



American Institute of Timber Construction

7012 South Revere Parkway • Suite 140 • Centennial, CO 80112

Phone: 303/792-9559 Fax: 303/792-0669

AITC 406-2005

STANDARD FOR PROOF-GRADED LUMBER FOR GLUED LAMINATED TIMBER

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406.1. SCOPE

This standard covers procedures to be used in developing grades of lumber for laminating through the process of proof loading.

406.2. INTRODUCTION

Proof grading is a process of loading the full length of each piece of a candidate grade of lumber in tension to a stress level that can fail some portion of the lower strength members of the population tested. The stress level is selected to provide the desired strength performance in the surviving pieces. This standard provides a method for qualifying a proof grade process for solid sawn lumber and for maintaining the process by subsequent quality control. The survivors of the proof grade process are suitable for use as laminating grades. Qualification and quality control are carried out by means of tension tests of full-size laminating lumber under qualified supervision. This standard is composed of six essential elements: the grade description; the selection of the target levels of performance; the selection of the proof-load level; the qualification test; quality control; and supervision.

406.2.1 This standard is for solid sawn lumber. If the standard is to be applied to laminations containing end joints, the provisions of AITC T121 shall be met and the more restrictive standard shall govern.

406.2.2 This standard shall apply only to lumber that has been proof loaded for its entire length; i.e., except for the ends of the piece in the tension grips, the entire piece is subject to the proof load.

406.3. GRADE DESCRIPTION

The grade of lumber to be qualified by test shall be described in a manner permitting the grade to be reproduced by qualified personnel.

406.3.1 Existing Grades. If the grade to be qualified is an existing ALS or AITC grade, this grade description shall be followed with no exceptions, and the grading shall be verified and supervised in accordance with the appropriate authority (grading supervision meeting ANSI/AITC A190.1 provisions. Records of this compliance shall be maintained.

406.3.2 New Grades. If the grade to be qualified is not an existing ALS or AITC grade, the characteristics of the grade affecting strength shall be described using the terminology of AITC 200. The adequacy of the description shall meet the requirements of the supervisory inspection agency. The grade description shall be followed with no exceptions, and the grading shall be verified and supervised in accordance with the appropriate authority (grading supervision meeting ANSI/AITC A 190.1 provisions). Records of this compliance shall be maintained.

406.3.3 Grades Including "And Better" in the Grade Description. Grades which include "and better" in the grade description, such as "L₁ and Better" and are described and sampled as "and better" grades are required to be maintained as an "and better" grade during production (i.e., no higher grade is removed from above the grade as described unless qualification is repeated). Grades likely to be removed according to market conditions (e.g. clears) shall be removed for qualification.

406.3.4 End-of-piece Rules. All grades shall include grading requirements for the ends of the piece that are within the tension machine grips and, therefore, not subject to the full tensile load. The intent of this requirement is to ensure the piece quality at the unstressed ends approximates the quality in the area subjected to the tensile load. If the piece grade already exists (such as in 406.3.1 above), and contains an end-of-the-piece rule, the rule to be applied to the proof-graded ends shall be consistent with, or complimentary to, the existing rule. If a new piece grade has been developed (such as in 406.3.2), the end-of-the-piece rule applied shall consider the general quality permitted in the grade, emphasizing knot size, knot location, and slope-of-grain and their effects on the strength of the untested area.

406.4. SELECTION OF THE QUALIFICATION TARGET LEVELS

The mechanical property performance targets for the candidate grade shall be the tensile strength and long span average E levels specified in AITC 407 for the grades to be substituted for by the proof-graded lumber.

406.4.1 Tensile Strength Levels. The tensile strength levels shall be interpreted for the purpose of this Standard as the nonparametric 5% tolerance limit with 75% confidence, using a minimum sample size of 102 on-grade specimens. The long span average E of the qualifying sample shall equal or exceed the design long span E of the grade.

406.5. SELECTION OF THE PROOF TEST LEVEL

The proof test level selection is an empirical process supplemented where possible by data previously obtained on the tensile strength distribution of the candidate grade. The proof load level is correct when the survivors of that proof test can be shown to have a 5% tolerance limit with 75% confidence equal to or exceeding the target qualifying strength level described in 406.4.

406.5.1 It is recommended that preliminary tests be run before the qualifying step in order to aid in selecting the proof test level. These trial tests may be a destructive test of an entire sample of the candidate grade or may be proof tested at a level sufficient to break a large portion of the lower tail (e.g. 20%). With the destructive test data, an estimate may be made of the appropriate proof test level for production.

406.5.2 It should be remembered that any sample is intended to represent the entire population of the candidate grade; but, in fact, the sample is only an estimate. Likewise, the proof test level chosen on the basis of the trial run is only an estimate of the "correct" proof load for production.

- (a) Example 1: A new grade is proposed as the candidate for proof tested 2x8. The grading parameters are carefully defined and confirmed as operable by the supervisory agency. A 5% tolerance limit with 75% confidence of 3600 psi is required by AITC for the target performance level in the survivors of the proof test process. It is decided to estimate the necessary proof test level by breaking the lower 20% of a sample of 200 pieces of the "new" candidate grade. To be sure that the 20th percentile is identified, the Warren-Glick procedure described in AITC Test T123 is used as a guide. When completed, all of the weakest 20% of the pieces (and others as well) have been broken and ranked by the breaking level. The proof test level necessary for production is estimated so that the residual of the candidate grade (those passing the proof test) have a 5% tolerance limit with 75% confidence of 3600 psi. [Note: If few pieces failed below 3600, it may be difficult to estimate the production proof level and additional testing may be desirable.]
- (b) Example 2: A 5% tolerance limit with 75% confidence of 3750 psi is required by AITC as the target performance level in 2x10 survivors of the proof test process. L1 2x10 is chosen as the target population. It is decided to estimate the production proof test level from all of the 2x10 specimens with tensile strengths less than 4000 psi, using a sample of 170. Consequently, all 170 specimens are proof tested in tension to 4000 psi. When completed, all of the broken specimens are ranked by breaking strength. The proof test level for qualification is estimated using this data.

406.6. QUALIFICATION TEST

AITC Test T123 shall be followed to establish tensile strength qualification. Long span E shall be measured following methods of AITC Test T116.

406.6.1 Sample Size. Select a sample of sufficient size to assure at least 102 survivors after proof loading to the preselected level. If the number of survivors is less than 102, the qualification sample will have to be repeated.

406.6.2 Proof level. Proof load the samples to the selected level.

406.6.3 AITC Test T116. Conduct AITC Test T116 on the survivors of the proof load. The mean long span E of the survivors must not be significantly lower than the design long span E by the criteria stated in 406.3.

406.6.4 AITC Test T123. Conduct AITC Test T123 on the survivors to determine the 5% tolerance limit with 75% confidence.

406.6.5 Conclusions. If the results of T116 and T123 substantiate the target long span E and tensile strength performance levels, the qualification test is successfully completed. If not, the test shall be repeated with a new sample and a newly selected proof level.

406.7. QUALITY CONTROL

Once qualification is achieved, a continuous quality control system employing full-size tensile tests shall be developed before production is initiated. This QC program shall be applied to the survivors of the production proof grading system on a regular basis during each operating period. Accepted QC methodology shall be employed to demonstrate on a continuing basis that the survivors of the production proof load meet the qualification performance targets.

406.8. SUPERVISION

The proof grading process shall be under the supervision of an accredited inspection agency meeting the requirements of ANSI/AITC A190.1.

406.8.1 A QC manual shall be prepared for the qualifying production facility. This manual shall contain the following minimum items:

- (a) The grade description and specification of the candidate lumber.
- (b) The name and assigned personnel of the supervisory inspection agency.
- (c) Sampling and testing procedures for the QC program:
 - Sample selection
 - Sampling frequency
 - Test procedure
 - Test analysis
- (d) Compliance procedures and related actions.
- (e) The manual shall have the approval of the testing agency.

406.8.2 Quality control records shall be maintained as required by the accredited inspection agency and the plant quality manual. Records shall be made available to the laminator's accredited inspection agency upon request.