

FLUID FACILITIES AND MACHINERY

GUIDE TO LABORATORY PRACTICALS

University of the Basque Country (UPV/EHU)

Energy Engineering Department

PRACTICAL P2: PUMPS 2: ROTATION SPEEDS

1. EXPERIMENTAL PROCEDURE: PRACTICAL DEVELOPMENT.

The following procedure must be followed to complete the practical:

Obtaining the characteristic curve of pump B.1, at 46 [Hz].

1. The valve located on the suction (inlet) line MUST NOT BE TOUCHED. Check the water level.
2. Turn on the facility.
3. Correctly position the red shut-off valves.
4. Find the "zero" position of the dynamometer.
5. The flow regulation valve must be CLOSED.
6. Turn on pump B.2 (moving valve handle to the left).
7. Adjust the frequency (if necessary) to fix the rotation speed at 46 [Hz].
8. Obtain the characteristic curve of the pump, by progressively increasing the flow from $Q = 0$ [m³/h] to the point where the discharge pressure equals 10 [m W.C.]. The pressure values at the vacuum gauge-manometer (inlet) and the manometer (outlet) of the pump and, force [g], electric power [W] and rotation speed [r.p.m.] will be taken at the two previously specified points and at FIVE additional intermediate operational points.
9. Close the flow regulation valve.
10. Turn off pump B.2.

Obtaining the characteristic curve of B.2, at 42,5 [Hz].

Repeat steps 5 to 10 again and then set the rotation speed at 42,5 [Hz].

The mechanical power of the pump may be obtained with the following expression:
 $P_m = M \cdot N = F \cdot d \cdot N$. Where, F is the force in [N]; d is the distance of the torque arm (0,11 [m]); and, N is the rotation speed in [r.p.m.]. The force is obtained operating with the dynamometer for each flow rate that is tested.

Table 2: *Experimental data.*

PUMPS 2: Rotation speed		Q	P	F	Vac.-Man	Manomete r	N
		[m ³ /h]	[W]	[g]	[m W.C.]	[m W.C.]	[r.p.m.]
XX Hz	Points X						

2. RESULTS

The student will fill in a results table in an EXCEL file. This table will show the experimental data collected in the laboratory, which will justify the experimental results. Having analyzed the experimental results, the following graphs will be prepared:

- **Graph 1:** $H-Q$ characteristic curve of pump B.2 operating at 46 [Hz].
- **Graph 2:** Power-flow rate curves for pump B.2 operating at 46 [Hz]: hydraulic power, P_h-Q ; mechanical power, P_m-Q ; and, electrical power, P_e-Q .
- **Graph 3:** Efficiency-flow rate curves for pump B.2 operating at 46 [Hz]: Overall efficiency of the pump, $\eta_{G.B.}-Q$; overall efficiency of the engine, $\eta_{G.M.}-Q$; overall efficiency of the pump-engine system, $\eta_{G.M.B.}-Q$.
- **Graph 3:** Performance curves – Flow rate for pump B.2 operating at 46 [Hz]: global performance of the pump, $\eta_{G.B.}-Q$; global performance of the motor, $\eta_{G.M.}-Q$; and global performance of both pump and motor, $\eta_{G.M.B.}-Q$.
- **Graphs 4, 5, and 6:** Obtain the equations that correspond to pump B.2 when operating at 42,5 [Hz] to represent the following curves: $H-Q$, P_h-Q , P_m-Q , and $\eta_{G.B.}-Q$. Each curve must be represented in one graph. On each curve, denote the experimental points obtained with pump B.2 operating at 42,5 [Hz].

The $H-Q$ characteristic curves that correspond to graphs 1, 2, and 3 must be fitted to the corresponding polynomial degree, and the regression as well as the corresponding

equation must be shown. All graphs must have a title and each axis (x,y) must be labelled with the corresponding units. These graphs must be presented in the report and the traceability of the information in each graph back to a primary source must be ensured.

3. CONCLUSIONS

The main conclusions must be written in the Excel file, must relate to the objective of the practical, and must provide an analysis of the possible differences between the experimental and the theoretical results for the connection section.

4. EXPERIMENTAL DATA

P2: Pumps: Rotation Speed		Q	P	F	Vac.-Man	Manometer	N
Frequency	Points	[m ³ /h]	[W]	[g]	[m W.C.]	[m W.C.]	[r.p.m.]
45 Hz	1	0,00	380	1000	-1,0	19,0	2668,2
	2	2,02	460	1250	-1,2	17,5	2656,3
	3	3,39	520	1460	-1,7	16,0	2651,0
	4	4,46	570	1560	-2,1	14,5	2645,4
	5	5,45	600	1640	-2,8	13,0	2640,3
	6	6,15	630	1710	-3,2	11,5	2639,4
	7	6,8	650	1780	-3,8	10,0	2636,6
40 Hz	1	0,00	290	840	-1,0	15,0	2372,9
	2	1,31	325	1000	-1,0	14,2	2367,5
	3	2,48	375	1130	-1,2	13,2	2361,1
	4	3,25	400	1220	-1,5	12,4	2358,2
	5	3,94	420	1310	-1,9	11,6	2356,9
	6	4,52	440	1390	-2,1	10,8	2353,2
	7	5,06	450	1420	-2,4	10,0	2352,4