ANSI/CEMA STANDARD B105.1-2015
(A revision of ANSI/CEMA STANDARD B105.1-2009)
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CEMA Standard B105.1

Specifications for

Welded Steel Conveyor Pulleys

With Compression Type Hubs

Conveyor Equipment Manufacturers Association

The Conveyor Pulley Subsection of the Conveyor Equipment Manufacturers Association has the responsibility for maintenance of this standard.

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FOREWORD

Welded steel conveyor pulleys have been in common use since the 1930's. MPTA formed a Steel Pulley Engineering Committee in 1958 to develop recommended pulley load ratings. This Committee consisted of pulley and conveyor engineers who studied available information on pulley design, theoretical stress analysis, and data from actual tests. All parts of the pulley and shaft assembly were included in the study. In May, 1960, recommended load ratings for standard conveyor pulleys were published.

In June, 1966 - The combined revised standard was approved as B105.1 U. S. STANDARD SPECIFICATION FOR WELDED STEEL CONVEYOR PULLEYS.

In November, 1987 - The standard was transferred to the Conveyor Equipment Manufacturers Association (CEMA). The CEMA Engineering Committee reviewed the standard and decided to revise the method used for determining Drive Shaft diameters so that the method would conform to the ANSI B106.1M-1985 "Design of Transmission Shafting" standard. Also, a run-out tolerance on pulley diameters was added. This industry standard is not intended in any way to limit the design of any manufacturer.

ANSI B106.1M was withdrawn in 1994. 1995, the CEMA Eng. Conference determined that the methods used by this former standard were technically sound and consistent with modern fatigue analysis methods. Therefore, the relevant data from ANSI B106.1M remains incorporated in this standard, and in Chapter 8 of CEMA's Publication "Belt Conveyors for Bulk Materials."

In the 2003 edition, the Conveyor Pulley Subsection:

1) Revised the Scope to clarify that the standard is not applicable to cone clamping keyless locking devices
2) Added Section 2.6 Shaft Run-out
3) Added information to Section 3.2 and a footnote to Table 2 describing the origin of the Load Ratings

In the 2009 edition, the Conveyor Pulley Subsection reviewed the standard and:

1) Added capability to use keyless locking devices in Scope and 3.6 Hub and bushing types
2) Added data and trapezoidal crown to 2.5 Crown
3) Clarified applications where better than standard tolerance is recommended in 2.6 Shaft Run-out
4) Added Section 2.7 limiting belt speed to 800 fpm.
5) Added overload information for 6th belt book into 3.4 Overloads
6) Standard has had selection method and examples intermingled. Created a generic selection method (4.1 – 4.7) and put examples into Appendix IV.
7) Inserted figures and tables in area of use rather than grouped at the end.
8) Reduced maximum PIW to 800 in Table 1 of Section 4.1 Pulley Diameter selection.
9) Added resultant load updates from 6th Belt Book into Section 4.2 and added discussion of use without weight.
10) Created section 4.3 overhung loads, added Appendix III for more background and historical reference.
11) Added overhung load multiplier to section 4.4 Shaft Fatigue.
12) Added Section 4.5 Pulley Fatigue Life.
13) Added overhung load and fatigue factors into Section 4.6 Pulley Selection. Clarified deflection versus stress control in Table 2. Added shaded area to clarify loads potentially exceeding 800 PIW.

In the 2015 edition, the Conveyor Pulley Subsection reviewed the standard and:

1) Metric equivalents and examples added.
2) Added figure 4 and figure 5 in appendix III.
3) Added appendix V describing Mine Duty and Engineered Pulleys.
4) Edited text, references, and tables numbers, for internal consistency and ease of reading
5) Added an index of tables and figures

TABLE OF CONTENTS

1. SCOPE

1.1 This standard applies to a series of straight face and crowned face welded steel conveyor pulleys that have a continuous rim and two end discs each with a compression type hub to provide a clamp fit on the shaft. It is not applicable to single disc pulleys, wing or slat type pulleys, or cast pulleys. This standard applies to pulleys using compression type hubs and high pressure keyless locking assemblies. It does not cover pulleys welded to the shaft.

The standard establishes load ratings, allowable variation from nominal dimensions, permissible crown dimensions and such overall dimensions as are normally necessary to establish clearances for location of adjacent parts. It is not intended to specify construction details, other than as outlined above, nor to establish the actual dimensions of any component parts.

The series of pulley sizes and shaft combinations shown in Tables 5-A and 5-B, and the load ratings shown in Tables 4-A and 4-B, cover the majority of combinations of welded steel pulleys with compression type hubs normally used in belt conveyor and elevator practice. Only the series shown are covered by this standard.

This standard is not intended to provide thorough guidance on shaft design at all potential failure points. The standard is intended to provide a shaft diameter at the pulley connection consistent with other external components such as bearings and drive components. It is assumed that the shaft is a consistent diameter throughout and layout clearances between components are minimized.

1.2 Welded steel conveyor pulleys covered by this standard should not be used with steel cable and other high modulus belts because such belts create stress concentrations and demand manufacturing tolerances beyond the capacities of these pulleys. High modulus belts are defined as those having operating tension ratings greater than 800 PIW (140 kN/m) or a modulus greater than 80,000 PIW (14000 kN/m). Consult your CEMA pulley manufacturer for assistance.

2. DIMENSIONS AND TOLERANCES

2.1 Diameters

Standard welded steel pulley diameters are as shown in Tables 5-A and 5-B. All other sizes are considered special. These nominal diameters apply to straight and crown face pulleys and are for bare pulleys only; they do not include any increase brought about by lagging.

2.2 Diameter Variations

Permissible diameter variations from nominal diameter are based on face width as follows:

FACE WIDTH in (mm)	OVER NOMINAL DIAMETER in (mm)	UNDER NOMINAL DIAMETER in (mm)
12 (305) thru 26 (660)	0.250 (6.35)	0.125 (3.18)
over 26 (660) thru 66 (1676)	0.625 (15.88)	0.125 (3.18)

These limitations apply equally to straight face and crown face pulleys with nominal diameter measured at the midpoint of the face width. The diameter is defined as the bare diameter exclusive of lagging.

Permissible diameter variations listed are not to be considered as diameter run-out tolerances. Listed nominal diameter variation may occur from one pulley to another. Diameter run-out tolerance at midpoint of the bare pulley face is as follows:

DIAMETERS in (mm)	MAXIMUM TOTAL INDICATOR READING (TIR) in (mm)
8 (203) thru 24 (610)	0.125 (3.18)
over 24 (610) thru 48 (1219)	0.188 (4.75)
over 48 (1219) thru 60 (1524)	0.250 (6.35)

2.3 Face Width Variations

Permissible face width variation from nominal face width is plus or minus 0.125 in (3.18 mm) for all sizes. Face width is defined as the length of the rim along the shaft axis.

The permissible face width variation is not to be construed as an edge run-out tolerance. The listed variation in face width may occur from one pulley to another. Edge run-out tolerance is specified by the individual CEMA pulley manufacturers.

2.4 Clearance along the Shaft

The distance between the outer faces of the hubs shall never exceed the overall pulley face width.

2.5 Crown

Crown is defined as the amount (expressed in inches) per foot of total face width by which the diameter at the center of the face exceeds the diameter at the edge.

Crowns running the full face are often made at a set diameter to face travel change rate, which results in the diameter difference increasing with face width. Amount of crown may be from 1/16 to 1/8 in per foot (5.2 to 10.4 mm per meter) of total face width.

Trapezoidal crowns have a center section of uniform diameter with tapered sections on either end. The difference in diameter from center to end ranges from 1/8 to 1/4 in (3.2 mm to 6.4 mm) regardless of face width. Crowned end sections typically have a diameter versus face travel rate of change similar to full crowns.

2.6 Shaft Run-out

The shaft extension run-out is measured from the bearing journals after the shaft is installed in the pulley. Radial shaft extension Total Indicator Reading (TIR) shall not exceed 0.002 in per in (0.002 mm per mm) of shaft extension beyond the bearing center. Typically bearings will introduce an additional run-out, which is not included in this limit.

Flexible couplings, backstops and parallel shaft mount reducers are used with this limit as long as components remain close to bearing, torque restraint has ample flexibility and visual motion is permitted. Examples of situations where a more conservative limit may be desired are given. Consult your CEMA pulley manufacturer for details.

- As shaft extension increases, run-out may become visually noticeable. A perception issue may occur even when component attachments are designed to tolerate the run-out.
- Right angle reducer/motor assemblies supported by pulley shaft commonly require lower limits. These assemblies tend to be quite long, which accentuates the run-out.
- Drives attached with rigid couplings commonly require lower limits. The coupling essentially increases the shaft extension which accentuates the run-out.

2.7 Belt Speed

It is not recommended to operate standard drum pulleys above a belt speed of 800 fpm (4 m/s). For higher speeds consult your CEMA pulley manufacturer.

3. PULLEY SELECTION - GENERAL INFORMATION

3.1 Pulley Diameter and Face Width

The following selection procedures assume the pulley diameter and face width have been established consistent with belting and conveyor design requirements.

3.2 Ratings

The tabulated ratings for pulley and shaft combinations are based on the use of non-journalled shafting with pulleys centrally located between two bearings. Ratings are based on SAE 1018 shaft material using either a maximum shaft bending stress of 8000 psi (55.16 MPa) or a maximum free shaft deflection slope at the hub of 0.0023 in per in (0.0023 mm per mm) or [tangent of 8 min], whichever governs. (See Appendix II for shaft deflection formula.)

Pulleys used on shafting selected with a bending stress greater than 8000 psi (55.16 MPa), or a slope exceeding 0.0023 in per in (0.0023 mm per mm), are special and are not covered by this standard. High strength shafting may be used in drive pulleys to withstand the added torsional shaft stresses. See Section 4.4 and Appendix III and IV for shaft calculations, or consult your CEMA pulley manufacturer for assistance.

3.3 Rating Interpolation

Four values are listed in Tables 4-A and 4-B, Load Ratings (Pounds & Kilonewtons) for Pulleys and Shaft Combinations. In this table, interpolation may be used for determining a load rating for an unlisted value of bearing centers minus face width.

3.4 Overloads

Excessive belt tensions may result in premature failure of pulleys, shafting or bearings. Differentiating between transient tension increases and steady state running tensions is important for proper pulley design.

Transient, or dynamic tension increases happen for a short period and then subside. These periods generally last for a few minutes or less and represent less than 1 percent of operating time. Some examples are starting, stopping and jam-ups. Transient loads should not exceed design loads by more than 50 percent. If greater than 50 percent or more than 1 percent of running time, mine duty or engineered pulleys are recommended, and this information should be provided to your CEMA pulley manufacturer.

Steady state running tensions happen for a significant period of time and represent the fundamental operating conditions. Conditions that can increase running tensions are excessive belt misalignment, excessive material loaded, excessive take-up weight, gravity take-up frictional increases and over tightening of screw take-ups. Normal running tensions for engineered pulleys should not exceed ratings within this standard.

3.5 Hub Size

The rating tables are based upon using the smallest hub size that will accommodate the required shaft diameter. Specifying a larger hub size, in some cases, results in a decreased rather than an increased