

BALANCING TIP # 105

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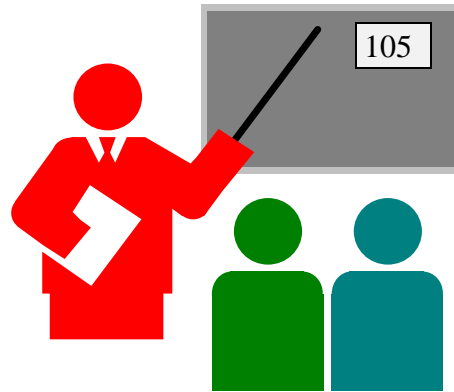
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BALANCING ARMATURES TO THE EASA STANDARD

Section 2.7 of the EASA Standards covers the balancing of armatures. The following Tip will provide a quick way to calculate and apply the Standard. If your balancing machine does not read out in units of weight (ounces, grams) look at Balancing Tip 102 to assist in using the Standard.



The EASA Standards for the Repair of Electrical Apparatus includes a section (Section 2.7) on balancing. This reads as follows;

“Dynamic Balancing should be to the level specified by the customer. In the absence of a requested level, dynamic balancing to balance quality grade G2.5 (ISO 1940/1) should enable the machine to meet final vibration limits as defined in 6.4.6.”

Reference: EASA Standards dated February, 1995, Section 2, Page 2.

The following procedure presents an easy way to calculate the tolerance required for an armature based upon the referenced specification (Quality grade G2.5 (ISO 1940/1)).

DISCUSSION

To understand and apply the referenced ISO Standard to rotor balancing requires a knowledge of three facts; the speed of the rotor, the dimensional shape of the rotor and the weight of the rotor. Applying the Standard to motor armatures is simplified since the speed is always known and the dimensional shape is generally symmetrical. This allows for a simplified approach for easy calculation of the tolerance based upon weight.

For reference only, the general formulas for calculating unbalance tolerances to the ISO Standard are as follows;

- (a) Acceptable Level of Unbalance in ounce inches = $6.015 \times G \times W/N$
- (b) Acceptable Level of Unbalance in gram inches = $170.5 \times G \times W/N$
- (c) Acceptable Level of Unbalance in gram mm = $9549 \times G \times W/N$

were G is the balance quality grade from the ISO Standard
W is the weight of the rotor in pounds (a & b) or Kgs (c)
N is the operating speed of the rotor

and the acceptable level of unbalance calculated is total for the rotor.

Since the EASA Standard states the Quality Grade required (2.5) and most motor armatures are symmetrical (allows the total unbalance to be divided by 2) and RPM is always known, we can easily calculate the tolerance based on weight.

As an example, to calculate ounce inches of unbalance for a 3600 RPM symmetrical armature;

$$\begin{aligned} \text{Acceptable level on balance per plane in ounce inches} &= \frac{6.015 \times G \times W/N}{2} \\ &= \frac{6.015 \times 2.5 \times W/3600}{2} \\ &= .004177 \times W / 2 \\ &= .002088 \times W \end{aligned}$$

For any 3600 RPM motor armature, the balance tolerance per plane can be determined from this formula by simply knowing the weight.

The following chart will show the simplified formulas for 3600, 1800, 1200, 900 and 600 RPM as well as several examples.

FORMULA	3600 RPM	1800 RPM	1200 RPM	900 RPM	600 RPM
Allowable Unbalance per plane (oz - in) =	.002089 x W	.004177 x W	.00627 x W	.00835 x W	.01253 x W
Allowable Unbalance per plane (gm - in) =	.0592 x W	.1184 x W	.1776 x W	.2368 x W	.3552 x W

W = Weight of the Rotor in pounds

EXAMPLES

Unbalance Tolerance per plane in both ounce inches and gram inches

Rotor Weight in Pounds	3600 RPM		1800 RPM		1200 RPM		900 RPM		600 RPM	
	oz-in/ plane	gm-in/ plane	oz-in/ plane	gm-in/ plane	oz-in/ plane	gm-in/ plane	oz-in/ plane	gm-in/ plane	oz-in/ plane	gm-in/ plane
250	0.522	14.8	1.044	29.6	1.568	44.4	2.088	59.2	3.133	88.80
500	1.045	29.6	2.089	59.2	3.135	88.8	4.175	118.4	6.265	177.6
1000	2.089	59.2	4.177	118.4	6.270	177.6	8.350	236.8	12.53	355.2
2000	4.177	118.4	8.354	236.8	12.54	355.2	16.70	473.6	25.06	710.4
2500	5.223	148.0	10.44	296.0	15.68	444.0	20.88	592	31.33	888.0
4000	8.356	236.8	16.71	473.6	25.08	710.4	33.40	947.2	50.12	1421
5000	10.45	296.0	20.89	592.0	31.35	888.0	41.75	1184	62.65	1776
7500	15.67	444.0	31.33	888.0	47.03	1332	62.63	1776	93.98	2664
10000	20.89	592.0	41.77	1184	62.70	1776	83.50	2368	125.3	3552
15000	31.34	888.0	62.66	1776	94.05	2664	125.3	3552	188.0	5328

PROCEDURE

STEP 1.

Select the proper formula above based on the RPM to balance a rotor to G2.5 from the ISO Standard and comply with the EASA Standard.

STEP 2.

Weigh the rotor and calculate the proper tolerance per plane from the formula.

STEP 3.

When the proper tolerance has been calculated, divide the tolerance by the radius at which weight will be added.

EXAMPLE:

The unbalance tolerance for a 1000 pound, 3600 RPM rotor is 59.2 gram inches per plane.

The radius to the balance ring is 10 inches.

Weight = unbalance tolerance / radius = $59.2 / 10 = 5.92$ grams per plane

STEP 4.

Balance the rotor until the unbalance tolerance has been met.

This page can be copied and placed near the balancing machine for reference by the machine operators.

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