

Numerical Determination of the Equivalent Sand Roughness of a Turbopump's Surface and Its Roughness Influence on the Pump Characteristics

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Supplementary Material: Data Base of Drag Coefficients for Regular Shapes

Within porous cells, the Discrete Porosity Method (DPM) simplifies irregular roughness shapes to regular ones. Therefore, four different shapes were chosen in this approximation: a right triangle with its right angle on left side, on right side and a triangle with its tip in the center. Moreover, a rectangle was added to the database. For the triangles, the shapes are parametrized in their slope angle, as can be seen in Figure 10 in the manuscript, whereas the rectangle is parametrized in its aspect ratio.

The following tables show the 2D drag coefficients from the RANS computations for the given shapes.

Table S1. c_D -values for left right-angular triangle.

β [°] Re	15	30	45	60	75
1000	1.5065	1.5144	1.651	2.2806	2.798
5000	1.2659	1.4285	1.6084	2.2162	1.815
20,000	1.3686	1.4317	1.7072	2.2776	3.075
50,000	1.1119	1.4175	1.7015	2.0226	3.174
100,000	1.1349	1.3855	2.2911	2.7913	3.138
125,000	1.1206	1.3782	2.1815	2.4477	3.149
150,000	1.1217	1.3725	2.4417	2.0362	3.543
200,000	1.1143	1.3115	2.1004	2.1353	3.659
> 200,000	1.1143	1.3115	2.1004	2.1353	3.659

Table S2. c_D -values for right right-angular triangle.

β [°] Re	15	30	45	60	75
1000	0.6642	1.2588	1.5363	1.4358	2.74
5000	0.6723	1.1929	1.6748	1.6709	1.796
20,000	0.6793	1.2921	1.4655	1.6103	2.31
50,000	0.8574	1.4156	1.5723	2.0511	3.665
100,000	0.8505	1.4507	1.4498	1.5907	2.363
125,000	0.8536	1.2407	1.4542	1.7197	2.344
150,000	0.8589	1.4008	1.4439	2.0157	2.101
200,000	0.8592	1.389	1.4788	2.3294	2.214
> 200,000	0.8592	1.389	1.4788	2.3294	2.214

Table S3. c_D -values for centered tip triangle.

β [°] Re	15	30	45	60	75
1000	0.5938	0.9356	1.3218	1.4015	2.196
5000	0.6084	0.9696	1.4445	1.9692	2.321
20,000	0.6133	0.9149	1.0864	1.6169	1.989
50,000	0.8992	0.8709	1.2237	1.5761	2.117
100,000	0.6257	0.8725	1.2932	1.6421	1.896
125,000	0.9075	0.8727	1.2994	1.6205	1.85
150,000	0.9129	0.8732	1.2828	1.56	1.833
200,000	0.9135	0.8732	1.2824	1.5381	1.919
> 200,000	0.9135	0.8732	1.2824	1.5381	1.919

Table S4. c_D -values for rectangles.

Re	Aspect ratio L/D						
	0.25	0.33	0.5	1	2	3	4
1000	1.84	1.861	1.77	1.78	1.62	1.5	1.2
5000	2.03	1.87	1.948	1.88	1.8	1.64	1.3
20,000	2.06	1.84	2.08	1.98	1.78	1.7	1.18
50,000	2.07	1.85	2.1	2.09	1.95	1.79	1.48
100,000	2.08	1.862	2.42	2.49	2	1.84	1.15
125,000	2.08	1.862	2.58	2.78	1.89	1.89	1.18
150,000	2.14	1.89	1.79	3.014	1.984	1.93	1.16
200,000	2.18	1.91	1.8	3.11	2.02	1.98	1.18
> 200,000	2.18	1.91	1.8	3.11	2.02	1.98	1.18