MPTA-B2c-2017

STANDARD PRACTICE FOR SHEAVE/PULLEY BALANCING

MPTA STANDARD

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Abstract

This standard defines the balance tolerances to be used with all transmission sheaves/pulleys with or without grooves or teeth.

Copyright Position Statement

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1. Foreword

This foreword is provided for informational purposes only and is not to be construed to be part of any technical specification.

When a body rotates, centrifugal forces act upon each particle in that body, tending to impel the particles away from the axis of rotation. If the mass of a rotating body is unevenly distributed about its axis of rotation, these centrifugal forces are unbalanced and there is a tendency for the entire body to rotate about its center of gravity. These unbalanced forces may cause vibration, noise, poor bearing life, and high fatiguing stresses. To minimize these forces, it may or may not be necessary to alter the mass distribution (add or subtraction of material) to make the center of mass concentric with the axis of rotation. That is known as Balancing the Product.

Suggestions for the improvement of or comments on this publication are welcome.
They should be sent to www.mpta.org .

2. Scope

This standard applies to sheaves/pulleys for rubber V-Belts covered under ARPM/MPTA publications IP-20 (Classical), IP-21 (Double -V), IP-22 (Narrow), IP-23 (Light Duty), IP-24 (Synchronous Belts), IP-26 (V-Ribbed), and IP-27 (Curvilinear Toothed Synchronous Belts).

3. Types of Balancing

3.1. One-Plane Balancing (static)
A one-plane balance is the recommended balance for all products.

3.2. Two Plane Balancing (dynamic)
A two-plane balance is recommended only in certain cases where the product face width is relatively large and the operational speed relatively fast, or where balance is considered very critical. A two-plane balance is an option which must be specified.

4. Units of Unbalance and Terminology

Unbalance may be measured in various ways and unbalance units may take several forms. This standard will list four:

Measure	**English Units**	**Metric Units**
Mass at Rim O.D.	ounce	Gram
Unbalance	ounce-inch	gram-millimeter
Eccentricity	Inch	Millimeter
Balance Quality Grade (G)	inch/sec	millimeter/sec

Terminology

O.D. = Outside Diameter
RPM = Revolutions Per Minute
FPM = Feet Per Minute
Eccentricity = The displacement from the center of mass to the center of rotation. This term should not be confused with vibration displacement measurements.

Balance Quality Grade = Grade representing balance level requirements for typical machinery types as defined in ISO 1940-1: Mechanical Vibration-Balance Quality Requirements of Rigid Rotors-Part 1: Determination of Permissible Residual Unbalance and ISO 254: Belt Drives-Pulleys-Quality, Finish and Balance

5. One-Plane Balancing (static)

5.1. The balance level values are based on the allowable peripheral speed of Gray iron (6,500 ft/min or 33m/sec).

5.2. Since it is impractical to attain a good balance level on sheaves/pulleys which are light in mass, the required lower limit of balance level is broken into two categories:

5.2.1. Standard or general purpose products (ARPM/MPTA IP-20, -22 and -24) when the mass is under 11 pounds (5 Kg mass).

5.2.2. Fractional Horsepower or Light Duty products such as ARPM/MPTA Standard IP-23 (2L, 3L, 4L and 5L) are excepted when the mass is under 22 pounds (10 Kg mass).

5.3. Refer to Table 1 for the balancing formulas.

6. Two-Plane Balancing (dynamic)

6.1. When considering two-plane balance, it is necessary to determine when two-plane balancing is recommended and the unbalance limits.

6.2. To determine whether two-plane balancing is recommended, perform the following calculation:

Formula #1

$$RPM = \frac{15{,}500}{\sqrt{D \times F}}$$

Where: *D* is the Diameter in inches
F is the Face Width in inches

OR

Formula #2

$$RPM = \frac{25.4 \times 15{,}500}{\sqrt{D \times F}}$$

Where: *D* is the Diameter in millimeters

F is the Face Width in millimeters

6.3. The resultant RPM is the maximum recommended operating RPM for a sheave or pulley with a one-plane balance. If the sheave or pulley is to be operated at a higher RPM, a two-plane balance is recommended.

6.4. When two-plane balancing is recommended, the formulas given in Table 2 or Table 3 should be applied.

6.4.1. When operating speed is not known, use Table 2.

6.4.2. When operating speed is known, refer to Section 6.6.

6.4.3. The two-plane balance level is based on a peripheral rim speed of 6,500 FPM or 33m/sec for Gray iron* and 10,000 FPM or 50.8 m/sec for Ductile iron*.

WARNING: When belt speeds exceed 6,500 feet per minute, special materials must be used. Consult your manufacturer for special design requirements.

6.5. Since it is impractical to maintain a constant balance level of smaller products, Gray iron* products less than 57.6 pounds (26.2 Kg) and Ductile iron* products less than 88.7 pounds (40.3 Kg) are balanced to a lesser precision.

6.6. When products will knowingly be operated below their maximum speed limits*, the formulas given in Table 3 may be used. These formulas will provide for a balance level equal to those given in Table 2, but require less correction because of the lower operating speeds.

* Rim speed based on material specified in MPTA-B13i-2013 Rim Speed Limits.

Table 1, MPTA balancing formulas for one-plane balancing (static)

English Units *D* = Product OD (in.) *M*= Product Mass (lb.)	Light Duty Pulleys Under 22 lbs.	Standard Pulleys Under 11 lbs.	Light Duty 22 lbs or More Standard Duty 11 lbs or More
ounce @ Rim	0.352	0.176	$0.016 \times M$
ounce-inch	$0.176 \times D$	$0.088 \times D$	$0.008 \times M \times D$
e (inch)	$\frac{0.011 \times D}{M}$	$\frac{0.0055 \times D}{M}$	$0.0005 \times D$
G (inch/sec.)	$\frac{28.6}{M}$	$\frac{14.3}{M}$	1.30
Metric Units *D* = Product OD (mm) *M* = Product Mass(kg)	Light Duty Pulleys Under 10 kg.	Standard Pulleys Under 5 kg	Light Duty 10 kg or More Standard Duty 5 kg or More
g @ Rim	10	5	M
g–mm	$5.0 \times D$	$2.5 \times D$	$\frac{(M \times D)}{2}$
e (mm)	$\frac{0.005 \times D}{M}$	$\frac{0.0025 \times D}{M}$	$0.0005 \times D$
G (mm/sec)	$\frac{330}{M}$	$\frac{165}{M}$	33.0

Table 2, MPTA balancing formulas for two-plane balancing (dynamic)
(use when operating speed is unknown)

English Units D = Product OD (in.) M= Product Mass (lb.)	Gray Iron* Products $V_{max} =$ 6,500 FPM or 33 m/sec		Ductile Iron* Products $V_{max} =$ 10,000 FPM or 50.8 m/sec	
	All Products Less Than 57.6 lb	All Products 57.6 lb or More	All Products Less Than 88.7 lb	All Products 88.7 lb or More
ounce @ Rim (1)	0.088	$0.0015 \times M$	0.088	$0.001 \times M$
ounce-inch (1)	$0.044 \times D$	$0.00075 \times D \times M$	$0.044 \times D$	$0.0005 \times D \times M$
e (inch) (2)	$\frac{0.0055 \times D}{M}$	$0.000095 \times D$	$\frac{0.0055 \times D}{M}$	$0.000062 \times D$
G (inch/sec.) (2)	$\frac{14.3}{M}$	0.248	$\frac{22.0}{M}$	0.248
Metric Units D = Product OD (mm) M = Product Mass (kg)	All Products Less Than 26.2 Kg	All Products 26.2 Kg or More	All Products Less Than 40.3 Kg	All Products 40.3 Kg or More
g @ Rim (1)	2.5	$0.095 \times M$	2.5	$0.062 \times M$
g–mm (1)	$1.25 \times D$	$0.0475 \times M \times D$	$1.25 \times D$	$0.031 \times M \times D$
e (mm) (2)	$\frac{0.0025 \times D}{M}$	$0.000095 \times D$	$\frac{0.0025 \times D}{M}$	$0.000062 \times D$
G (mm/sec) (2)	$\frac{165}{M}$	6.3	$\frac{254}{M}$	6.3

(1) Values given for each correction plane.
(2) Values for entire product

* Rim speed based on material specified in MPTA-B13i-2013 Rim Speed Limits.

Table 3, MPTA balancing formula for two-plane balancing (dynamic)
(use when operating speed is known)

English Units *D* = Product OD (in.) *M* = Product Mass (lb.) (a) *V* = Rim Speed (FPM)	All Products Less Than 57.6 lb	All Products 57.6 lb or More
ounce @ Rim (1)	0.088	$\frac{10 \times M}{V}$
ounce-inch (1)	$0.044 \times D$	$\frac{5 \times D \times M}{V}$
e (inch) (2)	$\frac{0.0055 \times D}{M}$	$\frac{0.62 \times D}{V}$
G (inch/sec.) (2)	$\frac{0.0022 \times V}{M}$	0.248
Metric Units *D* = Product OD (mm) *M* = Product Mass (kg) (b) *V* = Rim Speed (m/sec)	All Products Less Than 26.2 Kg	All Products 26.2 Kg or More
g @ Rim (1)	2.5	$\frac{3.15 \times M}{V}$
g–mm (1)	$1.25 \times D$	$\frac{1.575 \times D \times M}{V}$
e (mm) (2)	$\frac{0.0025 \times D}{M}$	$\frac{0.00315 \times D}{V}$
G (mm/sec) (2)	$\frac{5 \times V}{M}$	6.3

(a) Speed (FPM) = 0.262 x D x RPM
(b) Speed (m/sec) = 0.000052 x D x RPM
(1) Values given for each correction plane.
(2) Values given for entire product.

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