

CDOT Construction Manual

APPENDIX D MISCELLANEOUS DATA

July 2002 [Revised August 2004]

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APPENDIX D

MISCELLANEOUS DATA

Appendix D presents common tables, figures, and miscellaneous data that Project Engineers and Project Inspectors will use on a day-to-day basis. These include such items as legal dimensions and weights for trucks, procedures for measuring and documenting vertical and lateral clearances at structures, grade stamps used by accredited lumber inspection agencies, and miscellaneous mathematical formulas.

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FYI

Colorado Motor Carrier Services
One Stop Shopping Center
 1881 Pierce Street
 Lakewood, Colorado 80214

FOR YOUR INFORMATION Phone: Denver (303) 205-5691 FAX (303) 205-5764

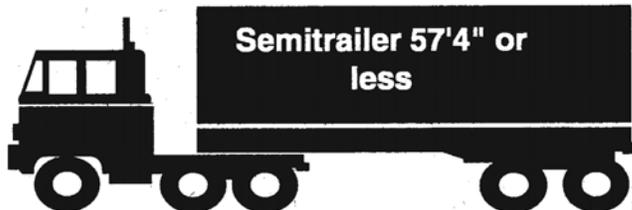
LEGAL VEHICLE DIMENSIONS (CDOT FYI 1)

The figures below reflect legal size limitations, any dimensions exceeding these limitations will require an oversize permit **C.R.S. 42-4-510(11)** The metric equivalents are not part of the statutory references, but are displayed only for informational purposes.



Vehicle 45' max

Single unit maximum length is **45' (13.72 meters)** as measured from extreme front bumper to extreme rear bumper. **C.R.S. 42-4-504(2)**



Semitrailer 57'4" or less

No overall length limit for a combination with a single trailer length of **57'4" (14.47 meters)** or less in length. **C.R.S. 42-4-404(4)**



Semitrailer 28'6" or less

Trailer 28'6" or less

No overall length limit for a combination of units with trailers **28'6" (8.68 meters)** or less in length. The common name for this combination is "Western Double". **C.R.S. 42-4-504(4)**



Saddlemounts are allowed **75' (22.86 meters)** in length for no more than **4** total units. A fullmount also may be transported as part of this combination. A fullmount is a smaller vehicle that is mounted completely on the frame of either the first or last vehicle in a saddlemount combination.

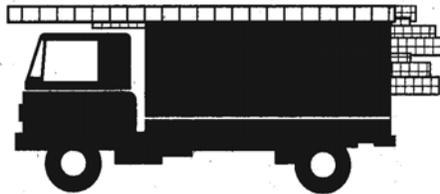
C.R.S. 42-4-504(4.5)

15' (4.57 meters) Drawbar



When one vehicle is towing another the drawbar or other connection shall be of sufficient strength to pull all weight towed, and the drawbar or other connection shall not exceed **15 feet (4.57 meters)** from one vehicle to the other **C.R.S. 42-4-506(1)**

Load may not project more than **4 feet (1.22 meters)** from the front most part of the grill. **C.R.S. 42-4-504(5)**



Load may not project more than **10 feet (3.05 meters)** to the rear of the vehicle bumper. Overhangs for automobile and boat transporters are restricted to **6 feet (1.83 meters)**. **C.R.S. 42-4-504(6)**

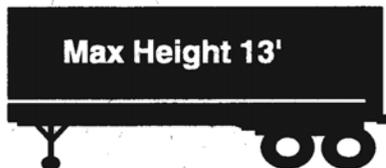
DAYLIGHT TRAVEL -

Red flags are required at the end of the load projections greater than **4 feet (1.22 meters)**. **C.R.S. 42-4-209**

NIGHT TRAVEL - A red light or lantern is required at the end of the load projections greater than **4 feet (1.22 meters)**. **C.R.S. 42-4-209**



The total outside width of any vehicle or load shall not exceed **102" (2.59 meters)**, excluding mirrors or safety devices. **C.R.S. 42-4-502 (1),(5)**

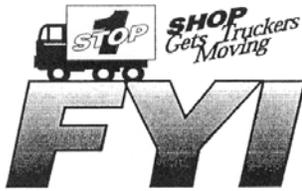


No vehicle unladen or with load shall exceed a height of **13' (3.96 meters)**; except that vehicles with a height of **14' 6" (4.42 meters)** shall be operated only on highways designated by the State Department of Transportation. **C.R.S. 42-4-504(1)**

**PERMIT FEES FOR VEHICLES THAT EXCEED LEGAL VEHICLE LIMITATIONS
C.R.S. 42-4-510 (11)**

| | | |
|---------------------|--------------|---|
| Single Trip Permit | (Oversize) | \$15.00 |
| | (Special) | \$125.00 required when a load exceeds maximum extra-legal dimensions. |
| Annual Permit | (Oversize) | \$250.00 per permitted power unit. |
| Annual Fleet Permit | (Overlength) | This fleet permit only applies to public utility vehicles and loads. \$1,500.00 plus \$15.00 per fleet vehicle. |

For detailed information and requirements concerning oversize/overweight permits, please refer to the Department of Transportation's Rules and Regulations titled "Pertaining to Transport Permits for the Movement of Extra-Legal Vehicles or Loads" (2 CCR 601-4). For more information contact CDOT at (303) 757-9539 or 1-800-350-3765.



Colorado Motor Carrier Services
One Stop Shopping Center
 1881 Pierce Street
 Lakewood, Colorado 80214

FOR YOUR INFORMATION Phone: Denver (303) 205-5691 FAX (303) 205-5764

LEGAL VEHICLE WEIGHT LIMITS (CDOT FYI 2)

The figures below reflect legal weight limits **C.R.S. 42-4-508**, any weights exceeding these limitations will require an overweight permit **C.R.S. 42-4-510(11)**. The metric equivalents are not part of the statutory references, but are displayed only for informational purposes.

AXLE WEIGHT LIMITATIONS C.R.S. 42-4-507

A single axle shall not exceed 20,000 pounds (9,072 kg) **1**
 Tandem axles shall not exceed 36,000 pounds (16,330 kg), 40,000 pounds (18,144 kg) non-interstate.
 Tridem axles shall not exceed 54,000 pounds (24,490 kg).

TWO AXLE/SINGLE UNIT



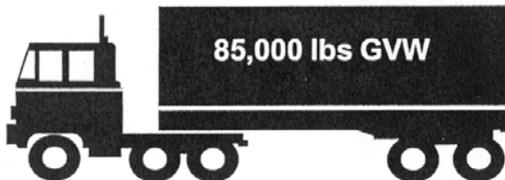
Maximum gross weight allowed on any Colorado highway is **36,000 pounds (16,330 kg)**. **2** Total weight must be distributed so that no axle exceeds the maximum gross weight for single axles. **C.R.S. 42-4-508(1)(a)(II), (1)(c)(I)**

THREE OR MORE AXLES/SINGLE UNIT



Maximum gross weight allowed on any Colorado highway is **54,000 pounds (24,490 kg)**. **2** Total weight must be distributed so that no single or tandem axle exceeds the maximum gross weight limits allowed on the road where they are weighed. **C.R.S. 42-4-508(1)(a)(III), (1)(c)(II)**

NON-INTERSTATE HAULERS

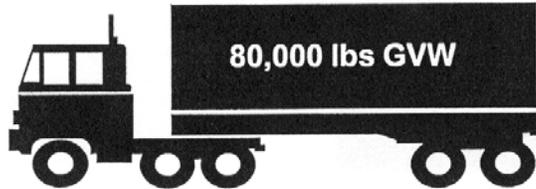


Maximum gross weight allowed on any Colorado non-interstate highway is **85,000 pounds (38,556 kg)**. **2** In addition vehicles must comply with the axle weight limitations and the Colorado Bridge Formula. **C.R.S. 42-4-508(1)(b)**

COLORADO BRIDGE FORMULA
 (Length + 40) x 1,000 = Gross Weight

- 1** A single axle shall not exceed 21,000 pounds (9,530 kg) for digger-derrick or bucket boom trucks operated by an electric utility on a **non-interstate** highway. **C.R.S. 42-5-507(2)(b.5)**
- 2** Gross weight limits are increased by 1,000 pounds (450 kg) for vehicles or combination of vehicles that contain an alternative fuel system and that operate on alternative fuel and conventional fuel on the **non-interstate** highways. **C.R.S. 42-5-508(1.5)**

INTERSTATE HAULERS



Maximum gross weight allowed on any Colorado Interstate highway is **80,000 pounds (36,288 kg)**. In addition vehicles traveling on interstate highways must comply with the Federal Bridge Formula. **C.R.S. 42-4-508 (1)(c)(III)**

FEDERAL BRIDGE FORMULA

$$\text{Gross weight} = 500 (LN/N-1 + 12N + 36)$$

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

N = Number of axles being considered. In computations of this formula no gross vehicle weight shall exceed 80,000 pounds except as may be authorized under Section 42-4-510(II).

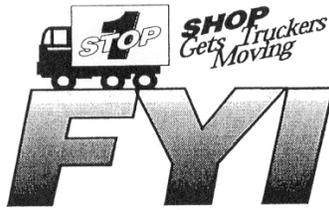
PERMIT FEES FOR VEHICLES THAT EXCEED LEGAL WEIGHT LIMITATIONS C.R.S. 42-4-510(11)

| | |
|---------------------|---|
| Single Trip Permit | |
| Overweight | \$15.00 plus \$5.00 per axle. |
| Special | \$125.00 This special permit is for structural, oversized, or overweight moves requiring extraordinary action or moves involving weight in excess of two hundred thousand pounds. |
| Annual Permit | |
| Overweight | \$400.00 per permitted power unit. |
| Annual Fleet Permit | |
| Overweight | This fleet permit only applies to Longer Vehicle Combinations as defined in C.R.S. 42-4-505. \$1,500.00 plus \$25.00 per vehicle to be permitted. |

Payment for permits will be accepted as follows:

1. Money Order
2. Certified Check
3. Cashiers Check **NO PERSONAL CHECKS WILL BE ACCEPTED**
4. Company Check
5. Cash
6. Escrow Accounts
7. Credit Cards (Please inquire as to which credit cards are accepted).

For detailed information and requirements concerning overweight/oversize permits, please refer to the Department of Transportation's Rules and Regulations titled "Pertaining to Transport Permits for the Movement of Extra-Legal Vehicles of Loads" (2 CCR 601-4). For more information contact CDOT at (303) 757-9539 or 1-800-350-3765.

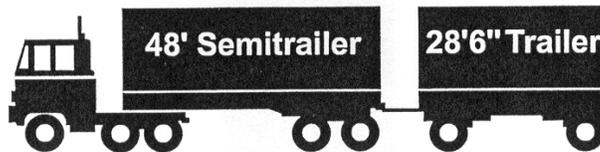


Colorado Motor Carrier Services
One Stop Shopping Center
 1881 Pierce Street
 Lakewood, Colorado 80214

FOR YOUR INFORMATION Phone: Denver (303) 205-5691 FAX (303) 205-5764

LONGER VEHICLE COMBINATIONS (CDOT FYI 3)

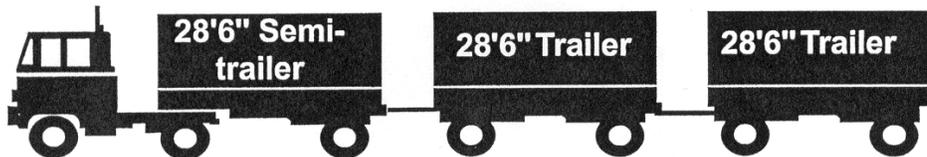
A Longer Vehicle Combination (LVC) (C.R.S. 42-4-505) shall not have more than three cargo units, fewer than six axles nor more than nine axles. The heaviest gross weight shall be hauled in the first semitrailer. LVCs must obtain a special permit and may only travel on designated routes. LVCs, except the "Truck with Trailer" combination, have no overall length limitation. Vehicle weight (GVW) is 80,000 pounds (36,288 kg) unless an overweight permit is purchased. C.R.S. 42-4-510(11) The metric equivalents are not part of the statutory references, but are displayed only for informational purposes.



An unladen truck tractor, one semitrailer which shall not exceed 48' (14.63 meters) and one trailer which shall not exceed 28' 6" (8.68 meters). The shorter trailer shall be operated as the rear trailer. The common name for this combination is "Rocky Mountain Double." C.R.S. 42-4-505 (2)(c)



An unladen truck tractor, one semitrailer and trailer which shall be of approximately equal lengths not to exceed 48' (14.63 meters). This combination may operate with up to eleven axles provided that the trailers are empty. The common name for this combination is "Turnpike Double." C.R.S. 42-4-505 (2)(b)



An unladen truck tractor, one semitrailer and two trailers which shall be of approximately equal lengths not to exceed 28' 6" (8.68 meters). The common name for this combination is "Triple." C.R.S. 42-4-505 (2)(a)



One single unit truck and trailer which shall not exceed 85' (25.91 meters). The truck shall not be more than 35' (10.67 meters) and the trailer not more than 40' (12.19 meters). The common name for this combination is "Truck With Trailer." C.R.S. 42-4-505 (2)(d)

DESIGNATED ROUTES

- a) On I-25 from the Colorado-New Mexico state line to the Colorado-Wyoming state line.
- b) On I-70 from the junction of US 40 and SH 26, in Denver, to the Colorado-Kansas state line.
- c) On I-76 from the junction of I-70, in Denver, to the Colorado-Nebraska state line.
- d) On I-270 from the junction of I-70 to the junction of I-76.
- e) On I-225 from the junction of I-25 to the junction of I-70.
- f) On I-70 from the Colorado-Utah state line to the junction of SH 13.
- g) On SH 133, in Delta County, from Milepoint 8.9 to Milepoint 9.7 (Non-Interstate Highway).

HOURS OF OPERATION

A LVC shall not operate on the following designated highway segments during the hours of 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m., Monday through Friday, for Colorado Springs, Denver, and Pueblo. LVCs operating above the legal maximum weight are subject to different hours of operation restrictions. Refer to rules pertaining to Extra-Legal Vehicles or Loads.

| | |
|------------------|--|
| Colorado Springs | I-25 from SH 83 (Academy Blvd. South) to SH 83 (Academy Blvd. North). |
| Denver | I-25 from I-225 to SH 128 (120th Ave.). I-70 from US 40/SH 26 to I-225. I-76 from I-70 to SH 85. I-225 from I-25 to I-70. I-270 from I-76 to I-70. |
| Pueblo | I-25 from Lake Ave. (Exit #94) to SH 47/SH 50 (Exit #101). |

INGRESS AND EGRESS

Longer Vehicle Combinations can be permitted to go to the following facilities: 1) Manufacturing or distribution centers, warehouses, or truck terminals, that are located in an area where industrial uses are permitted; and, 2). Construction sites. This off-highway-segment travel is limited to a maximum of 10 miles which shall be measured by the most direct travel rather than by the radius from the facility to the designated route. The ingress and egress route(s) between the designated state highway segment and the facility must be approved in advance by the public entity (CDOT, municipality, or county) having jurisdiction for the roadway(s) that make up the route(s).

MAXIMUM WEIGHTS

The legal maximum gross vehicle weight of a longer vehicle combination is 80,000 pounds (36,288 kg), the vehicle shall not exceed 20,000 pounds (9,072 kg) on any single axle or 36,000 pounds (16,330 kg) on any tandem axle and the vehicle must comply with the Federal Bridge Formula. If an overweight permit is purchased, the vehicle must comply with the aforementioned axle weight limitations and the maximum gross vehicle weight shall not exceed the **minimum** of any of the following conditions:

- 1. 110,000 pounds (49,896 kg).
- 2. 800 (L + 40).
- 3. 500 (LN/N-1 + 12N + 36).

For more details see the Department of Transportation's Rules and Regulations titled "Pertaining to Transport Permits for the Movement of Extra-Legal Vehicles or Loads" (2 CCR 601-4). For more information contact CDOT at (303) 757-9539 or 1-800-350-3765.

PERMIT FEES C.R.S.42-4-505(1)

Annual Permit; \$250.00 for each applicant.

For more detailed information and requirements concerning a Longer Vehicle Combination permit, please refer to the Department of Transportation's Rules and Regulations titled "Operation of Longer Vehicle Combinations on Designated State Highway Segments" (2 CCR 601-9). For more information contact CDOT at (303) 757-9539 or 1-800-350-3765.

HAZARDOUS MATERIALS

For more detailed information concerning the transportation of hazardous materials on Longer Vehicle Combinations, refer to the Department of Public Safety's Rules and Regulations titled "Hazardous Materials Transportation Permits" (8 CCR 1507-8). For more information contact the Colorado State Patrol at (303) 239-4546.

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AMERICAN LUMBER STANDARD COMMITTEE, INCORPORATED

H.R. Friesen, Chairman
S.R. Ingram, Vice Chairman
R.K. Caron, Treasurer
T. D. Searles, President

**American Lumber
Standard Committee, Incorporated**
P. O. Box 210
Germantown, Maryland 20875-0210
301-972-1700
Fax: 301-540-8004
e-mail: alsc@alsc.org

July, 2001

(this list supercedes all previous lists)

The following rules have been certified as conforming to the American Softwood Lumber Standard, PS20, by the Board of Review of the American Lumber Standard Committee:

1. **Standard Grading Rules for Northeastern Lumber**; published by the Northeastern Lumber Manufacturers Association (NeLMA), 272 Tuttle Road, P.O. Box 87A, Cumberland Center, ME 04021; phone 207-829-6901; fax 207-829-4293.
2. **Standard Grading Rules**; published by Northern Softwood Lumber Bureau (NSLB), 272 Tuttle Road, P.O. Box 87A, Cumberland Center, ME 04021; phone 207-829-6901; fax 207-829-4293.
3. **Standard Specifications for Grades of California Redwood Lumber**; published by the Redwood Inspection Service (RIS), 405 Enfrente Drive, Suite 200, Novato, CA 94949; phone 415-382-0662; fax 415-382-8531.
4. **Standard Grading Rules for Southern Pine Lumber**; published by the Southern Pine Inspection Bureau (SPIB), 4709 Scenic Highway, Pensacola, FL 32504; phone 850-434-2611; fax 850-433-5594.
5. **Standard Grading Rules for West Coast Lumber**; published by the West Coast Lumber Inspection Bureau (WCLIB), Box 23145, Portland, OR 97281-3145; phone 503-639-0651; fax 503-684-8928.
6. **Western Lumber Grading Rules**; published by Western Wood Products Association (WWPA), Yeon Building, 522 SW Fifth Avenue, Portland, OR 97204-2122; phone 503-224-3930; fax 503-224-3934.
7. **Standard Grading Rules for Canadian Lumber**; published by the National Lumber Grades Authority (NLGA), 406-First Capital Place, 960 Quayside Drive, New Westminster, B.C. V3M 6G2; phone 604-524-2393; fax 604-524-2893

Agencies Accredited By the Board of Review of the American Lumber Standard Committee, Incorporated and Typical Grade Stamps.

TYPICAL GRADE STAMP



AGENCY NAMES AND ADDRESSES

California Lumber Inspection Service (CLIS)

420 West Pine Street
Suite #10
Lodi, CA 95240
209-334-6956
Fax: 209-334-6970

1. Approval as an inspection agency including mill supervisory service under:
 - a. WCLIB rules
 - b. RIS rules
 - c. WWPA rules
 - d. NGR, Decking and Western Red Cedar portions of NLGA rules
 - e. NGR, Boards and Scaffold Plank portions of SPIB rules
2. Approved to supervise glued lumber.



Northeastern Lumber Manufacturers Association (NeLMA)

272 Tuttle Road, P.O. Box 87A
Cumberland Center, Maine 04021
207-829-6901
Fax: 207-829-4293
e-mail: nelma@javanet.com

1. NeLMA is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory services under:
 - a. NeLMA rules
 - b. NSLB rules
 - c. NGR, Posts and Timbers, and Beams and Stringers portions of WCLIB rules
 - d. NGR, Selects and Common Boards, 4/4 Shop, Heavy Shop, Posts and Timbers, and Beams and Stringers under the WWPA rules
 - e. NGR portion of the SPIB rules
3. Approved to supervise glued and machine graded lumber.

**Northern Softwood Lumber Bureau (NSLB)**

272 Tuttle Road, P.O. Box 87A
Cumberland Center, Maine 04021

207-829-6901
Fax: 207-829-4293
e-mail: nelma@javanet.com

1. NSLB is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory service under:
 - a. NSLB rules
 - b. NGR portions of the WCLIB rules
 - c. NGR portions of the WWPA rules
 - d. NGR portions of the NLGA rules
3. Approved to supervise glued and machine graded lumber.

**Pacific Lumber Inspection Bureau (PLIB)**

33442 First Way South
Suite 300
Federal Way, WA 98003

253-835-3344
Fax: 253-835-3371
e-mail: plib@foxinternet.com

1. Approval as an inspection agency including mill supervisory service under:
 - a. WCLIB rules
 - b. WWPA rules
 - c. RIS rules
 - d. NLGA rules
2. Approved to supervise glued and machine graded lumber.

**Redwood Inspection Service (RIS)**

405 Enfrente Drive, Suite 200
Novato, California 94949

415-382-0662
Fax: 415-382-8531
e-mail: cjjourdain@worldnet.att.net

1. RIS is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory service under:
 - a. RIS rules
 - b. WCLIB rules
 - c. WWPA rules
3. Approved to supervise machine graded lumber.

**Renewable Resource Associates, Inc. (RRA)**

3091 Chaparral Place
Lithonia, Georgia 30038

770-482-9385
Fax: 770-484-2541
e-mail: rra.inc@mindspring.com

1. Approval as an inspection agency including mill supervisory service under:
 - a. SPIB rules
 - b. NGR, Posts and Timbers, and Beams and Stringers portions of the NLGA rules
 - c. NGR, Selects and Finish, Boards, Posts and Timbers and Beams and Stringers portions of the WWPA rules
 - d. NGR, Posts and Timbers, and Beams and Stringers portions of the WCLIB rules
 - e. NGR, Selects and Finish, Boards, Posts and Timbers, and Beams and Stringers portions of the NeLMA rules
 - f. NGR, Selects and Finish, Boards, Mouldings, Posts and Timbers, and Beams and Stringers portions of the NSLB rules
2. Approved to supervise glued and machine graded lumber.

SPIB® No. 2
KD19 (7)

Southern Pine Inspection Bureau (SPIB)

4709 Scenic Highway
Pensacola, Florida 32504

850-434-2611
Fax: 850-433-5594
e-mail: spib@spib.org

1. SPIB is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory service under:
 - a. SPIB rules
 - b. Southern pine graded under WWPA Moulding Stock and Shop Lumber rules
 - c. NGR, Posts and Timbers, and Beams and Stringers portions of NeLMA rules
 - d. NGR, Posts and Timbers, and Beams and Stringers portions of NSLB rules
 - e. NGR, Posts and Timbers, and Beams and Stringers portions of WCLIB rules
 - f. NGR, Posts and Timbers, and Beams and Stringers portions of WWPA rules
 - g. NGR, Posts and Timbers, and Beams and Stringers portions of NLGA rules
3. Approved to supervise glued and machine graded lumber.

AUDITED BY
TP® NO.2 S-DRY
000 SYP

Timber Products Inspection (TP)

P.O. Box 919
Conyers, Georgia 30012

770-922-8000
Fax: 770-922-1290
e-mail: jmoore@tpinspection.com

1. Approval as an inspection agency including mill supervisory service under:
 - a. SPIB rules
 - b. RIS rules
 - c. WCLIB rules
 - d. WWPA rules
 - e. NGR, Posts and Timbers, and Beams and Stringers, and Section 6-Eastern White Pine Board Grades portions of the NeLMA rules
 - f. NGR, paragraph 112-Selects and paragraph 113-Commons portions of the NLGA rules
 - g. NGR portion of the NSLB rules
2. Approved to supervise glued and machine graded lumber.

AUDITED BY
TP® NO.1 S-DRY
000 D.FIR-L

West Coast Lumber Inspection Bureau (WCLIB)

Box 23145
Portland, OR 97281-3145

503-639-0651
Fax: 503-684-8928
e-mail: bshelley@wclib.org
e-mail: info@wclib.org

MILL 10
WC
LB
NO. 2
DOUG FIR S-DRY

1. WCLIB is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory service under:
 - a. WCLIB rules
 - b. RIS rules
 - c. WWPA rules
 - d. NLGA rules
 - e. NGR, Scaffold Plank, Radius Edge Decking, Finish and Boards portions of the SPIB rules
3. Approved to supervise glued and machine graded lumber.

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S-DRY
D.
FIR

Western Wood Products Association (WWPA)

522 SW Fifth Avenue, Suite 500
Portland, Oregon 97204-2122

503-224-3930
Fax: 503-224-3934
e-mail: info@wwpa.org

1. WWPA is a rules writing agency.
2. Approval of rules they publish and as an inspection agency including mill supervisory service under:
 - a. WWPA rules
 - b. WCLIB rules
 - c. NLGA rules
 - d. RIS rules
 - e. NGR and Scaffold Plank portions of the SPIB rules
3. Approved to supervise glued and machine graded lumber.

National Lumber Grades Authority (NLGA)

406-First Capital Place
960 Quayside Drive
New Westminster, British Columbia V3M 6G2

604-524-2393
Fax: 604-524-2893
e-mail: nlga@axionet.com

The NLGA is the rules writing agency for Canada. The following Canadian agencies have been accredited by the Board of Review of the American Lumber Standard Committee as inspection agencies including mill supervisory service as indicated below.

A.F.P.A.[®] 00
S-P-F
S-DRY STAND

Alberta Forest Products Association (AFPA)

11738 Kingsway Avenue # 200
Edmonton, Alberta T5G 0X5

780-452-2841
Fax: 780-455-0505
e-mail: ndupuis@compusmart.ab.ca

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
2. Approved to supervise glued and machine graded lumber.

CL[®]A
S-P-F
100
No. 2
S-GRN.

CL[®]A 100
SPRUCE-PINE-FIR
NO. 1 S-DRY

Canadian Lumbermen's Association (CLA)

27 Goulburn Avenue
Ottawa, Ontario K1N 8C7

613-233-6205
Fax: 613-233-1929
e-mail: info@cla-ca.ca

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of NeLMA rules
2. Approved to supervise glued and machine graded lumber.


100
HEM-FIR(N)
®

No 1
S-DRY

Canadian Mill Services Association (CMSA)

Suite 1115, Two Bentall Centre
555 Burrard Street
Box 226
Vancouver, British Columbia V7X 1M8

604-891-1200
Fax: 604-891-1217
e-mail: beatty@canserve.org

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of WWPA rules for Douglas fir, larch and SPF(S).
2. Approved to supervise glued and machine graded lumber.

CSI No 1
S-DRY
000 HEM-FIR(N)

Canadian Softwood Inspection Agency, Inc. (CSI)

22089 28th Avenue
Langley, British Columbia V2Z 1P1

604-532-7624
Fax: 604-532-7625
e-mail: thomasr@uniserve.com

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of WWPA rules
 - c. NGR portion of WCLIB rules
2. Approved to supervise glued and machine graded lumber.

 S-DRY 1
S-P-F

Cariboo Lumber Manufacturers Association (CLMA)

205-197 N. 2nd Avenue
Williams Lake, British Columbia V2G 1Z6

250-392-7778
Fax: 250-392-4692
e-mail: clma@wlake.com

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
2. Approved to supervise glued and machine graded lumber.

CFPA[®] 00
S-P-F S-DRY
CONST

Central Forest Products Association (CFPA)

Suite #309, 35-2855 Pembina Hwy.
Winnipeg, Manitoba R3T 2N5

204-487-7403
Fax: 204-487-3769

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of the NeLMA rules
2. Approved to supervise glued and machine graded lumber.

 **100**
1 S-DRY
SPRUCE-PINE-FIR

Gateway Lumber Inspection Bureau (GLIB)

992 Burns Street
North Bay, Ontario P1B 3V4

705-474-9148
Fax: 705-474-3644
e-mail: maurice.bosselle@sympatico.ca

1. Approved as an inspection agency including mill supervisory service under:
 - a. NGR, paragraph 114, Posts and Timbers, and Beams and Stringers portions of the NLGA rules
2. Approved to supervise glued lumber

**Interior Lumber Manufacturers Association (ILMA)**

360-1855 Kirschner Road
Kelowna, British Columbia V1Y 4N7

250-860-9663
Fax: 250-860-0009
e-mail: ilma@ilma.com

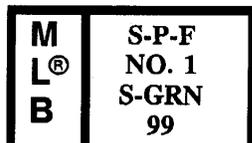
1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of the WWPA rules
2. Approved to supervise glued and machine graded lumber.

**Macdonald Inspection (MI)**

110-1720 14th Avenue
Campbell River, British Columbia V9W 8B9

250-287-4422
Fax: 250-287-4622
e-mail: macinsp@island.net

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR portion of the WWPA rules
 - c. NGR portion of the WCLIB rules
2. Approved to supervise glued and machine graded lumber.

**Maritime Lumber Bureau (MLB)**

P.O. Box 459
Amherst, Nova Scotia B4H 4A1

902-667-3889
Fax: 902-667-0401
e-mail: mlb@ns.sympatico.ca

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR and Section 6-Eastern White Pine Board Grades portions of the NeLMA rules
2. Approved to supervise glued lumber.

NFLD.LUMBER**Newfoundland and Labrador Lumber Producers Association (NLPA)**

P.O. Box 8
Glovertown, Newfoundland A0G 2L0

709-533-2206
Fax: 709-533-2611

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules

**Northern Forest Products Association (NFPA)**

400-1488 Fourth Avenue
Prince George, British Columbia V2L 4Y2

250-564-5136
Fax: 250-564-3588
e-mail: nfpa@pgweb.com

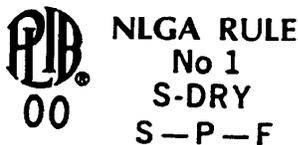
1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
2. Approved to supervise glued and machine graded lumber.

**Ontario Lumber Manufacturers Association (OLMA)**

65 Queen Street West, Suite 210
Toronto, Ontario M5H 2M5

416-367-9717
Fax: 416-367-3415
e-mail: olmassoc@aol.com

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR and Section 6-Eastern White Pine Board Grades portions of the NeLMA rules
2. Approved to supervise glued and machine graded lumber.

**Pacific Lumber Inspection Bureau (PLIB)**

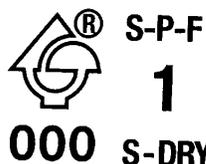
33442 First Way South
Suite 300
Federal Way, WA 98003

British Columbia Division:

P.O. Box 19118
Fourth Avenue Postal Outlet
Vancouver, British Columbia V6K 4R8

253-835-3344
Fax: 604-732-1782
e-mail: plib@foxinternet.com

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. WCLIB rules
 - c. WWPA rules
2. Approved to supervise glued and machine graded lumber.

**Quebec Lumber Manufacturers Association (QLMA)**

1175 Lavigerie Avenue, Suite 200
Ste-Foy, QB G1V 4P1

418-657-7916
Fax: 418-657-3365
e-mail: gilles.jeanie@sciage-lumber.qc.ca

1. Approved as an inspection agency including mill supervisory service under:
 - a. NLGA rules
 - b. NGR and paragraph 6.5 Commons portions of the NeLMA rules
2. Approved to supervise glued and machine graded lumber.

INTERPRETING GRADE STAMPS

With few exceptions (see note), all approved grade stamps include the following five elements.

Visually Graded Lumber ¹:

| | |
|----------------------------|------------------------------|
| (a) TRADEMARK® | (c) Grade Designation |
| (b) Mill Identification | (d) (e) Species Seasoning |

- a. *Trademark* – indicates identity of agency quality supervision
- b. *Mill Identification* – product manufacturer name, brand or assigned mill number
- c. *Grade Designation* – grade name (number or abbreviation)
- d. *Species Identification* – name or abbreviation of individual species or species combination
- e. *Condition of Seasoning* – moisture content classification at time of surfacing:
 1. *S-Dry* – 19% maximum moisture content
 2. *MC 15* – 15% maximum moisture content
 3. *KD* – kiln dried to moisture content indicated in grading rules
 4. *S-GRN* – over 19% moisture content (unseasoned)

Machine Graded Lumber ¹:

Grade stamps on machine graded lumber include the five elements listed above for visually graded lumber. Grade designations for the two types of machine graded lumber, machine stress rated (MSR) lumber and machine evaluated lumber (MEL), are distinctive from those used for visually graded lumber grades.

Machine Stress Rated Lumber (MSR) Stamp:

| | | |
|----------------------------|-----------------------|------------------|
| (b) Mill Identification | (d) Species | (e) Seasoning |
| (a) TRADEMARK® | (c) #### Fb - #.#E | |
| Machine Rated | | |

- MSR grade designations are composed of the assigned extreme fiber in bending (Fb or f) in psi and the assigned modulus of elasticity (E) in millions of pound per square inch. Examples include 1650f-1.5E, 2100f-1.8E and 2400f-2.0E.
- The phrase “Machine Rated” or “MSR” is also required on machine stress rated lumber stamps.

Machine Evaluated Lumber (MEL) Stamp:

| | |
|-------------------|----------------------------|
| (a) TRADEMARK® | (b) Mill Identification |
| (d) Species | (e) Seasoning |
| (c) M – xx | |
| #### Fb | #.# E #### Ft |

- MEL grade designations use the format, M-xx; where xx indicates a one or two digit number. Examples include M-12, M-15 and M-19.
- In addition, the assigned extreme fiber in bending (Fb or f) in psi, the assigned modulus of elasticity (E) in millions of pound per square inch, and the assigned tension parallel to grain (Ft) in psi are required elements on machine evaluated lumber stamps.

Glued Lumber ¹:

| | |
|--|----------------------------|
| (a) TRADEMARK® | (b) Mill Identification |
| (d) Species | (e) Seasoning |
| (c) Grade Identification (Type Glue/Appropriate Use) | |

Grade stamps on glued lumber include all the information indicated for visually graded lumber. In addition, the grade stamp includes a designation or abbreviation indicating the type of glue joint and appropriate use. Examples include “Stud Use Only”, “Vertical Use Only”, “Certified End Joint” and “Certified Exterior Joints”.

¹ Grade Stamp Layout – The placement of the required elements within a grade stamp may vary, depending on the preferences of the specific supervising agency. The sample grade stamp facsimiles that accompany the agency listing herein provide a good example of the typical placement of elements preferred by that particular agency. Contact the agency, whose trademark appears on the lumber, for specific information related to the agency’s grade stamping policies.

Note: Grade stamps for timbers are not required to include the condition of seasoning. Grade stamps are permitted to include information that is not required, so long as the additional information is not confusing, misleading or deceptive. Contact the agency, whose trademark appears on the lumber, for specific information related to the agency’s grade stamping policy.

AMERICAN LUMBER STANDARD COMMITTEE, INCORPORATED
 P.O. Box 210
 Germantown, Maryland 20875-0210
 301-972-1700 fax 301-540-8004 e-mail: alscc@alscc.org

American Lumber Standard Committee, Incorporated

H.R. Friesen, Chairman
S.R. Ingram, Vice Chairman
R.K. Caron, Treasurer
T.D. Searles, President

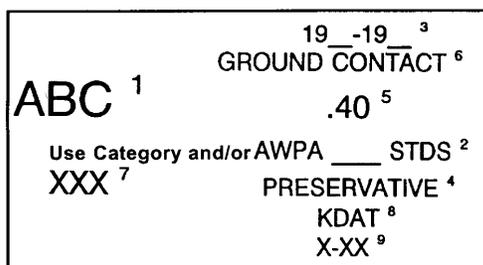
P.O. Box 210
Germantown, Maryland 20875-0210
Telephone: (301) 972-1700
Fax: (301) 540-8004
E-Mail: alsc@alsc.org

ACCREDITED AGENCIES FOR SUPERVISORY AND LOT INSPECTION OF PRESSURE TREATED WOOD PRODUCTS JULY, 2001

(this list supercedes all previous lists)

Agencies accredited by the Board of Review of the American Lumber Standard Committee, Incorporated and typical quality marks.

Interpreting a Quality Mark



- 1 - The identifying symbol, logo or name of the accredited agency.
- 2 - The applicable American Wood-Preservers' Association (AWPA) commodity standard and/or Use Category.
- 3 - The year of treatment if required by AWPA standard/use category.
- 4 - The preservative used, which may be abbreviated.
- 5 - The preservative retention.
- 6 - The exposure category (e.g. Above Ground, Ground Contact, etc.).
- 7 - The company name and location of home office; or company name and number; or company number.
- 8 - If applicable, moisture content after treatment.
- 9 - If applicable, length, and/or class.

As specified below for particular agencies, some or all of the following American Wood-Preservers' Association commodity standards are used by American Lumber Standard Committee, Incorporated accredited agencies which supervise facilities which pressure treat wood products:

- C1 All Timber Products--Preservative Treatment by Pressure Processes
- C2 Lumber, Timbers, Bridge Ties and Mine Ties--Preservative Treatment by Pressure Processes
- C3 Piles--Preservative Treatment by Pressure Processes
- C4 Poles--Preservative Treatment by Pressure Processes
- C5 Fence Posts--Preservative Treatment by Pressure Processes
- C6 Crossties and Switch Ties--Preservative Treatment by Pressure Process
- C9 Plywood--Preservative Treatment by Pressure Processes
- C15 Wood for Commercial-Residential Construction--Preservative Treatment by Pressure Processes
- C17 Playground Equipment Treated with Inorganic Preservatives--Preservative Treatment by Pressure Processes
- C18 Standard for Pressure Treated Material in Marine Construction
- C22 Lumber and Plywood for Permanent Wood Foundations--Preservative Treatment by Pressure Processes
- C23 Round Poles and Posts used in Building Construction--Preservative Treatment by Pressure Processes
- C24 Sawn Timber Used to Support Residential and Commercial Structures
- C25 Sawn Crossarms--Preservative Treatment by Pressure Process
- C28 Standard for Preservative Treatment by Pressure Process of Structural Glued Laminated Members and Laminations Before Gluing.
- C31 Lumber Used Out of Contact With the Ground and Continuously Protected from Liquid Water--Treatment by Pressure Processes
- C33 Standard for Preservative Treatment of Structural Composite Lumber by Pressure Processes
- C34 Shakes and Shingles--Preservative Treatment by Pressure Processes

| AWPA Use Categories and Corresponding AWPA Commodity Standards *** | | |
|--|--|--|
| AWPA Use Category (UC) | Use Category Service Conditions | Corresponding AWPA Commodity Standard (C) |
| UC1 | Interior construction, dry, above ground | C1, C2, C15, C28, C31 |
| UC2 | Interior construction, damp above ground | C1, C2, C9, C15, C28, C31 |
| UC3A | Exterior construction, coated, above ground | C1, C2, C15, C34 |
| UC3B | Exterior construction, above ground | C1, C2, C9, C15, C25, C28, C33, C34 |
| UC4A | Ground contact or fresh water | C1, C2, C4, C5, C6, C9, C15, C17, C28, C33 |
| UC4B | Ground contact or fresh water or important construction components | C1, C2, C3, C4, C5, C6, C15, C22, C23, C24, C28, C33 |
| UC4C | Ground contact or fresh water or critical construction components | C1, C2, C3, C4, C6, C24, C28, C33 |
| UC5A, UC5B, UC5C | Salt or brackish water and adjacent mud zone | C1, C2, C3, C9, C18 |

*** For additional information concerning the AWPA Use Category and Commodity Standard treatment requirements contact the American Wood-Preservers' Association, P.O. Box 5690, Granbury, Texas 76049 (Telephone: 817-326-6300, Fax: 817-326-6306, E-Mail: awpa@itexas.net; Web Site: www.awpa.com.)

KEY TO THE FOLLOWING TABLES

As specified in the following tables, some or all of the following preservatives are used:

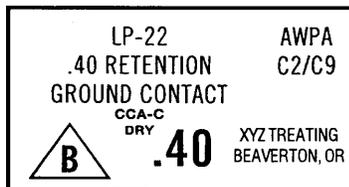
- CCA - chromated copper arsenate
- ACA - ammoniacal copper arsenate
- ACZA - ammoniacal copper zinc arsenate
- ACC - acid copper chromate
- ACQ - ammoniacal copper quat.
- COPPER NAP - copper naphthenate
- PENTA - pentachlorophenol
- CREOSOTE - creosote and/or solutions
- BORATE - borates
- CBA-A - copper azole - A
- CC - ammoniacal copper citrate
- CDDC - copper bis (dimethyldithiocarbamate)

- 1 - sawn material and plywood
- 2 - plywood only
- 3 - sawn material only
- R - round commodities
- SP - southern pine
- RP - red pine
- PP - ponderosa pine
- HF - hem-fir
- DF - coastal Douglas fir
- LP - lodgepole pine
- WH - western hemlock
- RDP - radiata pine
- CP - caribbean pine
- EWP - eastern white pine
- JP - jack pine

**ACCREDITED AGENCY
AND ADDRESSES**

Bode Inspection
P.O. Box 307
Beaverton, Oregon 97075-0307
503-590-3555
Fax: 503-590-2802
e-mail: bodeins@aol.com

TYPICAL QUALITY MARK



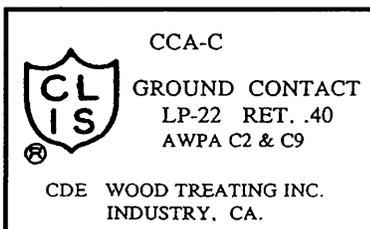
**TABLE OF COMMODITIES,
BY SPECIES & PRESERVATIVE**

(See Key)

| | HF | DF | WH |
|------------|----|-----|----|
| CCA | 1 | 2,R | R |
| ACA | 1 | 1,R | R |
| ACZA | 1 | 1,R | R |
| ACC | 1 | 2,R | R |
| ACQ | 1 | 1 | |
| COPPER NAP | 1 | 1,R | R |
| PENTA | 1 | 1,R | R |
| CREOSOTE | 1 | 1,R | R |

California Lumber Inspection Service

420 West Pine Street
Suite #10
Lodi, CA 95240
209-334-6956
Fax: 209-334-6970

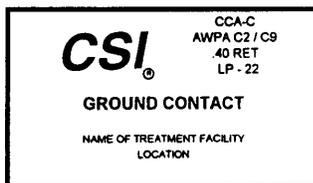


| | SP | RP | PP | HF | DF | LP | WH |
|------------|-----|-----|-----|----|-----|-----|-----|
| CCA | 1,R | 1,R | 1,R | 1 | 2,R | R | R |
| ACA | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R |
| ACZA | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R |
| ACC | 1,R | 1,R | 1,R | 1 | 2,R | 1,R | 1,R |
| COPPER NAP | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R |
| PENTA | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R |
| CREOSOTE | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R |

California Lumber Inspection Service maintains a laboratory accredited for the analysis of wood samples pressure treated with the following preservative(s): CCA, ACA, ACZA, ACC and COPPER NAP.

Canadian Softwood Inspection Agency, Inc.

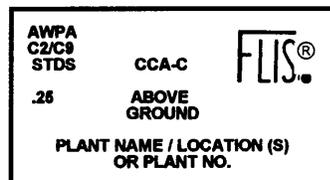
22089 28th Avenue
Langley, BC V2Z 1P1 Canada
604-532-7624
Fax: 604-532-7625
e-mail: thomasr@uniserve.com



| | SP | RP | PP | HF | DF | LP | WH | JP |
|--------|-------------------------------|-----|-----|----|-----|-----|-----|-----|
| CCA | 1,R | 1,R | 1,R | 1 | 1,R | 1,R | 1,R | 1,R |
| BORATE | 1-All AWPA Applicable Species | | | | | | | |

Florida Lumber Inspection Service

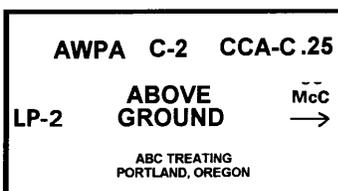
P. O. Box 898
Conyers, GA 30012
770-922-8000
Fax: 770-922-1290
flis@perry.gulfnet.com



| | SP | RP | PP | RDP | CP |
|------------|-----|-----|-----|-----|-----|
| CCA | 1,R | 1,R | 1,R | 1,R | 1,R |
| COPPER NAP | 1,R | 1,R | 1,R | 1,R | 1,R |
| PENTA | 1,R | 1,R | 1,R | 1,R | 1,R |
| CREOSOTE | 1,R | 1,R | 1,R | 1,R | 1,R |

McCutchan Inspection, Inc.

P.O.Box 397
Banks, OR 97106
503-324-5210
Fax: 503-324-7912
e-mail: sasu1@msn.com

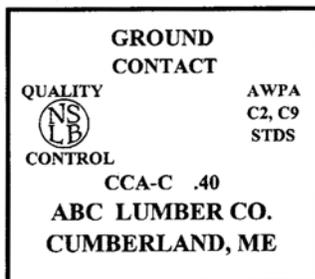


| | SP | RP | PP | HF | DF |
|------------|-----|-----|----|----|-----|
| CCA | 1,R | 1,R | 1 | 1 | 1,R |
| ACA | 1,R | 1,R | 1 | 1 | 1,R |
| ACZA | 1,R | 1,R | 1 | 1 | 1,R |
| ACC | 1,R | 1,R | 1 | 1 | 1,R |
| COPPER NAP | 1,R | 1,R | 1 | 1 | 1,R |
| PENTA | 1,R | 1,R | 1 | 1 | 1,R |
| CREOSOTE | 1,R | 1,R | 1 | 1 | 1,R |

**ACCREDITED AGENCY
AND ADDRESSES**

**Northern Softwood
Lumber Bureau**
272 Tuttle Road
P.O. Box 87A
Cumberland Center, Maine 04021
207-829-6901
Fax: 207-829-4293
e-mail: nelma@javanet.com

TYPICAL QUALITY MARK

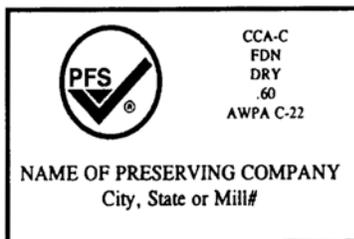


**TABLE OF COMMODITIES,
BY SPECIES & PRESERVATIVE**

(See Key)

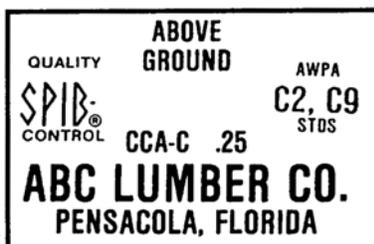
| | SP | RP | PP | EWP |
|------|----|----|----|-----|
| CCA | 1 | 1 | 1 | 1 |
| ACZA | 1 | 1 | 1 | 1 |

PFS Corporation
2402 Daniels Street
Madison, Wisconsin 53718
608-221-3361
Fax: 608-221-0180
e-mail: pfsteco@pfs-teco.com



| | SP | RP | PP | HF | DF | LP | WH |
|----------|-----|-----|-----|----|-----|----|----|
| CCA | 1,R | 1,R | 1,R | 1 | 2,R | R | R |
| ACA | 1,R | 1,R | 1,R | 1 | 1,R | R | R |
| ACZA | 1,R | 1,R | 1,R | 1 | 1,R | R | R |
| ACC | 1,R | 1,R | 1,R | 1 | 2,R | R | R |
| CREOSOTE | 1,R | 1,R | 1,R | 1 | 1,R | R | R |

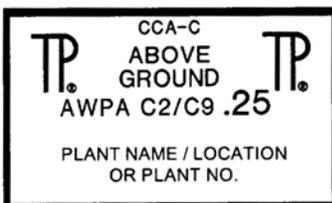
Southern Pine Inspection Bureau
4555 Spanish Trail
Pensacola, Florida 32504
850-434-5011
Fax: 850-434-5388
e-mail: spib@spib.org



| ALL AWPA APPLICABLE SPECIES | |
|-----------------------------|-----|
| CCA | 1,R |
| PENTA | R |
| CREOSOTE | R |
| ACQ | 1 |
| ACZA | 1 |
| BORATE | 1 |

Southern Pine Inspection Bureau maintains a laboratory accredited for the analysis of wood samples pressure treated with the following preservative(s): CCA, ACZA, BORATE, PENTA, CRESOTE, and ACQ.

Timber Products Inspection
P. O. Box 919
Conyers, Georgia 30012
770-922-8000
Fax: 770-922-1290
e-mail: tpinsp@mindspring.com



| ALL AWPA APPLICABLE SPECIES | |
|-----------------------------|-----|
| CCA | 1,R |
| ACA | 1,R |
| ACZA | 1,R |
| ACC | 1,R |
| ACQ | 1,R |
| COPPER NAP | 1,R |
| PENTA | 1,R |
| CREOSOTE | 1,R |
| BORATE | 1 |
| CBA-A | 3 |
| CC | 1,R |
| CDDC | 3 |

Timber Products Inspection maintains a laboratory accredited for the analysis of wood samples pressure treated with the following preservative(s): CCA, ACA, ACZA, ACC, ACQ, COPPER NAP, PENTA, CRESOTE, BORATE, CBA-A, CC and CDDC.

AREAS OF PLANE FIGURES

| | |
|--|---|
| | <p>Square</p> <p>Diagonal = $d = s\sqrt{2}$ Area = $s^2 = 4b^2 = 0.5d^2$ Example: $s = 6$; $b = 3$; Area = $(6)^2 = 36$ Ans. $d = 6 \times 1.414 = 8.484$ Ans.</p> |
| | <p>Rectangle and Parallelogram</p> <p>Area = ab or $b\sqrt{d^2 - a^2}$ Example. $a = 6$; $b = 3$. Area = $3 \times 6 = 18$ Ans.</p> |
| | <p>Trapezoid</p> <p>Area = $\frac{1}{2}h(a + b)$ Example: $a = 2$; $b = 4$; $h = 3$ Area = $\frac{1}{2} \times 3(2 + 4) = 9$ Ans.</p> |
| | <p>Trapezium</p> <p>Area = $\frac{1}{2}[a(h + h^1) + bh^1 + ch]$ Example: $a = 4$; $b = 2$; $c = 2$; $h = 3$; $h^1 = 2$. Area = $\frac{1}{2}[4(3 + 2) + (2 \times 2) + (2 \times 3)] = 15$ Ans.</p> |
| | <p>Triangles</p> <p>Both formulas apply to both figures.</p> <p>Area = $\frac{1}{2}bh$ Example: $h = 3$; $b = 5$ Area = $\frac{1}{2}(3 \times 5) = 7\frac{1}{2}$ Ans.</p> <p>Area = $\sqrt{S(S - a)(S - b)(S - c)}$ where $S = \frac{a + b + c}{2}$ Example: $a = 2$; $b = 3$; $c = 4$ $S = \frac{2 + 3 + 4}{2} = 4.5$; Area = $\sqrt{4.5(4.5 - 2)(4.5 - 3)(4.5 - 4)} = 2.9$ Ans.</p> |
| | <p>Regular Polygons</p> <p>Area</p> <ul style="list-style-type: none"> 5 sides = $1.720477S^2 = 3.63271r^2$ 6 sides = $2.598150S^2 = 3.46410r^2$ 7 sides = $3.633875S^2 = 3.37101r^2$ 8 sides = $4.828427S^2 = 3.31368r^2$ 9 sides = $6.181875S^2 = 3.27573r^2$ 10 sides = $7.694250S^2 = 3.24920r^2$ 11 sides = $9.365675S^2 = 3.22993r^2$ 12 sides = $11.196300S^2 = 3.21539r^2$ <p>n = number of sides; r = short radius; S = length of side; R = long radius.</p> <p>Area = $\frac{n}{4}S^2 \cot \frac{180^\circ}{n} = \frac{n}{2}R^2 \sin \frac{360^\circ}{n} = nr^2 \tan \frac{180^\circ}{n}$</p> |

AREAS OF PLANE FIGURES

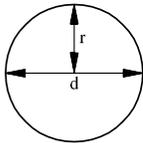
Circle

$\pi = 3.1416$; A = area; d = diameter

p = circumference or periphery; r = radius

$$p = \pi d = 3.1416d \qquad p = 2\sqrt{\pi A} = 3.54\sqrt{A}$$

$$p = 2\pi r = 6.2832r \qquad p = \frac{2A}{r} = \frac{4A}{d}$$



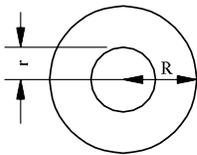
$$d = \frac{p}{\pi} = \frac{p}{3.1416} \qquad d = 2\sqrt{\frac{A}{\pi}} = 1.128\sqrt{A}$$

$$r = \frac{p}{2\pi} = \frac{p}{6.2832} \qquad r = \sqrt{\frac{A}{\pi}} = 0.564\sqrt{A}$$

$$A = \frac{\pi d^2}{4} = 0.7854d^2 \qquad A = \frac{p^2}{4\pi} = \frac{p^2}{12.57}$$

$$A = \pi r^2 = 3.1416r^2 \qquad A = \frac{pr}{2} = \frac{pd}{4}$$

Circular Ring



$$\text{Area} = \pi(R^2 - r^2) = 3.1416(R^2 - r^2)$$

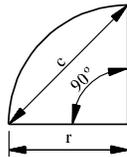
$$\text{Area} = 0.7854(D^2 - d^2) = 0.7854(D-d)(D+d)$$

Area = difference in areas between the inner and outer circles.

Example: R = 4; r = 2.

$$\text{Area} = 3.1416(4^2 - 2^2) = 37.6992 \text{ Ans.}$$

Quadrant



$$\text{Area} = \frac{\pi r^2}{4} = 0.7854r^2 = 0.3927c^2$$

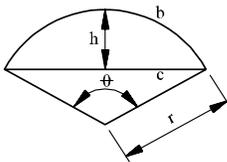
Example. r = 3; c = chord.

$$\text{Area} = 0.7851 \times 3^2 = 7.0686 \text{ Ans.}$$

Segment

b = length of arc; θ = angle in degrees; c = chord = $\sqrt{4(2hr - h^2)}$

$$\text{Area} = \frac{1}{2} [br - c(r - h)] = \pi r^2 \frac{\theta}{360} - \frac{c(r - h)}{2}$$

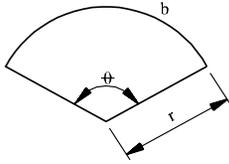


When θ is greater than 180° then $\frac{c}{2} \times$ difference between r and h is added to

the fraction $\frac{\pi r^2 \theta}{360}$.

Example: r = 3; $\theta = 120^\circ$; h = 1.5

$$\text{Area} = 3.1416 \times 3^2 \times \frac{120}{360} - \frac{5.196(3 - 1.5)}{2} = 5.5278 \text{ Ans.}$$

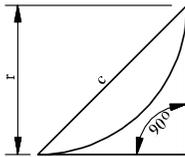
AREAS OF PLANE FIGURES**Sector**

$$\text{Area} = \frac{br}{2} = \pi r^2 \frac{\theta}{360^\circ}$$

θ = angle in degrees; b = length of arc

Example: $r = 3$; $\theta = 120^\circ$

$$\text{Area} = 3.1416 \times 3^2 \times \frac{120}{360} = 9.4248 \text{ Ans.}$$

Spandrel

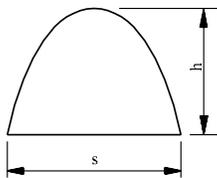
$$\text{Area} = 0.2146r^2 = 0.1073c^2$$

Example: $r = 3$

$$\text{Area} = 0.2146 \times 3^2 = 1.9314 \text{ Ans.}$$

Parabola

l = length of curved line = periphery – s



$$l = \frac{s^2}{8h} \left[\sqrt{c(1+c)} + 2.0326 \times \log(\sqrt{c} + \sqrt{1+c}) \right] \text{ where } c = \left(\frac{4h}{s} \right)^2$$

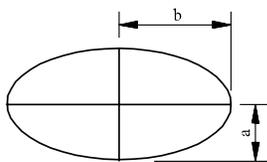
$$\text{Area} = \frac{2}{3} sh$$

Example: $s = 3$; $h = 4$

$$\text{Area} = \frac{2}{3} \times 3 \times 4 = 8 \text{ Ans.}$$

Ellipse

$$\text{Area} = \pi ab = 3.1416ab$$



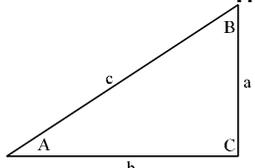
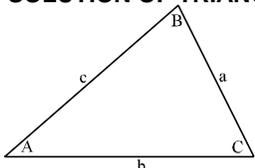
$$\text{Circum.} = 2\pi \sqrt{\frac{a^2 + b^2}{2}} \text{ (close approximation)}$$

Example. $a = 3$; $b = 4$.

$$\text{Area} = 3.1416 \times 3 \times 4 = 37.6992 \text{ Ans.}$$

$$\text{Circum.} = 2 \times 3.1416 \sqrt{\frac{(3)^2 + (4)^2}{2}} = 6.2832 \times 3.5355 = 22.21 \text{ Ans.}$$

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| TRIGONOMETRIC SOLUTION OF TRIANGLES | | |
|---|--|--|
|  |  | $S = \frac{a + b + c}{2}$ |
| Given: | Sought: | Formulae: |
| RIGHT-ANGLED TRIANGLES | | |
| a,c | A,B,b | $\sin A = \frac{a}{c}, \quad \cos B = \frac{a}{c}, \quad b = \sqrt{c^2 - a^2}$ |
| | Area | $\text{Area} = \frac{a}{2} \sqrt{c^2 - a^2}$ |
| a,b | A,B,c | $\tan A = \frac{a}{b}, \quad \tan B = \frac{b}{a}, \quad c = \sqrt{a^2 + b^2}$ |
| | Area | $\text{Area} = \frac{ab}{2}$ |
| A,a | B,b,c | $B = 90^\circ - A, \quad b = a \cot A, \quad c = \frac{a}{\sin A}$ |
| | Area | $\text{Area} = \frac{a^2 \cot A}{2}$ |
| A,b | B,a,c | $B = 90^\circ - A, \quad a = b \tan A, \quad c = \frac{b}{\cos A}$ |
| | Area | $\text{Area} = \frac{b^2 \tan A}{2}$ |
| A,c | B,a,b | $B = 90^\circ - A, \quad a = c \sin A, \quad b = c \cos A$ |
| | Area | $\text{Area} = \frac{c^2 \sin A \cos A}{2} \text{ or } \frac{c^2 \sin 2A}{4}$ |
| OBLIQUE-ANGLED TRIANGLES | | |
| a,b,c | A | $\sin \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}}, \quad \cos \frac{1}{2} A = \sqrt{\frac{s(s-2a)}{bc}}, \quad \tan \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$ |
| | B | $\sin \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{ac}}, \quad \cos \frac{1}{2} B = \sqrt{\frac{s(s-b)}{ac}}, \quad \tan \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{s(s-b)}}$ |
| | C | $\sin \frac{1}{2} C = \sqrt{\frac{(s-a)(s-b)}{ab}}, \quad \cos \frac{1}{2} C = \sqrt{\frac{s(s-c)}{ab}}, \quad \tan \frac{1}{2} C = \sqrt{\frac{(s-a)(s-b)}{s(s-c)}}$ |
| | Area | $\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$ |
| a,A,B | b,c | $b = \frac{a \sin B}{\sin A}, \quad c = \frac{a \sin C}{\sin A} = \frac{a \sin(A+B)}{\sin A}$ |
| | Area | $\text{Area} = \frac{1}{2} a b \sin C = \frac{a^2 \sin B \sin C}{2 \sin A}$ |

TRIGONOMETRIC SOLUTION OF TRIANGLES

| | | |
|--|------|--|
| a,b,A | B | $\sin B = \frac{b \sin A}{a}$ |
| | c | $c = \frac{a \sin C}{\sin A} = \frac{b \sin C}{\sin B} = \sqrt{a^2 + b^2 - 2ab \cos C}$ |
| | Area | $\text{Area} = \frac{1}{2} ab \sin C$ |
| a,b,C | A | $\tan A = \frac{a \sin C}{b - a \cos C}, \quad \tan \frac{1}{2}(A - B) = \frac{a - b}{a + b} \cot \frac{1}{2} C$ |
| | c | $c = \sqrt{a^2 + b^2 - 2ab \cos C} = \frac{a \sin C}{\sin A}$ |
| | Area | $\text{Area} = \frac{1}{2} ab \sin C$ |
| $a^2 = b^2 + c^2 - 2bc \cos A, \quad b^2 = a^2 + c^2 - 2ac \cos B, \quad c^2 = a^2 + b^2 - 2ab \cos C$ | | |

PROBABLE COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS

$$S^{28} = S^7 + 30\sqrt{S^7}$$

where: S^{28} = approximate 28 day strength.

S^7 = known 7 day strength.

For approximating strengths at other ages from known strengths at various ages the following table may be used.

| AGE (days) | PROBABLE COMPRESSIVE STRENGTH (pounds per square inch) | | | | | | | | |
|-----------------------|---|------|------|------|------|------|------|------|------|
| 100 | 1550 | 2250 | 2900 | 4150 | 4720 | 5400 | 5970 | 6560 | |
| 90 | 1500 | 2180 | 2830 | 3440 | 4050 | 4620 | 5280 | 5840 | 6430 |
| 80 | 1460 | 2110 | 2740 | 3350 | 3950 | 4510 | 5150 | 5710 | 6290 |
| 70 | 1390 | 2030 | 2640 | 3250 | 3830 | 4380 | 5000 | 5550 | 6110 |
| 60 | 1330 | 1940 | 2540 | 3120 | 3690 | 4220 | 4840 | 5370 | 5930 |
| 55 | 1290 | 1890 | 2470 | 3050 | 3610 | 4140 | 4750 | 5270 | 5820 |
| 50 | 1250 | 1840 | 2410 | 2970 | 3520 | 4050 | 4640 | 5170 | 5700 |
| 45 | 1200 | 1780 | 2330 | 2890 | 3420 | 3950 | 4520 | 5040 | 5570 |
| 40 | 1150 | 1700 | 2250 | 2790 | 3310 | 3830 | 4400 | 4910 | 5430 |
| 38 | 1130 | 1670 | 2220 | 2760 | 3280 | 3790 | 4350 | 4860 | 5380 |
| 36 | 1110 | 1640 | 2190 | 2720 | 3230 | 3740 | 4300 | 4800 | 5310 |
| 34 | 1080 | 1610 | 2140 | 2670 | 3180 | 3680 | 4220 | 4720 | 5240 |
| 32 | 1050 | 1580 | 2100 | 2620 | 3120 | 3620 | 4160 | 4650 | 5170 |
| 30 | 1030 | 1540 | 2050 | 2560 | 3060 | 3560 | 4090 | 4570 | 5090 |
| 28 | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | 5000 |
| 26 | 960 | 1450 | 1950 | 2450 | 2930 | 3410 | 3930 | 4400 | 4900 |
| 24 | 920 | 1400 | 1890 | 2380 | 2850 | 3340 | 3840 | 4300 | 4800 |
| 22 | 890 | 1350 | 1830 | 2310 | 2780 | 3250 | 3750 | 4200 | 4700 |
| 20 | 850 | 1300 | 1770 | 2240 | 2700 | 3160 | 3640 | 4100 | 4590 |
| 19 | 830 | 1270 | 1730 | 2200 | 2650 | 3110 | 3590 | 4040 | 4510 |
| 18 | 800 | 1240 | 1690 | 2150 | 2600 | 3050 | 3520 | 3980 | 4450 |
| 17 | 780 | 1200 | 1650 | 2100 | 2550 | 3000 | 3460 | 3910 | 4380 |
| 16 | 750 | 1170 | 1600 | 2050 | 2490 | 2940 | 3400 | 3830 | 4300 |
| 15 | 720 | 1130 | 1550 | 2000 | 2430 | 2870 | 3310 | 3770 | 4210 |
| 14 | 690 | 1090 | 1500 | 1950 | 2360 | 2800 | 3250 | 3690 | 4130 |
| 13 | 660 | 1050 | 1450 | 1890 | 2300 | 2740 | 3180 | 3600 | 4050 |
| 12 | 630 | 1000 | 1400 | 1820 | 2230 | 2660 | 3090 | 3500 | 3960 |
| 11 | 590 | 950 | 1350 | 1750 | 2150 | 2570 | 3000 | 3400 | 3850 |
| 10 | 550 | 900 | 1280 | 1680 | 2070 | 2490 | 2900 | 3300 | 3730 |
| 9 | 510 | 840 | 1200 | 1590 | 1980 | 2380 | 2780 | 3170 | 3600 |
| 8 | 460 | 780 | 1130 | 1500 | 1880 | 2280 | 2650 | 3050 | 3460 |
| 7 | 400 | 700 | 1040 | 1380 | 1750 | 2120 | 2500 | 2890 | 3280 |
| 6 | 340 | 600 | 920 | 1260 | 1610 | 1980 | 2340 | 2700 | 3100 |

CONVERSION TABLES

| MULTIPLY | BY | TO OBTAIN |
|-------------------|-----------|----------------------------|
| ACRES | 43560 | SQUARE FEET |
| BARRELS OF CEMENT | 376 | POUNDS OF CEMENT |
| BAGS OF CEMENT | 94 | POUNDS OF CEMENT (1 CU FT) |
| CUBIC FEET | 7.48052 | U.S. GALLONS |
| CUBIC FEET | 1728 | CUBIC INCHES |
| CUBIC FEET | 62.4 | POUNDS OF WATER |
| CUBIC INCHES | 0.0005787 | CUBIC FEET |
| CUBIC INCHES | 0.004329 | U.S. GALLONS |
| CUBIC YARDS | 27 | CUBIC FEET |
| CUBIC YARDS | 46656 | CUBIC INCHES |
| CUBIC YARDS | 201.97 | U.S. GALLONS |
| FATHOMS | 6 | FEET |
| FEET | 0.3048 | METERS |
| FEET PER SECOND | 0.68182 | MILES PER HOUR |
| METERS | 3.281 | FEET |
| METERS | 39.37 | INCHES |
| METERS | 1.094 | YARDS |
| MILES | 5280 | FEET |
| MILES PER HOUR | 88 | FEET PER MINUTE |
| MILES PER HOUR | 1.46667 | FEET PER SECOND |
| POUNDS OF WATER | 0.01602 | CUBIC FEET |
| POUNDS OF WATER | 27.68 | CUBIC INCHES |
| POUNDS OF WATER | 0.12 | U.S. GALLONS |
| SQUARE FEET | 144 | SQUARE INCHES |
| SQUARE MILES | 640 | ACRES |
| SQUARE YARDS | 9 | SQUARE FEET |
| SQUARE FEET | 0.0002066 | ACRES |
| TONS (SHORT) | 2000 | POUNDS |
| TONS (LONG) | 2240 | POUNDS |

**CONVERSION FACTORS
LENGTH MEASUREMENTS**

| UNITS | INCHES | FEET | YARDS | RODS | MILES | METERS |
|---------------|---------|----------|----------|----------|--------------|----------|
| 1 Inch | 1 | 0.08333 | 0.027778 | 0.005051 | 0.0000157828 | 0.0254 |
| 1 Foot | 12 | 1 | 0.3333 | 0.060606 | 0.00018939 | 0.304801 |
| 1 Yard | 36 | 3 | 1 | 0.181818 | 0.000568182 | 0.914402 |
| 1 Rod | 198 | 16.5 | 5.5 | 1 | 0.003125 | 5.029216 |
| 1 Mile (Stat) | 63360 | 5280 | 1760 | 320 | 1 | 1609.347 |
| 1 Meter | 39.37 | 3.280833 | 1.093611 | 0.198838 | 0.00062137 | 1 |
| 1 Link | 7.92 | 0.66 | 0.22 | 0.04 | 0.000125 | 0.201168 |
| 1 Chain | 792 | 66 | 22 | 4 | 0.0125 | 20.177 |
| 1 Station | 1200 | 100 | 33.33 | 6.060606 | 0.0189394 | 30.4801 |
| 1 Furlong | 7920 | 660 | 220 | 40 | 0.125 | 201.168 |
| 1 Mile (Naut) | 72913 | 6076.103 | 2025.366 | 368.248 | 1.15078 | 1852 |
| 1 Millimeter | 0.03937 | 0.003281 | 0.001094 | 0.000199 | -- | 0.001 |
| 1 Centimeter | 0.3937 | 0.032808 | 0.010936 | 0.001988 | -- | 0.01 |
| 1 Kilometer | -- | 3280.833 | 1093.611 | 198.836 | 0.621370 | 1000 |

**CONVERSION MEASUREMENTS
WEIGHT MEASUREMENTS**

| UNITS | OUNCES | POUNDS | TONS (SHORT) | TONS (LONG) | KILOGRAMS | TONS (METRIC) |
|-----------------------|-----------|----------|--------------|-------------|-----------|---------------|
| 1 OUNCE | 1 | 0.0625 | --- | --- | 0.028349 | --- |
| 1 POUND | 16 | 1 | 0.0005 | 0.000464 | 0.4535924 | 0.00045359 |
| 1 TON (SHORT) | 32000 | 2000 | 1 | 0.892857 | 907.18486 | 0.907185 |
| 1 TON (LONG) | 35840 | 2240 | 1.12 | 1 | 1016.047 | 1.016047 |
| 1 KILOGRAM | 35.27396 | 2.204622 | 0.0011023 | 0.0009842 | 1 | 0.001 |
| 1 TON (METRIC) | 35273.96 | 2204.62 | 1.10231 | 0.98421 | 1000 | 1 |
| 1 HNDRDWEIGHT (SHORT) | 1600 | 100 | 0.05 | 0.044643 | 45.3592 | 0.045359 |
| 1 HNDRDWEIGHT (LONG) | 1792 | 112 | 0.056 | 0.05 | 50.8023 | 0.050802 |
| 1 GRAIN | 0.0022857 | --- | --- | --- | --- | --- |
| 1 GRAM | 0.0352739 | 0.002204 | --- | --- | 0.001 | --- |
| 1 MILLIGRAM | --- | --- | --- | --- | 0.000001 | --- |

**CONVERSION FACTORS
AREA MEASUREMENTS**

| UNITS | SQUARE INCHES | SQUARE FEET | SQUARE YARDS | SQUARE RODS | ACRES | SQUARE MILES | SQUARE METERS |
|---------------------|---------------|-------------|--------------|-------------|-----------|--------------|---------------|
| 1 SQUARE INCH | 1 | 0.006944 | 0.0007716 | --- | --- | --- | 0.00064516 |
| 1 SQUARE FOOT | 144 | 1 | 0.11111 | 0.0036731 | --- | --- | 0.09290341 |
| 1 SQUARE YARD | 1296 | 9 | 1 | 0.033058 | 0.0002066 | --- | 0.8361307 |
| 1 SQUARE ROD | 39204 | 272.25 | 30.25 | 1 | 0.00625 | --- | 25.29295 |
| 1 ACRE | --- | 43560 | 4840 | 160 | 1 | 0.0015625 | 4046.873 |
| 1 SQUARE MILE | --- | --- | 3097600 | 102400 | 640 | 1 | 2589998 |
| 1 SQUARE METER | 1550 | 10.76387 | 1.195985 | 0.0395367 | 0.0002471 | --- | 1 |
| 1 SQUARE LINK | 62.7264 | 0.4356 | 0.0484 | 0.0016 | 0.00001 | --- | 0.040468 |
| 1 SQUARE CHAIN | 627264 | 4356 | 484 | 16 | 0.1 | --- | 404.689 |
| 1 SQUARE | 14400 | 100 | 11.1111 | 0.367309 | 0.0022956 | --- | 9.29034 |
| 1 SECTION | --- | --- | 3097600 | 102400 | 640 | 1 | 2589998 |
| 1 SQUARE CENTIMETER | 0.1549997 | 0.0010764 | 0.0001196 | --- | --- | --- | 0.0001 |
| 1 HECTARE | --- | 107638.7 | 11959.85 | 395.367 | 2.471044 | 0.003861 | 10000 |
| 1 SQUARE KILOMETER | --- | --- | 1195985 | 39536.7 | 247.1044 | 0.3861006 | 1000000 |

**CONVERSION FACTORS
VOLUME MEASUREMENTS**

| UNITS | CUBIC INCHES | CUBIC FEET | CUBIC YARDS | PINTS (LIQUID) | QUARTS (LIQUID) | GALLONS (U.S.) | LITERS (1000 cc) |
|------------------------|-----------------|---------------|----------------|-------------------|--------------------|-------------------|---------------------|
| 1 CUBIC INCH | 1 | 0.000579 | 0.0000214 | 0.034632 | 0.017316 | 0.004329 | 0.016387 |
| 1 CUBIC FOOT | 1728 | 1 | 0.037037 | 59.844 | 29.922 | 7.4805 | 28.31625 |
| 1 CUBIC YARD | 46656 | 27 | 1 | 1615.8 | 807.9 | 201.975 | 764.54 |
| 1 PINT (LIQUID) | 28.875 | 0.016710 | 0.000619 | 1 | 0.5 | 0.125 | 0.473168 |
| 1 QUART (LIQUID) | 57.75 | 0.033420 | 0.001238 | 2 | 1 | 0.25 | 0.946333 |
| 1 GALLON (U.S.) | 231 | 0.1336805 | 0.004951 | 8 | 4 | 1 | 3.78533 |
| 1 LITER (1000 cc) | 61.025 | 0.035316 | 0.001308 | 2.11336 | 1.056682 | 0.264178 | 1 |
| 1 GILL | 7.21876 | 0.004177 | 0.000155 | 0.25 | 0.125 | 0.03125 | 0.118292 |
| 1 PINT (DRY) | 33.6003 | 0.019445 | 0.000720 | 1.163647 | 0.581823 | 0.145456 | 0.550599 |
| 1 QUART (DRY) | 67.200625 | 0.038889 | 0.001440 | 2.32730 | 1.163646 | 0.290912 | 1.10120 |
| 1 QUART (IMPERIAL) | 69.35503 | 0.040135 | 0.001486 | 2.4019 | 1.200953 | 0.300238 | 1.13650 |
| 1 GALLON (IMPERIAL) | 277.4201 | 0.16054 | 0.0059457 | 9.60762 | 4.80381 | 1.20095 | 4.54609 |
| 1 PECK | 537.605 | 0.311114 | 0.011523 | 18.61835 | 9.309177 | 2.327294 | 8.809586 |
| 1 BUSHEL (U.S.) | 2150.42 | 1.2444 | 0.046089 | 74.47341 | 37.23670 | 9.3092 | 35.238329 |
| 1 BOARD FOOT | 144 | 0.08333 | 0.003086 | 4.987012 | 2.493506 | 0.623376 | 2.3597 |
| 1 CORD | 221184 | 128 | 4.74074 | 7660.051 | 3830.025 | 957.506 | 3624.48 |
| 1 PETROLEUM BARREL | 9701.975 | 5.614569 | 0.207947 | 336 | 168 | 42 | 158.9839 |
| 1 BARREL (U.S. LIQUID) | 7276.370 | 4.21086 | 0.15596 | 252 | 126 | 31.5 | 119.237895 |
| 1 CUBIC METER | 61023.38 | 35.314445 | 1.307943 | 2113.4 | 1056.7 | 264.178 | 999.973 |
| 1 CUBIC CENTIMETER | 0.061024 | 0.0000353 | ... | 0.002113 | 0.001057 | 0.0002642 | 0.000999 |

EQUIVALENT WEIGHTS OF AGGREGATES

| POUNDS PER CUBIC FOOT | POUNDS PER CUBIC YARD | TONS PER CUBIC YARD | CUBIC YARDS PER TON | POUNDS PER CUBIC FOOT | POUNDS PER CUBIC YARD | TONS PER CUBIC YARD | CUBIC YARDS PER TON | POUNDS PER CUBIC FOOT | POUNDS PER CUBIC YARD | TONS PER CUBIC YARD | CUBIC YARDS PER TON |
|-----------------------|-----------------------|---------------------|---------------------|-----------------------|-----------------------|---------------------|---------------------|-----------------------|-----------------------|---------------------|---------------------|
| 60 | 1620 | 0.81 | 1.23 | 94.4 | 2550 | 1.28 | 0.78 | 94.4 | 2550 | 1.28 | 0.78 |
| 65 | 1755 | 0.88 | 1.14 | 96.3 | 2600 | 1.30 | 0.77 | 96.3 | 2600 | 1.30 | 0.77 |
| 70 | 1890 | 0.95 | 1.06 | 98.1 | 2650 | 1.33 | 0.75 | 98.1 | 2650 | 1.33 | 0.75 |
| 75 | 2025 | 1.01 | 0.99 | 100.0 | 2700 | 1.35 | 0.74 | 100.0 | 2700 | 1.35 | 0.74 |
| 80 | 2160 | 1.08 | 0.93 | 101.9 | 2750 | 1.38 | 0.73 | 101.9 | 2750 | 1.38 | 0.73 |
| 85 | 2295 | 1.15 | 0.87 | 103.7 | 2800 | 1.40 | 0.71 | 103.7 | 2800 | 1.40 | 0.71 |
| 90 | 2430 | 1.22 | 0.82 | 105.6 | 2850 | 1.43 | 0.70 | 105.6 | 2850 | 1.43 | 0.70 |
| 95 | 2565 | 1.28 | 0.78 | 107.4 | 2900 | 1.45 | 0.69 | 107.4 | 2900 | 1.45 | 0.69 |
| 100 | 2700 | 1.35 | 0.74 | 109.3 | 2950 | 1.48 | 0.68 | 109.3 | 2950 | 1.48 | 0.68 |
| 105 | 2835 | 1.42 | 0.71 | 111.1 | 3000 | 1.50 | 0.67 | 111.1 | 3000 | 1.50 | 0.67 |
| 110 | 2970 | 1.49 | 0.67 | 113.0 | 3050 | 1.53 | 0.66 | 113.0 | 3050 | 1.53 | 0.66 |
| 115 | 3105 | 1.55 | 0.64 | 114.8 | 3100 | 1.55 | 0.65 | 114.8 | 3100 | 1.55 | 0.65 |
| 120 | 3240 | 1.62 | 0.62 | 116.7 | 3150 | 1.58 | 0.63 | 116.7 | 3150 | 1.58 | 0.63 |
| 125 | 3375 | 1.69 | 0.59 | 118.5 | 3200 | 1.60 | 0.63 | 118.5 | 3200 | 1.60 | 0.63 |
| 130 | 3510 | 1.76 | 0.57 | 120.4 | 3250 | 1.63 | 0.62 | 120.4 | 3250 | 1.63 | 0.62 |
| 135 | 3645 | 1.82 | 0.55 | 122.2 | 3300 | 1.65 | 0.61 | 122.2 | 3300 | 1.65 | 0.61 |
| 140 | 3780 | 1.89 | 0.53 | 124.1 | 3350 | 1.68 | 0.60 | 124.1 | 3350 | 1.68 | 0.60 |
| 66.7 | 1800 | 0.90 | 1.11 | 125.9 | 3400 | 1.70 | 0.59 | 125.9 | 3400 | 1.70 | 0.59 |
| 68.5 | 1850 | 0.93 | 1.08 | 127.8 | 3450 | 1.73 | 0.58 | 127.8 | 3450 | 1.73 | 0.58 |
| 70.4 | 1900 | 0.95 | 1.05 | 129.6 | 3500 | 1.75 | 0.57 | 129.6 | 3500 | 1.75 | 0.57 |
| 72.2 | 1950 | 0.97 | 1.03 | 131.5 | 3550 | 1.78 | 0.56 | 131.5 | 3550 | 1.78 | 0.56 |
| 74.1 | 2000 | 1.00 | 1.00 | 133.3 | 3600 | 1.80 | 0.56 | 133.3 | 3600 | 1.80 | 0.56 |
| 75.9 | 2050 | 1.03 | 0.98 | 135.2 | 3650 | 1.83 | 0.55 | 135.2 | 3650 | 1.83 | 0.55 |
| 77.8 | 2100 | 1.05 | 0.85 | 137.0 | 3700 | 1.85 | 0.54 | 137.0 | 3700 | 1.85 | 0.54 |
| 79.6 | 2150 | 1.08 | 0.93 | 138.0 | 3750 | 1.88 | 0.53 | 138.0 | 3750 | 1.88 | 0.53 |
| 81.5 | 2200 | 1.10 | 0.91 | 140.7 | 3800 | 1.90 | 0.52 | 140.7 | 3800 | 1.90 | 0.52 |
| 83.3 | 2250 | 1.13 | 0.89 | 142.6 | 3850 | 1.93 | 0.52 | 142.6 | 3850 | 1.93 | 0.52 |
| 85.2 | 2300 | 1.15 | 0.87 | 144.4 | 3900 | 1.95 | 0.51 | 144.4 | 3900 | 1.95 | 0.51 |
| 87.0 | 2350 | 1.18 | 0.85 | 146.3 | 3950 | 1.98 | 0.51 | 146.3 | 3950 | 1.98 | 0.51 |
| 88.9 | 2400 | 1.20 | 0.83 | 148.1 | 4000 | 2.0 | 0.50 | 148.1 | 4000 | 2.0 | 0.50 |
| 90.7 | 2450 | 1.23 | 0.82 | 150.0 | 4050 | 2.03 | 0.49 | 150.0 | 4050 | 2.03 | 0.49 |
| 92.6 | 2500 | 1.25 | 0.80 | | | | | | | | |

**TEMPERATURE-VOLUME CORRECTIONS
FOR EMULSIFIED ASPHALTS**

Legend: t = observed temperature in degrees Celsius
(Fahrenheit)

M = multiplier for correcting volumes to the
basis of 15.6°C (60°F)

| °C | | | °F | | | °C | | | °F | | |
|------|----|---------|------|-----|--------|------|-----|--------|----|--|----|
| t | | M* | t | | M* | t | | M* | t | | M* |
| 10.0 | 50 | 1.00250 | 35.0 | 95 | .99125 | 57.8 | 136 | .98100 | | | |
| 10.6 | 51 | 1.00225 | 35.6 | 96 | .99100 | 58.3 | 137 | .98075 | | | |
| 11.1 | 52 | 1.00200 | 36.1 | 97 | .99075 | 58.9 | 138 | .98050 | | | |
| 11.7 | 53 | 1.00175 | 36.7 | 98 | .99050 | 59.4 | 139 | .98025 | | | |
| 12.2 | 54 | 1.00150 | 37.2 | 99 | .99025 | 60.0 | 140 | .98000 | | | |
| 12.8 | 55 | 1.00125 | 37.8 | 100 | .99000 | 60.6 | 141 | .97975 | | | |
| 13.3 | 56 | 1.00100 | 38.3 | 101 | .98975 | 61.1 | 142 | .97950 | | | |
| 13.9 | 57 | 1.00075 | 38.9 | 102 | .98950 | 61.7 | 143 | .97925 | | | |
| 14.4 | 58 | 1.00050 | 39.4 | 103 | .98925 | 62.2 | 144 | .97900 | | | |
| 15.0 | 59 | 1.00025 | 40.0 | 104 | .98900 | 62.8 | 145 | .97875 | | | |
| 15.6 | 60 | 1.00000 | 40.6 | 105 | .98875 | 63.3 | 146 | .97850 | | | |
| 16.1 | 61 | .99975 | 41.1 | 106 | .98850 | 63.9 | 147 | .97825 | | | |
| 16.7 | 62 | .99950 | 41.7 | 107 | .98825 | 64.4 | 148 | .97800 | | | |
| 17.2 | 63 | .99925 | 42.2 | 108 | .98800 | 65.0 | 149 | .97775 | | | |
| 17.8 | 64 | .99900 | 42.8 | 109 | .98775 | 65.6 | 150 | .97750 | | | |
| 18.3 | 65 | .99875 | 43.3 | 110 | .98750 | 66.1 | 151 | .97725 | | | |
| 18.9 | 66 | .99850 | 43.9 | 111 | .98725 | 66.7 | 152 | .97700 | | | |
| 19.4 | 67 | .99825 | 44.4 | 112 | .98700 | 67.2 | 153 | .97675 | | | |
| 20.0 | 68 | .99800 | 45.0 | 113 | .98675 | 67.8 | 154 | .97650 | | | |
| 20.6 | 69 | .99775 | 45.6 | 114 | .98650 | 68.3 | 155 | .97625 | | | |
| 21.1 | 70 | .99750 | 46.1 | 115 | .98625 | 68.9 | 156 | .97600 | | | |
| 21.7 | 71 | .99725 | 46.7 | 116 | .98600 | 69.4 | 157 | .97575 | | | |
| 22.2 | 72 | .99700 | 47.2 | 117 | .98575 | 70.0 | 158 | .97550 | | | |
| 22.8 | 73 | .99675 | 47.8 | 118 | .98550 | 70.6 | 159 | .97525 | | | |
| 23.3 | 74 | .99650 | 48.3 | 119 | .98525 | 71.1 | 160 | .97500 | | | |
| 23.9 | 75 | .99625 | 48.9 | 120 | .98500 | 71.7 | 161 | .97475 | | | |
| 24.4 | 76 | .99600 | 49.4 | 121 | .98475 | 72.2 | 162 | .97450 | | | |
| 25.0 | 77 | .99575 | 50.0 | 122 | .98450 | 72.8 | 163 | .97425 | | | |
| 25.6 | 78 | .99550 | 50.6 | 123 | .98425 | 73.3 | 164 | .97400 | | | |
| 26.1 | 79 | .99525 | 51.1 | 124 | .98400 | 73.9 | 165 | .97375 | | | |
| 26.7 | 80 | .99500 | 51.7 | 125 | .98375 | 74.4 | 166 | .97350 | | | |
| 27.2 | 81 | .99475 | 52.2 | 126 | .98350 | 75.0 | 167 | .97325 | | | |
| 27.8 | 82 | .99450 | 52.8 | 127 | .98325 | 75.6 | 168 | .97300 | | | |
| 28.3 | 83 | .99425 | 53.3 | 128 | .98300 | 76.1 | 169 | .97275 | | | |
| 28.9 | 84 | .99400 | 53.9 | 129 | .98275 | 76.7 | 170 | .97250 | | | |
| 29.4 | 85 | .99375 | 54.4 | 130 | .98250 | 77.2 | 171 | .97225 | | | |
| 30.0 | 86 | .99350 | 55.0 | 131 | .98225 | 77.8 | 172 | .97200 | | | |
| 30.6 | 87 | .99325 | 55.6 | 132 | .98200 | 78.3 | 173 | .97175 | | | |
| 31.1 | 88 | .99300 | 56.1 | 133 | .98175 | 78.9 | 174 | .97150 | | | |
| 31.7 | 89 | .99275 | 56.7 | 134 | .98150 | 79.4 | 175 | .97125 | | | |
| 32.2 | 90 | .99250 | 57.2 | 135 | .98125 | | | | | | |
| 32.8 | 91 | .99225 | | | | | | | | | |
| 33.3 | 92 | .99200 | | | | | | | | | |
| 33.9 | 93 | .99175 | | | | | | | | | |
| 34.4 | 94 | .99150 | | | | | | | | | |

*Multiplier (M) for °C is a close approximation.