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**Hydrodynamic plain journal bearings under  
steady-state conditions — Circular  
cylindrical bearings —**

**Part 2:**  
Functions used in the calculation procedure

*Paliers lisses hydrodynamiques radiaux fonctionnant en régime stabilisé —  
Paliers circulaires cylindriques —*

*Partie 2: Fonctions utilisées pour le calcul*

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7902-2 was prepared by Technical Committees ISO/TC 123, *Plain bearings*, Subcommittee SC 4, *Methods of calculation of plain bearings*.

ISO 7902 consists of the following parts, under the general title *Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings*:

- *Part 1: Calculation procedure*
- *Part 2: Functions used in the calculation procedure*
- *Part 3: Permissible operational parameters*

Annex A of this part of ISO 7902 is for information only.

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# Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings —

## Part 2:

## Functions used in the calculation procedure

### 1 Scope

This part of ISO 7902 specifies the values of the basic functions used in the calculation procedure for oil-lubricated circular cylindrical hydrodynamic bearings under conditions of full lubrication.

The values are given for the assumptions and boundary conditions given in ISO 7902-1. The values necessary for the calculation may be determined from the tables of bearing characteristics, the graphs and from the equations.

The descriptions of the symbols used and calculation examples are given in ISO 7902-1.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7902. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7902 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification*.

ISO 7902-1:1998, *Hydrodynamic plain journal bearings under steady-state conditions — Circular cylindrical bearings — Part 1: Calculation procedure*.

### 3 Tables of basic bearing characteristics

Tables 1 to 30 give

- the attitude angle,  $\beta$ ,
- The Sommerfeld number,  $S_o$ ,
- the specific coefficient of friction, taking account of the unloaded area of lubricant film,  $f'/\psi$ ,
- the specific coefficient of friction in the loaded area of the lubricant film,  $f/\psi$ ,
- The coefficient of lubricant flow rate, parameter  $Q_3^*$ , due to generation of the internal pressure, as a function of angular span,  $\Omega$ , relative eccentricity  $\varepsilon$  and relative bearing width  $B/D$ ,

for various values of  $\varepsilon$ ,  $\Omega$  and  $B/D$ .

**Table 1 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 1,5$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	72,5236	0,4273	7,5992	4,9684	0,0477
0,4	62,6588	1,0005	3,6035	2,6582	0,0935
0,6	51,9692	1,9724	2,2272	1,6695	0,1361
0,8	38,1601	4,6824	1,3653	1,0736	0,1759
0,9	27,961	10,1382	0,9218	0,7604	0,1939
0,925	24,6184	13,8256	0,7906	0,6678	0,198
0,95	19,8007	22,044	0,6173	0,5359	0,201
0,975	13,5971	48,8429	0,404	0,3586	0,2036

**Table 5 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 0,5$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	75,8188	0,7788	41,2641	26,8322	0,0233
0,4	61,7628	0,2026	17,0875	12,0101	0,0468
0,6	47,9703	0,4995	8,0837	5,8561	0,0703
0,8	32,9653	1,74	3,2267	2,3698	0,0938
0,9	23,5037	5,1579	1,5768	1,2604	0,1054
0,925	20,3171	7,9168	1,205	0,992	0,1082
0,95	16,5292	14,1757	0,8449	0,7198	0,1107
0,975	11,7164	36,438	0,487	0,415	0,1128

**Table 2 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 1,25$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	73,3427	0,341	9,4978	6,2016	0,0444
0,4	62,6533	0,8155	4,3808	3,2457	0,0876
0,6	51,3901	1,6715	2,5837	1,9257	0,1287
0,8	37,2474	4,2107	1,4855	1,1285	0,1679
0,9	27,2701	9,4621	0,9678	0,7949	0,1860
0,925	23,9586	13,0839	0,8197	0,6900	0,1901
0,95	19,3045	21,1271	0,6332	0,5484	0,1936
0,975	13,3154	47,5332	0,4097	0,3631	0,1959

**Table 6 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 0,25$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	75,8522	0,0209	153,2452	99,5571	0,0123
0,4	61,4843	0,056	61,5567	41,8879	0,0246
0,6	47,4076	0,146	27,1065	18,7058	0,0368
0,8	31,2896	0,6053	8,8577	6,3961	0,0492
0,9	21,5315	2,2037	3,4356	2,6972	0,0553
0,925	18,5306	3,6707	2,3994	1,9424	0,0568
0,95	15,078	7,3466	1,4931	1,2546	0,0582
0,975	10,7792	22,6665	0,7149	0,5632	0,0595

**Table 3 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 1$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	74,208	0,2492	12,958	8,4489	0,0394
0,4	62,5744	0,611	5,7868	4,2721	0,0785
0,6	50,4545	1,3182	3,2102	2,3761	0,1164
0,8	36,0278	3,5955	1,6915	1,2766	0,1533
0,9	26,3685	8,5203	1,0457	0,8537	0,1708
0,925	23,0726	12,0342	0,8682	0,7275	0,1748
0,95	18,6392	19,799	0,6599	0,5696	0,1783
0,975	12,9388	45,5721	0,4193	0,371	0,1808

**Table 7 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 1,5$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	66,6767	0,3781	8,5718	4,5565	0,0385
0,4	54,2395	0,8711	4,0972	2,4424	0,0628
0,6	44,2171	1,7528	2,4496	1,6803	0,0755
0,8	32,582	4,3531	1,4182	1,1391	0,075
0,9	24,256	9,6987	0,9161	0,796	0,0675
0,925	21,5177	13,4451	0,7846	0,6782	0,0632
0,95	18,6557	20,5259	0,6423	0,5495	0,0589
0,975	12,6652	47,2761	0,4059	0,3701	0,0501

**Table 4 — Values of the basic characteristics for  $\Omega = 360^\circ$  and  $B/D = 0,75$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	75,022	0,1584	20,3909	13,2372	0,3255
0,4	62,2584	0,3993	8,7606	6,183	0,065
0,6	49,3554	0,9155	4,5167	3,3161	0,0972
0,8	34,5144	2,7848	2,1067	1,5712	0,1292
0,9	25,1887	7,1614	1,1979	0,9696	0,1447
0,925	21,8823	10,4611	0,9627	0,801	0,1483
0,95	17,7393	17,7363	0,7119	0,6114	0,1516
0,975	12,4264	42,3829	0,4384	0,3869	0,153

**Table 8 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 1,25$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	67,7085	0,3106	10,4155	5,5146	0,0369
0,4	55,2027	0,7326	4,8431	2,8666	0,0615
0,6	44,3642	1,5312	2,7744	1,8931	0,0748
0,8	32,4491	3,9819	1,5296	1,2248	0,0747
0,9	24,0337	9,2279	0,9643	0,822	0,0682
0,925	21,247	12,8584	0,8106	0,7075	0,0642
0,95	18,433	19,9471	0,6549	0,5589	0,0601
0,975	12,3471	46,7535	0,4066	0,3706	0,0507

**Table 9 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 1$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	69,0182	0,2328	13,8683	7,3068	0,0338
0,4	56,4093	0,5601	6,2861	3,6873	0,0575
0,6	44,589	1,2448	3,3652	2,2797	0,0729
0,8	32,3681	3,4514	1,7312	1,3799	0,0735
0,9	23,7701	8,4037	1,039	0,9061	0,0679
0,925	20,8981	11,9405	0,8574	0,7446	0,064
0,95	18,1351	18,5775	0,691	0,5894	0,0601
0,975	11,9017	45,771	0,4094	0,3754	0,0513

**Table 13 — Values of the basic characteristics for  $\Omega = 150^\circ$  and  $B/D = 1,5$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	61,7703	0,3058	10,5742	4,7678	0,3288
0,4	47,9337	0,738	4,7933	2,489	0,0445
0,6	39,8508	1,5547	2,7181	1,6599	0,0521
0,8	30,2152	4,0616	1,4905	1,1082	0,0501
0,9	23,4459	9,2073	0,9618	0,7712	0,0437
0,925	20,432	13,0508	0,7949	0,6551	0,0403
0,95	17,262	20,5699	0,6301	0,525	0,0365
0,975	12,396	46,5565	0,4083	0,35	0,0325

**Table 10 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 0,75$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	70,5349	0,1513	21,2824	11,1513	0,0289
0,4	57,8558	0,381	9,1663	5,3207	0,0513
0,6	45,0124	0,8883	4,6328	3,1078	0,066
0,8	32,3128	2,6987	2,154	1,705	0,0698
0,9	23,3367	7,1375	1,188	1,0322	0,0649
0,925	20,4384	10,4252	0,9546	0,8278	0,0617
0,95	17,5793	16,7465	0,7469	0,639	0,058
0,975	11,2948	43,5128	0,4204	0,3801	0,0513

**Table 14 — Values of the basic characteristics for  $\Omega = 150^\circ$  and  $B/D = 1,25$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	62,7765	0,2588	12,4784	5,604	0,0283
0,4	48,8773	0,6374	5,5282	2,8501	0,0445
0,6	40,2801	1,3806	3,0383	1,8436	0,0526
0,8	30,2311	3,7472	1,5987	1,1844	0,0509
0,9	23,4326	8,6906	1,0083	0,8002	0,0447
0,925	20,2954	12,4741	0,8232	0,6805	0,0413
0,95	17,1592	19,8337	0,6474	0,5425	0,0375
0,975	12,2987	45,3826	0,4154	0,3705	0,0334

**Table 11 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 0,5$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	72,2939	0,0747	43,0117	22,4028	0,0213
0,4	58,1928	0,2002	17,2897	9,961	0,0394
0,6	45,6971	0,49	8,2284	5,4518	0,0522
0,8	31,5756	1,7222	3,2498	2,5502	0,0573
0,9	22,246	5,1676	1,5666	1,3352	0,0547
0,925	19,7514	7,8436	1,2104	1,039	0,053
0,95	16,5935	13,852	0,862	0,7419	0,0508
0,975	10,7691	38,055	0,4601	0,412	0,0451

**Table 15 — Values of the basic characteristics for  $\Omega = 150^\circ$  and  $B/D = 1$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	64,1708	0,2022	15,9459	7,1228	0,0268
0,4	50,1904	0,5099	6,8759	3,51	0,0434
0,6	41,1351	1,1434	3,6318	2,1757	0,0526
0,8	30,2445	3,2967	1,7897	1,3189	0,0511
0,9	22,9634	8,0787	1,0677	0,8862	0,045
0,925	20,115	11,5986	0,8719	0,7488	0,0419
0,95	16,9465	18,7837	0,6741	0,5636	0,0383
0,975	12,1844	43,3026	0,4294	0,376	0,0339

**Table 12 — Values of the basic characteristics for  $\Omega = 180^\circ$  and  $B/D = 0,25$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	73,9364	0,019	169,0777	87,6215	0,011
0,4	59,6743	0,0537	64,0354	36,5135	0,0214
0,6	45,5631	0,1465	27,0145	16,9891	0,0295
0,8	30,5214	0,6054	8,8522	6,0472	0,0339
0,9	21,4482	2,1725	3,4821	2,7036	0,0334
0,925	19,5175	3,4617	2,543	2,0119	0,0332
0,95	14,9385	7,3485	1,4916	1,2603	0,0321
0,975	9,4617	23,4266	0,6837	0,5668	0,0299

**Table 16 — Values of the basic characteristics for  $\Omega = 150^\circ$  and  $B/D = 0,75$**

$\varepsilon$	$\beta$	$S_o$	$f' \psi$	$f \psi$	$Q_3^*$
0,2	65,9611	0,1367	23,5537	10,4496	0,0238
0,4	51,9963	0,3561	9,7827	4,9274	0,04
0,6	42,1174	0,8372	4,8918	2,8877	0,05
0,8	30,6367	2,6068	2,211	1,6154	0,0497
0,9	22,6695	6,9438	1,2114	1,0008	0,0443
0,925	19,8534	10,1662	0,9704	0,8155	0,0415
0,95	16,6812	16,9409	0,7302	0,608	0,0382
0,975	11,9044	40,5953	0,4488	0,3809	0,0337

**Table 17 — Values of the basic characteristics for  $\Omega = 150^\circ$  and  $B/D = 0,5$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	67,9821	0,0706	45,4882	20,0289	0,0184
0,4	54,2896	0,1899	18,2097	9,0211	0,0323
0,6	43,0078	0,4775	8,4291	4,9152	0,0412
0,8	30,3047	1,6927	3,2951	2,3785	0,0431
0,9	22,1859	5,0335	1,6018	1,293	0,0402
0,925	19,66	7,5834	1,246	1,022	0,0385
0,95	16,3781	13,2552	0,8946	0,7383	0,0361
0,975	11,4673	34,9703	0,5012	0,4245	0,0317

**Table 21 — Values of the basic characteristics for  $\Omega = 120^\circ$  and  $B/D = 1$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	59,3987	0,153	21,0369	7,6506	0,0188
0,4	44,1285	0,4075	8,5506	3,6497	0,0288
0,6	35,8837	0,9779	4,1915	2,1578	0,0336
0,8	27,36	3,0094	1,9237	1,2665	0,0316
0,9	21,2549	7,6581	1,1043	0,8525	0,027
0,925	18,9981	11,0222	0,9007	0,7282	0,0251
0,95	16,1452	18,0536	0,6894	0,5418	0,0225
0,975	12,4702	39,7924	0,4606	0,3896	0,0197

**Table 18 — Values of the basic characteristics for  $\Omega = 150^\circ\text{C}$  and  $B/D = 0,25$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	70,1417	0,0185	173,6574	75,8912	0,0099
0,4	56,4804	0,0529	65,0018	31,7011	0,0185
0,6	43,9464	0,1447	27,351	15,6846	0,0248
0,8	29,8093	0,6008	8,9143	6,3433	0,0269
0,9	21,2152	2,1539	3,509	2,6112	0,0259
0,925	18,3268	3,5871	2,4504	1,9114	0,0251
0,95	15,8538	6,8272	1,6035	1,2701	0,0244
0,975	10,7917	21,4295	0,751	0,6315	0,0221

**Table 22 — Values of the basic characteristics for  $\Omega = 120^\circ$  and  $B/D = 0,75$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	61,3045	0,1102	29,1962	10,5409	0,0175
0,4	45,8179	0,301	11,5302	4,8583	0,0277
0,6	37,1249	0,7471	5,4372	2,7565	0,0328
0,8	27,9978	2,4401	2,3336	1,5185	0,0318
0,9	21,1836	6,6561	1,2454	0,9561	0,0273
0,925	18,9015	9,7602	0,9969	0,7665	0,0255
0,95	15,9688	16,4057	0,744	0,5905	0,0229
0,975	12,3551	37,1528	0,4849	0,401	0,0202

**Table 19 — Values of the basic characteristics for  $\Omega = 120^\circ$  and  $B/D = 1,5$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	56,6763	0,2196	14,6822	5,3943	0,0195
0,4	42,0362	0,5536	6,3258	2,7433	0,0284
0,6	34,5662	1,2672	3,2692	1,7133	0,0335
0,8	27,0973	3,6108	1,6323	1,0858	0,0308
0,9	21,2301	8,7261	0,9889	0,768	0,0254
0,925	19,1732	12,2582	0,8264	0,6673	0,0235
0,95	16,2459	19,7605	0,642	0,5148	0,0209
0,975	12,5263	42,6121	0,4375	0,3537	0,0181

**Table 23 — Values of the basic characteristics for  $\Omega = 120^\circ$  and  $B/D = 0,5$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	63,7072	0,0611	52,602	18,8173	0,0144
0,4	48,3597	0,1713	20,1556	8,3305	0,0238
0,6	39,0125	0,4446	9,0214	4,4692	0,0295
0,8	27,961	1,6413	3,3776	2,1664	0,0297
0,9	20,9013	4,9561	1,6148	1,2272	0,0263
0,925	18,9454	7,4106	1,2659	0,9624	0,025
0,95	15,6856	13,2503	0,8878	0,6913	0,0227
0,975	11,9048	31,9505	0,5481	0,4365	0,0199

**Table 20 — Values of the basic characteristics for  $\Omega = 120^\circ\text{C}$  and  $B/D = 1,25$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	58,2103	0,1848	17,4382	6,3717	0,0191
0,4	42,953	0,4869	7,1767	3,0911	0,0287
0,6	35,0689	1,1449	3,6023	1,8732	0,0338
0,8	27,2067	3,3665	1,7382	1,1514	0,0313
0,9	21,2163	8,3078	1,0304	0,7984	0,0263
0,925	19,0681	11,7869	0,8526	0,6911	0,0243
0,95	16,1962	19,0952	0,6594	0,5305	0,0223
0,975	12,4971	41,1775	0,4488	0,3751	0,0189

**Table 24 — Values of the basic characteristics for  $\Omega = 120^\circ$  and  $B/D = 0,25$**

$\varepsilon$	$\beta$	$S_o$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	66,2399	0,0169	190,0235	67,3268	0,0082
0,4	51,432	0,0507	67,7051	27,357	0,0148
0,6	41,1596	0,1387	28,5117	13,7269	0,019
0,8	28,6466	0,5892	9,0777	5,6831	0,0199
0,9	20,7885	2,1244	3,5523	2,5177	0,0185
0,925	17,9741	3,5485	2,4728	1,8782	0,0176
0,95	14,8377	7,0378	1,5512	1,1951	0,0165
0,975	11,0159	20,7702	0,7739	0,6091	0,0153

**Table 25 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 1,5$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	53,3402	0,1176	27,355	7,6276	0,0114
0,4	37,1665	0,3301	10,5034	3,54	0,0159
0,6	28,9167	0,8642	4,6881	1,9758	0,0174
0,8	23,2037	2,8817	1,9746	1,1041	0,0151
0,9	18,8315	7,6366	1,089	0,7487	0,0125
0,925	17,1845	11,0261	0,8865	0,6235	0,0115
0,95	14,9265	18,2683	0,6731	0,5097	0,0105
0,975	11,5294	40,8914	0,4432	0,3541	0,0097

**Table 28 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 0,75$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	56,9444	0,0724	44,3583	12,2068	0,0109
0,4	40,2697	0,2094	16,4973	5,4332	0,0163
0,6	30,87	0,5746	6,9886	2,8638	0,0185
0,8	24,1523	2,0933	2,6649	1,4568	0,0171
0,9	18,9534	6,0576	1,336	0,9064	0,0143
0,925	17,1651	9,0204	1,0531	0,7373	0,0132
0,95	14,8237	15,3757	0,7759	0,578	0,0117
0,975	11,44	36,0784	0,488	0,3878	0,0103

**Table 26 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 1,25$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	54,1165	0,1069	30,0617	8,3605	0,0115
0,4	37,6101	0,3074	11,266	3,786	0,0161
0,6	29,1984	0,8008	5,05	2,1145	0,0178
0,8	23,3782	2,719	2,0844	1,1605	0,0158
0,9	18,857	7,3176	1,1304	0,7752	0,0131
0,925	17,2396	10,5982	0,9172	0,6451	0,0121
0,95	14,908	17,5885	0,6942	0,519	0,011
0,975	11,5117	39,9392	0,4513	0,3601	0,0099

**Table 29 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 0,5$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	59,758	0,0436	73,56	20,0318	0,0096
0,4	42,7063	0,132	26,0987	8,4393	0,0151
0,6	32,766	0,3731	10,6866	4,2761	0,0176
0,8	24,8677	1,4685	3,7338	2,0008	0,0168
0,9	19,1302	4,6261	1,7054	1,1418	0,0143
0,925	17,1373	7,1405	1,2942	0,8704	0,0132
0,95	14,7154	12,6882	0,9136	0,6752	0,0118
0,975	11,2711	31,5255	0,5438	0,4308	0,0103

**Table 27 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 1$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	55,8145	0,0893	35,9792	9,9463	0,0112
0,4	38,6932	0,266	13,0103	4,335	0,0163
0,6	29,8006	0,7105	5,6762	2,3567	0,0183
0,8	25,6536	2,4774	2,274	1,2576	0,0165
0,9	19,043	6,803	1,2062	0,8233	0,0138
0,925	17,2021	10,0115	0,9626	0,6735	0,0126
0,95	14,9196	16,8158	0,7206	0,5377	0,0115
0,975	11,4801	38,4785	0,4645	0,3699	0,0103

**Table 30 — Values of the basic characteristics for  $\Omega = 90^\circ$  and  $B/D = 0,25$**

$\varepsilon$	$\beta$	$S_0$	$f'/\psi$	$f/\psi$	$Q_3^*$
0,2	62,8374	0,0137	234,8592	63,2038	0,0061
0,4	46,1719	0,0435	79,0197	24,8942	0,0103
0,6	35,8747	0,1276	30,9565	11,9186	0,0129
0,8	26,2754	0,5626	9,484	4,9014	0,013
0,9	19,4224	2,0827	3,6103	2,286	0,0114
0,925	17,2907	3,434	2,5451	1,6958	0,0108
0,95	14,5522	6,8003	1,5989	1,1093	0,0099
0,975	10,663	20,2802	0,7873	0,5875	0,0087

### 4 Graphs of basic bearing characteristics

Figures 1 to 50 graphically represent the functions  $\beta$ ,  $S_o$ ,  $f'/\psi$ ,  $f/\psi$  and  $Q_3^*$ .

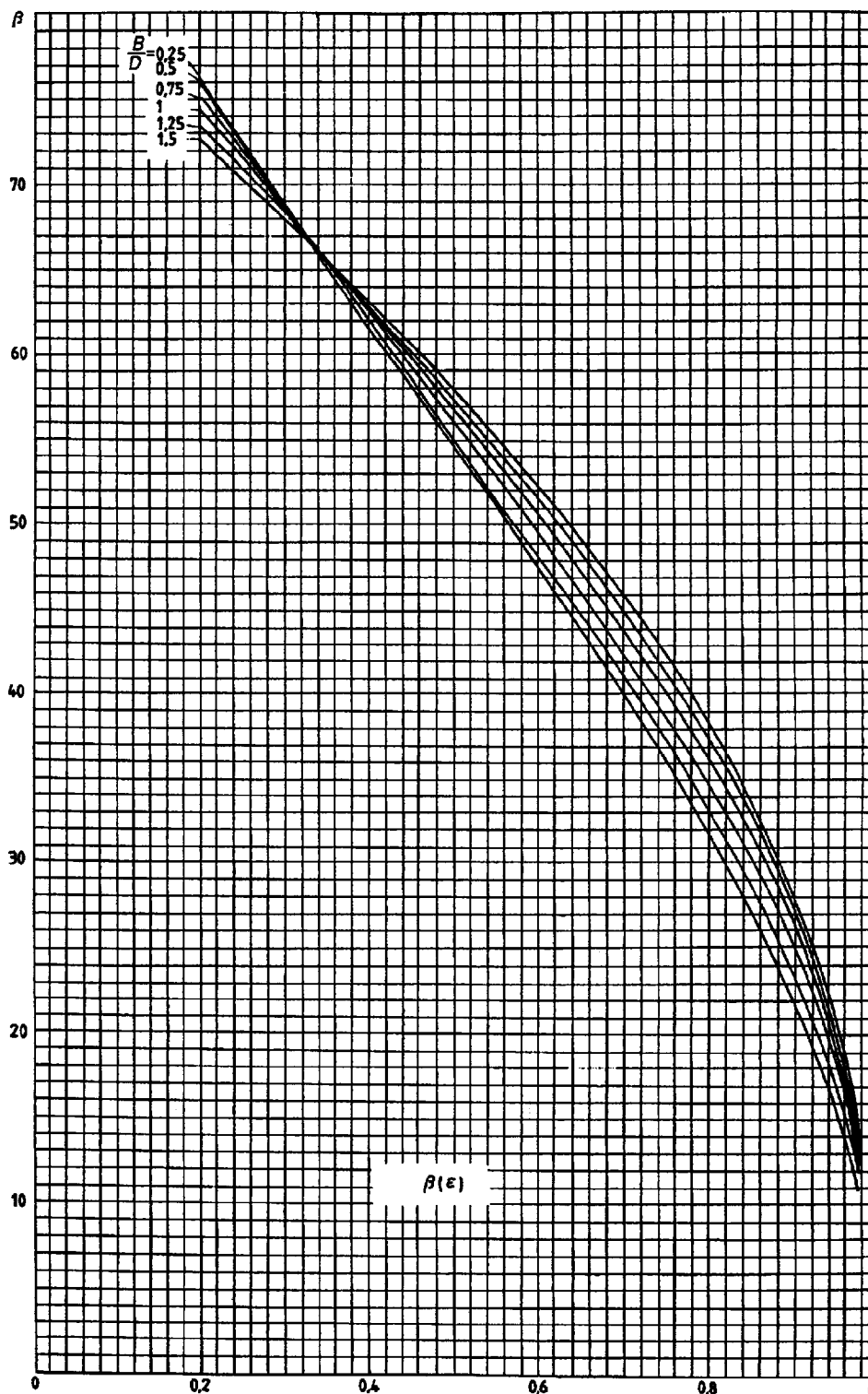


Figure 1 — Attitude angle  $\beta$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 360^\circ$



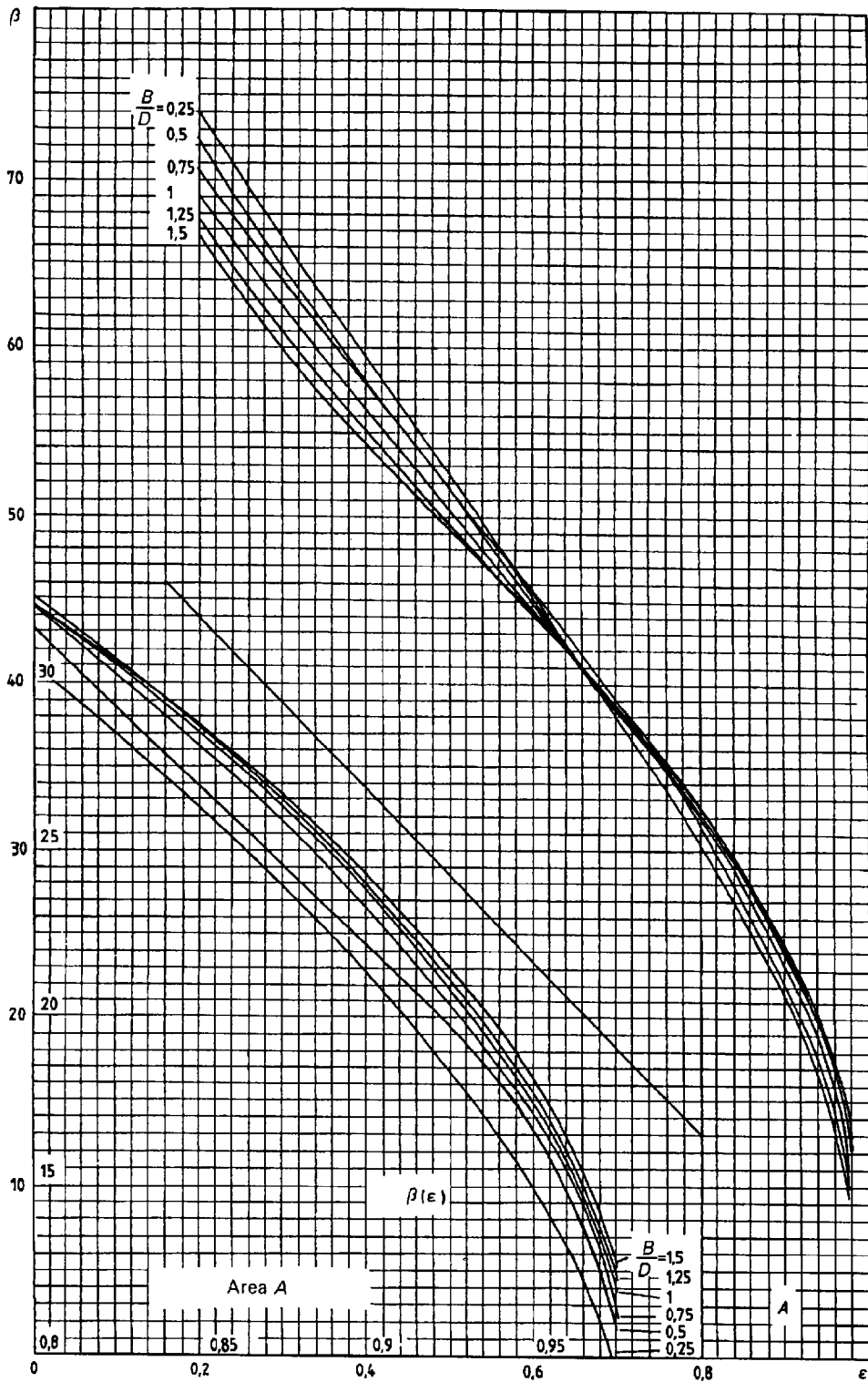


Figure 2 — Attitude angle  $\beta$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 180^\circ$

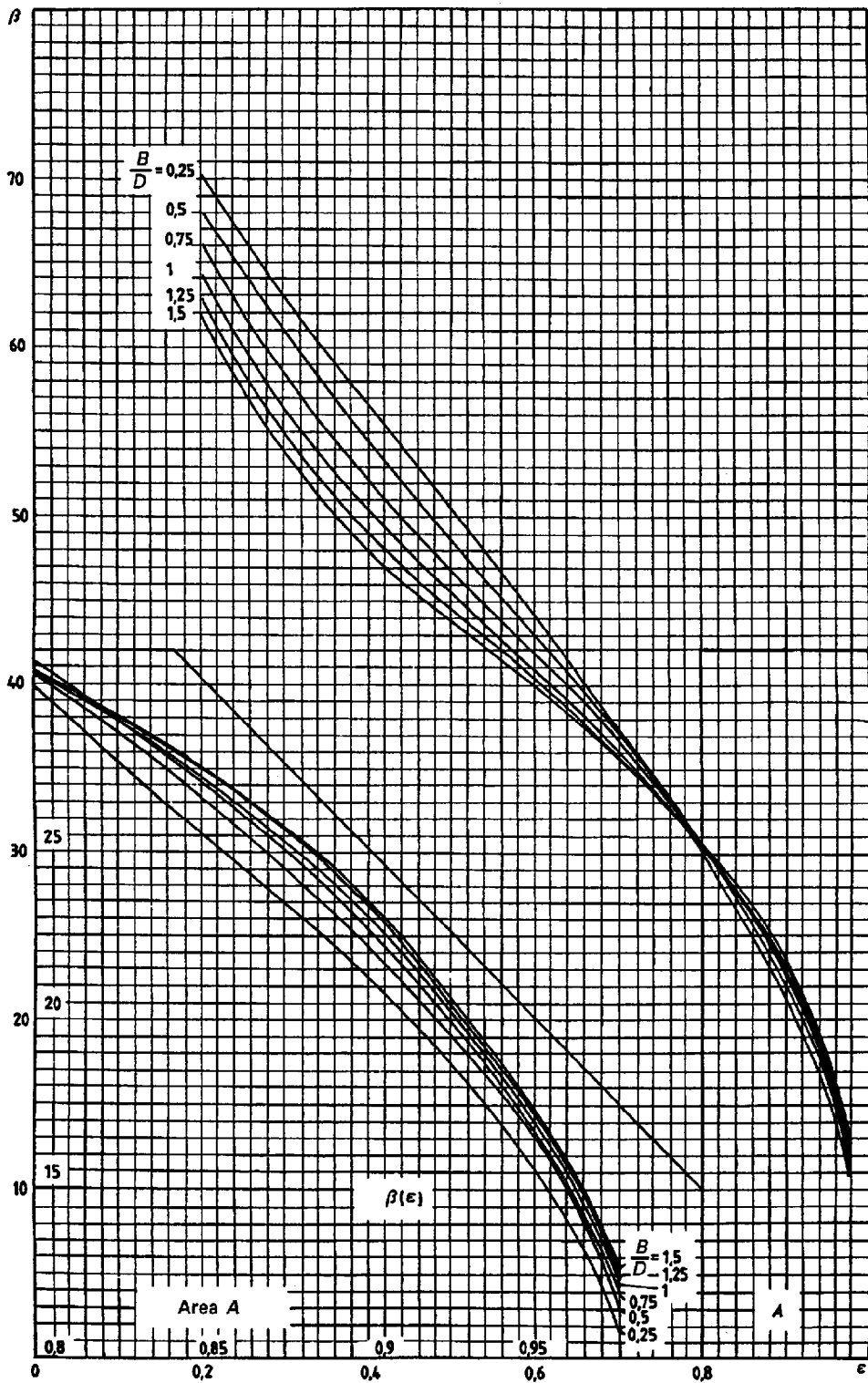


Figure 3 — Attitude angle  $\beta$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 150^\circ$

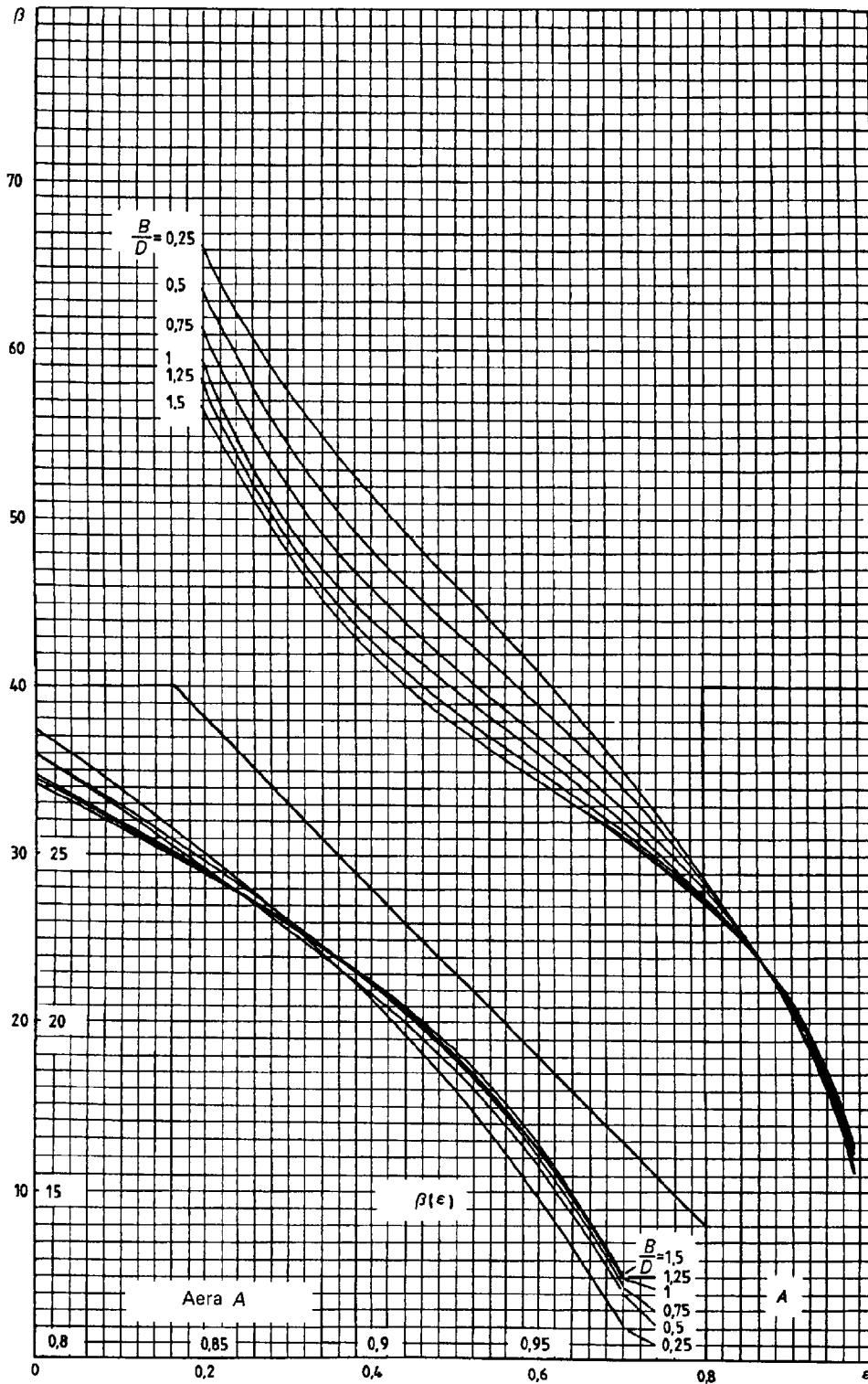


Figure 4 — Attitude angle  $\beta$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 120^\circ$

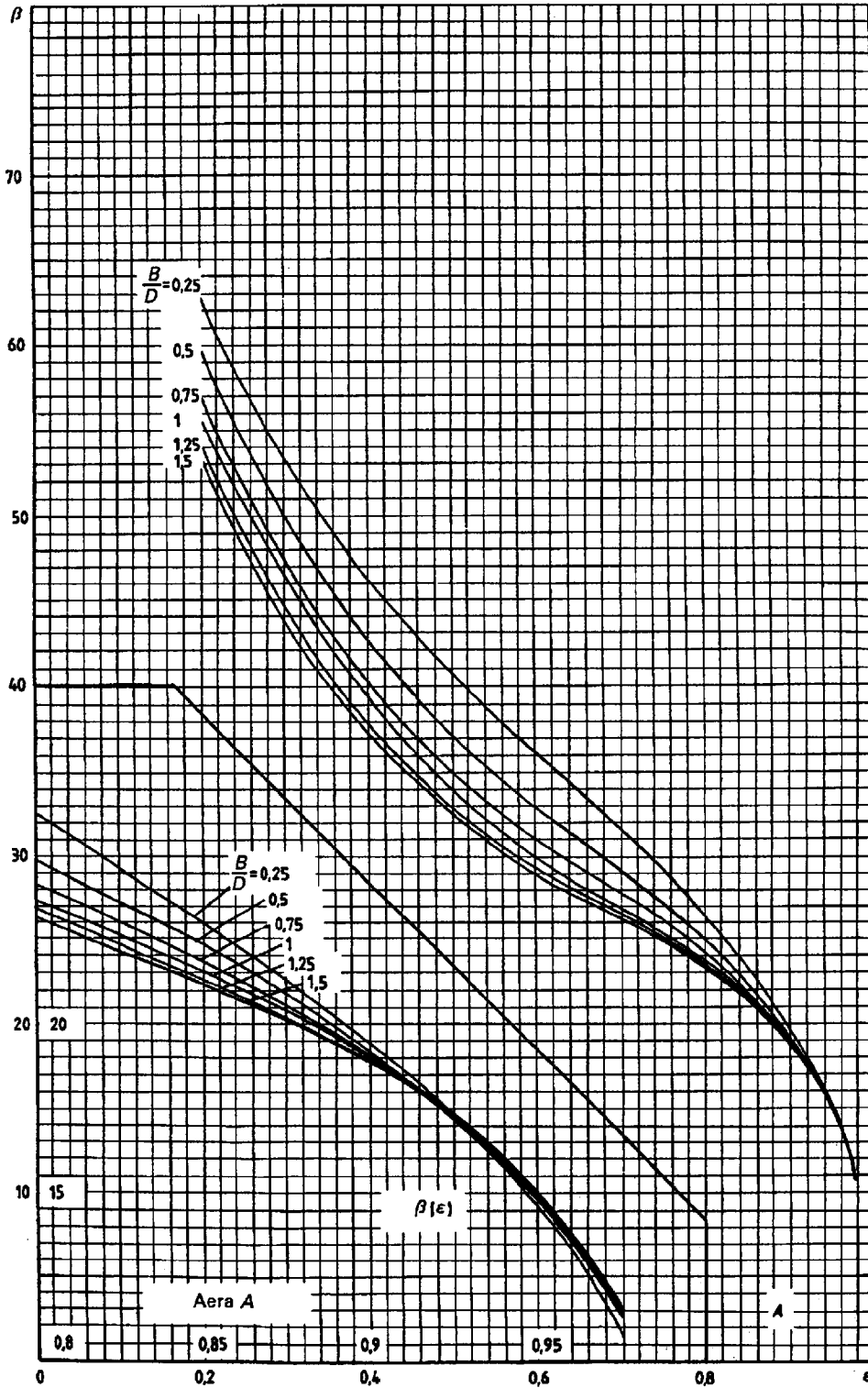


Figure 5 — Attitude angle  $\beta$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 90^\circ$

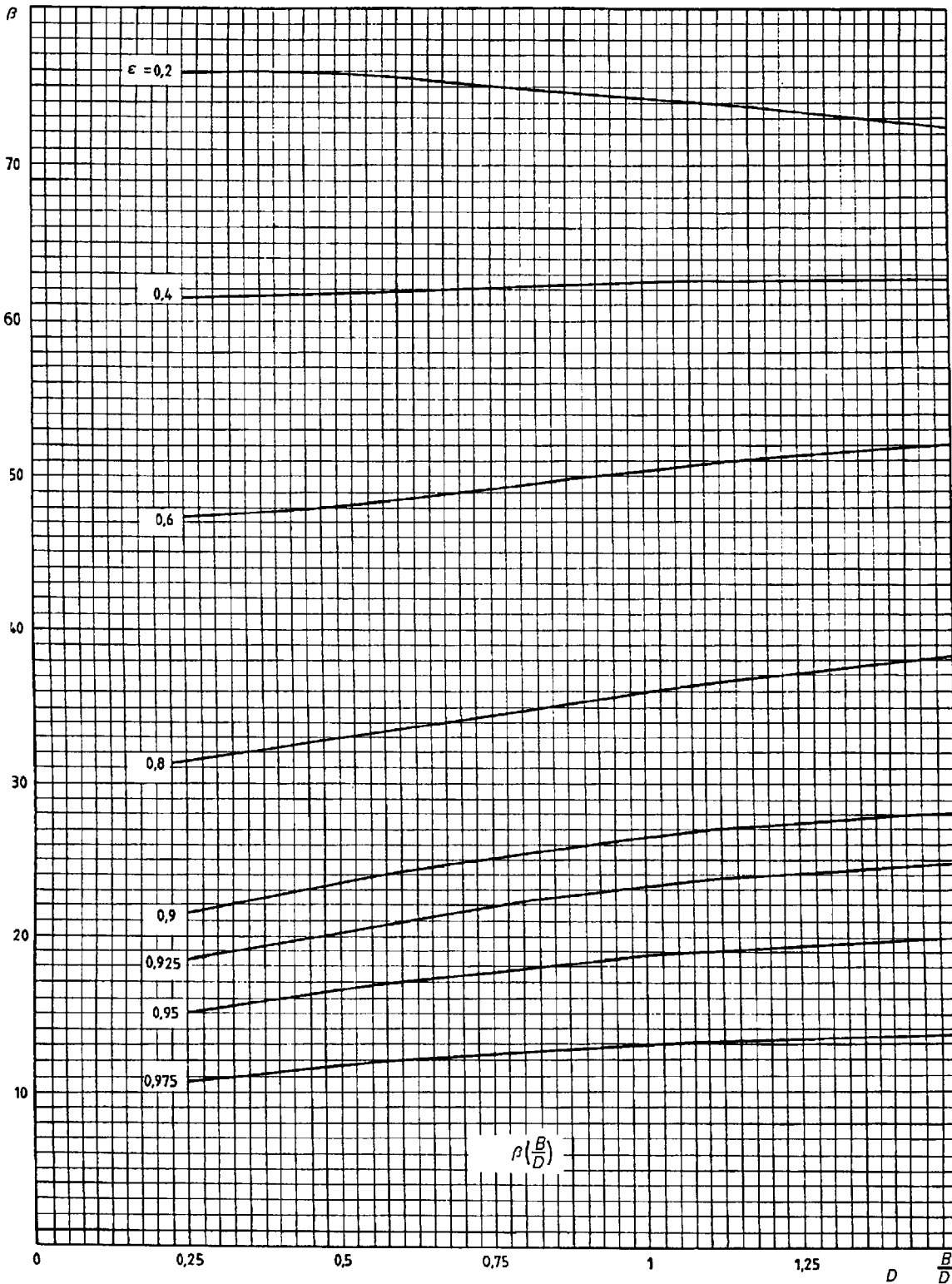


Figure 6 — Attitude angle  $\beta$  as a function of relative bearing width  $B/D$  for  $\Omega = 360^\circ$

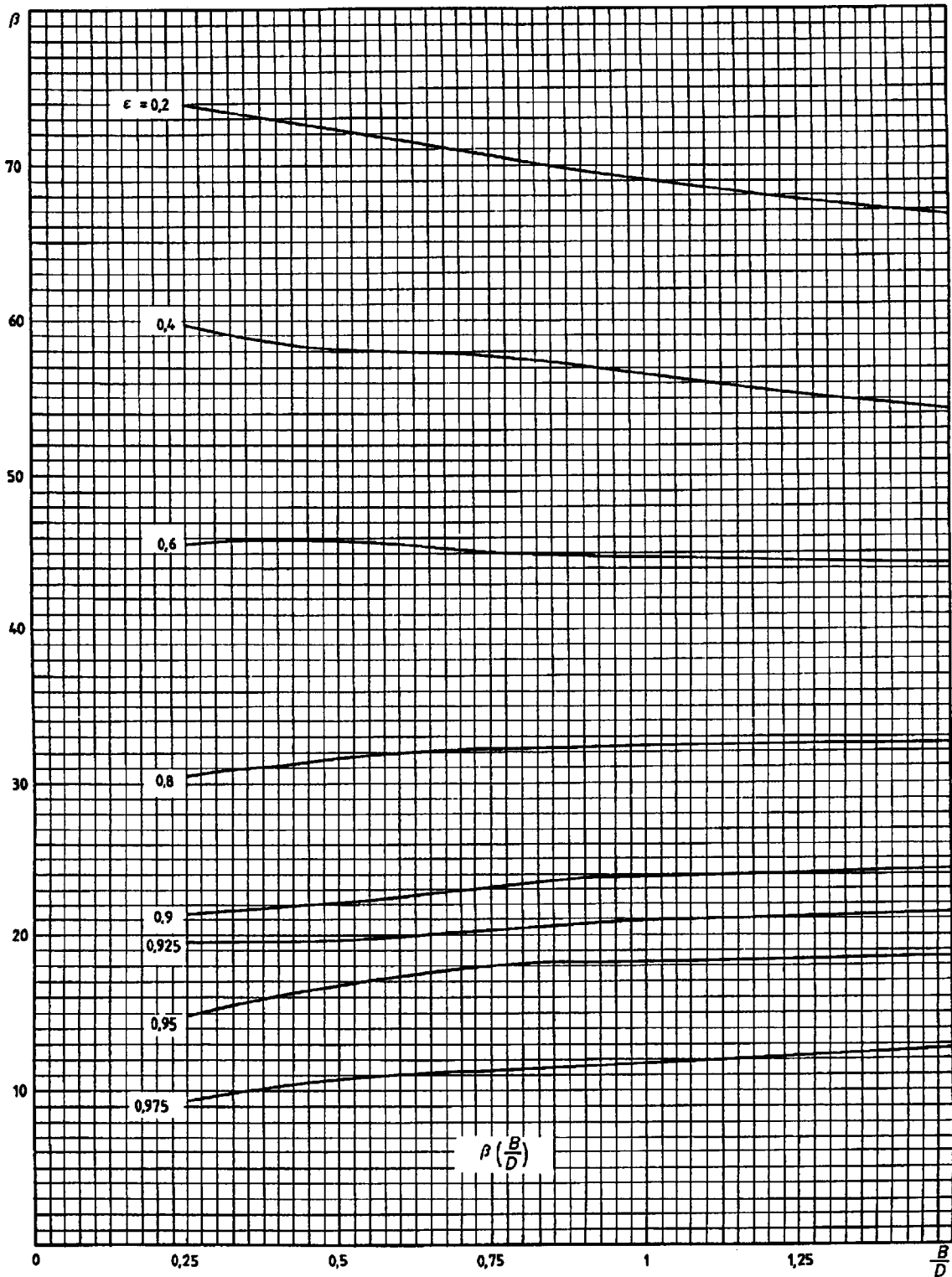


Figure 7 — Attitude angle  $\beta$  as a function of relative bearing length  $B/D$  for  $\Omega = 180^\circ$

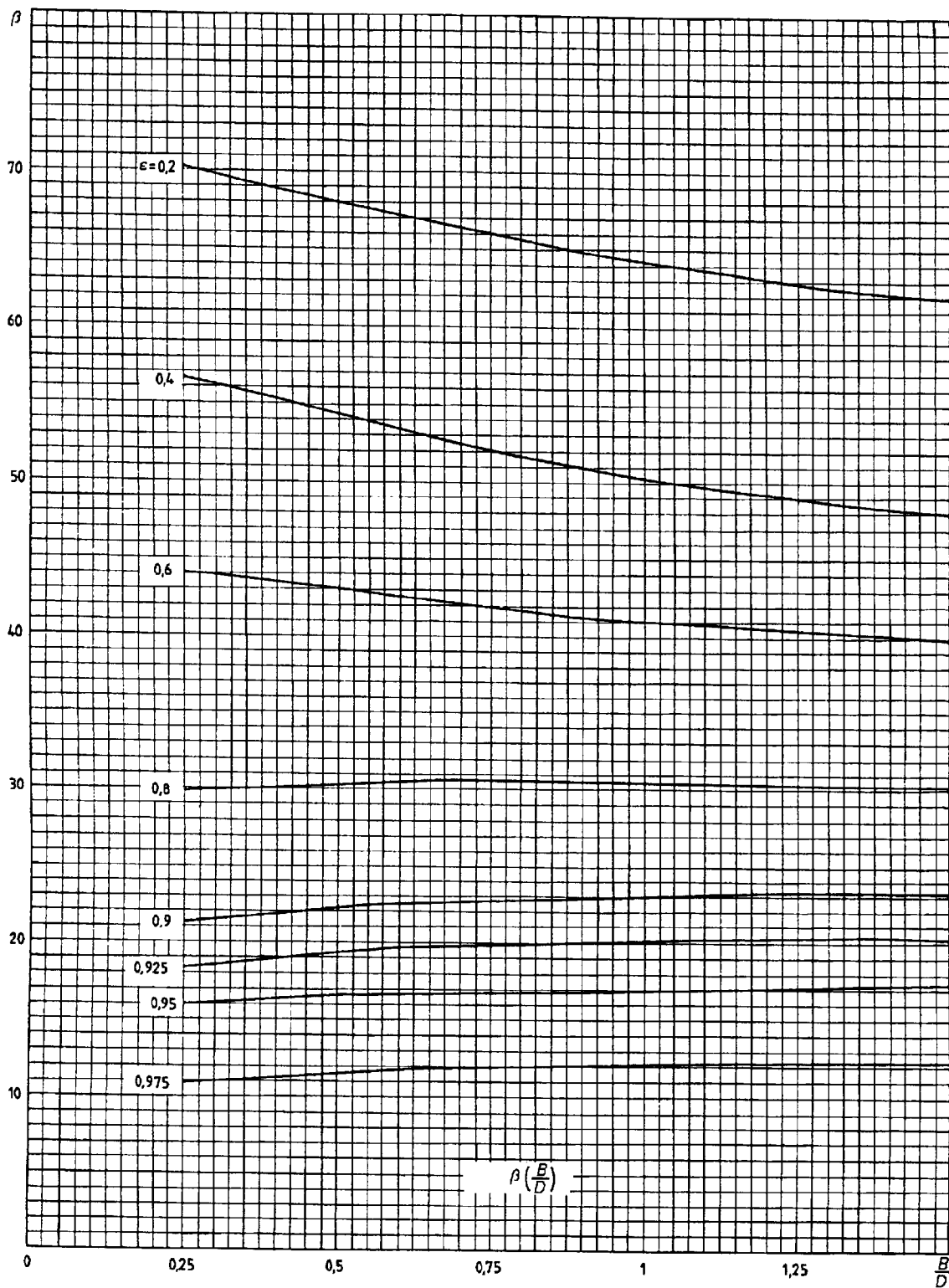


Figure 8 — Attitude angle  $\beta$  as a function of relative bearing length  $B/D$  for  $\Omega = 150^\circ$

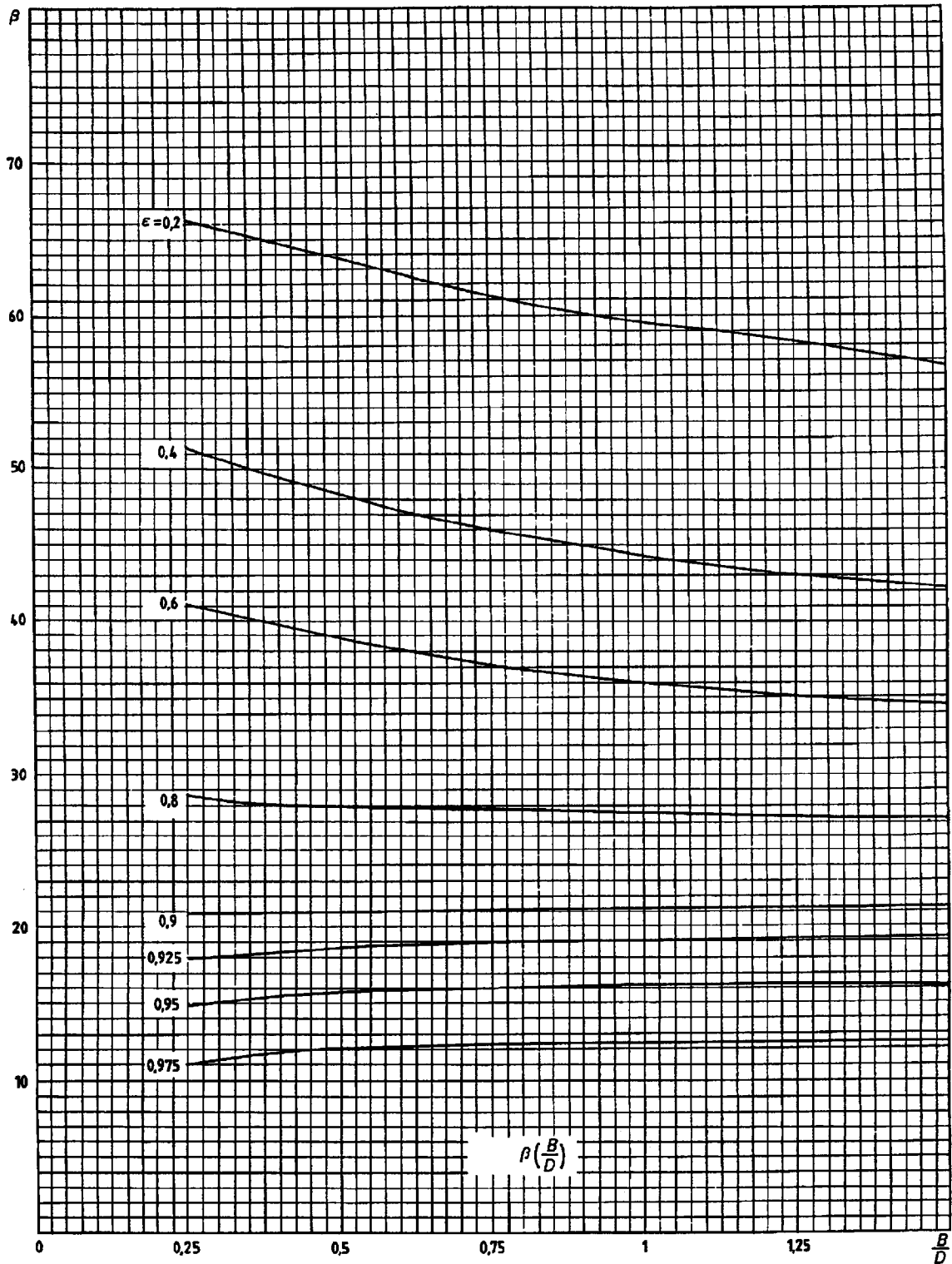


Figure 9 — Attitude angle  $\beta$  as a function of relative bearing width  $B/D$  for  $\Omega = 120^\circ$



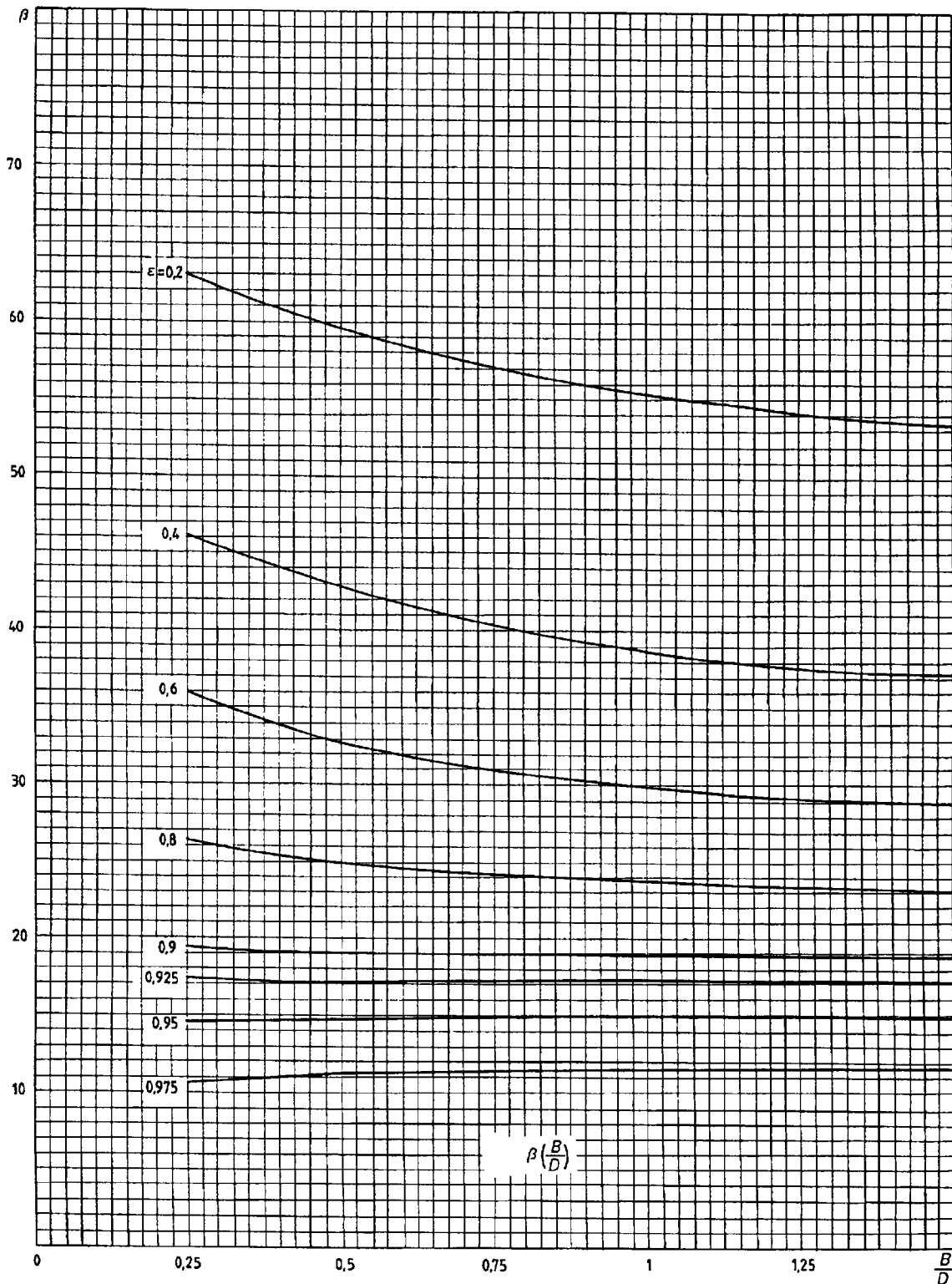


Figure 10 — Attitude angle  $\beta$  as a function of relative bearing width  $B/D$  for  $\Omega = 90^\circ$

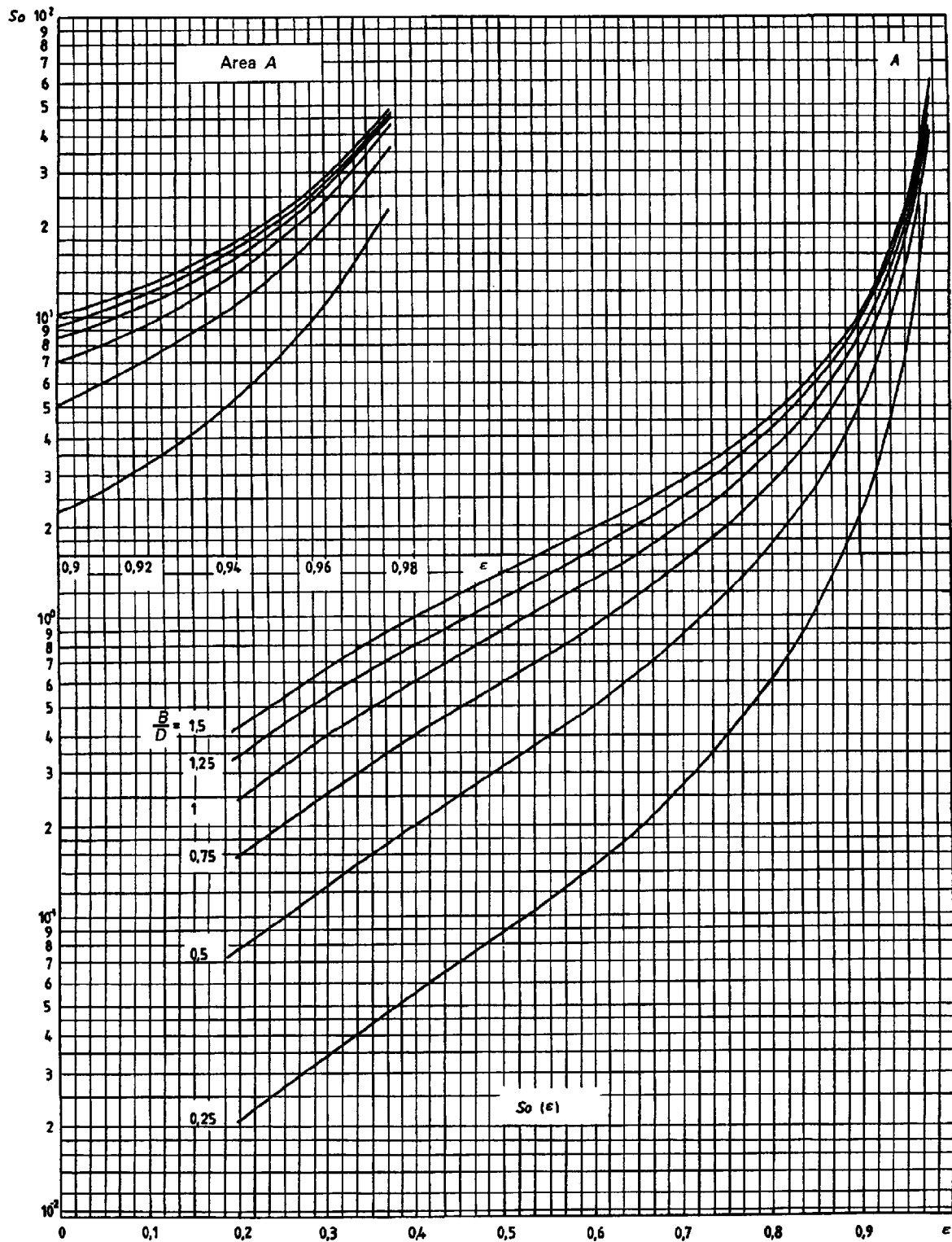


Figure 11 — Sommerfeld number  $S_o$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 360^\circ$

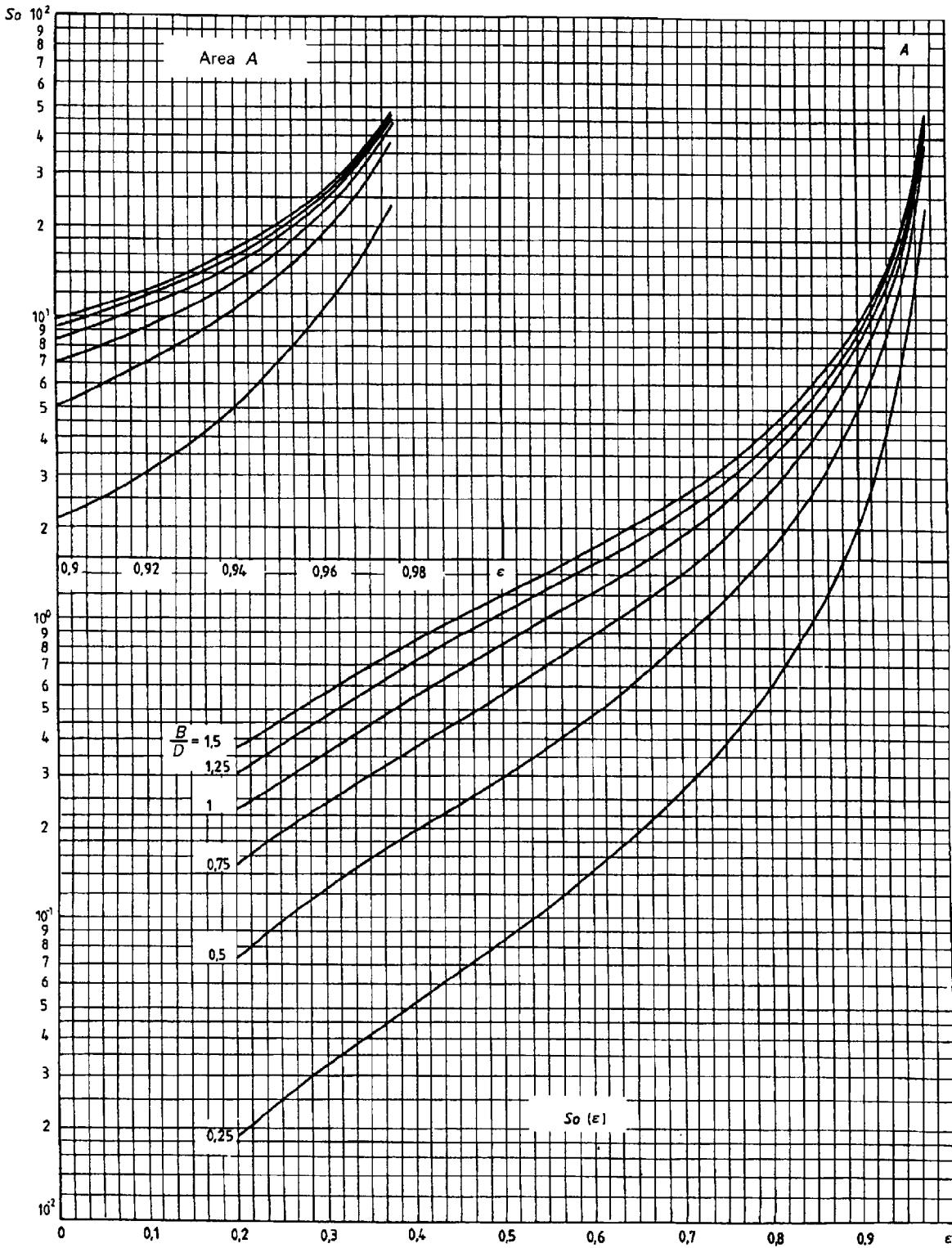


Figure 12 — Sommerfeld number  $S_o$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 180^\circ$

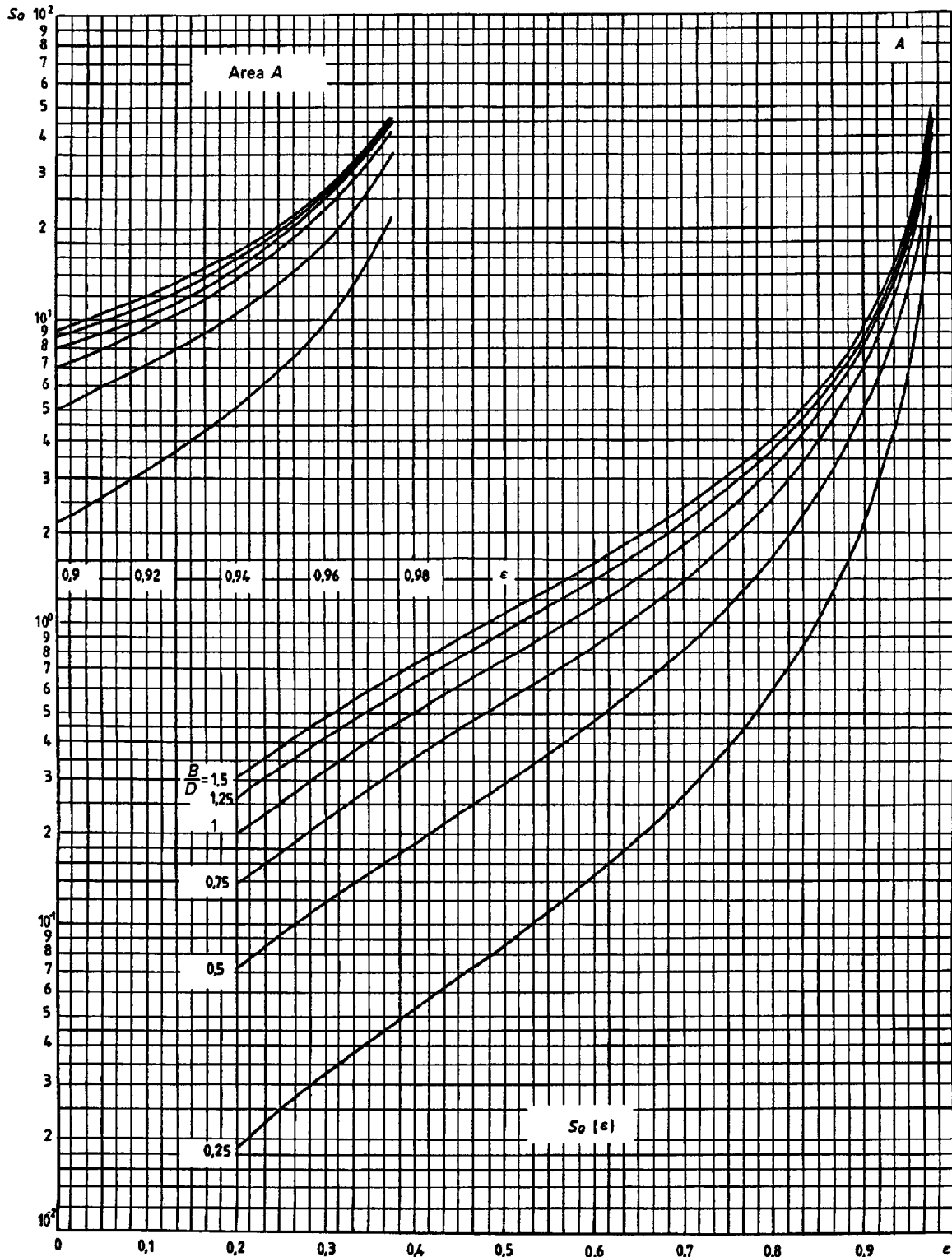


Figure 13 — Sommerfeld number  $S_o$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 150^\circ$

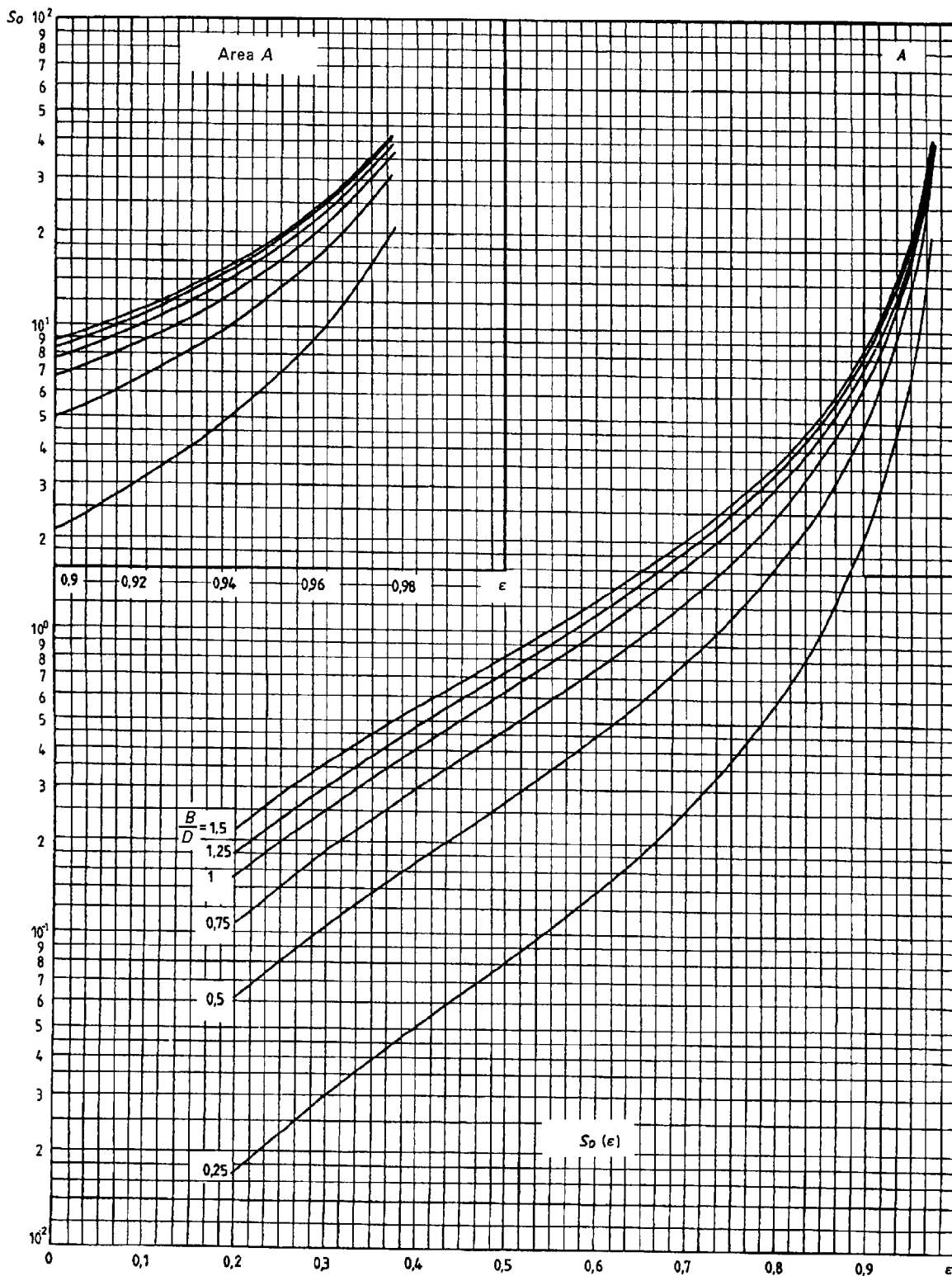


Figure 14 — Sommerfeld number  $S_o$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 120^\circ$

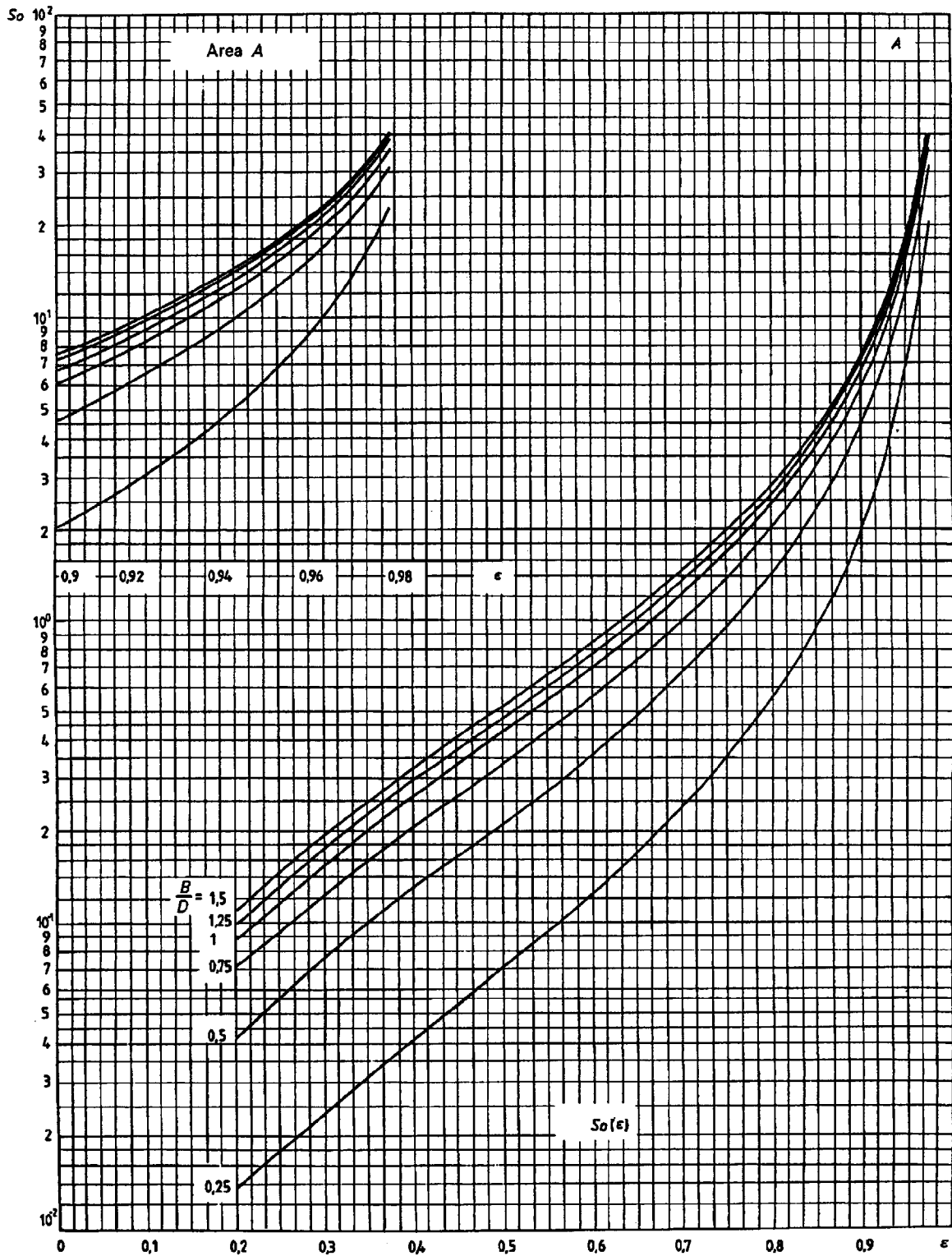


Figure 15 — Sommerfeld number  $S_o$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 90^\circ$

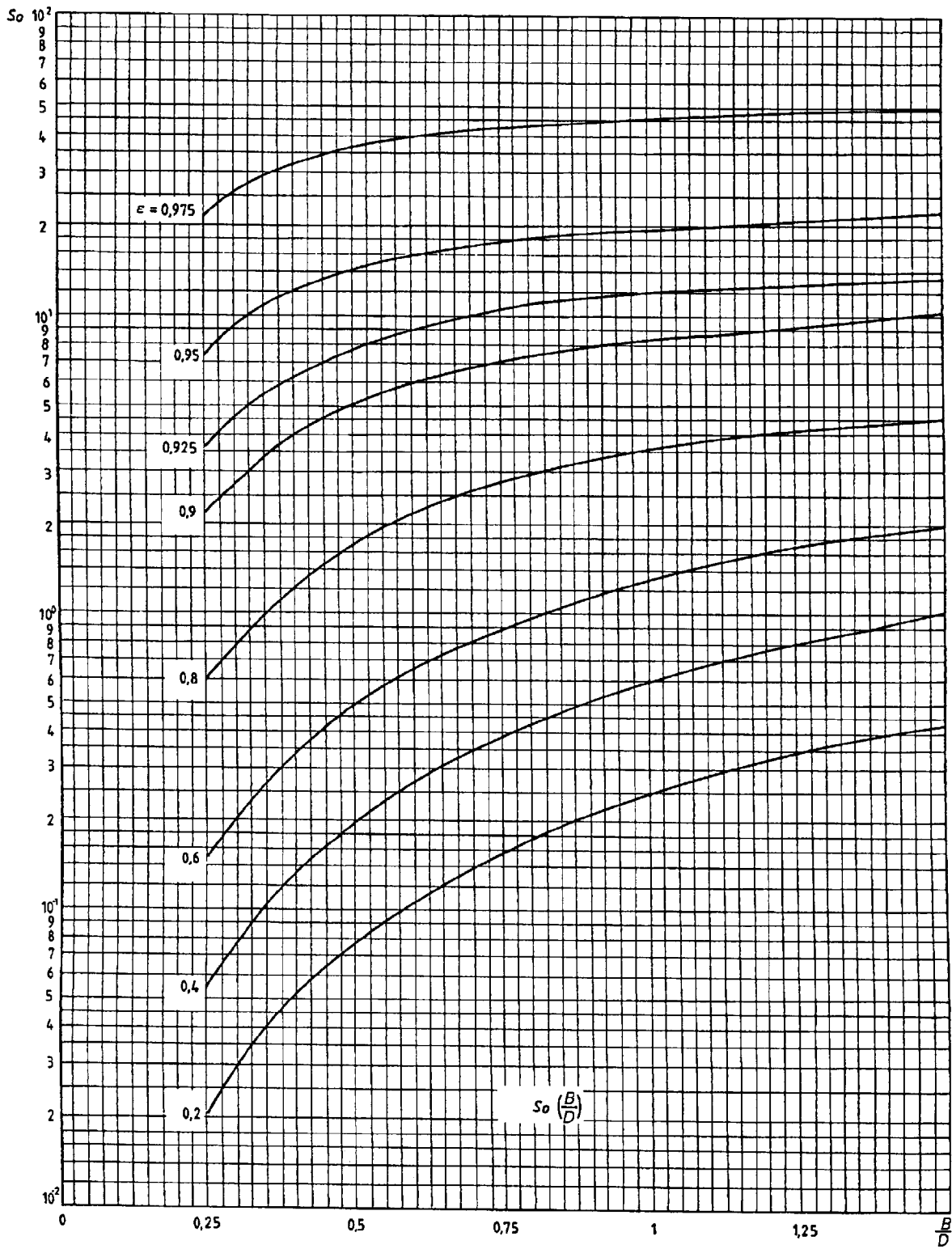


Figure 16 — Sommerfeld number  $S_o$  as a function of relative bearing width  $B/D$  for  $\Omega = 360^\circ$

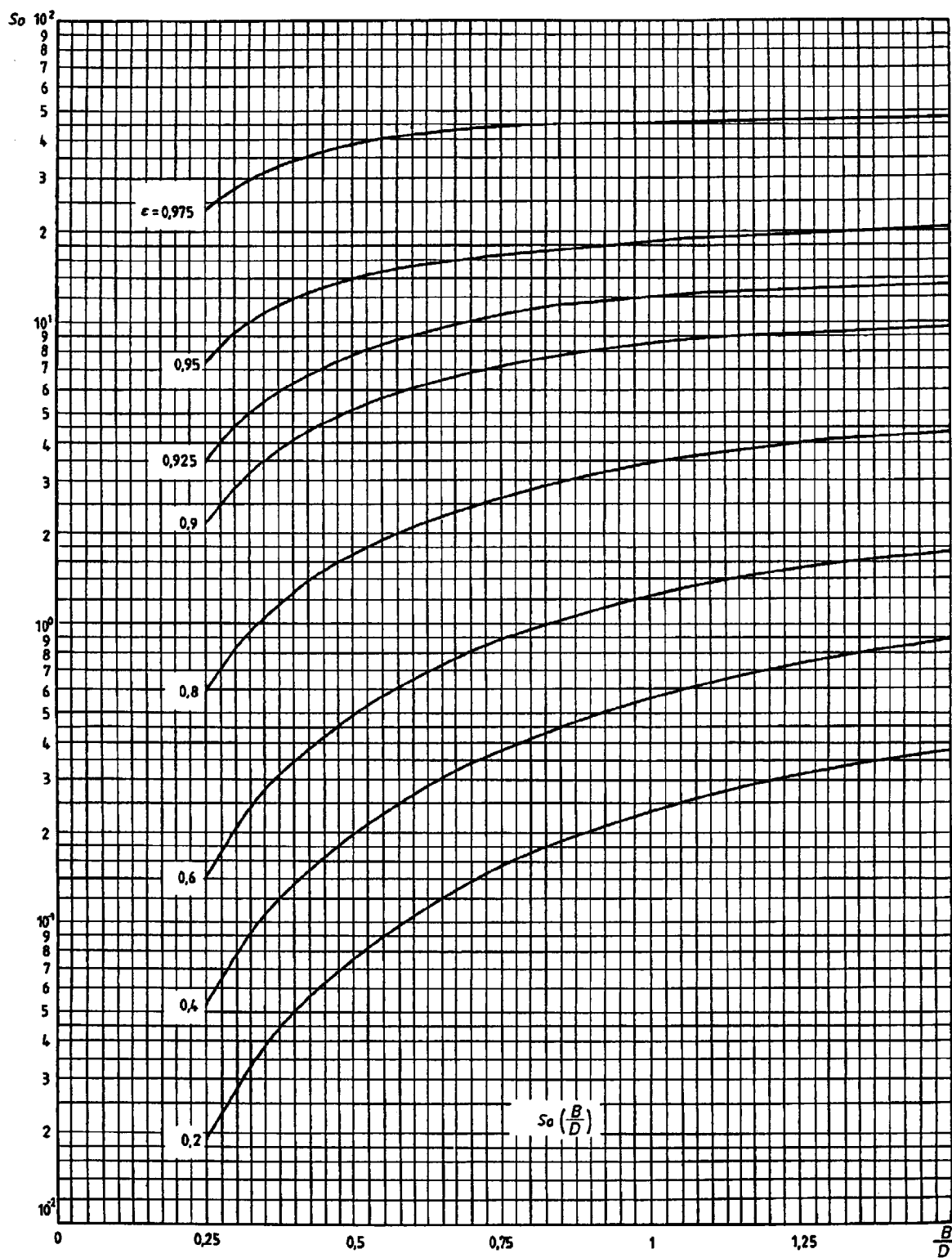


Figure 17 — Sommerfeld number  $S_o$  as a function of relative bearing width  $B/D$  for  $\Omega = 180^\circ$



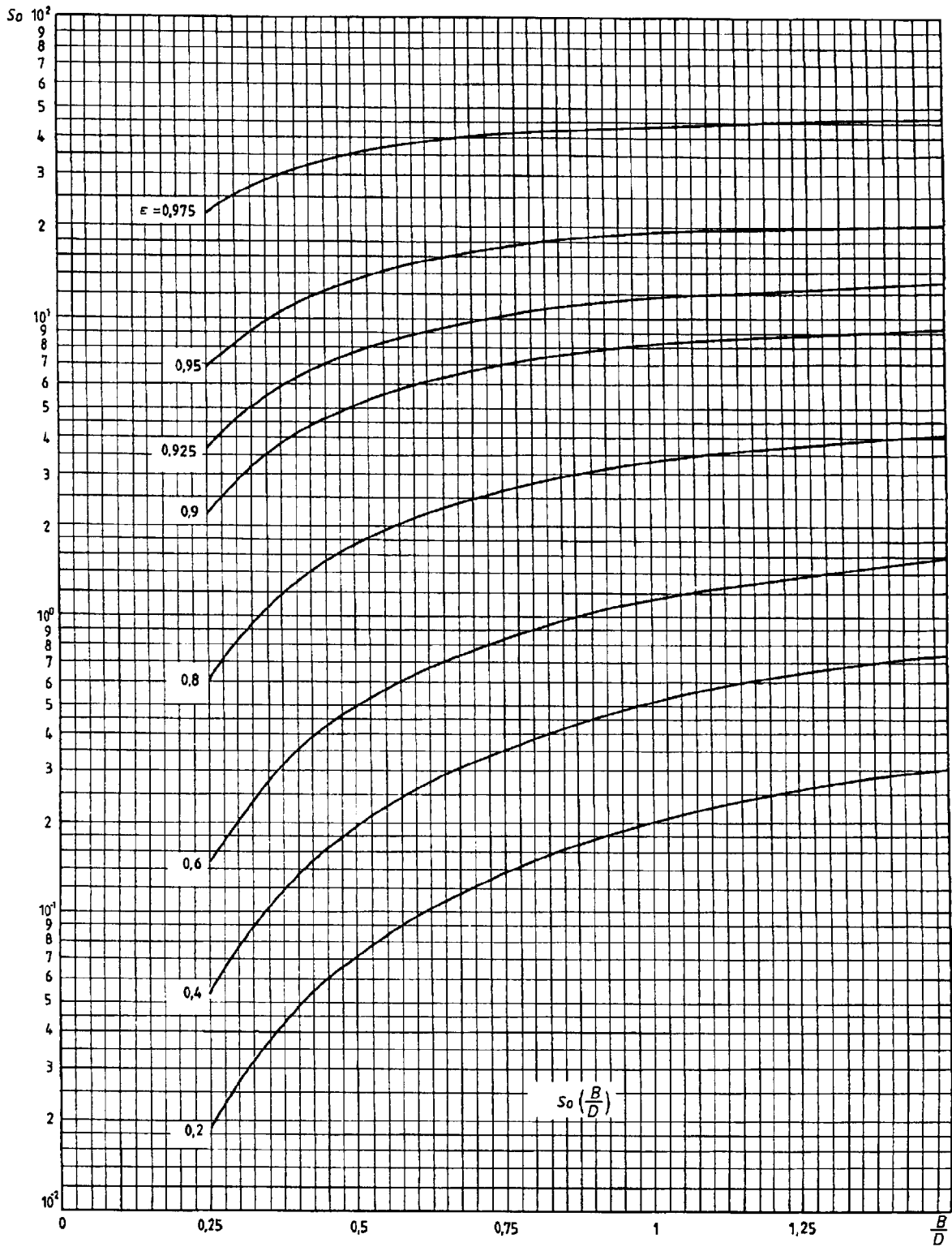


Figure 18 — Sommerfeld number  $S_o$  as a function of relative bearing width  $B/D$  for  $\Omega = 150^\circ$

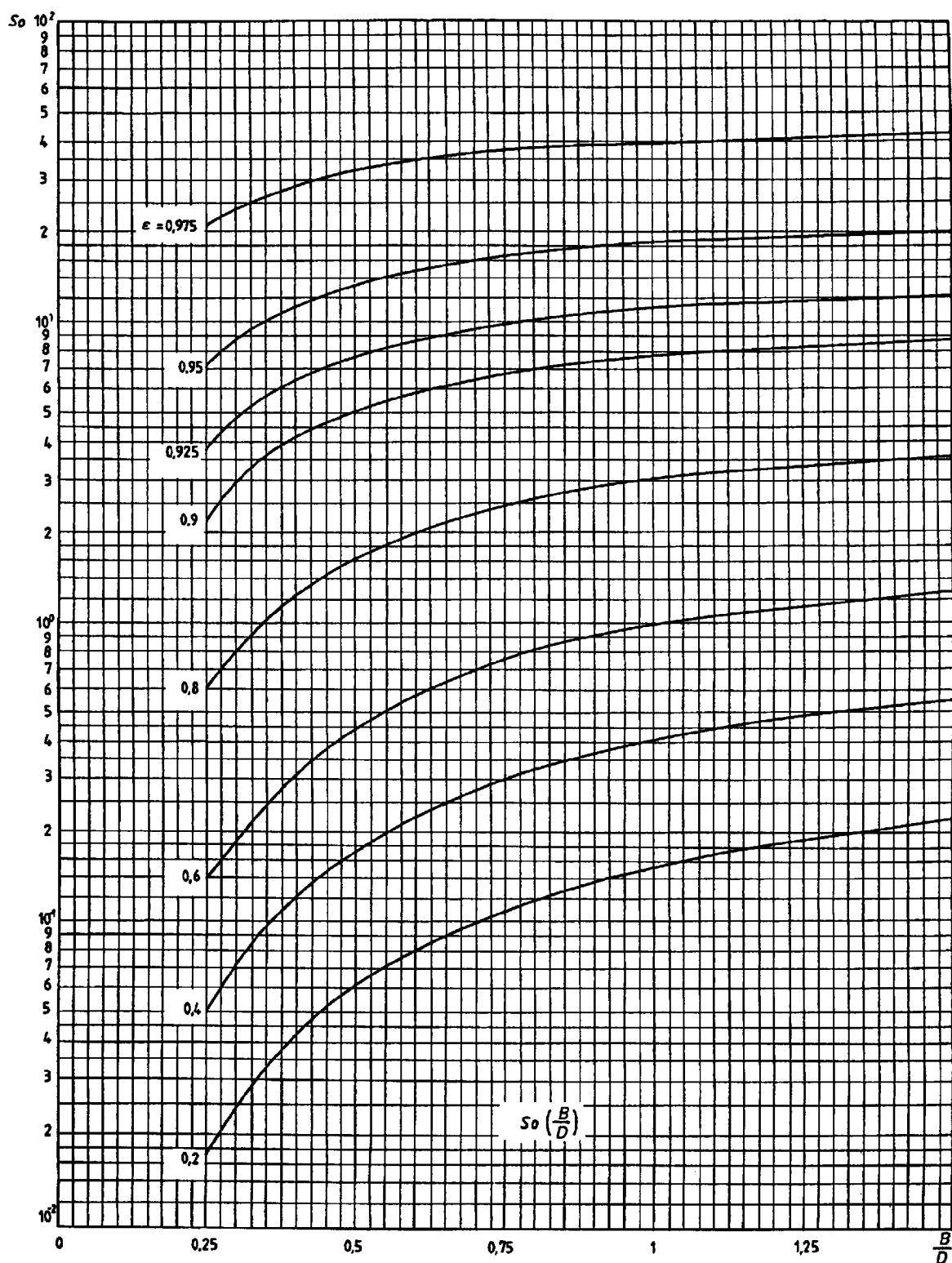


Figure 19 — Sommerfeld number  $S_0$  as a function of relative bearing width  $B/D$  for  $\Omega = 120^\circ$

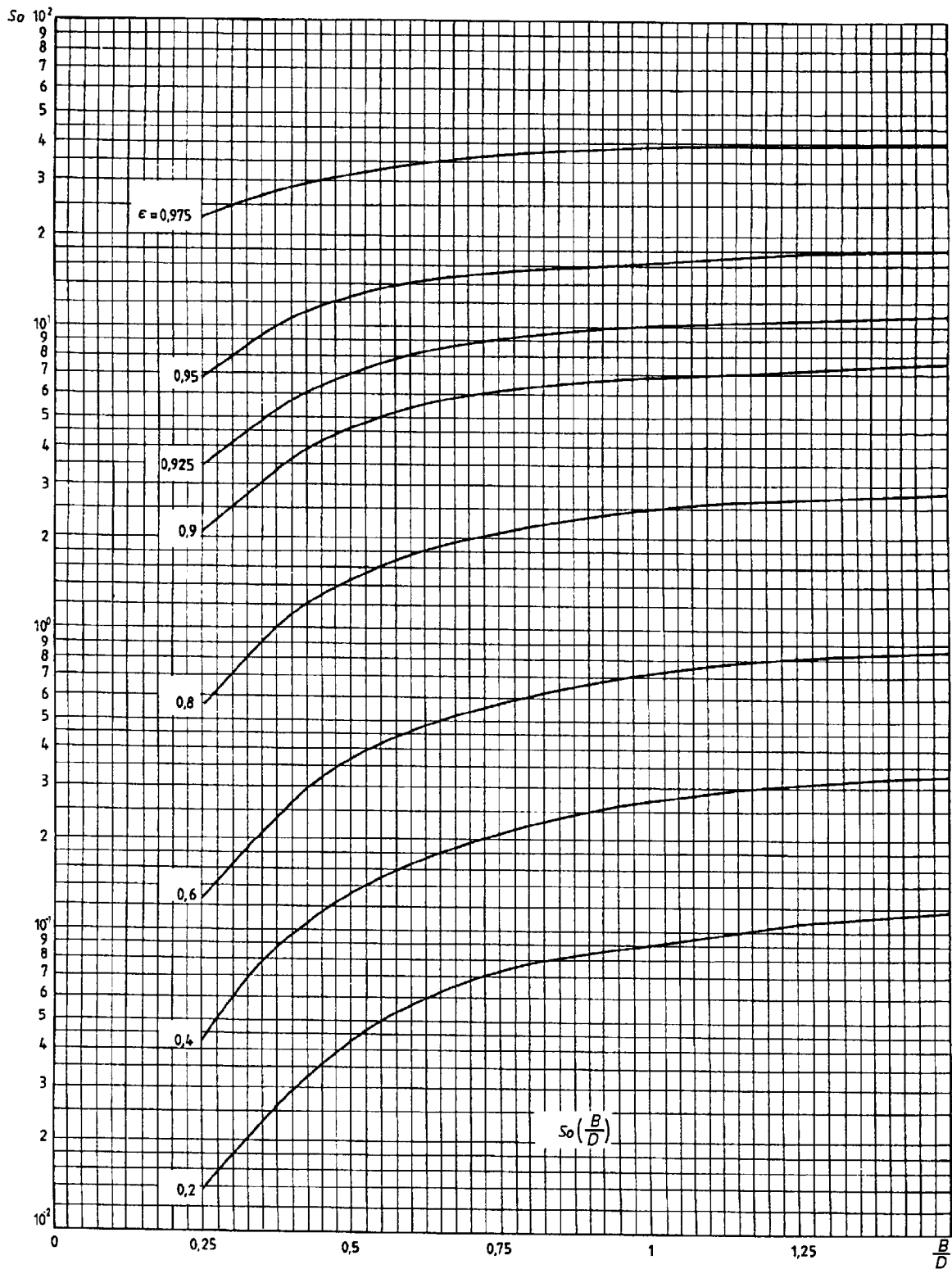


Figure 20 — Sommerfeld number  $S_o$  as a function of relative bearing width  $B/D$  for  $\Omega = 90^\circ$

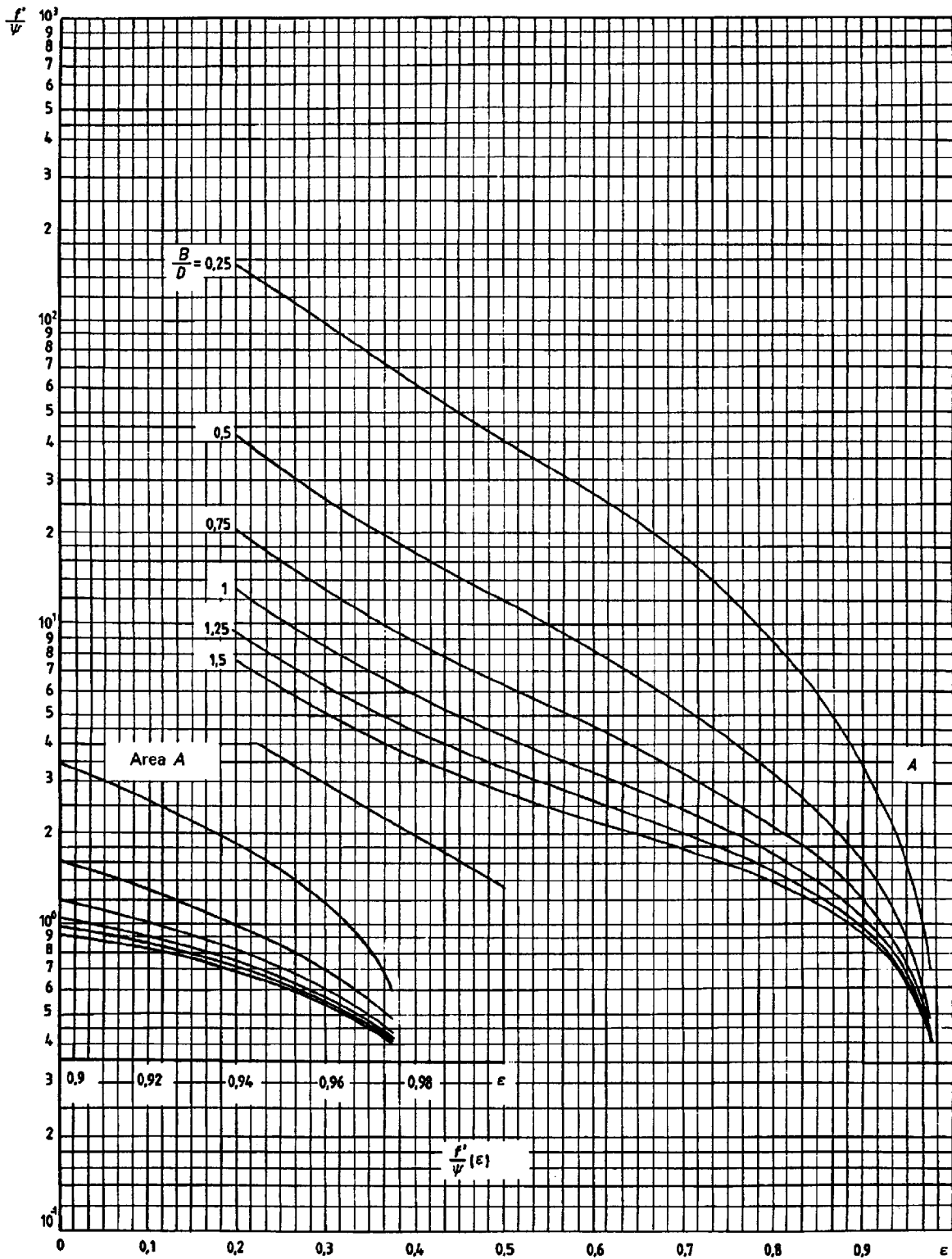


Figure 21 — Specific coefficient of friction  $f'/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 360^\circ$

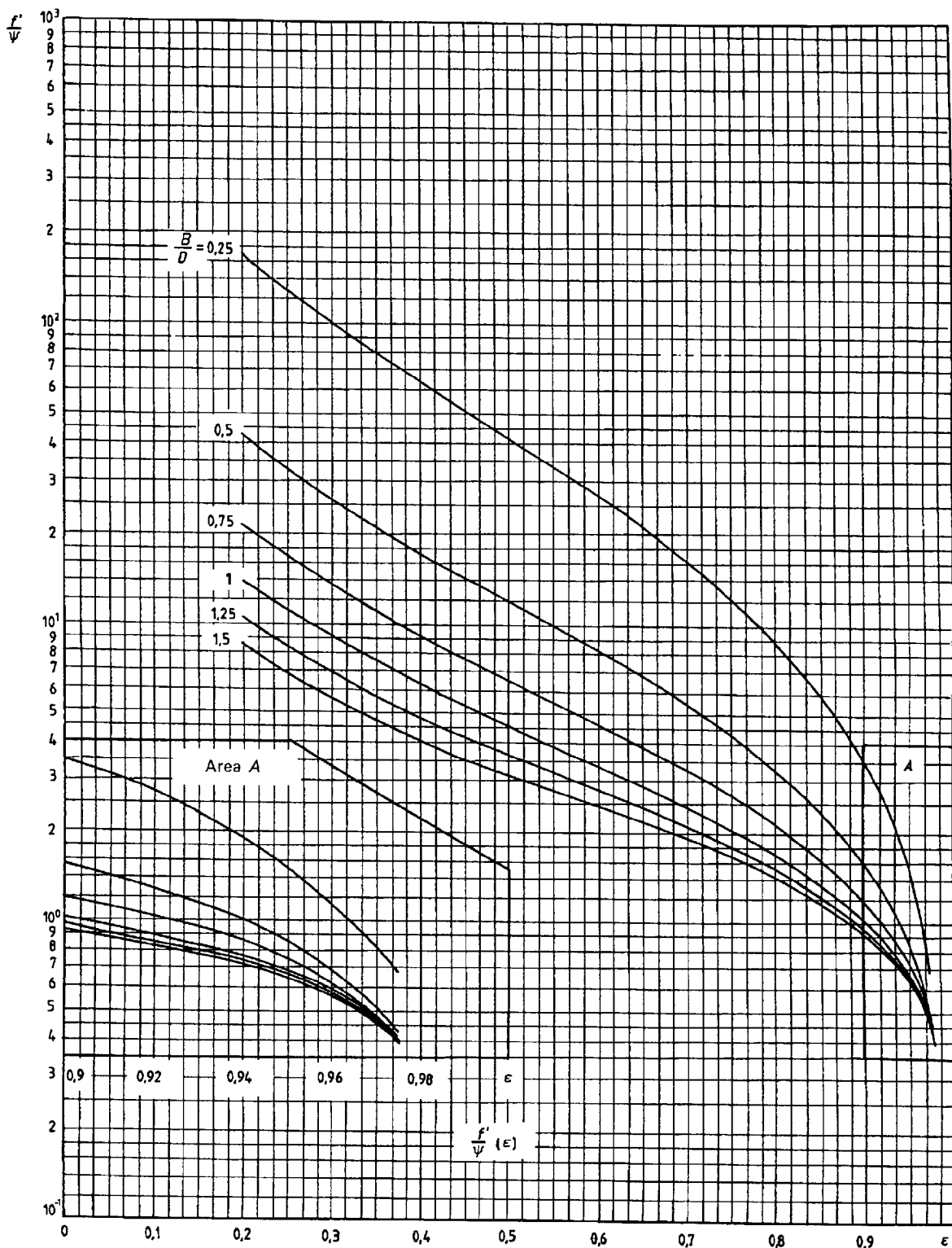


Figure 22 — Specific coefficient of friction  $f'/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 180^\circ$

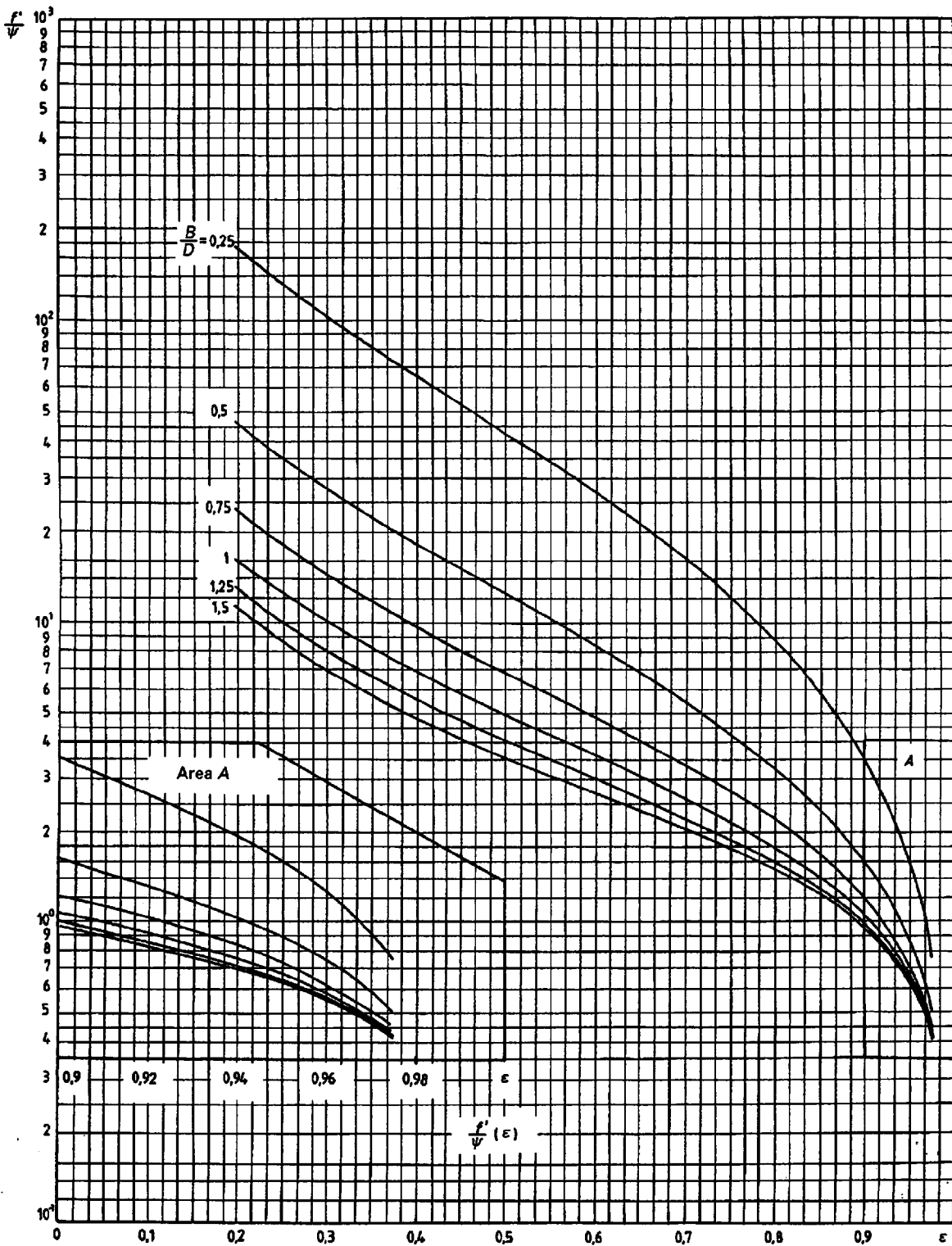


Figure 23 — Specific coefficient of friction  $f'/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 150^\circ$

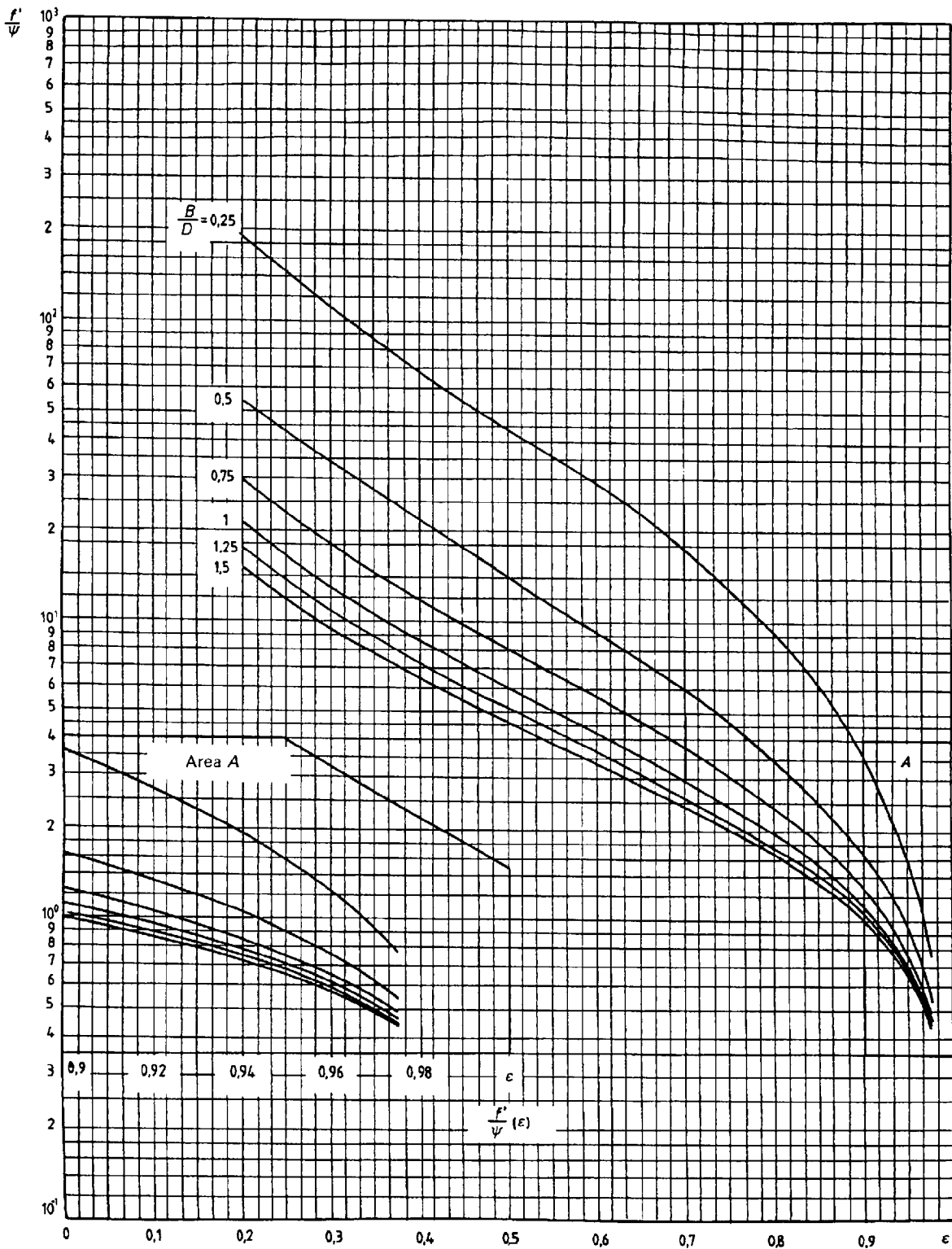


Figure 24 — Specific coefficient of friction  $f'/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 120^\circ$

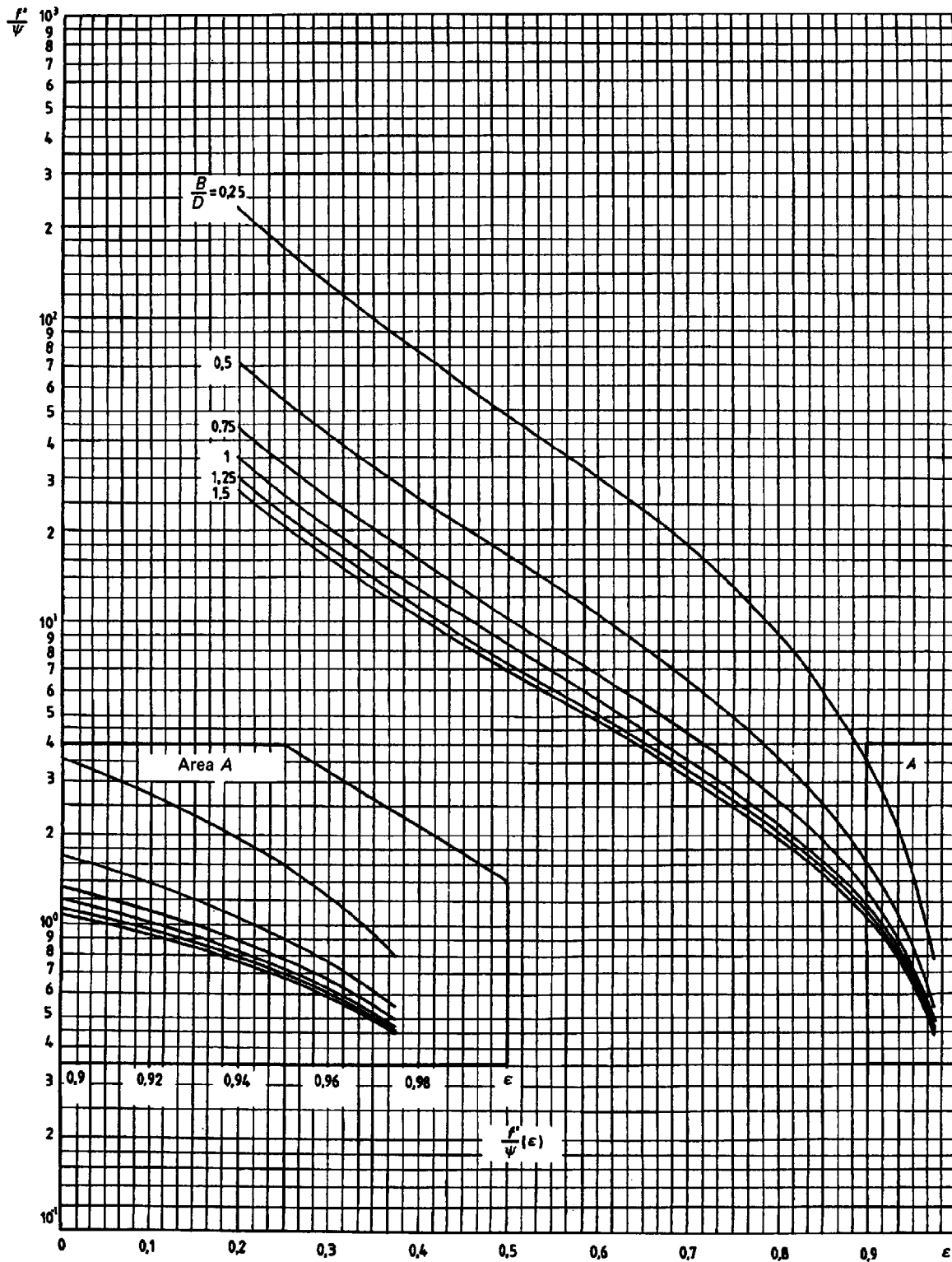


Figure 25 — Specific coefficient of friction  $f'/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 90^\circ$



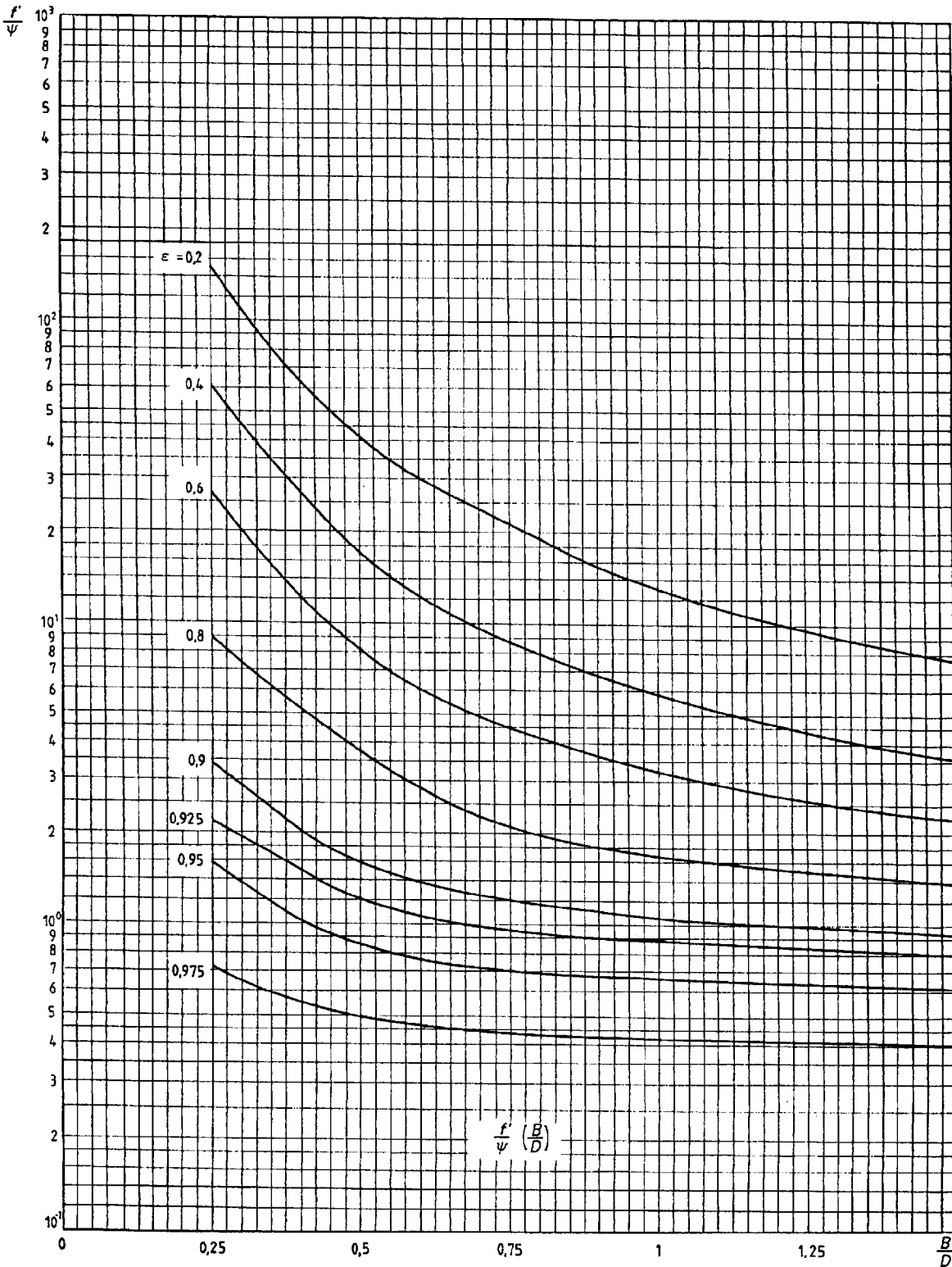


Figure 26 — Specific coefficient of friction  $f'/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 360^\circ$

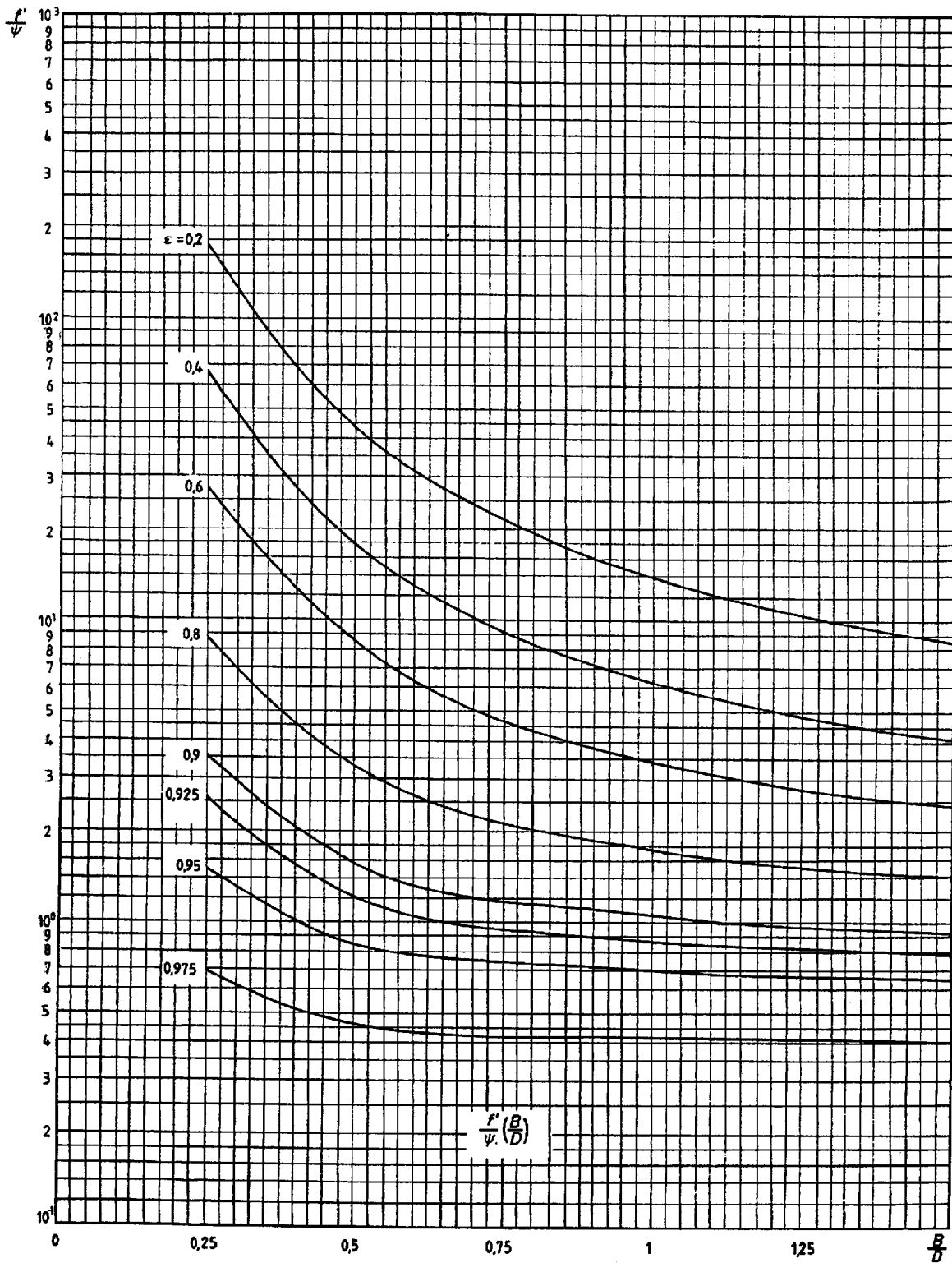


Figure 27 — Specific coefficient of friction  $f'/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 180^\circ$

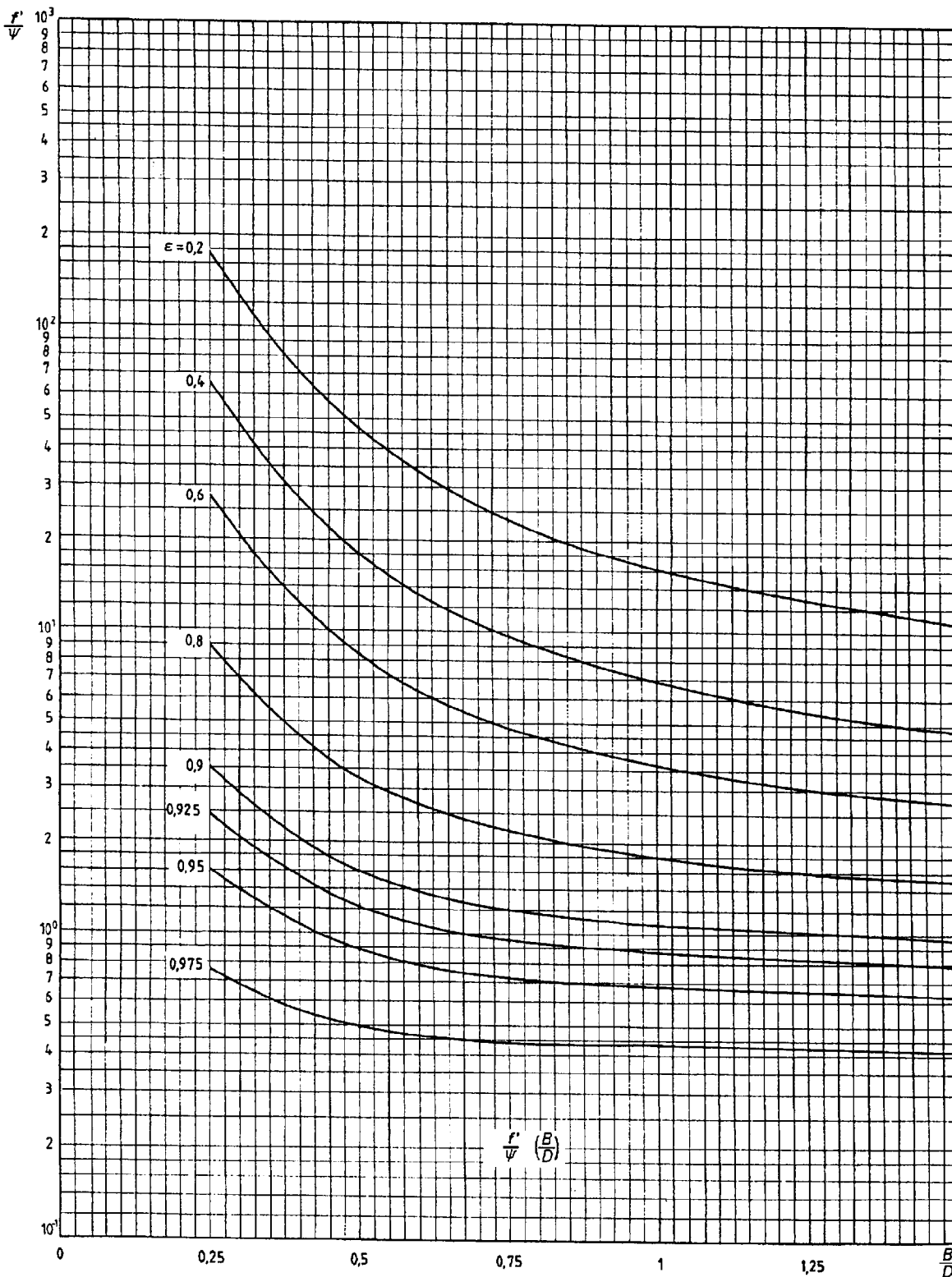


Figure 28 — Specific coefficient of friction  $f'/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 150^\circ$

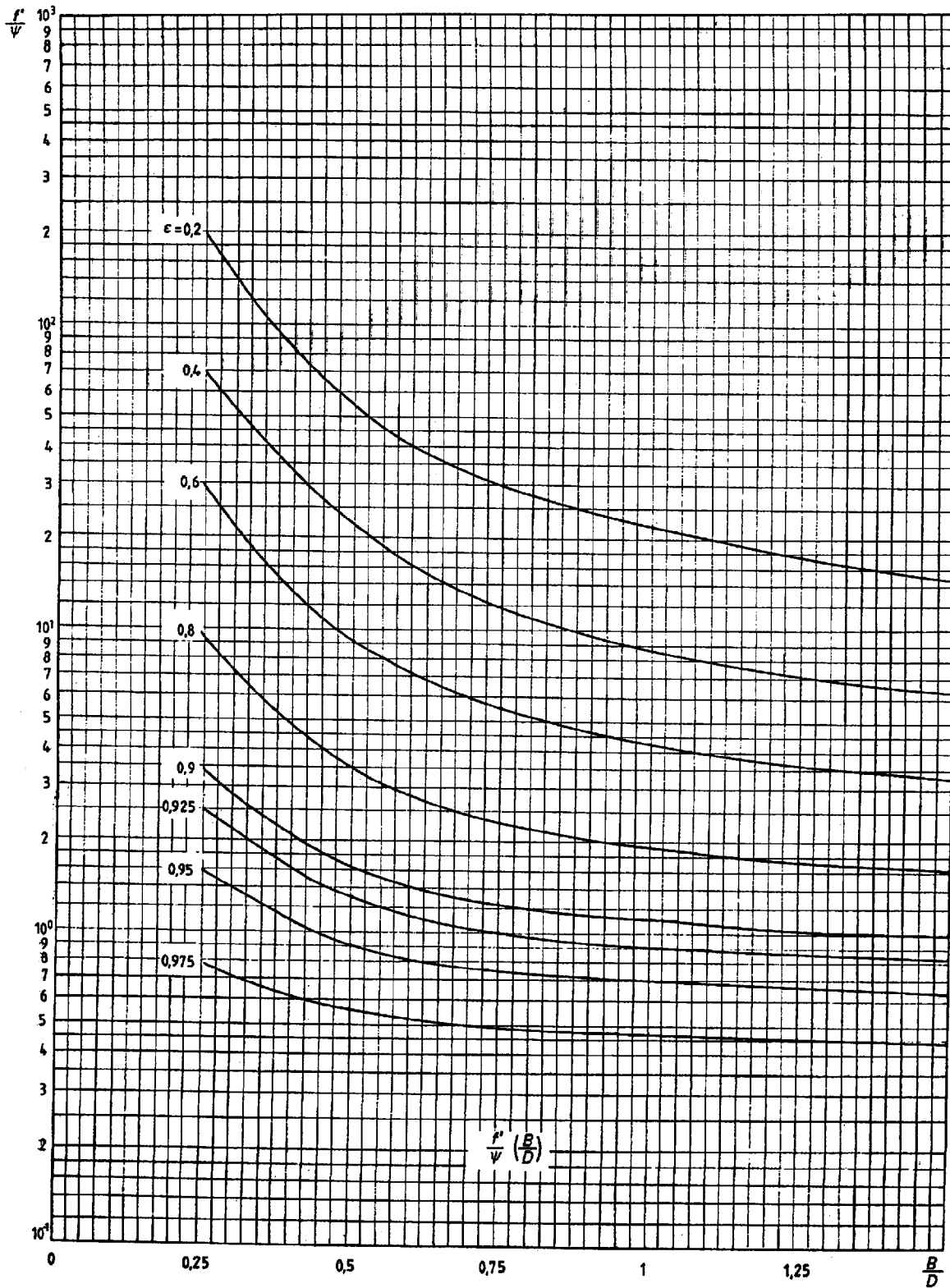


Figure 29 — Specific coefficient of friction  $f'/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 120^\circ$

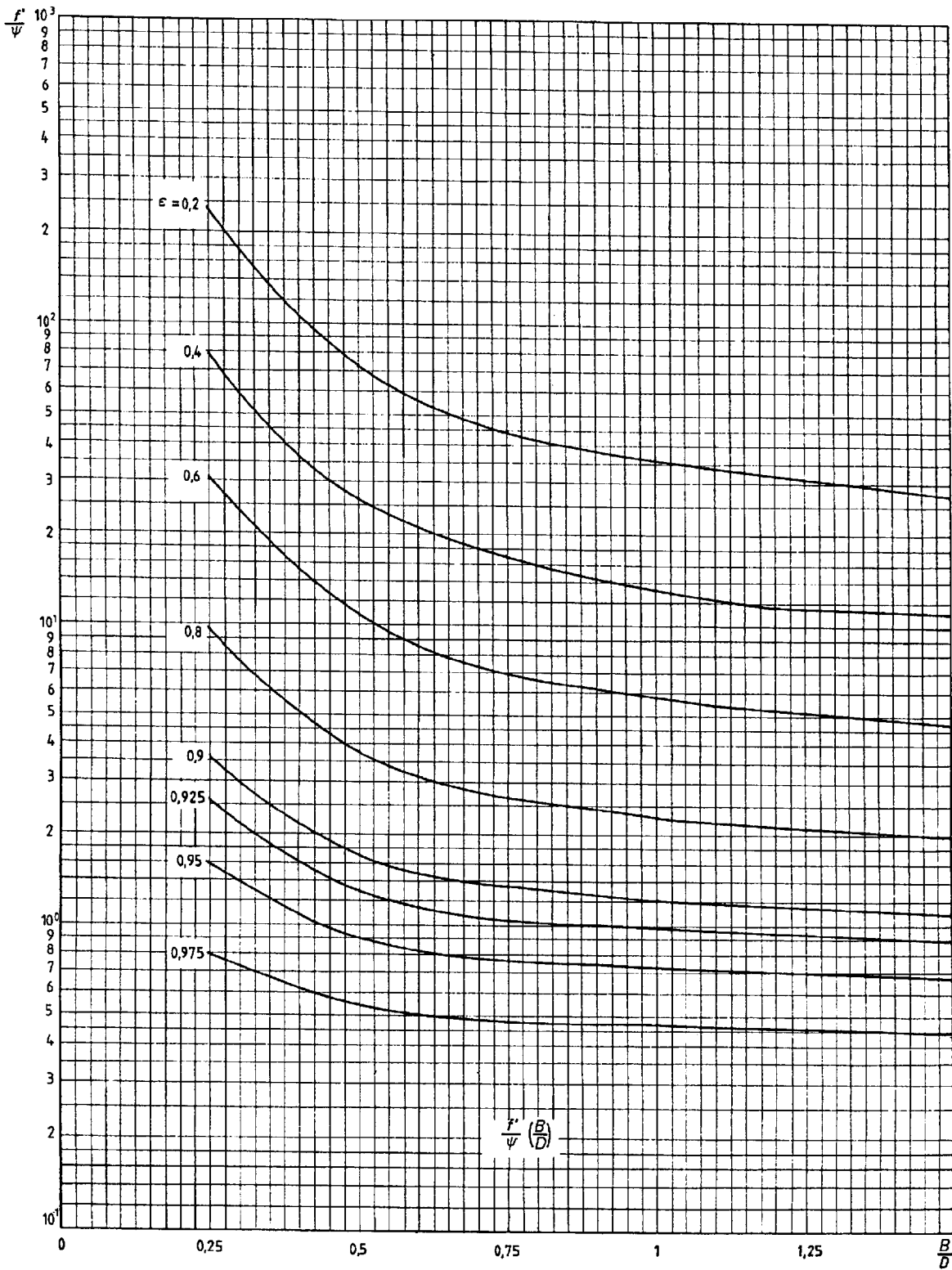


Figure 30 — Specific coefficient of friction  $f'/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 90^\circ$

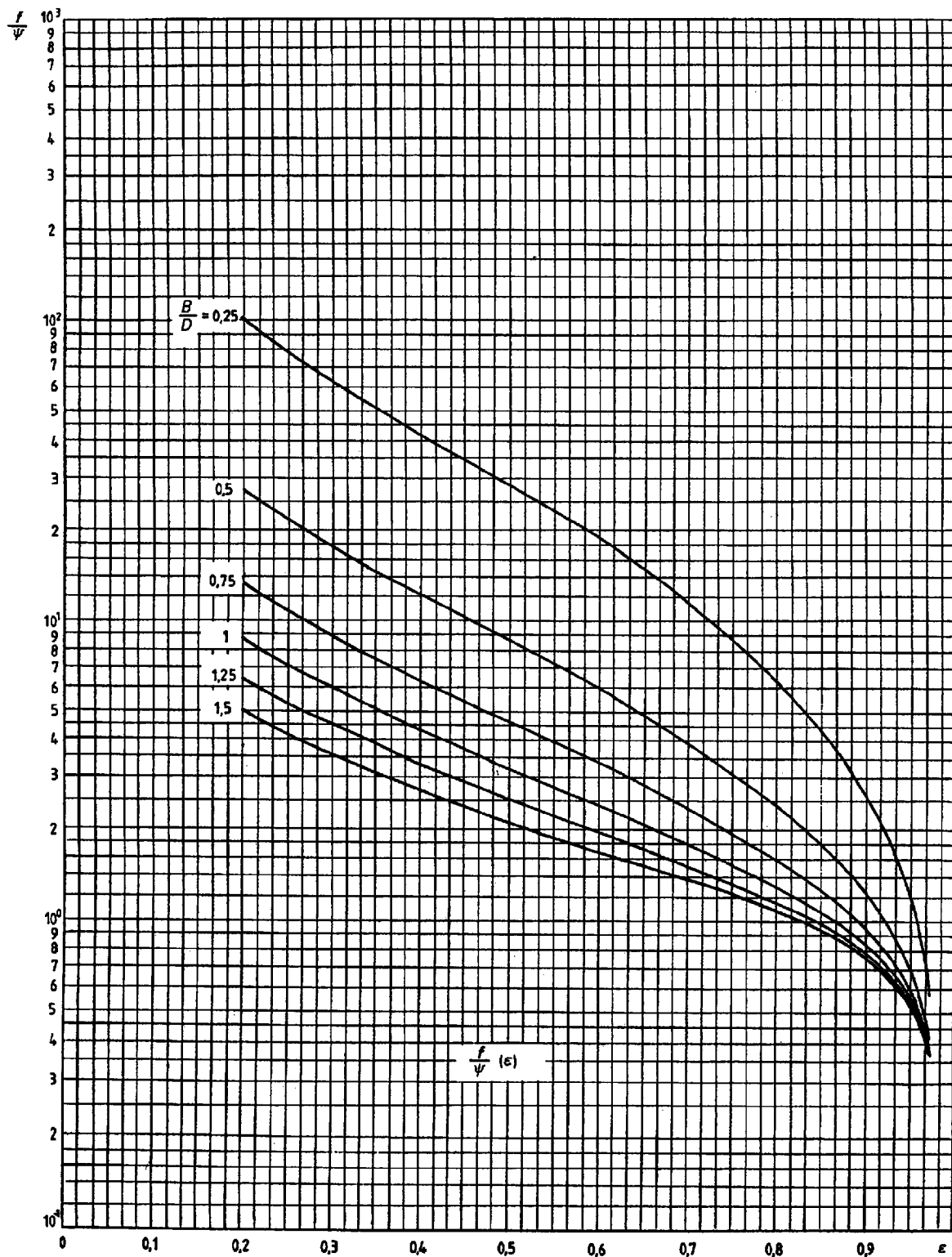


Figure 31 — Specific coefficient of friction  $f/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 360^\circ$

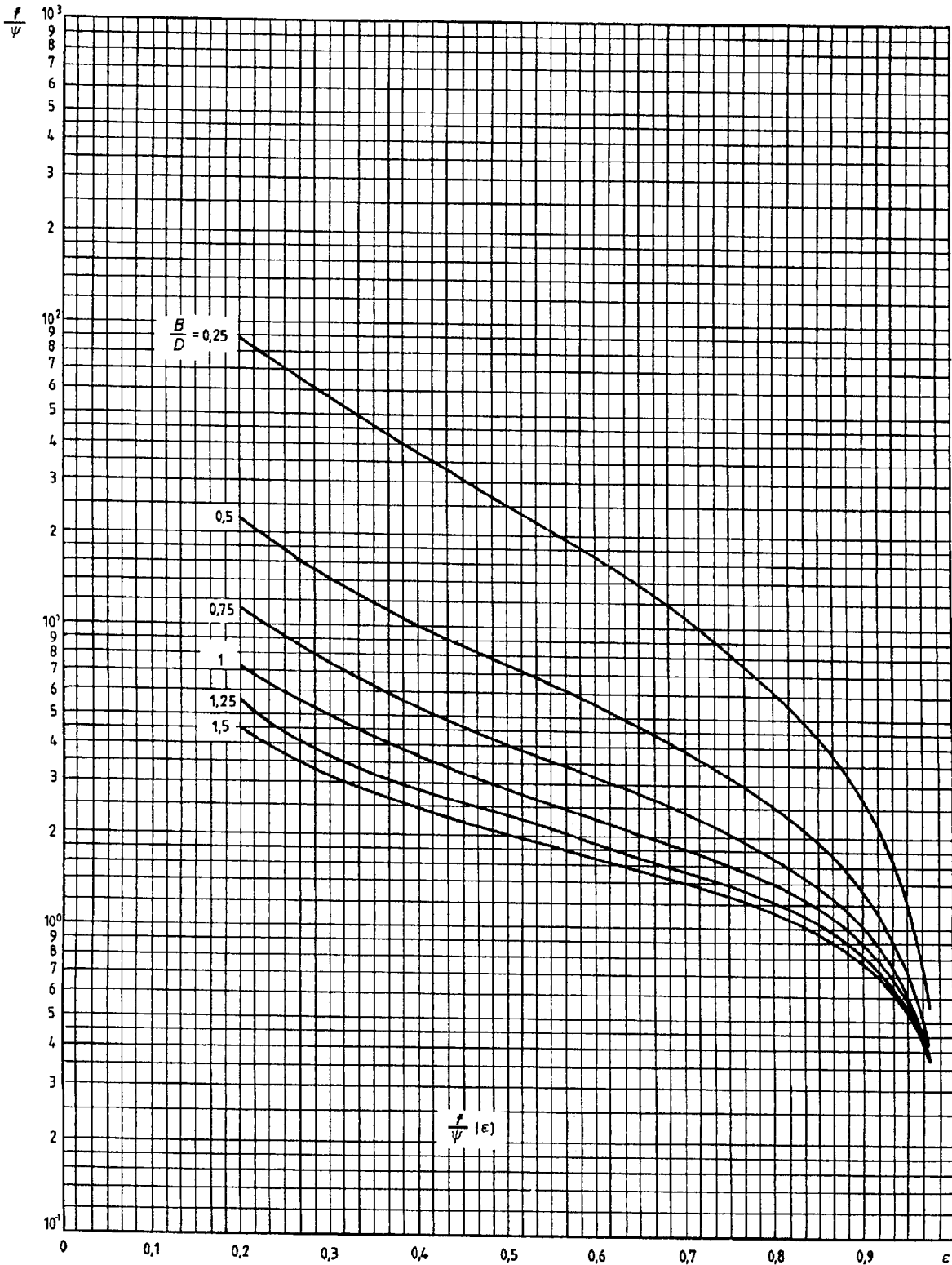


Figure 32 — Specific coefficient of friction  $f/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 180^\circ$

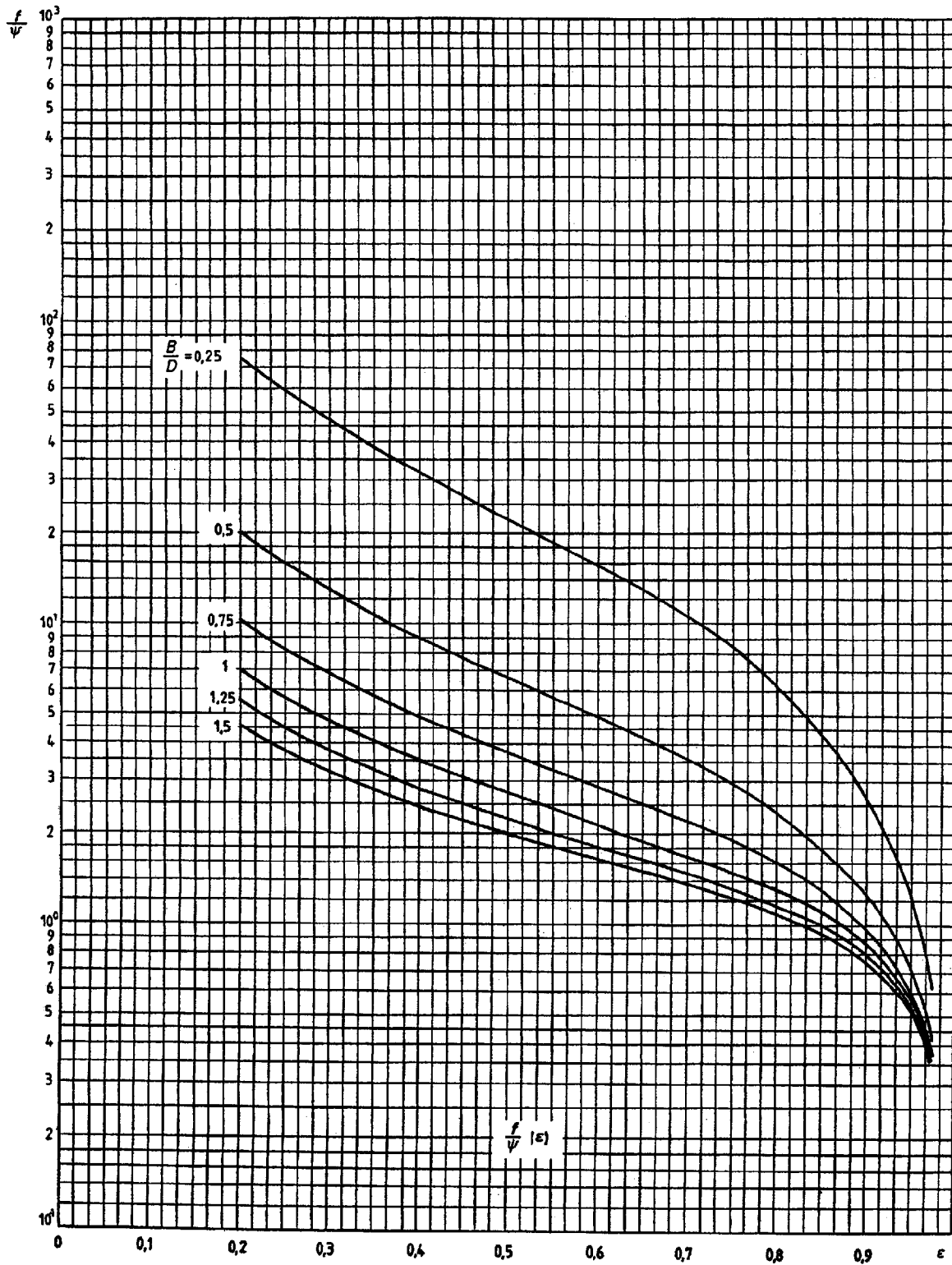


Figure 33 — Specific coefficient of friction  $f/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 150^\circ$



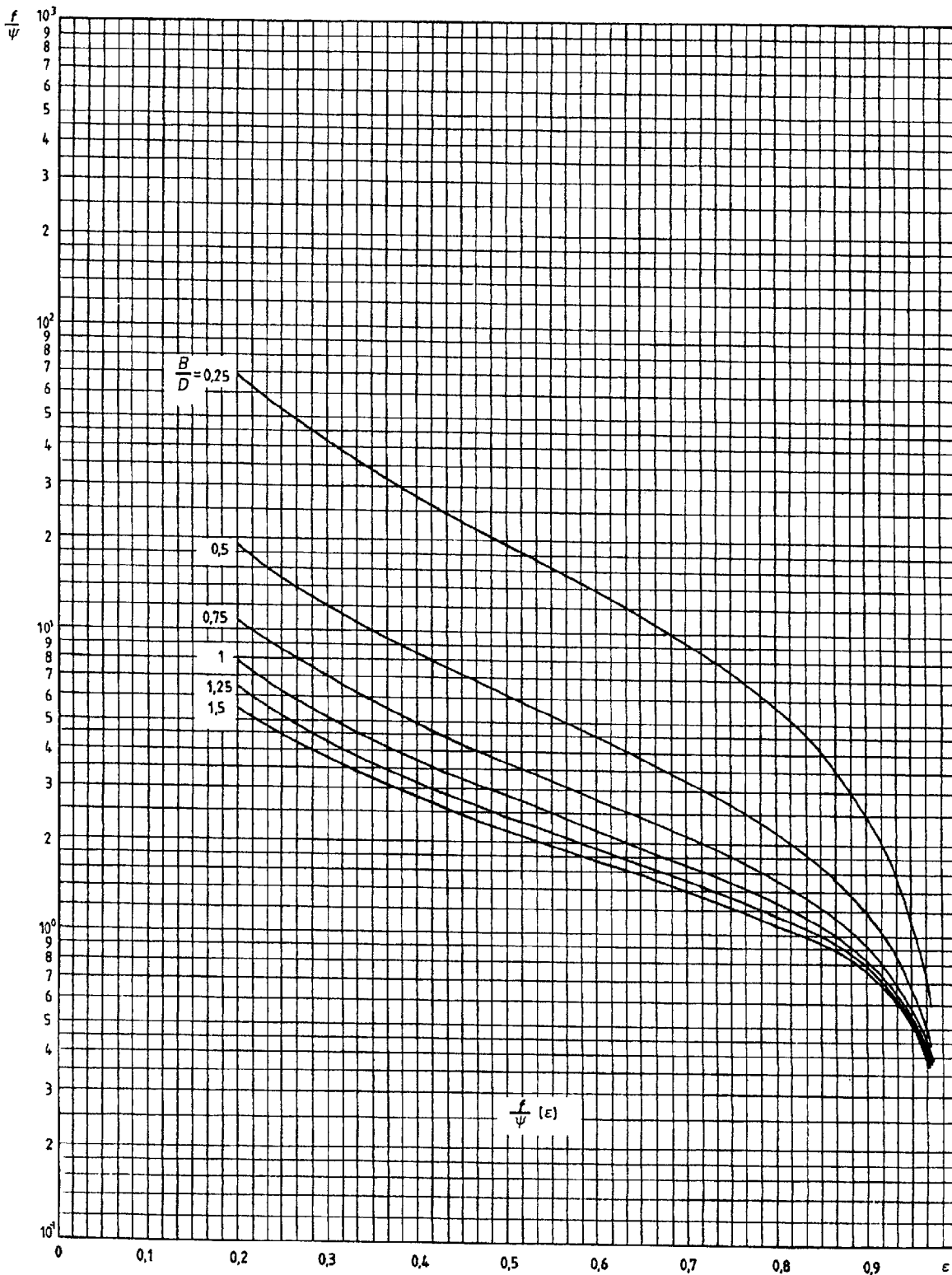


Figure 34 — Specific coefficient of friction  $f/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 120^\circ$

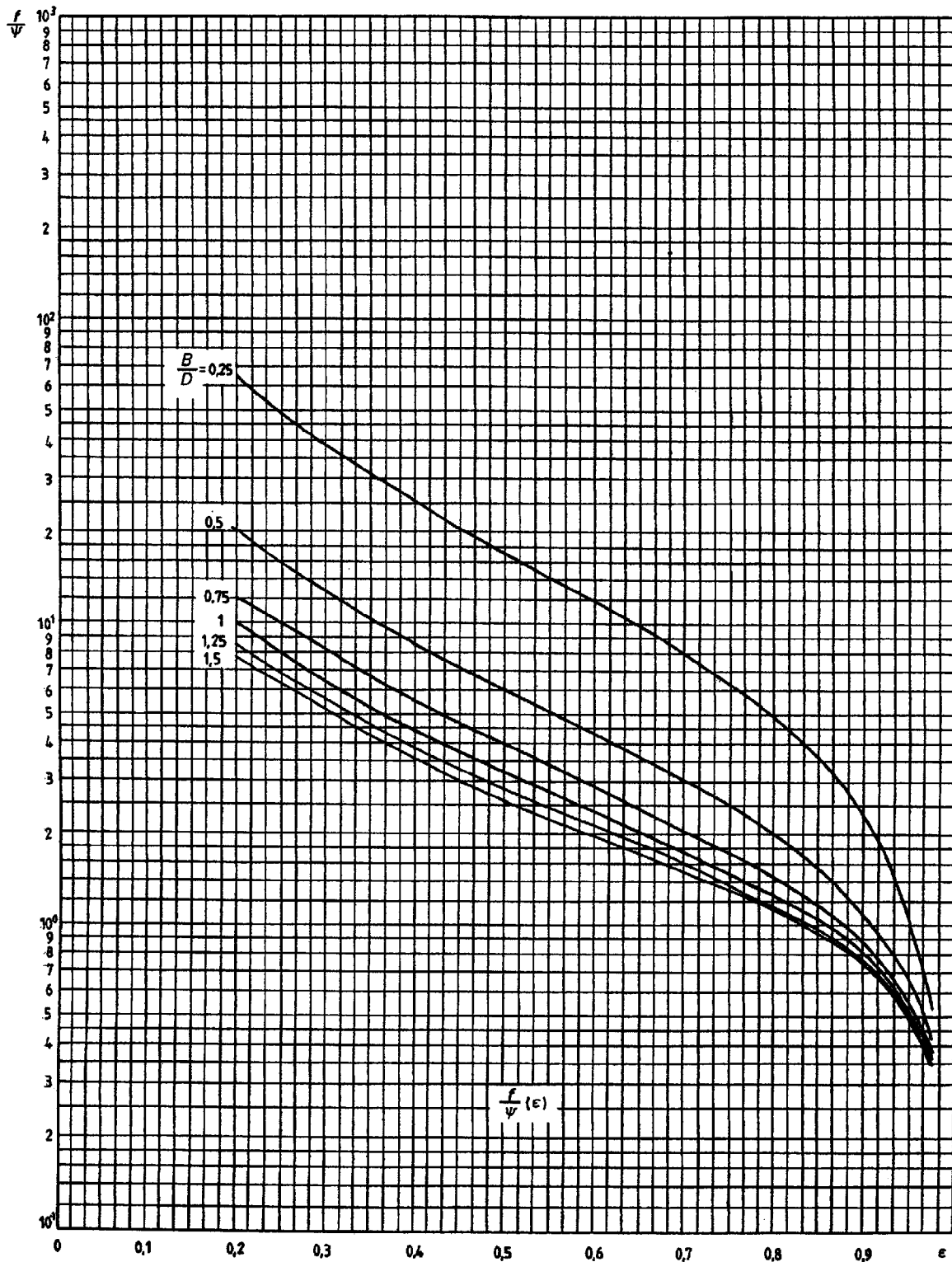


Figure 35 — Specific coefficient of friction  $f/\psi$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 90^\circ$

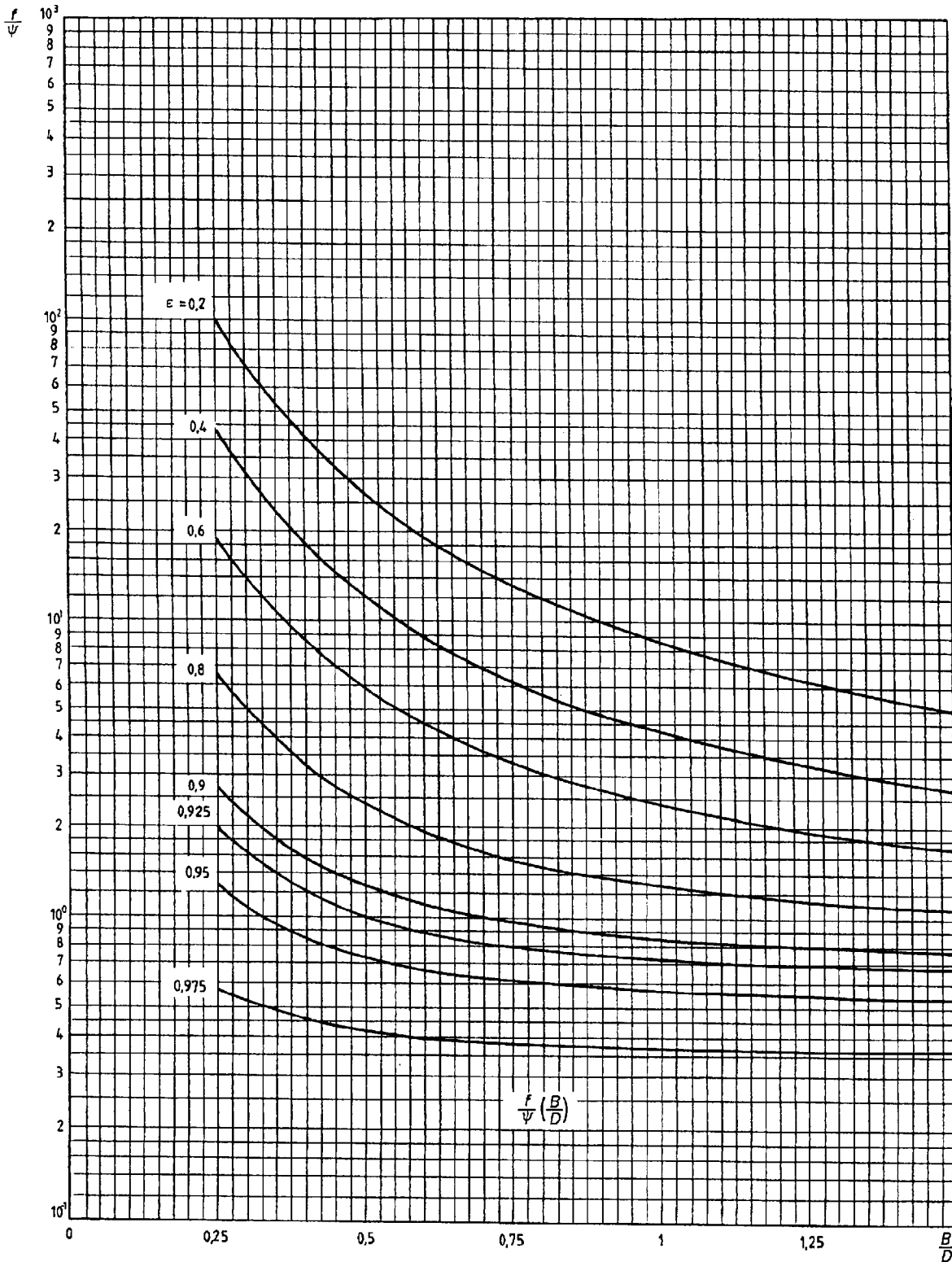


Figure 36 — Specific coefficient of friction  $f/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 360^\circ$

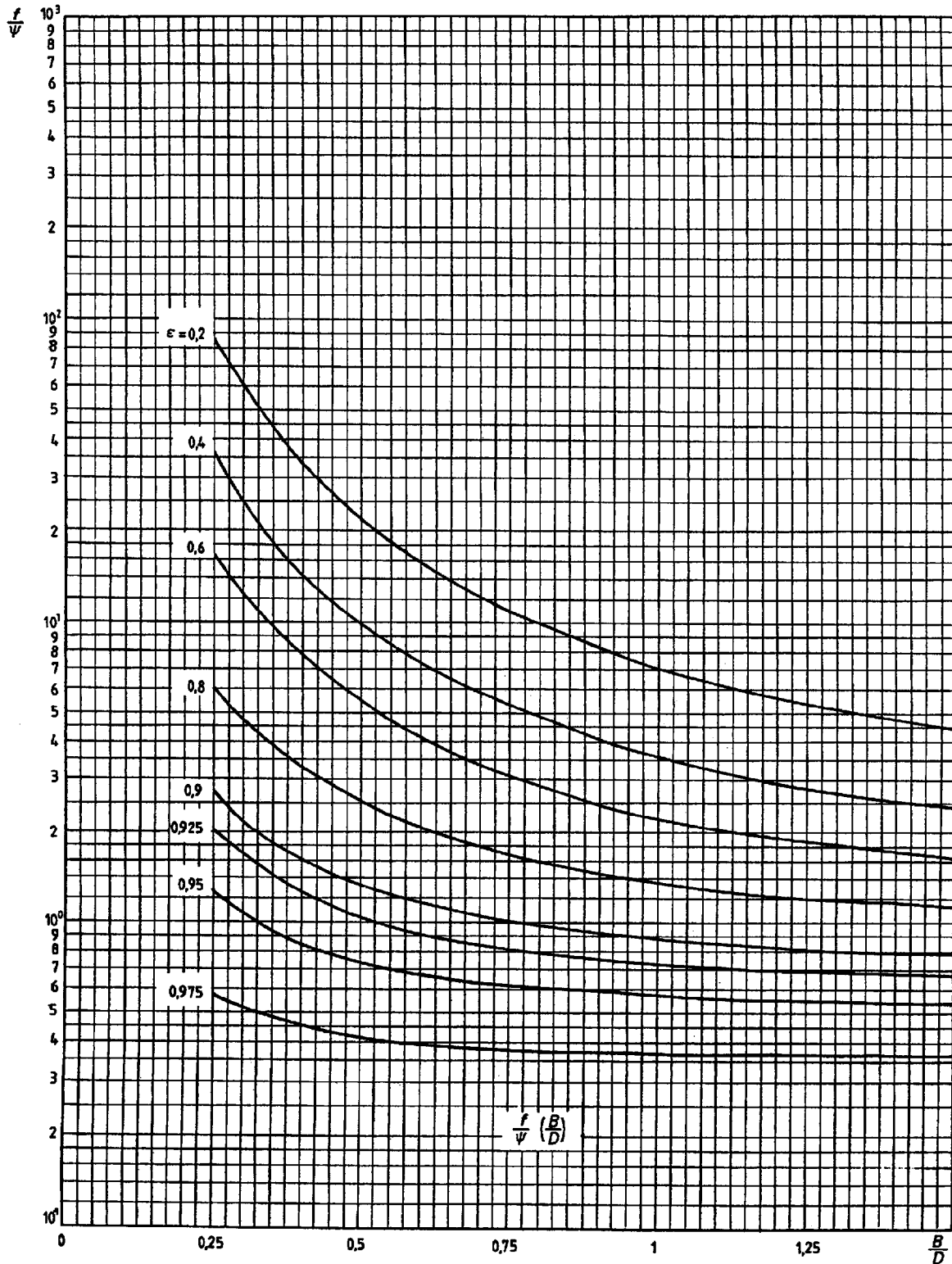


Figure 37 — Specific coefficient of friction  $f/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 180^\circ$

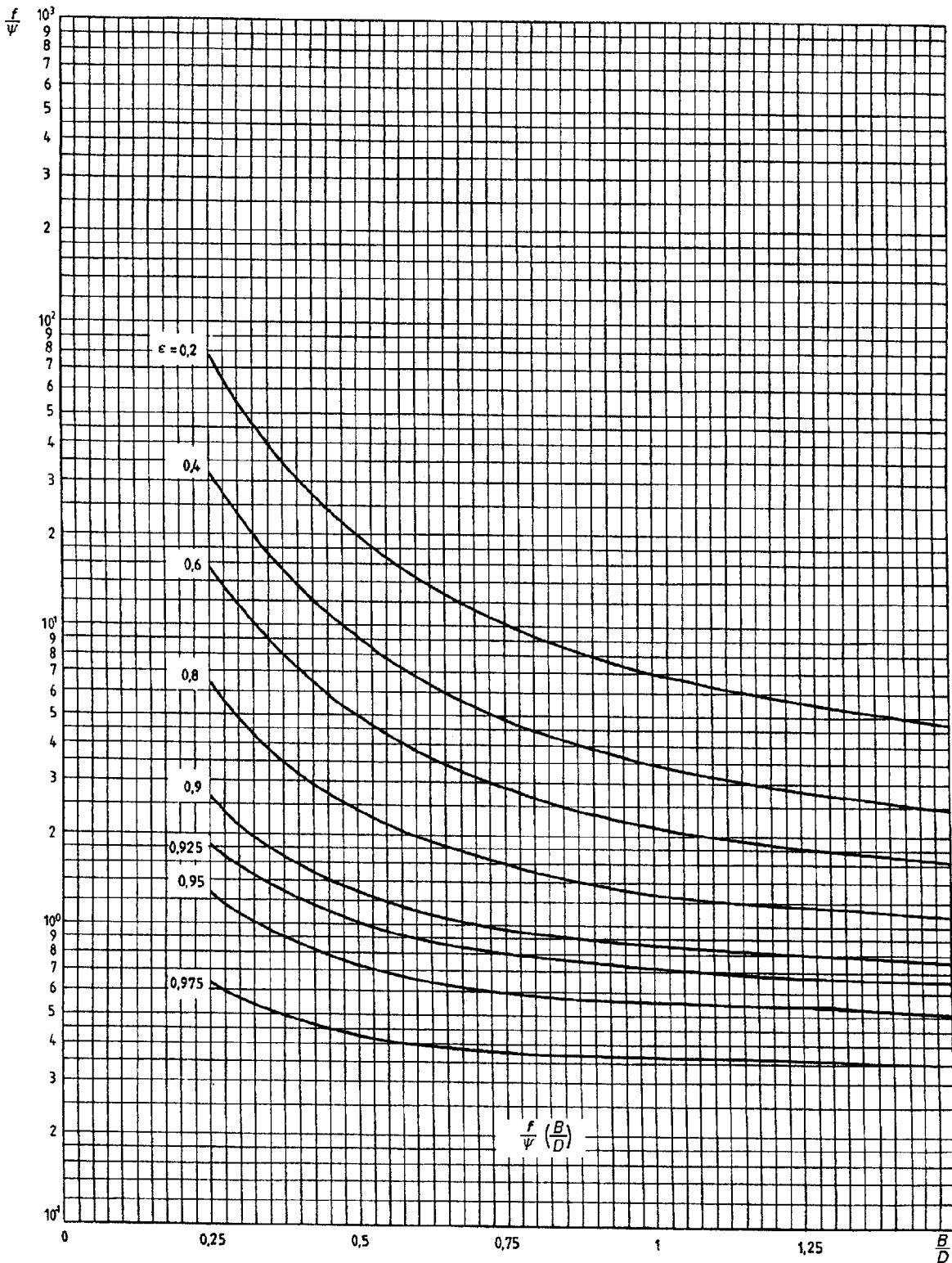


Figure 38 — Specific coefficient of friction  $f/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 150^\circ$

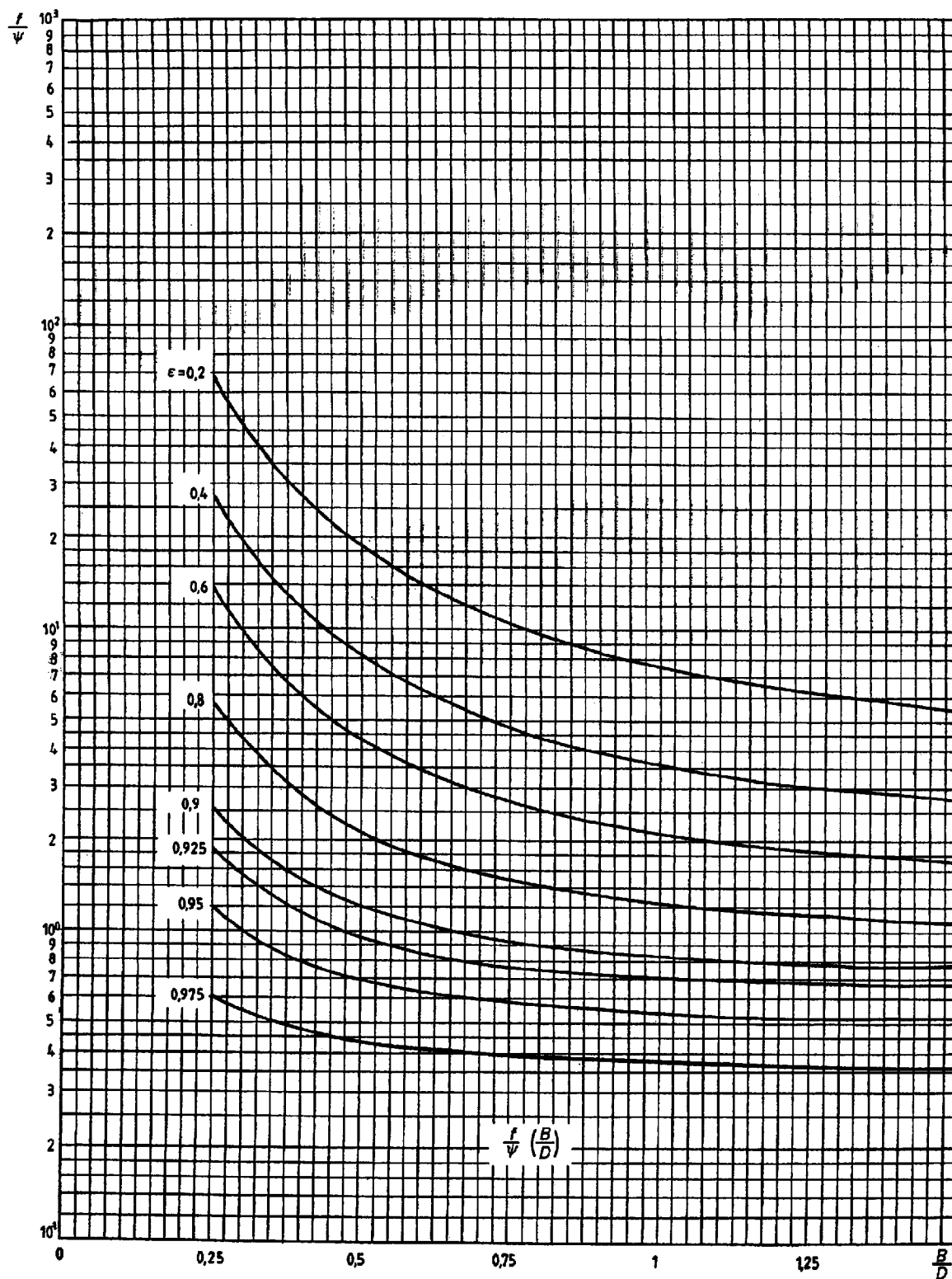


Figure 39 — Specific coefficient of friction  $f/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 120^\circ$

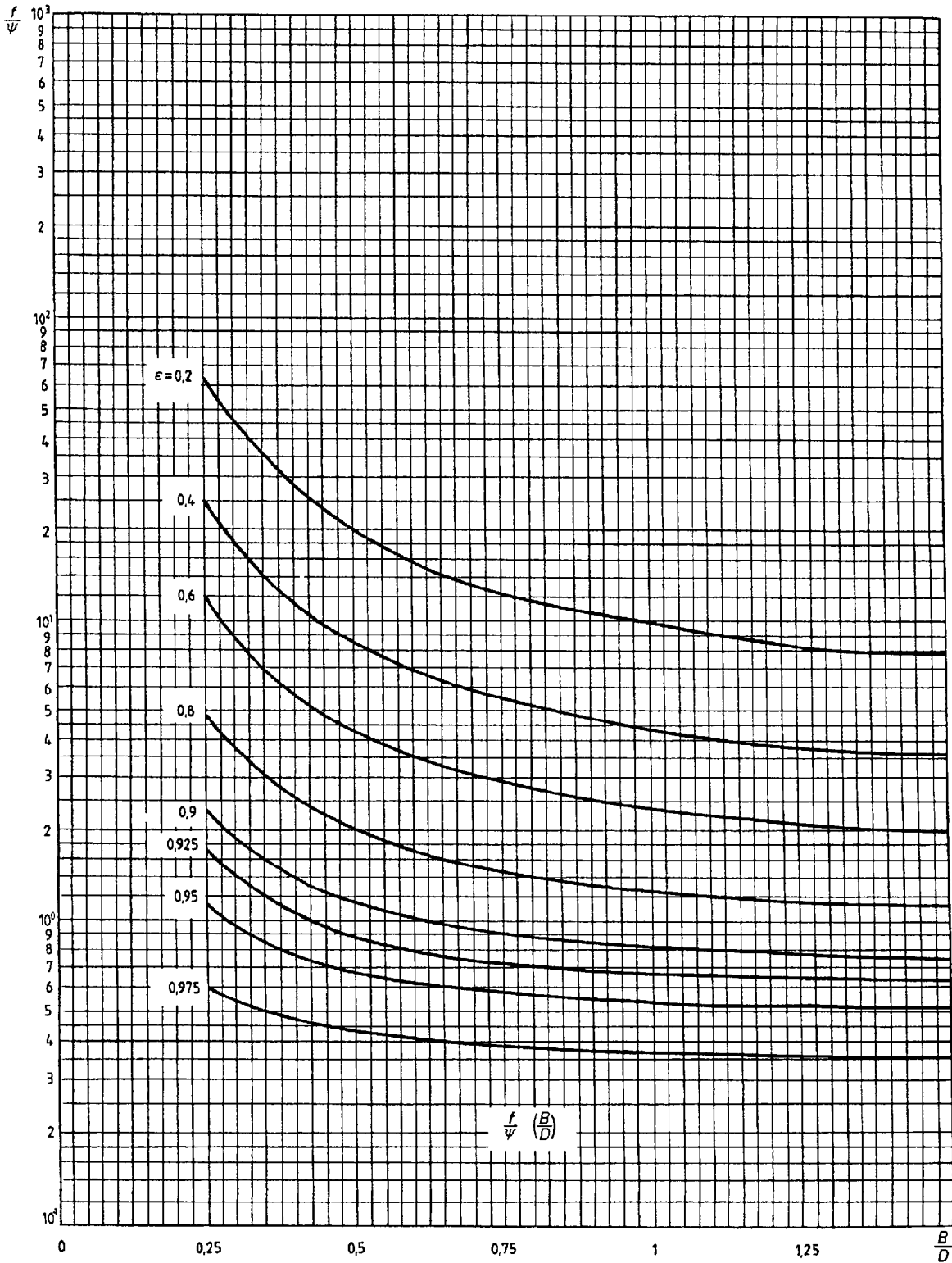


Figure 40 — Specific coefficient of friction  $f/\psi$  as a function of relative bearing width  $B/D$  for  $\Omega = 90^\circ$

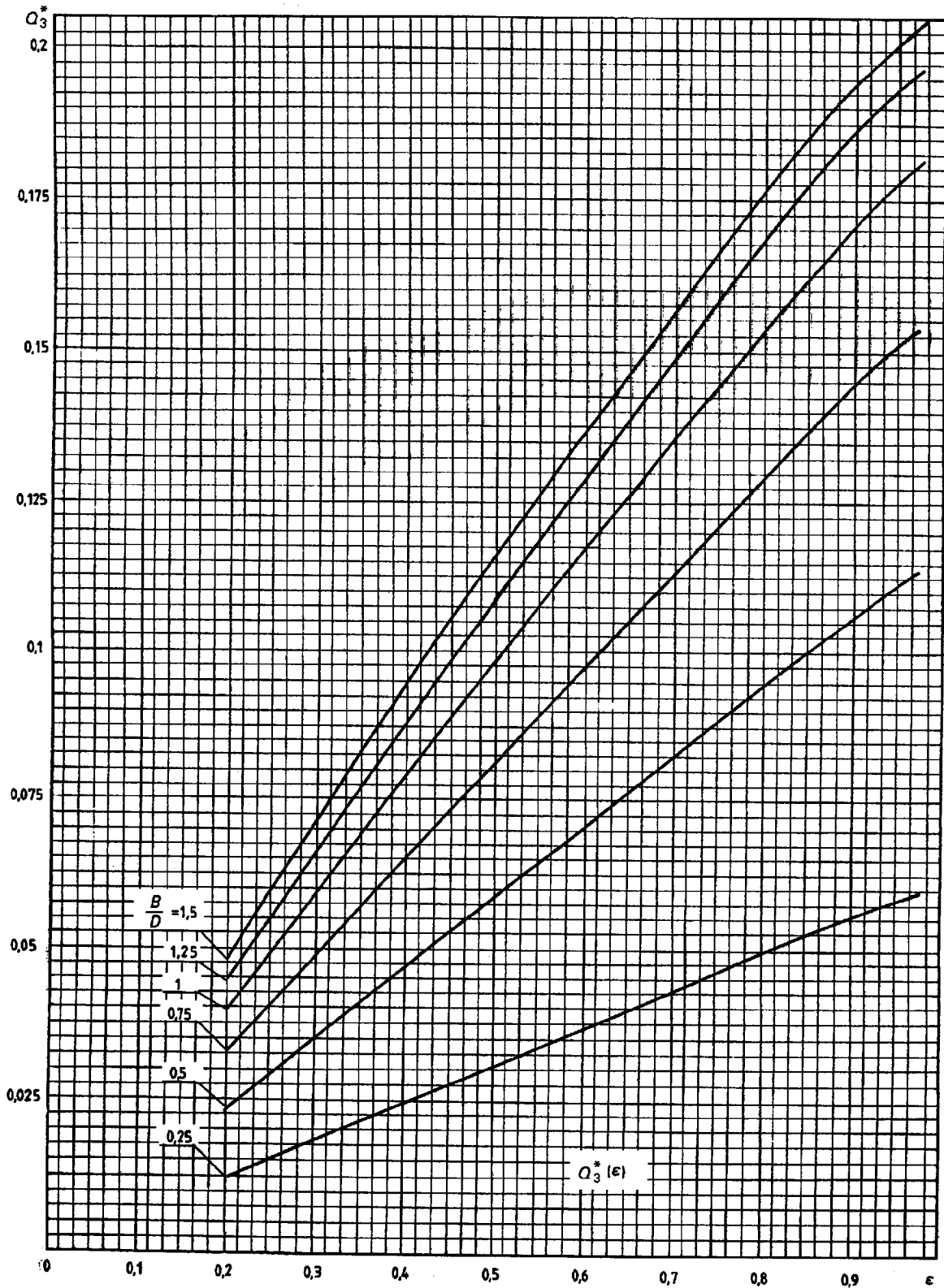


Figure 41 — Lubricant flow parameter  $Q_3^*$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 360^\circ$



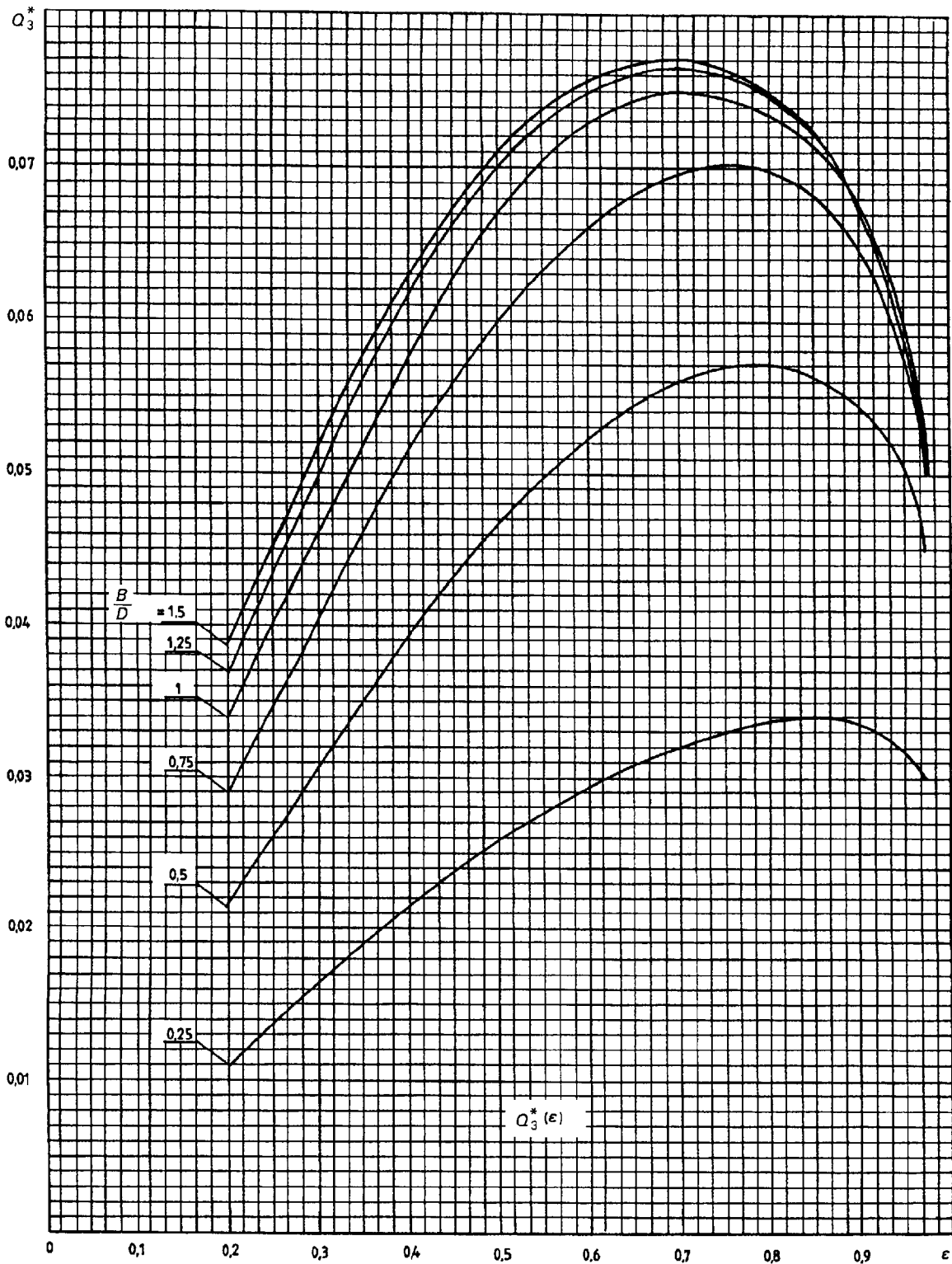


Figure 42 — Lubricant flow parameter  $Q_3^*$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 180^\circ$

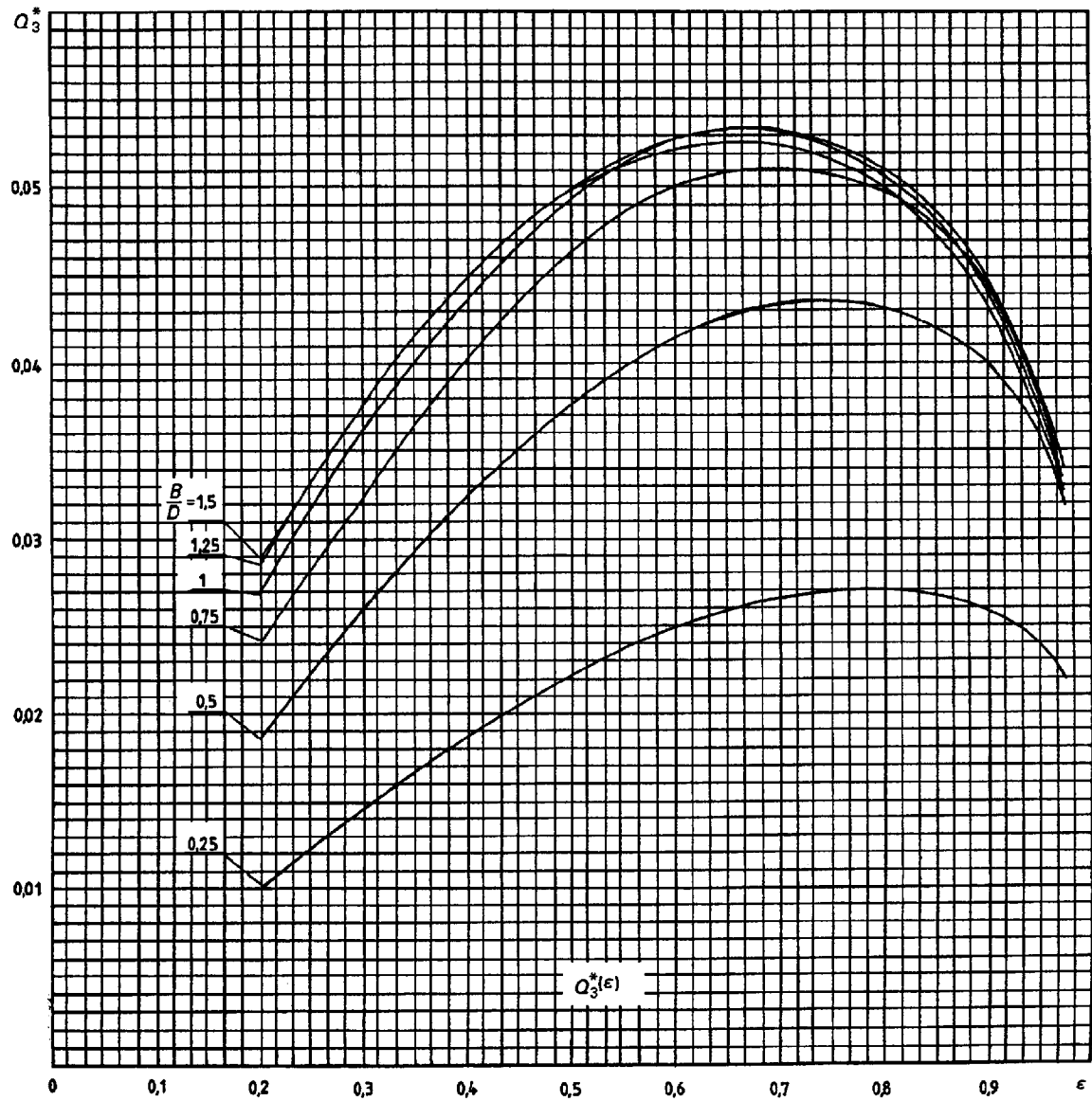


Figure 43 — Lubricant flow parameter  $Q_3^*$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 150^\circ$

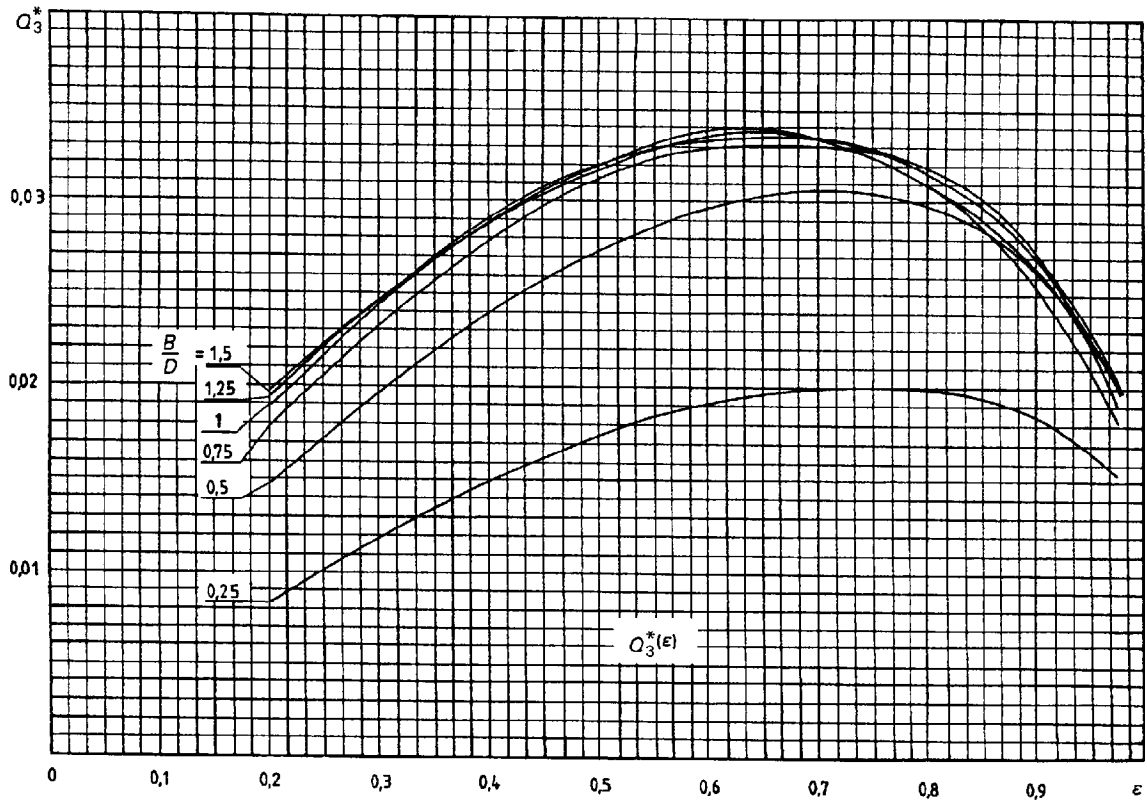


Figure 44 — Lubricant flow parameter  $Q_3^*$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 120^\circ$

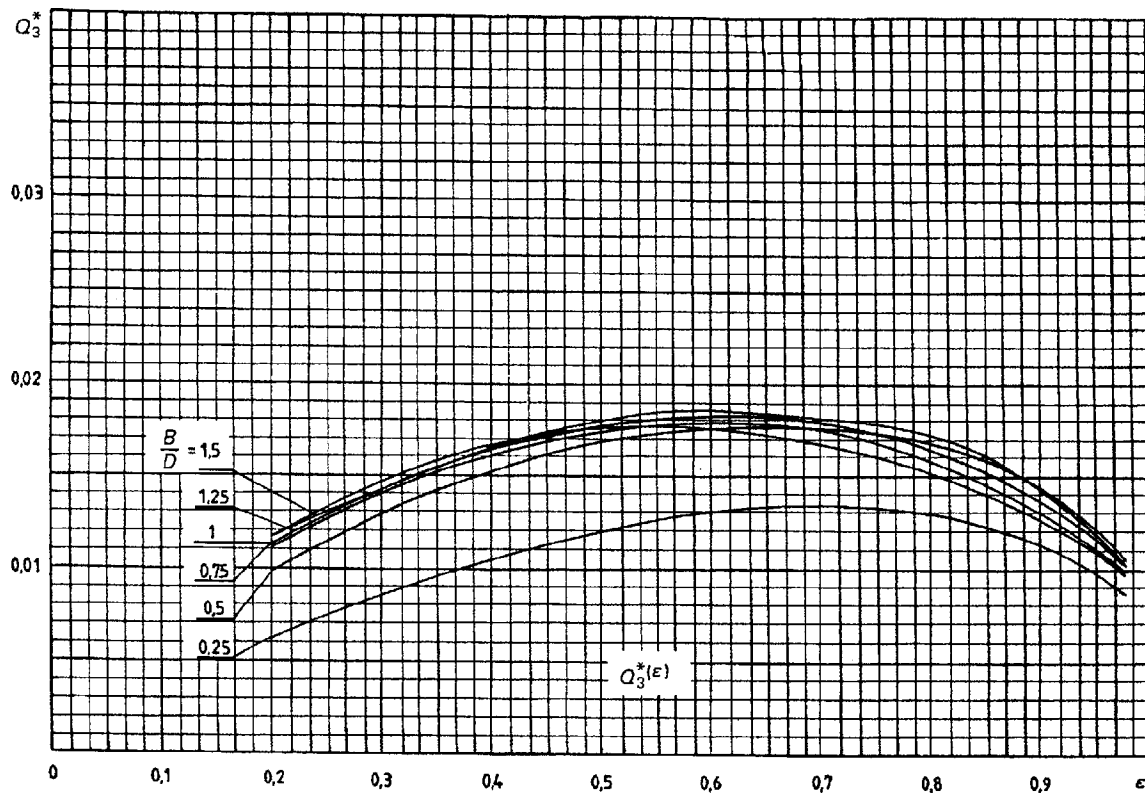


Figure 45 — Lubricant flow parameter  $Q_3^*$  as a function of relative eccentricity  $\epsilon$  for  $\Omega = 90^\circ$

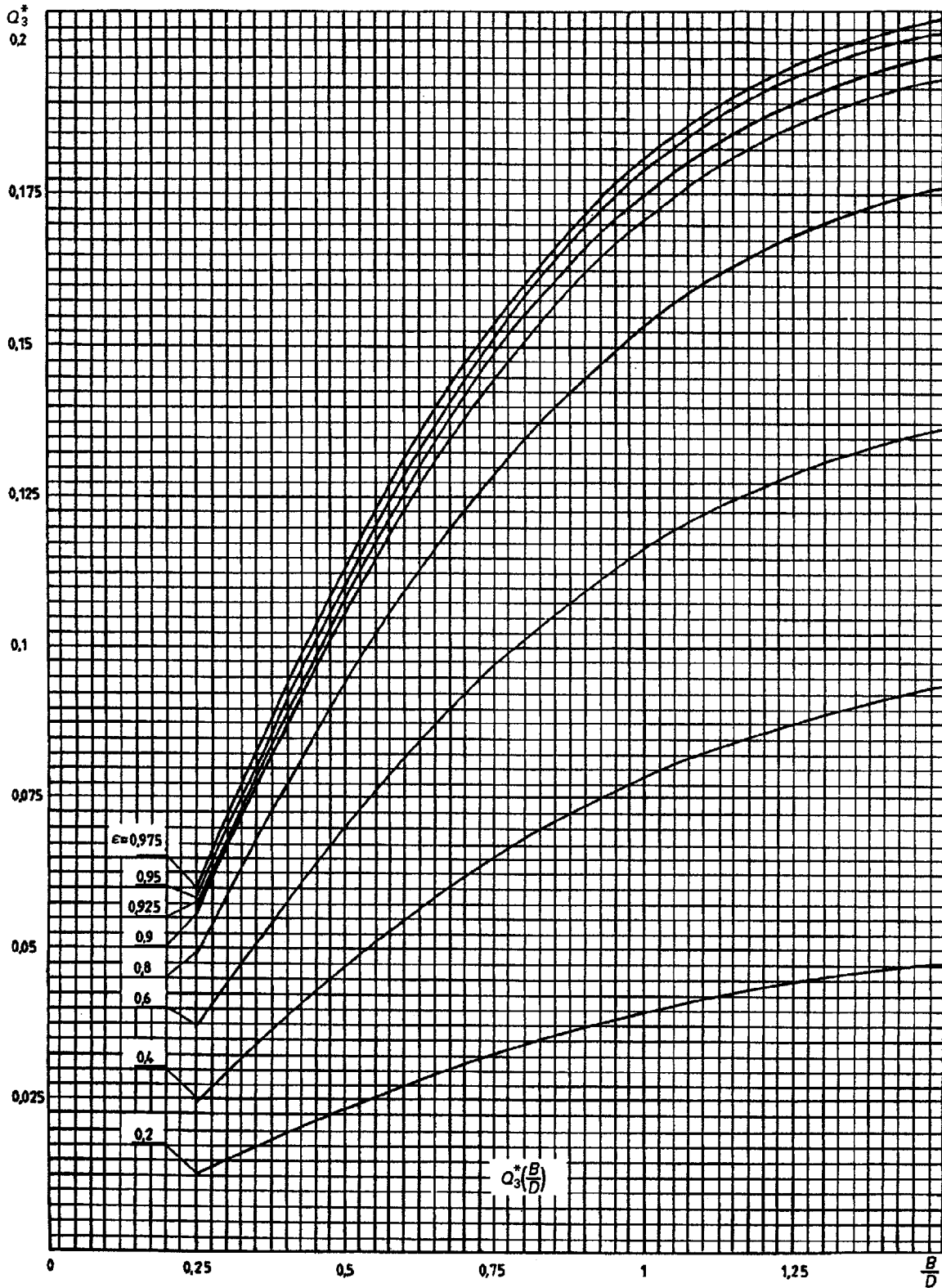


Figure 46 — Lubricant flow parameter  $Q_3^*$  as a function of relative bearing width  $B/D$  for  $\Omega = 360^\circ$

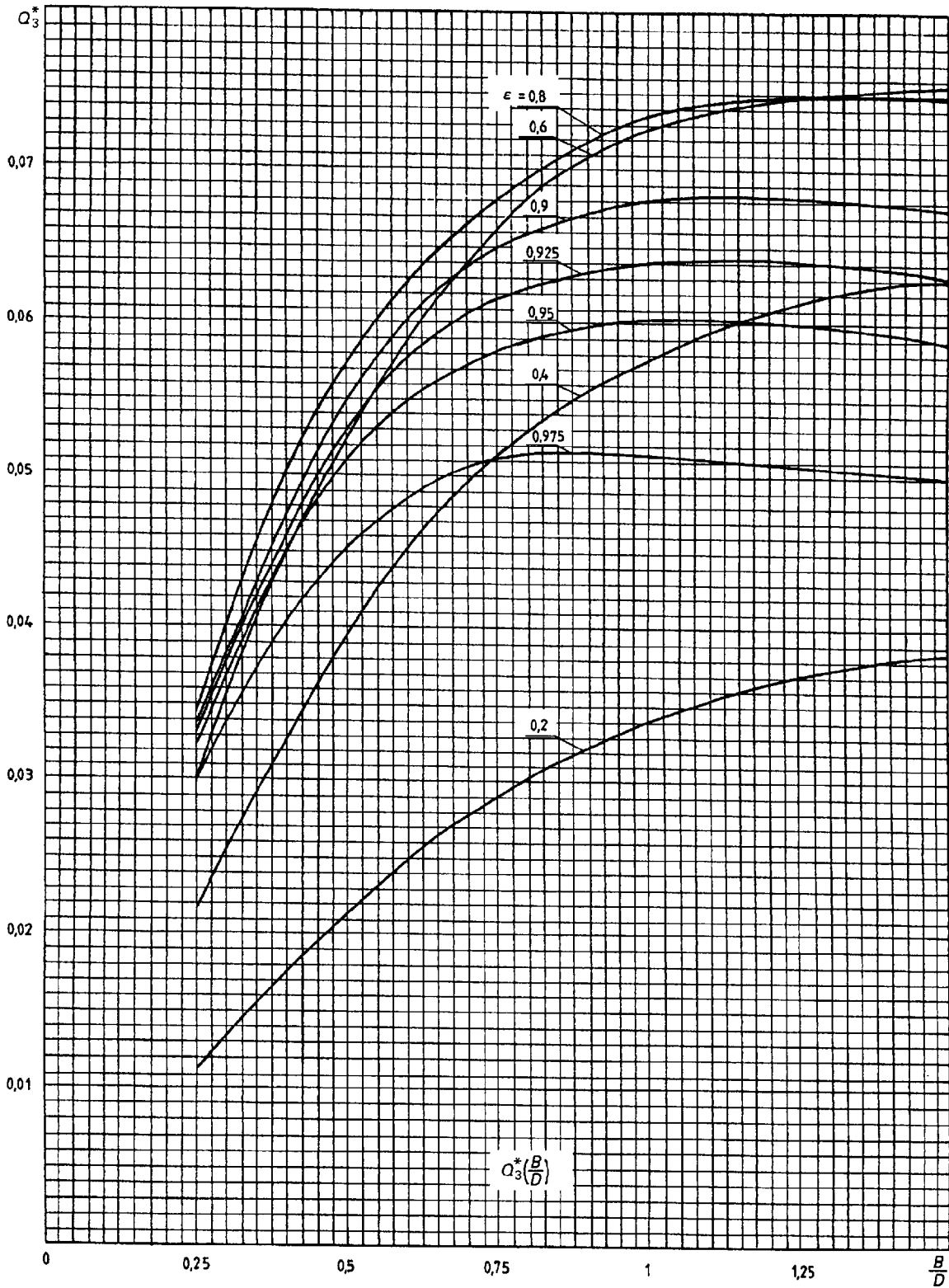


Figure 47 — Lubricant flow parameter  $Q_3^*$  as a function of relative bearing width  $B/D$  for  $\Omega = 180^\circ$

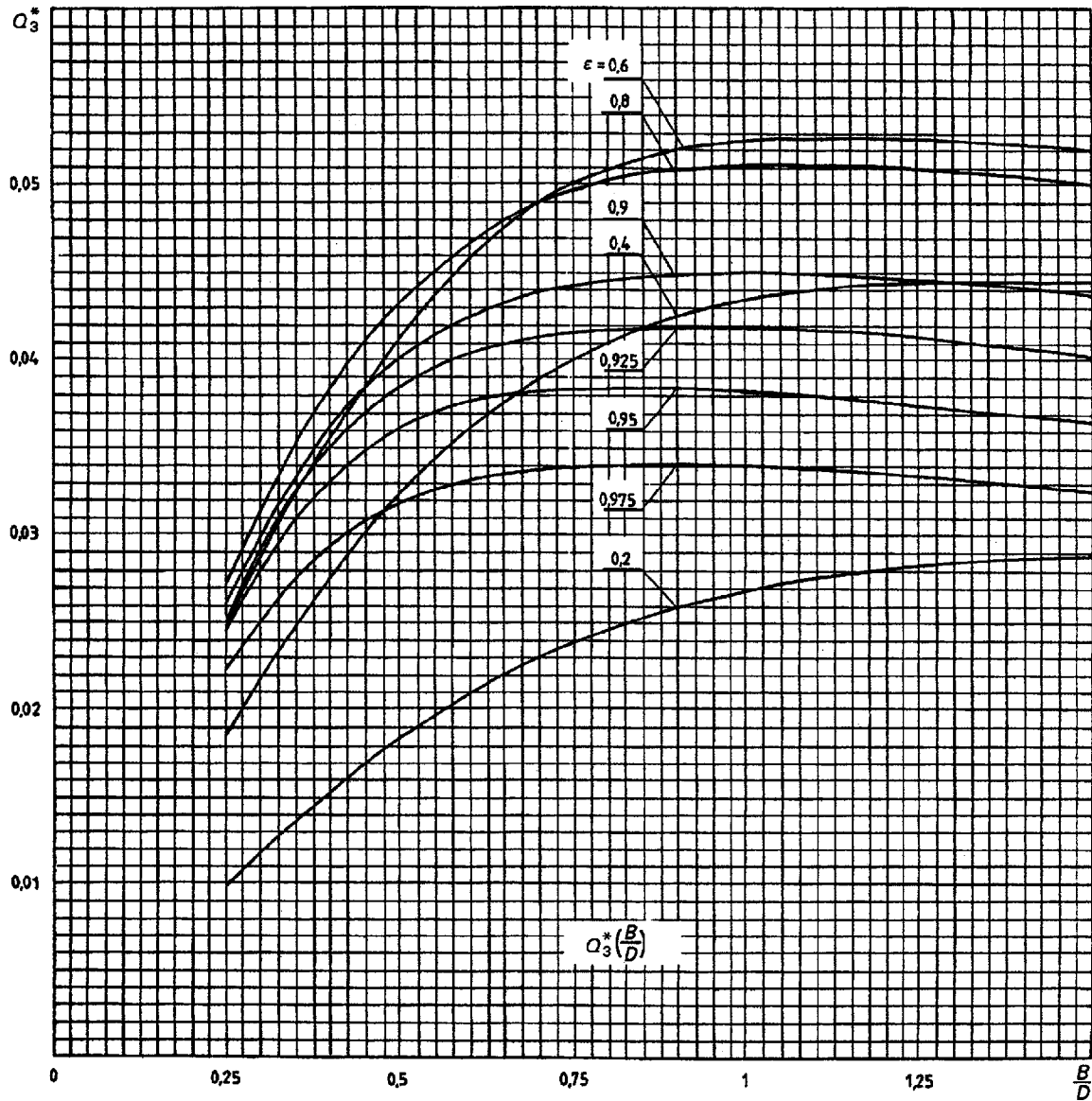


Figure 48 — Lubricant flow parameter  $Q_3^*$  as a function of relative bearing width  $B/D$  for  $\Omega = 150^\circ$

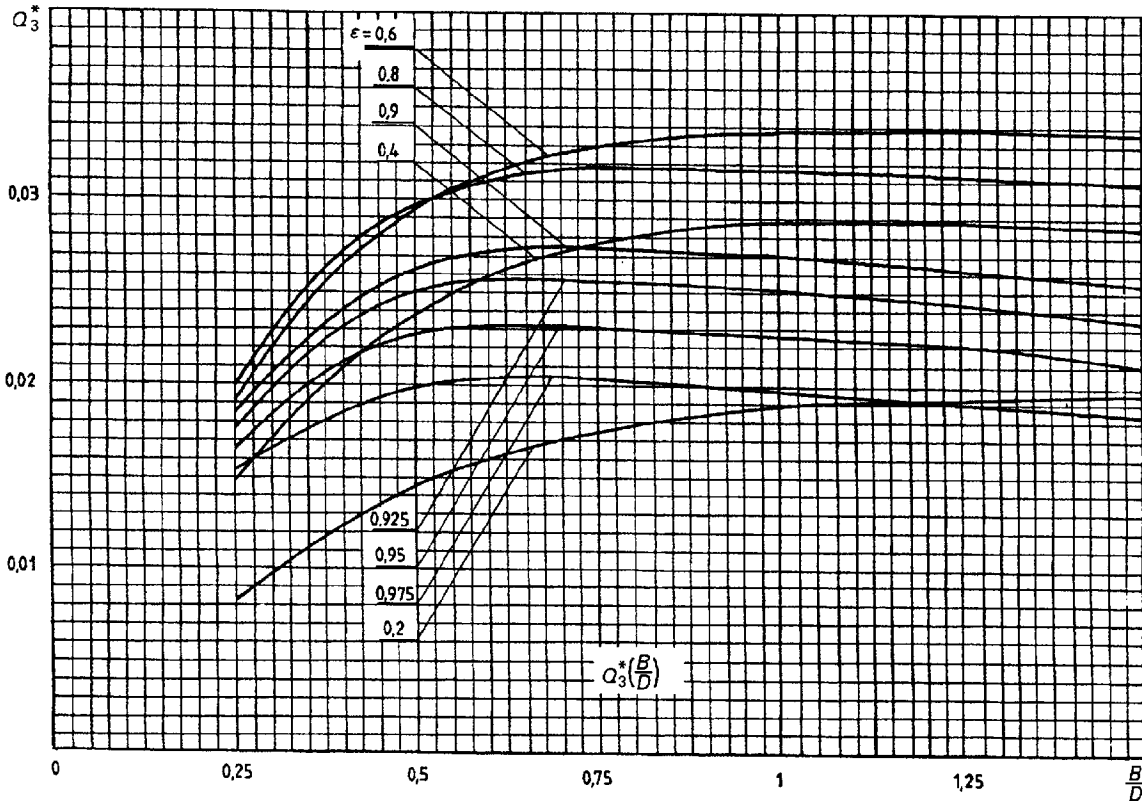


Figure 49 — Lubricant flow parameter  $Q_3^*$  as a function of relative bearing width  $B/D$  for  $\Omega = 120^\circ$

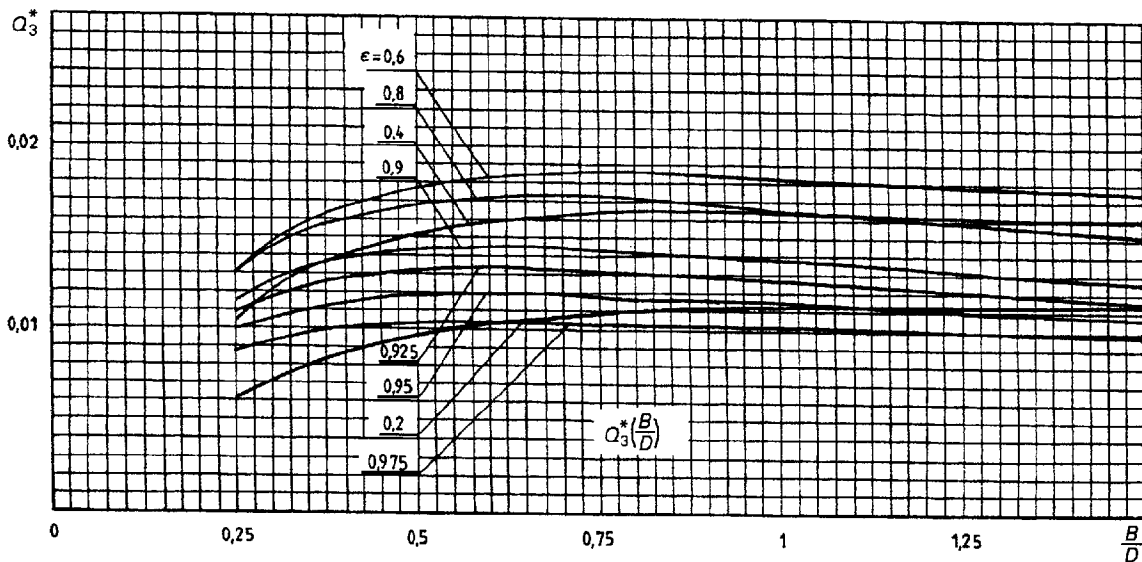


Figure 50 — Lubricant flow parameter  $Q_3^*$  as a function of relative bearing width  $B/D$  for  $\Omega = 90^\circ$

## 5 Friction power loss in the lubricant film as a function of the design of the lubricant feed elements

5.1 If the lubricant fills only the loaded area of the bearing then the friction force  $F_f$  in the lubricant film is given by the following equation, independently of the design of the lubricant feed elements.

$$F_f = \frac{\eta_{\text{eff}} \omega_h}{\psi_{\text{eff}}} DB \xi = \frac{\eta_{\text{eff}} \omega_h}{\psi_{\text{eff}}} DB \frac{f}{\psi_{\text{eff}}} S_o \quad \dots (1)$$

5.2 If the lubricant fills the whole of the lubricant clearance gap, i.e. both the loaded and unloaded areas, then with the lubricant fed through the lubricating holes and longitudinal (axial) grooves (with no lubricating pockets and circumferential grooves), the friction force in the lubricant film  $F'_f$  is given by

$$F'_f = \frac{\eta_{\text{eff}} \omega_h}{\psi_{\text{eff}}} DB \xi' = \frac{\eta_{\text{eff}} \omega_h}{\psi_{\text{eff}}} DB \frac{f'}{\psi_{\text{eff}}} S_o \quad \dots (2)$$

5.3 If the lubricant fills the whole of the lubricant clearance gap and the design of the lubricant feed elements provides for lubricating holes and circumferential grooves (see ISO 7902-1:1998, figure A.3), then the friction force in the lubricant film  $F'_f$  is found from the formula given in [1]:

$$F'_f = \frac{\eta_{\text{eff}} \omega_h BD}{\psi_{\text{eff}}} \left[ \frac{f'}{\psi_{\text{eff}}} S_o - \frac{b_P}{B} \left( \frac{\Omega_P}{2\sqrt{1-\varepsilon^2}} - \frac{\psi_{\text{eff}} D}{2h_P} \xi_P \right) - \frac{b_G}{B} \left( \frac{\Omega_G}{2\sqrt{1-\varepsilon^2}} - \frac{\psi_{\text{eff}} D}{2h_G} \xi_G \right) \right] \quad \dots (3)$$

Here, the friction power loss in the pocket and the grooves is taken correspondingly by the coefficients,  $\xi_P$  and  $\xi_G$ :

$$\xi_P = 0,5 \Omega_P \left( 4 + 0,0012 Re_P^{0,94} \right)$$

$$\xi_G = 0,5 \Omega_G \left( 4 + 0,0012 Re_G^{0,94} \right)$$

where  $Re_P$  and  $Re_G$  are the Reynolds numbers of the lubricant flow in the pocket and the grooves respectively:

$$Re_P = \frac{\rho \omega_h h_P D}{2\eta_{\text{eff}}}$$

$$Re_G = \frac{\rho \omega_h h_G D}{2\eta_{\text{eff}}}$$

Frictional power losses in the bearing are given by equations (6) and (7) in ISO 7902-1:1998.

## 6 Lubricant flow rate resulting from feed pressure

The lubricant flow rate resulting from feed pressure is given by equation (9) in ISO 7902-1:1998.

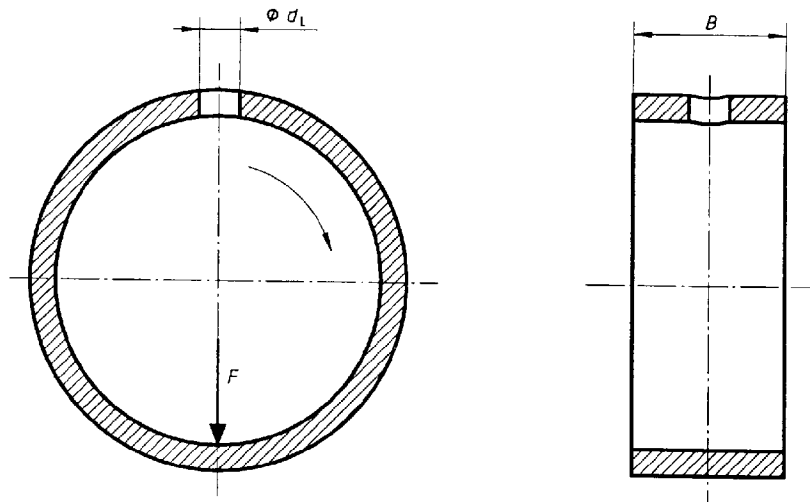
$$Q_p = \frac{D^3 \psi_{\text{eff}}^3 p_{\text{en}}}{\eta_{\text{eff}}} Q_p^*$$

where  $Q_p^*$  is given by equations (4) to (8).

For the sake of simplification, the attitude angle  $\beta$  has only been taken into account approximately.



**6.1 Lubricant feed through the lubrication hole located opposite to direction of load**

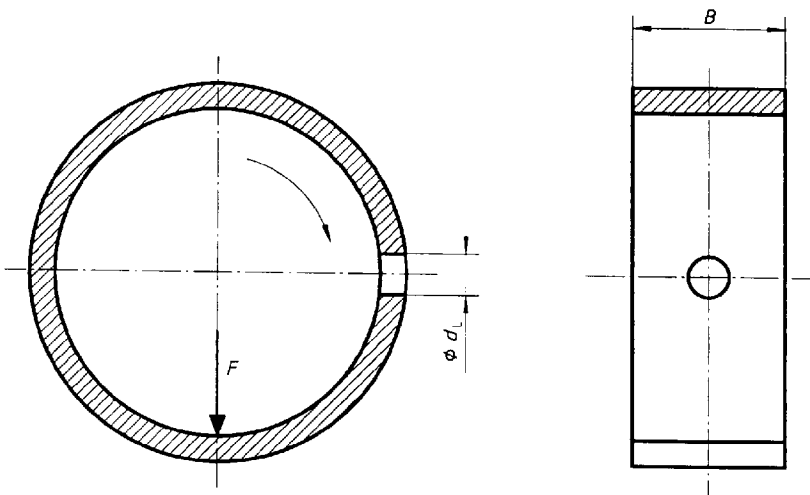


**Figure 51**

$$Q_p^* = \frac{\pi}{48} \frac{(1 + \varepsilon)^3}{\ln\left(\frac{B}{d_L}\right) q_L} \dots (4)$$

where  $q_L = 1,204 + 0,368(d_L/B) - 1,046(d_L/B)^2 + 1,942(d_L/B)^3$

**6.2 Lubrication feed through the lubrication hole located at 90° to direction of load**

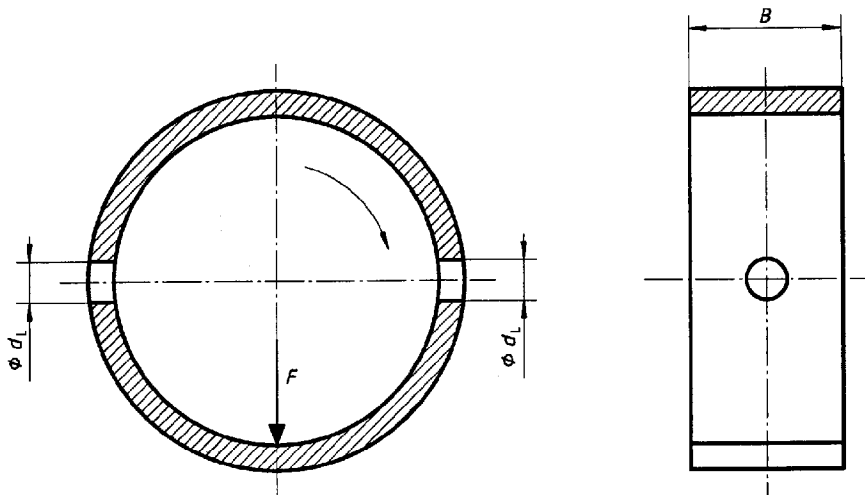


**Figure 52**

$$Q_p^* = \frac{\pi}{48} \frac{1}{\ln\left(\frac{B}{d_L}\right) q_L} \dots (5)$$

where  $q_L$  is as given in equation (4).

**6.3 Lubrication feed through two lubrication holes located at 90° to direction of load**

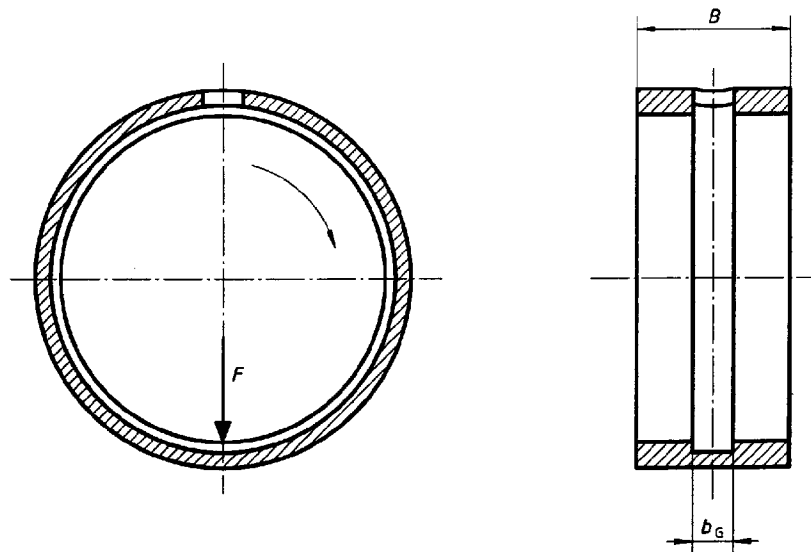


**Figure 53**

$$Q_p^* = \frac{\pi}{48} \frac{2}{\ln\left(\frac{B}{d_L}\right)} q_L \quad \dots (6)$$

where  $q_L$  is as given in equation (4).

**6.4 Lubrication feed through circumferential groove (full groove)**



**Figure 54**

$$Q_p^* = \frac{\pi}{24} \frac{1 + 1,5\varepsilon^2}{\left(\frac{B}{D}\right)} \frac{B}{B - b_G} \quad \dots (7)$$

6.5 Lubricant feed through circumferential groove (partial groove)

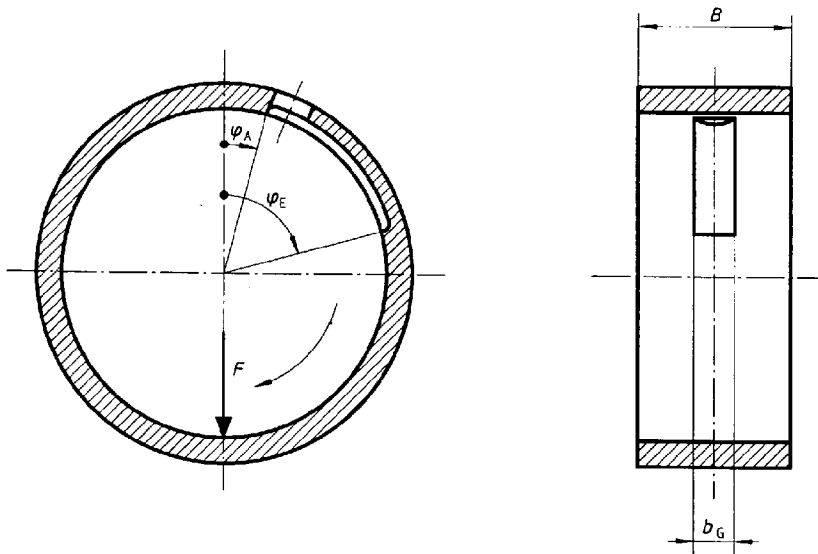


Figure 55

$$Q_p^* = \frac{1}{48} \frac{\left( \hat{\varphi}_E - \hat{\varphi}_A \right) \left( 1 + 1,5\varepsilon^2 \right) + \left( 3\varepsilon + \varepsilon^3 \right) \left( \sin \varphi_E - \sin \varphi_A \right) + 0,75\varepsilon^2 \left( \sin^2 \varphi_E - \sin^2 \varphi_A \right) - \frac{\varepsilon^3}{3} \left( \sin^3 \varphi_E - \sin^3 \varphi_A \right)}{\frac{B - b_G}{D}} \dots (8)$$

For  $\hat{\varphi}_E = 90^\circ$  and  $\hat{\varphi}_A = -90^\circ$  (180° groove) equation (8) reduces to

$$Q_p^* = \frac{1}{48} \frac{\pi \left( 1 + 1,5\varepsilon^2 \right) + 6\varepsilon + 1,33\varepsilon^3}{\frac{B - b_G}{D}}$$

6.6 Lubricant feed through lubrication pocket, located opposite to direction of load

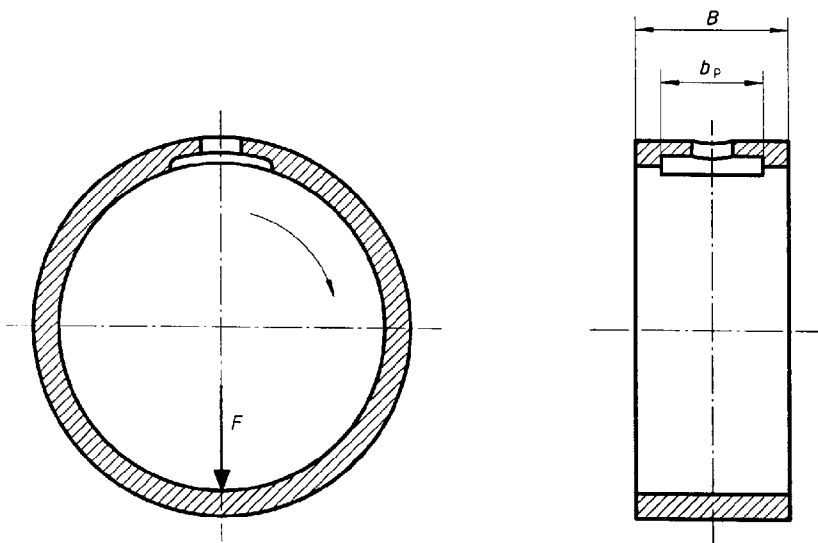


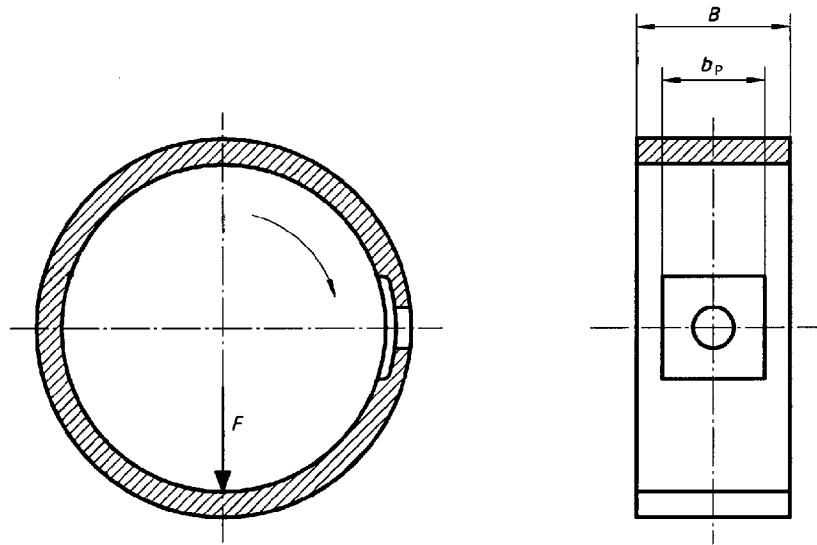
Figure 56

$$Q_p^* = \frac{\pi}{48} \frac{(1+\varepsilon)^3}{\ln\left(\frac{B}{b_p}\right) q_p} \quad \dots (9)$$

where  $q_p = 1,188 + 1,582\left(\frac{b_p}{B}\right) - 2,585\left(\frac{b_p}{B}\right)^2 + 5,563\left(\frac{b_p}{B}\right)^3$

valid for  $0,05 \leq \left(\frac{b_p}{B}\right) \leq 0,7$

**6.7 Lubricant feed through lubrication pocket located at 90° to direction of application load**

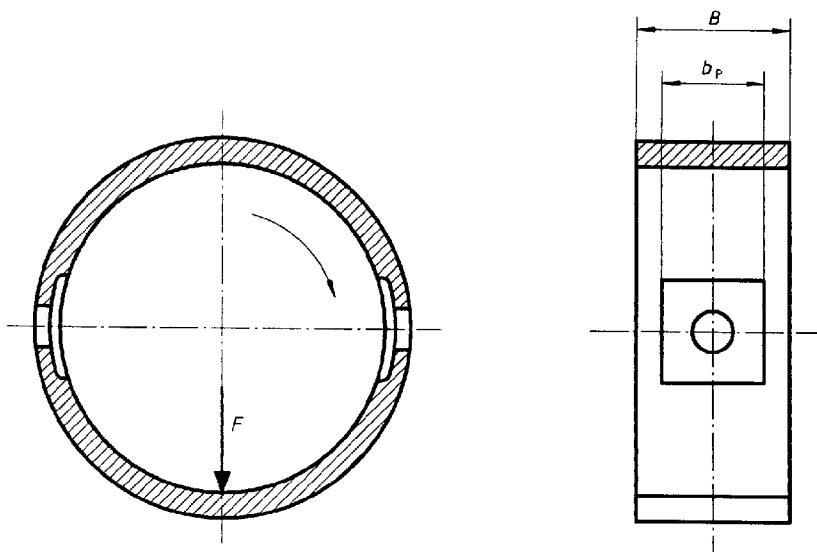


**Figure 57**

$$Q_p^* = \frac{\pi}{48} \frac{1}{\ln\left(\frac{B}{b_p}\right) q_p} \quad \dots (10)$$

where  $q_p$  is as given in equation (9).

**6.8 Lubricant feed through two lubrication pockets at ± 90° to direction of load**



**Figure 58**

$$Q_p^* = \frac{\pi}{48} \frac{2}{\ln\left(\frac{B}{b_p}\right)} q_p \quad \dots (11)$$

where  $q_p$  is as given in equation (9).

**7 Effective dynamic viscosity  $\eta_{eff}$  of the lubricant as a function of effective bearing temperature  $T_{eff}$**

If the relationship between dynamic viscosity and temperature is not known, either from parameters supplied by the lubricant manufacturers or by measurement, it can be determined at a given ISO viscosity class and a given viscosity index in accordance with ISO 3448.

For the viscosity index  $VI = 100$ , the dependency of the effective dynamic viscosity  $\eta_{eff}$  of the lubricant from the effective bearing temperature  $T_{eff}$  can be determined from figure 59.

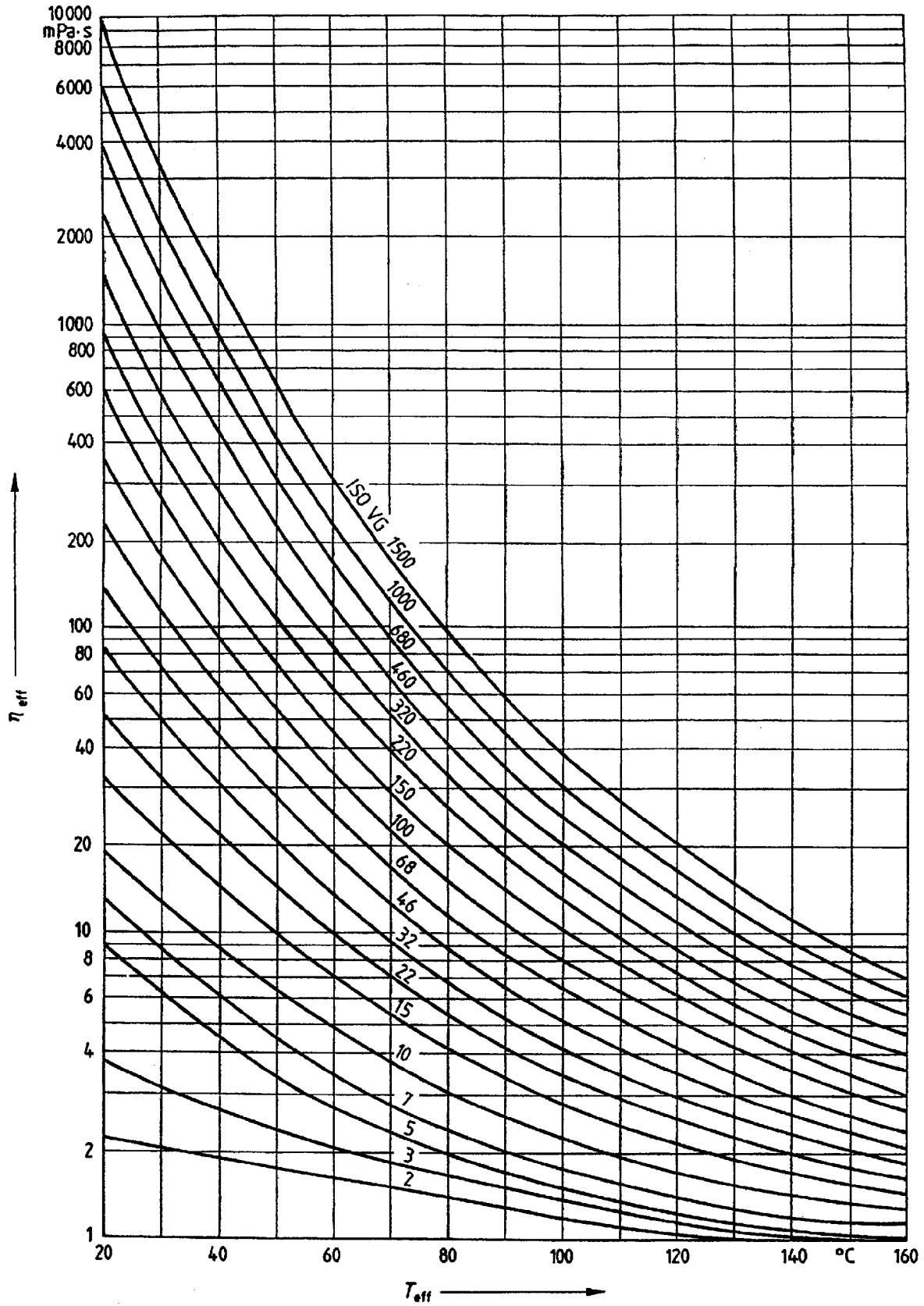


Figure 59 — Effective dynamic viscosity  $\eta_{eff}$  as a function of the effective bearing temperature  $T_{eff}$  for lubricants complying with ISO 3448, with VI = 100 and  $\rho = 900$  kg/h

## **Annex A**

(informative)

### **Bibliography**

- [1] CONSTANTINESCU, V. Basic Relationships in Turbulent Lubrication and their Extension to Include Thermal Effects. *Transactions of the ASME*, Series, F, No. 2, **95**, 1973, pp. 35-43.

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**ICS 21.100.10**

**Descriptors:** bearings, plain bearings, rules of calculation.

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