EXAMPLE 3: ROTOR MODEL

Here is an example of a non-symmetrical rotor with a very flexible shaft. The layout is shown in Figure 10.

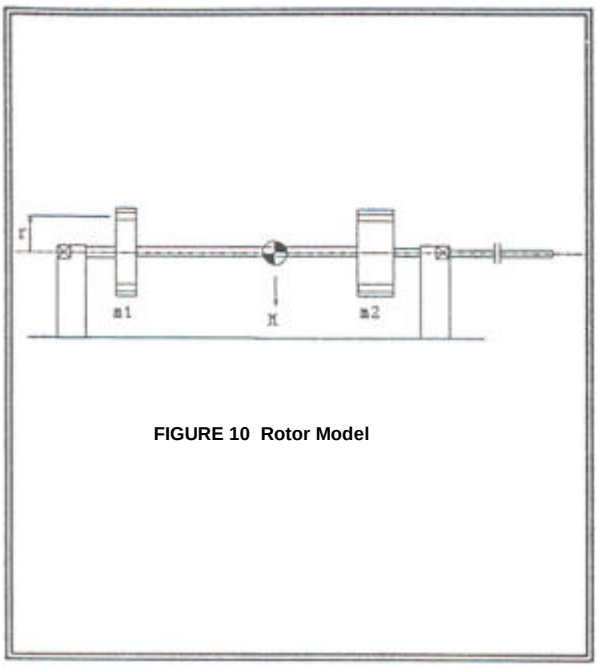

FIGURE 10 Rotor Model

M = 1612 g
m_1 = 629 g
m_2 = 816 g

w = 5000 rpm
w_c = 3500 rpm
r = 1.2”
c = .66

Estimated and actual sensitivities are as follows:

Static Sensitivity:

Estimated, S_s = .0284 oz-in/mil p-p
Actual, S_s = .0177 oz-in/mil p-p

Dynamic Sensitivity:

Estimated, S_D = .0102 oz-in/mil p-p
Actual, S_D = .0289 oz-in/mil p-p

The discrepancies between actual and estimated values result from the fact that the shaft is neither rigid or symmetrical.

It should be noted that there are additional sources of dynamic unbalance when the balance weights at a plane are not symmetrically applied.

Table 1 summarizes the estimated and actual sensitivities of the three examples presented.

TABLE 1 STATIC AND DYNAMIC BALANCE SENSITIVITIES – ESTIMATED VS. ACTUAL

CASE STUDY	W/w c1 / W/w c2	STATIC SENSITIVITY			DYNAMIC SENSITIVITY		
		ACTUAL oz-in/mpp	ESTIMAT-ED oz-in/mpp	ACT/ EST	ACTUAL oz-in/mpp	ESTIMAT-ED oz-in/mpp	ACT/ EST
Rotor Model 1.6 kg Rotor 5000 rpm	1.43 .71	.0177	.0284	.62	.0289	.0102	2.83
Generator 11,800 kg 3600 rpm	2.67 <1	200	208	.96	14-21	21.8	.61 - .96
Dryer Exhaust Fan 10,000 kg 1190 rpm	1.35 <1	271	180	1.5	163	224	.73

This type of modal balancing enables a good first estimate of balance sensitivities when the rotor is rigid and symmetrical about its center of gravity. The degree to which the rotor becomes flexible and non-symmetrical determines the variation between the estimated and actual sensitivities.

References: Csokmay, J.M.,
“Rotor-Balancing by Static-Couple Derivation.”
IRD Mechanalysis, Inc.
Columbus, Ohio