Electric Motor Systems EMSA

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Solution

Example 2,
Use of the Motor Systems Tool – an energy advisory case

Situation A:
You are an energy adviser. One day the encounter a fan installation. The installation is a three-phase motor driving a fan directly. The facility at where you are is well equipped and is able to provide the datasheet for the fan (see page 2). The motor nameplate can be read on site:

50 Hz, 5.5kW, 380V, 12A, cos phi 0.83, 1425 rpm.

Using your multi-meter, you find the power consumption of the installation to be 6.15 kW. From the fan curve, electrical measurement and you knowledge of motors we can take a qualified guess of the amount of air delivered by the fan:

4 m3/s at a differential pressure of **1000** pa

These numbers are verified on site. Having interviewed the operating personnel of the machine and by measuring actual duty points the following load profile is established:

1. Highest flow: P1 = 5.40 kW for 500 hours/year
2. Lower flow: P1 = 6.15 kW for 1800 hours/year
3. Lower flow: P1 = 5.82 kW for 1800 hours/year
4. Lowest flow: P1 = 5.34 kW for 2500 hours/year

What is the annual power consumption in the current situation? **37.596 kWh**

What would the annual power consumption be, if the motor was replaced by an IE3 motor? (*IE2, IE4?*)
(Not taking a potential speed variation into account)

Annual savings with IE3 (same load profile): (With IE2, IE4?)

IE3 = 35.313 kWh **IE3 = 2.283 kWh**
IE2 = 36.135 kWh ***IE2 = 1.461 kWh***
IE4 = 34.366 kWh ***IE4 = 3.230 kWh***

Situation B:
Imagine the same situation but in this case the fan, for mechanical reasons, is driven by two belts (XPB narrow cogged, both pulleys Ø140). With unchanged hydraulic conditions (P4) the "new" load profile would look like this:

1. Highest flow: P1 = 5.87 kW for 500 hours/year
2. Lower flow: P1 = 6.65 kW for 1800 hours/year
3. Lower flow: P1 = 6.31 kW for 1800 hours/year
4. Lowest flow: P1 = 5.81 kW for 2500 hours/year

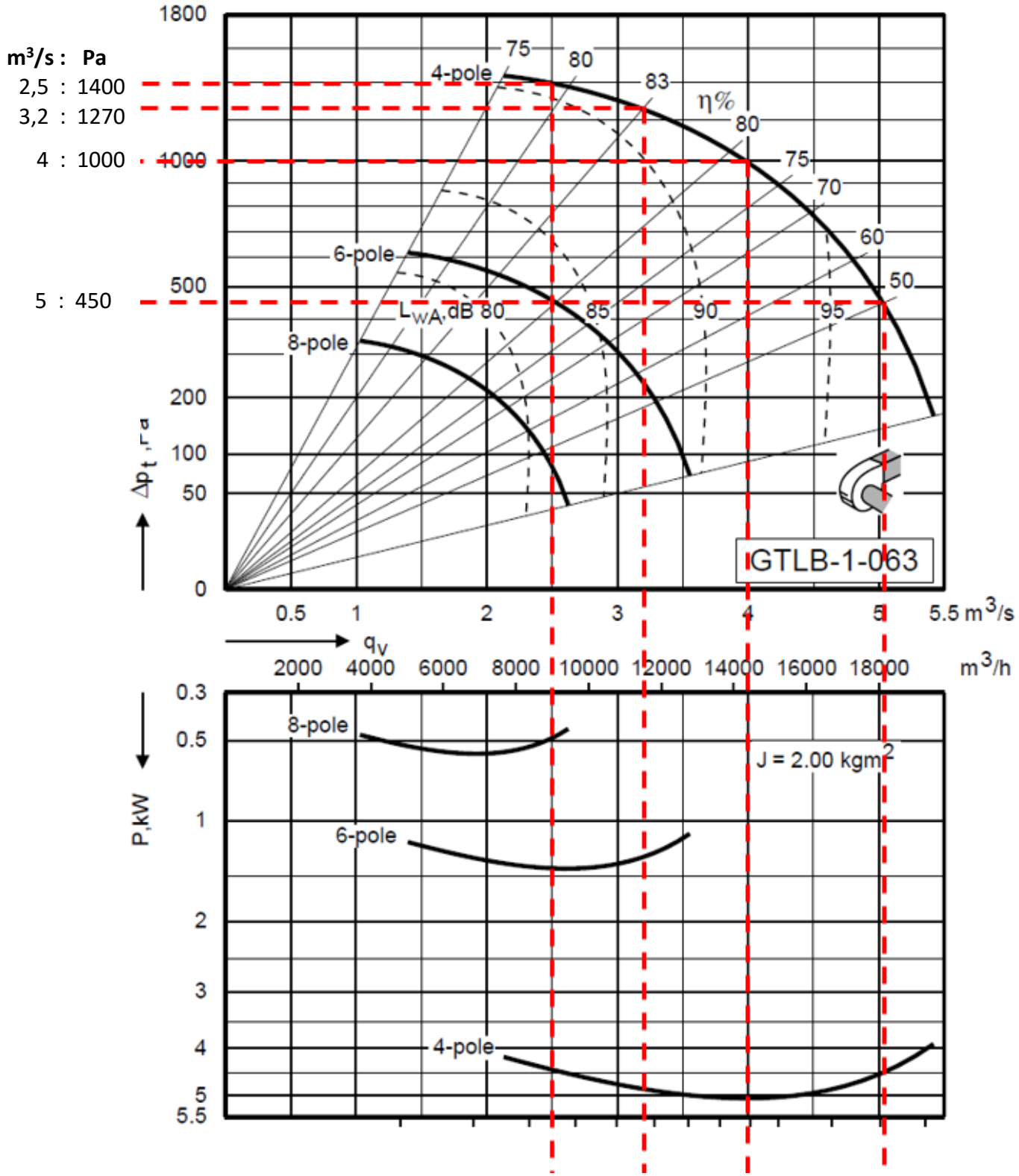
Before annual:
40.788 kWh

What would be an obvious action for saving energy – and why? **One belt + 180 mm pulley:**
39.423 kWh

What would the savings potential be for this action? **1.365 kWh**

What would the total savings of these actions be considering both replacement of belt and motor to IE3? (IE4?)

IE3: **IE4:**
36.934 kWh **35.941 kWh**
3.854 kWh ***4.847 kWh***


m³/s : Pa
2,5 : 1400
3,2 : 1270
4 : 1000
5 : 450
1800
1400
1000
500
200
100
50
0
Δpt, Pa
4-pole
6-pole
8-pole
75
80
83
η%
80
75
70
60
50
LWA,dB 80
85
90
95
GTLB-1-063
0.5
1
2
3
4
5
5.5 m³/s
qv
2000
4000
6000
8000
10000
12000
14000
16000
18000
m³/h
0.3
0.5
1
2
3
4
5
5.5
P,kW
8-pole
J = 2.00 kgm²
6-pole
4-pole
4
3
2
1