

Reston Diesel Mechanics Series

Robert N. Brady

Heavy-Duty Truck Suspension, Steering, and Braking Systems



HEAVY-DUTY TRUCK SUSPENSION, STEERING, AND BRAKING SYSTEMS

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and
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A RESTON BOOK
PRENTICE HALL, Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging-in-Publication Data

BRADY, ROBERT N.
Heavy-duty truck suspension, steering, and braking systems.

Robert N. Brady.

p. cm.—(Reston diesel mechanics series)

"A Reston book."

Includes index.

ISBN 0-13-385824-3

1. Trucks—Springs and suspension. 2. Trucks—Springs and suspension—Maintenance and repair. 3. Trucks—Steering-gear. 4. Trucks—Steering-gear—Maintenance and repair. 5. Trucks—Brakes. 6. Trucks—Brakes—Maintenance and repair. I. Title. II. Series.

TL257.B7 1989

88-35926

629.2'4—dc19

CIP

Editorial/production supervision and
interior design: Tom Aloisi
Cover photo: D. Luria, FPG International
Manufacturing buyer: Bob Anderson



© 1989 by Prentice-Hall, Inc.
A Division of Simon & Schuster
Englewood Cliffs, New Jersey 07632

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Printed in the United States of America

10 9 8 7 6 5 4 3 2

ISBN: 0-13-385824-3

Prentice-Hall International (UK) Limited, *London*
Prentice-Hall of Australia Pty. Limited, *Sydney*
Prentice-Hall Canada Inc., *Toronto*
Prentice-Hall Hispanoamericana, S.A., *Mexico*
Prentice-Hall of India Private Limited, *New Delhi*
Prentice-Hall of Japan, Inc., *Tokyo*
Simon & Schuster Asia Pte. Ltd., *Singapore*
Editora Prentice-Hall do Brasil, Ltda., *Rio de Janeiro*

Dedication

When a writer completes a book, all the long hours of research and development that kept him from his family are often forgotten. In consideration of all the hours that I spent sequestered at the wordprocessor and for all the outings that we were not able to make together, I dedicate this book to my family.

To my wonderful wife Linda, to my children—Alanna, Alicia, Scott, Tracy, and Adele—and to Mum and Dad. Love always!

To all my mentors and colleagues—too numerous to list—who, through the years, have inspired and instilled in me the desire and ability to continue life-long learning and to strive for excellence in all my endeavors. Thank you for your knowledge and guidance in sharing your thoughts and experiences with me!

Preface

This textbook represents one volume of a two-volume companion set that has grown out of an original book entitled "*On-Highway Truck: Power Trains, and Suspension Systems*," which was first published in 1982 by Reston Publishing Company, Inc. The second volume in this set is entitled "*Heavy-Duty Truck Power Trains: Transmissions, Drive Lines, and Axles*." The success of the original book generated many requests from vocational/technical school and college users for expanded coverage of new technologies that have since burst forth in the design of both medium- and heavy-duty on-highway trucks.

Feedback from major users of the original book in the United States indicated that many commercial transport programs have structured their course content to cover clutches, transmissions, and axles in one area, while frames, steering, and braking systems are offered as a separate specialty. Technological changes have necessitated the addition of new material, as well as the expansion of the original chapters. Therefore, rather than create a text of 1200 or more pages, the decision was made to offer this new material in a two-volume companion format. In this way, users of the books can choose to zero-in on subjects that are complementary to one another. Together, the books offer the reader a comprehensive resource of the "how and why" of the major subject areas required in servicing and repairing medium- and heavy-duty highway trucks. In the day-to-day servicing of a single or large truck fleet, much of the mechanic/technicians time and effort is devoted to the maintenance, troubleshooting, and repair of the truck running gear rather than the engine.

Since the original edition of this book, the heavy-duty truck market has gone through many changes. Today, the association of European, Japanese, and U.S. manufacturers has resulted in the incorporation of the best design concepts from all countries. This has created a standardization of many heavy-duty truck components under different truck "marques." Examples of working arrangements among major users include GMC offering midrange trucks from their tie-in with Isuzu Motors in Japan, Peterbilt's arrangement with Volkswagen in South America for their midrange line, and Mack Trucks, Inc., and Renault in France offering similar midrange models. In the heavy-duty Class 8 rating, a recently formed joint venture between AB Volvo of Sweden and General Motors has resulted in the Volvo/GM Heavy Truck Corporation. These truck products will bear Volvo and White/GMC name plates. Along with a new series of Autocar trucks and tractors, Volvo

drivetrain components will also be offered as an option for most Class 8 White/GMC trucks built in the United States.

Other ventures have resulted in the following changes. Mercedes-Benz now owns Freightliner; DAF (Netherlands) owns Freight Rover (Leyland) in Britain; and International Harvester has been reorganized into NAVISTAR International Transportation Corporation. Names such as Scania, Mercedes-Benz, Iveco, Nissan, Hino, Isuzu, and Mitsubishi are now becoming regular sights on North American roads.

These close working agreements and ventures among major truck manufacturers have truly created a world-wide approach to improving truck technology. The integrated driveline concept has also seen several major truck manufacturers develop and manufacture their own power transfer products, from the engine back through the rear axle. Two examples of companies using this approach are Mack and Volvo.

The trucking industry employs hundreds of thousands of people in a wide variety of jobs; however, it is the fleet mechanic who is responsible, in the final analysis, for keeping these trucks and trailers on the highway in a ready state of repair and in a mechanically sound condition.

The truck fleet mechanic today must be capable of understanding the intricate operation of heavy-duty automatic and standard transmissions, differentials, and inter-axle lockup features, driveline problems, rear axle and front axle maintenance, fifth wheels, drums, hubs and brakes, plus the intricate operation of steering geometry, wheels and tires, and accessory braking devices and suspension systems.

Manufacturers are also now integrating automotive electronics into their various truck components at an accelerated pace. The diesel engine is the component most affected at this time. Detroit diesel corporation was the first major engine manufacturer to offer electronic fuel injection on its Series 92 and 71 on-highway truck engines. It did so in September of 1985. The release of DDC's Series 60 four-stroke cycle engine was a further advancement of its DDEC (Detroit Diesel Electronic Controls), with a DDEC 11 system now standard on this engine series.

In addition, Caterpillar also offers its PEEC (Programmable Electronic Engine Control) system on the 3406 heavy-duty Class 8 truck engine, while Cummins has now introduced its PACE electronic fuel control system.

Manufacturers are also incorporating automotive

electronics into other parts of their truck systems—for example, Allison's (GMC), Voith's, and ZF's truck and bus automation transmissions. Eaton/Fuller is also engaged in this type of development. It plans to release shortly an AMT (Automated Mechanical Transmission) which will employ an air-operated/electronic-controlled shifting system on its standard gear-shift model transmissions, as well as a "Shift-Mate" system for teaching drivers when to shift for optimum fuel efficiency. Also available on Scania buses is a system known as Scania CAG (Computer-Aided Gear Changing) which employs a microprocessor system with various sensors (road speed, current gear, and accelerator position) to signal the driver which gear to use for optimum fuel performance. The driver depresses the clutch pedal, and the recommended gear automatically clicks into place. The driver can override the gear proposal by preselecting another gear by use of a toggle switch, or the driver can declutch to accept the computer recommendation. This system is used mainly for inner-city application. Bus or refuse trucks, where gears have to be shifted often, are the natural applications for use of this system.

Electronic on-board recording systems are also now widely used to provide data on both the driver and vehicle activity so that fleet records can be maintained on a regular operating basis for each individual vehicle. These recording systems help fleet managers maximize fuel economy and reduce maintenance costs.

This book is a culmination of many hours of discussions with industry personnel. They all were extremely interested in seeing a textbook dealing specifically with the topics mentioned in the previous paragraphs.

This book is systematically arranged so that general information and useful working formulas are included at the start of the book. These are followed by discussion on components, beginning with the clutch assembly and progressing rearwards in the vehicle to the other major components and accessories.

The author has spent many years as a mechanic, maintenance superintendent, factory service representative, factory instructor, college instructor, and department head of a college diesel mechanic/technician program.

Input from mechanics, students, service managers, and others involved with the day-to-day training of truck mechanics formulated the approach to the material presented within this book.

Other well-known major component suppliers, such as Eton, Spicer, and Rockwell, now work very closely with all major truck manufacturers to offer technical support and, in some cases, form joint ventures in the design and integration of their products into a wide range of truck models.

Rockwell recently acquired SOMA of Europe and America, which is a French off-highway axle and transmission manufacturer, while both Spicer (Dana Corporation) and Fuller (Eaton Corporation) companies have expanded their own operations overseas to promote wider use of their own excellent and well-known axle, transmission, clutch, and driveline components.

No attempt is made to cover diesel engine overhaul and repair in this book since a separate text would be required to do it justice. I fully covered diesel-engine fuel-system operation, maintenance, troubleshooting, tuneup, and repair in my book, *Medium/Heavy Truck Diesel Fuel Systems*. The text is published by Prentice Hall, Englewood Cliffs, New Jersey 07632.

The material presented in this book is aimed specifically at those personnel who desire to become first-class heavy-duty truck mechanics and to assist those already working in the trade who, day in and day out, keep the hundreds of thousands of small, medium-, and heavy-duty Class 8 highway trucks rolling over countless millions of miles in many countries of the world.

The truck transportation industry is one of the most dynamic of its kind in the world, since it is responsible for the delivery of approximately 80 percent of all food stuffs and goods that we come into contact with each day of our lives. Billions of dollars are spent yearly on the maintenance, repair, and purchase of new trucks and trailers in order to satisfy the demands placed upon individual trucking companies.

This book is not meant to circumvent the use of truck and equipment suppliers' service manuals, which should be consulted for specific information relating to any one vehicle or component; however, it will provide both the experienced and inexperienced reader or truck mechanic with a sound reference of operation, maintenance, troubleshooting, and repair.

It will not on its own make you a highly skilled mechanic. Used in conjunction with day-to-day, hands-on experience, however, it will allow you the opportunity to put into practice both the how and why of the operation and maintenance of the powertrain components employed on heavy-duty highway trucks.

In this ever changing world where shortages of natural resources are a fact of life, the one resource that is always capable of continuity is the "mark of excellence." This one resource is your greatest asset in your every-day employment while maintaining heavy-duty trucks and equipment. Use it to advantage.

The author gratefully acknowledges the assistance of all those manufacturers of trucks and truck components who courteously allowed reproduction of many excellent drawings and photographs from their own service literature in order to make this book as up-to-date and presentable as possible. Also to those individuals

who reviewed individual sections and chapters of the book and offered constructive criticism, I remain deeply appreciative.

Through your comments and assistance, I feel that the finished product will be valuable and equal to your expectations.

Any reader who wishes to offer suggestions on any part of the book should please write to the author at Prentice Hall.

Robert N. Brady

Acknowledgments

This book represents one volume of a two-volume companion set of texts that deals with heavy-duty on-highway truck operation and maintenance. It was originally published in 1982 as a single-volume edition entitled *On-Highway Trucks: Power Trains, and Suspension Systems*. The success of this text demanded a new approach that not only would expand the original subject matter but also deal with the current level of technology. In order to achieve an acceptable finished product, approximately fifty major truck manufacturers and major truck equipment component suppliers were contacted for information about their latest product offerings.

This two-volume set could never have been written without the strong support and assistance that I received for my research from many company individuals who went out of their way to ensure that I received the sales and technical information required to present their company products to you, the reader. Some of these products are featured in both volumes, while others may only be featured in the one volume in which the products can be specifically related to particular chapter content.

On behalf of all these individuals and companies who lent assistance, encouragement, and support, I hope that the finished product before you is equal to your expectations.

The following companies and individuals therefore deserve special mention for their time, effort, and—most of all—the standards of excellence that they strive to maintain in their product offerings.

1. Allison Transmission Division of General Motors Corporation, P.O. Box 894, Indianapolis, Indiana, 46206-0894. Mr. John J. McCardle, Manager, Public Relations.
2. Aluminum Company of America, Forging Division, 1600 Harvard Avenue, Cleveland, Ohio 44105. Mr. Scott C. Cameron, Sales & Marketing Services Manager, Wheel Products Division.
3. American Steel Foundries, Amsted Industries, 3600 Prudential Plaza, Chicago, Illinois 60601. Mr. C. N. Hood, II, Manager, Truck Equipment Sales.
4. Bee Line Company, Box 709, Bettendorf, Iowa 52722-0709. Mr. Vernon L. Olson, Vice President.
5. Dayton-Walther Corporation, 2800 East River Road, Dayton, Ohio 45401. Mr. Edwin L. Carmel, Product Engineer, Engineering; Mr. Paul E. Hartef, Vice-President, Marketing; Cathie Whitten Bererr, Marketing Assistant.
6. Diesel Equipment Superintendent Magazine, Business Journals Inc., P.O. Box 5550, Norwalk, CT 06856. Mr. James E. Jones, Editor & Publisher.
7. Eaton Corporation, Axle & Brake Division, P. O. Box 4008, Kalamazoo, Michigan 49003. Mr. Chip Culpepper, Manager, Technical Service.
8. Firestone Industrial Products Company, Division of the Firestone Tire and Rubber Company, Firestone Boulevard, Noblesville, Indiana 46060-3023. Mr. Mark Johnson, Coordinator/Advertising & Sales Promotion.
9. Ford Motor Company of Canada, Limited, The Canadian Road, P.O. Box 2000, Oakville, Ontario L6J 5E4. Mr. K. Shikaze, Manager, Heavy Truck Field Operations; and Mr. R. H. Jewitt, Technical Training Specialist.
10. Freightliner/Mercedes-Benz Truck Company, 4747 North Channel Avenue, Portland, Oregon 97217-7699. Debi Nicholson, Public Relations.
11. Fruehauf Corporation, Sales & Marketing and the Law Department, 10900 Harper Avenue, P.O. Box 238, Detroit, Michigan 48232. Mr. Patrick S. Lancaster, Associate General Counsel.
12. GMC Truck Division, Truck & Bus Group, General Motors Corporation, 31 Judson Street, Pontiac, Michigan 48058. Mr. G. A. Fishwild, Supervisor, Service Publications.
13. Hendrickson Suspension, 15W660 West 79th Street, P. O. Box 249, Burr Ridge, Illinois 60521. Mr. William J. Adlaf, Technical Service Manager.
14. Holland Hitch Western Limited, 17909 Roan Place, Surrey, B.C. V3S 5K1. Mr. D. Ian Patton, General Manager.
15. Hunter Engineering Company, 11250 Hunter Drive, Bridgeton, Missouri 63044. Mr. Allan H. Meier, Director of Marketing Communications; and Mr. Kevin Rogers, Supervisor of Instructors.
16. Kent-Moore Heavy Duty Division, Sealed Power Corporation, 28635 Mound Road, Warren, Michigan 48092-3499. Andrea W. Kolton, Advertising Manager.
17. Kenworth Trucking Company, P.O. Box 1000, Kirkland, Washington 98033. Shawn Larsen, Advertising; and Mr. Paul Elo.
18. Mack Trucks, Inc., World Headquarters, 2100 Mack Boulevard, Box 1791, Allentown, PA 18105-1801. Mr. J. B. Curcio, Chairman of the

- Board, President and Chief Executive Officer; also, Mr. R. E. Davis, Manager, Publications and Technical Support.
19. Midland Heavy Duty Systems, 490 South Chestnut Street, Owosso, Michigan 48867. Mr. C. A. Wittenberg, District Manager, Technical Services.
 20. Motor Wheel Corporation, 400 Collins Road, Lansing, Michigan 48910. Mr. Bob Yates, Manager, Marketing Communications; and Mr. D. M. Cyrill, General Sales Manager, Automotive Sales.
 21. NAVISTAR International Transportation Corporation, 401 North Michigan Avenue, Chicago, Illinois 60611. Mr. Chris Benner, Manager, Medium Engine Strategy.
 22. Neway Operations, Lear Siegler Truck Products Corporation, 1950 Industrial Boulevard, P. O. Box 425, Muskegon, Michigan 49443-0425. Mr. Nathan C. Ware, Director Patents & Licensing; and Mr. William C. Pierce, Chief Engineer.
 23. Nuturn Corporation, Heavy Duty Products Division, 570 Metroplex Drive, Nashville, Tennessee 37211. Mr. Dennis E. Long, Marketing Manager.
 24. OTC Tool and Equipment Division of SPX Corporation, 655 Eisenhower Drive, Owatonna, Minnesota 55060. Mr. Douglas R. Snorek, OTC Marketing Communications.
 25. Peterbilt Motors Company, A Division of PACCAR, 38801 Cherry Street, P.O. Box 404, Newark, California 94560. Mr. Bill Doig, Manager, Field Support and Quality.
 26. Reyco Industries, Inc., P.O. Box 2268, Springfield, Missouri 65801-2268. Mr. Len A. Weakley, Director of Marketing; and Mr. Harvey Meadows, Customer Service Manager.
 27. Ridewell Corporation, P.O. Box 4586, Springfield, Missouri 65808. Mr. D. Chris Bylander, Director, Marketing and Sales.
 28. Rockwell International Corporation, Automotive Operations, 2135 West Maple Road, Troy, Michigan 48084. Diane L. Mitchell, Manager, Training and Technical Publications; and Mr. Frank Panisko, Communications Specialist.
 29. Rubber Manufacturers Association, Inc., Tire Division, 1400 K Street N. W. Washington, D.C. 20005. Mr. Frank E. Timmons, Deputy Director; and Gloria E. M. Bartholomew, Staff Associate, Tire Division.
 30. Spicer Heavy Axle Division, Dana Corporation, P.O. Box 2229, Fort Wayne, Indiana 46801-2229. Mr. Gus Franklin, Vice President and General Manager; and Gerry Weaver.
 31. Colt Industries, Stemco Inc., P.O. Box 1989, Longview, Texas 75606. Mr. Tim Ralston, Product Manager; and Mr. Robert F. LaBarge, OEM Sales Administrator.
 32. The Maintenance Council, American Trucking Associations, 2200 Mill Road, Alexandria, Virginia 22314. Mr. Bill Tracy, Executive Director; and Mrs. Gerri Murphy, Director, Member Services.
 33. Trailmobile Inc., 200 East Randolph Drive, Chicago, Illinois 60601. Mr. George A. M. Hammond, Director of Marketing.
 34. Southam Business Publications, Motor Trucking Magazine, 1450 Don Mills Road, Don Mills, Ontario M3B 2X7. Mr. Barry Holmes, Executive Editor.
 35. U.S. Department of Transportation, NHTSA, Washington, D.C.
 36. VOLVO GM Heavy Truck Corporation, 7825 National Service Road, Airpark West, P.O. Box 26115, Greensboro, North Carolina 27402-6115. Mr. Rudolph R. Spik, Manager, Public Relations.
 37. Western Star Trucks, Inc., 2076 Enterprise Way, Kelowna, B.C. V1Y 6H8. Mr. Glen H. Ashdown, Chief Engineer, Engineering.

About the Author

Robert N. Brady has been involved in the automotive and heavy-duty truck and equipment field for 30 years, having served a recognized five-year apprenticeship, and having worked as a shop foreman, service manager, and fleet maintenance superintendent. In addition, his experiences have included positions as National Service Trainer (Canada) for Detroit Diesel Allison Division of GMC, as well as a Field Service Representative.

He has taught for 19 years at Vancouver Community College, ten of those as a Department Head of the Diesel Mechanic/Technician Program, in Commercial Transport Mechanics, Heavy-Duty Mechanics, and Diesel Engine Mechanics.

He has developed technical training programs for a number of major companies in both the automotive and heavy-duty truck and equipment fields, and acts as a technical consultant through his own company, HiTech Consulting Limited.

This is his sixth and seventh book for Reston/Pren-

tice-Hall, *Diesel Fuel Systems; On-Highway Trucks: Power Trains and Suspension Systems; Electric and Electronic Systems for Cars and Trucks; Automotive and Small Truck Field Injection Systems, Gas and Diesel; and Automotive Computers and Digital Instrumentation.*

He is a certified automotive mechanic/technician as well as a heavy-duty truck and equipment mechanic/technician.

He is a member of the Society of Automotive Engineers Inc; and currently, he sits on the governing board of the British Columbia chapter. He is also a member of the Association of Diesel Specialists, NACAT (National Association of College Automotive Teachers), the Canadian Vocational Association, the Vocational Instructors' Association of Vancouver Community College, (Past President), and TMC/ATA—The Maintenance Council, American Trucking Associations.

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CHAPTER 1 General Information

INTRODUCTION

There are very few items that are used in everyday life around the house, in the office, or at work that did not come by truck transport from its original source to the store in which you purchased it.

The transportation network that exists in North America is the finest in the world and is a major employer and contributor to the economy of the country, with 7.2 million employees.

There are approximately 2000 major truck transportation companies in the United States. The ATA (American Trucking Associations) reported that in 1987 these companies reported freight revenues of over \$200 billion from truck/trailer combinations that logged close to 138 billion miles on the nation's highways.

The operation and maintenance of these vehicles and trailers offer interesting and rewarding employment in a variety of positions:

- Truck driver
- Truck owner/operator
- Fleet mechanic
- Shop supervisor
- Service management
- Service/sales
- Fleet maintenance management
- Parts sales
- Fleet maintenance training (instructing)

Various conservative estimates are available from several reliable sources that indicate the heavy-truck replacement parts market for 1990 will amount to between \$8 and \$10 billion. Of this total, ten parts categories command 70% of this replacement market for the following systems:

- Engine system parts
- Power plant replacement
- Brake systems
- Power tailgates
- Cranking systems
- Rear axles
- Cooling systems
- Clutches
- Transmissions
- Drivelines

Contained within this book in the appendix are specifications on Class 6 through Class 8 trucks, from engines to transmissions to axles, that can be used as a reference to assist you when establishing what components are common to certain makes of vehicles.

The majority of trucks used in the Class 6, 7, and 8 range are diesel-powered, with the largest expected increase in truck diesel power through 1990-95 expected to occur within the Class 6 and 7 range. Almost 100% of all Class 8 heavy-duty trucks are presently powered by diesel engines.

Factory sales of trucks from United States plants in the Class 8 category accounted for 135,000 vehicles in 1987.

The material contained within this book introduces the reader to each component of the drivetrain found on heavy-duty trucks. The author has made no attempt to discuss the engine since a separate book alone would be required to do justice to this assembly.

The information is presented in a systematic fashion to allow the reader an opportunity to appreciate the operation and maintenance of the drivetrain components.

HIGHWAY TRUCK CLASSIFICATION

Highway trucks presently in use are classified by weight of the load they can transport. Table 1-1 shows the class and weight range. (Also refer to Table 9-1 for semi-trailer lengths.)

WEIGHT LIMITS FOR ON-HIGHWAY VEHICLES: CANADA, AND THE UNITED STATES

Load Variations and Vehicle Widths

Vehicle widths and weight limitations are not standard in North America. In general, Canada accepts wider vehicle widths and heavier loads. It may be noted here that the Canadian and American Trucking Associations have done many studies that prove that larger loads can be transported as safely as existing weight limitations will allow, plus do it at an appreciable savings in fuel.

Allowable tractor/trailer widths for on-highway use are currently set at 102 inches (259 cm/2590 mm) both in Canada and the United States. Regulations regarding maximum allowable size and weight restrictions for commercial vehicles are listed in Table 1-2 for the Canadian provinces and in Table 1-3 for the various U.S. states. Note that the maximum allowable weight per axle on heavy-duty trucks and trailers is generally subject to

variation in many provinces and states, particularly in the early spring when road thaw sets in after many months of below freezing weather. Signs posted by departments of highways on major roads and highways should be your guide here. In addition, the weight limitations that are listed in Tables 1-2 and 1-3 are subject to governmental change. Therefore, always check with your local motor vehicle commercial transport bureau to determine maximum allowable loads if you have any doubts.

For those not familiar with the Canadian Provinces, Quebec is twice the size of Texas, and Ontario is slightly larger than the combined areas of California, Montana, and Colorado. The distance from the eastern Quebec border to the western border of Ontario is as far as the distance from Bangor in Maine to Minot in North Dakota.

In the United States, the size and weight limitations vary from state to state. Therefore, it is best to consult local authorities when any doubt exists regarding allowable lengths and gross combination weights. A summary of both size and weight limits is published twice a year from the Motor Carrier Advisory Service by the American Trucking Associations, Inc., 2200 Mill Road, Alexandria, Virginia, 22314-4654, Telephone (703) 838-1797. The above-listed publication can be obtained for a service fee of \$3.50; and bulk prices are also available upon request.

Longer lengths and gross combination weights are allowable in different states on turnpike and toll-road operations than those listed in Table 1-3. Note that, within this table, there are references to Tables A and B, as well as to Formula B. All this special information can be found in the ATA's "Summary of Size and Weight Limits" publication mentioned above.

Formula B states

$$W = 500 (LN/N - 1 + 12N + 36)$$

where

W = Maximum weight in pounds carried on any group of two or more axles computed to the nearest 500 lb (227 kg)

TABLE 1-1

Truck-weight classification

Class 1 GVW*	6000 lbs	2721.6 kg
Class 2 "	6001-10,000 lbs	2722-4536 kg
Class 3 "	10,001-14,000 lbs	4536.45-6350.4 kg
Class 4 "	14,001-16,000 lbs	6350.85-7257.6 kg
Class 5 "	16,001-19,500 lbs	7258-8845.2 kg
Class 6 "	19,501-26,000 lbs	8845.65-11793.6 kg
Class 7 "	26,001-33,000 lbs	11794-14968.8 kg
Class 8 "	33,001 lbs and over	14969.25 kg

* Gross Vehicle Weight

Notes: Class 1 and 2 are known as light-duty, 3 to 6 as medium-duty, and 7 and 8 as heavy-duty. Tractors are used from 50,000 lbs GCW (gross combination weight) and above.

To convert pounds to kilograms, multiply the pounds by 0.4536.

L = Distance in feet between the extreme of any group of two or more consecutive axles.

N = Number of axles in group under consideration.

By way of example, special permits are required from state authorities when combination tractor/trailer lengths and weights which exceed those listed in Table 1-3 are considered. The state of Kansas will allow twin 48' (14.62 m) trailers subject to an overall 119' (36.27 m) length and 120,000 lb (54,432 kg) GVW. In addition, triple trailer combinations subject to the above restrictions in overall length and weight are allowed by the Kansas Turnpike Authority. The New York State Thruway Authority allows twin turnpike doubles subject to a 114' (34.74 m) overall length and 143,000 lb (64,865 kg) GVW. However, no triple combinations are allowed. The Florida Turnpike Authority allows twin 45' (13.71 m) trailers to operate on the turnpike subject to 110' (33.52 m) lengths and 138,271 lb (62,720 kg) GVW limitations. Other states have regulations that limit lengths and gross vehicle weights to less than those discussed above. There are also a number of states that do not allow any use of triple trailer combinations.

In addition to the "Summary of Size and Weight Limits" publication, the ATA has other publications that treat safety regulations, oversize/overweight permits, and the handling of hazardous wastes. These publications can be ordered by writing to the address given above, by calling the 1-800-ATA-LINE, or by calling 703-838-1754 collect.

The term "Rocky Mountain Double" is the name for a tractor and twin-trailer arrangement. Its components include a tandem semitrailer and a shorter three-axle full trailer and fixed single-axle converter dolly with a roller-type fifth wheel. Its overall length should not exceed that specified by the various state authorities. Because of these different state laws, the overall length of the front trailer and shorter rear trailer becomes subject to change so that the vehicle complies with these regulations. Other terms, such as an A or a B train tractor/trailer combination, are shown in Table 1-2. Overall lengths, widths, and weights are also subject to current individual state or provincial laws.

The current trend both in Canada and the United States is to increase the allowable weights that can be carried since studies on both sides of the border have proved that the cost per mile is approximately 30 to 40% less than with the existing setup; but most importantly, these larger loads can be carried at a fuel savings of 25 to 30% over that of two tractors pulling single 45-ft (13.7-m) trailers. Also, less damage is done to the highways since the load is spread over a greater number of axles. Future truck/tractor/trailer combinations would therefore appear to be destined for acceptance in the very near future at these larger sizes and loads that have been under evaluation by several Provinces and States.

Federal, State, and Provincial Weight Limits

In the United States, federal interstate highway limits are 20,000 lb (9072 kg) for single-axle vehicles, and 34,000 lb (15,422 kg) for tandem axle vehicles. American and Canadian weight limits for single and tandem axles are shown in Tables 1-2 and 1-3.

HIGHWAY DEFINITIONS

The following definitions are commonly used to indicate the class or grade of highway.

1. *Class AA*: Turnpike. Operation on limited-access, well-maintained multilane concrete or asphalt highway, with maximum adverse grades up to 3%.
2. *Class A*: On-Highway. Exclusively on well-maintained major highway of excellent concrete or asphalt construction, with uniform grades up to 8%. Subject to legal weight and dimensional limitations.
3. *Class B*: On-Off Highway. Secondary road of good concrete or asphalt construction with partial operation on well-maintained crushed rock surface of similar material, and with variable grades up to 12%. Subject to legal weight and dimensional limitations.
4. *Class C*: Off-Highway. Exclusively on private road. Asphalt or maintained crushed rock or surface of similar material, and with variable grades. Not subject to legal weight and dimensional limitations. May have provision for a width limit.
5. *Class D*: Off-Road. Exclusively off-highway on private road with partial operation entirely off-road on areas with no maintained hard surface, and with variable grades. Not subject to legal weight and dimensional limitations.

METRIC INFORMATION

With the present move towards metrication, the truck mechanic and others within the transportation industry must be able to identify a "metric" nut or bolt from the customary American type of thread.

Mismatched or incorrect nuts, bolts, and screws can result in damage, malfunction, or possible personal injury; therefore the following information indicates the difference between the customary bolt and the "metric thread."

The accepted standard now being adopted by everyone is the SI or Systeme Internationale. For example, a 1/4-20 and 1/4-28 screw is replaced by its metric equivalent, the M6.0 \times 1 screw, which has nearly the same









TABLE 1-2

Canadian size and weight requirements for commercial vehicles. (Courtesy of Motor Truck Magazine, Southam Business Publications.)

Canadian size and weight requirements for commercial vehicles														TRUCK Fleet
Copyright 1986, Truck Fleet magazine. Must not be re-produced in whole or in part without express permission.														Revised September 1986. Note, however, that the regulations change frequently. Contact the appropriate authority at the number listed at the bottom of the chart for current information. Most, particularly B.C. and N.B., handle enquiries in metric only.
	N.F.L.D.	N.S.	N.B.	P.E.I.	QUE.	ONT.	MAN.	SASK.	ALTA.	B.C.	Y.T.	N.W.T.		
LENGTH Single Powered Vehicle (ft, m)	41.0 12.5	41.0 12.5	41.0 12.5	40.0 12.2	41.0 12.5 KK	41.0 12.5	41.0 12.5	41.0 12.5	41.0 12.5	41.0 12.5	41.0 12.5	40.0 12.5		
OVERALL LENGTH Combination (ft, m)	68.9 21.0	68.9 21.0	68.9 21.0 EE	69.0 21.0	68.9 21.0 PP	75.5 23.0 PP	65.6 20.0 D	65.6 20.0 Q	65.5 20.0 CC	65.6 20.0 Q	65.6 20.0 NN	80 24.4 TT		
MAXIMUM WIDTH (in., m)	102 2.6	102.4 2.6	102.4 2.6	102.4 2.6	102.4 2.6	102.4 2.6	102.4 2.6	102.4 2.6	102 2.6	102.4 2.6	102.4 2.6	120.0 3.05		
MAXIMUM HEIGHT (ft, m)	13.6 4.15	13.6 4.15	13.5 4.12	14.8 4.5	13.6 4.15	13.6 4.15	13.6 4.15	13.6 4.15	13.5 4.15	13.6 4.15	13.8 4.2	13.5 4.2		
NUMBER OF TRAILERS ALLOWED	2	2, S	2	A	2, S	A, S	2, A, Q	2, A, S	2, A	2, B	2, W	2		
MAXIMUM LOADS (lb, kg)	20,000 9,000	19,900 9,000 F	19,900 9,000	20,000 9,100	22,000 10,000 J	22,000 10,000 Z, MM	20,000 9,100 X	20,000 9,100 K	20,000 9,100	20,000 9,100 DD	22,000 10,000	18,000 8,128		
	39,700 18,000 M	39,700 18,000 F, M	39,700 18,000 M	40,000 18,100 M	44,000 20,000 J	42,100 19,100 AA	35,000 16,000 X	35,000 16,000 K	35,000 16,000	37,500 17,000 C	42,100 19,100 E	36,000 16,256		
Straight truck: 2 axles	30,000 13,500 F, L	29,800 13,500 L	29,800 13,500 FF	30,000 13,650 L	40,800 18,500 J, P	41,800 19,000 G, Z	32,200 14,600 X	32,000 14,500 K, J	36,100 16,400	32,000 14,600 T	33,000 15,000 E	26,460 12,192 E		
Tandem straight truck: 3 axles	47,400 21,500 F, L, C	47,400 21,500 L	47,400 21,500 FF	47,500 21,500 L	62,800 28,500 J, P	62,000 28,100 G, Z	47,400 21,500 X	47,400 21,500 K, J	51,400 23,300 W	49,600 22,500 C, T	55,100 25,000 E	45,200 20,320 E		
Tractor and semitrailer: 3 axles	50,000 22,500 F, L	49,600 22,500 L	49,600 22,500 FF, BB	50,000 22,550 L	62,800 28,500 J, P	62,390 28,300 G, Z	52,250 23,700 X	52,000 23,600 K, J	56,000 25,400 W	52,250 23,700 T	55,100 25,000 E	45,200 20,320 E		
Tractor and tandem semitrailer: 4 axles	69,700 31,500 F, L, C	69,500 31,500 L, W	69,500 31,500 FF, BB	70,000 31,800 L, M	84,900 38,500 J, P	83,333 37,800 G, Z	67,500 30,500 X	67,000 30,400 J, K	71,000 32,200 W	69,700 31,600 C, T	75,200 34,100 E	62,830 28,448 E		
Tandem tractor and semitrailer: 4 axles	67,500 30,500 F, L, C	67,200 30,500 L, W	67,200 30,500 FF, BB	67,500 30,700 L, M	84,900 38,500 J, P	83,333 37,800 G, Z	67,500 30,600 X	67,000 30,400 J, K	71,000 32,200 W	69,700 31,600 C, T	77,200 35,000 E	62,830 28,448 E		
Tandem tractor and tandem semitrailer: 5 axles	87,100 39,500 F, L, C	87,100 39,500 L, W	87,100 39,500 FF, BB	87,500 39,700 L, M	106,900 48,500 J, P	104,000 47,200 G, Z	82,700 37,500 X	82,700 37,500 K, J	86,000 39,000 W	87,000 39,500 C, S, T, V	95,250 43,200 E	80,470 36,576 E		
Tandem tractor and 3-axle semitrailer: 6 axles	107,000 48,500 F, L, C	106,900 48,500 L, W	106,900 48,500 FF, BB	107,500 48,700 L, M	126,800 57,500 J, P	123,457 56,000 G, Z	82,700 37,500 X	82,700 37,500 K, J	86,000 39,000 W	95,900 43,500 C, S, T, U, V	116,200 52,700 E	89,290 36,576 GG		

Revised September 1986. Note, however, that the regulations change frequently. Contact the appropriate authority at the number listed at the bottom of the chart for current information. Most, particularly B.C. and N.B., handle enquiries in metric only.

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Straight truck and full trailer: 4 axles		69,500 31,500 F,L	69,500 31,500 L	69,500 31,500 FF,BB	Special permit required.			84,900 38,500 J,P	83,333 37,800 G,Z	72,300 32,800 X	72,300 32,800 J,K	76,000 34,500 W	72,300 32,800 T	77,200 35,000 E	62,830 28,448
Straight truck and tandem full trailer: 5 axles		89,300 40,500 F,L,C	89,300 40,500 L,W	89,300 40,500 FF,BB	Special permit required.			106,900 48,500 J,P	104,718 47,500 G,Z	87,500 39,700 X	87,000 39,500 K,J	91,000 41,300 W	83,800 38,000 C,T,V	90,600 41,100 E	80,470 36,576
Tandem straight truck and tandem full trailer: 6 axles		107,000 48,500 F,L,C	107,000 48,500 L,W	106,900 48,500 FF,BB	Special permit required.			126,800 57,500 J,P	123,457 56,000 G,Z	102,750 46,600 X	102,000 46,300 K,J	106,000 48,100 W	107,100 48,600 T,V	117,300 53,200 E	89,290 44,704 RR
Tractor semitrailer, full trailer: 5 axles - A-train		89,300 40,500 H,L,LL	89,300 40,500 L,W		Special permit required.			106,900 48,500 J,P	104,718 47,500 G,Z	92,400 41,900 X	92,000 41,700 K,J	96,000 43,500 W	83,800 38,000 T,V	Special permit required.	
Tandem tractor, tandem trailer, full trailer: 7 axles - A-train		115,700 52,500 H,L,LL	110,250 50,000 W		Special permit required.			126,800 57,500 J,P	139,550 63,300 G,Z	122,800 55,700 X	118,000 53,500 K,J	118,000 53,500 W	127,200 57,700 C,T,V	Special permit required.	
Tandem tractor, tandem semitrailer, tandem full trailer: 8 axles - A-train		118,000 53,500 H,L,LL	110,250 50,000 W		Special permit required.			126,800 57,500 J,P	140,000 63,500 G,Z	124,600 56,500 X	118,000 53,500 K,J	118,000 53,500 W	140,000 63,500 C,T,V	Special permit required.	
Tandem tractor, tandem semitrailer, tandem semitrailer: 7 axles - B-train		124,600 56,500 H,L,LL	110,250 50,000 W	125,000 56,500 BB,FF	Special permit required.			126,800 57,500 J,P	139,550 63,300 G,Z	118,000 53,500 X	118,000 53,500 K,J	118,000 53,500 W	124,600 56,500 C,T,V	139,600 63,300 G	116,840 54,000
Tandem tractor, 3-axle semitrailer, tandem semitrailer: 8 axles - B-train		124,600 56,500 H,L,LL	110,250 50,000 W	Special Permit	Special Permit			126,800 57,500 J,P	140,000 63,500 G,Z	118,000 53,500 X	118,000 53,500 K,J	118,000 53,500 W	140,000 63,500 C,T,U,V	139,600 63,300 G	116,840 54,000
For further information contact: *(Dempster Hwy. info. - 979-7283)		709/ 576-3808	902/ 424-5973	506/ 453-2802	902/ 643-2235	416/ 248-7151	204/ 945-3898	306/ 787-4848	403/ 340-5293	604/ 387-4404	403/ 667-5670	403/ 984-3341*			
Explanatory notes															
A — Limited by length of train only, except in Alberta, Man., and Sask. where two trailers are generally permitted and triple trailers are allowed on divided highways by special permit.															
B — If gross weight of combination is greater than 24,000 lb (11,000 kg).															
C — Based on tandem axle spacing between 59 and 73 in. (1.5 and 1.85 m).															
D — A combination must not exceed 70.5 ft (21.5 m) — 75.5 ft (23 m) in Alberta, Man. and Sask. and where distance from pin to rear-most trailer is 55 ft (16.75 m) or less. Max. semi-trailer length, 48 ft (14.8 m).															
E — Must meet axle spacing and tire size regulations. Based on 11,000 lb (5000 kg) on steering axle, but subject to increase when front axle and tires designed for more. Gross weight over 85,000 lb (38,500 kg) allowed only on certain highways.															
F — Add tolerance of 1100 lb (500 kg) per axle.															
G — This is the theoretical max. gross weight allowed on a vehicle or combination with this number of axles, obtained from Ontario MTC tables, assuming max. spreads and 19,800 lb (9000 kg) front axle.															
H — Max. regardless of axles.															
I — Based on 16.8 ft (4.8 m) min. distance between two extreme trailer axles.															
J — Must meet regulations on axle spacing (from 38,580 lb/17,500 kg to 44,092 lb/20,000 kg) and tire load. Max. front axle 18,700 lb (8500 kg) but capacity must be documented over 12,125 lb (5500 kg).															
K — On designated highways only.															
L — Based on 10,000 lb (4450 kg) on steering axle — 9000 lb (4500 kg) in N.S. — but subject to increase when design capacity more. In N.S. max. depends on spreads.															
M — According to axle spacing and tire size. In N.B. and Nfld. max. on drive tandem axle group is 17,500 lb (7900 kg).															
P — This is a theoretical max. gross weight allowed on a vehicle or combination with this number of axles obtained from Quebec tables, assuming 44,000 lb (19858.4 kg) tandem axle at 8 ft (2.44 m) spreads, and 18,750 lb (8505 kg) front axle.															
Q — One full trailer only, though may be towed behind a semitrailer providing combination is no more than 70.5 ft (21.5 m) long. See note D.															
R — Max. length of semitrailer 48 ft (14.6 m).															
S — Based on 12,000 lb (5500 kg) steering axle and providing vehicle meets axle spread and tire requirements.															
T — Three-axle group prohibited unless first and/or last steers or articulates.															
U — No combination to exceed 83,774 lb (38,000 kg) unless the gross mass to horsepower ratio exceeds 331 lb/hp (150 kg/hp) and it has two drive shafts.															
V — On designated highways only. Must meet spread and tire requirements. Front axle load of 10,000 lb (4540 kg) assumed. In Alberta, max. loading plus tolerance gives 18,000 lb (7300 kg) front axle load. In N.S., max. gross weight on Schedule C highways is 110,000 lb (50,000 kg); on all others, 85,000 lb (38,500 kg).															
W — On Class A1 highways only. Front axle of 12,000 lb (5500 kg) is assumed. Max. gross weight must not exceed 200 lb (90 kg) per 10 min of tire tread width. A 10% increase in tandem axle or axle group weights is applied. Max. front axle load is 18,000 lb (8165 kg) on Class A1 and B1 highways. Dec. 1 to Feb. 28, with axle spread and tire requirements.															
X — On Class A1 highways only. Front axle of 12,000 lb (5500 kg) is assumed. Max. gross weight must not exceed 200 lb (90 kg) per 10 min of tire tread width. A 10% increase in tandem axle or axle group weights is applied. Max. front axle load is 18,000 lb (8165 kg) on Class A1 and B1 highways. Dec. 1 to Feb. 28, with axle spread and tire requirements.															
Z — Front axle over 11,000 lb (5000 kg) must be rated for weight and driver must carry verification of rating.															
AA — Depending on axle spacing. Super single tires, 39,600 lb (18,000 kg).															
BB — Max. length of trailer or semitrailer: 45.9 ft (14 m).															
CC — 75.5 ft (23 m) if two or more articulation points and front kingpin to rear of combination does not exceed 55 ft (16.75 m) or less.															
DD — Gross mass on any wheel is not to exceed 242.5 lb (110 kg) per cm															