35 - 40 - 45 - 50	5
+ 68 / + 43	20 - 25 - 30 - 35 - 40 - 45 - 50	5
+ 68 / + 43	25 - 35 - 40	5
+ 68 / + 43	22 - 28 - 35	5
+ 68 / + 43	25 - 30 - 35 - 40 - 45 - 50 - 60	5
+ 68 / + 43	22 - 28 - 36 - 45	5
+ 68 / + 43	22 - 28 - 36 - 45	5
+ 68 / + 43	25 - 35 - 45	5
+ 68 / + 43	35 - 40 - 45 - 50	5
+ 68 / + 43	25 - 30 - 32 - 40 - 50	5
+ 68 / + 43	25 - 32 - 40 - 45 - 50 - 60	5
+ 83 / + 53	28 - 36 - 45 - 56	5
+ 83 / + 53	30 - 35 - 40 - 45 - 50 - 55 - 60	5
+ 83 / + 53	28 - 36 - 45 - 56	5
+ 83 / + 53	40 - 45 - 50 - 60	2
+ 83 / + 53	32 - 40 - 50 - 63	2
+ 83 / + 53	32 - 40 - 45 - 50 - 60	2
+ 83 / + 53	40 - 55 - 70	2
+ 89 / + 59	50 - 60 - 90 - 120	2
+ 89 / + 59	50 - 60 - 70	1
+ 89 / + 59	90 - 120	1
+ 89 / + 59	40 - 50	1
+ 89 / + 59	90 - 120	1
+ 125 / + 71	80 - 120	1
+ 163 / + 79	80 - 120	1

Type B. Flanged

Pre-fitting diameter		Flange		Le
d = inner Ø	D = Ø outer	D = Ø outer	e = Thickness	L (Toler
3 + 17 / + 3	6 + 37 / + 19	9	1,5	4 - 5 - 6 - 10
4 + 22 / + 4	8 + 45 / + 23	12	2	4 - 5 - 8 - 10 -
6 + 22 / + 4	10 + 45 / + 23	14	2	6 - 10 - 15 -1
8 + 27 / + 5	12 + 55 / + 28	16	2	8 - 10 - 12 -
9 + 27 / + 5	14 + 55 / + 28	19	2,5	6 - 10 - 14
10 + 27 / + 5	13 + 55 / + 28	16	1,5	10 - 16 - 20
10 + 27 / + 5	14 + 55 / + 28	18	2	10 - 15 - 20
10 + 27 / + 5	15 + 55 / + 28	20	3	10 - 15 - 16 -
10 + 27 / + 5	16 + 55 / + 28	22	3	8 - 10 - 16
12 + 33 / + 6	15 + 55 / + 28	18	1,5	12 - 16 - 20
12 + 33 / + 6	17 + 55 / + 28	22	3	10 - 12 - 15 -
12 + 33 / + 6	18 + 55 / + 28	24	3	8 - 12 - 20
14 + 33 / + 6	18 + 55 / + 28	22	2	14 - 18 - 22
14 + 33 / + 6	20 + 68 / + 35	25	3	14 - 15 - 18 -
15 + 33 / + 6	19 + 68 / + 35	23	2	16 - 20 - 25
15 + 33 / + 6	20 + 68 / + 35	25	3	15 - 20 - 25 -
15 + 33 / + 6	21 + 68 / + 35	27	3	16 - 20 - 25 -
16 + 33 / + 6	20 + 68 / + 35	24	2	16 - 20 - 25
16 + 33 / + 6	22 + 68 / + 35	28	3	15 - 16 - 20 -
18 + 33 / + 6	22 + 68 / + 35	26	2	18 - 22 - 28
18 + 33 / + 6	24 + 68 / + 35	30	3	18 - 22 - 28
18 + 33 / + 6	25 + 68 / + 35	32	4	20 - 25 - 30 -
20 + 40 / + 7	24 + 68 / + 35	28	2	10 - 16 - 20 -
20 + 40 / + 7	26 + 68 / + 35	32	3	15 - 16 - 20 -
20 + 40 / + 7	28 + 68 / + 35	35	4	20 - 25 - 30 -
22 + 40 / + 7	27 + 68 / + 35	32	2,5	18 - 22 - 28
22 + 40 / + 7	28 + 68 / + 35	33	4	15 - 20 - 25 -
22 + 40 / + 7	29 + 68 / + 35	36	3,5	18 - 22 - 28 -
25 + 40 / + 7	30 + 68 / + 35	35	2,5	20 - 25 - 32
25 + 40 / + 7	32 + 82 / + 43	40	4	20 - 25 - 30 -
25 + 40 / + 7	35 + 82 / + 43	45	5	16 - 25 - 30
28 + 40 / + 7	33 + 82 / + 43	38	2,5	22 - 28 - 36
28 + 40 / + 7	36 + 82 / + 43	44	4	22 - 25 - 28 -
30 + 40 / + 7	38 + 82 / + 43	46	4	20 - 25 - 30
30 + 40 / + 7	40 + 82 / + 43	48	4	25 - 30 - 35 -
32 + 48 / + 9	38 + 82 / + 43	44	3	20 - 25 - 32
32 + 48 / + 9	40 + 82 / + 43	48	4	20 - 25 - 30 -
35 + 48 / + 9	45 + 82 / + 43	55	5	20 - 25 - 30 -
36 + 48 / + 9	42 + 82 / + 43	48	3	22 - 28 - 36
36 + 48 / + 9	45 + 82 / + 43	54	4,5	22 - 28 - 36
40 + 48 / + 9	46 + 82 / + 43	52	3	25 - 32 - 40
40 + 48 / + 9	50 + 82 / + 43	60	5	25 - 30 - 32 -
45 + 48 / + 9	51 + 99 / + 53	57	3	28 - 36 - 45
45 + 48 / + 9	56 + 99 / + 53	67	5,5	28 - 36 - 45
50 + 48 / + 9	56 + 99 / + 53	62	3	32 - 40 - 50
50 + 48 / + 9	60 + 99 / + 53	70	5	32 - 40 - 50
60 + 56 / + 10	70 + 105 / + 59	80	5	50 - 60

Lengths (Tolerance js13)	Parts p/bag
	25
12	25
6	25
15 - 16	25
	10
	10
	10
20	10
	10
	10
16 - 20 - 25	10
	10
	10
20 - 22 - 25 - 28 - 30	10
	10
30	10
32	10
	10
25 - 30 - 32	10
	10
	10
35	10
25	10
25 - 30 - 32	10
35	10
	10
30 - 35 - 40	10
36	10
	10
32 - 35 - 40	10
	10
30 - 35 - 36 - 40	10
	10
40	10
	10
32 - 35 - 40	10
35 - 40	10
	10
	10
35 - 40	5
	5
	5
	5
	5
	5
	5

Type "C". Spherical

d = inner Ø (Tolerance H7)	E = sphere Ø (Tolerance ± 0,05)	L = Lengths (Tolerance ± 0,15)	Parts p/bag
4	10	8	25
5	12	9	25
6	14	11	25
7	16	12	25
8	18	13	25
9	20	14,5	25
10	22	16	25
12	23	16	25

Type "D". Spherical with collar

d = inner Ø (Tolerance H7)	E = sphere Ø (Tolerance ± 0,05)	C = collar Ø (Tolerance ± 0,05)	L = Length (Tolerance ± 0,15)	Parts p/bag
4	10	6	10	25
5	12	8	11	25
6	14	9	13	25
7	16	10,5	14	25
8	18	12,5	16	25
9	20	14	17	25
10	22	15	18	25
12	23	17,5	18	25

Machining rods
(Tolerances in mm.)

Hollow inner Ø	Hollow outer Ø	Hollow Length	Parts p/bag	Solid Ø	Solid Length	Parts p/bag
38 ± 1	66 ±1,5	65 ±2	1	15 ±0,8	30 ±1,5	5
38 ± 1	66 ±1,5	120 ±2	1	20 ±0,8	25 ±1,5	5
45 ± 1	105 ±1,5	120 ±2	1	20 ±0,8	50 ±1,5	2
53 ± 1	85 ±1,5	65 ±2	1	25 ±0,8	25 ±1,5	2
53 ± 1	85 ±1,5	120 ±2	1	25 ±0,8	50 ±1,5	2
68 ± 1	104 ±1,5	65 ±2	1	32 ±0,8	40 ±1,5	2
68 ± 1	104 ±1,5	120 ±2	1	32 ±0,8	80 ±1,5	1
83 ± 1	123 ±1,5	65 ±2	1	42 ±0,8	50 ±1,5	1
83 ± 1	123 ±1,5	120 ±2	1	42 ±0,8	100 ±2	1
98 ± 1	142 ±1,5	65 ±2	1	45 ± 1	90 ±2	1
98 ± 1	142 ±1,5	120 ±2	1	52 ± 1	60 ±2	1
				52 ± 1	120 ±2	1
				62 ±1,5	120 ±2	1
				70 ±1,5	120 ±2	1
				80 ±1,5	120 ±2	1
				105 ± 2	120 ±2	1
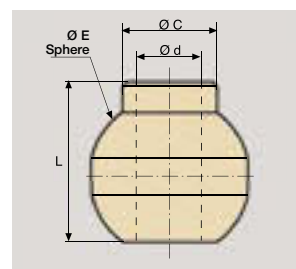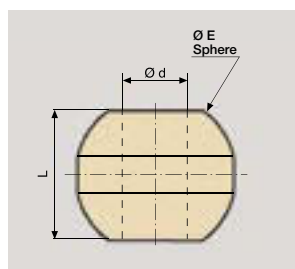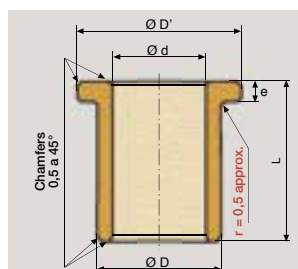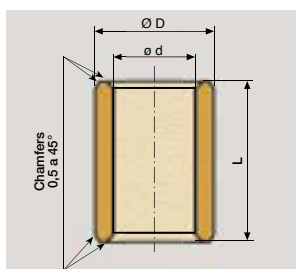
Type "A" Cylindrical

TOLERANCES

Unmounted bearings:

d = ø inner	Tolerance: G7
D = Ø outer	Tolerance: s7
L = Length	Tolerance: js13

Eccentricity: Total comparator reading:

ext. Ø = up to 50: IT-9 min 50 μm
Ø ext. > 50 IT-10

Bearings after press-fitting

See fitting conditions on pages 16 to 17 in the technical documentation.

DESIGNATION

A bearing with an inner Ø of 22 mm, outer Ø of 28 mm and length of 30 mm will be specified in the following way:

**– SELFOIL Bearing
A-22-28-30**

(The letter A indicates cylindrical bearings).

Type "B" Flanged

TOLERANCES

Unmounted bearings:

d = ø inner	Tolerance: G8
D = Ø outer	Tolerance: s8
L = Length	Tolerance: js13
D' = Ø Flange	Tolerance: js13
e = Thickness	Tolerance: js14

Eccentricity: Total comparator reading:

ext. Ø = up to 50: IT-9 min 50 μm
Ø ext. > 50 IT-10

Bearings after press-fitting

See fitting conditions on pages 16 up to 17 in the technical documentation.

DESIGNATION

A bearing with an inner Ø of 22 mm, outer Ø of 28 mm and length of 30 mm will be specified in the following way:

**– SELFOIL Bearing
B-22-28-30/33-4**

(The letter B indicates flanged bearings).

Type C Spherical

DESIGNATION

A spherical bearing with:

Inner Ø of 10 mm, sphere Ø of 22 mm and length of 16 mm will be specified in the following way:

**– SELFOIL Bearing
C-10-22-16**

(The letter C indicates spherical bearings).

Type D Spherical with collar

DESIGNATION

Spherical bearing with collar with: inner Ø of 10 mm, sphere Ø of 22 mm, collar Ø of 15 mm and total length of 18 mm will be specified in the following way:

**– SELFOIL Bearing
D-10-22-15-18**

(The letter D indicates spherical bearings with collar).

WHY BRONFIL?

The BRONFIL filtering elements have been developed by AMES in accordance with advanced technology due to its efficient filtering action, ease in cleaning, mechanical strength resistance to extreme temperatures, etc.

BRONFIL® is uniformly porous and contains an extensive capillary network of filtering element which ensures proper performance for a long time, something which cannot be achieved with other technologies.

AMES manufactures a range of Standard Types of BRON-FIL Silencers which are permanently in stock.

• Elimination of exhaust noise in pneumatic valves.

• QUALITY and highly resistant to deformation.

• ECONOMICAL, easily mounted and cleaned.
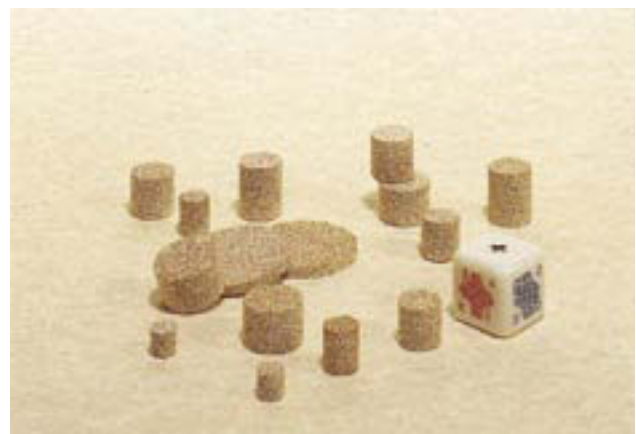
BRONFIL® Silencers

Silencer with self-locking thread

Type	A	B	C	D	Working surface in cm²	Air flow in litres/minute*
1/8"	11	1/8"	24	17,5	3,50	875
1/8" BPC	11	1/8"	30	23,5	4,40	1.835
1/4"	14	1/4"	27	18,5	6,00	1.500
1/4" BPC	14	1/4"	38	29,5	9,10	3.410
3/8"	17,5	3/8"	35	25	10,00	2.500
3/8" BPC	17,5	3/8"	46	36	14,80	5.550
1/2"	21	1/2"	44	33	18,00	4.500
1/2" BPC	21	1/2"	58	47	23,66	8.875
3/4"	26,8	3/4"	60	46,6	32,00	8.000
3/4" BPC	26,8	3/4"	69	55,5	37,00	13.875
1"	38	1"	71	56	45,00	15.500
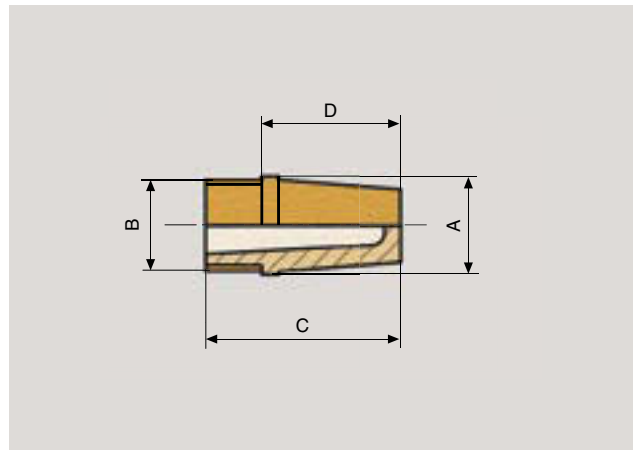
BRONFIL® "RL" Silencers

Silencer with solid brass thread

Type	A	B	C	D	E	F	G	H	Working surface in cm²	Air flow in litres/minute*
M5	8	M5	19	5,4	4	3	3	17,3	1,50	630
1/8"	12	1/8"	23,5	7,8	5	3,5	5,1	21,5	3,10	1.100
1/8" BPC	12	1/8"	28,9	7,8	5	3,5	5,1	26,9	4,20	2.210
1/4"	15	1/4"	29,6	9,5	6	4,6	7,1	27,3	5,10	2.225
1/4" BPC	15	1/4"	36,4	9,5	6	4,6	7,1	34,1	6,90	3.040
3/8"	19	3/8"	36,8	12,6	7	5,5	9	34,2	8,60	2.905
3/8" BPC	19	3/8"	45,7	12,6	7	5,5	9	43,1	11,70	4.205
1/2"	23	1/2"	45,6	16	8,5	6,2	13,2	42,6	15,85	4.620
1/2" BPC	23	1/2"	57,1	16	8,5	6,2	13,2	54,1	21,40	7.225
3/4"	29	3/4"	56,3	20,4	10	7	17,6	52,8	26,10	7.075
3/4" BPC	29	3/4"	71,5	20,4	10	7	17,6	68,0	35,20	11.535
1"	36	1"	70	26	12	8	24	66	41,80	16.935
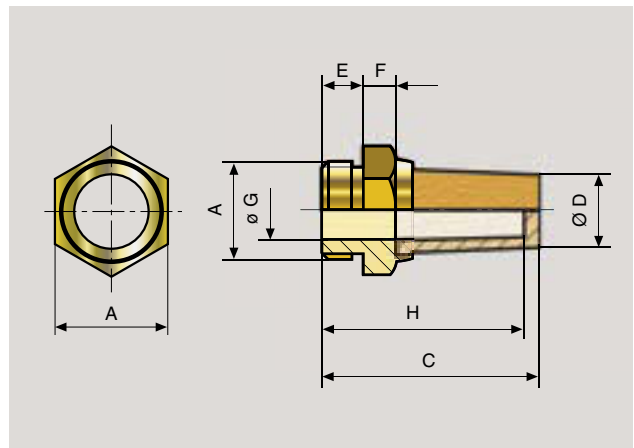
BRONFIL® disc-shaped filters

D	L
4	4
6	3
6	6
8	10
10	4
10	10
12	10
12	12
12	15
14	10
16	10
28	3
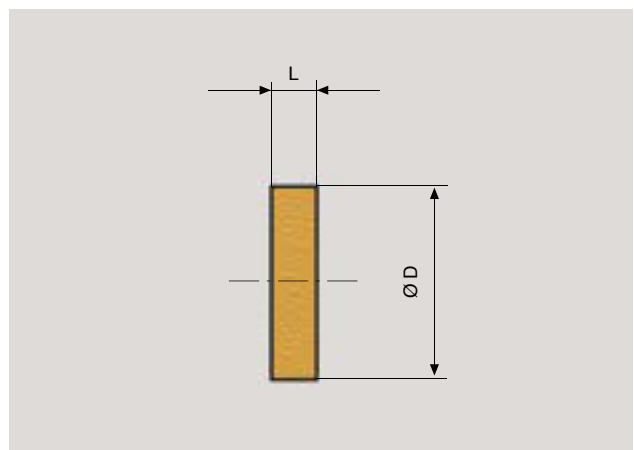
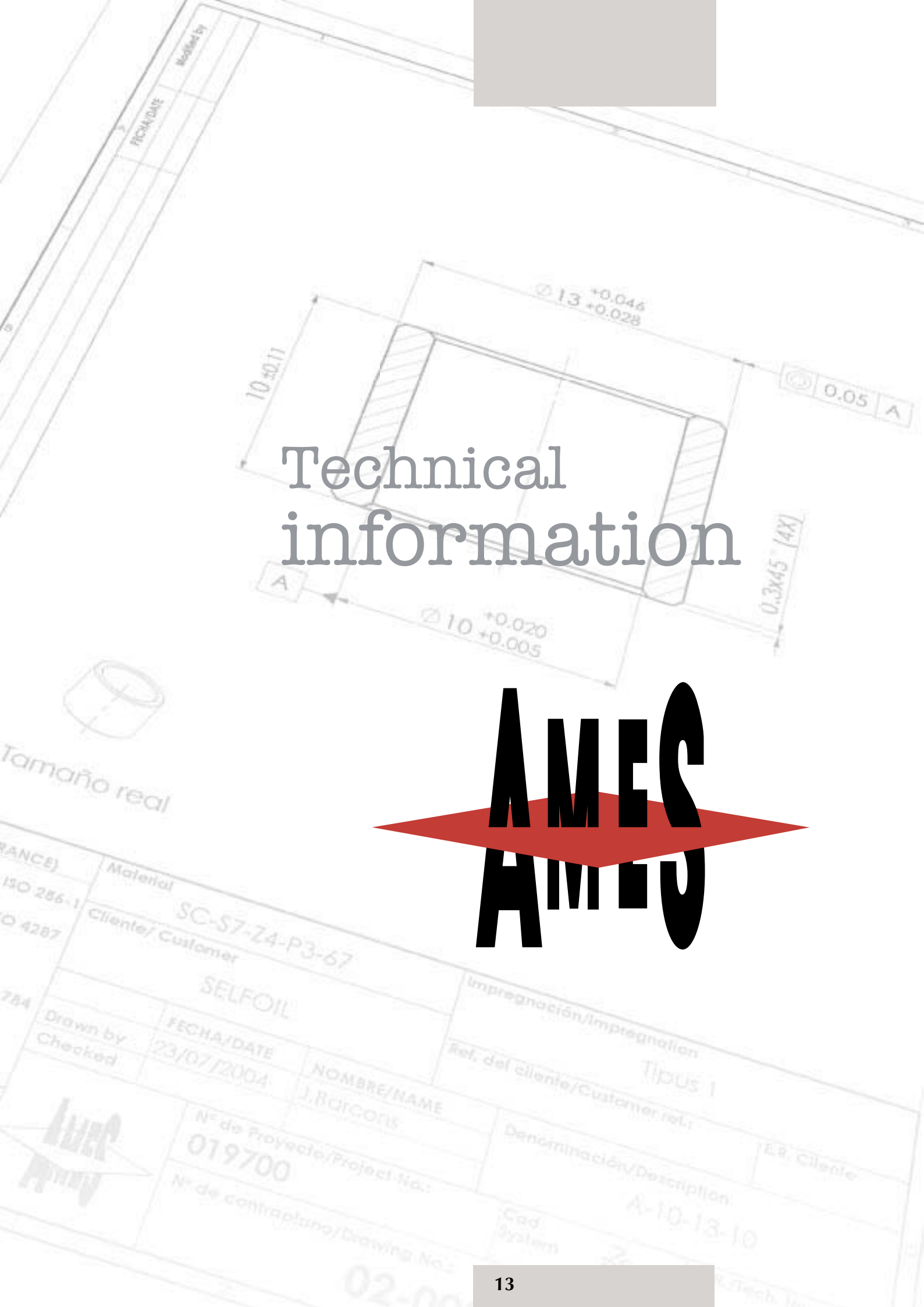* Head loss in the Silencers with these flow rates will be 0.5 bar.

PRESTIGIOUS FIRM, FACTORY AND PRODUCT

It is important to emphasize that true QUALITY ASSURANCE in Self-lubricating Bearings can only be offered when there is a technical and industrial basis such as that of AMES, by completely dedicating one of its factories, SIMET, S.A., to the sole manufacture of self-lubricating bearings in close cooperation with its Central Metallurgical Laboratories.

The sophisticated production means needed to assure the Quality in terms of dimensions, metallurgical structure, lubricant and impregnation for a self-lubricated bearing need the guarantee and industrial backing that only an internationally reputed company like AMES can offer. SELFOIL bearings offer you all the industrial and product guarantee that your application requires.

Caution! Not all self-lubricating bearings are SELFOIL!
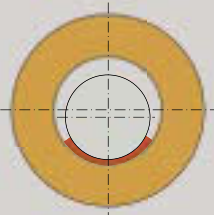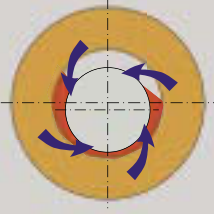
CERTIFICATIONS
ISO / TS 16949
ISO 14001

Technical information
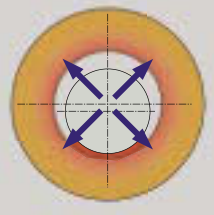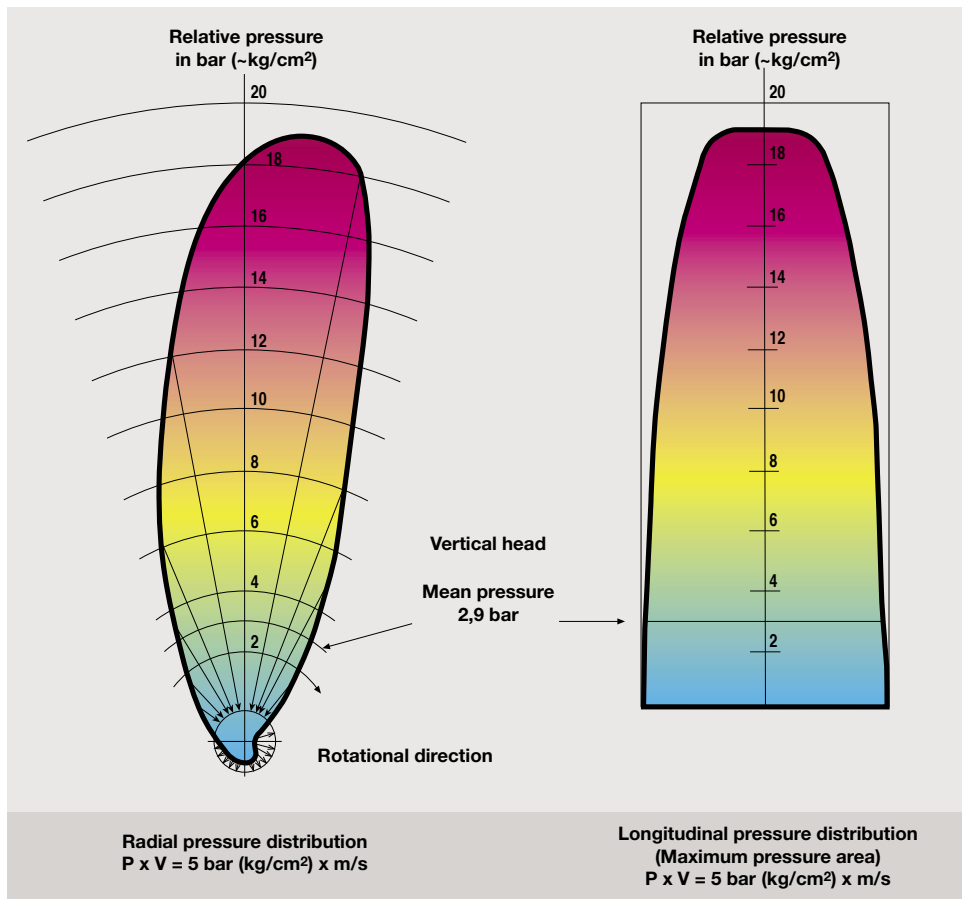
OPERATIONAL HYDRODYNAMICS

CAPILLARY POROSITY
1. At rest
25% of the volume of the porous structure is impregnated with a high-performance lubricating oil to the saturation point.

OIL FILM
2. While rotating
The negative and positive pressure generated by the shaft causes the lubricant to circulate, thus creating hydrodynamic operating conditions and an "oil film."

REABSORBED OIL
3. Stopped and at rest
When the shaft is stopped, the capillary structure of the pores causes the oil to be reabsorbed inside the bearing.

Relative pressure in bar (~kg/cm^2)

20

18

16

14

12

10

8

6

4

2

Vertical head

Mean pressure 2,9 bar

Rotational direction

Relative pressure in bar (~kg/cm^2)

20

18

16

14

12

10

8

6

4

2

Radial pressure distribution
P x V = 5 bar (kg/cm^2) x m/s

Longitudinal pressure distribution
(Maximum pressure area)
P x V = 5 bar (kg/cm^2) x m/s

HOW A SELF-LUBRICATING BEARING WORKS.

When a shaft turns on a Self-lubricating Bearing, an oil film is formed in the space between both. Negative pressure is produced at the point where there is no load whereas high pressure is generated in the area which supports it. The diagram, shown above, illustrates the radial pressure distribution in the entire bearing for a value of:

P x V = **5 bar** x **m/s**,

in a shaft of 25 mm diameter turning at a speed of 3,000 r.p.m.

The oil circulates around the shaft and a certain amount is forced to circulate, through the porosity of the bearing, from the area of maximum pressure pumping to the negative pressure zone. As a result, oil circulates on a small scale through the porosity of the bearing.

At the ends of the bearing, two rings of oil are formed which are reabsorbed by capillary action when the shaft is at rest.

CALCULATION METHOD OF A SELF-LUBRICATING BEARING

Two main parameters are involved in determining the correct Self-Lubricating Bearing:
– The "linear" speed of the shaft surface, and
– The specific load.

PV Concept.-
These parameters, under normal operating conditions, are limited by the following relationship:

P x **V = K**

where **P** is the load in kg/cm² of the design surface area (inner Ø x bearing length), **V** is the linear shaft speed in m/sec, and **K** = 18 is a Constant for SELFOIL Bronze.

This value can be considerably increased depending on certain conditions: hardness and condition of the shaft surface, alignment and run-in, supplementary lubrication, etc.

Practical load calculation.-

Linear speed = **n** x π x **d**
    n = rpm
    d = Int. Ø

$$\frac{\pi \times d \times n}{60.000} = m/s$$

π x **d** = development of a turn

Practical load calculation.-
The chart below illustrates the afore mentioned parameters graphically.
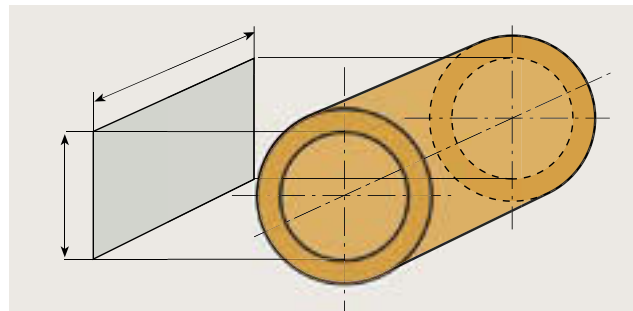
1st Example: Which is the total load permitted with a 20 mm inner Ø, a 25 mm length and a 1,000 r.p.m. Shaft speed?
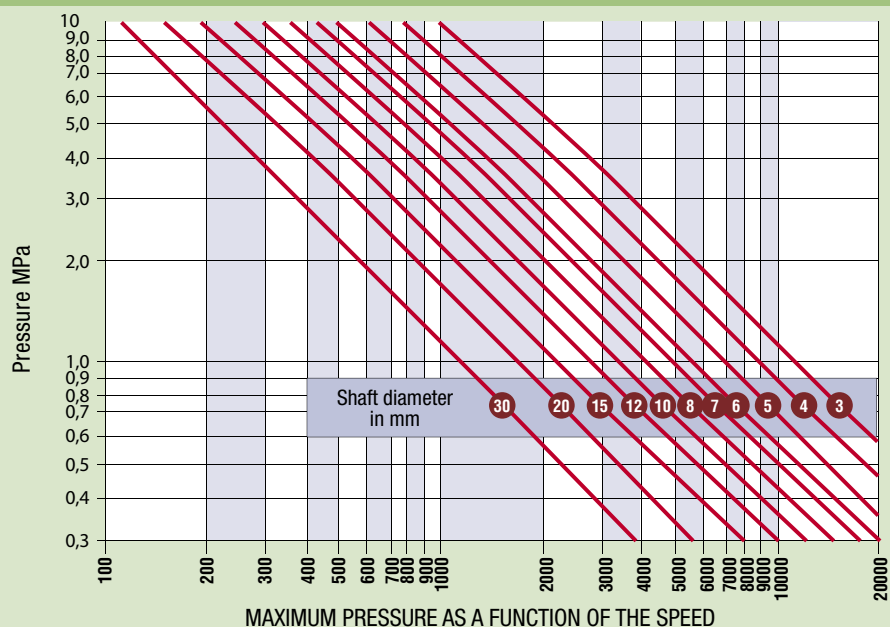**Solution:**
By reading the chart for a speed of 1,000 r.p.m. and a 20-mm. shaft, you obtain a load P = 18 kg / cm².
The design surface area will be:
2 cm (inner Ø) x 2.5 cm (length) = 5 cm².
The total load permitted will be:
18 kg/cm² x 5 cm² = 90 kg.

2nd Example: Determine the bearing length for a total load of 175 kg. with a 20 mm. shaft, turning at 500 r.p.m.

Solution:
For a speed of 500 r.p.m. and with a 20 mm inner Ø shaft, we obtain a load of 35 kg / cm² from the chart.
If the load is 175 kg, the design surface area will be
175 / 35=5 cm²
500 mm² / 20 = 25 mm.

LOAD/SPEED CHART FOR SELFOIL SELF-LUBRICATING BEARING

Pressure MPa

Shaft diameter in mm: 30 20 15 12 10 8 7 6 5 4 3

MAXIMUM PRESSURE AS A FUNCTION OF THE SPEED
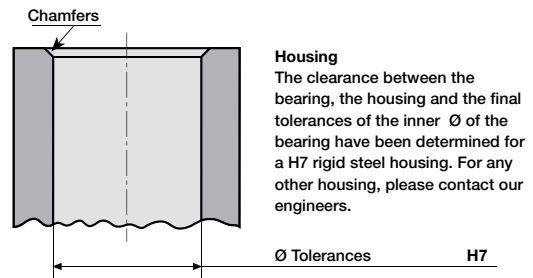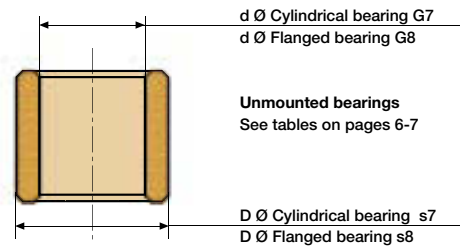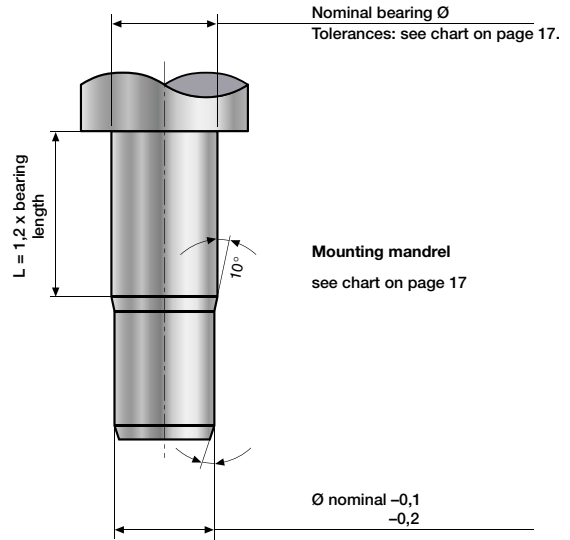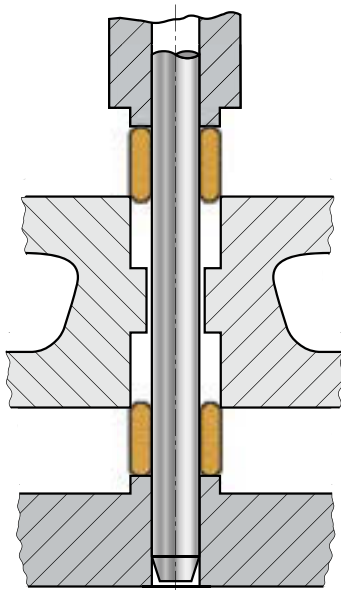
MOUNTING OF CYLINDRICAL BEARINGS

When mounting SELFOIL bearings in a rigid housing, the inner diameter undergoes a deformation which is equal to the interference fit applied to ensure that it is held properly. As a result, it is very important to take as much care as possible with the precision of the housing and possible defects in shape and position.

The dispersion of the inner diameter of the bearing, once it has been mounted, will be affected by the bearing tolerance, the tolerance of the outer diameter and the tolerance of the housing (see page 8). Assuming that the tolerances of these three diameters are of ISO7 Quality, in the end we will obtain a dispersion in the inner diameter which meets ISO 10 Quality.
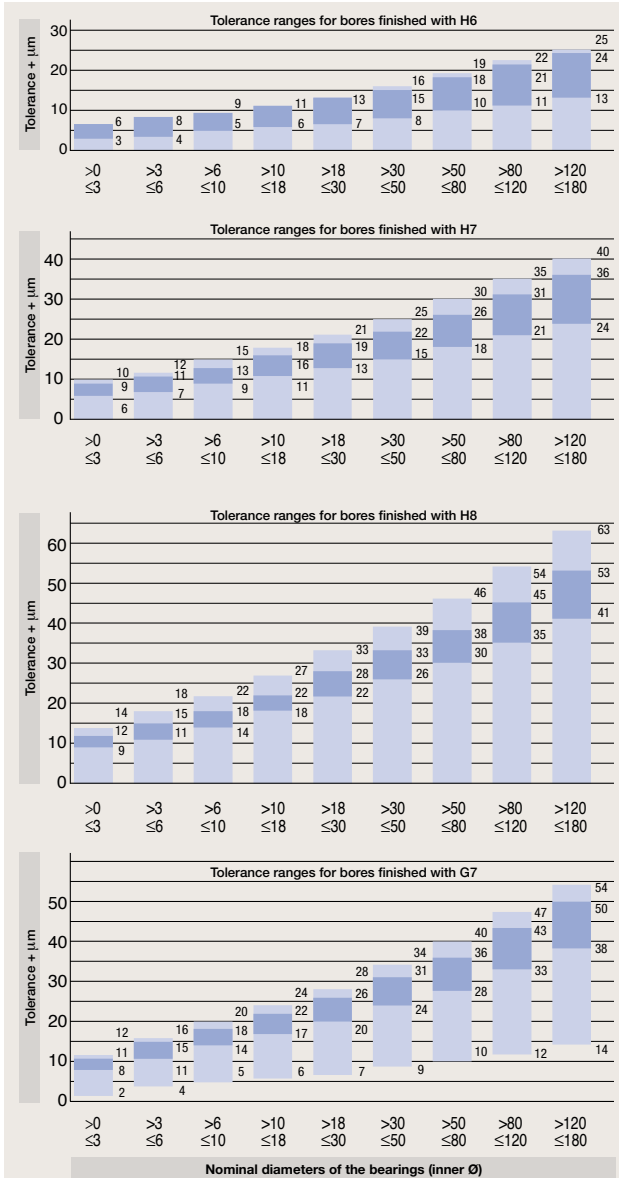
To reduce this dispersion once more when a minimum precision of ISO 7 is desired, you must use a mounting mandrel to calibrate the bearing when mounting.

When mounting two aligned and relatively close cylindrical bearings, it is a good idea to use the same mounting mandrel in order to ensure proper alignment.

Our Technical Department is always available to help you determine the SELFOIL Bearings mounting method which is most suitable to your needs.

L = 1,2 x bearing length

Nominal bearing Ø
Tolerances: see chart on page 17.

Mounting mandrel
see chart on page 17

10°

Ø nominal −0,1
−0,2

d Ø Cylindrical bearing G7
d Ø Flanged bearing G8

Unmounted bearings
See tables on pages 6-7

D Ø Cylindrical bearing s7
D Ø Flanged bearing s8

Chamfers

Housing
The clearance between the bearing, the housing and the final tolerances of the inner Ø of the bearing have been determined for a H7 rigid steel housing. For any other housing, please contact our engineers.

Ø Tolerances   H7

Bearings after fitting

Ø Bearings after fitting   H7
Ø Flanged bearing   H8

Shaft

Tolerance Ø   f7
A more precise tolerance of g6 can also be used.

TOLERANCES

Tolerance ranges for bores finished with H6
Tolerance + μm

>0 ≤3	>3 ≤6	>6 ≤10	>10 ≤18	>18 ≤30	>30 ≤50	>50 ≤80	>80 ≤120	>120 ≤180
6 / 3	8 / 4	9 / 5	11 / 6	13 / 7	15 / 8	18 / 10	22 / 21 / 11	25 / 24 / 13
						16	19 / 18	

Tolerance ranges for bores finished with H7
Tolerance + μm

>0 ≤3	>3 ≤6	>6 ≤10	>10 ≤18	>18 ≤30	>30 ≤50	>50 ≤80	>80 ≤120	>120 ≤180
10 / 9 / 6	12 / 11 / 7	15 / 13 / 9	18 / 16 / 11	21 / 19 / 13	25 / 22 / 15	30 / 26 / 18	35 / 31 / 21	40 / 36 / 24

Tolerance ranges for bores finished with H8
Tolerance + μm

>0 ≤3	>3 ≤6	>6 ≤10	>10 ≤18	>18 ≤30	>30 ≤50	>50 ≤80	>80 ≤120	>120 ≤180
14 / 12 / 9	18 / 15 / 11	22 / 18 / 14	27 / 22 / 18	33 / 28 / 22	39 / 33 / 26	46 / 38 / 30	54 / 45 / 35	63 / 53 / 41

Tolerance ranges for bores finished with G7
Tolerance + μm

>0 ≤3	>3 ≤6	>6 ≤10	>10 ≤18	>18 ≤30	>30 ≤50	>50 ≤80	>80 ≤120	>120 ≤180
12 / 11 / 8 / 2	16 / 15 / 11 / 4	20 / 18 / 14 / 5	24 / 22 / 17 / 6	28 / 26 / 20 / 7	34 / 31 / 24 / 9	40 / 36 / 28 / 10	47 / 43 / 33 / 12	54 / 50 / 38 / 14

Nominal diameters of the bearings (inner Ø)

The final tolerances, shown in a light colour, after mounting the cylindrical bearings are shown on the diagram for final inner diameter tolerances of ISO H6, H7, H8 and G7 quality.

The intermediate tolerances, shown in a dark colour, correspond to those which the mounting mandrel must have to mount the Bearings and obtain the Tolerances indicated.

The table below corresponds to the most common ISO Tolerance Types and Qualities for Self-Lubricating Sintered Bearings, both for the bearing diameters and lengths and for the shafts.

ISO / Dimension	E7	F7	G6	G7	G8	H6	H7	H8	g6	f7	js13	r6	r7	s7	s8
> 0	+ 24	+ 16	+ 8	+ 12	+ 16	+ 6	+ 10	+ 14	− 2	− 6	+ 70	+ 16	+ 20	+ 24	+ 28
≤ 3	+ 14	+ 6	+ 2	+ 2	+ 2	+ 0	+ 0	+ 0	− 8	− 16	− 70	+ 10	+ 10	+ 14	+ 14
> 3	+ 32	+ 25	+ 12	+ 16	+ 22	+ 8	+ 12	+ 18	− 4	− 10	+ 90	+ 23	+ 27	+ 31	+ 37
≤ 6	+ 20	+ 10	+ 4	+ 4	+ 4	+ 0	+ 0	+ 0	− 12	− 22	− 90	+ 15	+ 15	+ 19	+ 19
> 6	+ 40	+ 28	+ 14	+ 20	+ 27	+ 9	+ 15	+ 22	− 5	− 13	+ 110	+ 28	+ 34	+ 38	+ 45
≤ 10	+ 25	+ 13	+ 5	+ 5	+ 5	+ 0	+ 0	+ 0	− 14	− 28	− 110	+ 19	+ 19	+ 23	+ 23
> 10	+ 50	+ 34	+ 17	+ 24	+ 33	+ 11	+ 18	+ 27	− 6	− 16	+ 135	+ 34	+ 41	+ 46	+ 55
≤ 18	+ 32	+ 16	+ 6	+ 6	+ 6	+ 0	+ 0	+ 0	− 17	− 34	− 135	+ 23	+ 23	+ 28	+ 28
> 18	+ 61	+ 41	+ 20	+ 28	+ 40	+ 13	+ 21	+ 33	− 7	− 20	+ 165	+ 41	+ 49	+ 56	+ 68
≤ 30	+ 40	+ 20	+ 7	+ 7	+ 7	+ 0	+ 0	+ 0	− 20	− 41	− 165	+ 28	+ 28	+ 35	+ 35
> 30	+ 75	+ 50	+ 25	+ 34	+ 48	+ 16	+ 25	+ 39	− 9	− 25	+ 195	+ 50	+ 59	+ 68	+ 82
≤ 50	+ 50	+ 25	+ 9	+ 9	+ 9	+ 0	+ 0	+ 0	− 25	− 50	− 195	+ 34	+ 34	+ 43	+ 43
> 50	+ 90	+ 60	+ 29	+ 40	+ 56	+ 19	+ 30	+ 46	− 10	− 30	+ 230	+ 62	+ 73	+ 83 / + 89	+ 99 / + 105
≤ 80	+ 60	+ 30	+ 10	+ 10	+ 10	+ 0	+ 0	+ 0	− 29	− 60	− 230	+ 41	+ 41	+ 53 / + 59	+ 53 / + 59
> 80	+ 107	+ 71	+ 34	+ 47	+ 66	+ 22	+ 35	+ 54	− 12	− 36	+ 270	+ 76	+ 89	+ 106 / + 114	+ 125 / + 133
≤ 120	+ 72	+ 36	+ 12	+ 12	+ 12	+ 0	+ 0	+ 0	− 34	− 71	− 270	+ 51	+ 51	+ 71 / + 79	+ 71 / + 79
> 120	+ 125	+ 83	+ 39	+ 54	+ 77	+ 25	+ 40	+ 63	− 14	− 43	+ 315	+ 93	+ 108	–	–
≤ 180	+ 85	+ 43	+ 14	+ 14	+ 14	+ 0	+ 0	+ 0	− 39	− 83	− 315	+ 63	+ 63	–	–

COMPATIBILITY OF TOLERANCES OF THE SELFOIL BEARINGS

The tolerances of the inner and outer diameters of the SELFOIL bearings are completely compatible with the European tolerances and even more advantageous, as we will see below.

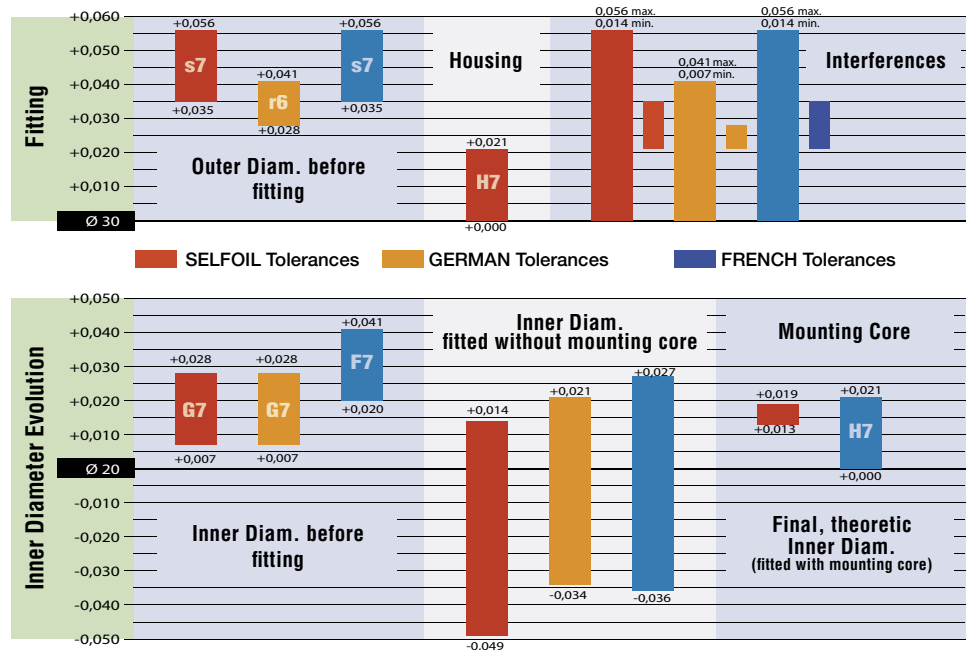When fitting a bearing into a housing, two main aspects are important:

1.– The bearing must be properly fitted into the housing to assure a good fixation.

2.– The inner diameter must assure a correct dimensional finishing. For this reason it is essential to have interference with the diameter of the fitting core to assure a sizing of the Inner Diameter that guarantees the tolerance and correct surface condition.

We will now see why the SELFOIL tolerances are compatible with the European ones and sometimes even better.

FITTING in the Housing.

Any of the European standards (we will pay attention to the French and German ones) specify, for a rigid housing, an H7 tolerance. SELFOIL recommends the same one.

The fitting graph shows the maximum and minimum theoretic interferences between bearing and housing according to the SELFOIL, German and French tolerances.

These interferences are obtained comparing the maximum of the Outer Diameter of the bearing with the minimum of the Housing Diameter and vice versa.

Among the possible fitting interferences, we can see that the SELFOIL tolerances show values equal to those of the French standard, while the ones of the German standard present a minimum value that can achieve lower reading of 7µm, which hardly guarantees a good grip of the Bearing.

Inner Diameter.

Once the bearing is fitted, its Inner Diameter copies the dimensional reduction caused by the fitting interference.

The graph showing the evolution of the inner diameters presents the original diameters of the SELFOIL Bearings and those of the German and French standards, as well as the diameters after the fitting, if the mandrel sizing would not exist.

Finally, using the Mounting Core to size the inner diameter in the fitting operation, one can see that the SELFOIL tolerances present always an outstanding interference with the Mounting Core, so that the final H7 tolerance is assured. On the contrary, in the French standard there may be some cases in which the Diameter after fitting is larger that the H7 diameter; therefore there will be no I.D. action and the final diameter will exceed the H7 tolerance. The German standard is half way between the SELFOIL tolerances and the French standard.

Conclusion.

Once more, the tolerances of the SELFOIL Bearings appear as the most reasonable ones and are proved perfectly compatible to achieve inner diameters with H7 tolerance in bearings fitted in housings with H7 tolerance, according to the international standards.

MOUNTING OF
SELF-LUBRICATING BEARINGS
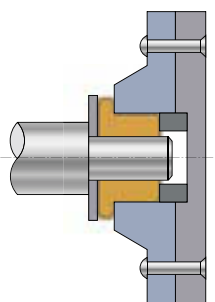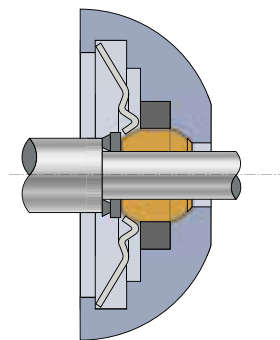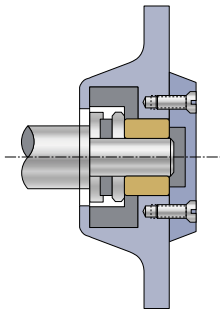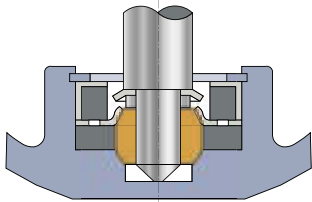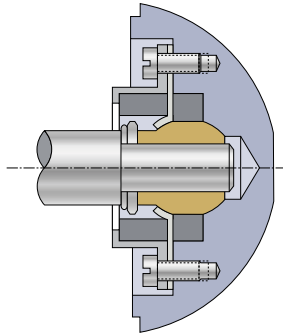
Some methods for mounting self-lubricating bearings are given here:

Proper mounting of a Self-lubricating Bearing practically guarantees that the bearing has an unlimited life, normally even longer than the predicted life of the assembly in which it is mounted.

For applications with continuous work, it is wise to design a felt wrapped around the bearing to act as a backup reservoir of oil.

In cylindrical bearings, it is important that the bearing and shaft alignment be correct. This is achieved by careful machining of the housing. Basic characteristic of the Types "C" and "D" Spherical Self-Lubricating Bearings is that they automatically align themselves with the shaft, since they act as a swivel.

In order to obtain a self-centring system, the bearing should be mounted in its housing with a pressure that permits it to swivel but also prevents it from rotating easily in the same direction as the shaft. One simple way of checking the proper pressure consists of introducing a steel rod (with diameter D equal to the bearing diameter and with a length that is 25-30 times the diameter) in a horizontal position. This rod should be in unstable equilibrium, i.e. it should rock slightly when applying a slight pressure.

D

25-30 D
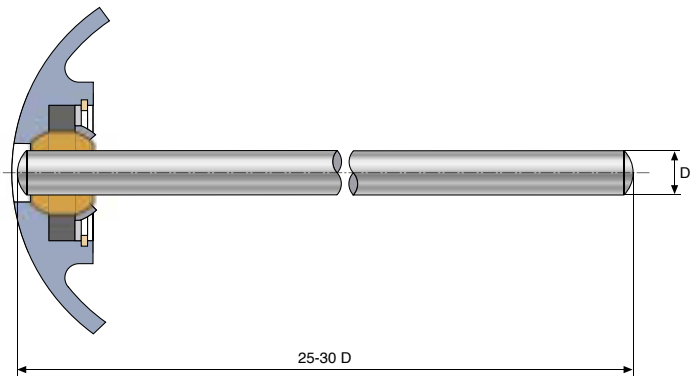
RECOMMENDATIONS FOR QUALITY CONTROL

Normally, the factor which users of Self-Lubricating Sintered Bronze Bearings find easiest to control are the dimensional specifications. It is, however, easy to make a mistake when measuring the bearings. For this reason, we include some practical steps to be taken to ensure a proper control of the dimensions.

Inner diameters.-
The most common is the control by direct measurement using GO-NO-GO plug gauges.
A very sensitive feeler comparator is to be used. If the measurement is made with variables.
Normally, shape errors, for example: Conicity, ovality, etc. are acceptable, if they are by half the total tolerance. It is worth noting that in the case of cylindrical bearings and flanged cylindrical bearings, ovality is corrected or worsened if these same defects exist in the housing. This means that housing precision is crucial to the proper use of the Self-Lubricating Bearings.
When using pneumatic measuring equipment, be sure to remember that the porosity of the bearing can cause errors in the measurement.

Outer diameters.-
Normally, a micrometric gauge is used. Take special care

when using with thin walls. Nevertheless, it is advisable to perform the measurement with the GO side of the Plug Gauge introduced into the inner diameter (see figure) in order to prevent the pressure of the gauge from deforming the bearing.
The same acceptance criteria are used for defects in shape, ovality, conicity, etc. as for the inner diameters.
Although not a frequently used method, GO-NO-GO horseshoe gauges may also be used to check the dimensions.

Lengths.-
Use a centesimal micrometer or even a calliper since the tolerance is quite large.

Eccentricities.-
To measure the eccentricity between the inner and outer diameters, measure the variation in the wall thickness with a set-up like the one indicated in the figure using a centesimal comparator clock. Turn the bearing and the "total needle deviation" will indicate the TCR (Total comparator reading) which is equal to twice the eccentricity value.

Sphere.-
This is measured with a micrometric or centesimal gauge (see figure). Diameter measurements are taken at several points of the sphere, subsequently checking that
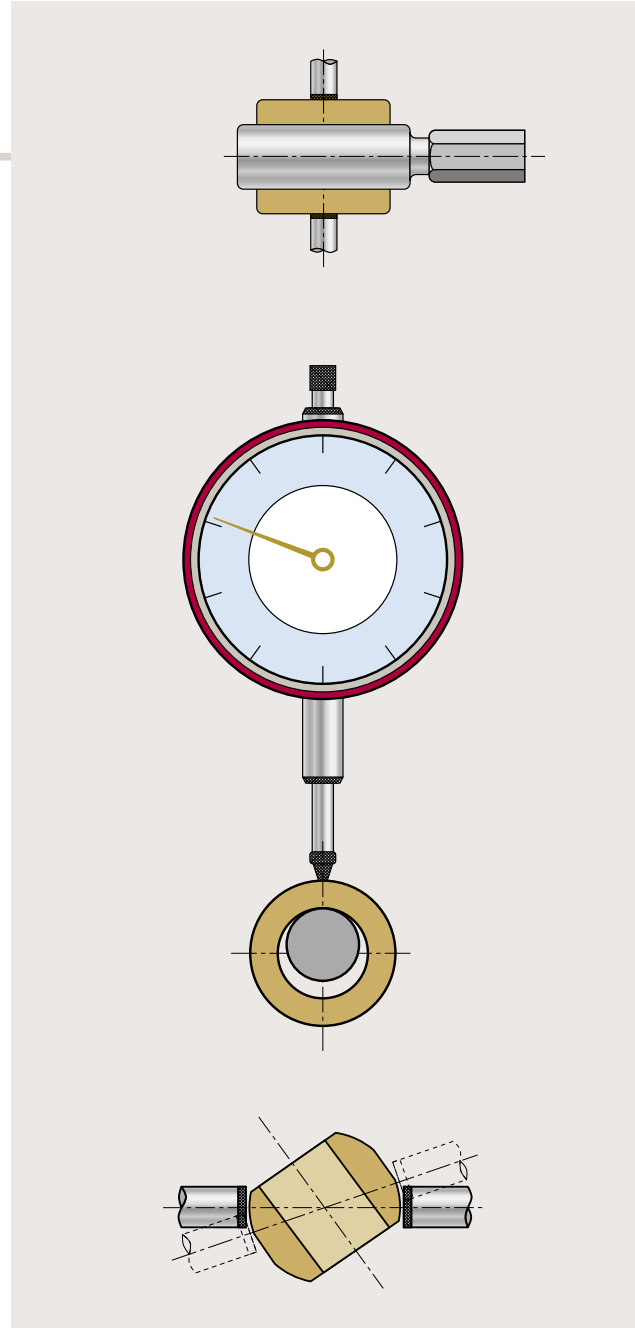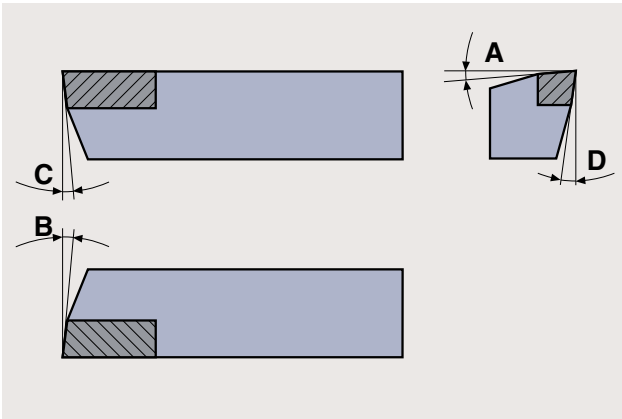
they are within the tolerance specified.
The diameter of the equator (cylindrical part of the bearing) should never be larger than the sphere diameter.

Physical and Chemical Characteristics:
Our lab technicians are avai-

lable and will be pleased to help with questions about these laboratory controls.

How to Machine Sintered Bronze

Cutting conditions

Angle	Angle in degrees
A	0-3
B	5-7
C	5-7
D	5-7

	Rough turning	Final turning
Cutting speed	100-120 m/min	100-120 m/min
Feed	0,1 mm/turn	0,06 mm/turn
Pass depth	1 mm	0,05 - 0,1 mm

Machinability.
Due to its structure, SELFOIL Sintered Bronze permits oil to be absorbed through microporosity.
This Bronze can absorbe up to 20% of its volume in oil which then acts as a lubricant for the bearing.
Thus, it is extremely important that the machining is made only under dry conditions and that no bore oil or cutting oil are used, as they may be absorbed by the bearing and contaminate the final impregnation.
You can use air as a coolant for the cutting tool.
SELFOIL Sintered Bronze is machined under similar conditions as other common solid bronzes.
For the self-lubricating function to work properly, it is important to maintain the "openness" of the surface porosity in the work areas, especially in the inner diameter

HOW TO TURN SINTERED BRONZE BEARINGS AND RODS

Turning.
The machining tools and fittings should be rigid to minimise possible vibrations.
We suggest you to use Type K10 Tungsten Carbide or NBo Boron Nitride tools. The tool can be sharpened with a 200-grain diamond wheel with abundant cooling. The final pass should be done with a recently sharpened tool.

Drilling and tapping.
These operations must be performed under dry conditions and with the normal speeds and feeds used for solid bronze. We recommend the use of Tungsten Carbide drill bits and super-fast steel taps.

Grinding.
We do not recommend that you grind the areas that are subject to creepage and the self-lubricating effect. Abrasive particles can become embedded in the pores and cause premature wear in the shafts or elements subject to creepage.

Reimpregnation after machining.
The hollow and solid SELFOIL rods are supplied without lubricating oil, which permits them to be machined under dry conditions.
The self-lubricating bearing and machining Rods are supplied oil soaked and we recommend to eliminate the oil before the machining.
We advice to re-impregnate the bearing after machining, using the following process:

• Eliminate the filings or dust with a volatile solvent and, if possible, with ultrasound. Then dry completely in an oven or at rest for at least 48 hours.

• Immerse the parts in the lubricating oil chosen (warmed to 80°C) for 1 hour for wall thicknesses of up to 3 mm and for 3 hours for thicker walls.

• Let the bath cool with the immersed bearings still inside until it reaches room temperature. This will ensure total saturation of the micropore volume.

Felt impregnated with oil.

LUBRICANTS AND SUPPLEMENTARY LUBRICATION

The impregnation oil used and the degree of impregnation obtained play an important role in guaranteeing proper working conditions and the expected life of the SELFOIL Bearings.

It is very important to prevent all contact with absorbent materials (such as paper, cardboard, wood, etc.) when storing SELFOIL Bearings since these materials absorb oil from the bearing and affect its self-lubricating properties.

The mechanics of the lubrication process involve the following factors: viscosity, lubricating capacity of the oil and working conditions, i.e.: load on the bearing, operating temperature, lineal shaft speed, starting torque when cold, etc.

Special working conditions often have contradictory solutions, which make it harder to give a generalized standard for choosing the most suitable lubricating oil.

The parameters which must be considered initially are: the operating temperature of the Bearing and the viscosity of the impregnation oil. In the cases where the bearings are expected to operate at the temperature limits, it is advisable to use an additional greasing process as illustrated above, making sure that the oil used for the supplementary lubrication is the same oil used

to impregnate the bearings or is a true equivalent.

Our technical department is always available to help to solve the lubrication problems that may appear.

There are solutions for:

- Extreme temperatures, from -60°C to +250°C.
- High loads and low shaft speed.
- Quiet motors or assemblies.
- Very weak starting torque, etc.

Felt impregnated with oil and greasing chamber.

Oil reservoir.

The oil used to impregnate the SELF-OIL Bearings which are always in stock has the following characteristics:

AMES Type 1
– Paraffin mineral oil of ISO-VG-68 viscosity grade.
– Temperatures from –20°C up to +120°C.
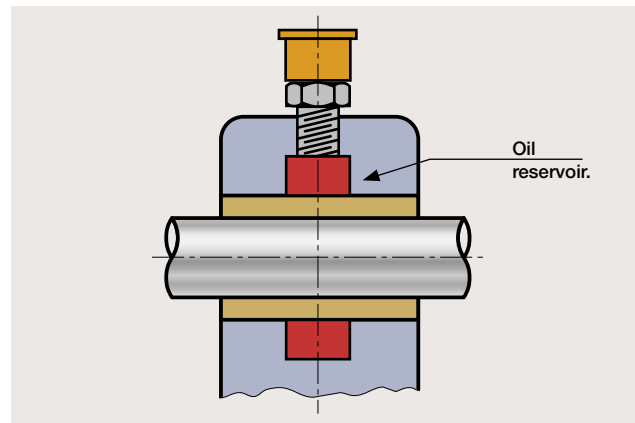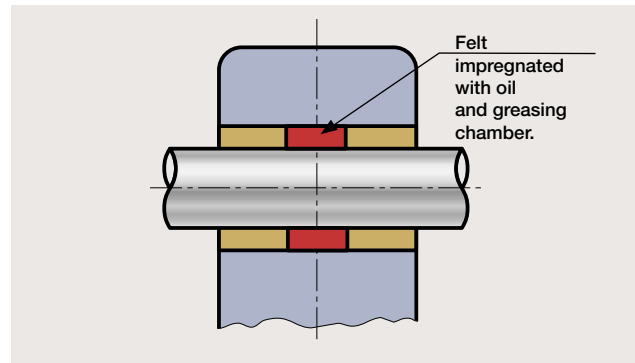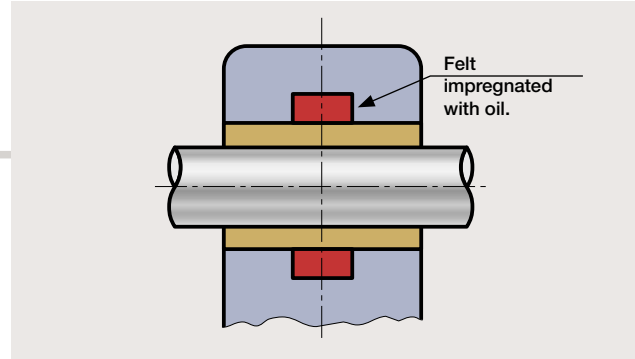
For certain applications such as: dusty environment, temperatures higher than 90°C, heavy-duty service, excessive loads, etc., it is advisable to use a felt pad impregnated with the same type of oil as used in the bearing impregnation.

MATERIAL USED IN THE SELF-LUBRICATING BEARINGS

The mechanical characteristics are as follows:			
	Typical values	Limiting values	
		Minimum	Maximum
Density in gr/cc	—	6,4	6,8
Oil content in %	—	19	—
Porosity (indicative) in %	22	—	—
Radial breaking strength in N/mm^2	170	150	
Hardness (indicative) in HRH	50	—	—

Operating conditions:	
Shaft speed in m/s	Allowable load in N/mm^2
low or intermittent	10
up to 0,25	10
0,25 a 0,50	3,5
0,5 a 4	2,5

As a result of its broad experience, AMES has chosen the material which provides the best characteristics and affordability from among the standard materials which it has:

Material
SC-S7,5 - Z4,5 - P3 - 66
Equivalent in mechanical properties to the Standards:

ASTM	B-438 degré 1, classe A, type II
MPIF	CT-1000 - K26
ISO 5755	C-T-10-K140

Equivalent in chemical composition to:

AENOR	UNE 96.001 C-T7Z4L3-K140

Standard testing of the mechanical strength of a SELFOIL Self-Lubricating Bearing:

Radial strength: The bearing is compressed between two flat plates which are parallel to its shaft up to the failure point. If the specimen is not cylindrical, machine a cylinder so that the test can be performed.
The minimum strength required is described by the following equation:

$$P = K \frac{L \times T^2}{D - T}$$

P = Theoretical radial crushing strength in N.
K = Strength constant for this material 178 N/mm^2.
L = Bearing length in mm.
T = Thickness of the bearing wall or mach. cylinder in mm.
D = Outer diameter of the bearing in mm.

For shaft linear surface speeds greater than 1.01 m/s, the allowable load is calculated as follows:

$$P = \frac{1,77}{V}$$

P = Allowable load in N/mm^2 (*)
V = Shaft surface speed in m/s

(*): 1,77 N/mm^2 is equivalent to a PV of 18 [1,8 MPa] [m/s]

Bronfil® Silencers

The diagram shows the head loss (ΔP) in gr/cm², or cm of water column (cm w.c.)
– For different AMES BRONFIL standard filtering degrees.
– As a function of flow, expressed in litres/min.
– per cm² of filtering surface.
– for a wall thickness of 1 mm.
– under laminar flow conditions.
– with air at 20°C.

These charts are valid for other values of viscosity (expressed in centipoises or micro-poiseuilles), wall area and thickness, using the proper coefficients and remembering that the flow rates are:
– Directly proportional to the surface areas.
– Inversely proportional to the viscosity and wall thicknesses.

The preparation of this diagram is based on laminar flow conditions, where the flow rates are described by Poiseuille's Law:

$$Q = K \ \frac{S \ x \ \Delta P}{\eta \ x \ e}$$

Q = Flow rate in litres/min
K = Specific coefficient for the filter
S = Filtering area in cm².
ΔP = Head loss in gr/cm².

Bronze Wall 1 mm   **AIR viscosity 183 micro-poiseuilles at 20ºC**

FB 150
FB 110
FB 85
FB 60
FB 40
FB 24
FB 12
FB 8

Air flow dm³/min/cm²

ΔP g/cm² or cm w.c.

Bronfil silencers are manufactured with FB 85/110 granulometry. The other curves correspond to other granulometries of AMES manufacturing program.

η = Viscosity of molecular viscosity in centi-poiseuilles
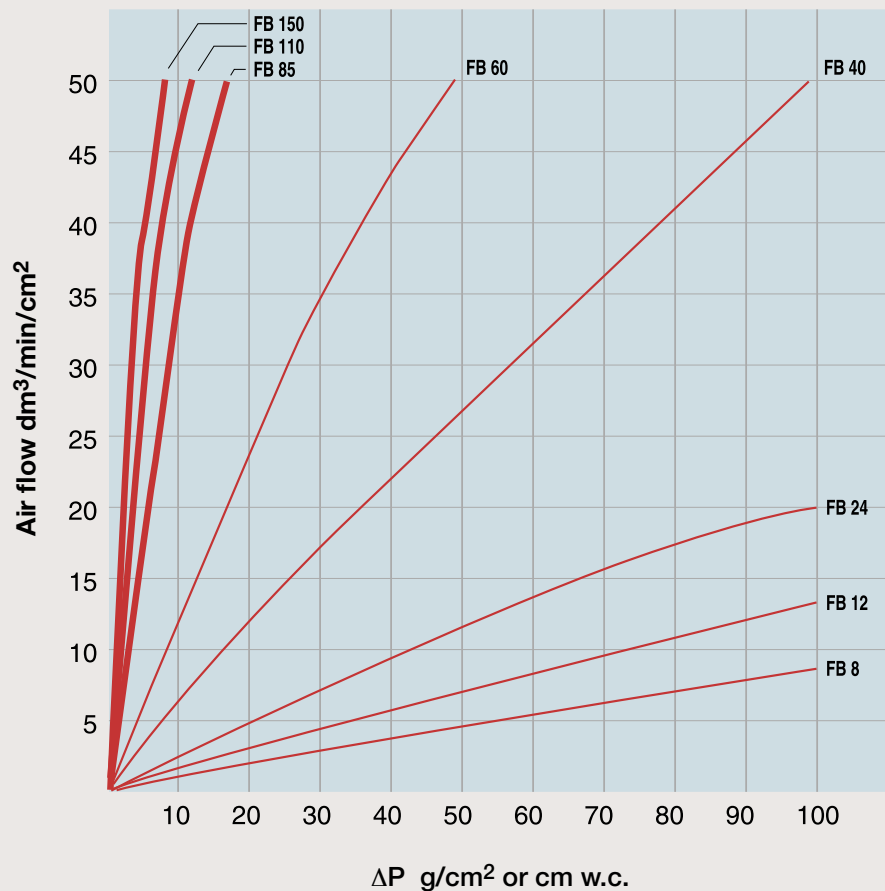e = Wall thickness of the filter in mm.

At high flow rates, conditions tend to become turbulent and the flow rate is not quite proportional to ΔP. Nevertheless, without a high risk of making a mistake, we can say that the rate law is normally applicable within a wide range of limits.

We should also point out that the curves define the theoretical flow rates with a clean filter, which means that the calculated area has been assigned a usage factor of 1.5. This factor takes into consideration the fact that there are always some impurities. For this reason, we recommend that you clean the filter frequently. One of the advantages of BRONFIL silencers is that you can clean with strong solvents and against the current, meaning that they last much longer than other types of materials.

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