

ANSI / CEMA B105.1-2009

A REVISION OF
ANSI/CEMA B105.1-2003
(Approved May 19, 2009)

CEMA Standard B105.1

Specifications for

Welded Steel

Conveyor Pulleys

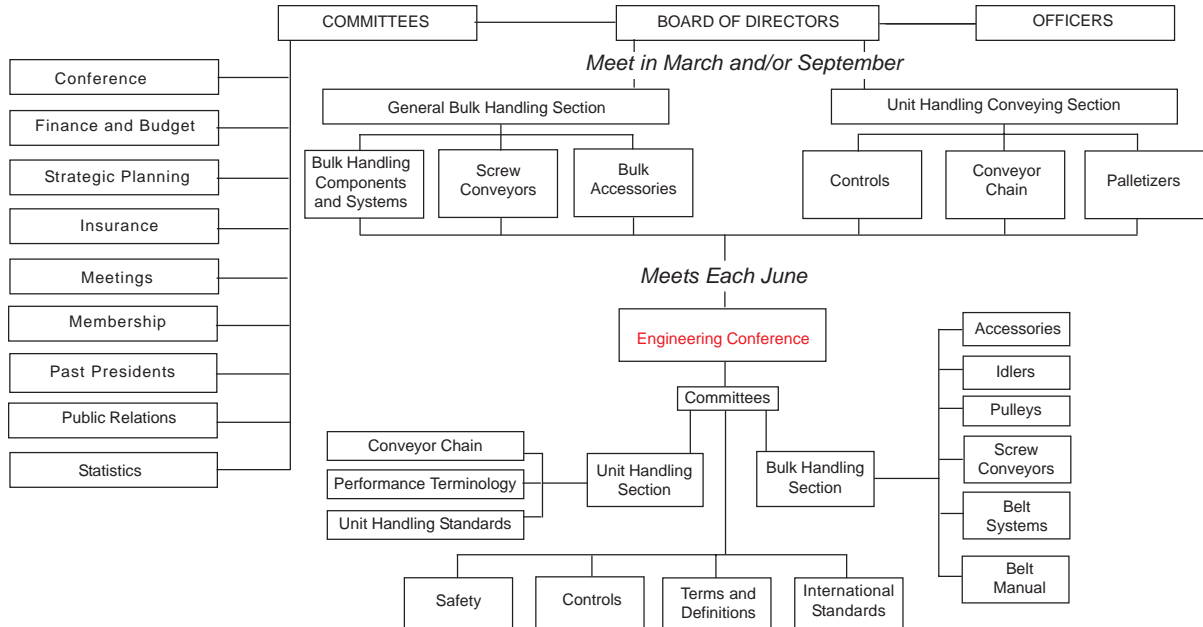
With Compression Type Hubs



*Conveyor Equipment
Manufacturers Association*

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The labels are available for sale to member companies and non-member companies.

A full description of the labels, their purpose, and guidelines on where to place the labels on typical equipment, has been published in CEMA's *Safety Label Brochure* No. 201. The Brochure is available for purchase by members and non-members of the Association. Safety Labels and Safety Label Placement Guidelines, originally published in the Brochure, are also available free on the CEMA Web Site at http://www.cemanet.org/CEMA_Safety_Pg.htm

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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. The committee has continued its work since then and published the following:

October, 1961 - WELDED STEEL CONVEYOR PULLEY STANDARD, which covered the overall dimensions representing standard practice in welded steel conveyor pulley design at that time.

March, 1962 - MPTA submitted both of the above standards with a letter ballot to a list of substantially concerned organizations. On the basis of suggestions received, the standards were combined and revised.

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

June, 1974 - The MPTA submitted MPTA 301-1974 to ANSI as a proposed revision of B105.1.

July 23, 1976 - The standard was approved as ANSI B 105.1-1976

December 30, 1983 - The standard was approved as ANSI B105.1-1983

November, 1987 - The standard was transferred to the Conveyor Equipment Manufacturers Association (CEMA).

In 1987, 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 runout 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 Runout
- 3) Added information to Section 3.2 and a footnote to Table 2 describing the origin of the Load Ratings

For this 2009 edition, the Conveyor Pulley Committee made the following changes to the 2003 Standard::

- 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 Runout
- 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.
- 14) Clarified deflection versus stress control in Table 2. and added shaded area to clarify loads potentially exceeding 800 piw.

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

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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 Table 3 and the load ratings shown in Table 2 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 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 or a modulus greater than 80,000 PIW.

2. DIMENSIONS AND TOLERANCES

2.1 Diameters

Standard welded steel pulley diameters are as shown in Table 3. *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.

| FACE WIDTH | OVER NOMINAL DIAMETER | UNDER NOMINAL DIAMETER |
|-----------------|-----------------------|------------------------|
| Inches | Inches | Inches |
| 12 thru 26 | 1/4 | 1/8 |
| over 26 thru 66 | 5/8 | 1/8 |

2.2 Diameter Variations

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

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 runout tolerances. Listed nominal diameter variation may occur from one pulley to another. Diameter runout tolerance at midpoint of the bare pulley face is as follows:

| DIAMETERS | MAXIMUM TOTAL INDICATOR READING (TIR) |
|-----------------|---|
| Inches | Inches |
| 8 thru 24 | 0.125 |
| over 24 thru 48 | 0.188 |
| over 48 thru 60 | 0.250 |

2.3 Face Width Variations

Permissible face width variation from nominal face width is plus or minus 1/8 inch 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 runout tolerance. The listed variation in face width may occur from one pulley to another. Edge runout tolerance is specified by the individual 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 inch per foot 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 inch regardless of face width. Crowned end sections typically have a diameter versus face travel rate of change similar to full crowns.

2.6 Shaft Runout

The shaft extension runout 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 inch per inch of shaft extension beyond the bearing center. Typically bearings will introduce an additional runout, 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 pulley manufacturer for details.

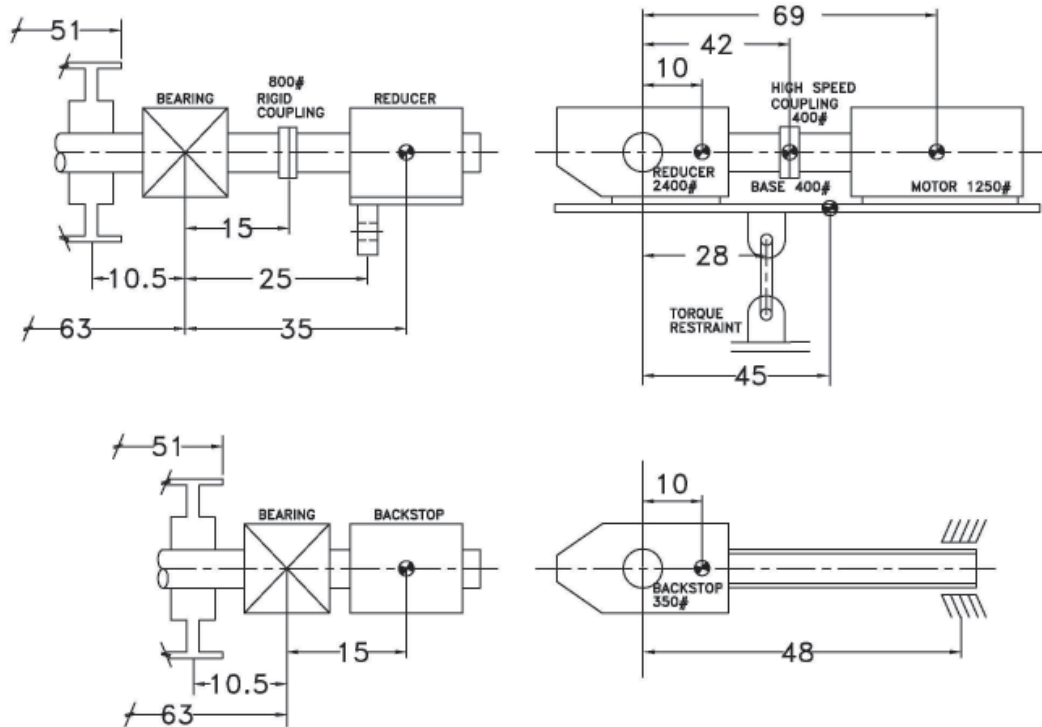
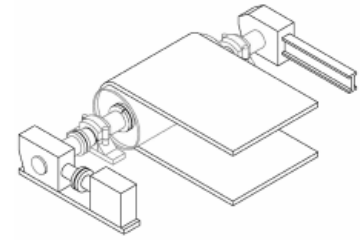
- As shaft extension increases, runout may become visually noticeable. A perception issue may occur even when component attachments are designed to tolerate the runout.
- Right angle reducer/motor assemblies supported by pulley shaft commonly require lower limits. These assemblies tend to be quite long,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

2.7 Belt Speed

It is not recommended to operate standard drum pulleys above a belt speed of 800 feet per minute. For higher speeds consult your pulley manufacturer for details.

Example 4: Non-symmetric multiple overhung loads (Drive Pulley with backstop)

A conveyor is being designed to move material up a 20° hill. A 48 inch belt was previously chosen to run at 600 fpm. The power requirement calculated is 75 hp without material load and 175 hp with normal running load. A 200hp motor is selected. A right angle shaft mount reducer is desired and a backstop is used. The drive will be snubbed to 210° and a gravity take-up is used.



Review of selection is as follows:

Step 1. Pulley Diameter Selection, section 4.1.

Determine belt tensions at various running conditions using CEMA methods. Applicable equations from other standards given below.

$$\begin{aligned} T_e &= 33,000 * \text{hp} / \text{fpm} \\ T_2 &= C_w * T_e = 0.38 * T_e \\ T_1 &= T_e + T_2 \end{aligned}$$

High speed coupling will be set to maximum of 125% of full horsepower so this is taken as maximum possible condition. Other operating conditions anticipated are stationary with no power, running without load, running at normal load and full motor power.

| DRIVE CONDITION | BACKSTOP CONDITION | HP | Te (lb) | T1 (lb) | PIW |
|-----------------|--------------------|-------|---------|---------|-----|
| No Power | Not Engaged | 0 | 0 | 4,180 | 70 |
| No Power | Normal Load | 100 | 5,500 | 9,680 | 161 |
| No Power | Full Power | 125 | 6,875 | 11,055 | 184 |
| No Power | Max Probable | 175 | 9,625 | 13,805 | 230 |
| No Load | Not Engaged | 75 | 4,125 | 8,305 | 138 |
| Normal Load | Not Engaged | 175 | 9,625 | 13,805 | 230 |
| Full Power | Not Engaged | 200 | 11,000 | 15,180 | 253 |
| Max. Power | Not Engaged | 250.0 | 13,750 | 17,930 | 299 |

Comparing full power PIW of 253 and 210° belt wrap with Table 1 results in a match with a 30 inch diameter pulley.