



TSI TECHNICAL NOTE 80581

THERMO-LAG 330 CONFORMABLE STRESS SKIN

THREE HOUR FIRE WALL SYSTEM

APPLICATION PROCEDURES

FEBRUARY 1982

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THREE HOUR FIRE WALL SYSTEM

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1.0 INTRODUCTION

This procedure sets forth the sequential steps involved in applying the THERMO-LAG 330 Conformable Stress Skin Three Hour Fire Wall System to fire walls.

The THERMO-LAG 330 Conformable Stress Skin Three Hour Fire Wall System consists of THERMO-LAG 330-1 Subliming Coating, THERMO-LAG Stress Skin Type 330-69 and THERMO-LAG 351 Series Primer.

2.0 PRE-APPLICATION PRACTICES

2.1 Qualification of Contractor

The application shall be performed by a qualified contractor who has had prior training in applying the materials and who has the equipment required to perform the application.

2.2 Safety Precautions

The contractor shall follow standard industrial safety practices established for the handling of chemical coatings and shall conform to applicable OSHA and owner safety rules in all respects.

2.3 Delivery

The coating materials shall be delivered to the jobsite in originally sealed containers which show the product name, batch or lot number, color, name of the manufacturer and the expiration date.

2.4 Storage

The coating materials shall be stored off the ground when not in use in an area provided for that purpose. The materials in storage shall be protected against freezing and from temperatures above 100°F.

2.5 Temperature and Precipitation

The coating materials shall be applied only to dry surfaces. The temperature of the coating material and surfaces to be coated shall be above 40°F during the material application and curing periods. The contractor shall furnish and install any protective covers required to protect the newly applied coating from rainfall, hard freeze or contaminants during its initial curing period.

2.6 Protection of Adjacent Surfaces

The contractor shall make off or otherwise protect all adjacent areas and "in place equipment" from receiving any material overspray during the coating application. Any spilled material and overspray shall be removed promptly using water wet rags or sponges before the material has dried.

3.0 EXPANDED METAL OR OTHER STEEL SUPPORT MATERIAL SURFACE PREPARATION

- 3.1 Prepare the surface on both sides of the expanded metal or other steel support material for application of the THERMO-LAG 351 Primer by removing any dirt, scale, rust or other contaminants. Never apply the primer directly over any hard or glossy painted surfaces without roughening the surface in accordance with standard painting practices.

Make sure that the surfaces on both sides of the cleaned expanded metal or other steel support material are compatible with the THERMO-LAG 330-1 Subliming Coating by making cross hatch adhesion tests. Always apply a barrier coat of THERMO-LAG 351 Primer over steel surfaces which have been previously primed with a zinc based primer. All doubtful painted surfaces should be removed using mechanical methods.

- 3.2 Apply the THERMO-LAG 351 Primer to both sides of the properly prepared expanded metal or other steel support material using spray equipment or a roller. The minimum acceptable dry primer thickness shall be 0.002 inches, which is normally achieved by applying at a spread rate of circa 200 sq. ft. per gallon.



- 3.3 Measure primer thickness using an approved direct reading gauge.
- 3.4 Make cross hatch adhesion tests, as per Federal Standard 141a, on the primed surface on each side of the expanded metal or other steel support material to assure proper adhesion between the primer and the steel surface exists - prior to proceeding with the application of the THERMO-LAG 330-1 Subliming Coating.
- 3.5 Make at least one cross hatch adhesion test every 100 square feet of primed steel surface area. Any primed surface area which fails the cross hatch adhesion test shall be removed using mechanical cleaning methods and shall be reprimed with THERMO-LAG 351 Primer.
- 3.6 Surfaces are ready to receive the application of the THERMO-LAG 330-1 Subliming Coating after successful cross hatch adhesion tests have been established.

4.0 APPLICATION OF THERMO-LAG 330-1 SUBLIMING COATING AND THERMO-LAG STRESS SKIN TYPE 330-69

- 4.1 Coat both primed sides of the expanded metal or other steel support material with THERMO-LAG 330-1 Subliming Coating. Use absorbent material such as plywood or particle board as a backing for the expanded metal when spraying the first side of the expanded metal. The coating shall be applied in accordance with instructions given in Section 4.0, Paragraph 4.1.1 through 4.1.6 of TSI's Technical Note 80181 - Revision II - dated December 1981, shown herein as Appendix A.
- 4.2 Apply THERMO-LAG Stress Skin Type 330-69 to the wet surfaces on each side after the final pass and use a roller to flatten out any wrinkles and to embed the Stress Skin securely. Then apply sufficient THERMO-LAG 330-1 Subliming Coating to cover the embedded THERMO-LAG Stress Skin.

OR WHEN COATING PRIOR TO MOUNTING

- 4.3 Cut four identical sections of THERMO-LAG Stress Skin large enough to comprise a portion of the fire wall.
- 4.4 Coat two sections of the THERMO-LAG Stress Skin with THERMO-LAG 330-1 Subliming Coating. The coating shall be applied in accordance with instructions given in Section 4.0, Paragraph 4.1.1 through 4.1.6 of TSI's Technical Note 80181 - Revision II - dated December 1981, shown herein as Appendix A.

- 4.5 Apply one of the previously cut sections of Stress Skin to each of the two coated sections after the first pass with THERMO-LAG 330-1 Subliming Coating. Use a roller to flatten out any wrinkles and to embed the Stress Skin securely.
- 4.6 Mount the two sections of coated Stress Skin on the expanded metal or other steel support material using #10 bolts, washers and nuts. The holes and counterbore for the #10 bolt assemblies are to be drilled on 12 inch centers with the two coated sections being held in place.
- 4.7 Apply sufficient amounts of THERMO-LAG 330-1 Subliming Coating to fill the counterbore holes and to cover the embedded Stress Skin.

OR AS AN ACCEPTABLE OPTION

- 4.8 Cut four identical sections of Stress Skin together with an identical section of expanded metal large enough to mount on the installed rectangular steel tubing or other structural steel entities.
- 4.9 Fasten one section of Stress Skin to each side of the expanded metal section using mechanical fasteners.
- 4.10 Coat both attached Stress Skin sections with THERMO-LAG 330-1 Subliming Coating. The coating shall be applied in accordance with instructions given in Section 4.0, Paragraph 4.1.1 through 4.1.6 of TSI's Technical Note 80181 - Revision II, dated December 1981 and shown herein as Appendix A.
- 4.11 Apply one of the previously cut sections of Stress Skin to each of the two coated sections after the final pass of THERMO-LAG 330-1 Subliming Coating. Use a roller to flatten out any wrinkles and to embed the Stress Skin securely.
- 4.12 Mount the coated section on the rectangular steel tubing or other structural steel entities using long bolts, washers and nuts.
- 4.13 Apply sufficient amounts of THERMO-LAG 330-1 Subliming Coating to cover the bolt heads and the rectangular steel tubing or other structural steel entities.

5.0 POST APPLICATION PRACTICES

5.1 A clean and orderly condition shall be maintained in the application area. Following the application, all overspray, debris and equipment shall be removed and the area left in a condition acceptable to the owner.

6.0 EQUIPMENT SUGGESTIONS

6.1 The most economical and satisfactory method of applying THERMO-LAG 330-1 Subliming Material is by either airless or air type spray equipment.

6.2 Suggested complement of spray equipment for both types are shown in Appendix B to this procedure.

6.3 A schematic of Suggested Penetrating Measuring Devices is shown in Appendix C to this procedure.

TSI

APPENDIX A

TSI'S TECHNICAL NOTE 80181 - REVISION II - DATED DECEMBER 1981

SECTION 4.0

COATING APPLICATION TECHNIQUES

4.0 COATING APPLICATION TECHNIQUES

4.1 Spray Application

- 4.1.1 Apply the THERMO-LAG 330-1 Subliming Coating over a properly prepared surface. Make sure that the surface to be coated is clean, dry, above 40°F and free from scale, rust or other contaminants.
- 4.1.2 Apply the material in as many passes as required to provide the required film build of the coating thickness, taking care to avoid slumping or sagging of the coating. Normally, a required 0.500 inch dry coating thickness is accomplished by applying three wet coats of 0.225 inches. However, the thickness which can be safely applied in a single pass will depend on the temperature, humidity and other factors that are best determined on the job site.
- 4.1.3 Apply the material in smooth even passes, taking care to keep the spray gun fan pattern at a 90° angle whenever possible. Reaching with a spray gun will cause the spray pattern to vary from the 90° angle and will result in a rougher surface than normal.
- 4.1.4 Take frequent wet thickness measurements during the application using a penetration measuring device such as shown in Appendix A to ensure that the coating is being applied uniformly and at the required wet film thickness. These wet thickness checks shall be made every five square feet or every two running feet of coated surface area.
(Note: When taking measurements allow for a shrinkage rate of circa 25% between the wet and the desired dry film coating thickness.)
- 4.1.5 Remove excess build up of coating material at edges and joints by brushing or rolling the surface with a damp sponge roller.
- 4.1.6 Spray edges of the substrate from each side to cause the material to wrap around the edge. If the edge coating is not completed closed, use a wet roller or trowel to seal the edge surface.
- 4.1.7 Apply Fiberglass Armoring to the wet surface after the final pass and use a roller to flatten out any wrinkles and to embed the fiberglass securely. Then apply sufficient material to cover the embedded fiberglass.
- 4.1.8 Remove all runs, sags, drips or other surface imperfections before the material cures using wet sponge rollers, brushes or hand trowels.



4.2 Hand Application

- 4.2.1 Trowel the material to a uniform thickness using moderate pressure and avoid overworking. The trowel should be wetted with water when a smooth finish is required.
- 4.2.2 Glove the material to cables and small pipes using standard work gloves. Work small areas and keep the gloves wet to insure a relatively uniform thickness.

4.3 Dry Film Thickness Measurements

- 4.3.1 Take dry film thickness measurements after the applied material has cured. Measurements shall be made using electrical, penetrating or magnetic measuring instruments.

4.4 Repair Procedures - Damage

- 4.4.1 Removed damaged and loose material using a knife and scraper. Cut back until sound adhering material is reached.
- 4.4.2 The edge should be undercut to form a beveled edge as in plaster repair.
- 4.4.3 Remove all foreign matter from the substrate using a wire brush.
- 4.4.4 Spray or trowel THERMO-LAG 330-1 onto patch area. Several coats of the material can be applied to achieve the desired film thickness. Be sure to allow for shrinkage of repair patch by building up a slight dome shape with the patch.

REVISION II

9.0 DIRECT SPRAY OVER EXPANDED METAL THREE HOUR FIRE WALL DESIGN

Installation of the Direct Spray over Stress Skin Three Hour Design to form a Fire Wall involves coating both sides of the expanded metal or other steel support material with THERMO-LAG 330-1 Subliming Material - Spray Grade, and then applying THERMO-LAG Stress Skin Type 330-69 to the wet surfaces on each side. The sequential steps involved in installing this fire barrier design on the fire wall support material are described in the following paragraphs.

9.1 Installation of Three Hour Fire Barrier Design

- 9.1.1 Attach the expanded metal to the structural steel framing in those cases where expanded metal is required.
 - 9.1.2 Prepare the surface on both sides of the expanded metal or other steel support material for application of the THERMO-LAG 351-2 Primer by removing any dirt, scale, rust or other contaminants. Never apply the primer directly over any hard or glossy painted surfaces without roughening the surface in accordance with standard painting practices.
 - 9.1.3 Apply the THERMO-LAG 351-2 Primer to both sides of the properly prepared expanded metal or other steel support material using spray equipment or a roller. The Primer shall be applied in accordance with instructions given in Paragraph 12.0 herein.
 - 9.1.4 Coat both primed sides of the expanded metal or other steel support material with THERMO-LAG 330-1 Subliming Material - Spray Grade. The coating shall be applied in accordance with instructions given in Paragraph 12.0 herein.
- Apply THERMO-LAG Stress Skin Type 330-69 to the wet surfaces on each side after the final pass and use a roller to flatten out any wrinkles and to embed the Stress Skin securely. Then apply sufficient THERMO-LAG 330-1 Subliming Material - Spray Grade, to cover the embedded THERMO-LAG Stress Skin.

OR WHEN COATING PRIOR TO MOUNTING

- 9.1.5 Cut two identical sections of THERMO-LAG Stress Skin large enough to comprise a portion of the fire wall.
- 9.1.6 Coat two sections of the THERMO-LAG Stress Skin with THERMO-LAG 330-1 Subliming Material - Spray Grade, in the required dry film coating thickness of 0.625" +/- 0.125". The material shall be applied in accordance with instruction given in Paragraph 12.0 herein.
- 9.1.7 Mount the two sections of coated Stress Skin on the expanded metal or other steel support material using approved #10 bolts, washers and nuts. The holes and counterbore for the approved #10 bolt assemblies are to be drilled on 12 inch centers with the two coated sections being held in place.
- 9.1.8 Apply sufficient amounts of THERMO-LAG 330-1 Subliming Material - Spray Grade, in the required dry film thickness to fill the counterbore holes.

OR AS AN ACCEPTABLE OPTION

- 9.1.9 Cut two identical sections of Stress Skin together with an identical section of expanded metal large enough to mount on the installed rectangular steel tubing or other structural steel entities.
- 9.1.10 Coating the expanded metal with a dry film thickness of 0.625" +/- 0.125" of the THERMO-LAG 330-1 Subliming Material - Spray Grade. The coating shall be applied in accordance with instructions given in Paragraph 12.0 herein.

- 9.1.1 Apply one of the previously cut sections of Stress Skin to each of the two coated sections after the final pass of THERMO-LAG 330-1 Subliming Material - Spray Grade. Use a roller to flatten out any wrinkles and to embed the Stress Skin securely.
- 9.1.2 Mount the coated section on the rectangular steel tubing or other structural steel entity using approved long bolts, washers and nuts.
- 9.1.3 Apply sufficient amounts of the THERMO-LAG 330-1 Subliming Material - Spray Grade to cover the bolt heads.



12.0 COATING APPLICATION TECHNIQUES

12.1 THERMO-LAG 351 Primer Application

- 12.1.1 Prepare the surface of the steel entity for application of the THERMO-LAG 351 Type Primer by removing any dirt, scale, rust or other contaminants. Never apply the primer directly over any hard or glossy painted surface without roughening the surface in accordance with standard painting practices.
- 12.1.2 Make sure that the cleaned steel surface is compatible with the THERMO-LAG 330-1 Subliming Material by making cross hatch adhesion tests as follows:

.Cross Hatch Adhesion Test.

The primer is cut over an area approximately 4" by 4" in a square matrix, each square being approximately 1/2" by 1/2". A high quality tape is applied diagonally to the square. Upon completion of the tape application, it is rubbed in firmly to assure good adhesion. With one complete jerking motion, the tape is removed. If more than 3 percent of the Primer is removed from the surface, the application is faulty. This test should be performed in areas which are deemed critical and in as many places as required by the specification. Upon completion of the Cross Hatch Adhesion Test, the test areas should be again with the THERMO-LAG 351-2 Primer by either brushing or light spray.



Always apply a barrier coat of THERMO-LAG 351 Type Primer over steel surfaces which have been previously primed with a zinc based primer. All doubtful surfaces should be removed using mechanical cleaning methods.

- 12.1.3 Apply the Primer to the properly prepared steel surface in one continuous coat using spray equipment or a roller. The minimum acceptable dry primer thickness should be 0.002 inches which is normally achieved by applying at a spread rate of circa 200 sq. ft. per gallon.
- 12.1.4 Measure Primer thickness using an approved magnetic direct reading gauge.
- 12.1.5 Make cross hatch adhesion tests on the primed surface to assure proper adhesion between the primer and the surface of the steel item prior to proceeding with the application of the THERMO-LAG 330-1 Subliming Material.
- 12.1.5 Coat the primed steel surface area with the THERMO-LAG 330-1 Subliming Material. The coating shall be applied in accordance with instructions given in Paragraph 12.2 or 12.3 herein.
- 12.2 THERMO-LAG 330-1 Subliming Material - Spray Application
 - 12.2.1 Apply the THERMO-LAG 330-1 Subliming Material - Spray Grade over a properly prepared surface. Make sure that the surface to be coated is clean, dry, above 40 F and free from scale, rust or other contaminants.
 - 12.2.2 Apply the material in as many passes as required to provide the required dry film build of the coating thickness, taking care to avoid slumping or sagging of the coating. Normally, a required 0.500 inch dry film coating thickness is accomplished by applying three wet coats of 0.255 inches. However, the thickness which can be safely applied in a single pass will depend on the temperature, humidity and other factors that are best determined on the jobsite.
 - 12.2.3 Apply the material in smooth even passes, taking care to keep the spray gun fan pattern at a 90 degree angle whenever possible. Reaching with a spray gun will cause the spray pattern to vary from the 90 degree angle and will result in a rougher surface than normal.



- 12.2.4 Take frequent wet thickness measurements during the application using a penetration measuring device as shown in Figure 15 to ensure that the coating is being applied uniformly and at the required wet film thickness. These wet thickness checks shall be made every five (5) square feet or every two (2) running feet of coated surface area. (Note: When taking measurements, allow for a shrinkage rate of circa 25% between the wet and the desired dry film coating thickness.)
- 12.2.5 Remove excess build up of coating material at edges and joints by brushing or rolling the surface with a damp sponge roller.
- 12.2.6 Spray edges of the substrate from each side to cause the material to wrap around the edge. If the edge coating is not completely closed, use a wet roller or trowel to seal the edge surface.
- 12.2.7 Remove all runs, sags, drips or other surface imperfections before the material cures, using wet sponge rollers, brushes or hand trowels.

12.3 THERMO-LAG 330-1 Subliming Material Trowel Application

- 12.3.1 Trowel the material to a uniform thickness using moderate pressure and avoid overworking. The trowel should be wetted with water when a smooth finish is required.

12.4 Dry Film Thickness Measurements

- 12.4.1 Take dry film thickness measurements after the applied material has cured. Measurement shall be made using electrical, penetrating or magnetic measuring instruments.

13.0 REPAIR PROCEDURES

The repair of a damaged section in a THERMO-LAG 330 Fire Barrier is easily accomplished by cutting out and removing the damaged material and then filling in the cut out section with new material.

The first step in this procedures is to remove the damaged and loose material using a knife and scraper. Care should be exercised that the damaged material is cut back until sound adhering material is reached.

The next step is to undercut the edges around the cut out section to form a beveled edge. All foreign matter is then removed from the exposed substrate surface in the cut out section.

Finally, the THERMO-LAG 330 Subliming Material is sprayed or troweled into the cut out section. If necessary, several coats can be applied to achieve the desired film thickness. Care should be taken to allow for shrinkage of the repair patch by building up a slight dome shape on the surface of the patch.

APPENDIX B

SUGGESTED COMPLEMENT OF REQUIRED SPRAY EQUIPMENT FOR THERMO-LAG 330-1 SUBLIMING COATING APPLICATION

AIRLESS SPRAY EQUIPMENT

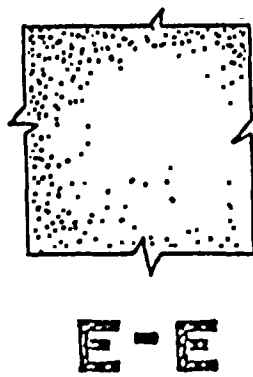
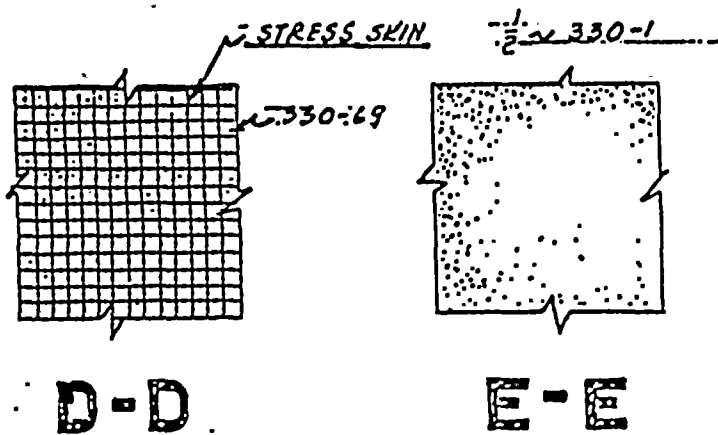
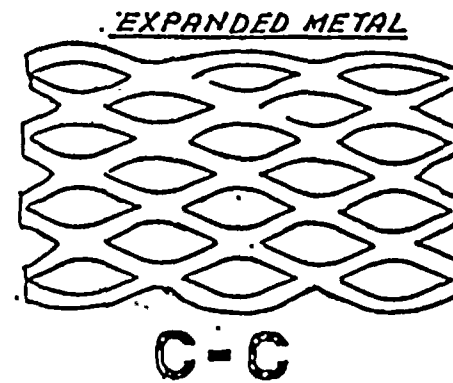
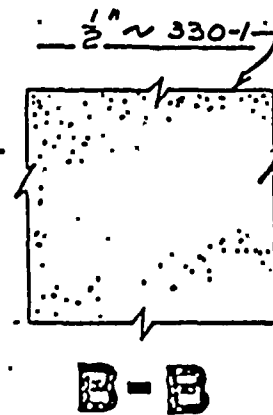
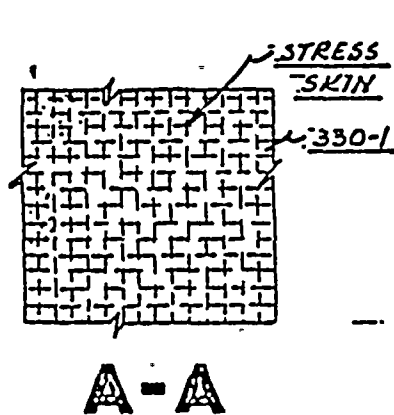
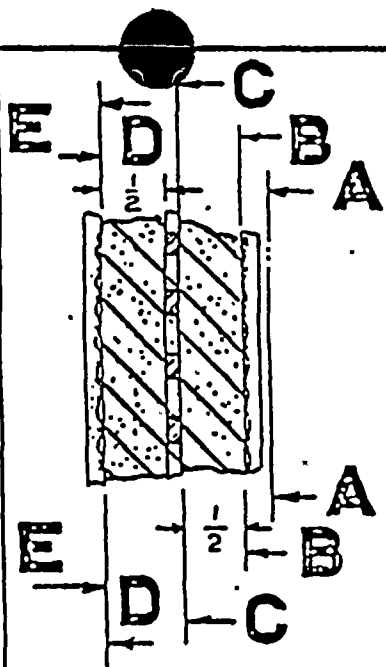
<u>QUANTITY</u>	<u>DESCRIPTION OF EQUIPMENT</u>
1 Each	Hydra Spray Pump 45:1
1 Each	Air Powered Ram
1 Each	Hydra Mastic Spray Gun
1 Each	Special Dump Valve
2 Each	RAC III with 0.55 Tips
1 Each	Air Agitator
1 Each	Air Regulator Kit
1 Each	Air Regulator Only with Gauge
1 Each	Air Line Filter
1 Each	Air Line Lubricator
5 Each	Pump Repair Parts Kits
6 Each	Extra Tips with Seals
100 Feet	1 Inch I.D. Hi Pressure Fluid Hose
75 Feet	1/2 Inch I.D. Hi Pressure Fluid Hose
25 Feet	3/8 Inch I.D. Hi Pressure Fluid Hose

APPENDIX B

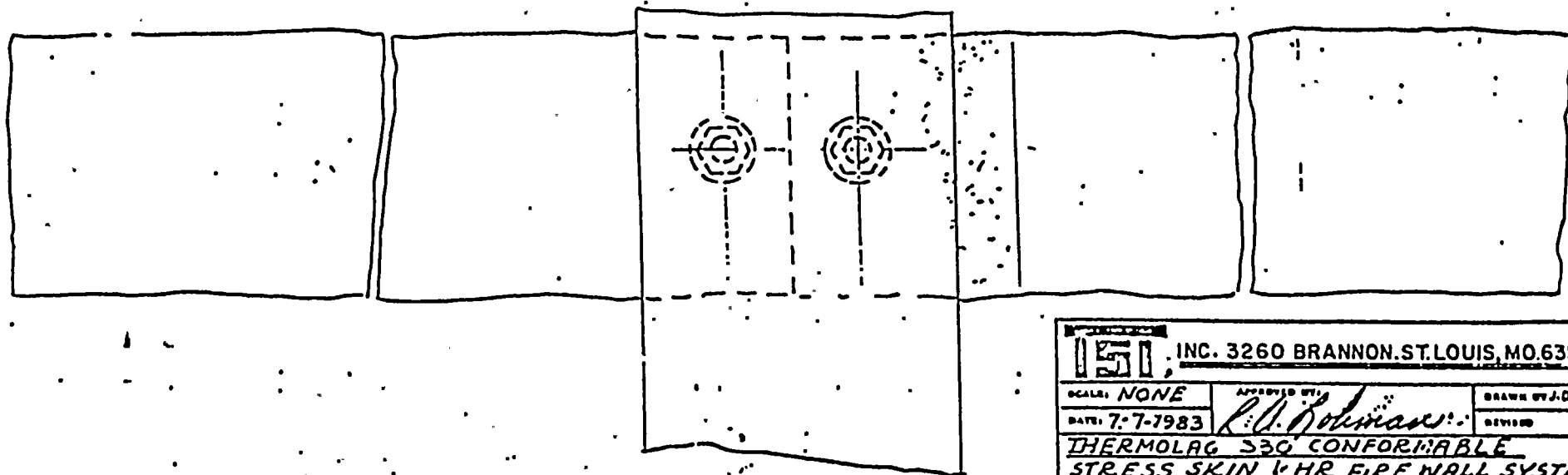
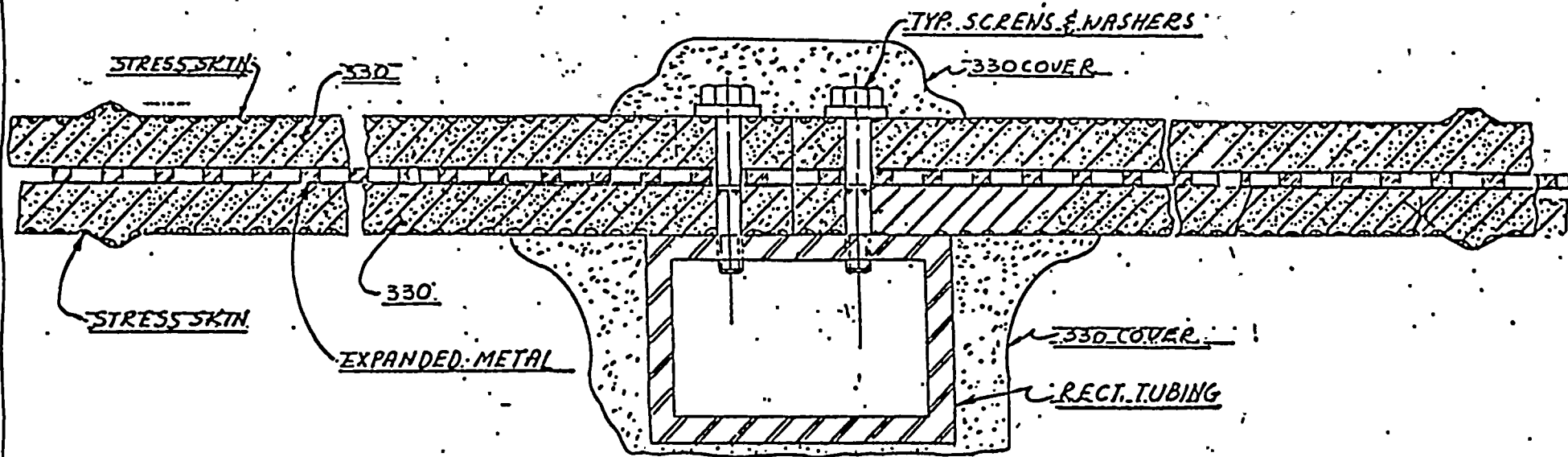
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AIR TYPE SPRAY EQUIPMENT

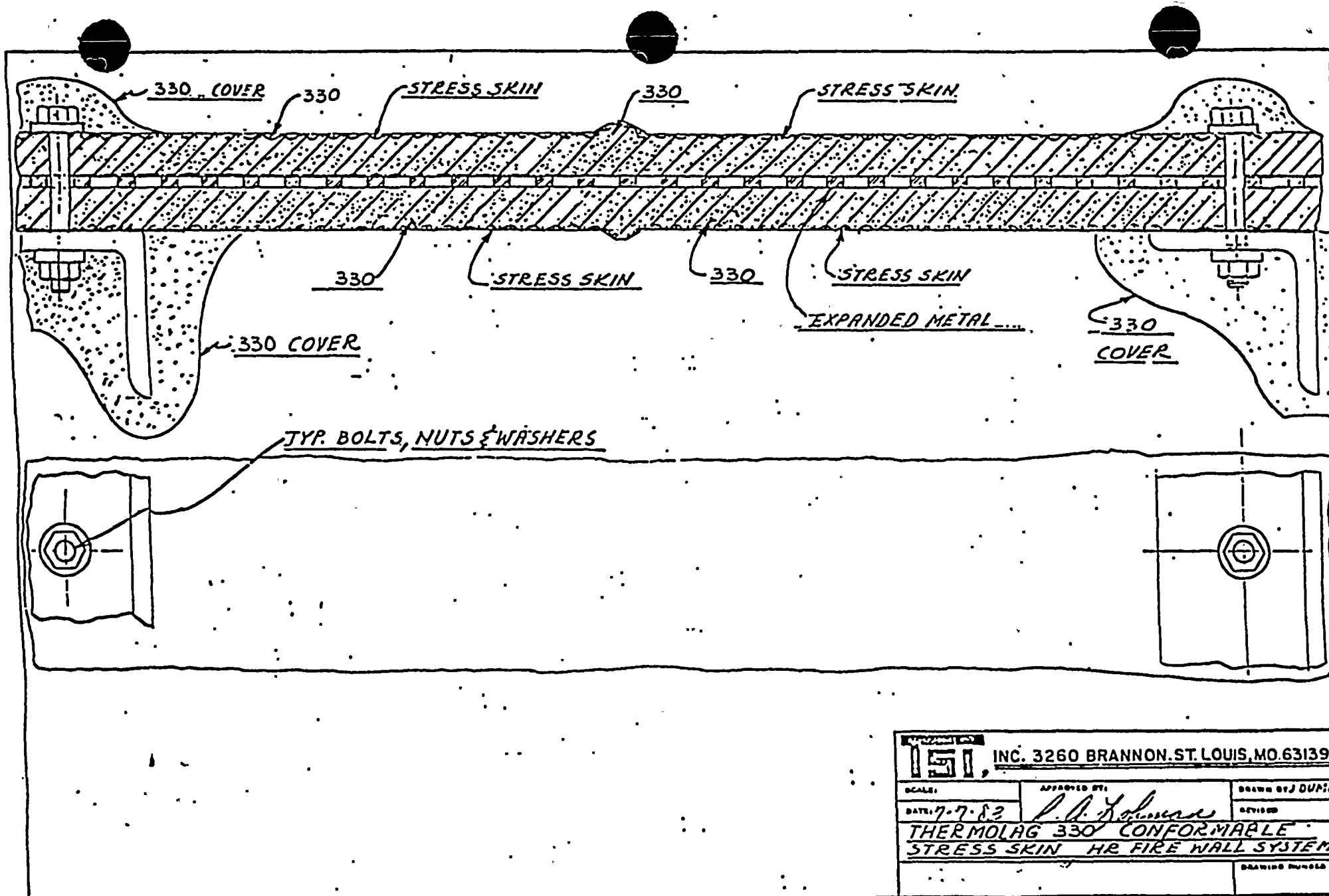
<u>QUANTITY</u>	<u>DESCRIPTION OF EQUIPMENT</u>
1 Each	10:1 President Spray Pump
1 Each	Air Powered Ram
1 Each	Heavy Mastic Spray Gun
1 Each	Special Dump Valve
2 Each	1/4 Inch or 1/4 Inch "E" Spray Tip
1 Each	Air Agitator
1 Each	Air Regulator Kit
1 Each	Air Regulator Only with Gauge
1 Each	Air Line Lubricator
1 Each	Air Line Filter
5 Each	Pump Repair Parts Kits
75 Feet	1/2 Inch I.D. Hi-Pressure Fluid Hose
25 Feet	3/8 Inch I.D. Hi-Pressure Fluid Hose



ISI, INC. 3260 BRANNON ST. LOUIS, MO. 63139		
SCALE:	APPROVED BY:	DRAWN BY: J. DUMPL.
DATE: 1-26-1981	<i>L. A. Solman</i>	
THERMOLAG 330 CONFORMABLE STRESS SKIN 3 HP FIRE WALL SYSTEM		
DRAWING NUMBER		



ISI, INC. 3260 BRANNON ST. LOUIS, MO. 63139.		
SCALE: NONE	APPROVED BY: <i>R. L. Robinson</i>	DRAWN BY: J. DUMPLIS
DATE: 7-7-1983	DESIGNED:	
THERMOLAG 330 CONFORMABLE STRESS SKIN 1 HR FIRE WALL SYSTEM.		
DRAWING NUMBER:		1



151 , INC. 3260 BRANNON ST. LOUIS, MO. 63139.		
SCALE:	APPROVED BY:	DRAWN BY J. DUMFRIES
DATE: 7-7-83	<i>P. D. Johnson</i>	REVISED
THERMOLAG 330 CONFORMABLE STRESS SKIN - FIRE WALL SYSTEM.		
		DRAWING NUMBER



February 3, 1984

American Electric Power
#1 Riverside Plaza
P. O. Box 16631
Columbus, Ohio 43216-6631

Attention: Mr. Vic DelFavio

Subject: Hatch Cover Requirements For THERMO-LAG 330 Fire Barrier System
For 3 Hour's Protection From An ASTM E119 Type Fire Environment

- RE:
- 1) Wesson & Associates Report entitled "Effectiveness of Fire Resistant Coatings Applied to Structural Steels Exposed To Direct Flames Contact, Radiant Heat Fluxes, and Mechanical and Cryogenic Thermal Shock"
 - 2) Underwriter's Laboratories Report No. R6802-6A, File No. X611 "Mastic Coating Applied To A W14X228 Steel Column"

Dear Mr. Del Favio:

We recommend that a minimum thickness of 0.5 inches dry of THERMO-LAG 330-1 Subliming Material be used on both sides of this cover to limit the maximum temperature rise of the steel to 1000°F when exposed to an incipient ASTM E119 type fire environment. If direct spray methods are employed, please use the procedures contained in TSI's Technical Note 80181 entitled: "THERMO-LAG 330 Subliming Fire Barrier Systems Application Procedures", Revision IV, dated June 1983. This minimum thickness recommendation can also be provided by the use of THERMO-LAG Prefabricated Panels in a 3 hour fire rated design.

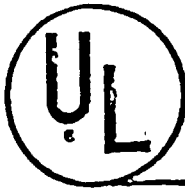
If you have any questions, do not hesitate to contact me.

Yours truly,

A handwritten signature in cursive script, reading 'R. A. Lohman', is written over the typed name.

R. A. Lohman
Manager-Quality Assurance

RAL/mls



UNDERWRITERS LABORATORIES INC.

333 PFINGSTEN ROAD - NORTHBROOK, ILLINOIS 60062

an independent, not-for-profit organization testing for public safety

R6802

Northbrook, IL
January 9, 1979

TSI, Inc.
3260 Brannon Ave.
St. Louis, MO 63139

Attention: R. Feldman

Subject: MASTIC COATINGS (CDWZ)

Gentlemen:

We are enclosing one copy of the Report revision, covering the above subject. The revision consists of the following:

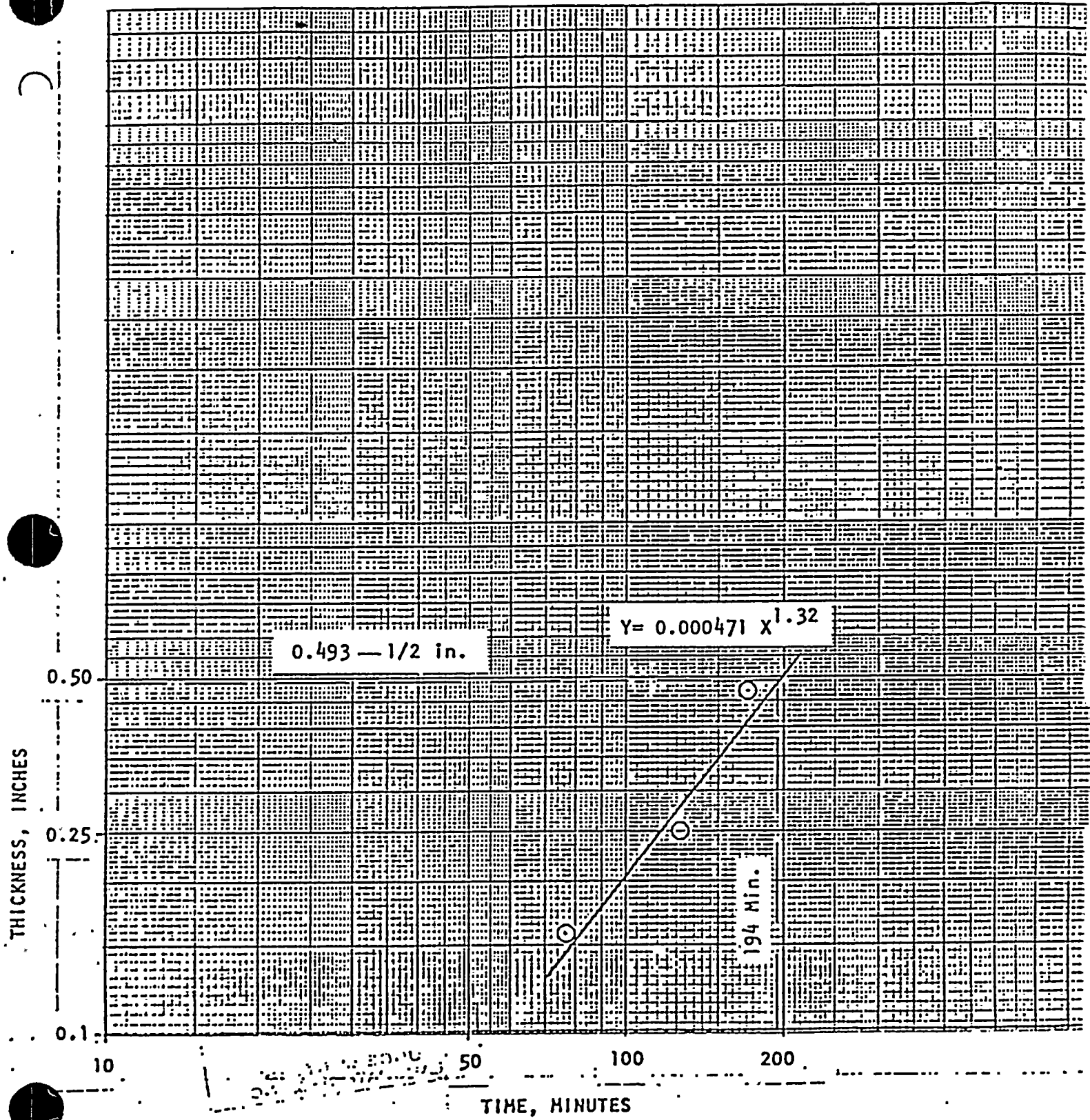
Revised illustration, 6 for report issued 6-5-78,
dated 1-8-79.

Very truly yours,

G. D. Palikij
Fire Protection Dept.

GP:pg
encl.

PLOT OF BEST FIT EQUATION FOR 3 HR. RATING





UNDERWRITERS LABORATORIES INC.

CHICAGO • NORTHBROOK, ILL. • MELVILLE, NY • SANTA CLARA, CALIF.

an independent, not-for-profit organization testing for public safety

File R6802-6A
Project 77NK422

June 5, 1978

REPORT

on

MASTIC COATING APPLIED TO A
W14X228 STEEL COLUMN

TSI, Inc.
St. Louis, Missouri

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G E N E R A L

The subject of this Report is the fire resistance Classification of a W14X228 steel column protected with Type 330 mastic subliming coating applied to a dry film thickness of 15/32 in. as described in the section entitled "Protection of Test Assembly," and as shown in ILL. 1.

The object of this investigation was to establish a fire resistance Classification for the column described herein by means of a fire endurance test conducted in accordance with the Standard for Fire Tests of Building Construction Materials, UL263 (ASTM E119, NFPA No. 251).

In addition to the fire endurance test, the submittor requested that we conduct an engineering evaluation of the tests described in this Report and their column tests described in Reports R6802-3 and R6802-4, to determine the minimum dry film thickness of the Type 330 mastic coating necessary to afford a 3 hr fire resistance rating when applied to a W14X228 steel column.

The fire test was supplemented by other tests and examinations to furnish information regarding the composition and physical properties of the materials used and to determine the practicability of handling and applying the coating.

GDP/RMB:plh

D E S C R I P T I O NEXAMINATION OF MATERIALS:

The materials used in the test assembly are described below.

Column - The column used in the test assembly was a W14X228 steel section measuring 8 ft, 3 in. long between the top and bottom concrete caps.

Primer - The primer was a corrosion inhibiting modified alkyd primer manufactured by TSI, Inc.

Glass Fiber Gauze - The glass fiber gauze was embedded in the mastic coating to provide reinforcement. The gauze was 12 in. wide and weighed 1.70 oz per sq yd.

Mastic Subliming Coating - The mastic subliming coating material was manufactured by TSI, Inc. and designated Thermo Lag Type 330. The coating material was supplied in 55 gal steel drums. The mastic coating is presently Classified by Underwriters Laboratories Inc. under Follow-Up Service. The composition and other properties of the mastic coating are considered proprietary and are on file at the Laboratories.

PROTECTION OF TEST ASSEMBLY:

The steel column was protected by workmen in the employ of the submitter under the observation of members of the Laboratories' staff.

The column surfaces were wiped with a solvent to remove surface contaminants. The primer was sprayed onto the column using an air gun.

The mastic coating, which was supplied in steel drums, was spray-applied to the column surfaces using equipment designed for such purposes.

The mastic coating was applied to the column in several coats at thicknesses of approximately $1/32$ to $1/16$ in. Each coat was allowed to become tacky before the following coat was applied. After the coating had been sprayed to an approximate thickness of $13/32$ in., the glass fiber gauze was pressed into the coating over the entire column with adjacent sections of the gauze overlapped 1 to 3 in. The gauze was lightly rolled with a paint roller. Approximately $3/32$ in. of additional coating was then applied to the column.

The coating was applied to a wet film thickness of approximately $1/2$ in. as determined by several measurements taken after spraying had been completed.

The wet and dry densities of the mastic subliming coating were determined by applying the material at a representative thickness to a 2 by 2 ft steel plate. The wet density was obtained by weighing the plate immediately after spraying and the dry density was determined using the air dried constant weight of the steel plate and coating. The average wet and dry densities of the mastic coating were 85.8 and 61.2 pcf, respectively.

While the mastic coating material was curing, several cracks varying in width from hairline to $1/8$ in. formed at the intersection of webs and flanges of the column. These cracks were repaired nine days after the spraying had been completed.

The final dry film thickness of $15/32$ in. was determined on the basis of 108 measurements taken on the column 40 days after the spraying had been completed and the material had dried at room temperature to a constant weight condition. Individual thickness readings varied from $11/32$ to $19/32$ in.

The appearance of the column assembly before the fire endurance test is shown on ILL. 2.

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T E S T R E C O R D N O. 1FIRE ENDURANCE TEST:

This test was conducted in accordance with the Standard of Underwriters Laboratories Inc. for Fire Tests of Building Construction and Materials, UL263 (NFPA No. 251, ASTM E119).

DESCRIPTION OF SAMPLE.

Prior to placing the column assembly in the furnace, several cracks were observed in the mastic coating at each web and flange intersection. These varied in width from hairline to 1/16 in. and were 1 to 2 in. long.

METHOD

The column was placed in the furnace and exposed to flames of controlled extent and severity in accordance with the Standard Time-Temperature Curve. Eight thermocouples, distributed around the column in two levels as shown on ILL. 3, measured the temperatures in the furnace chamber.

The temperatures of the steel column were measured by 14 thermocouples located as shown on ILL. 4. Throughout the test, observations were made to note the character of the fire, the condition of the exposed surface of the column, and all other data pertinent to the fire resistance performance of the column.

Character and Distribution of the Fire - The furnace fire was luminous and well distributed during the test, and the temperatures recorded in the furnace chamber followed the Standard Time-Temperature Curve as defined in the Standard for Fire Tests of Building Construction and Materials, UL263, and as shown on ILL. 3.

Observations During Test - The following observations were made during the fire test. All references to dimensions are approximate.

Test Time, Min	Observations
1	The mastic coating on the column flanges is turning black and developing blisters.
2	The color of the mastic coating on the column flanges is black. The mastic coating on the column web is turning black and developing small blisters.
3	The mastic coating is black in color and contains numerous blisters over the entire column.
4	Surface cracks are forming around blisters located on the column flanges.
4.5	Light flames are emitting from the fissures in the coating.
6	Flaming has stopped.
6.5	Coating is flaming again. The cracks are 1/8 to 1/4 in. wide.
8	The mastic coating is bowing out 1/8 to 1/4 in. from the cracks.
10	Small areas of the coating are turning tan in color.
15	The mastic coating is mostly tan in color. The coating continues to emit flames.
20	A triangular shaped area of the mastic coating is delaminating from the north flange 2 ft below the column cap. The affected area measures 12 in. in length, 3 to 6 in. wide and 1/4 in. thick.

Test Time, Min	Observations
25	The coating surface continues to flame and the cracks are now 1/8 to 1/2 in. wide.
26	The coating is delaminating at several areas on the web area.
30	Small pieces of the coating material are falling from the center area of the north flange. Flames continue to emanate from the cracks.
35	The coating has delaminated from several areas on both flanges. Average depth of the delaminated material is 1/8 in.
40	The surface of the coating material continues to flame. The material has bowed out 2 to 4 in. from the south flange.
45	The coating material is mostly rust colored with tan areas adjacent to the cracks.
60	The coating is no longer delaminating from the north flange but continues to flame.
70	The coating is becoming white in color.
85	Light flames continue to emanate from the cracks in the coating.
100	Light flaming continues. The cracks are now 1/8 to 1 in. wide.
110	The depth of the swelling on both flanges is 1-1/2 to 2 in.
120	The color of the mastic coating is mostly white and continues to emit flames. Most cracks are 1/8 to 1-1/2 in. wide.

Test
Time,
Min

Observations

130	Light lazy flames continue from the column web areas.
140	Light flames continue to emit from the coating at the intersection of the column web and both flanges.
150	The cracks in coating are closing due to swelling of the material. The fiberglass mesh is visible on several areas of the coating. All flaming has stopped and the coating is white in color.
160	Width of the cracks at the intersection of the column web and both flanges is 1 to 1-1/2 in.
170	Cracks at web and flange intersection are 1 to 2 in. wide.
188	Fire test terminated.

Temperatures Of The Column - The temperatures that developed during the fire test and the location of the thermocouples at the various levels are shown on ILL. 4.

Limiting temperatures are reached when the average temperature at any one level exceeds 1000 F or any individual temperature reading exceeds 1200 F. The limiting average temperature was reached at 172 min by the three thermocouples located at Level B. The individual temperature was reached at 187 min.

STUDY FOR CLASSIFICATION PURPOSES:

As discussed in the Section General of this Report, the submitter requested that an engineering evaluation be performed to determine the minimum dry film thickness of mastic coating required to afford a 3 hr rating when applied to a W14X228 structural steel column.

A summary of the column test results included in this engineering evaluation is shown below:

<u>Report</u>	<u>Material Thickness, In.</u>	<u>Occurrence Of Limiting Temperature, Min +</u>
R6802-3	5/32	77
R6802-4	1/4	127
R6802-6A	15/32	172

+ - Limiting average cross-sectional temperature of
1000 F used.

To determine the thickness of the mastic coating required for the 3 hr rating, a computer analysis of the above material thicknesses and time to reach the limiting temperatures was obtained. Based upon the resulting equation, $Y = 0.000471 \times 1.32$ it was determined that a minimum thickness of 1/2 in. would afford a 3 hr rating. The test data and the plot of the equation are shown on ILL. 6.

A safety factory of 8 percent (14 min) was used to determine the above thickness since the equation is an extrapolation of test data.

GDP/RMB

C O N C L U S I O N S

The following conclusions represent the judgement of Underwriters Laboratories Inc. based upon the results of the examination and tests conducted in the Report, as they relate to established principles and previously recorded data.

FIRE RESISTANCE. PROPERTIES:

It is judged that a 1/2 in. thickness of mastic coating, applied as described in this Report will afford a 3 hr rating when applied to a structural steel column whose size is equal to or greater than a W14X228 with a minimum flange thickness of 1-11/16 in., a minimum web thickness of 1-1/16 in., and a minimum cross sectional area of 67.06 sq in.

The assembly, in summarized form as shown on the individual design illustration included in this Report, will be illustrated in the Fire Resistance Directory as Column Design No. X611.

This Classification is based on the temperature limitations of 1000 F average and 1200 F maximum allowable as described under the "Conditions of Acceptance" for structural steel columns of the Standard of Underwriters Laboratories Inc. for Fire Tests of Building Construction and Materials, Standard UL263 (ASTM E119, NFPA No. 251).

PRACTICABILITY:

The mastic coating and glass fiber gauze of the type used for this investigation can be readily applied to steel columns by experienced workmen using proper equipment. Materials and spraying procedures in accordance with those described in this Report are significant factors in the fire resistance of this construction.

CONFORMITY:

This construction was tested in accordance with the Standard for Fire Tests of Building Construction and Materials, UL263 (ASTM E119, NFPA No. 251).

FOLLOW-UP PROGRAM:

The mastic coating as described herein is currently covered under the Classification and Follow-Up Service of Underwriters Laboratories Inc. Under the Service, the manufacturer is authorized to use the Laboratories' Classification Marking on such products which comply with the Follow-Up Service Procedure and any other applicable requirements of Underwriters Laboratories Inc. Only those products which properly bear the Laboratories' Classification Marking are considered as Classified by Underwriters Laboratories Inc.

The Classification Marking used on the mastic coating is illustrated below:

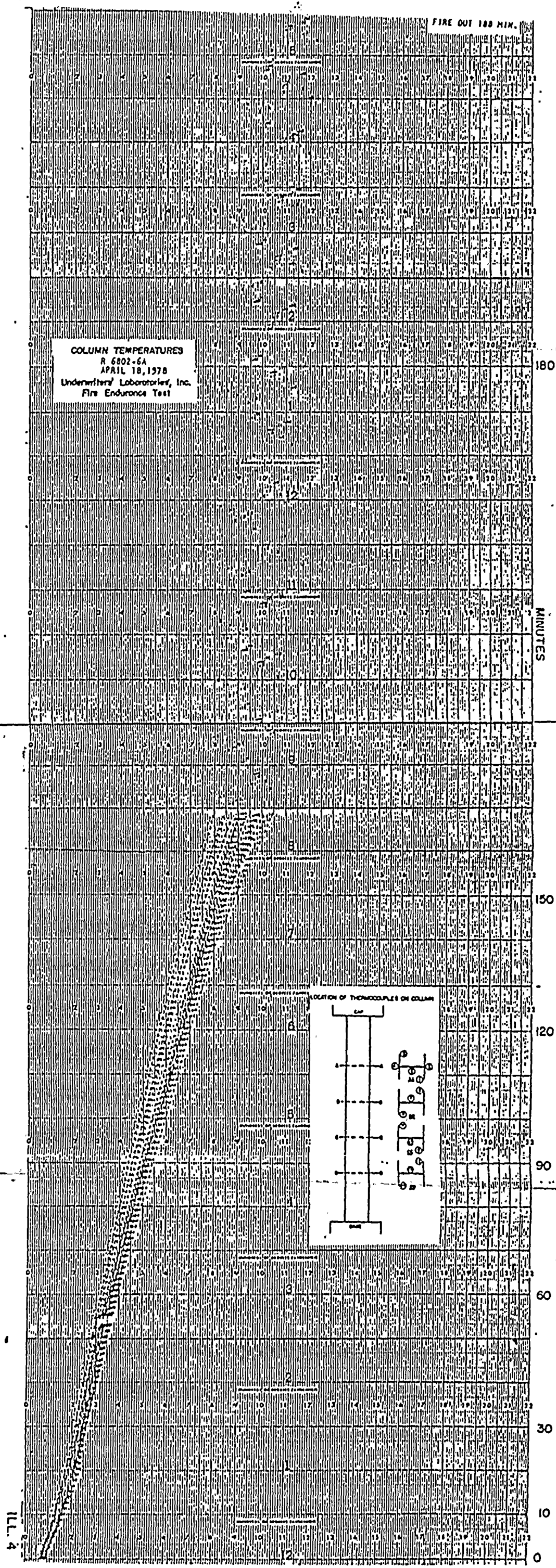
UNDERWRITERS LABORATORIES INC. (R)

CLASSIFIED

MASTIC COATINGS
FIRE RESISTANCE CLASSIFICATION
DESIGN NO. X611

SEE UL FIRE RESISTANCE DIRECTORY

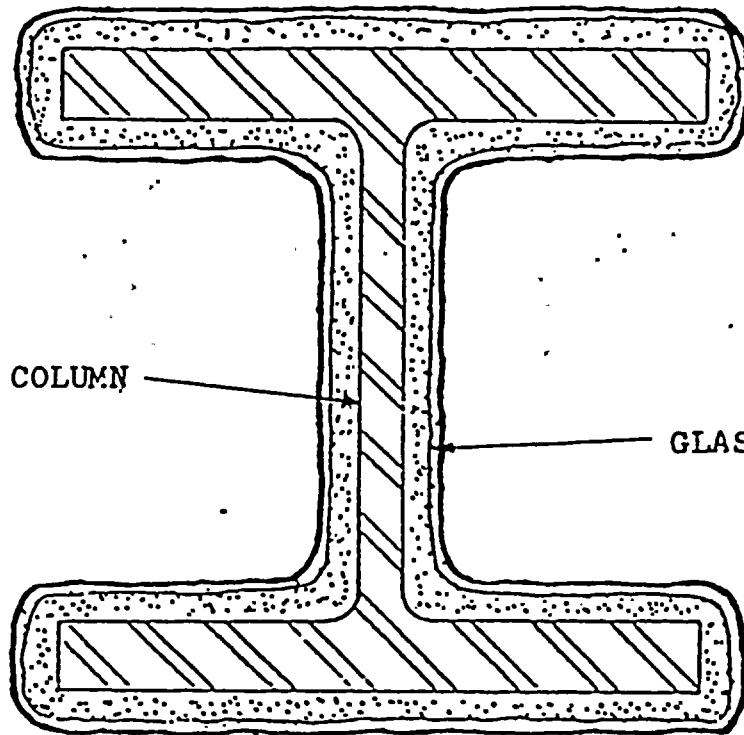


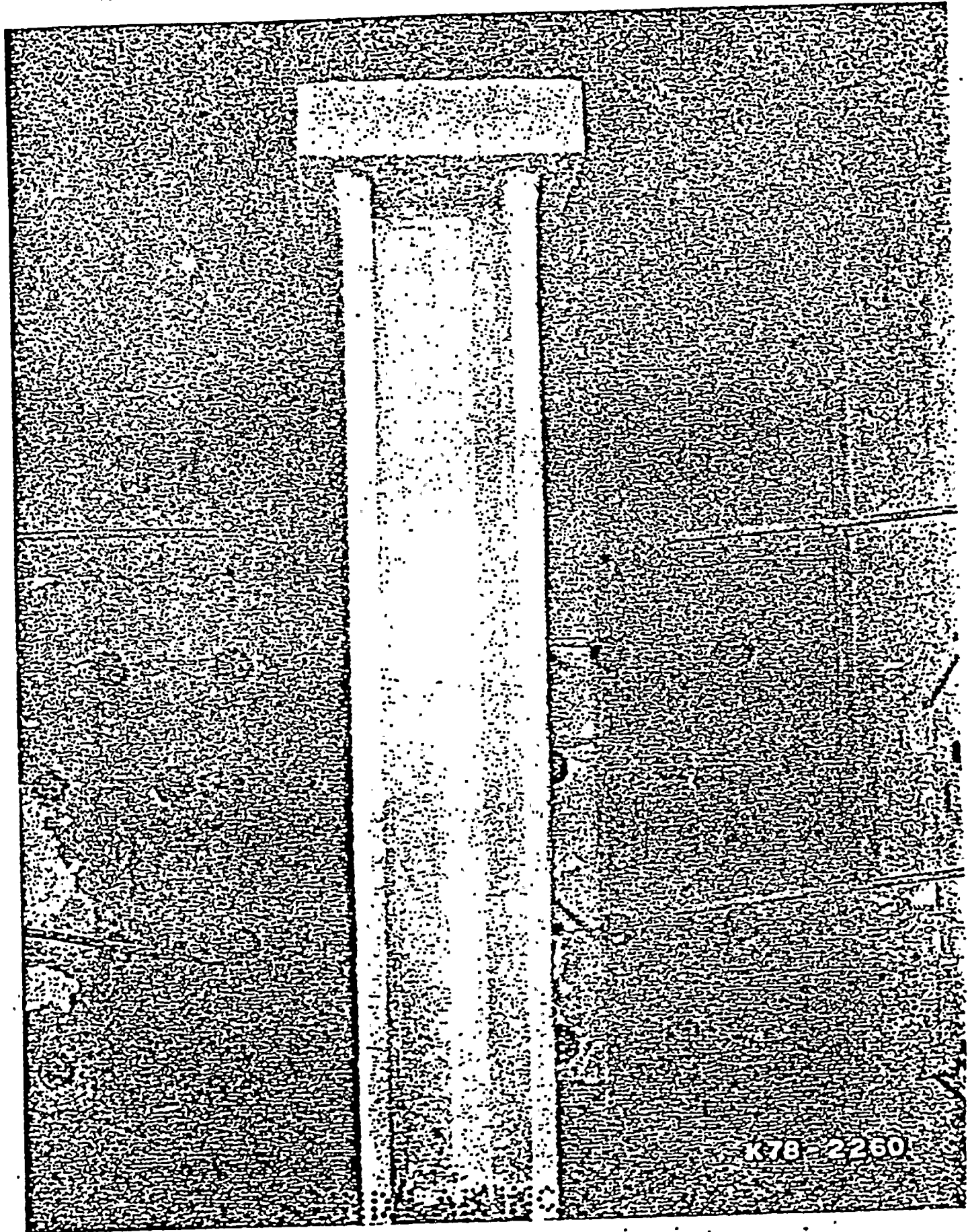


W14X228 STEEL COLUMN

GLASS FIBER GAUZE

TYPE 330 MASTIC COATING
APPLIED TO A DRY FILM
THICKNESS OF $19/32$ IN.



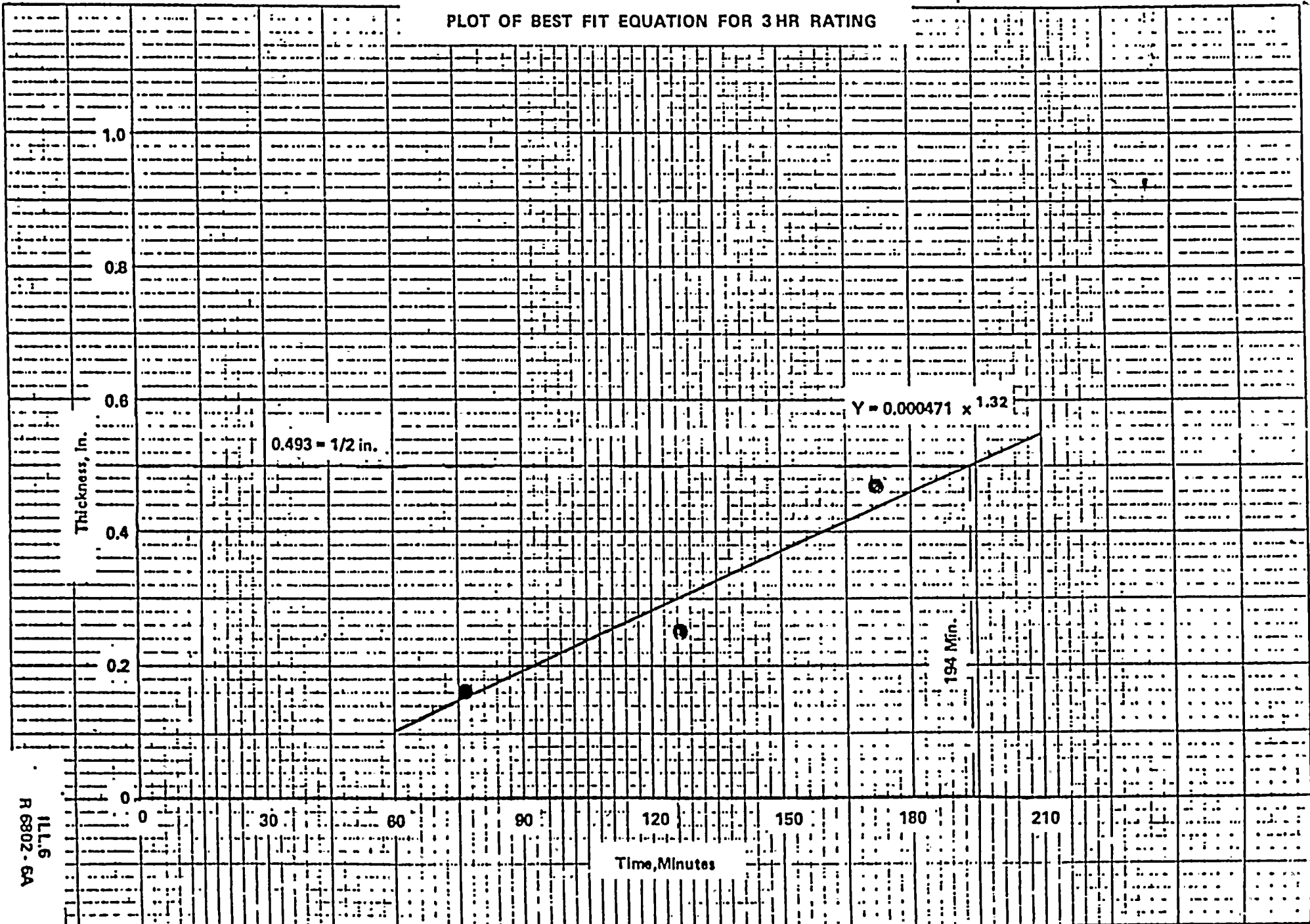


K78-2260





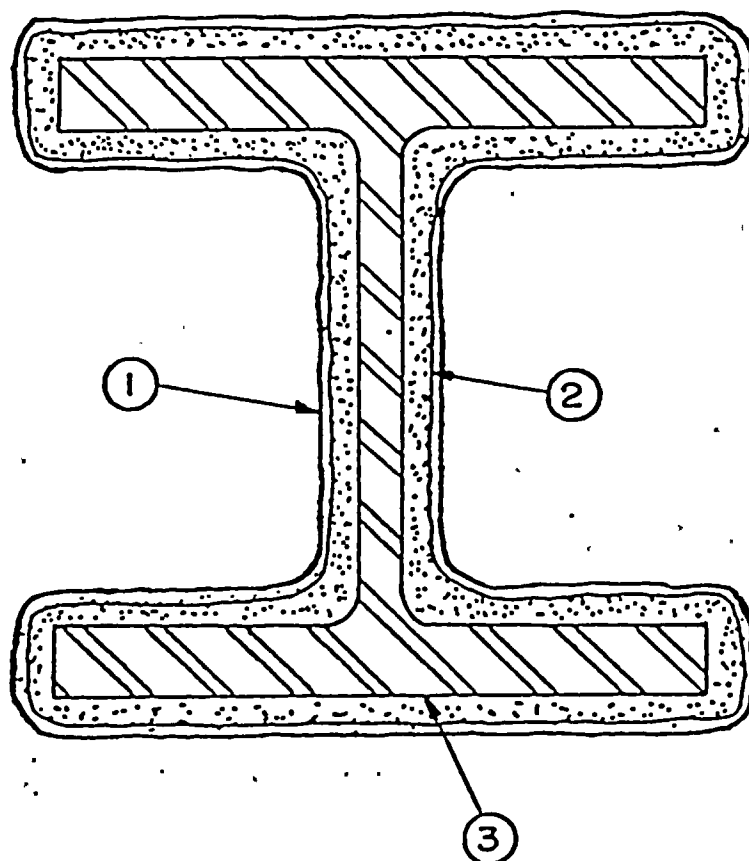
PLOT OF BEST FIT EQUATION FOR 3 HR RATING



FIRE RESISTANCE RATINGS

DESIGN NO. X611

RATING-3 HR.



Guide BXUV
Fire Resistance Ratings

June 5, 1978
(X611-B Card)

(Continued From X611-A Card)

1. Mastic Coatings* - Coating mixed thoroughly and spray applied in several coats for a dry film thickness of 1/2 in. to column surfaces which must be free of dirt, loose scale and oil. Column surfaces to be primed with a modified alkyd primer. Glass fiber gauze (Item 2) pressed into coating prior to application of final coat and lightly rolled in place with a paint roller. Coating may shrink causing cracks during curing. These cracks shall be filled with additional mastic coating.

TSI, Inc. - Type 330. Investigated for exterior and interior use. For exterior use, Type 350 top coat to be applied over mastic coating at a rate of approximately 150 sq ft per gal.

2. Glass Fiber Gauze - Nominally 12 in. wide, 1.70 oz per sq yd. Embedded in mastic coating around entire column.
3. Steel Column - Minimum size of column a W14X228, with outside dimensions of 16 by 15-7/8 in., a flange thickness of 1-11/16 in., a web thickness of 1-1/16 in., and a cross-sectional area of 67.06 sq in.

* - Bearing the UL Classification Marking.

Report by:
G. D. PALIKIJ
Engineering Assistant
Fire Protection Department

Reviewed by:

R. M. Berhinig
R. M. BERTHINIG
Engineering Group Leader
Fire Protection Department

SUBMITTED BY:

G. T. Castino
G. T. CASTINO
Managing Engineer
Fire Protection

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