THE “B” BOOK GUIDE
TO SINGLE PLANE BALANCING

HOW TO SINGLE-PLANE BALANCE
WITH A MODEL 216-D VIBRATION
ANALYZER/BALANCER

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How to Dynamically Single Plane Balance a Fan using the 216-D

NOTE: ROTATING MACHINERY has potentially dangerous moving parts and should be guarded in accordance with applicable OSHA and Safety Regulations. Balmac drawings and photographs in this material show guards removed for illustration purposes.

WARNING: ROTATING MACHINERY HAS POTENTIALLY DANGEROUS MOVING PARTS AND SHOULD BE GUARDED IN ACCORDANCE WITH APPLICABLE SAFETY REGULATIONS. Potential hazards to the operator or the surrounding area may exist. The user should evaluate his rotors, the balancing speeds, and the unbalance correction methods used to estimate the characteristics of the fragments and parts that might fly off the rotors or machine during balancing, and should calculate a worst-case potential for each fragment and part, and then select the best protection all personnel before the machinery is operated.

Connections

1. Thread the Model 055 Magnetic Base on to the Model 158 Pickup and connect the Pickup Cable. Connect the Pickup Cable to Input #1 on the side of the 216-D.

2. Connect the Model 295 Strobe Light to the Strobe Cable. Connect the Strobe Cable and AC Power Cord to the side of the 216-D.

3. Push Power button. (A green flag inside the button will indicate the power is ON.)

4. Mount the Pickup to the fan housing in a radial direction. (Horizontal mounting illustrated in photo.)

   Connect Magnetic Base to Pickup and Pickup to Input #1.
   Connect Strobe Cable to Strobe Light and Strobe Input.
   Push Power button to start instrument. A green flag inside the button will show power is ON.
   Connect Pickup to Fan.
5 Toggle Pickup Switch to #1.

6. Set Filter Mode Switch to DISP.

7. Set Filter Model Switch to OUT.

8. Set RPM Range Switch to x1 (200 to 2000 RPM).

9. Mark the fan shaft end with an easily observed Reference Mark, or use an existing keyway as the Reference Mark.

Run #1

1. Start the fan. When the fan attains running speed, turn the Amplitude Amount Range Switch until you get an on-scale reading on the Amplitude Meter (between 20% and 100%).

2. Note the RPM meter reading. Set Filter Mode Switch to IN.

3. Adjust the Tuning dial until the Green LED lights. You have now tuned the 216-D filter to the fan running speed. (Note: some side-to-side fluctuation may occur between the red and green LEDs due to slight speed variations.)

4. Turn ON the Strobe Light Switch and direct the strobe light at the face of the fan to see the Phase Reference position.
5. Visualize the fan face as a clock. Read the Phase Reference position as if it were a clock hand.

6. Read the Amplitude Meter and the Phase Reference and record them on the Polar Graph Pad under Plane “A”.

7. Stop the fan.

Run #2

8. Measure and record your Trial Weight Size. Add the Trial Weight at any known location on the rotor.

CAUTION: ATTACH WEIGHT SECURELY.

9. Restart fan.

10. Read the new Phase Reference using the Strobe Light.

11. Read the new amount on the Amplitude Meter. If the needle goes above 100% Full Scale, adjust the Amount Range switch until the needle is between 20% and 100%.

12. Record the new readings on the Polar Graph Pad under Plane “A”.

The Polar Graph

Note: if the Phase Reference does not change position, but the Amplitude amount increases, you may have added your Trial Weight to the heavy spot. However, if the Phase Reference does not change, and the Amplitude amount does not change, the size of the Trial Weight may not be sufficient and will need to be increased.

The addition of the Trial Weight increased the Amplitude reading to approximately 7 Mils.

Note: the Polar Graph provides a visual representation of both the Amplitude Amount and the Phase Reference readings.

Amplitude is represented as “0” at the very center of the graph, to “5” on the very last concentric circle. The graph as viewed would represent “0 to 5” Full Scale.
If your highest readings are above “5” Full Scale, you can designate each concentric circle to represent “2” and the entire graph would represent “0 to 10” Full Scale.

If your highest readings are above “10” Full Scale, you can designate each concentric circle to represent “3” or “4” or “5” and the entire graph would represent “0 to 15” or “0 to 20” or “0 to 25” Full Scale.

The radii on the graph each represent 10 degrees as on a Compass Rose. The clock numbers mentioned earlier are also printed around the outside of the graph.

### Plotting the Vectors

13. Plot/draw Run #1 Amplitude and Phase position on the circular graph and label it “1.”

14. Plot/draw Run #2 Amplitude and Phase position on the circular graph and label it “2.”

15. Draw a line from the graph center to number “1.” Label it “UB” for “Un Balance.”

16. Draw a line from “1” to “2.” Label it “TW” for “Trial Weight.”
17. Using a protractor, ruler or other measuring stick, measure the “UB” length, then measure the “TW” length on the graph.

18. Calculate the correct weight size:

\[ UB = \text{Distance from center to "1."} \]
\[ TW = \text{Distance from "1" to "2."} \]
\[ WS = \text{Weight Size} \]

\[ UB \times WS = \text{Correction Weight} \]
\[ TW \]

Using a Centimeter ruler, UB measures approximately 2.5 centimeters, TW measures approximately 1.5 centimeters. WS (the weight size of our Trial Weight is 5 grams.

\[ 2.5 \times 5 \text{ (grams)} = 8.3 \]
\[ 1.5 \]

The Correction Weight is approximately 8.3 grams.

19. The Correction Weight shift is opposite the direction of the TW line phase shift. If the TW line must move Counter Clockwise (CCW), the Correction Weight must move opposite (Clockwise - CW) on the fan face. In other words, if the line TW on the polar graph has to move CCW, the Correction Weight has to move CW on the fan face. If the line TW on the polar graph has to move CW, the Correction weight has to move CCW on the fan face.

20. In our example, the Correction Weight would be added to a fan blade approximately 120 degrees Clockwise (CW) from the original Trial Weight position.

Run #3

21. Add Correction Weight to proper location on fan blade. **Remove Trial Weight.**

22. Start fan.

23. Compare Amplitude and Phase readings with Run #1 readings.
24. Record new Amplitude and Phase readings. Use the Balmac Vibration Severity Chart to determine if the new Amplitude reading is acceptable.

25. Possible additional runs:

Move and/or adjust the size, location, or both of the correction weight.

Section 9 - How To Use the Vibration Severity Chart

The Model 216-D allows operators to read vibration amplitude in Velocity or in Displacement. Operators can compare their recorded readings with numbers on the Vibration Severity Chart to determine whether their readings fall in the Smooth, Good, Fair or Rough ranges.

Velocity measurements are in Inches Per Second (ips) Peak. Velocity measurements begin at the bottom left corner of the chart with .01 and run vertically up the left side until they reach 2 (ips) at the top. Velocity measurements are independent of speed (RPMs). A Velocity reading of 0.1 (ips) is SMOOTH at 100 RPMs or at 100,000 RPMs.

Example: to find a reading of .25 in Velocity, start at the bottom left side of the Severity Chart and read up vertically until you find .2. .25 is halfway between .2 and .3 and is in the Fair zone.

Displacement measurements are in Mils (Peak-to-Peak). Displacement measurements begin at the bottom right corner of the chart with .01 and run vertically up the right side and horizontally across the top until they reach 200. Displacement measurements are dependent on speed (RPMs). A measurement of 1 Mil at 2,000 RPM is SMOOTH (follow the diagonal line from 1 Mil down the page until it intersects with the vertical line at 2,000 RPM). However, a measurement of 1 Mil at 5000 RPMs is only FAIR and a 1 Mil measurement at 10,000 RPMs is ROUGH.
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