



ANSI / CEMA 350-2003
(Approved: September 11, 2003)

CEMA BOOK NO. 350
Third Edition

SCREW CONVEYORS for Bulk Materials

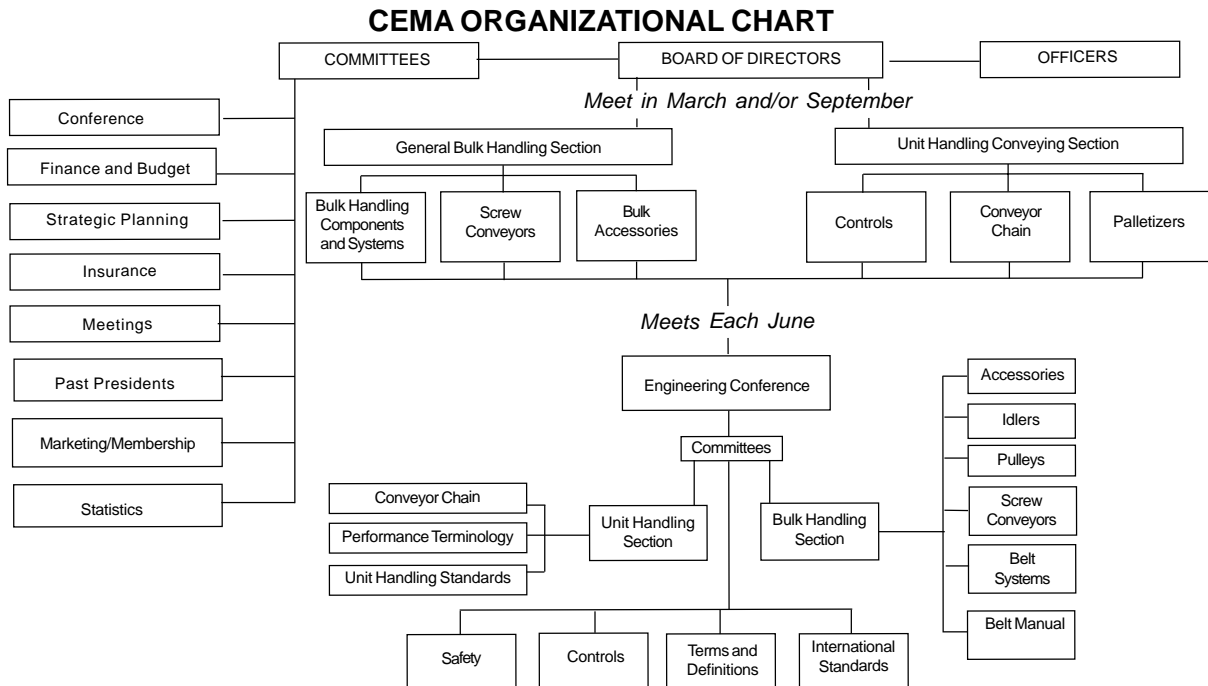


CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

ISBN 1-891171-458-5
PDF Version of
ISBN 1-891171-57-7

MEMBERS OF THE CEMA SCREW CONVEYOR PRODUCT SECTION

For a current list of Screw Conveyor Section companies,
visit CEMA's
web site: www.cemanet.org.



For Information on Company Membership
visit the CEMA Web Site at
<http://www.cemanet.org>



Prepared by the Screw Conveyor Engineering Committee of the
Engineering Conference
Conveyor Equipment Manufacturers Association

Screw Conveyors for Bulk Materials

CEMA Standard 350

Third Edition

Disclaimer

The information provided in this document is advisory only. These recommendations are provided by CEMA in the interest of promoting safety in the work place.

These recommendations are general in nature and are not intended as a substitute for a thorough safety program. Users should seek the advise, supervision or consultation of qualified engineers or other safety professionals.

Any use of this document, the information contained herein, or any other CEMA publication may only be made with the agreement and understanding that the user and the user's company assume full responsibility for the design, safety, specifications, suitability and adequacy of the system component, or mechanical or electrical device designed or manufactured using this information.

The user and the user's company understand and agree that CEMA, its member companies, its officers, agents and employees shall not be liable in any manner under any theory of liability for the user or user's reliance on these recommendations.

The users and the user's company agree to release, hold harmless and indemnify CEMA, its member companies, successors, assigns, officers, agents and employees from any and all claims of liability, costs, fees (including attorney's fees), or damages arising in any way out of the use of this information.

CEMA and its member companies, successors, assigns, officers, agents and employees make no representations or warranties whatsoever, either express or implied, about the information contained in this document, including, but not limited to, representations or warranties that the information and recommendations contained herein conform to any federal, state or local laws, regulations, guidelines or ordinances.

Published by the Conveyor Equipment Manufacturers Association
6724 Lone Oak Boulevard, Naples, Florida 34109 USA
239.514.3441 FAX 239.514.3470
www.cemanet.org

Copyright 2003 by the Conveyor Equipment Manufacturers Association. All rights reserved.
This book may not be reproduced in any form without written permission from CEMA.

Printed in the United States of America
ISBN 1-891171-28-3

Safety Notice

The Conveyor Equipment Manufacturers Association (CEMA) has developed ***Industry Standard Safety Labels*** for use on the conveying equipment of its member companies. The purpose of the labels is to identify common and uncommon hazards, conditions, and unsafe practices that can injure, or cause the death of, the unwary or inattentive person who is working at or around conveying equipment. The labels are available for sale to member companies and nonmember 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, 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://cemanet.org/safety/index.html>

PLEASE NOTE: Should any of the safety labels supplied by the equipment manufacturer become unreadable for any reason, the equipment USER is then responsible for replacement and location of these safety labels. Replacement labels can be obtained by contacting your equipment supplier or CEMA.

A Safety CD, entitled ***CEMA A/V Number 6 "SCREW CONVEYOR, DRAG CONVEYOR, AND BUCKET ELEVATOR SAFETY CD"***, has also been developed by the CEMA Screw Conveyor Section. It describes key safety practices people should adhere to when working with and around these different conveyors. It is available for purchase from CEMA.

Additionally a free handout ***WARNING AND SAFETY REMINDERS FOR SCREW, DRAG, AND BUCKET ELEVATOR CONVEYORS*** is available for free download from the CEMA Web Site's Safety Page

NOTE: Some pictures and diagrams of screw conveyors in this book are without covers or have exposed screws or shafting and are for illustration purposes only. Conveyors should never be used without covers, guards, or protective equipment.

Contents

-
- CHAPTER 1 *Screw Conveyor History and General Application*** **1**
Screw conveyor history. Discussion of application of screw conveyors. Data needed in preparation of screw conveyor design. Illustrations of screw conveyor installations.
- CHAPTER 2 *Bulk Material Characteristics, Material Code, Conveyor Size and Speed, Component Groups*** **9**
Discussion and codification of bulk material characteristics. Tables of bulk materials. Screw conveyor sizes, speeds and capacities. Lump size limitations. Enumeration and description of screw conveyor components. Component specifications for normal, heavy and extra heavy service.
- CHAPTER 3 *Horsepower Requirements, Torsional Ratings for Conveyor Screws, End Thrust, Typical Horizontal Screw Conveyor Problem*** **37**
Formula for horsepowers of horizontal screw conveyors. Torsional rating of conveyor screws and all screw parts. Horsepower limitation charts for conveyor screws based on bolted couplings. Screw conveyor end thrust. Deflections of conveyor screws. Detailed solution of typical horizontal screw conveyor problem.
- CHAPTER 4 *Screw Conveyor Layout, Screw Conveyor Components*** **53**
Instructions for layout of screw conveyors with dimensional data. Discharge arrangements described and illustrated. Detail data on screw conveyor components such as screws, flighting, modifications to flighting, troughs, discharge spouts and gates, trough ends, trough end bearings, trough end seals, trough covers, hangers and hanger bearings, shafting, bolts and trough supports.
- CHAPTER 5 *Materials of Construction, Classes of Enclosure, Weld Finish, Special Features and Modifications, Installation, Operation, Maintenance, Expansion*** **75**
Discussion of materials of construction. Codification of classes of enclosure. Description and codification of weld finishes. Description and illustration of special features of conveyor components for various purposes. Directions for installing screw conveyors, operating them and preventive maintenance. Calculation of the expansion of screw conveyors handling hot materials.

| | | |
|------------------|---|------------|
| CHAPTER 6 | <i>Screw Feeders, Single and Multiple</i> | 105 |
| | Description of single and multiple screw feeders, their uses and limitations, speeds, capacities, arrangements with extension conveyors, horsepowers required. Bin bottom type multiple screw feeders. | |
| CHAPTER 7 | <i>Inclined and Vertical Screw Conveyors</i> | 115 |
| | Discussion of capacity versus angle of incline and other factors concerning inclined screw conveyors, including horsepower. Description of vertical screw conveyors, their speeds, capacities, components and horsepowers required. | |
| CHAPTER 8 | <i>Screw Conveyor Drives, Drive Efficiencies and Drive Service Factors</i> | 127 |
| | Discussion and illustration of horizontal, inclined and vertical screw conveyor drives. Table of drive efficiencies. Service factor references. | |
| APPENDIX | <i>Derivation of Horsepower Formula for Horizontal Screw Conveyors, Individual Torsional Ratings of Conveyor Screw Parts, Metric Practice in Screw Conveyor Calculations</i> | 137 |

Foreword

While the screw conveyor as we know it today is the descendant of the oldest form of conveyor in recorded history, utilizing the oldest mechanical device employed by mankind, the inclined plane (wrapped around a core to form a helix), this book is the first attempt to bring together the collective knowledge and experience of leading manufacturers to codify what has come to be acceptable engineering practice for the benefit of user and manufacturer alike.

The Screw Conveyor Engineering Committee of the CEMA (Conveyor Equipment Manufacturers Association) Engineering Conference was assigned the task of bringing together under one cover the accumulated experience of many individuals and their companies in an effort to provide a common basis for the selection and installation of screw conveyors of sizes and capacities to handle the most commonly encountered bulk materials of commerce and industry.

This book is not intended as the final word on all screw conveyor engineering, but rather to serve as an engineering guide. Those who have contributed so generously of time and effort to its compilation strongly recommend that help from conveyor manufacturers be enlisted to check selection of sizes, capacities and types of conveyors where there is the least element of doubt, and always when materials of unknown, unusual or changeable character are involved. Today's rapidly changing technology and the continuous introduction of new materials—or old materials with new characteristics—emphasizes this recommendation as a means to the satisfactory performance of a conveyor or conveyor system.

The Conveyor Equipment Manufacturers Association believes that this publication represents a milestone in the long historical development of the screw conveyor as a vital machine for the transport of a wide variety of materials.

NOTE: *Environmental as well as many other conditions vary with each installation. As a result, this engineering manual is intended merely as a guide to conveyor selection. Neither the Conveyor Equipment Manufacturers Association nor its member companies warrant that adherence to the guidelines set forth in this brochure will necessarily result in proper selection, manufacture, installation or maintenance of conveyor equipment and/or a conveyor system. Unless there are specific written specifications or recommendations pursuant to a written contractual commitment, the Conveyor Equipment Manufacturers Association and its member companies hereby disclaim all responsibility for any equipment and/or system malfunction, any violations of law, property damage, personal injury or any other damages resulting from equipment and/or system selection, design, installation, maintenance, or operation carried out by the contractor or user.*

Nomenclature

The following list covers the symbols used in this book:

| | |
|--------|---|
| A | Area, square inches |
| A_b | Cross-sectional area of coupling bolt, square inches |
| A_p | Projected area of pipe and bushing bolt hole, square inches |
| a | Coupling bolt hole diameter, inches |
| C | Capacity, cubic feet per hour |
| C_F | Capacity factor |
| C_f | Screw feeder capacity, cubic feet per hour at one RPM |
| c | Coefficient of linear expansion, inches per inch per degree F |
| D | Diameter, inches |
| D_d | Coupling shaft diameter, inches |
| D_p | Pipe diameter, inches |
| D_s | Conveyor screw diameter, inches |
| E | Modulus of elasticity |
| e | Combined efficiency of drive motor and reduction gear |
| F_b | Hanger bearing factor |
| F_d | Conveyor diameter factor |
| F_f | Flight factor |
| F_m | Material factor |
| F_o | Overload factor |
| F_p | Paddle factor |
| F_v | Empirical Vertical Screw Conveyor Factor |
| HP | Horsepower |
| HP_a | Friction horsepower of empty feeder conveyor |
| HP_b | Friction horsepower of material only, in feeder conveyor |
| HP_f | Friction horsepower of empty screw conveyor |
| HP_m | Friction horsepower of material only, in a screw conveyor |
| HP_v | Horsepower to convey material vertically |
| I | Moment of inertia |
| J | Polar moment of inertia |
| K | Percent of trough loading, expressed decimally |
| L | Length, feet |

| | |
|-------|--|
| L_1 | Feeder conveyor length, feet |
| l | Length, inches |
| L_f | Equivalent length of feeder, feet |
| N | Speed of conveyor, RPM |
| n | Number of coupling bolts at each end of screw section |
| P | Pitch of screw flight, inches |
| psi | Pounds per square inch |
| R | Ratio of lump sizes |
| RPM | Revolutions per minute |
| r | Load radius, inches |
| S | Allowable working stress, psi |
| S_1 | Allowable shear stress in coupling bolts, psi |
| S_2 | Allowable bearing stress for coupling bolts, pipe and bushing, psi |
| S_3 | Allowable shear stress in pipe, psi |
| S_4 | Allowable shear stress of unhardened coupling, psi |
| S_5 | Allowable shear stress of hardened coupling, psi |
| T | Torque, inch pounds |
| T_1 | Torsional shear rating of coupling bolts, inch pounds |
| T_2 | Torsional bearing rating of coupling bolts, inch pounds |
| T_3 | Torsional rating of pipe, inch pounds |
| T_4 | Torsional rating of unhardened coupling, inch pounds |
| T_5 | Torsional rating of hardened coupling, inch pounds |
| t_1 | Higher of any two temperatures, degrees F |
| t_2 | Lower of any two temperatures, degrees F |
| W | Weight or apparent density of material, pounds per cubic foot |
| w | Weight of a section, part or piece, pounds |
| Z_p | Polar section modulus of pipe or coupling shaft |

CHAPTER 1

***Screw Conveyor History and
General Application***

**Screw Conveyor History
Application of Screw Conveyors
Design Preparation
Illustrations**
