

## ANNEX E

### AITC 405-92

#### STANDARD FOR STANDARD FOR NEW WET-USE STRUCTURAL

#### ADHESIVE TYPES

##### E-1. SCOPE

These tests are designed to evaluate new adhesive types-- adhesives with little or no in-service performance record--for use in the glued laminated timber industry for face bonding applications. Adequacy of the new adhesive is established by demonstrating it is equivalent in performance to phenol resorcinol formaldehyde (PRF) type adhesives that have been used successfully in the glulam industry.

##### E-2. GENERAL PROVISIONS

**E-2.1** The new adhesive will receive an initial plant use approval by the Inspection Bureau upon completion of the "Screening Tests" (See E-3) and the in-plant tests required by ANSI/AITC A190.1-1992 (See E-3.4). The action will be reported to the AITC Technical Review Board for review.

**E-2.2** In addition to the initial screening tests, where the new adhesive is intended for use in structural applications, the continuing long-term performance of the new adhesive must be reviewed by the Technical Review Board at the end of the three year test period described in Section E-3. If these test results are judged to be satisfactory, the new adhesive will be considered equivalent in performance to phenol resorcinol formaldehyde adhesives that have been used successfully in the glued laminated timber industry.

##### E-3. SCREENING TESTS

Prior to initial acceptance of any new adhesive type it shall perform satisfactorily in the following screening tests:

**E-3.1 ASTM\* D 2559-84**--"Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet-Use) Exposure Conditions:"

- (a) Include 2 species: Douglas Fir and Southern Pine.
- (b) Include 2 preservative treatments: One pentachloro-phenol and arsenical type.

**E-3.2 ASTM D 3434-84**--"Standard Practice for Multiple-Cycle Accelerated Aging Test (Automatic Boil Test) for Wet-Use Wood Adhesives"--Strength retention results after 800 cycles shall be compared to the PRF controls.

**E-3.3 ASTM D 4299-83**--"Standard Test Method for Effect of Bacterial Contamination on Permanence of Adhesive Preparations and Adhesive Films."

**E-3.4 ASTM D4300-88**--"Standard Test Method for Effect of Mold Contamination on Permanence of Adhesive Preparations and Adhesive Bonds."

**E-3.5 Heat Durability Test.** American Plywood Association "Heat Durability Test," (U.S. Product Standard PS 1-83, Section 4.5.4) shall be followed using a specimen made up from 5 plies of 1/8 in. heartwood Douglas Fir or Southern Pine veneer (in a crossbanded configuration) and the adhesive to be tested. The specimen layup must be assembled and cured following the adhesive manufacturer's recommendation.

Excerpt from PS1-83 (see Figure E-1 for test setup):

"Heat durability test--A specimen...shall be placed on a stand as illustrated in figure...A specimen shall then be subjected to a 1,472o to 1,652o flame from a Bunsen-type burner for a period of 10 minutes, or until a brown charred area appears on the back side, whichever occurs first. The burner impinges the entire width of the specimen in flame. The top of the burner shall be 1 inch from the specimen face and the flame 1-1/2 inches high. The flame shall impinge on the face of the specimen 2 inches from the bottom end. After the test, the sample shall be removed from the stand and the glue lines examined for delamination by separating the charred plies with a sharp chisel-like instrument..."

Any sign of glue line degradation shall be described in the report for this test, and forwarded to the AITC Inspection Bureau for review.

\*American Society for Testing and Materials

**E-3.6 Plant Evaluation.** Following completion of the prescribed screening tests, the adhesive shall meet the following in-plant test requirements:

**E-3.6.1** All conditions of ANSI/AITC A190.1-1992 for wet-use adhesive qualification (face bonding).

**E-3.6.2** All AITC in-plant qualification tests as described in AITC 200-92.

#### **E-4. FULL SCALE BEAM EXPOSURE TESTS**

The full scale beam exposure tests are run on beams manufactured from one species, not treated. The beams shall be manufactured in conformance with layup requirements specified in AITC 117-93--MANUFACTURING in accordance with ASTM-AITC A190.1-1992.

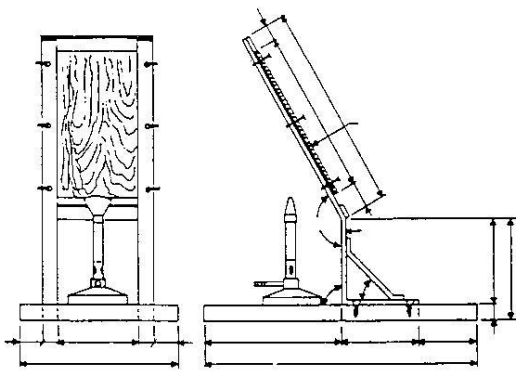


Figure E-1

Test beams manufactured with both the new adhesive and a PRF type adhesives are exposed to both carefully controlled test chamber conditions and also outdoor conditions. To serve as controls, the PRF beams are grouped with beams manufactured using the new adhesive in both the test chamber and outdoor exposure phases of the testing. Original properties are established by a separate group of beams which are not exposed.

##### **E-4.1 Test Methods**

**E-4.1.1 Test Beam Requirements.** Manufacture 70 beams (nominal size: span to depth ratio not to exceed 8:1\* - using 1x4 laminations) in an accredited plant using production equipment and gluing procedures recommended by the adhesive manufacturers; 40 beams are made with new

adhesive, 30 beams are made with presently approved PRF adhesive. End cuts from all beams shall be evaluated by AITC Tests T107 and T110 prior to installation of the beams into the test frames.

\*Where third point loading is used, design shear stresses will be approached at span to depth ratios in the 5.1 range. The test method described in this standard is based on members sized to be controlled in bending.

##### **E-4.1.2 Exposure Conditions.**

- (a) Test chamber conditions shall maintain 80% RH ( $\pm 3\%$ , and 140o ( $\pm 5\text{oF}$ ) for two weeks followed by ambient room conditions for two weeks in alternating cycles.
- (b) Full outdoor exposure shall take place in an area where climatic conditions include at least one month of sub-freezing weather. During months when the average daytime temperature is above 50o F, the test beams shall be sprinkled for 2-4 hour periods per week during dry periods.

**E-4.1.3 Long Term Loading.** Long term loading for exposure conditions described in E-4.1.2 (a) and (b) shall be as follows:

- (a) The beams are placed on a test frame that permits a constant two point loading to be applied. Loading may be applied from dead loads at the third points, or transferred through pulleys at ends of the members. (See Figure E-2).
- (b) Fifty percent of the beams in each category are loaded at 1.5 x design bending stress level (wet-use). Fifty percent of the beams are not stressed. Duration of test: 1 and 3 years.

##### **E-4.1.4 Ultimate Strength Tests.**

- (a) The beams set aside to determine original properties shall be tested to failure by procedures described in ASTM D 198-94.
- (b) Following completion of the one and 3 year test periods, the beams shall be tested to failure in accordance with ASTM D 198-84.

##### **E-4.2 Measurements and Observations.**

- (a) Load deformation measurements are made on all stressed beams for each condition; begin measurements daily, decrease to weekly, then monthly

as stabilization occurs. After one year, quarterly measurements will suffice.

- (b) MOE calculations are made at quarterly intervals.
- (c) Visual observations of a deeply scribed line placed vertically near an end of the beam, or squarely cut end, shall be employed to detect displacement of laminations if it occurs.
- (d) MOR measurements are made at the end of the assigned period.
- (e) Inspection of all exposed beams for signs of delamination or failure shall be made with a frequency as in (a) above.

**E-5. GLUE LINE DURABILITY TESTS ON EXPOSED BEAMS**

**E-5.1** AITC Test T107 and T110 are made on end sections of 4 of the unstressed beams (3 new adhesive, one control) on an annual basis. Delamination samples must be chiseled open for a more thorough analysis.

**E-5.2** All original test beams and the one year series should be subjected to AITC Tests (T107 and T110) after completion of the full scale bending tests.

**E-6. EVALUATION OF RESULTS ON EXPOSED BEAMS**

Performance of the new adhesive is evaluated by comparison with the performance of PRF adhesives exposed to the same test conditions. Both physical test results and qualitative observations are to be considered.

**E-6.1 Physical Test Results**--The pass/fail test criteria established for AITC Tests T107 and T110 as described in AITC 200-92 shall apply. Intermediate MOE values on test beams shall be compared to corresponding measurements on the controls. Average MOR values for the test beams shall be compared to control beam results.

Scribe line displacement at individual glue lines in the test beams shall not exceed the amount observed in the PRF control beams.

**E-6.2 Qualitative Observations:** All visual evaluations shall be related to appraisal of glue line quality. Instances of glue line failure in the test beams should be noted using a 0.006 in. thick, flat metal "feeler gage" where possible to probe openings. Overall observations as to the frequency of occurrence and severity of delamination shall be noted for comparison with control members.

**Table1. The test beams shall be grouped for testing in the following manner:**

	Initial Grouping		One Year Exposure		Three Years Exposure	
	Test	Control	Test	Control	Test	Control
Original Properties (Base Line)	8	6	--	--	--	--
Test Chamber:	16	12	8	6	8	6
Stressed	--	--	4	3	4	3
Unstressed	--	--	4	3	4	3
Outdoor Exposure:	16	12	8	6	8	6
Stressed	--	--	4	3	4	3
Unstressed	--	--	4	3	4	3

Figure E-2

