LOUISIANA POWER & LIGHT / 142 DELARONDE STREET
P. O. BOX 6008 • NEW ORLEANS, LOUISIANA 70174 • (504) 366-2345
MIDDLE SOUTH UTILITIES SYSTEM

L. V. MAURIN
Vice President
Nuclear Operations

September 28, 1982

W3P82-2757
3-A1.01.04
Q-3-P43.A1

Mr. T. H. Novak
Assistant Director of Licensing
U.S. Unclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Waterford 3 SES
Docket No. 50-382
Test Reports on
Fire Resistance Rating
of Penetration Seals

Dear Mr. Novak:

As addressed in Supplement 3 to the Waterford 3 Safety Evaluation Report LP&L committed to provide test reports to demonstrate the fire resistance rating of the penetration seals to be installed on Waterford 3.

Attached find the qualification test reports which demonstrate the fire resistance rating of penetration seal assemblies currently being installed at Waterford SES Unit No. 3. These tests were conducted at Southwest Research Institute, San Antonio, Texas and sponsored by B&B Insulation Inc., Houston, Texas - the supplier and installer for the penetration seals for Waterford 3 SES.

The summary of five qualification tests and American Nuclear Insurers (ANI) acceptances is provided as Attachment 1. Attachments 2 through 4 cover various fire qualification test reports, which are listed below.

Attachment 2 - Fire Qualification Test on Silicone Foam Floor Penetration Seals - Slab 1A, Project No. 03-6004-006. Also included are ANI acceptance forms dated May 1, 1981 and letter dated August 25, 1980 accepting above test report.

Attachment 3 - Fire Qualification Test on Penetration Seals - SLAB No. 2, Project No. 03-6004-004. Also included are ANI acceptance forms dated May 1, 1981 and letter dated August 25, 1980 accepting above test report.

Attachment 4 - Fire Qualification Test on Penetration Seals - B&B Test SLAB No. 4, SWRI Project No. 01-6763-212. Also included are ANI acceptance forms and ANI letter dated August 12, 1982, accepting these test reports.

B002

This should close the open item #8 of the SSER 3 and fulfill the commitment LP&L made to NRC in regard to fire qualification test reports on penetration seal.

If you have any questions concerning this please notify Mr. Roy Prados, Nuclear Project Support Group Licensing Supervisor.

Very truly yours,

L. V. Maurin

LVM/MGW/pco

Attachment

cc: S. Black, D. Kubeckie, E. Blake, M. Stevenson

bcc: Ebasco (2), J. M. Brooks, R. J. Milhiser (2), F. J. Drummond,
T. F. Gerrets, C. J. Decareaux, T. K. Armington, P. V. Prasankumar,
J. R. McGaha, J. F. Fager, Richard Hymes, L. L. Bass, M. I. Meyer,
R. W. Prados, K. R. Iyengar, J. J. Lewis, L. V. Maurin, G. B. Rogers,
M. G. Williams, G. Buxton (MSS), M. Flynn (site), E. J. Senac,
Central Records, Nuclear Records (3), Licensing Library

ATTACHMENT 1

B&B INSULATION, INC.
FIRE QUALIFICATION TEST SUMMARY
AND ANI ACCEPTANCE INDEX

CTP NO.	SLAB NO.	REPORT NO.	DATE OF TEST	DATE OF CURRENT ANI ACCEPTANCE	HOUR RATING	MATERIAL TESTED	DESCRIPTION
1001	1A	SwRI 03-6004-006 Dated 07/25/80	05/20/80	05/01/81	3	Dow Corning 3-6548 Silicone RTV Foam, JM Ceraproducts B&W Kaowool products, Dow Corning SYLGARD 170, Dow Corning 96-081/732 Adhesive Sealants	Non-lined penetrations, NO LIMITATIONS on Cable Construction - 100% VISUAL cable fill 10" Foam depth-electrical trays 6" Foam depth-conduit 6" Foam depth-mech < 6" annulus 10" Foam depth-mech > 6" annulus ½" or less gap-adhesive sealant
1002	2	SwRI 03-6004-004 Dated 07/25/80	05/27/81	05/01/81	3	B&B HI DENSITY LEADED MATRIX Keene/CHR boot fabric JM Ceraproducts B&B "RAD-FLEX"	Non-lined penetrations, NO LIMITATIONS on Cable Construction - 100% Visual Cable Fill 12" depth Lead Matrix-electrical & mechanical Full depth "RAD-FLEX" w/boots Fire Rated Boot Seals
1004	2	SwRI 03-6004-002 Dated 07/25/80	RAD-April/May CYCLE-May, 1980	Ref: CTP1002	-	B&B "RAD-FLEX"	Six test specimens irradiated to 5×10^7 RADS. Cycle testing on three axis. Radiation exposure and mechanical cycle testing in conjunction with 3 Hour Fire Test constitutes a TRIPLE-JEOPARDY Exposure.
1009	3	SwRI 01-6613-001A Dated 08/28/81	07/23/81	09/17/81	3	Dow Corning 3-6548 Silicone Foam, JM Ceraproducts, B&W Kaowool products	Steel lined penetration, IEEE Rated Cable construction, 100% Visual cable fill 9" Foam depth-electrical trays 6" Foam depth-conduit 9" Foam depth-mechanical

CTP NO.	SLAB NO.	REPORT NO.	DATE OF TEST	DATE OF CURRENT ANI ACCEPTANCE	HOUR RATING	MATERIAL TESTED	DESCRIPTION
1011	3	SwRI 01-6613-001A Dated 08/28/81	07/23/81	09/17/81	3	Dow Corning 3-6548 Silicone foam, JM Ceraproducts, B&W Kaowool Products	Repair of Silicone Foam Seal Cable(s) insertion/deletion
1010	3	SwRI 01-6613-001B Dated 08/28/81	07/23/81	09/17/81	3	B&B HI DENSITY LEADED MATRIX (Revised Formula)	Steel Lined Penetrations, IEEE Rated Cable Construction, 100% Visual Fill 8" Seal Depth-Electrical/Mechanica
1012	3	SwRI 01-6613-001B Dated 08/28/81	07/23/81	09/17/81	3	B&B HI DENSITY LEADED MATRIX (Revised Formula)	Repair of HI DENSITY seal (Addition of cables)
1014	3	SwRI 01-6613-001D Dated 08/28/81	07/23/81	09/17/81	3	B&B HI DENSITY LEADED MATRIX (Original and Revised Formulas)	Comparison of Original (CTP1002) and revised formulations. Establish 1/4" min. clearance between penetrant and blockout/ sleeve. Establish 147lb min. density
1015	3	SwRI 01-6613-001E Dated 08/28/81	07/23/81	09/17/81	3	B&B Flexible Seismic Seal Standard and Hi-Pressure consisting of JM Cerablanket/ B&W Kaowool Blanket SILTEMP' Fabric CHR/Keene Silicone-glass fabric DC 96-081/732 adhesive sealant	Flexible gap seal up to 12" width

B&B Insulation, Inc. Fire Qualification Test
Summary and ANI Acceptance
Page Three

CTP NO.	SLAB NO.	REPORT NO.	DATE OF TEST	DATE OF CURRENT ANI ACCEPTANCE	HOUR RATING	MATERIAL TESTED	DESCRIPTION
1020	4	SwRI 01-6763-211 Dated 06/16/82	04/21/82	8/12/82	3	JM Cerablanket, and B&W Kaowool Blanket B&B RAD-FLEX Keene/CHR Boot Fabric B&B Type 1 and Type 4 Sleeve Extenders	Corebores modified to facilitate attachment of flexible boot seals by the additional of sleeve and maintain extenders integrity for a 3 hour E-119 exposure with hose stream.
1021	4	SwRI 01-6763-211 Dated 06/16/82	04/21/82	8/12/82	3	JM Cerablanket and B&W Kaowool Blanket B&B RAD-FLEX Keene/CHR Boot Fabric B&B Type 1 and Type 4 Sleeve extenders	Flush mounted embedded sleeves modified to facilitate attachment of flexible boot seals by the addition of sleeve extenders and maintain integrity for a 3 hour E-119 exposure with hose stream
1022	4	SwRI 01-6763-212 Dated 06/16/82	04/21/82	8/12/82	3	JM Cerablanket and B&W Kaowool Blanket B&B HOLE-A Keene/CHR Boot Fabric B&B Type 4 sleeve extender	Penetration reduced with HOLE-A to facilitate pipe movement up to 1/2" in lateral direction and maintain integrity for a 3 hour E-119 exposure with hose stream
1023	4	SwRI 01-6763-212 Dated 06/16/82	04/21/82	8/12/82	3	B&B HOLE-A B&B HOLE-A with accelerators B&B HOLE-C (Non-leaded)	Comparision of HOLE-A, HOLE-A with 2% accelerator, and HOLE-C (non-lead filler). also qualify the addition of re-bar or threaded rod used as support for damming. Provides documented evidence that all three are equal in a E-119 exposure with hose stream
1024	4	SwRI 01-6763-212 Dated 06/16/82	04/21/82	8/12/82	3	B&B LDSE JM Cerafiber JM Ceraboard B&W Kaowool Board & Fiber	3 Hour qualification for a 4" depth LDSE as formulated by B&B. Electrical and mechanical. Insulated and non-insulated piping. No limitations on cable-100% visual fill

B&B Insulation, Inc. Fire Qualification Test
Summary and ANI Acceptance
Page Four

CTP No.	SLAB NO.	REPORT NO.	DATE OF TEST	DATE OF CURRENT ANI ACCEPTANCE	HOUR RATING	MATERIAL TESTED	DESCRIPTION
1025	4	SwRI 01-6763-212	04/21/82	8/12/82	3	B&B FIRE FLEX JM Cerafiber, Ceraboard B&W Kaowool Board, fiber	3 Hour qualification for a 6" depth "FIRE FLEX" as formulated by B&B. electrical and mechanical insulated & non-insulated piping NO LIMITATIONS ON CABLE - 100% VISUAL FILL. Documental movement characteristics of 1" lateral and 2" axial

THREE HOUR QUALIFICATION TEST

DATA SHEET

SLAB ONE-A CTP-1001, REV. 1

(SOUTHWEST RESEARCH PROJECT 03-6004-006, DATED JULY 25, 1980)

CABLE PENETRATIONS

MAXIMUM SIZE . . . . . *42"x48" - Trays, 6"Ø - conduit*

CABLE TRAY TYPE . . . . . *Ladder and Solid Back*

CABLE CONSTRUCTION . . . . . *Polyethylene insulation w/PVC jacket*

CABLE SIZE . . . . . *One third - 300 MCM (1 conductor)*
One third - 12 AWG (7 & 9 conductor)
One third - 16 AWG (2 conductor)

CABLE LOADING . . . . . *Up to 100% VISUAL*
(for cable size and loading specifics, see table 1, page 12 in Report)

MATERIAL . . . . . *Dow Corning 3-6548 Silicone RTV Foam*
Dow Corning 96-081/732 adhesive sealant

DENSITY . . . . . *14.0 lb/ft^3 MINIMUM (4"x2"x2" free rise method) Please note that comparison density samples were performed using standard nine ounce Dixie cups. B & B feels the 4"x2"x2" free rise method is a superior method to determine representative density. Refer to page III-19 and respective Quality Control Inspection Sheets for each specific penetration for details.*

NOTE: Attached Dow Corning APPLICATION GUIDE SPECIFICATIONS FOR 3-6548 refers to a Free Foam Density of 14-20 lb/ft^3. Their verification method is similar to our 4"x2"x2" method.

SEAL DEPTH . . . . . *Trays: 11" MINIMUM (1" dam - 10" foam)*
Conduit: 7" MINIMUM (1" dam - 6" foam)

DAM MATERIAL . . . . . *Johns-Manville Type 126/Type 103 Ceraboard (1" nominal)*
Babcock & Wilcox Kaowool 'M' Board (1" nom.)
Johns-Manville Cerafiber/Babcock & Wilcox Kaowool Ceramic Fiber
Johns-Manville Cerablanket/Babcock & Wilcox Kaowool Ceramic Blanket

FINAL FIRE TEST REPORT IS AVAILABLE FROM B & B INSULATION UPON WRITTEN REQUEST.

PIPE PENETRATIONS

MAXIMUM SIZE (Piping). . . . . *12"Ø pipe sleeve*
(HVAC/Gap) . . . . . *12" x 48" Plockout with 36" x 4" HVAC with gaps of 6", 2", 1" and ½"*

MATERIAL . . . . . *Dow Corning 3-6548 Silicone RTV Foam, Dow Corning 96-081 and Dow Corning 732 Adhesive Sealants*

DENSITY . . . . . *14.0 lb/ft^3 MINIMUM (4"x2"x2" free rise method)*
SEE NOTE FOR DENSITY ON CABLE PENETRATIONS

SEAL DEPTH . . . . . *7" MINIMUM (1" dam - 6" foam) We propose that a six inch (6") annulus rule be accepted based on results of this test. i.e. Open annulus of greater than six inches (6") shall be sealed with ten inches (10") of seal material plus damming. Open annulus of six inches (6") or less shall be sealed with six inches (6") of seal material plus damming. 1/2" bead Dow Corning 96-081 or Dow Corning 732 Adhesive Sealants on openings of 1/2" or less.*

DAM MATERIAL . . . . . *Johns-Manville Type 126/Johns-Manville Type 103 Ceraboard (1" nominal)*
Babcock & Wilcox Kaowool 'M' Board (1" nom.)
Johns-Manville Cerafiber/Babcock & Wilcox Kaowool Ceramic Fiber
Johns-Manville Cerablanket/Babcock & Wilcox Kaowool Ceramic Blanket

LIMITATIONS

TRAY TYPE . . . . . *Ladder back and solid back (no limitations)*

CABLE CONSTRUCTION . . . . . *No Limitations*

% CABLE LOADING . . . . . *100% Visual*

FINAL FIRE TEST REPORT IS AVAILABLE FROM B & B INSULATION UPON WRITTEN REQUEST.

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J Corney Vice President

August 25, 1980

Mr. L. Charles Spriggs
Quality Assurance Manager
B&B Insulation, Inc.
Post Office Box 2531
Houston, Texas 77001

Dear Charlie:

This will confirm the items discussed during your visit of August 22 to Farmington. Southwest Research Institute Reports of the 3 hour fire endurance and hose stream tests conducted on May 20, and May 27, 1980, which included various electrical and mechanical floor penetrations in test slabs 1A and 2 have been reviewed and are acceptable to American Nuclear Insurers for Insurance Purposes. ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance forms have been issued.

As we discussed, a maximum 6" annular space in Mechanical Penetrations is acceptable based on the successful test of Blockout No. 3 in Slab 1A which was sealed with 6" of Dow Corning 3-6548 Silicone Foam and 1" of B&W 'M' Board or Type 126 Ceraboard damming.

It is understood that you will be forwarding to us the sample of B&B Insulation Penetration sign-off sheet for addition to your Q.C. program in the near future.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

RFM:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington Connecticut 06032 / (203) 677-7305 ◘ Eng. Dept. (203) 677-7715 / TLX No. 643-029

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

B & B INSULATION, INC.

May 1, 1981

TO: VENDORS/SUPPLIERS HOLDING AN ANI ACCEPTANCE FOR A CABLE AND/OR PIPE PENETRATION FIRE STOP SYSTEM(S)

Please find attached two copies of American Nuclear Insurers' "Notification of ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance" Form for each system or design that you currently have an acceptance.

The form has been revised to include the name of the testing organization involved in the acceptance test, and the last paragraph regarding acceptance information has also been revised.

This revised acceptance form is valid for two (2) years from the date issued and the holder of the ANI acceptance should request that the form be re-issued at the end of the two year period.

If there are any questions/comments, please direct them to Mr. William Bornhoeft, Director - Property, Technical Review Section.

Sincerely,

J. J. Carney (RFM)

John J. Carney, Vice President
Property Engineering Department

JJC:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng Dept (203) 677-7715 / TLX No. 643-029

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/20/80 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	42" X 46"	4" pipe in 2" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Dow Corning 3-6548 RTV Silicone Foam Density: 14-20 lbs./cu. ft.	Same as for cable.
Fire Stop Thickness	Cable trays: 10" foam + 1" damming Conduit: 6" foam + 1" damming	6" foam + 1" damming
Form Material	Cable trays: Johns-Manville ceraboard or B + W 'M' Board Conduit: Cerafiber or Kaowool	B + W 'M' board or type 126 ceraboard

SPECIAL LIMITATIONS

Tray Types: OPEN LADDER + SOLID BOTTOM Cable Construction: NO LIMITATIONS
% Cable Loading: 100% Tray, 100% Conduit Max. Conduit Sleeve Size: 6"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. F. Carney (GEM)
John F. Carney

AMERICAN NUCLEAR INSURERS

MAERP
MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/20/80

HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	4" conduit	2 1/2" pipe in 4" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Dow Corning sylgard 170 Silicone Elastomer Density: 84 lbs./cu. ft.	Dow Corning 96-081 or 732 Adhesive sealants with or without Johns-Manville cerafiber
Fire Stop Thickness	Conduit: 4" silicone elastomer + 1" damming	1/2" bead of adhesive sealant at top + bottom of sleeve or 1/2" bead of sealant at top over 3" of cerafiber
Form Material	Johns-Manville cerafiber	

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: NO LIMITATIONS
% Cable Loading: N/A Tray, 50% Conduit Max. Conduit Sleeve Size: 4"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (WM)
John J. Carney

THREE HOUR QUALIFICATION TEST

DATA SHEET

SLAB TWO CTP-1002

(SOUTHWEST RESEARCH PROJECT 03-6004-004, DATED JULY 25, 1980)

CABLE PENETRATIONS

MAXIMUM SIZE	*42"x46" - Trays, 4"Ø - Conduit*
CABLE TRAY TYPE	*Ladder back and solid back*
CABLE CONSTRUCTION	*Polyethylene insulation with PVC jacket*
CABLE SIZE	*One third - 300 MCM (1 conductor)* *One third - 12 AWG (7 & 9 conductor)* *One third - 16 AWG (2 conductor)*
CABLE LOADING	*Up to 100% VISUAL* *(For cable size and loading specifics, see table on page I-27 of Slab Two Report)*
MATERIAL - Penetrations (trays) 1.1 to 1.7; 3.1, 3.2 & 3.4 (Conduit)	*B & B 150 lb. Hi-Density Matrix*
DENSITY	*150 lb/ft^3 MINIMUM (This minimum is accepted by the industry as providing effective gamma shielding by approximate same density as adjacent concrete.*
SEAL DEPTH - Penetrations 1.1 to 1.7, & 3.4	*Full depth of wall or floor (shielding purposes)*
Penetrations (Conduit) 3.1 & 3.2	*Six inches (6") minimum*
DAM MATERIAL	*Non-combustible forming used and removed (may be left in place in limited accessibility conditions). Large blockouts may necessitate addition of re-bar, etc. to maintain structural stability.*

FINAL FIRE TEST REPORT IS AVAILABLE FROM B & B INSULATION UPON WRITTEN REQUEST.

PIPING PENETRATIONS

MAXIMUM SIZE	*12"Ø pipe sleeve*
MATERIAL	*B&B Insulation 150 lb. Hi-Density Matrix* *B&B Insulation 150 lb. "RAD-FLEX 12" w/boots* *B&B Insulation 150 lb. "RAD-FLEX 14" w/boots* *Flexible Boots with ceramic fiber blanket fill* *Flexible Boots with Silicone RTV Foam fill* *Dow Corning 96-081 and 732 Adhesive Sealant*
DENSITY	*150 lb. Hi-Density Matrix and 150 lb. "RAD-FLEX" Matrices - 150 lb/ft^3 MINIMUM* *3-6548 Silicone RTV Foam - 14.0 lb/ft^3 MINIMUM*
SEAL DEPTH	*150 lb. Hi-Density Matrix - FULL DEPTH of wall or floor (Shielding purposes)* *150 lb. "RAD-FLEX" matrices - FULL DEPTH of sleeve plus boots* *Flexible Boots with ceramic fiber blanket fill - 12" MINIMUM* *Flexible boots with Silicone RTV Foam fill FULL DEPTH OF SLEEVE PLUS BOOTS*
DAM MATERIAL	*150 lb. Hi-Density Matrix - Non-combustible forming used and removed (May be left in place in limited accessibility conditions)* *150 lb. "RAD-FLEX" - none required*

LIMITATIONS

TRAY TYPE	*Ladder back and solid back (no limitations)*
CABLE CONSTRUCTION	*No limitations*
% CABLE LOADING	*100% Visual*

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

May 1, 1981

TO: VENDORS/SUPPLIERS HOLDING AN ANI ACCEPTANCE FOR A CABLE AND/OR PIPE PENETRATION FIRE STOP SYSTEM(S)

Please find attached two copies of American Nuclear Insurers' "Notification of ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance" Form for each system or design that you currently have an acceptance.

The form has been revised to include the name of the testing organization involved in the acceptance test, and the last paragraph regarding acceptance information has also been revised.

This revised acceptance form is valid for two (2) years from the date issued and the holder of the ANI acceptance should request that the form be re-issued at the end of the two year period.

If there are any questions/comments, please direct them to Mr. William Bornhoeft, Director - Property, Technical Review Section.

Sincerely,

J. J. Carney (RFM)

John J. Carney, Vice President
Property Engineering Department

JJC:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington Connecticut 06032 / (203)677-7305 ■ Eng. Dept. (203)677-7715 / TLX No. 643-029

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/27/80 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	42" X 46"	4" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Hi-density leaded matrix Density: 150 lbs./cu. ft.	Same as for cable
Fire Stop Thickness	Cable trays and 4" conduit: 12" Hi-density leaded matrix Conduit 3" or less: 6" leaded matrix + 1" damming.	12" Hi-Density leaded matrix
Form Material	Cable trays + 4" conduit: Non-combustible forming used and removed. Conduit 3" or less: Cerafiber or Kaowool.	Noncombustible forming used and removed.

SPECIAL LIMITATIONS

Tray Types: OPEN LADDER + SOLID BOTTOM Cable Construction: NO LIMITATIONS
% Cable Loading: 100% Tray, 100% Conduit Max. Conduit Sleeve Size: 4"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (KEM)
John J. Carney

NUCLEAR INSURERS

MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/27/80 | HOUR RATING: 3

GENERAL DATA

	PIPE ~~CABLE~~ PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	2" pipe in 10" sleeve	6" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	CHR No. 1032 Silicone Boot seals both sides filled with flexible rad seal matrix # 12 of # 14	Keene PE 2141 or CHR No. 1032 boot seals both side filled with cerablanket or Dow Corning DC 3-6548 silicone RTV foam.
Fire Stop Thickness	20" flexible rad seal matrix Density: 150 lbs./cu. ft.	12" cerablanket 20" silicone foam Density: 14-20 lbs./cu. ft.
Form Material	N/A	N/A

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (RFM)
John J. Carney

IRRADIATION OF FLEXIBLE RADIATION SEAL

DATA SHEET

(Performed prior to the Three Hour Fire Exposure Test as described in the THREE HOUR QUALIFICATION TEST of Slab Two, Southwest Research Institute Project No. 03-6004-004)

TEST SPECIMENS

10"Ø x 16" length pipe sleeve with a 2"Ø x 32" length pipe penetrant with a pre-fabricated boot seal on each end of sleeve. Boots constructed of CHR 1032 or Keene PE-2141 Silicone Fabric. Test Specimens prepared per B & B Procedure CTP-1004, Rev. 1, dated 03/17/80.

"RAD-FLEX" - FLEXIBLE RADIATION SEAL MATERIAL

Six separate formulations were prepared under Quality Control scrutiny by B & B Insulation personnel. Each of these formulations were installed into a test specimen prepared as described above. The purpose of the six separate formulations was to obtain the most effective material formulation to withstand a "Triple Jeopardy" exposure of 1) Radiation Exposure, 2) Cycle and Mechanical Flexibility Testing and 3) subsequent exposure to a Three Hour Fire Test per the criteria of the ASTM E-119.

FORMULATIONS TESTED

Test Specimen No. 1 . . . . . Formulation No. 1
Test Specimen No. 3 . . . . . Formulation No. 3
Test Specimen No. 4 . . . . . Formulation No. 4
Test Specimen No. 12 . . . . . Formulation No. 12
Test Specimen No. 14 . . . . . Formulation No. 14
Test Specimen No. 15 . . . . . Formulation No. 15

Quality Control Documentation is available for the preparation and installation of the various "RAD-FLEX" matrices. Actual formulation is PROPRIETARY in nature and available only to authorized parties.

IRRADIATION

The six specimens were irradiated individually to a minimum exposure of 5×10^7 Rads by Southwest Research Institute personnel. The rate of irradiation was determined to be 1×10^6 Rads/hour therefore, each specimen was irradiated for a minimum of fifty (50) hours.

Refer to the: FINAL REPORT - IRRADIATION OF FLEXIBLE RADIATION SEAL by Mr. David G. Cadena of Southwest Research Institute, dated July 2, 1980 for specific details. Copies of this Report are available upon request from B & B Insulation.

MECHANICAL FLEXIBILITY EVALUATION OF FLEXIBLE RADIATION SEALS

DATA SHEET

(Performed prior to the Three Hour Fire Exposure Test as described in the THREE HOUR QUALIFICATION TEST of Slab Two, Southwest Research Institute, Project No. 03-6004-004)

MECHANICAL FLEXIBILITY EVALUATION

TEST REQUIREMENTS - The test requirements of CTP-1004 specified three (3) separate movements to verify the flexibility of the test specimens following the irradiation of each. The initial movement was an axial movement of the center pipe of two inches (2") to each side of a neutral position. The cyclic rate was one stroke (Travel = 2") each minute or one complete cycle (Total Travel = 4") each two (2) minutes.

The second portion of the test was a vertical or transverse movement of +/- two inches (2"). Again a cyclic rate of 0.5 cycles per minute was maintained.

The third test, identified as a "thrust test", called for the same movement as in the first test sequence except the cyclic rate was increased to thirty (30) cycles per minute (0.5 cycles/sec). In all cases, the force was applied to the pipe penetrator from the "irradiated end" with the opposite end allowed free movement.

The mechanical testing as described above was performed on all six (6) test specimens.

RESULTS - (quoted from Southwest Research Institute Report)

In conducting the mechanical testing program at Southwest Research Institute, the following observations can be stated:

1. *The test procedure, as conducted, provides a "worst case" (as defined by B & B Procedure CTP-1004) condition in simulating pipe motions through a secondary seal barrier over a forty (40) year design plant life.*
2. *Test specimens 3, 4, 12, 14, and 15, completed the required tests and maintained conformance to the flexibility requirements referenced in the B & B Procedure CTP-1004.*
3. *Test Specimen No. 12 exhibited the most desirable performance by demonstrating only minor physical changes from the non-irradiated condition and still displaying virtually free movement characteristics after all tests were completed.*
4. *Test Specimen Numbers 14 and 15 also exhibited acceptable performance, but were not considered as desirable as Specimen Number 12.*

Refer to the: FINAL REPORT - MECHANICAL FLEXIBILITY EVALUATION OF FLEXIBLE RADIATION SEALS by Mr. George K. Wolfe of Southwest Research Institute, dated July 8, 1980 for specific details. Copies of this Report are available upon request from B & B Insulation.

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

May 1, 1981

TO: VENDORS/SUPPLIERS HOLDING AN ANI ACCEPTANCE FOR A CABLE AND/OR PIPE PENETRATION FIRE STOP SYSTEM(S)

Please find attached two copies of American Nuclear Insurers' "Notification of ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance" Form for each system or design that you currently have an acceptance.

The form has been revised to include the name of the testing organization involved in the acceptance test, and the last paragraph regarding acceptance information has also been revised.

This revised acceptance form is valid for two (2) years from the date issued and the holder of the ANI acceptance should request that the form be re-issued at the end of the two year period.

If there are any questions/comments, please direct them to Mr. William Bornhoeft, Director - Property, Technical Review Section.

Sincerely,

J. J. Carney (RFM)

John J. Carney, Vice President
Property Engineering Department

JJC:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX. No. 643-029

NUCLEAR INSURERS

MUTUAL ATOMIC ENERGY REINSURANCE POO

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/27/80

HOUR RATING: 3

GENERAL DATA

	PIPE CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	2" pipe in 10" sleeve	6" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	CHR No. 1032 Silicone Boot seals both sides filled with flexible rad seal matrix # 12 of # 14	Keene PE 2141 or CHR No. 1032 boot seals both side filled with cerablanket or Dow Corning DC 3-6548 silicone RTV foam.
Fire Stop Thickness	20" flexible rad seal matrix Density: 150 lbs./cu. ft.	12" cerablanket 20" silicone foam Density: 14-20 lbs./cu. ft.
Form Material	N/A	N/A

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (RFG)
John J. Carney

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J. Carney, Vice President

August 12, 1982

Mr. L. Charles Spriggs
Quality Assurance Manager
Fire Safety Division
B&B Insulation, Inc.
P.O. Box 2531
Houston, Texas 77001

Dear Mr. Spriggs:

We have reviewed the B&B Insulation, Inc. Fire Qualification Test on Penetration Seals Test Slab No. 4. These tests were conducted on April 21, 1982 at Southwest Research Institute. Enclosed are two copies each of the ANI/MAERP Fire Stop System Acceptance form for the configurations sealed with Light Density Silicone Elastomer or B&B FIREFLEX that successfully passed tests CTP-1024 and CTP-1025.

In addition, B&B Type 1 and Type 4 sleeve extenders were tested with a 2" pipe in a 6" corebore or 10" embedded sleeve sealed with alumina-silica blanket or Radflex seal. These Type 1 and Type 4 sleeve extenders are acceptable to American Nuclear Insurers for Insurance Purposes Only.

A 2" pipe in a 10" sleeve with an annulus reducer of High Density Leaded Elastomer (HDLE-A) min. density of 147 lbs./cu. ft. was also tested to facilitate pipe movement up to 1/2" in lateral direction with flexible boot seals on both ends and alumina-silica blanket inserted within the boots. This annulus reducer is also acceptable to ANI for Insurance Purposes.

A comparison test of 8" HDLE-A previously tested, with HDLE modified with the addition of accelerators or a metal filler other than lead to obtain the same minimum density of 147 lbs./cu. ft. was also tested and is acceptable to American Nuclear Insurers for Insurance Purposes Only.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan
Project Engineer

RFM:dm

The Exchange, Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX No. 643-029

ATTACHMENT 2

AMERICAN NUCLEAR INSURERS

MAERP
MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/20/80 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	4" conduit	2 1/2" pipe in 4" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Dow Corning sylgard 170 Silicone Elastomer Density: 84 lbs./cu. ft.	Dow Corning 96-081 or 732 Adhesive sealants with or without Johns-Manville cerafiber
Fire Stop Thickness	Conduit: 4" silicone elastomer + 1" damming	1/2" bead of adhesive sealant at top + bottom of sleeve or 1/2" bead of sealant at top over 3" of cerafiber
Form Material	Johns-Manville cerafiber	

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: NO LIMITATIONS
% Cable Loading: N/A Tray, 50% Conduit Max. Conduit Sleeve Size: 4"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/condui

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (WCA)
John J. Carney

v

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J Carney Vice President

August 25, 1980

Mr. L. Charles Spriggs
Quality Assurance Manager
B&B Insulation, Inc.
Post Office Box 2531
Houston, Texas 77001

Dear Charlie:

This will confirm the items discussed during your visit of August 22 to Farmington. Southwest Research Institute Reports of the 3 hour fire endurance and hose stream tests conducted on May 20, and May 27, 1980, which included various electrical and mechanical floor penetrations in test slabs 1A and 2 have been reviewed and are acceptable to American Nuclear Insurers for Insurance Purposes. ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance forms have been issued.

As we discussed, a maximum 6" annular space in Mechanical Penetrations is acceptable based on the successful test of Blockout No. 3 in Slab 1A which was sealed with 6" of Dow Corning 3-6548 Silicone Foam and 1" of B&W 'M' Board or Type 126 Ceraboard damming.

It is understood that you will be forwarding to us the sample of B&B Insulation Penetration sign-off sheet for addition to your Q.C. program in the near future.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

RFM:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX No. 643-029

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/20/80 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	42" X 46"	4" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Dow Corning 3-6548 RTV Silicone Foam Density: 14-20 lbs./cu. ft.	Same as for cable.
Fire Stop Thickness	Cable trays: 10" foam + 1" damming Conduit: 6" foam + 1" damming	6" foam + 1" damming
Form Material	Cable trays: Johns-Manville ceraboard or B + W 'M' Board Conduit: Cerafiber or Kaowool	B + W 'M' board or type 126 ceraboard

SPECIAL LIMITATIONS

Tray Types: OPEN LADDER + SOLID BOTTOM Cable Construction: NO LIMITATIONS
% Cable Loading: 100% Tray, 100% Conduit Max. Conduit Sleeve Size: 6"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/condui

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. F. Carney (FEM)
John F. Carney

FIRE QUALIFICATION TEST ON SILICONE FOAM FLOOR PENETRATION SEALS

SLAB 1A

PROJECT NO. 03-6004-006

by
Michael D. Pish
Larry J. Poirier

FINAL REPORT

B & B INSULATION INC.
P.O. BOX 2531
HOUSTON, TEXAS 77001

JULY 25, 1980

Reviewed:

George K. Wolfe

George K. Wolfe, P.E.
Manager, Special Projects
Ocean Engineering and Structural Design

Approved:

Edward M. Briggs

Edward M. Briggs, Director
Ocean Engineering
and Structural Design

B & B INSULATION, INC.

EXCERPTS FROM FINAL REPORT

FULL REPORT AVAILABLE UPON REQUEST FROM:

B & B INSULATION, INC.
P. O. Box 2531
Houston, TX 77001

SUMMARY

On 20 May 1980, twenty-six cable tray and pipe sleeve penetrations designed by B & B Insulation Incorporated were exposed to a three-hour fire endurance test following the ASTM E119-76 time/temperature curve.

The purpose of the test was to qualify electrical and mechanical radiation seals per current regulatory requirements and guidelines of the American Nuclear Insurers, (ANI); Nuclear Mutual Limited, (NML); and the Institute of Electrical and Electronic Engineers, (IEEE). In addition, a hose stream test as described in Section 5.3.12 of IEEE 634 and Section 2.B.2 of NEL-PIA/MAERP Standard Method of Fire Tests was to be applied. These standards are reproduced in Appendix VI. The test was performed to provide documented evidence that the penetrations as described herein will satisfactorily withstand an ASTM E119 fire exposure and shall conclusively demonstrate that these seal designs will provide an effective fire barrier for a three hour ANI acceptance rating.

Penetration seal construction consisting of various loaded cable tray and pipe seal openings sealed with Dow Corning Silicone RTV Foam products. In some cases, alumina silica material such as Kaowool and Ceraboard was used as damming material. The test slab, laboratory facilities, and cable loading was provided by Southwest Research Institute and cable seal material and installation was furnished by B & B Insulation. Quality Assurance functions were performed by B & B's parent company, INSULCO, Incorporated.

Test Attendees

Conducting the test:

Mr. Jesse Bietel, Test Engineer
Mr. Michael D. Pish, Project Manager
Dr. Frank Faraese, Consultant
Mr. A. L. Schraeder, Test Coordinator

Witnessing the test:

Mr. L. Charles Spriggs, INSULCO Incorporated
Mr. Kendall Harris, B & B Insulation Inc.

DESCRIPTION

A test slab with four blockout openings and six pipe sleeves was used. One of the blockout openings consisting of a 46" x 42" cable tray opening; another was a 26" x 42" opening; a third was 48" x 12"; and the fourth was 54" x 12". Four of the pipe sleeves were 4" standard pipe size and the remaining two sleeves were 12" pipe. A detailed description of each opening is contained in the discussion of the test slab construction, and the slab layout is shown in Figures 1 and 2.

All openings were cast into an 8' x 10' x 12" thick concrete slab. Once cured, the various penetration seal materials, cables, and mechanical penetrations as described in Appendix I were installed. Penetration identification is shown in Figure 3. Cable loading and pipe or conduit penetration sizes is shown in Figure 4. The penetration seal materials were allowed to cure prior to the fire exposure test.

The test slab was placed on a horizontal furnace and exposed to the standard ASTM E119 time/temperature curve. After three hours, the test slab was lifted in a horizontal position for the hose stream test and then moved to an area adjacent to the furnace, where it was put on blocks to cool and view.

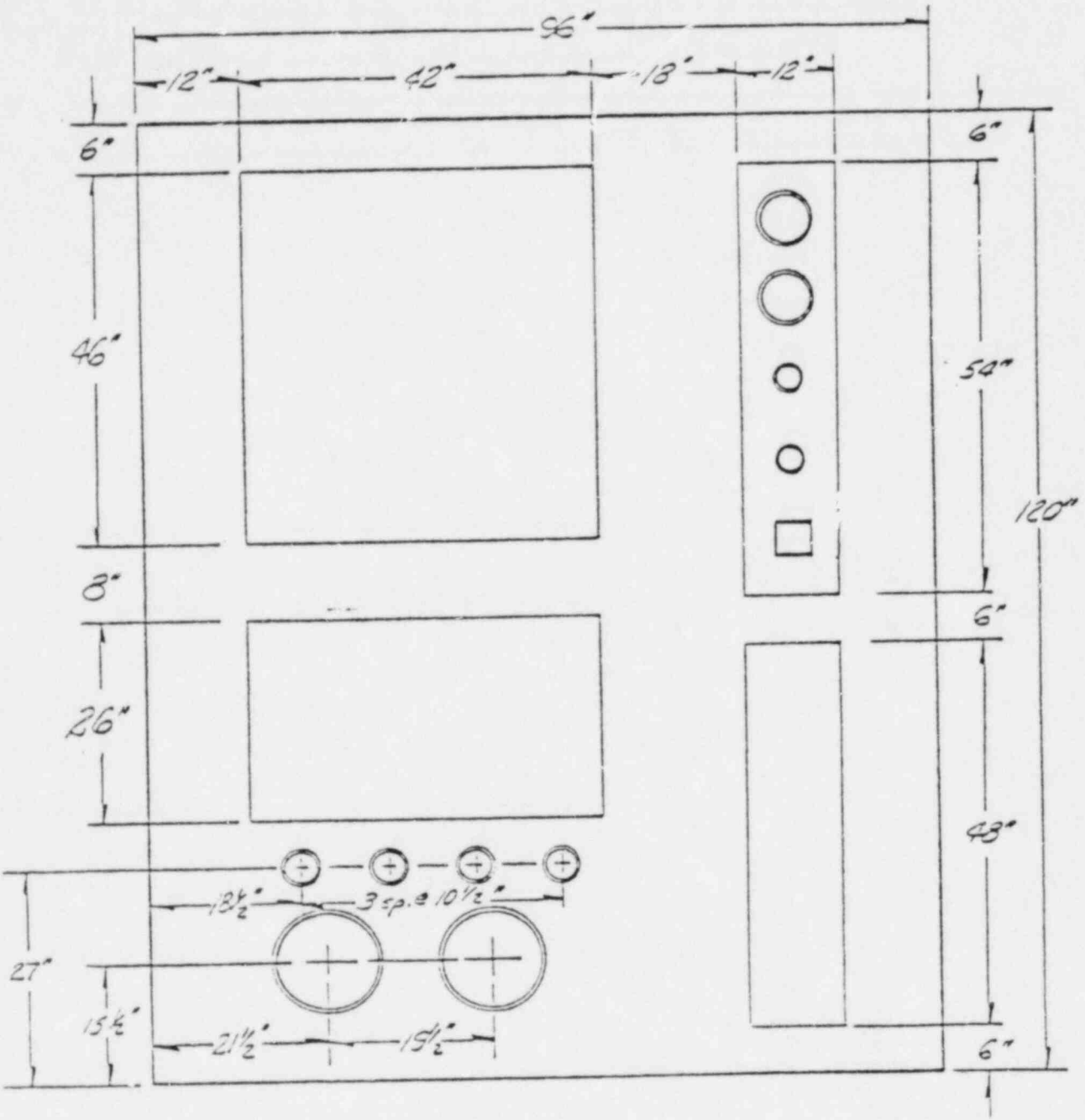


Figure 1. Slab Layout

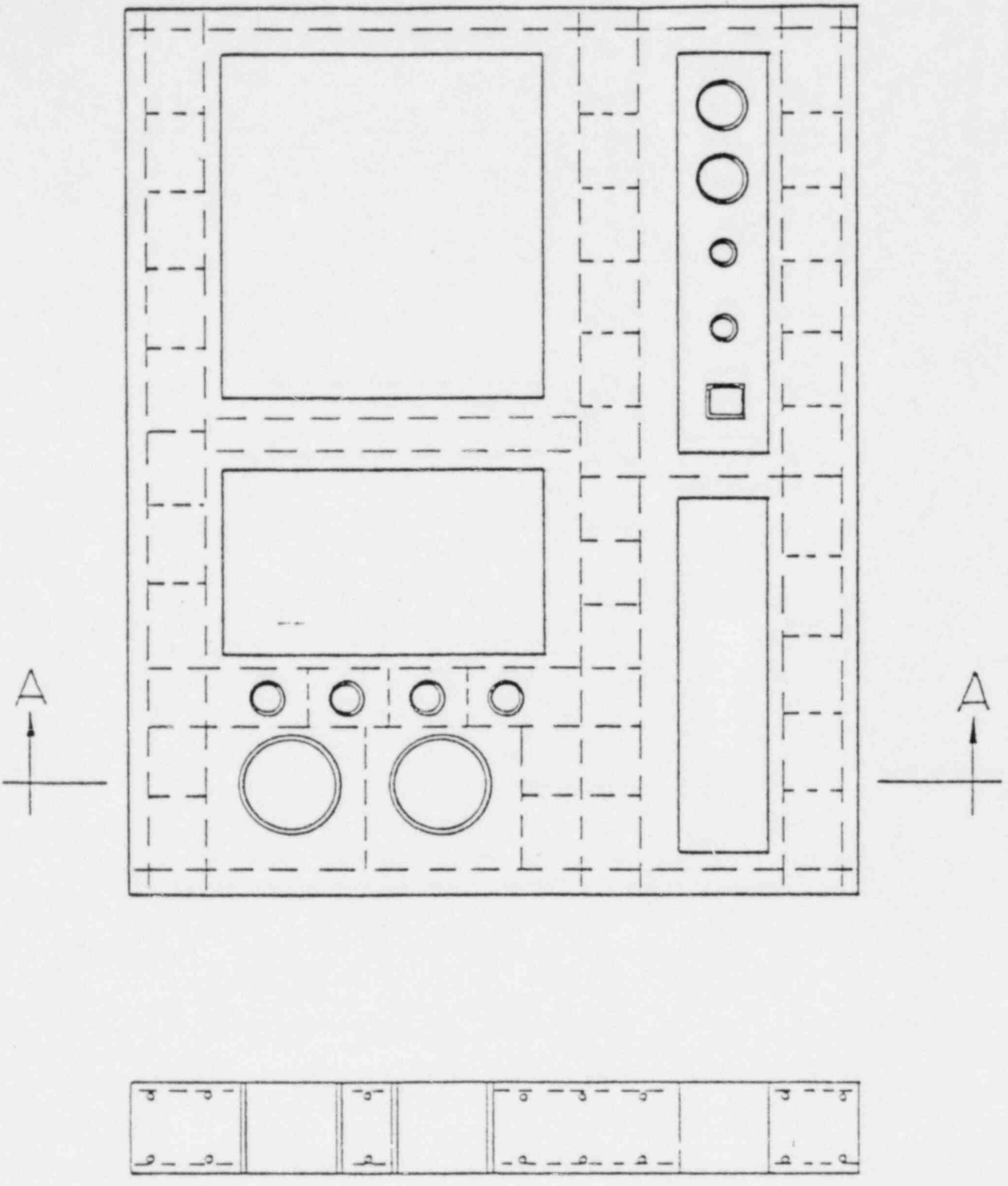


Figure 2. Reinforcement Detail

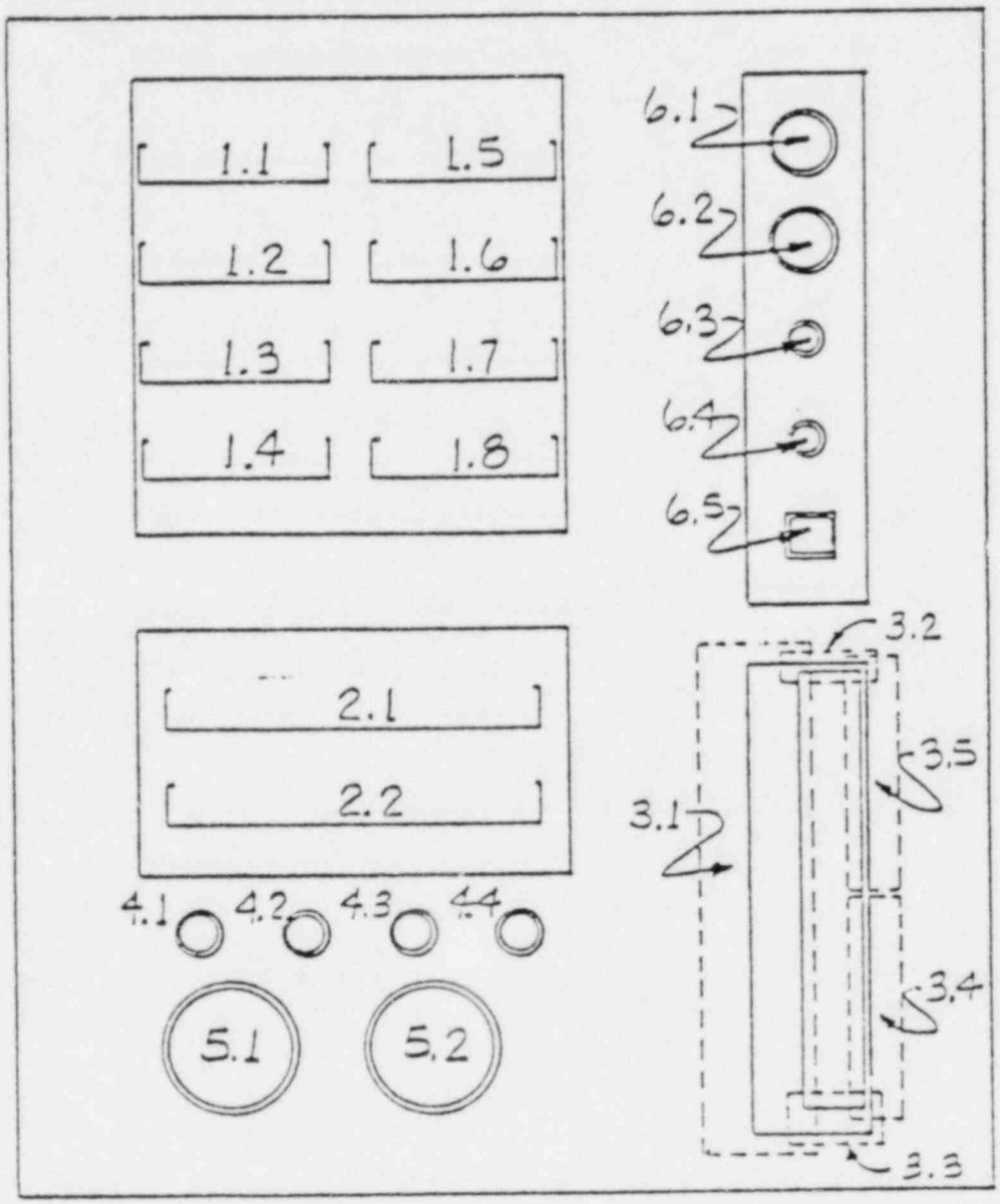


Figure 3. Penetration Identification

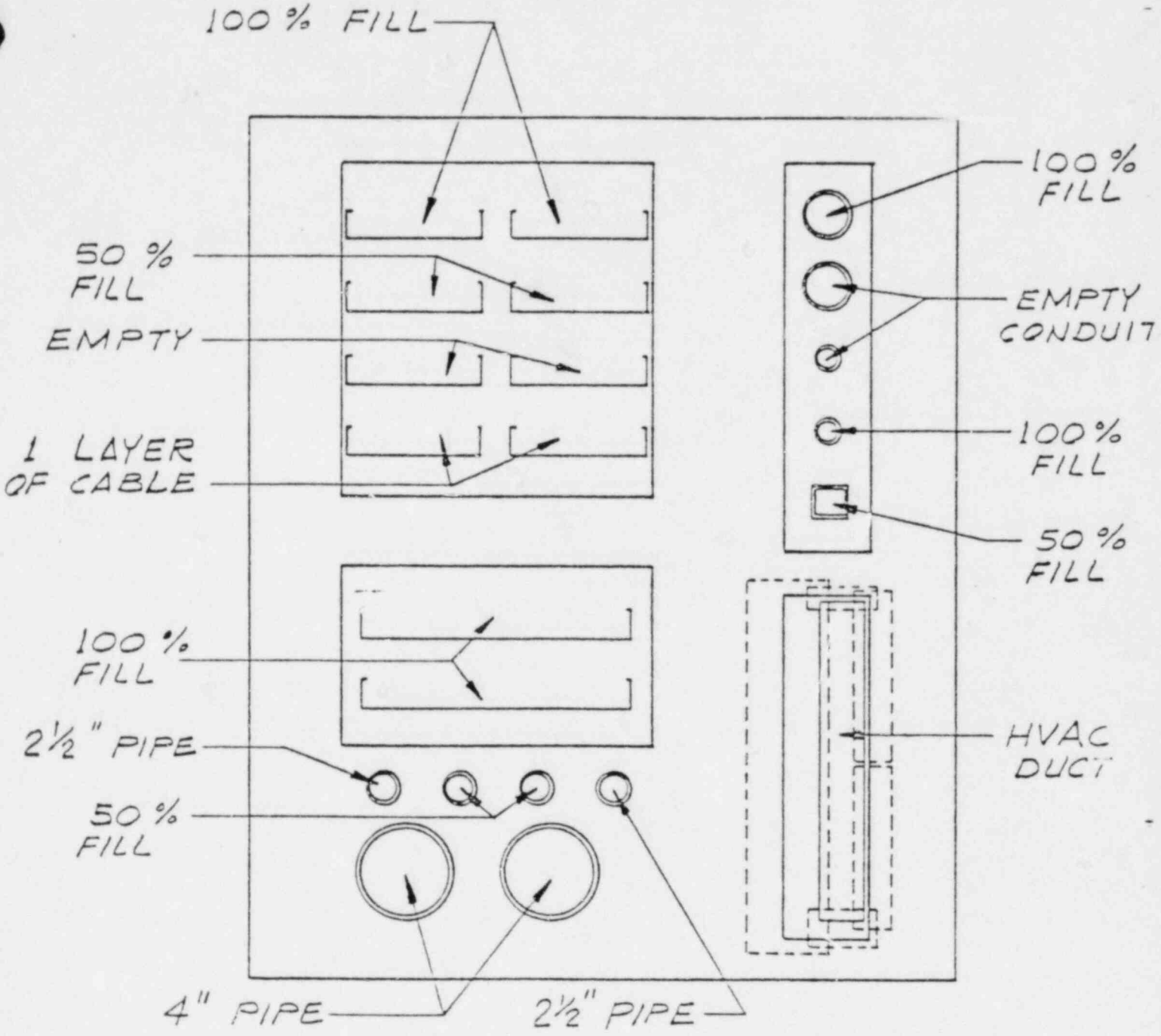


Figure 4. Cable Loading

TEST SLAB

A. Construction

The slab used for this test was one that had been previously constructed for a similar test. It was a floor section form, 8' x 10' x 12" thick constructed of 12" steel channel with a double mat of 1" rebar on 10 inch centers. A series of nine penetration openings were cast into the slab. Three of the openings were cable tray blockouts, the first being 80" x 42", another being 54" x 12" and the third being 48" x 12". The remaining openings were pipe sleeves, four of them being 4" diameter, and two were 12" diameter. The slab was modified by adding a reinforced concrete strip, 8 inches wide, in the 80" x 42" blockout, thus dividing it into two blockouts, one being 46" x 42" and the other 26" x 42".

The test slab was placed in a special enclosure and exposed to 400° F for one week in order to cure the newly poured divider. After the concrete had cured, cable tray supports were welded to the basic framework. Details of the steel framing and slab layout are shown in Figure 5.

B. Penetration Loading

The penetrations were loaded as defined by the B & B Insulation Inc. Procedure CTP-1001, revision 1, dated 5 May 1980, which is reproduced in Appendix I. The type and number of cables used in the cable penetrations is listed in Table 1.

C. Sealing of Penetrations

Seal installation was performed by B & B personnel using the materials defined in the referenced Procedure. A detailed listing of the seal installation appears in the Quality Control Documentation furnished by INSULCO, reproduced in Appendix III. Drawings of the penetration assemblies appear in Figures 6 through 34.

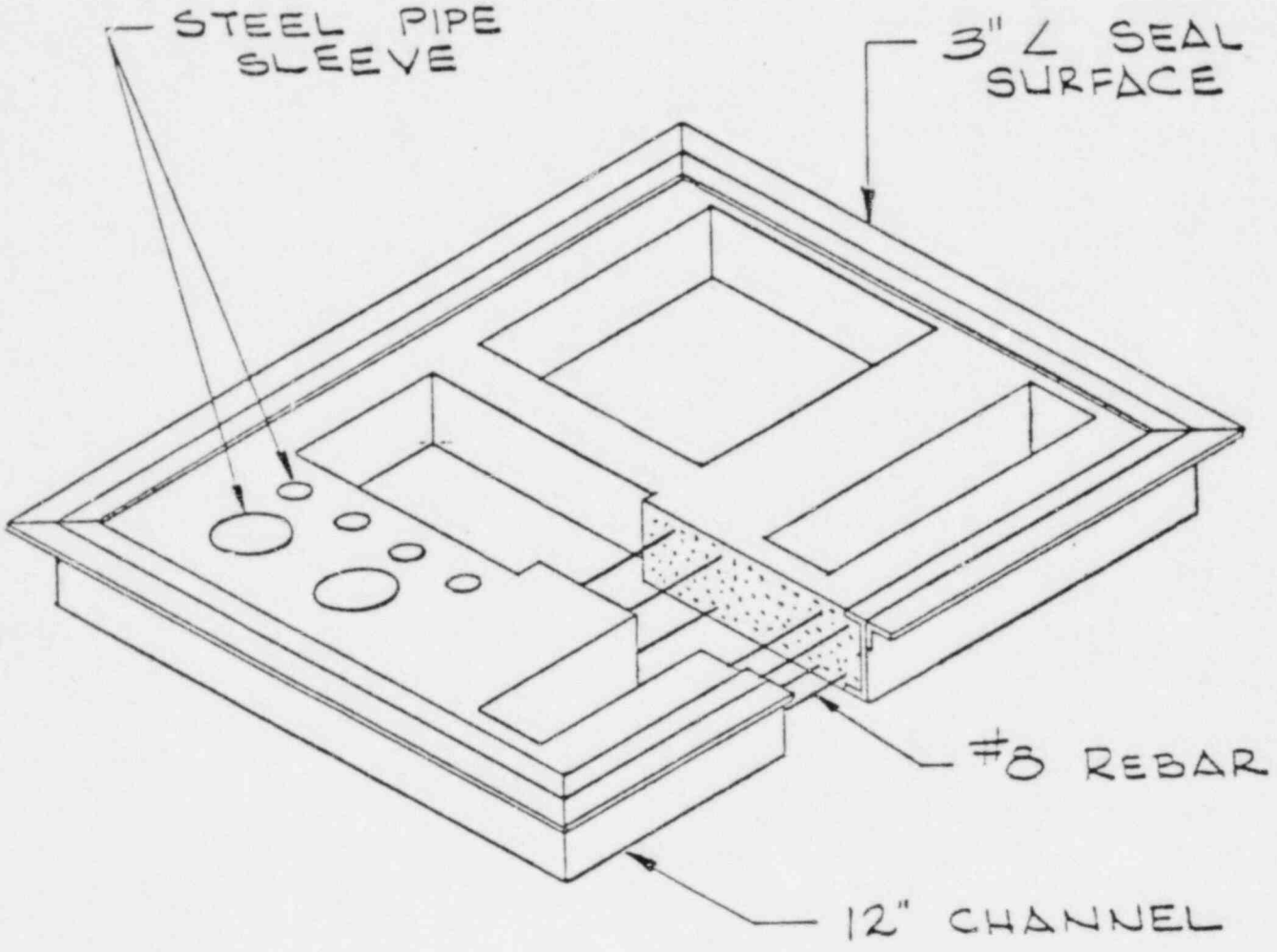


Figure 5. Schematic of Slab Layout

TABLE 1
Size and Type of Cable Per Penetration
B & B Slab 1A

Penetration No.	Loading	300 MCM (1 Cond.)	12 AWG (9 Cond.)	12 AWG (7 Cond.)	16 AWG (2 Cond.)
1.1	100%	14	28	- -	120
1.2	50%	7	16	- -	60
1.3	0	- -	- -	- -	- -
1.4	1 Layer	4	8	- -	40
1.5	100%	14	28	- -	120
1.6	50%	7	16	- -	60
1.7	0	- -	- -	- -	- -
1.8	1 Layer	4	8	- -	40
2.1	100%	30	34	12	260
2.2	100%	30	36	12	260
4.2	50%	1	2	- -	20
4.3	50%	1	2	- -	20
6.1	100%	4	8	- -	80
6.2	0	- -	- -	- -	- -
6.3	0	- -	- -	- -	- -
6.4	100%	1	2	- -	20
6.5	50%	1	2	- -	20

NOTE: All cables cross linked polyethylene insulation with PVC jacket, 600 volt rating. (See Spec sheet, App I, page 27)

Ranger Wire & Cable Company

3CD Dacoma•Houston, Texas 77092•713/681-8487

Southwest Research
6220 Culebra Rd.
San Antonio, Texas 78204

SPEC SHEET

300MCM 1 conductor

37 stranded, uncoated copper conductor

paper separator

65 mils cross-linked polyethylene insulation

60 mils poly-vinyl-chloride over-all

600 Volt cable

---

12 AWG 7 conductor

19 stranded uncoated copper conductors

with ~~or without paper or~~ mylar separator

30 mils cross-linked polyethylene insulation

60 mils poly-vinyl-chloride aver-all

600 Volt control cable

---

16 AWG 2 conductor

19 stranded uncoated copper conductors

with ~~or without paper or~~ mylar separator

30 mils cross-linked polyethylene insulation

45 mils poly-vinyl-chloride over-all

600 Volt control cable

TEST FACILITY

&

TEST PROCEDURE

TEST FACILITY

The floor penetration assembly fire resistance test was conducted using a horizontal furnace with an open area of 8 x 10 feet. (See Figure 35). A flue gas opening was provided on one end. Eight Maxon self-aspirating burners were mounted in the sides of the furnace. Eight furnace temperature thermocouples were located 2-1/2 ft. inside each wall at 2 ft. centers with the first pair of thermocouples 1-1/2 ft. from the flue end of the furnace at the 24 inch elevation. Eighty-six thermocouples on the unexposed side and embedded in the seal materials of the penetration seals were connected to multi-point temperature recorders with a range of zero to 2000°F. The temperature data is contained in Appendix IV, and the recording system is outlined in Appendix V.

All gas flow to the burners was controlled manually and continuously indicated by the average of six furnace temperature thermocouple readings taken at 12 inches from the exposed specimen surface. These average temperatures are shown in Figure 36 and Table 2. Since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E119 standards. This structure was adequate to prevent excessive air currents over the unexposed surface of the slab. The outside temperature was approximately 85 degrees at the start of the test.

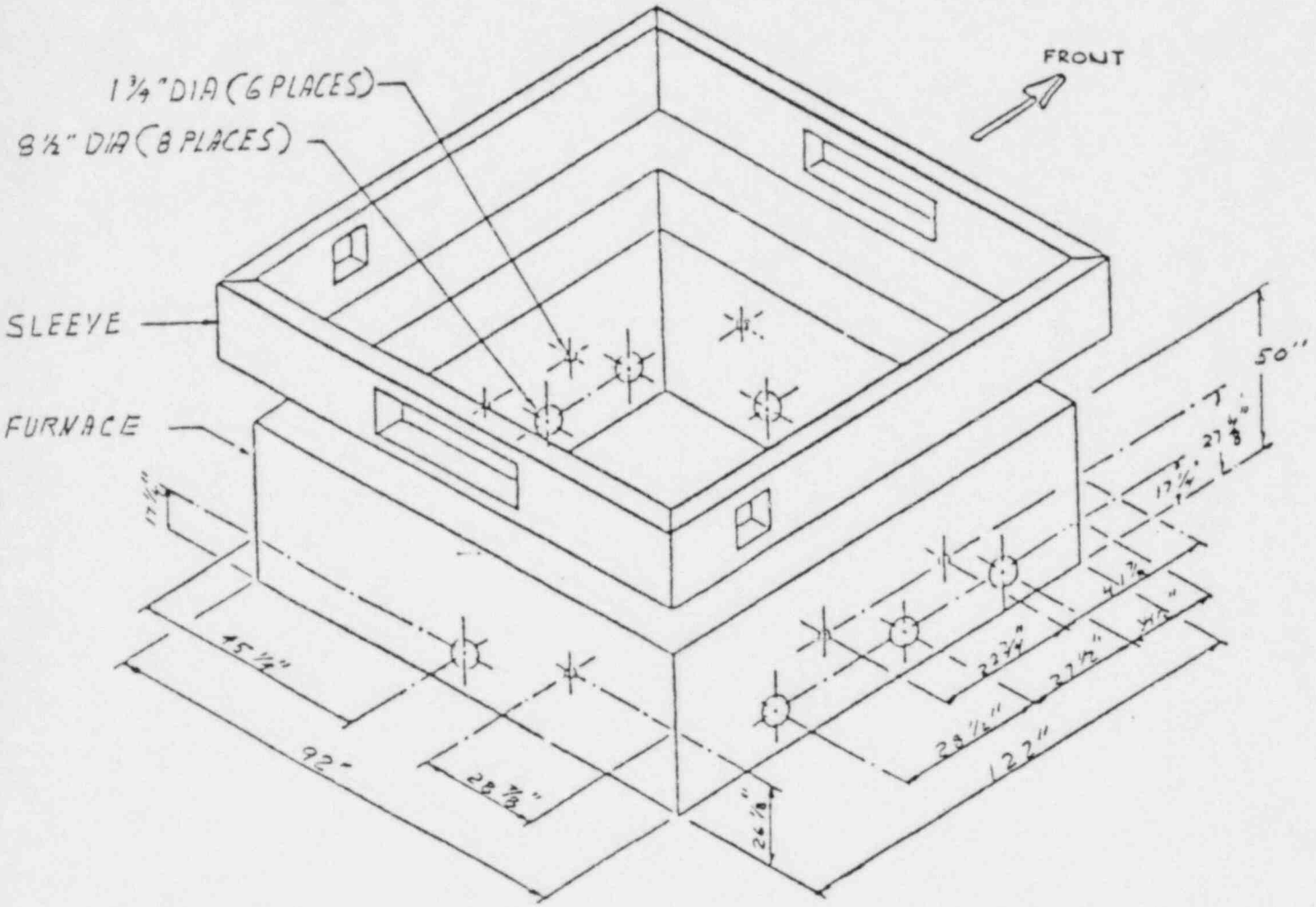


Figure 35. Test Furnace

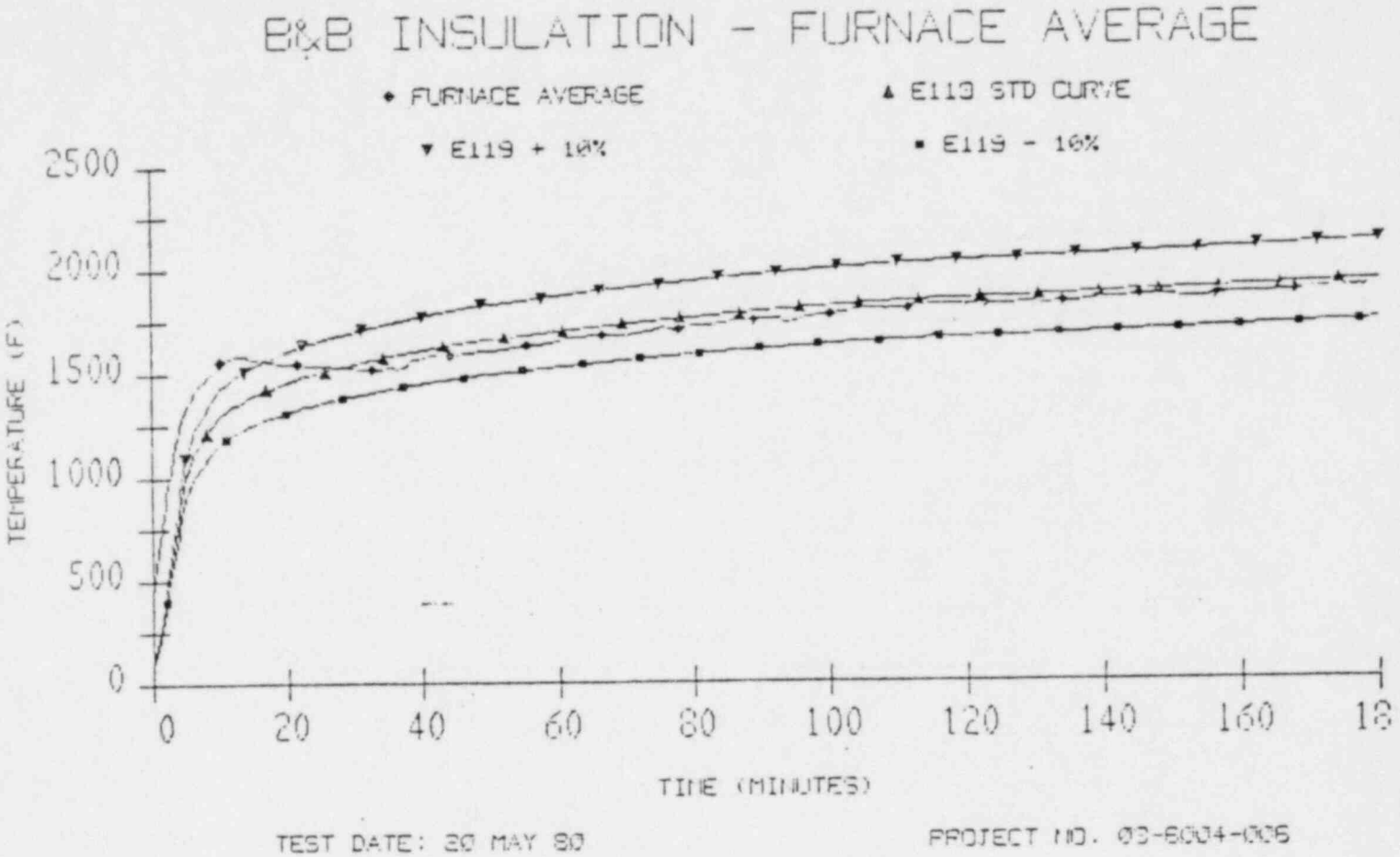


Figure 36. Furnace Temperature

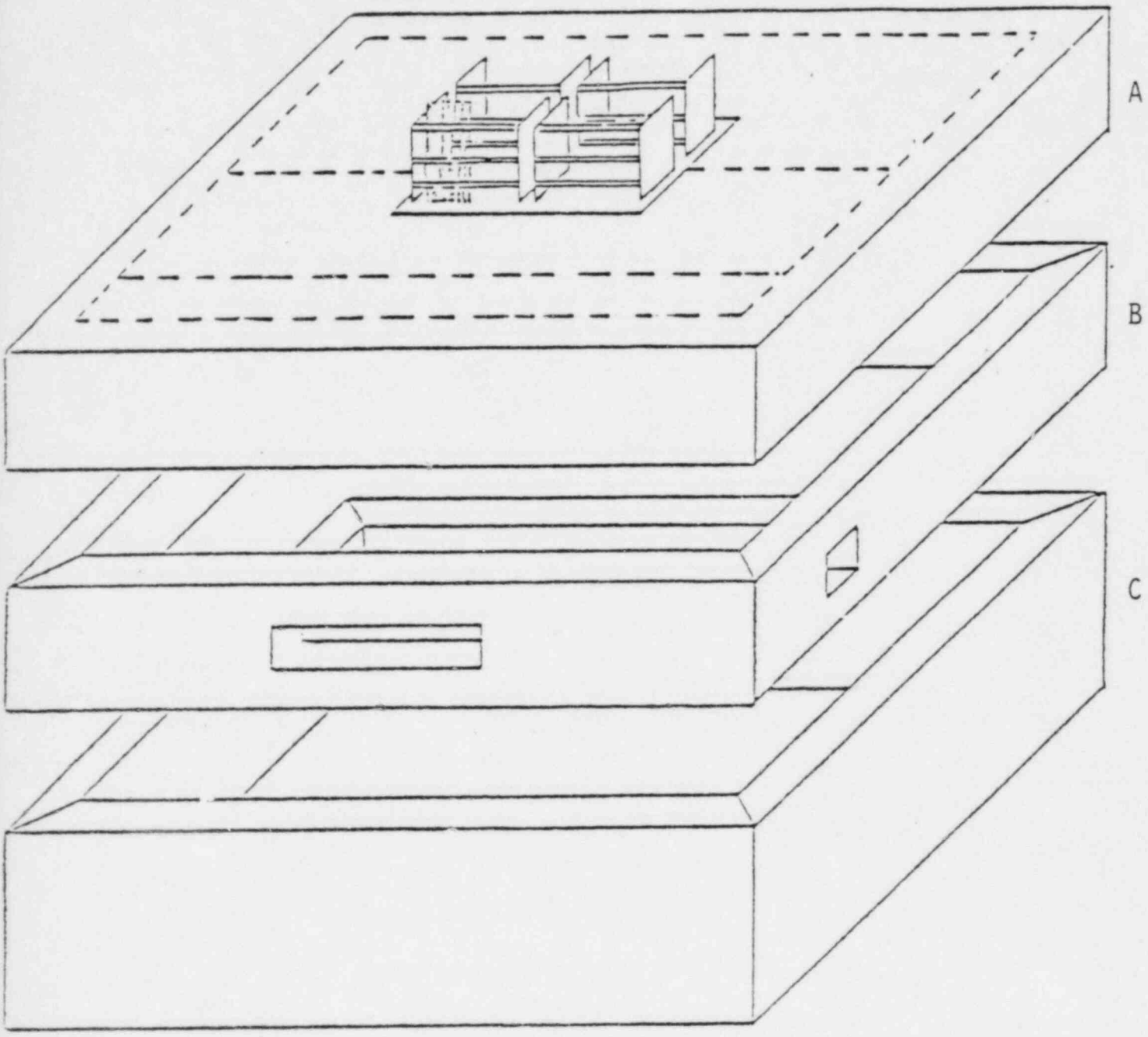
TABLE 2

ASTM E119 Time/Temperature Curve

Time	Standard Curve	-10%	Actual	+10%	Time
0	70	63	75	77	0
1	200	180		220	1
2	400	360		440	2
3	600	540		660	3
4	800	720		880	4
5	1000	900	1326	1100	5
6	1100	990		1212	6
7	1150	1035		1265	7
8	1200	1080		1320	8
9	1250	1125		1375	9
10	1300	1170	1547	1430	10
11	1320	1188		1452	11
12	1350	1206		1474	12
13	1360	1224		1496	13
14	1380	1242		1518	14
15	1399	1259	1569	1539	15
16	1414	1274		1555	16
17	1429	1286		1572	17
18	1435	1291		1579	18
19	1450	1305		1595	19
20	1462	1316	1549	1608	20
21	1474	1327		1621	21
22	1486	1337		1635	22
23	1498	1348		1648	23
24	1500	1350		1650	24
25	1510	1359	1542	1661	25
26	1520	1368		1672	26
27	1528	1375		1681	27
28	1537	1363		1691	28
29	1541	1387		1695	29
30	1550	1395	1531	1705	30
35	1584	1425	1531	1742	35
40	1613	1452	1577	1774	40
45	1630	1467	1590	1793	45
50	1661	1495	1605	1827	50
55	1681	1513	1630	1849	55
60	1700	1530	1652	1870	60
65	1718	1546	1681	1890	65
70	1735	1561	1679	1909	70
75	1750	1575	1711	1925	75
80	1765	1589	1726	1941	80
85	1779	1601	1736	1957	85
90	1792	1613	1751	1971	90
95	1804	1624	1743	1984	95
100	1815	1633	1775	1994	100
105	1826	1643	1798	2009	105
110	1835	1651	1804	2019	110
115	1843	1659	1816	2027	115
120	1850	1665	1812	2035	120
130	1862	1676	1826	2048	130
140	1875	1687	1844	2063	140
150	1888	1699	1856	2077	150
160	1900	1710	1868	2090	160
170	1912	1721	1880	2103	170
180	1925	1733	1909	2117	180

TEST PROCEDURE

The prepared floor penetration slab with fire stop materials in place was placed in position on top of the furnace. The temperature multi-point recorders were turned on, natural gas was supplied to the burners, ignited, and the test clock was started. The unexposed surface was continuously observed for penetration by flame or hot gases and its temperature monitored, by using the multipoint recorders. At the end of the three hour fire exposure period, the fuel gas was shut off and the enclosure building was removed. The test slab was lifted from the furnace, remaining in a horizontal position. A 15^{o} spray stream supplied from a 1 1/2 inch fire hose with a spray stream setting and 75 psi nozzle pressure and 75 gpm delivery was then directed at the floor penetration fire stops from a distance of 10 feet to conduct the hose stream test. This hose stream test is identified in Section 5.3.12 of IEEE 634-1978 and Section 2.B.2. of NEL-PIA/MAERP Standard Method of Fire Tests, both of which are reproduced in Appendix VI. The required hose stream application time for penetrations installed in a 10 x 8 ft. slab was 2 minutes. The time/temperature record of the test is shown in Figure 36 and Table 2. Figure 37 shows an exploded view of the test setup.



A) Test Slab (Typical)

B) Furnace Extension Sleeve

C) Furnace

Figure 37. Furnace Assembly

TEST RESULTS

TEST RESULTS

A. Observations

The following are observations madeduring the fire exposure period, the hose stream test, and the post test inspection.

TABLE 3. TEST OBSERVATIONS

Test Time	Event
-0:05	Furnace loaded, systems ready. Ambient temperature approximately 85°F.
0:00	Burners on, timer on, recorders on, start test
0:05	Temp. 1326°F Fast rise, reduce gas input
0:10	Temp. 1547°F Smoke from exposed side
0:15	Temp. 1569°F Stable
0:20	Temp. 1549°F
0:25	Temp. 1542°F Light smoke from 2.2, foam/ Cable interface
0:30	Temp. 1531°F Stable, on curve
0:35	Temp. 1531°F Heavy smoke, exposed side
0:40	Temp. 1577°F No smoke top side, stable
0:50	Temp. 1605°F
1:00	Temp. 1652°F
1:10	Temp. 1679°F Stable, on curve
1:20	Temp. 1726°F
1:30	Temp. 1751°F Light, cool smoke again, 2.2
1:40	Temp. 1775°F
1:50	Temp. 1804°F
2:00	Temp. 1812°F Smooth burn, all stable
2:10	Temp. 1826°F
2:20	Temp. 1844°F Light smoke,from 2.1 and 2.2
2:30	Temp. 1856°F Foam on 2.1 expanding
2:40	Temp. 1868°F Light smoke, cable ends, P1.2
2:50	Temp. 1880°F
3:00	temp. 1909°F End of fire exposure period
3:10	Protective cover removed
3:14	Slab hooked up for lift
3:18	Start Hose Stream Test
3:20	End of Hose Stream Test
3:25	Slab settled for examination

Post Test Observations

1. There was no passage of flame through any penetration during the fire exposure test.

2. There was some passage of light smoke through the seals, but the smoke was cool to the touch.

3. There was no passage of water through any penetration during the hose stream test.

B. Summary of Test Results

In order to be considered at an acceptable fire stop for the ANI and/or IEE, a penetration seal must have met the following requirements:

ANI

1) Fire shall not propagate to the unexposed side of the test assembly or shall any visible flaming be observed.

2) No individual thermocouple of the unexposed surface (field) of the fire stop shall exceed 325^{o}F above ambient temperature.

3) No opening develops that permits a project of water from the stream beyond the unexposed surface during the hose stream test.

IEEE 634 (Pagargaph 6.1)

1) The fire stop shall have withstood the fire endurance test without permitting the passage of flame, orthe occurrence of flaming on any element of the unexposed surface of the assembly for a period equal to the hourly classification for the fire stop.

2) The fire stop shall have withstood the fire endurance test and hose stream test without developing an opening that would permit a projection of water from the stream beyond the unexposed surface.

3) The transmission of heat through the fire stop during the fire endurance test for any recorded temperature on its unexposed surface shall not exceed 700°F on penetrations involving cable.

Accordingly, Table 4 shows the performance of the penetrations for the test period of three hours as documented in the test observation and Appendix IV.

To verify the condition of the penetration seals after the test, an examination was made to determine the char depth, the depth of any remaining insulation material, and the condition of the penetrants. The results of this examination are shown in Figures 38 through 63. Photographs of the fire exposure period, the hose stream test, and the post test condition of the penetrations can be found in Appendix II.

TABLE 4

TEST RESULTS

Penetration Number	ANI TEST RESULTS			IEEE TEST RESULTS		
	Cond.1	Cond.2	Cond.3	Cond.1	Cond.2	Cond.3
1.1	Pass	Pass	Pass	Pass	Pass	Pass
1.2	Pass	Pass	Pass	Pass	Pass	Pass
1.3	Pass	Pass	Pass	Pass	Pass	Pass
1.4	Pass	Pass	Pass	Pass	Pass	Pass
1.5	Pass	Pass	Pass	Pass	Pass	Pass
1.6	Pass	Pass	Pass	Pass	Pass	Pass
1.7	Pass	Pass	Pass	Pass	Pass	Pass
1.8	Pass	Pass	Pass	Pass	Pass	Pass
2.1	Pass	Pass	Pass	Pass	Pass	Pass
2.2	Pass	Pass	Pass	Pass	Pass	Pass
3.1	Pass	Pass	Pass	N/A	N/A	N/A
3.2	Pass	Pass	Pass	N/A	N/A	N/A
3.3	Pass	Pass	Pass	N/A	N/A	N/A
3.4	Pass	Pass	Pass	N/A	N/A	N/A
3.5	Pass	Pass	Pass	N/A	N/A	N/A
4.1	Pass	Pass	Pass	Pass	Pass	Pass
4.2	Pass	Pass	Pass	Pass	Pass	Pass
4.3	Pass	Pass	Pass	Pass	Pass	Pass
4.4	Pass	Pass	Pass	Pass	Pass	Pass
5.1	Pass	Pass	Pass	N/A	N/A	N/A
5.2	Pass	Pass	Pass	N/A	N/A	N/A
6.1	Pass	Pass	Pass	Pass	Pass	Pass
6.2	Pass	Fail	Pass	Pass	Pass	Pass
6.3	Pass	Pass	Pass	Pass	Pass	Pass
6.4	Pass	Pass	Pass	Pass	Pass	Pass
6.5	Pass	Pass	Pass	Pass	Pass	Pass

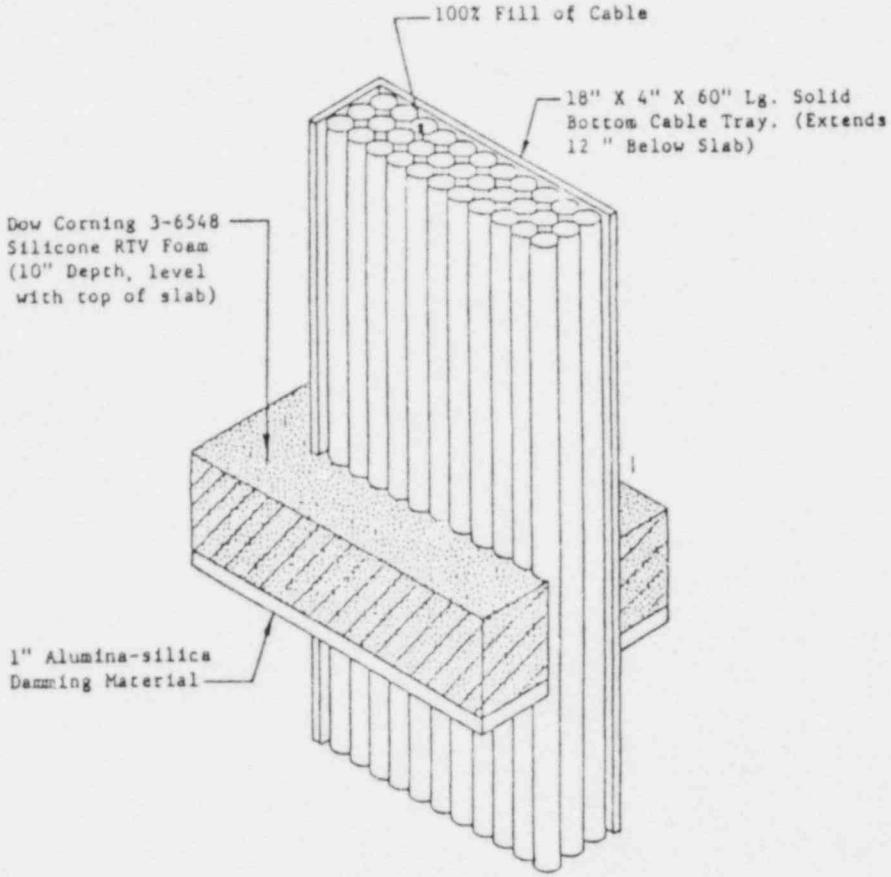


Figure 7. Penetration 1.1

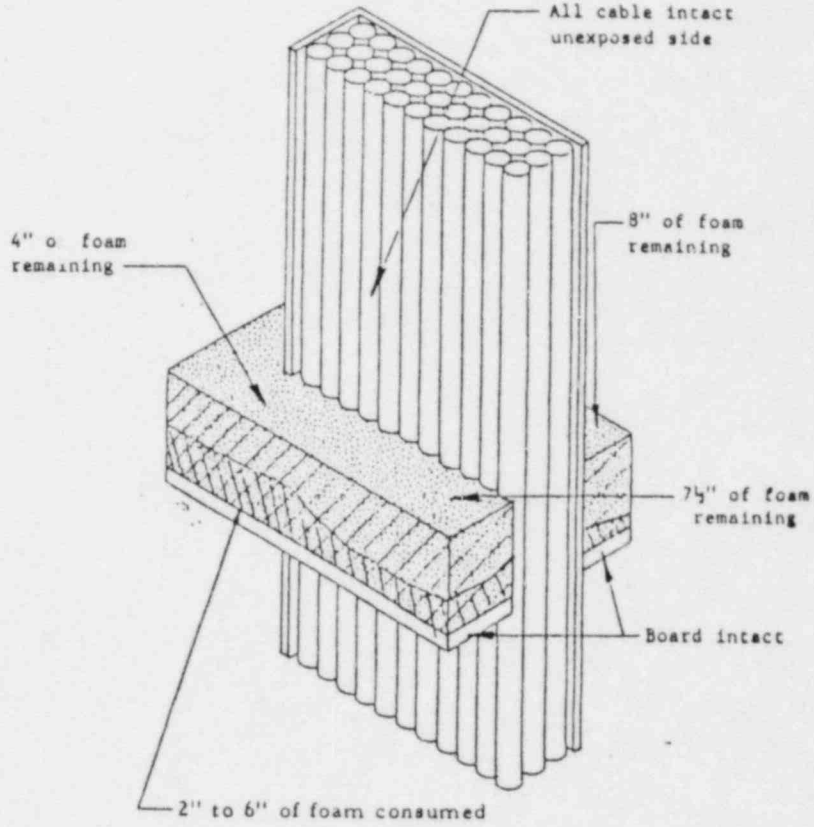


Figure 38. Penetration 1.1 After Test

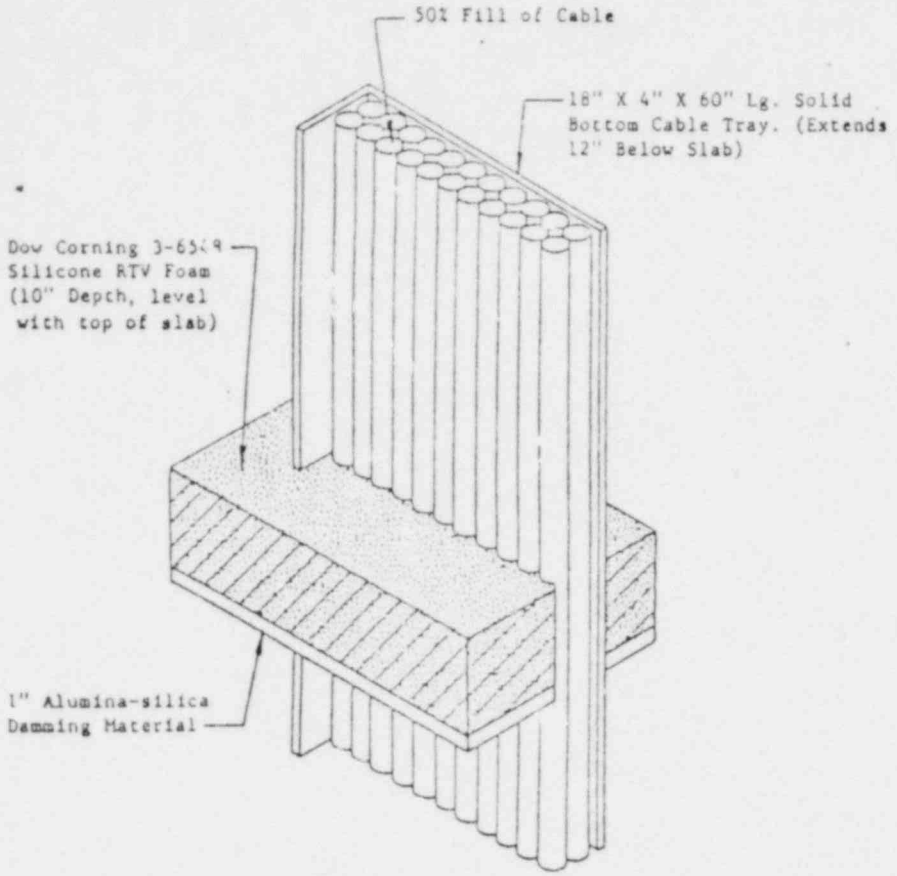


Figure 8. Penetration 1.2

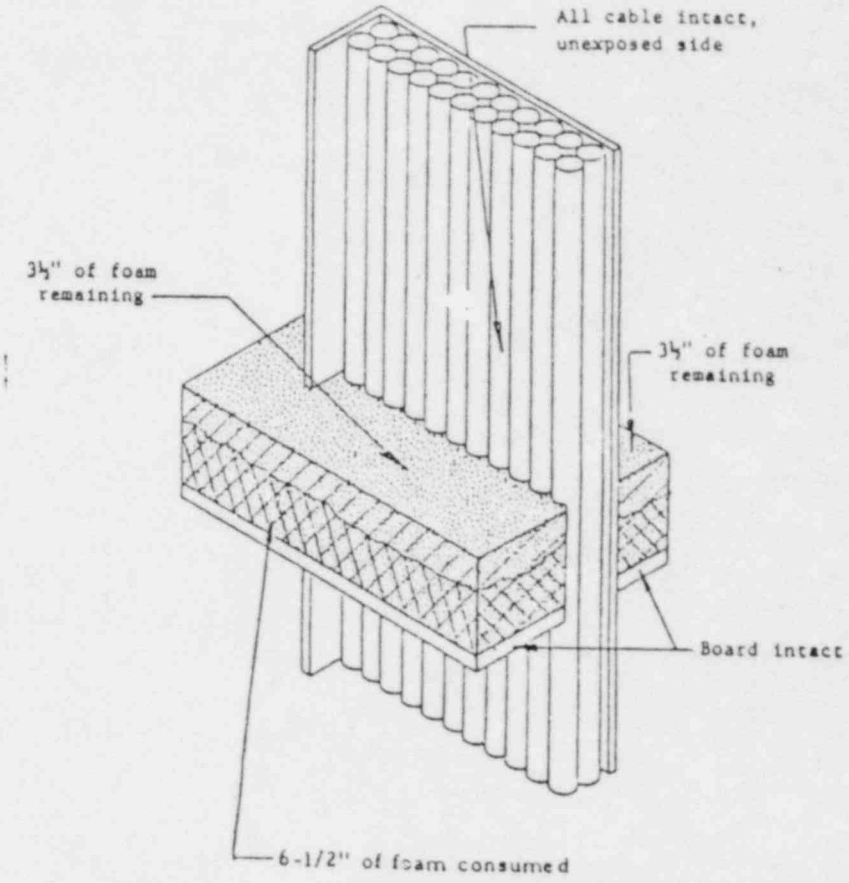


Figure 39. Penetration 1.2 After Test

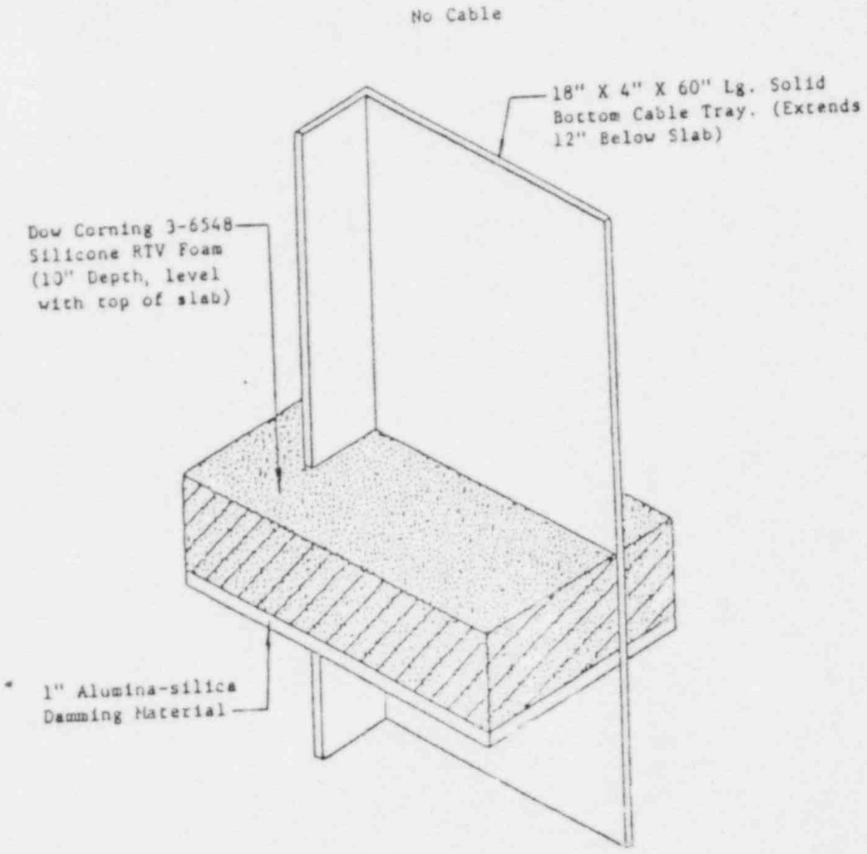


Figure 9. Penetration 1.3

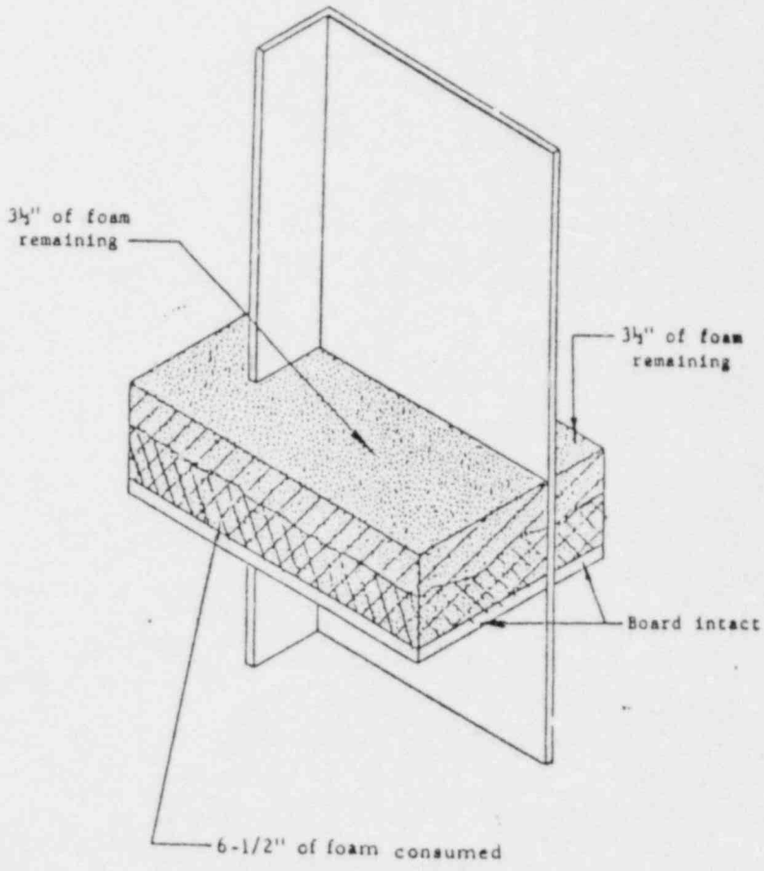


Figure 40. Penetration 1.3 After Test

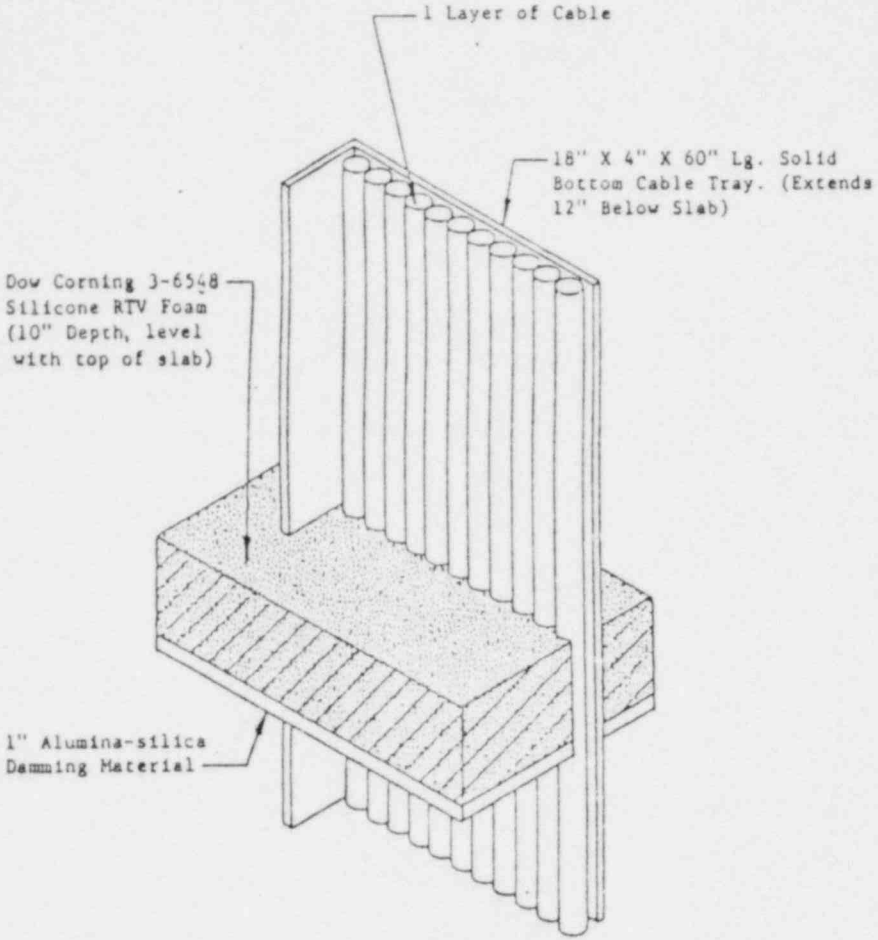


Figure 10. Penetration 1.4

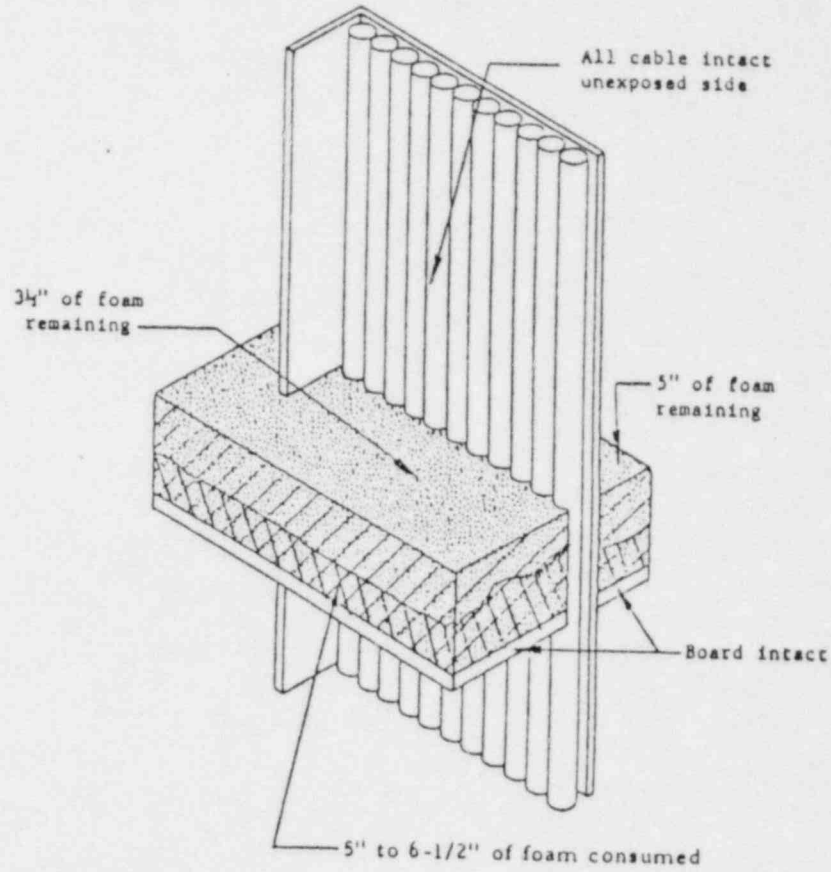


Figure 41. Penetration 1.4 After Test

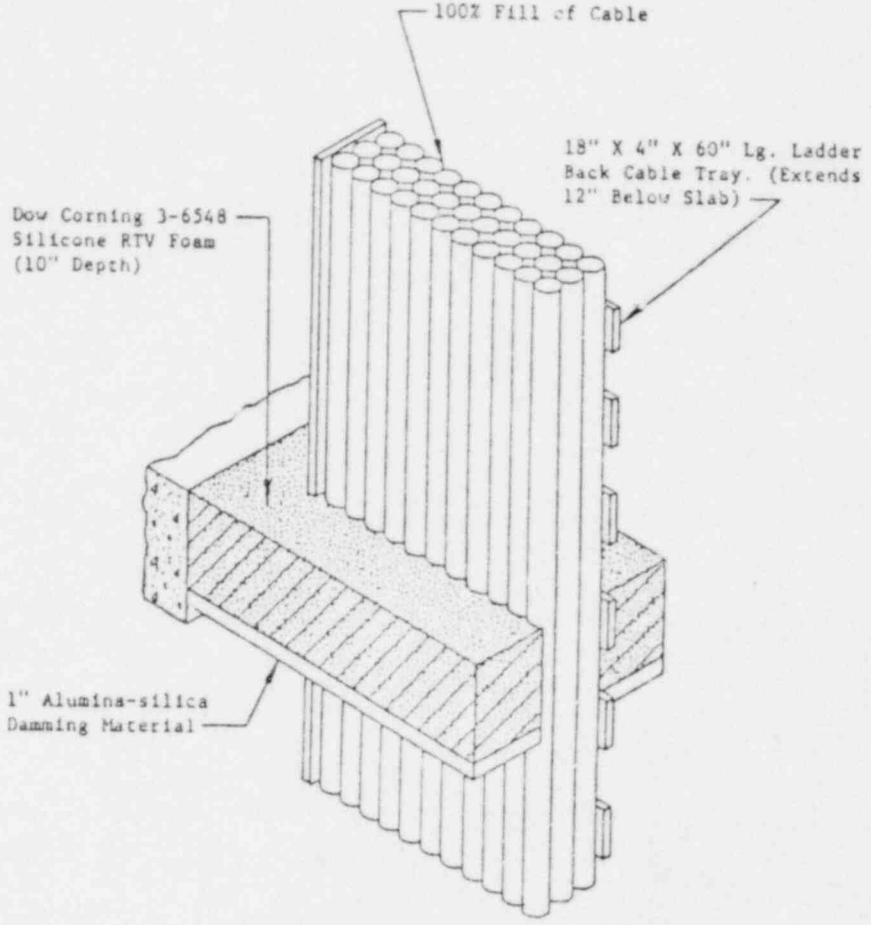


Figure 11. Penetration 1.5

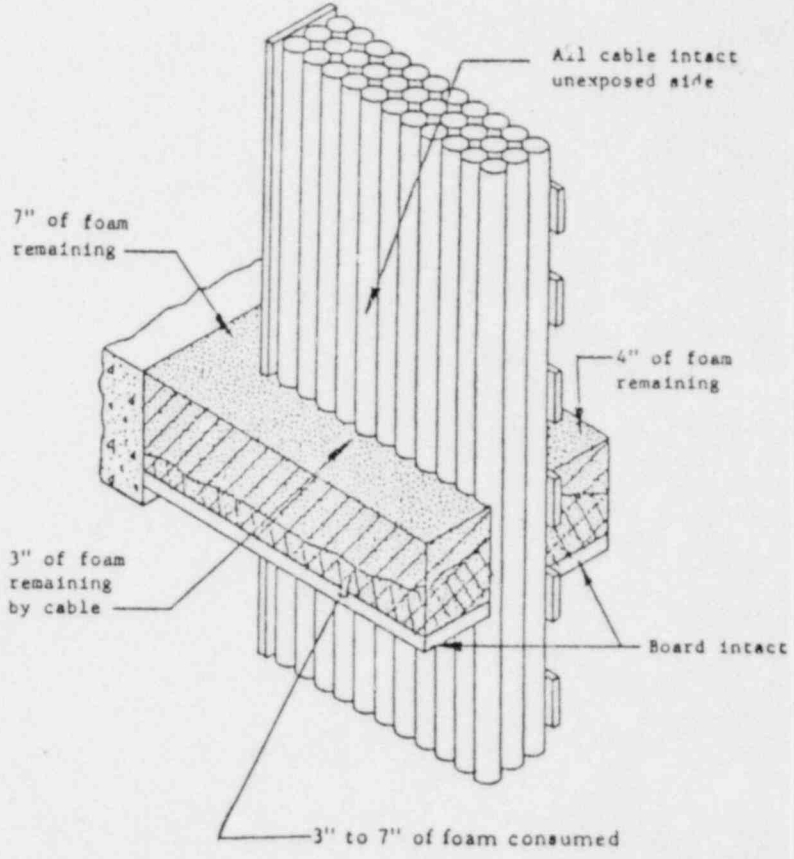


Figure 42. Penetration 1.5 After Test

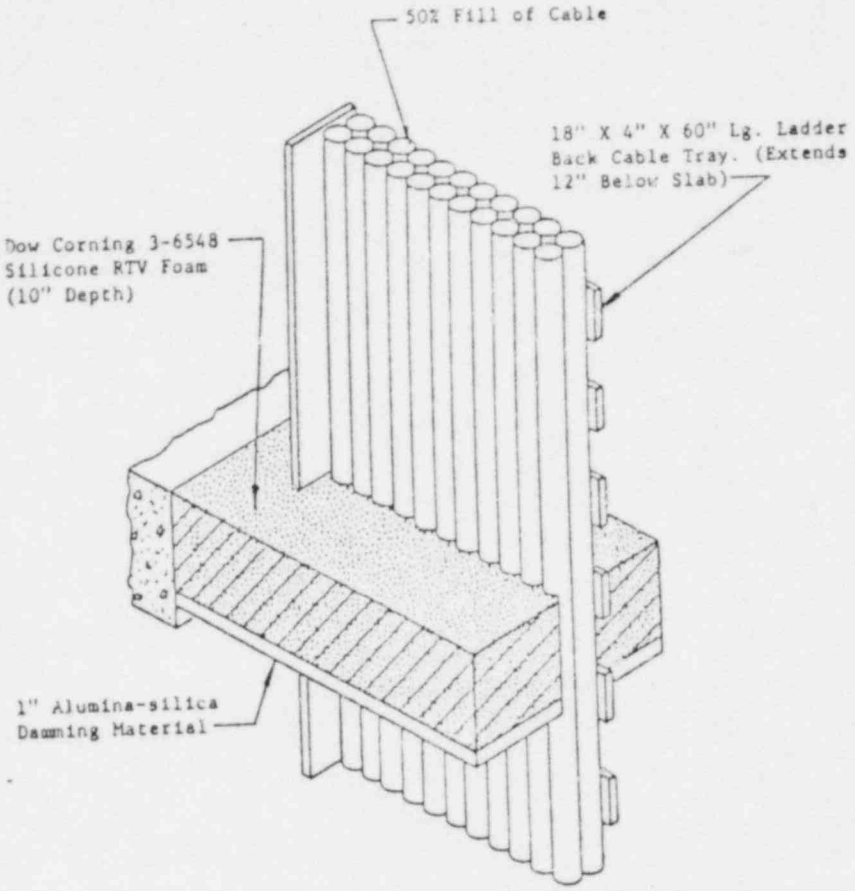


Figure 12. Penetration 1.6

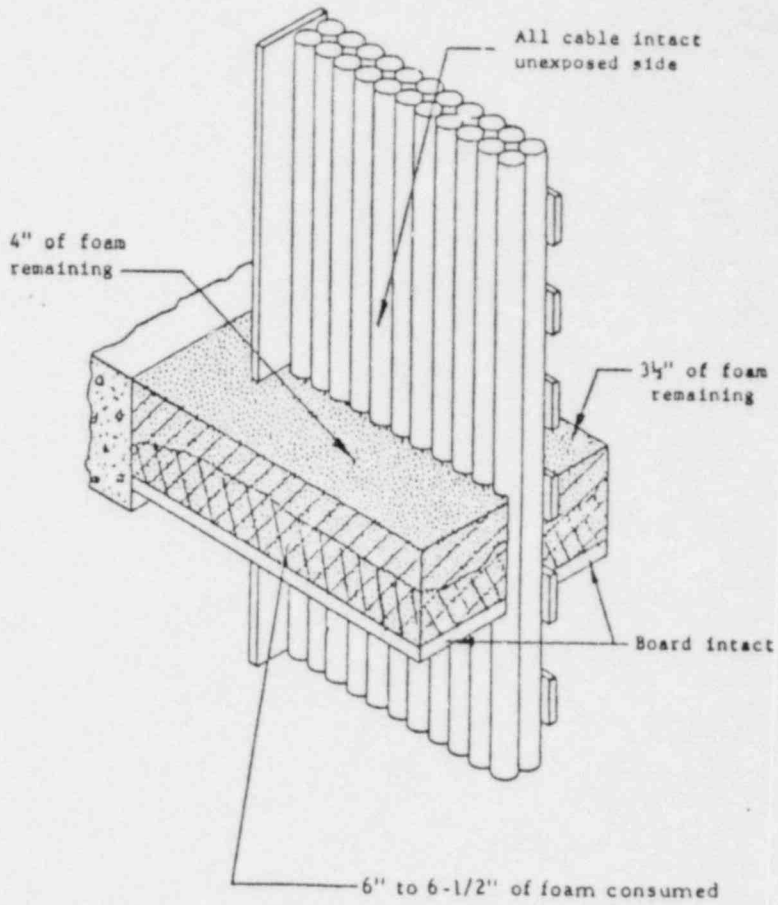


Figure 43. Penetration 1.6 After Test

No Cable

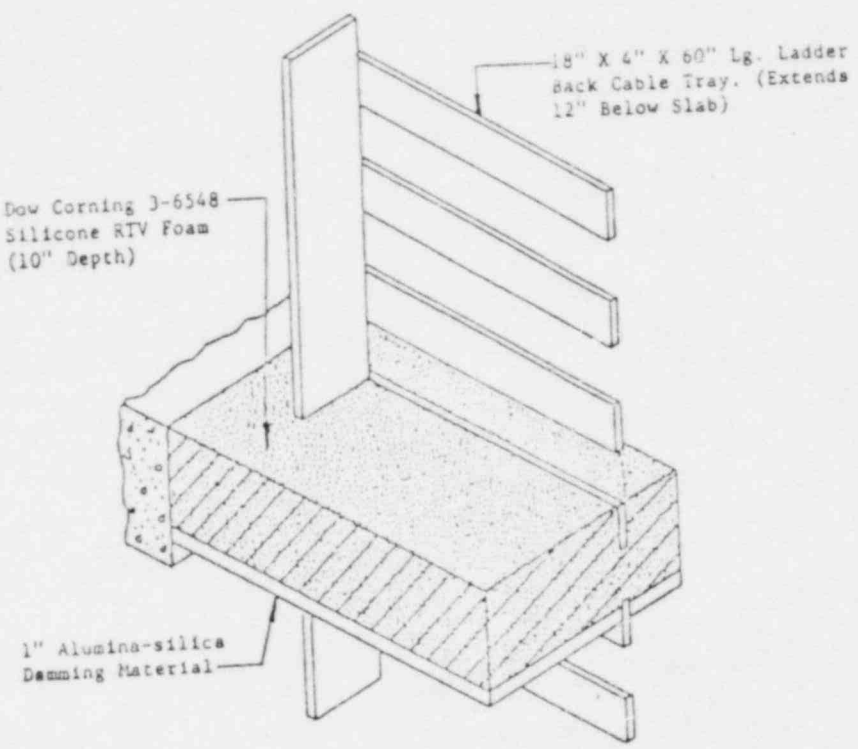


Figure 13. Penetration I. 7

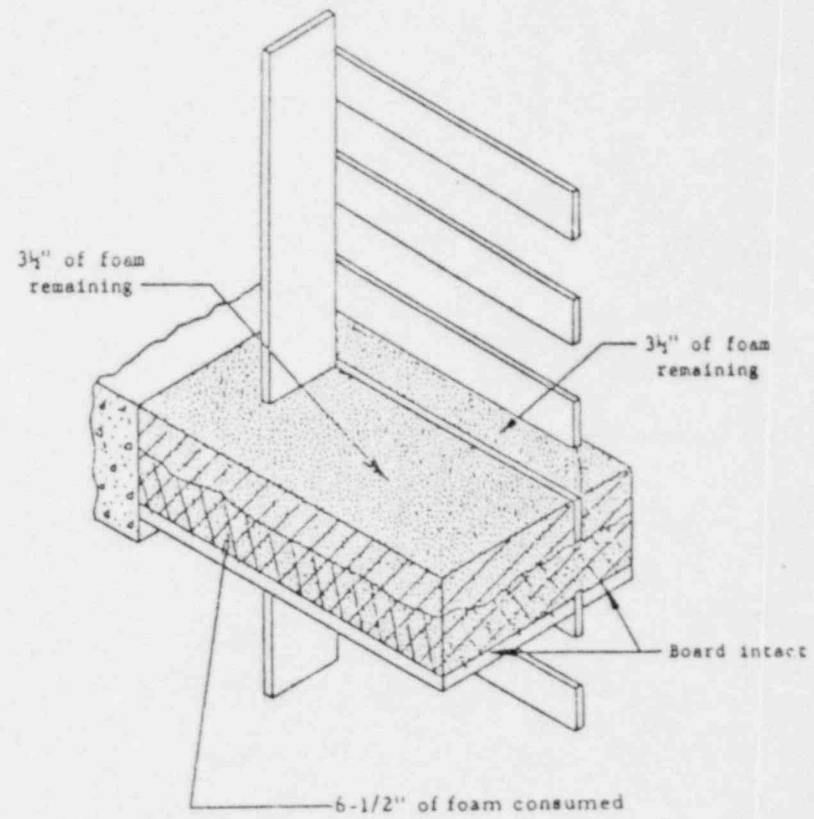


Figure 44. Penetration I. 7 After Test

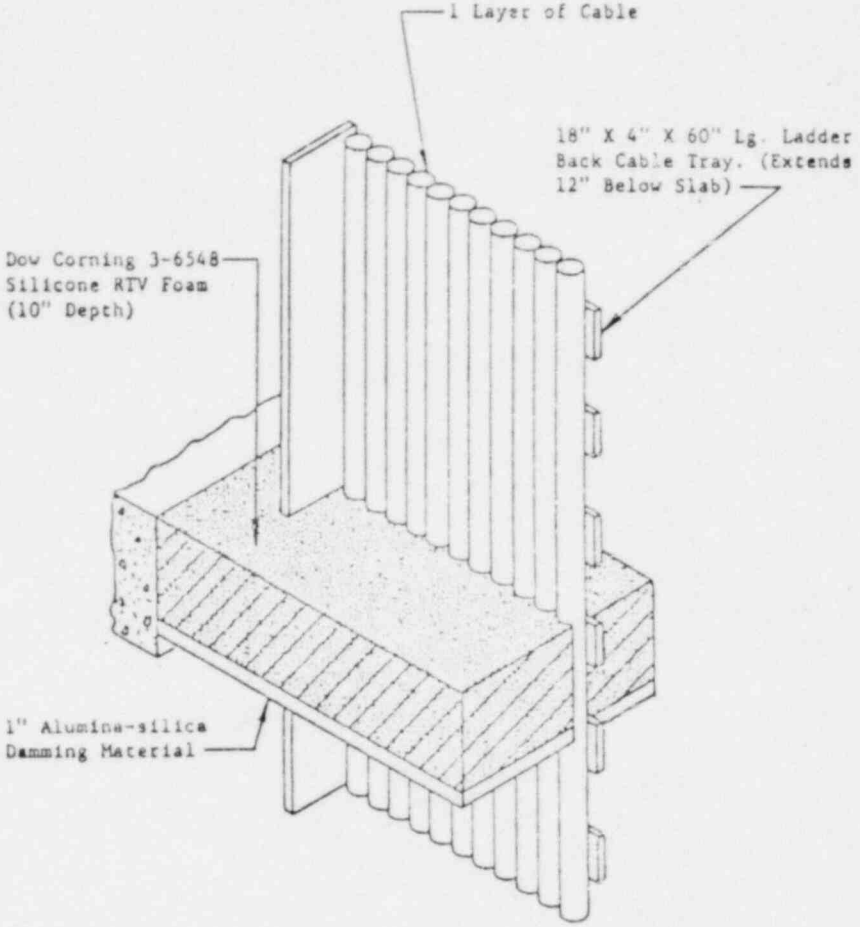


Figure 14. Penetration 1.8

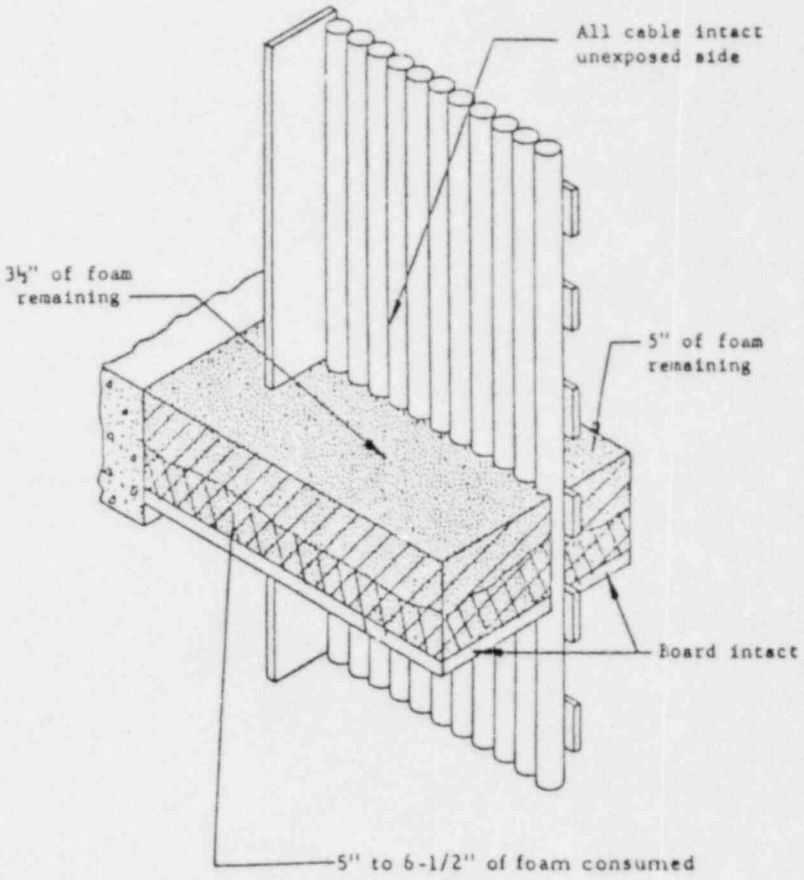


Figure 45. Penetration 1.8 After Test

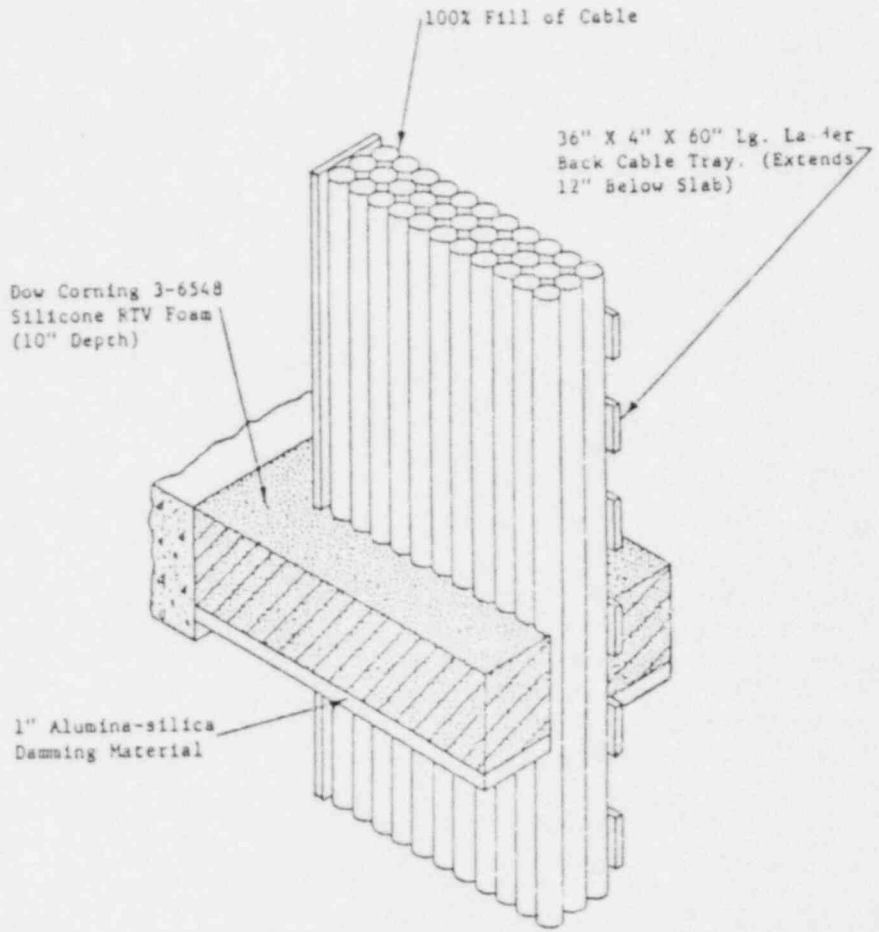


Figure 45. Penetration 2.1

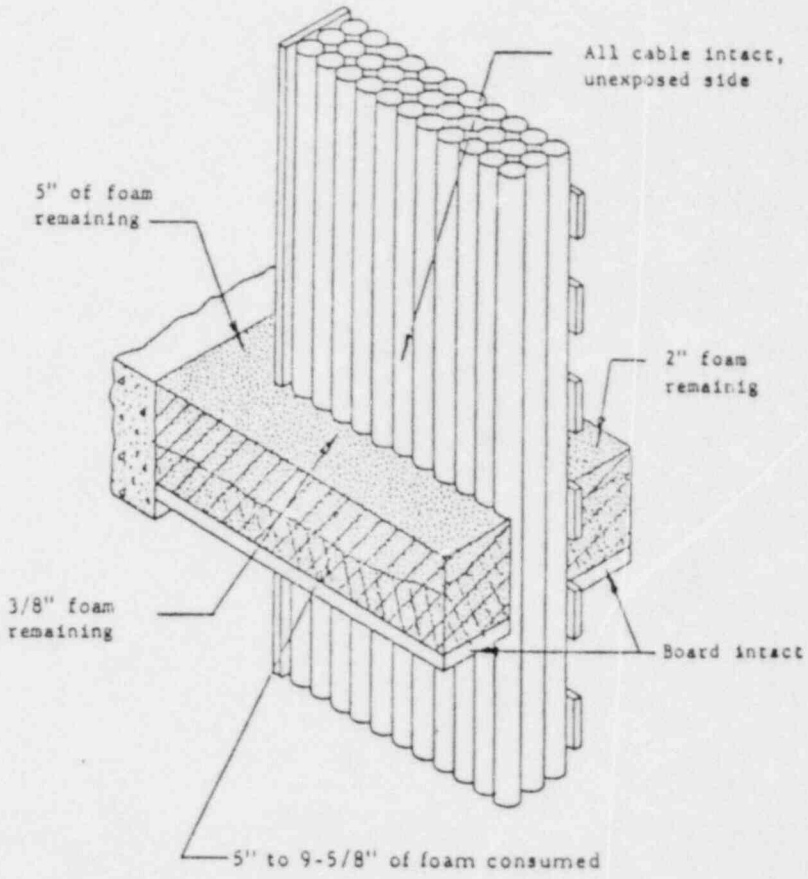


Figure 46. Penetration 2.1 After Test

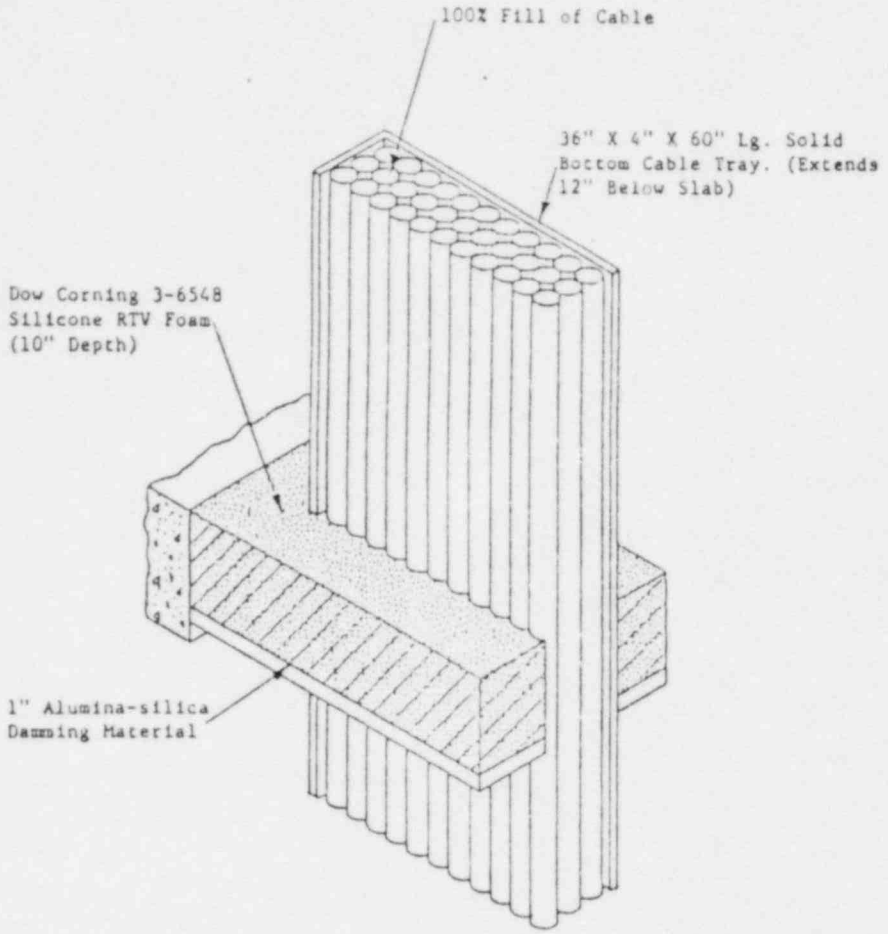


Figure 16. Penetration 2.2

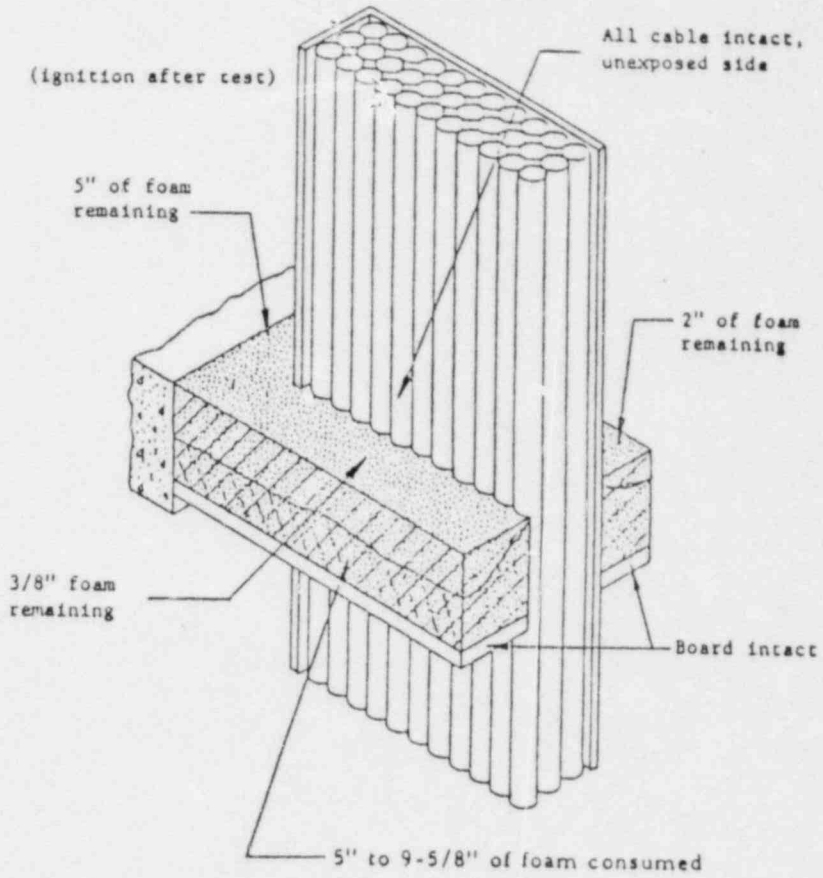


Figure 47. Penetration 2.2 After Test

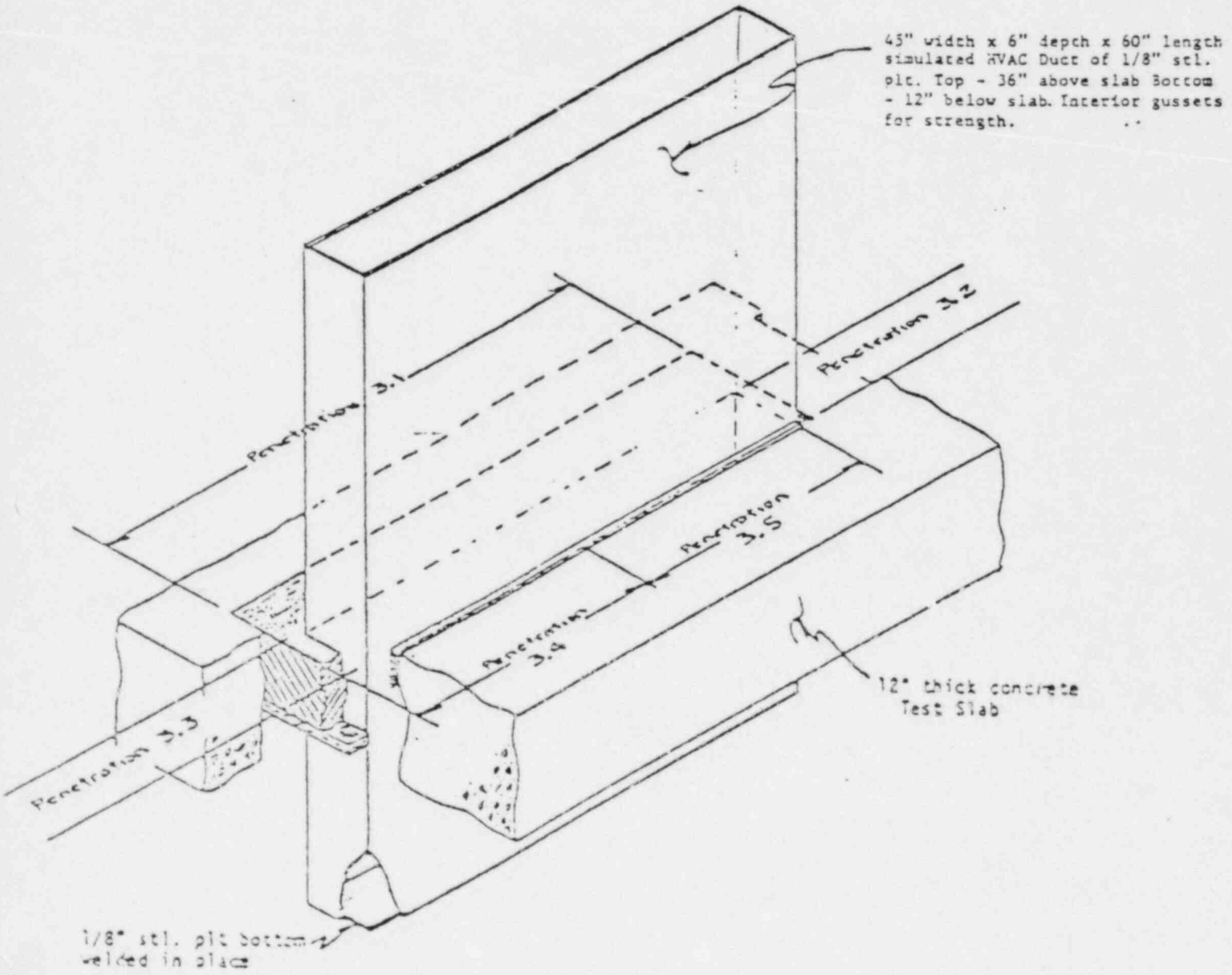


Figure 17. Layout, Blockout 3

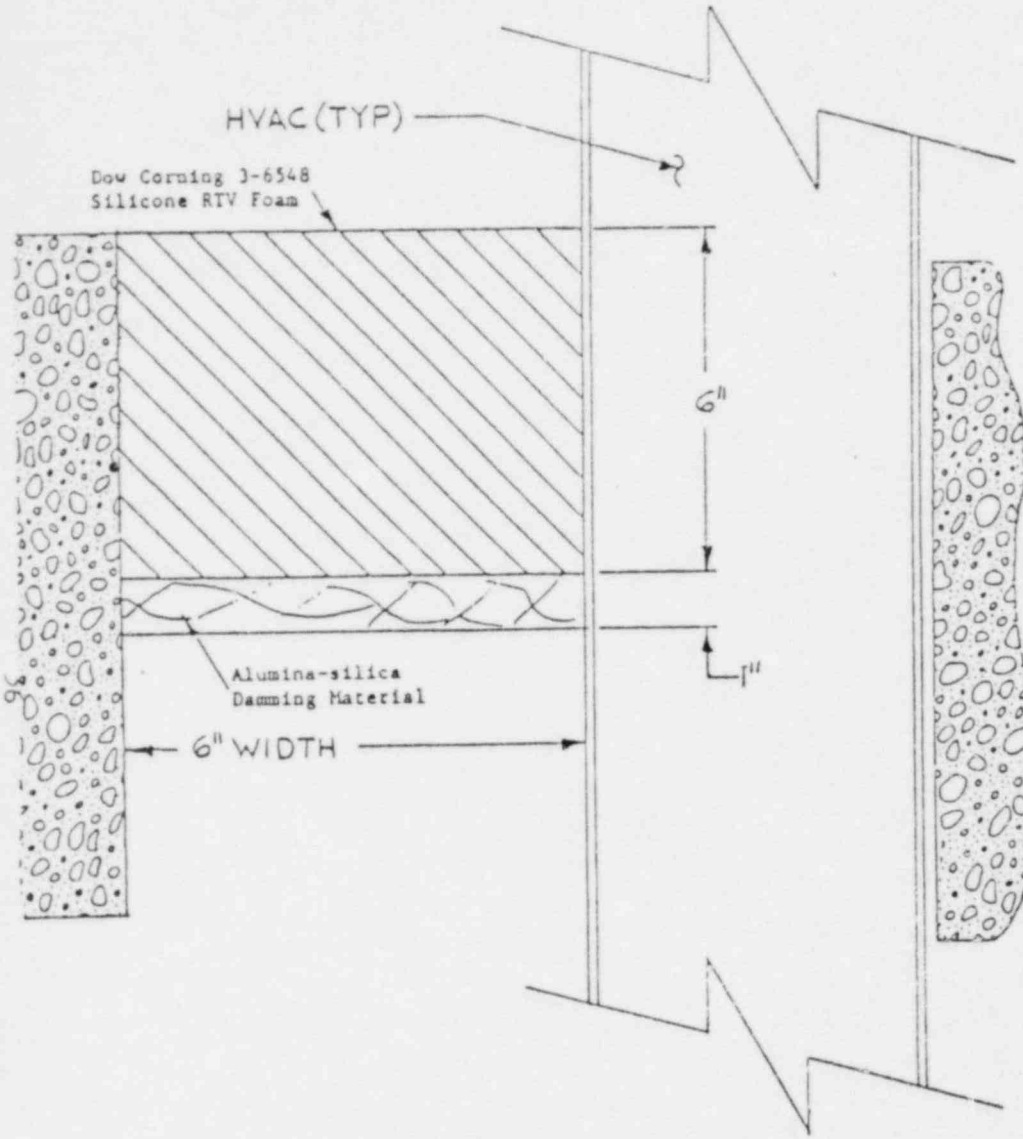


Figure 18. Penetration 3.1

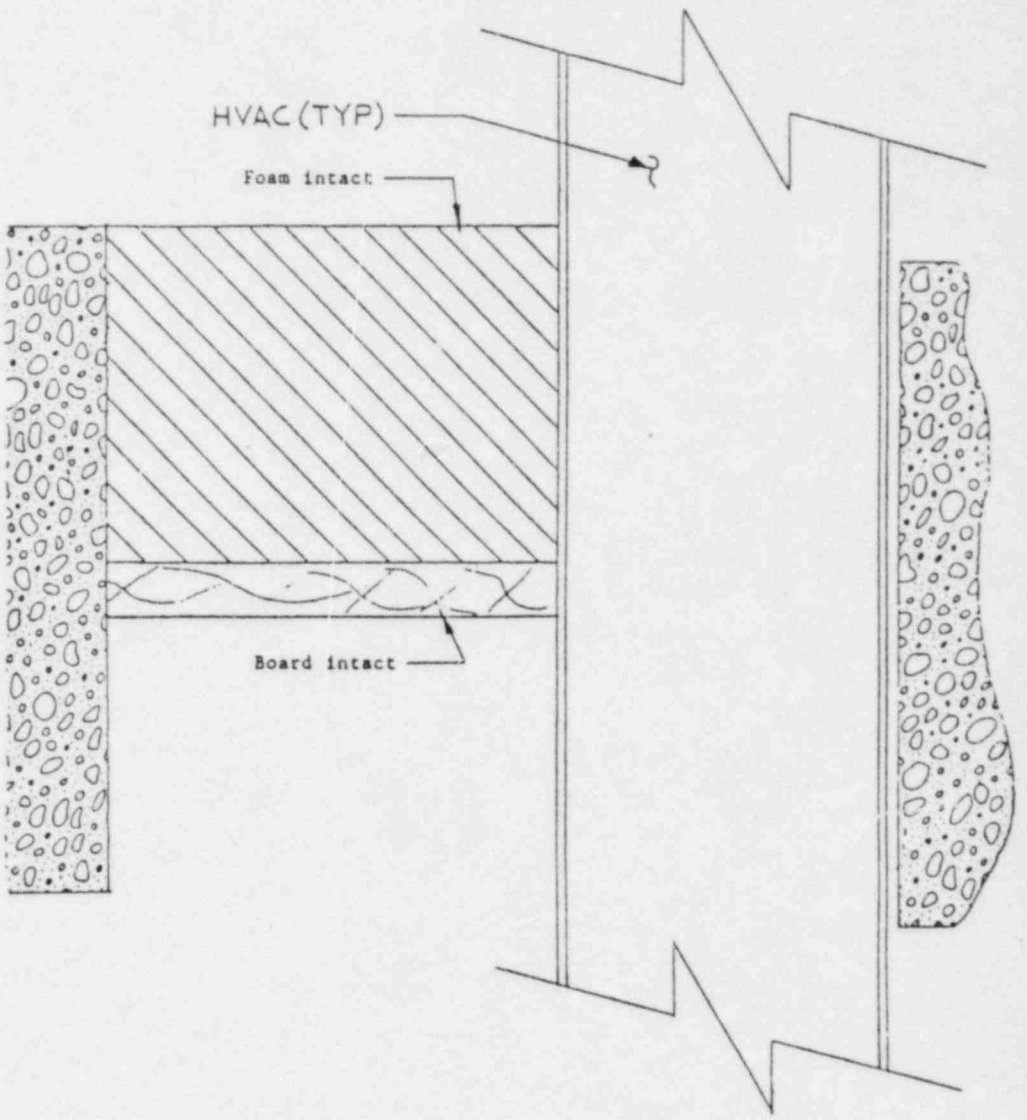


Figure 48. Penetration 3.1 After Test

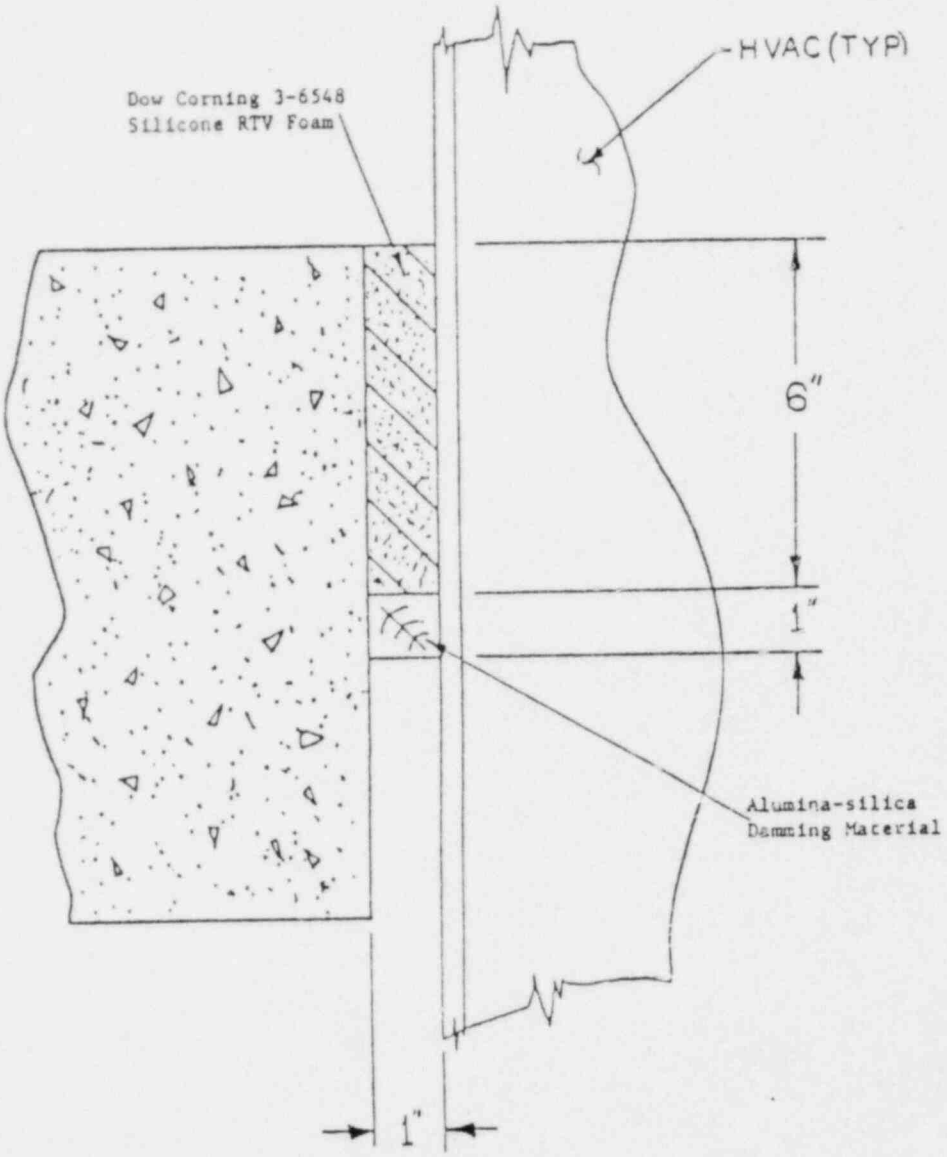


Figure 19. Penetration 3.2

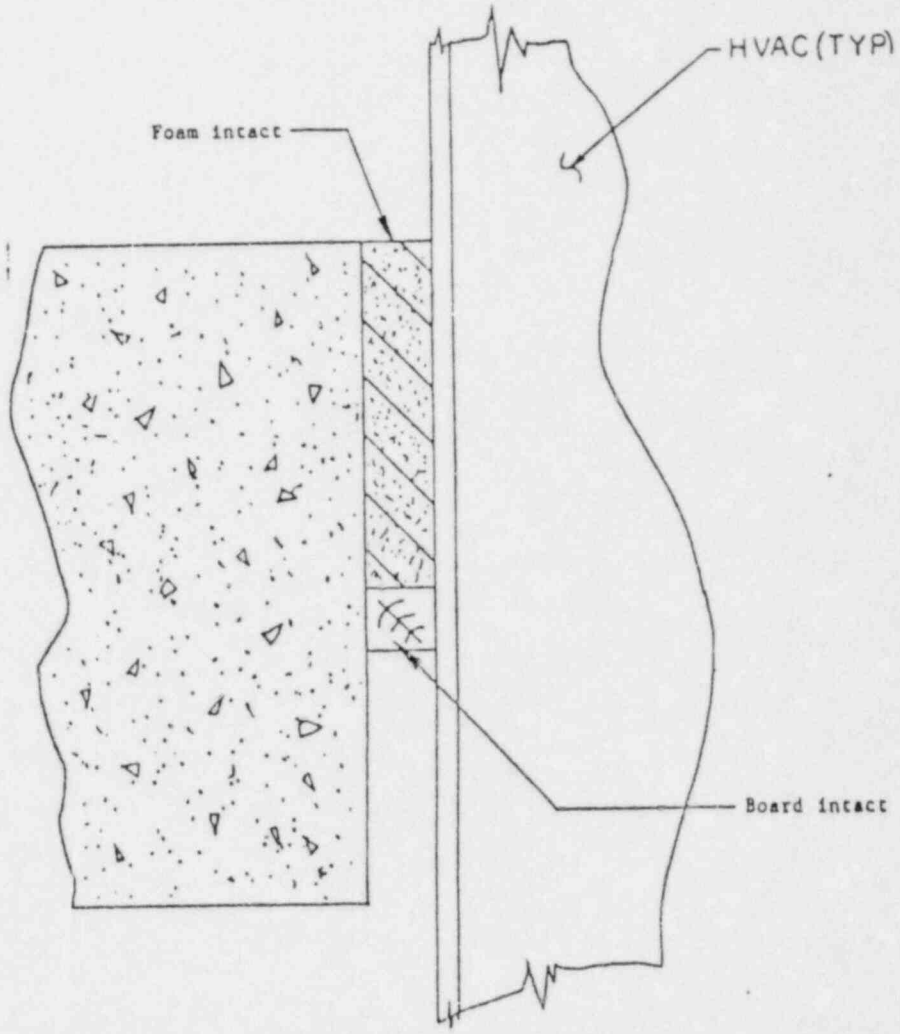


Figure 49. Penetration 3.2 After Test

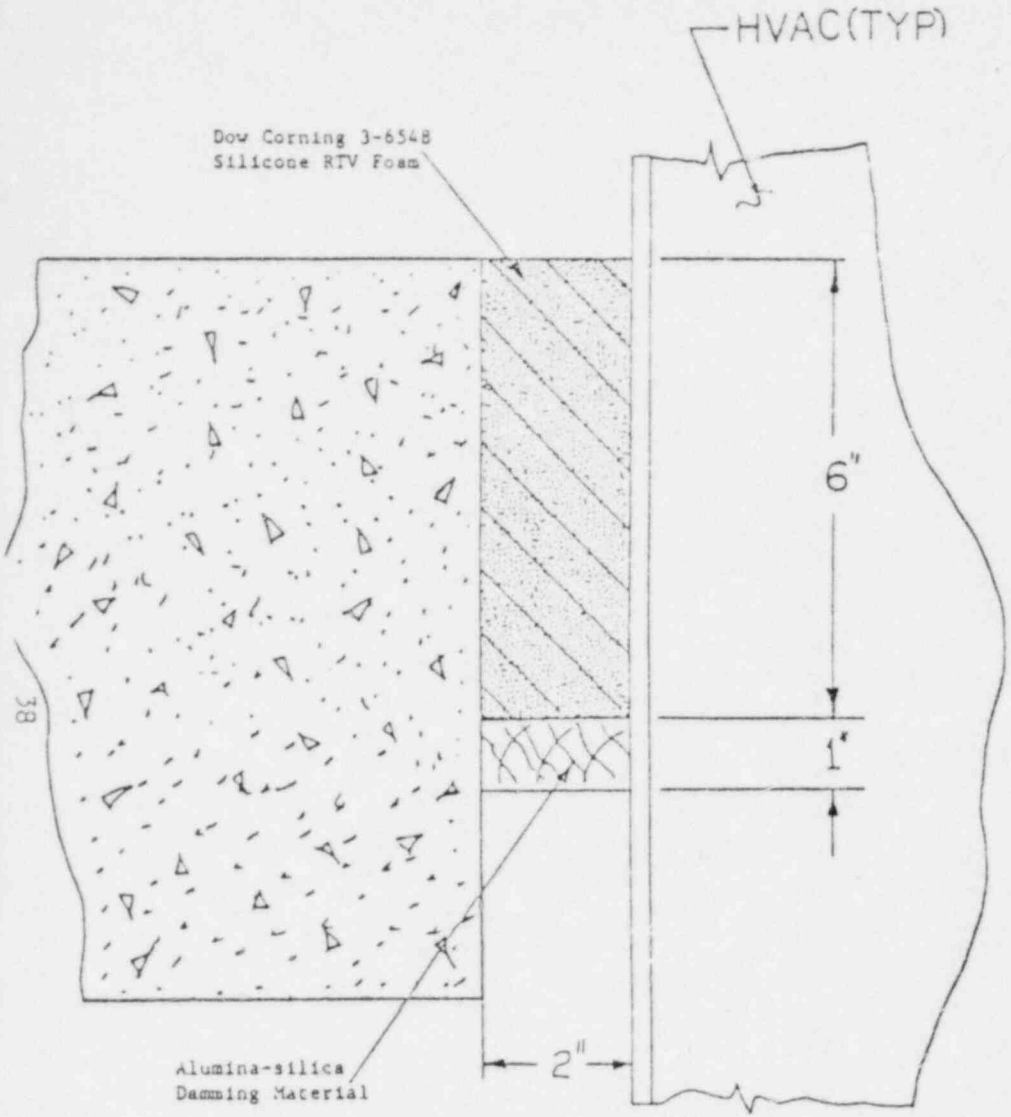


Figure 20. Penetration 3. 3

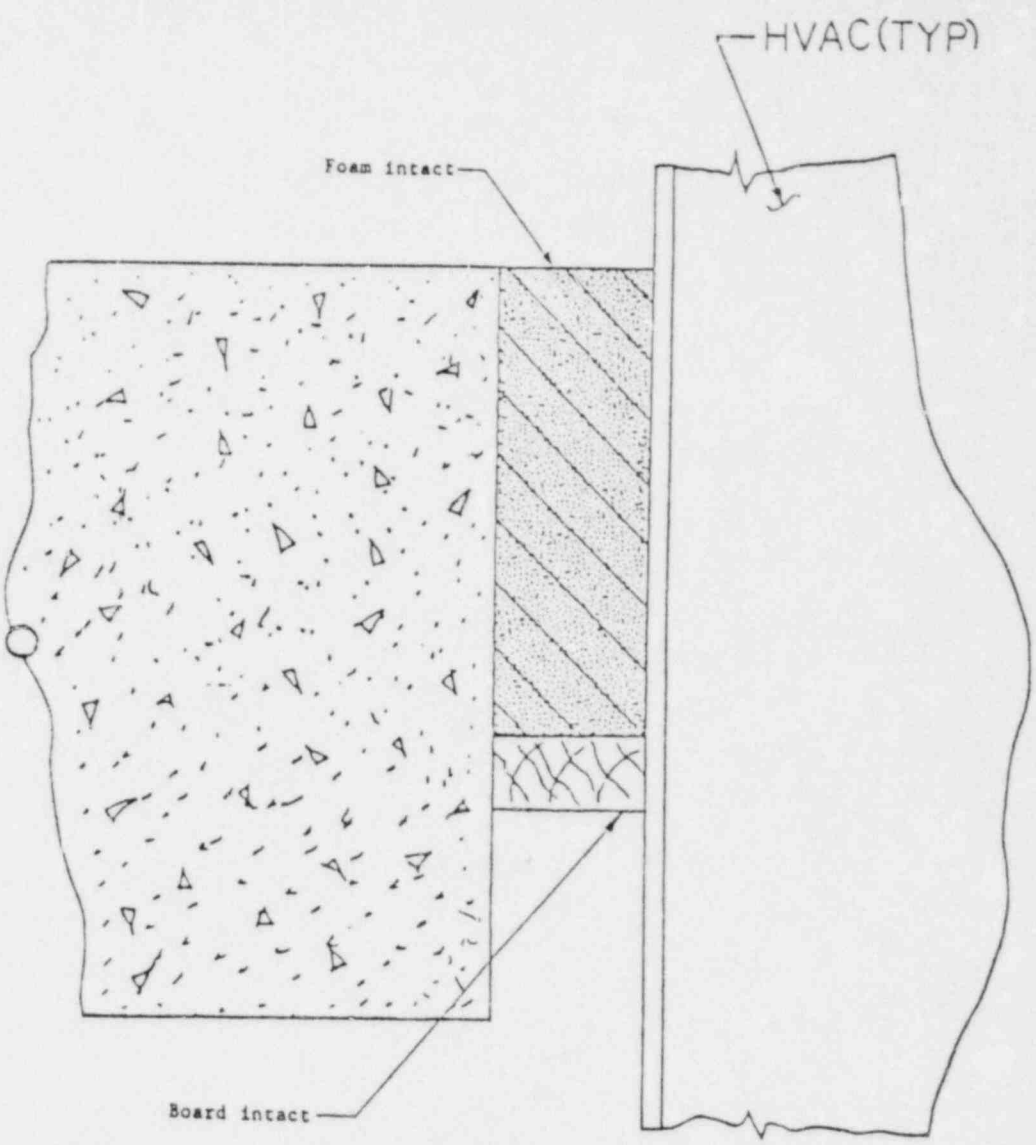


Figure 50. Penetration 3. 3 After Test

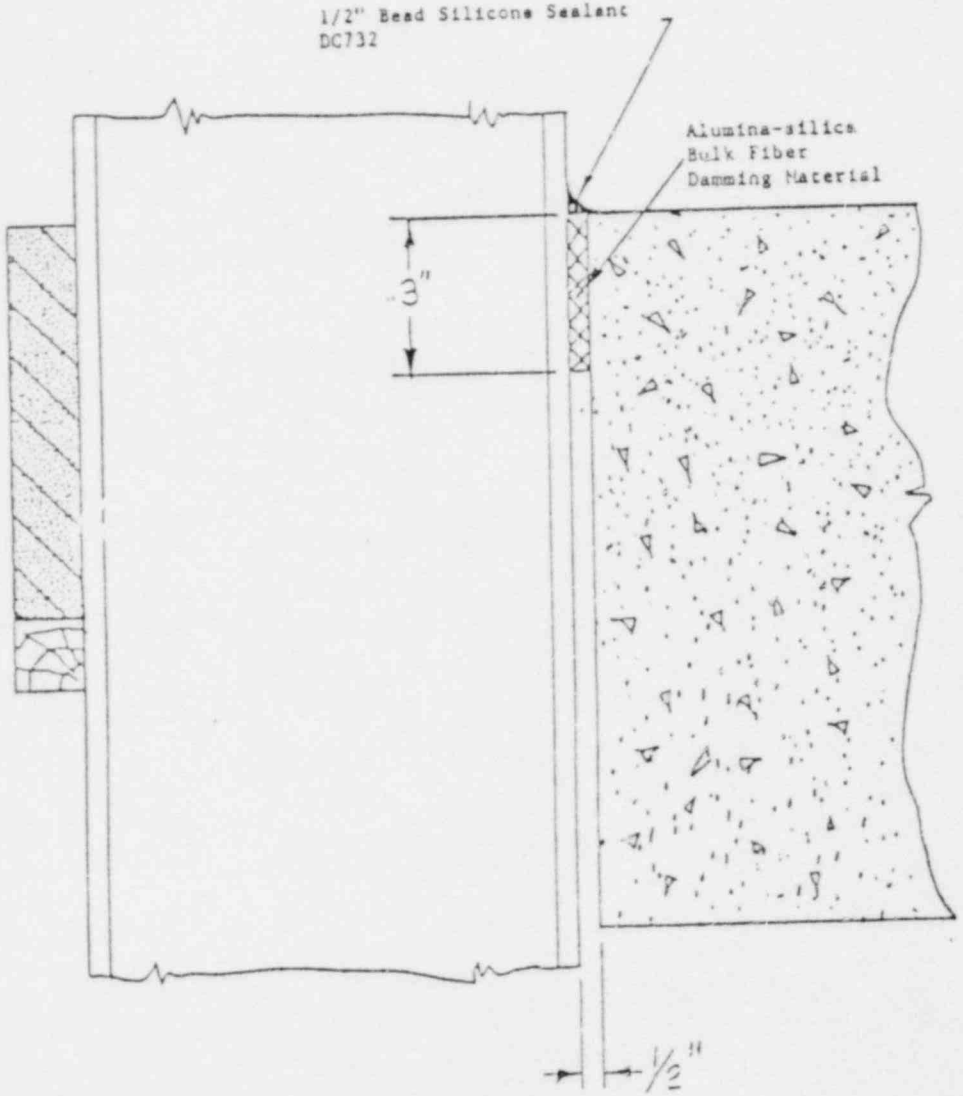


Figure 21. Penetration 3.4

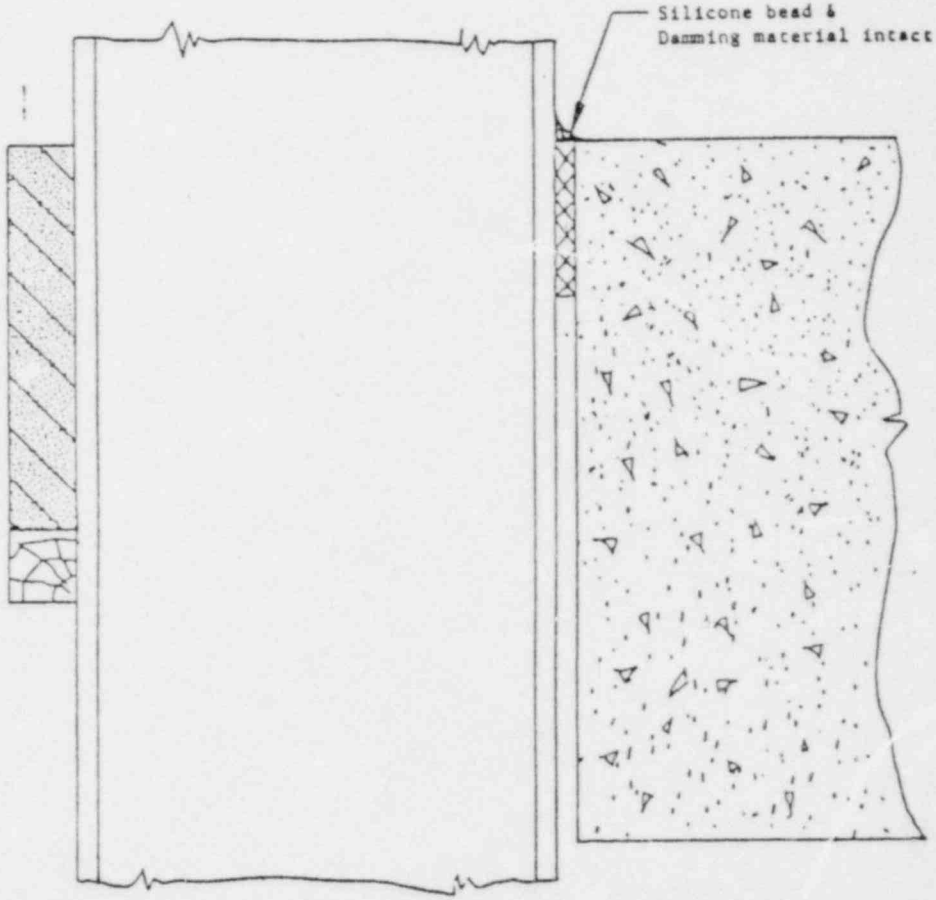


Figure 51. Penetration 3.4 After Test

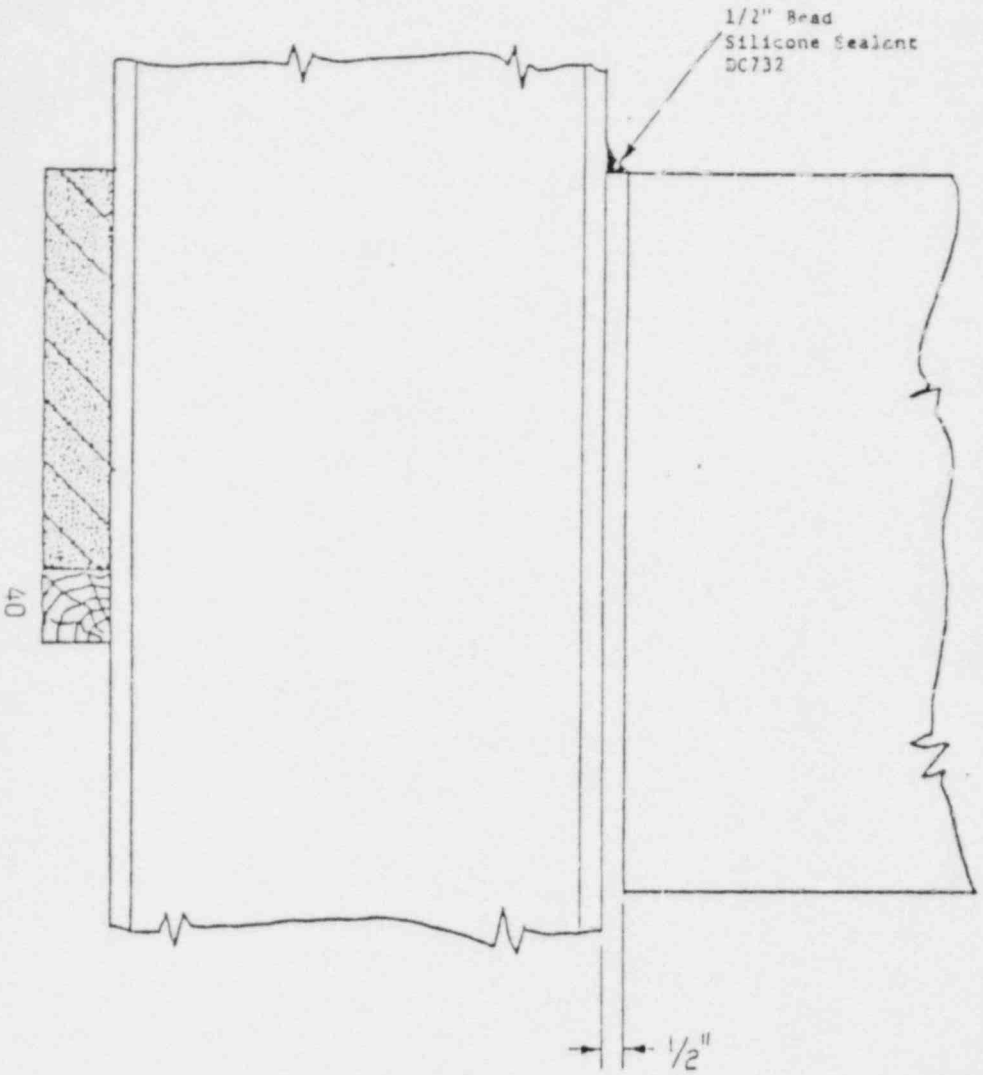


Figure 22. Penetration 3.5

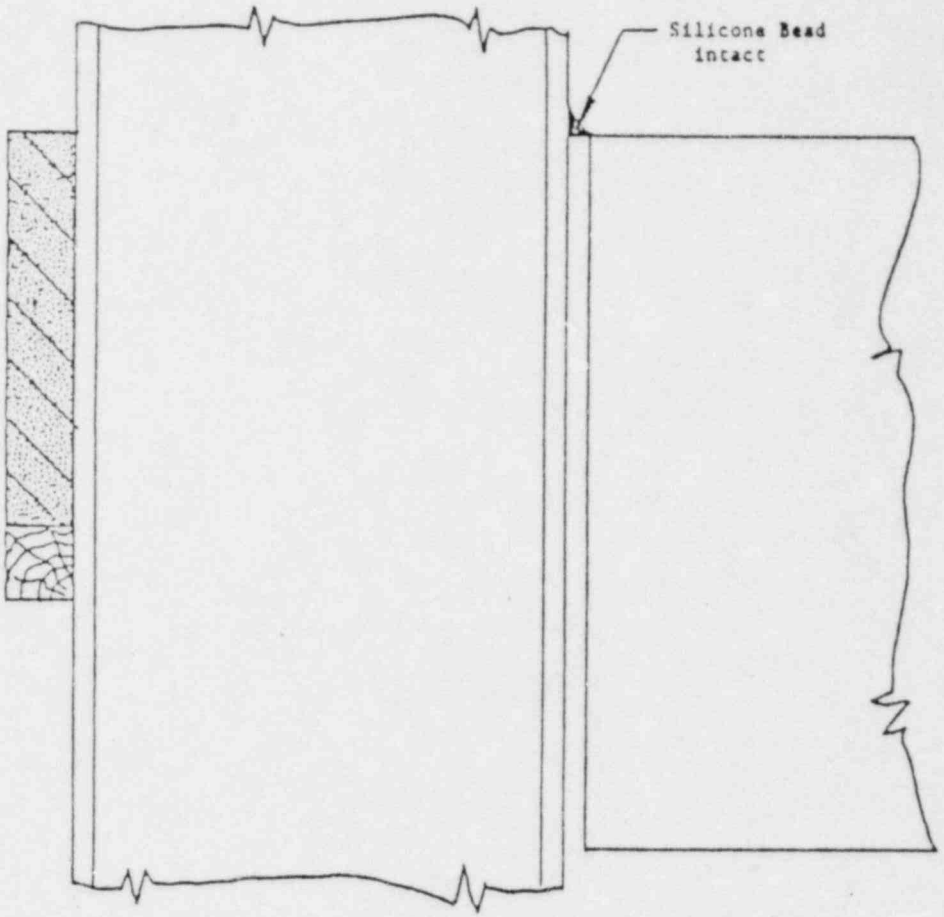


Figure 52. Penetration 3.5 After Test

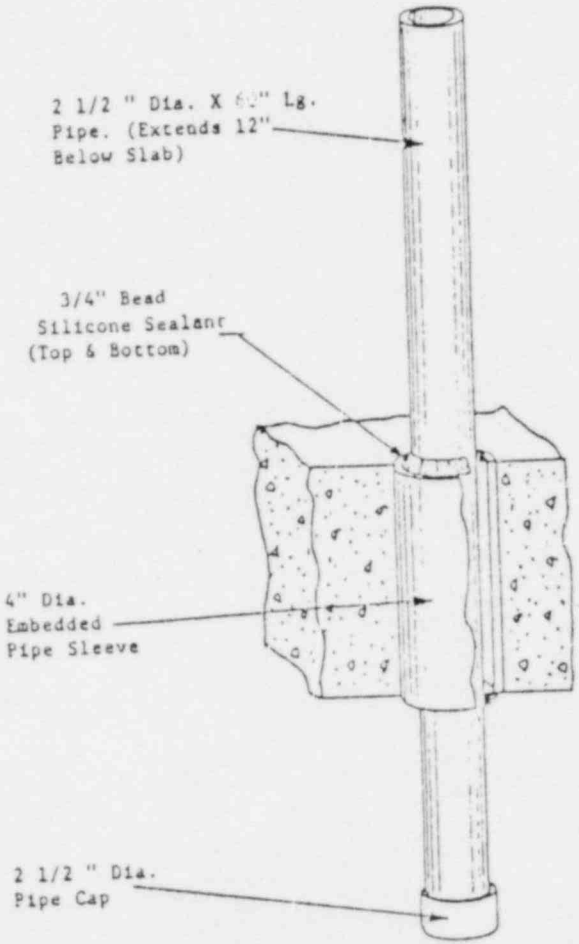


Figure 23. Penetration 4.1

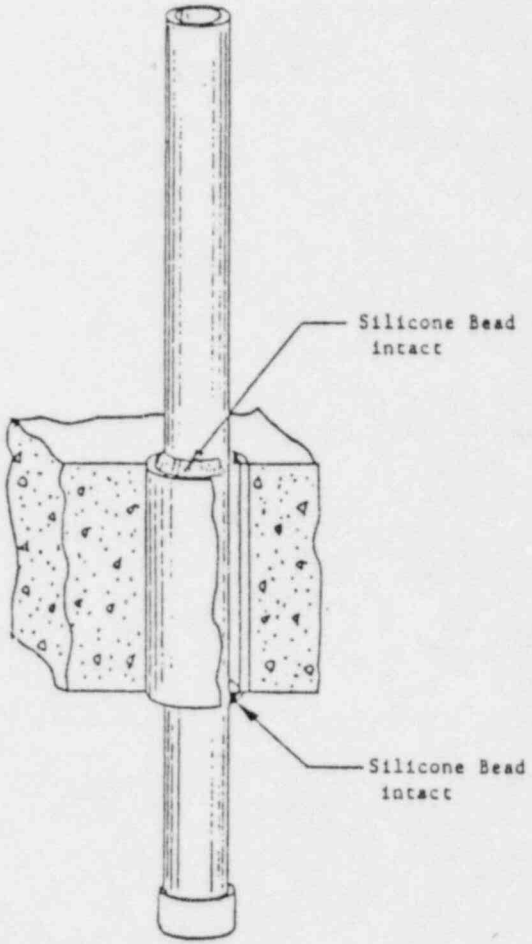


Figure 53. Penetration 4.1 After Test

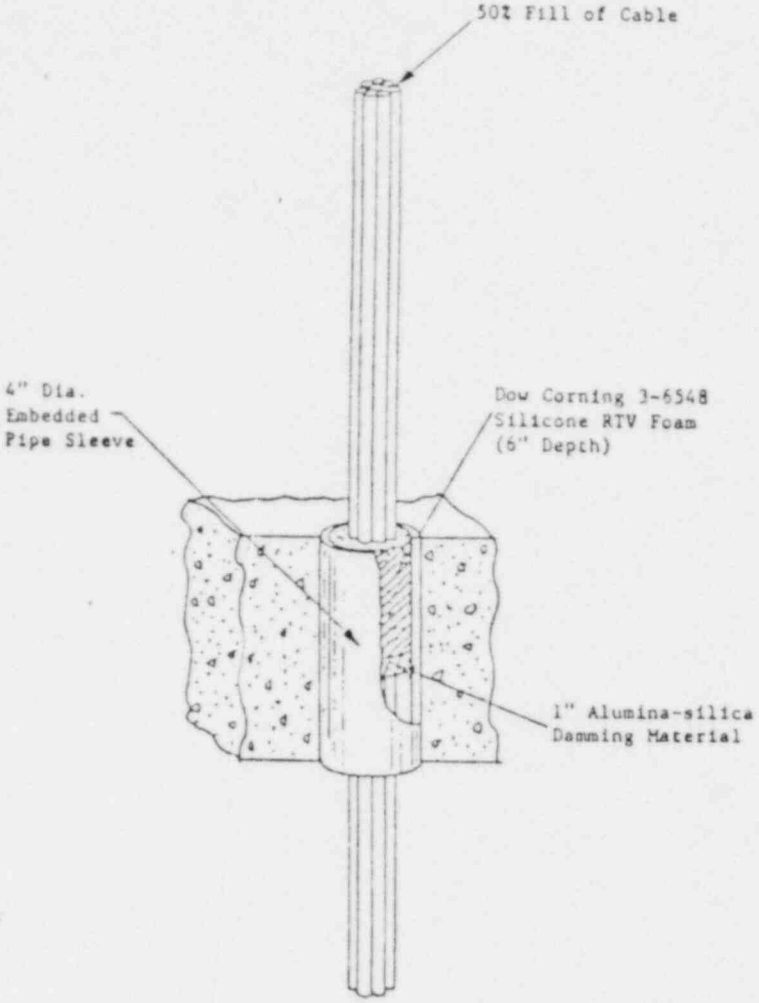


Figure 24. Penetration 4.2

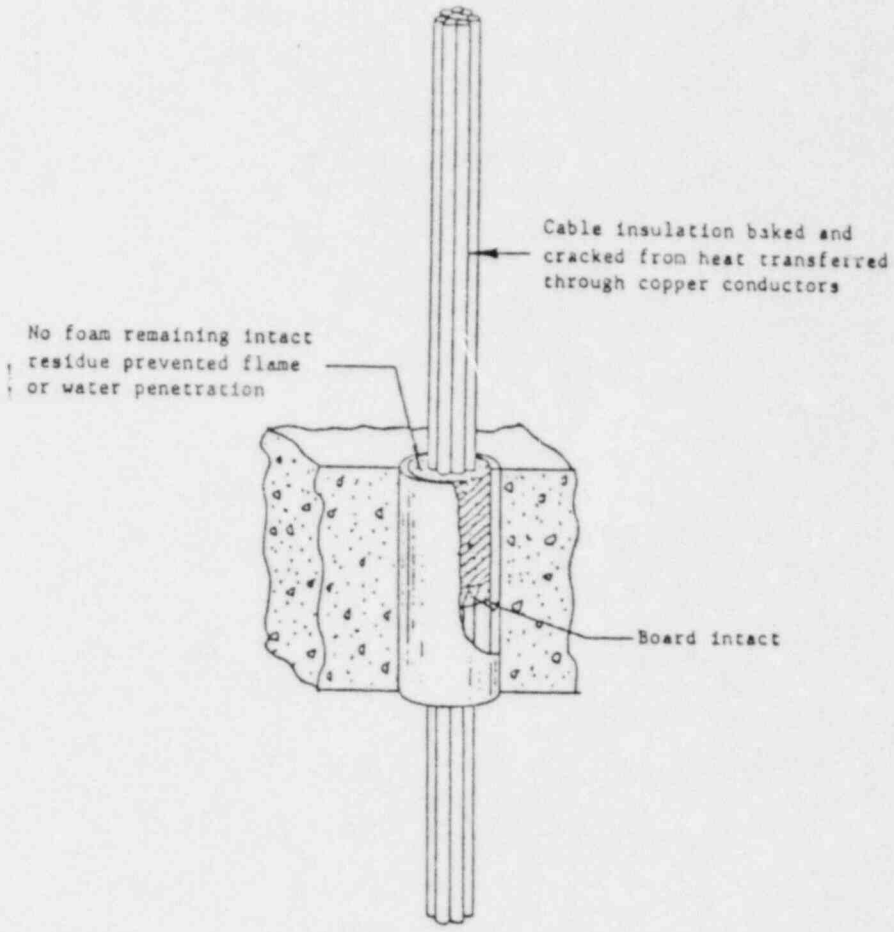


Figure 54. Penetration 4.2 After Test

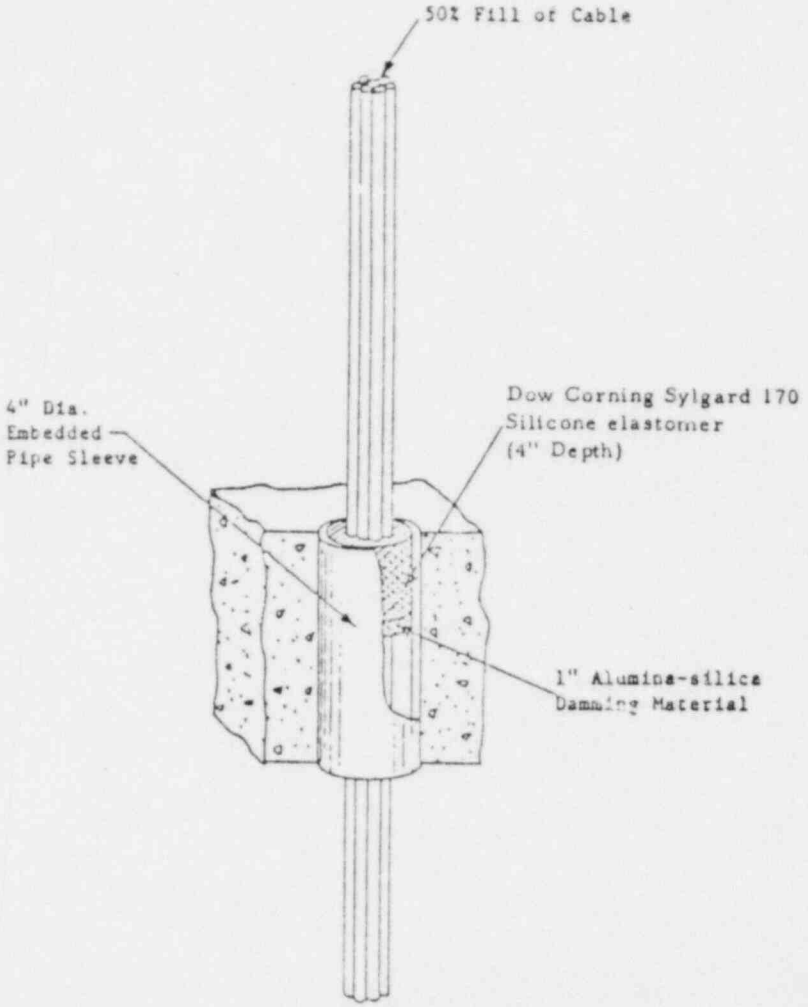


Figure 25. Penetration 4.3

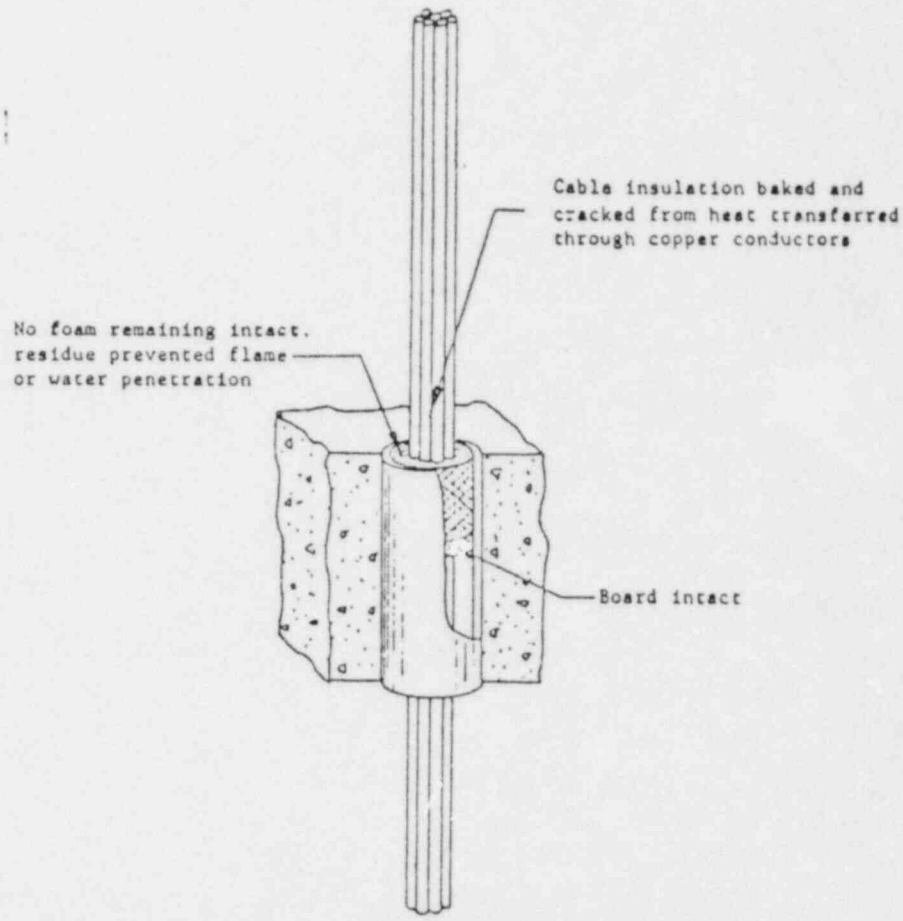


Figure 55. Penetration 4.3 After Test

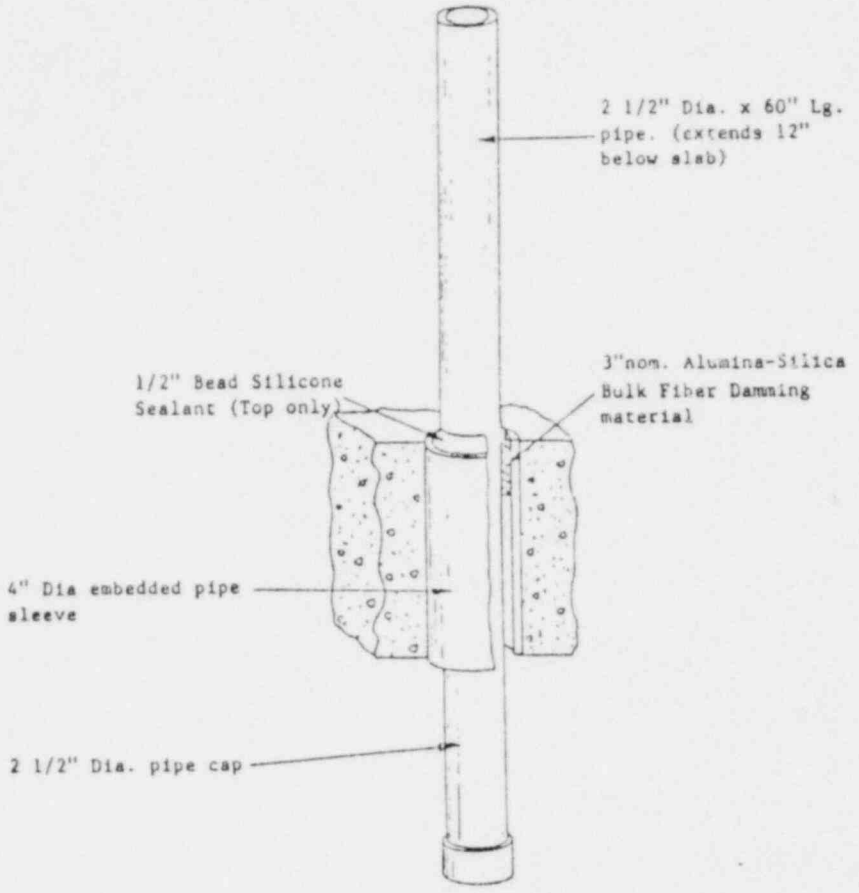


Figure 26. Penetration 4.4

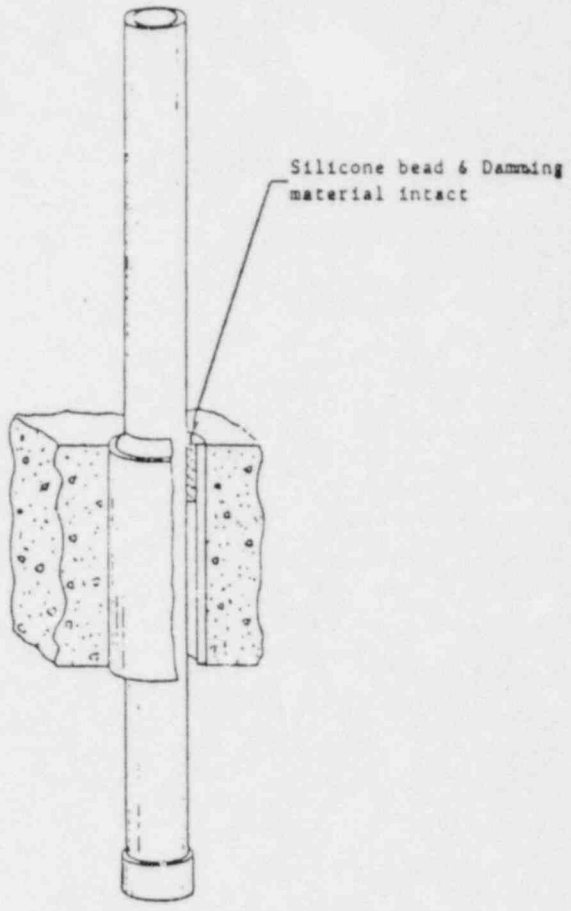


Figure 56. Penetration 4.4 After Test

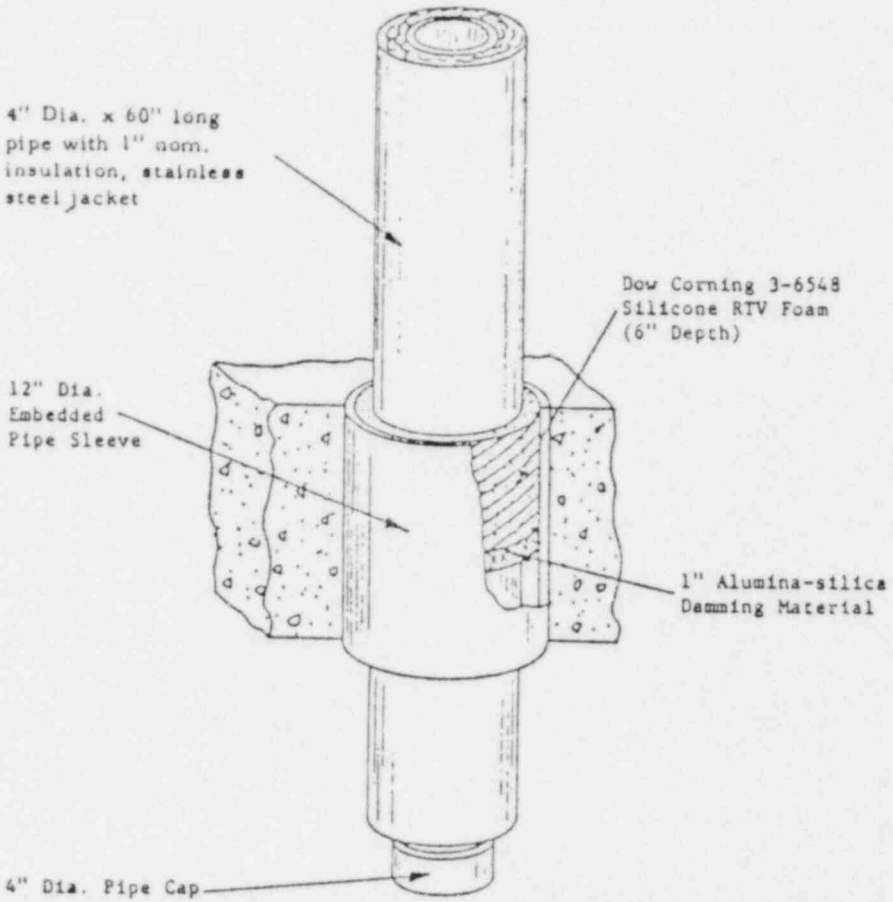


Figure 27. Penetration 5.1

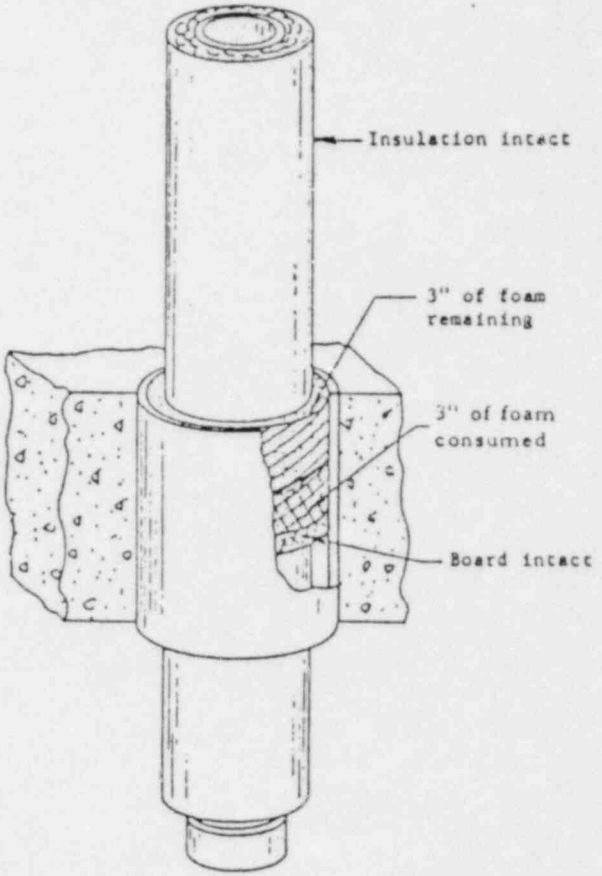


Figure 57. Penetration 5.1 After Test

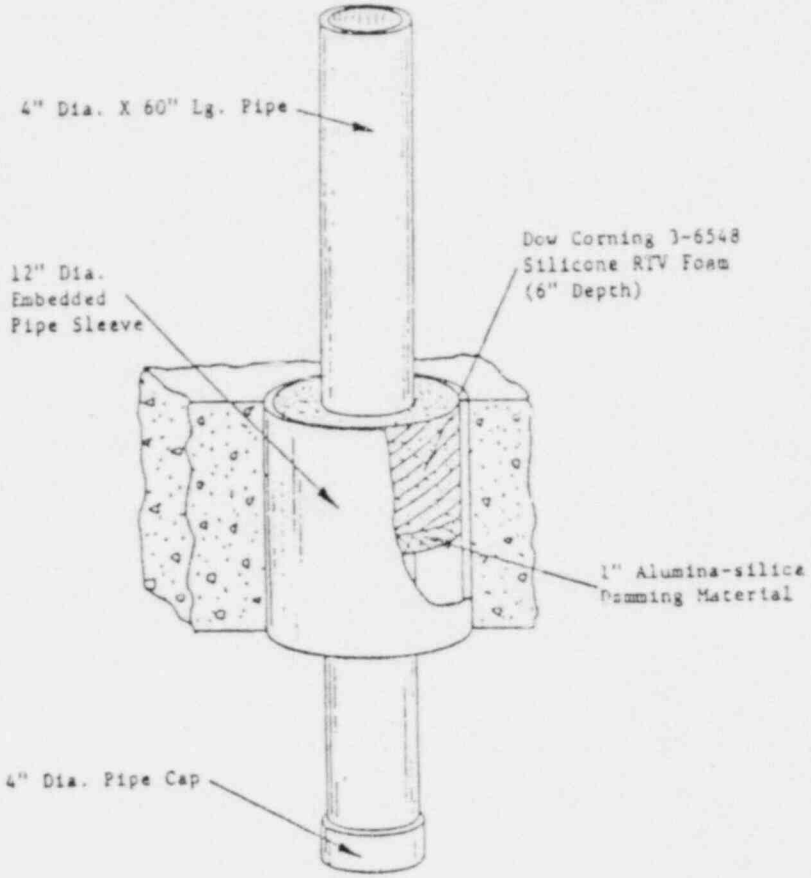


Figure 28. Penetration 5.2

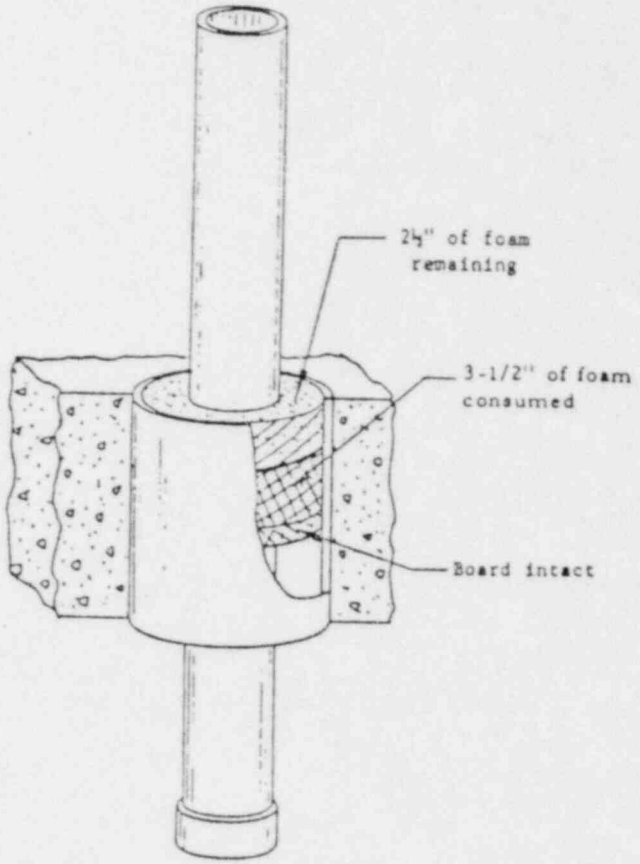


Figure 58. Penetration 5.2 After Test

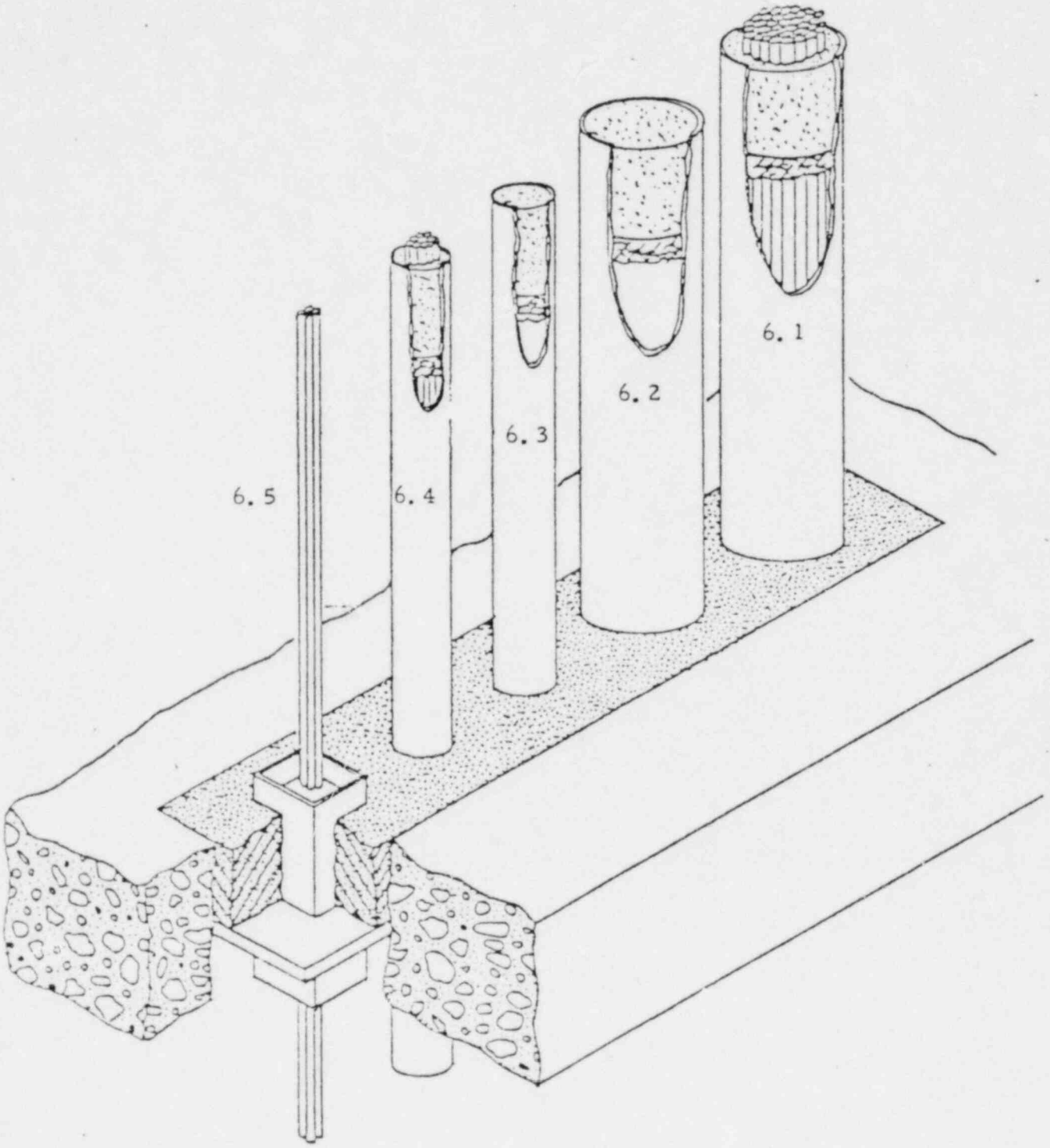


Figure 29. Layout, Blockout 6

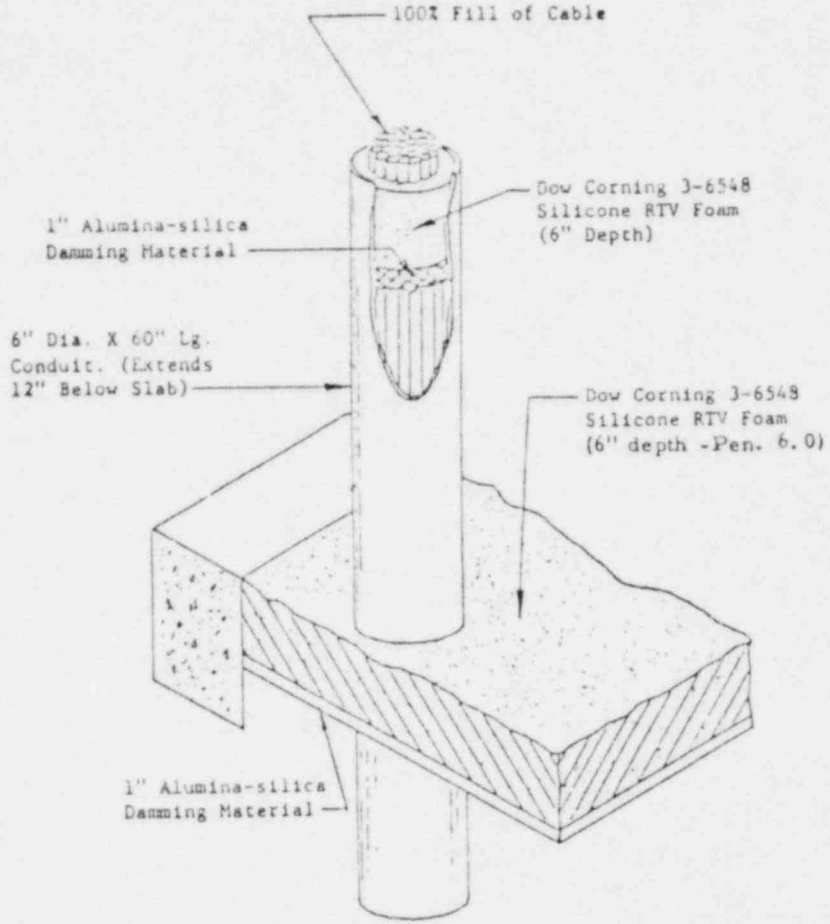


Figure 30. Penetration 6.1

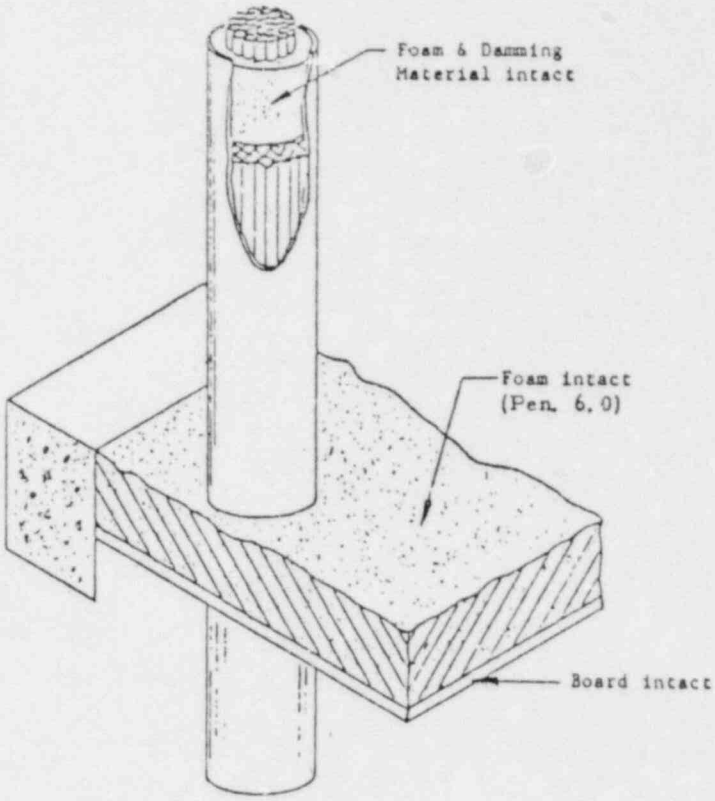


Figure 59. Penetration 6.1 After Test

No Cable

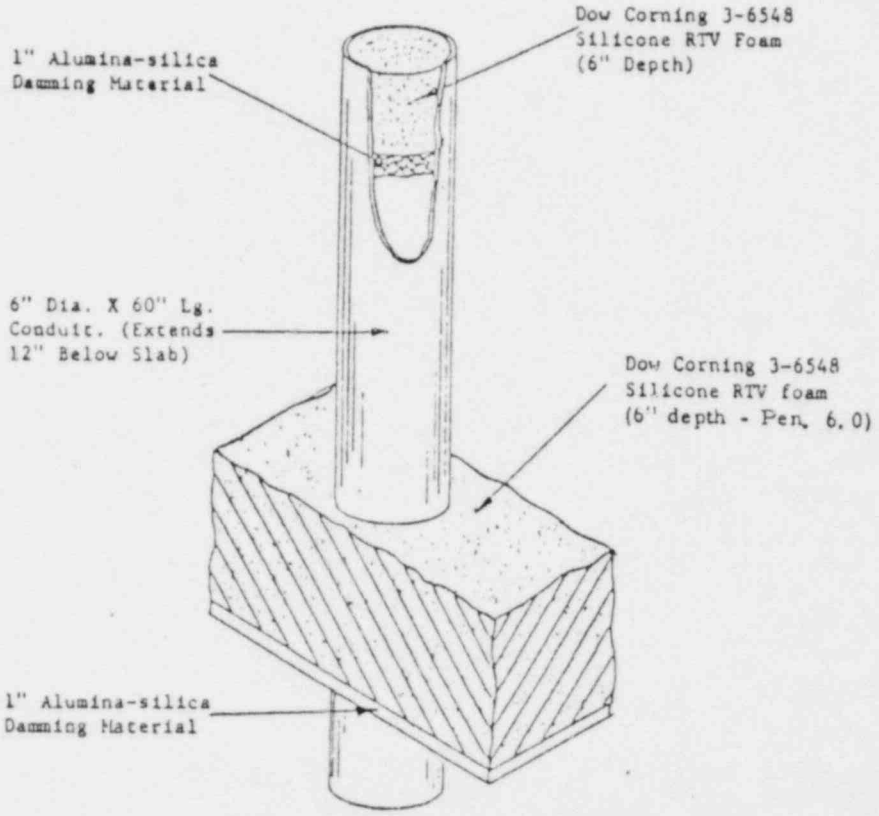


Figure 31. Penetration 6.2

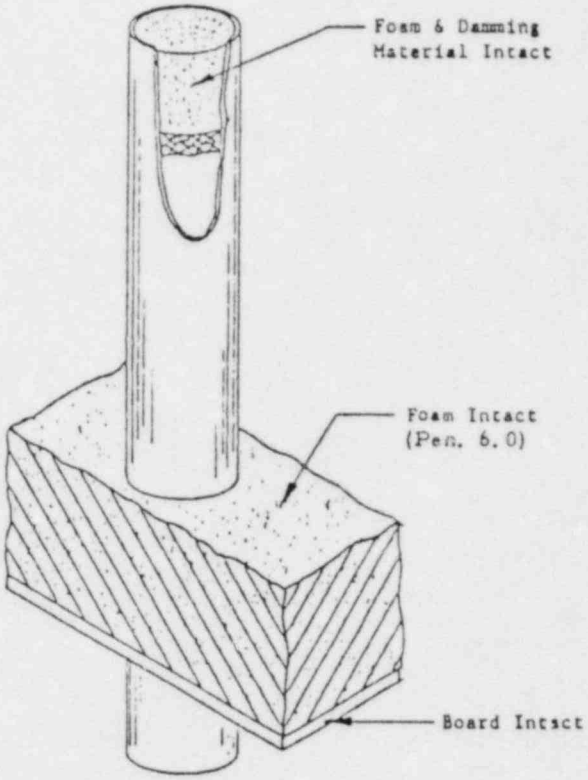


Figure 60. Penetration 6.2 After Test

No Cable

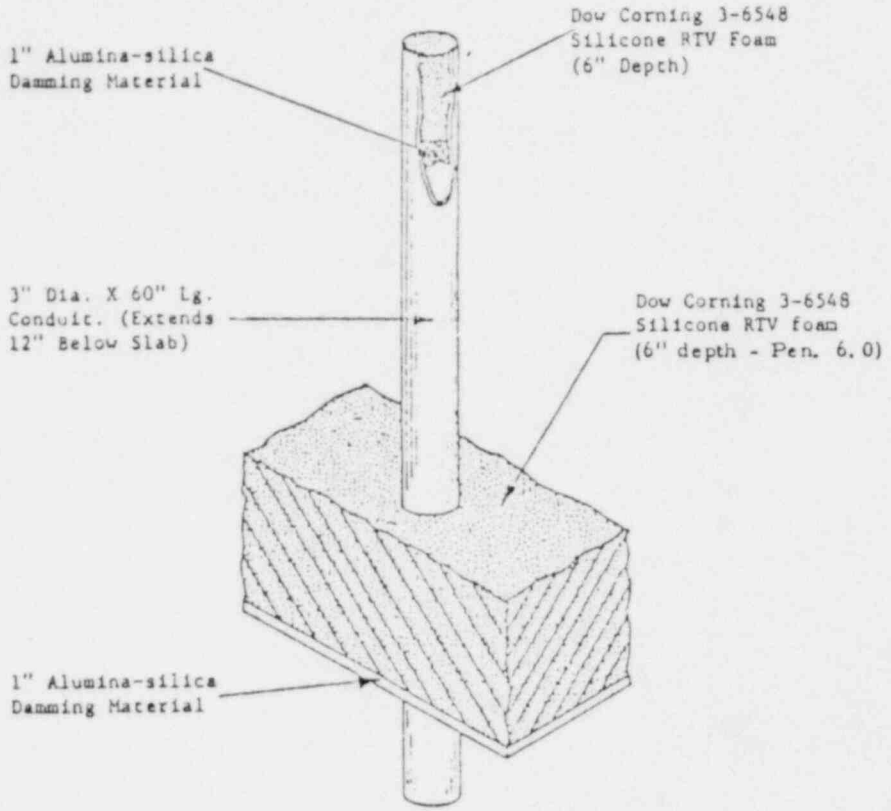


Figure 32. Penetration 6.3

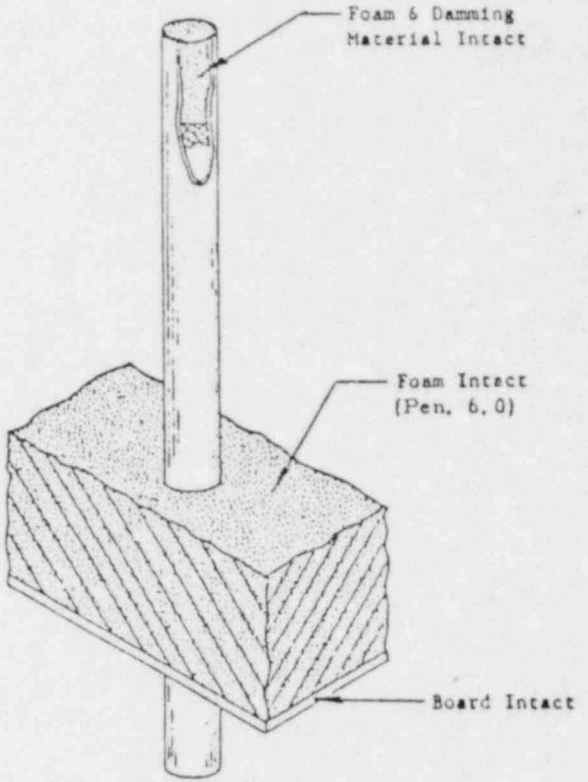


Figure 61. Penetration 6.3 After Test

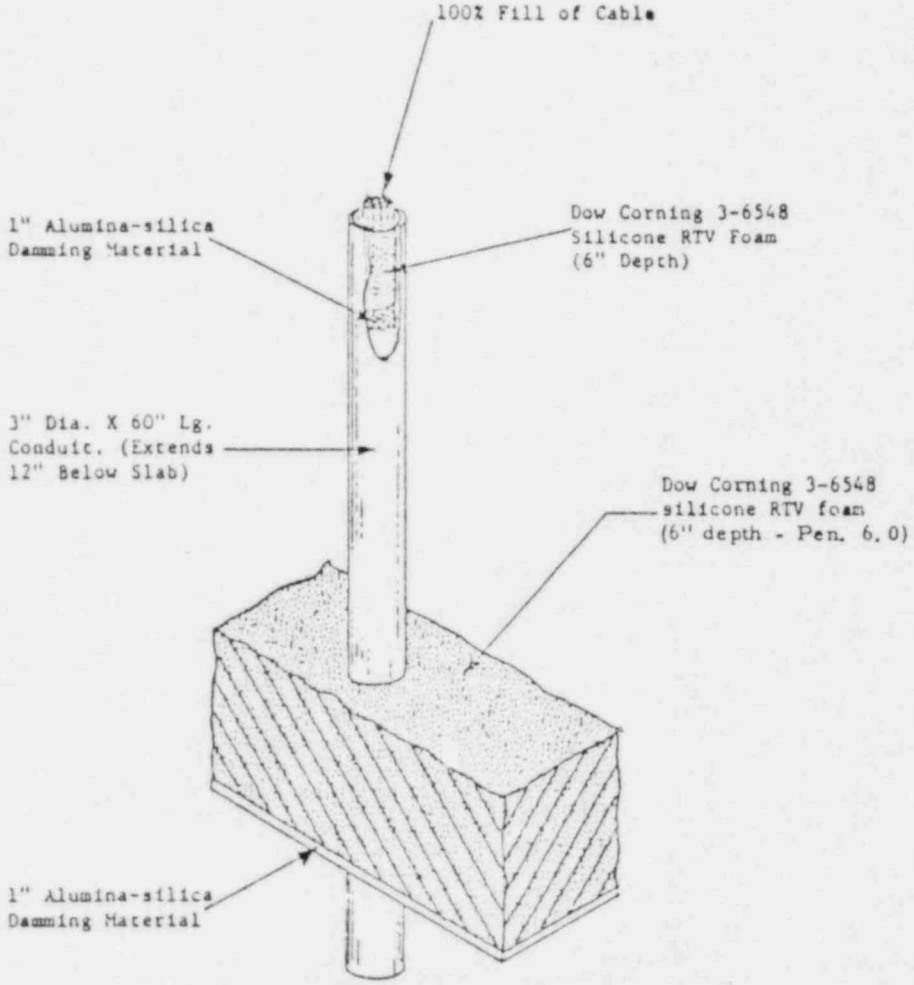


Figure 33. Penetration 6.4

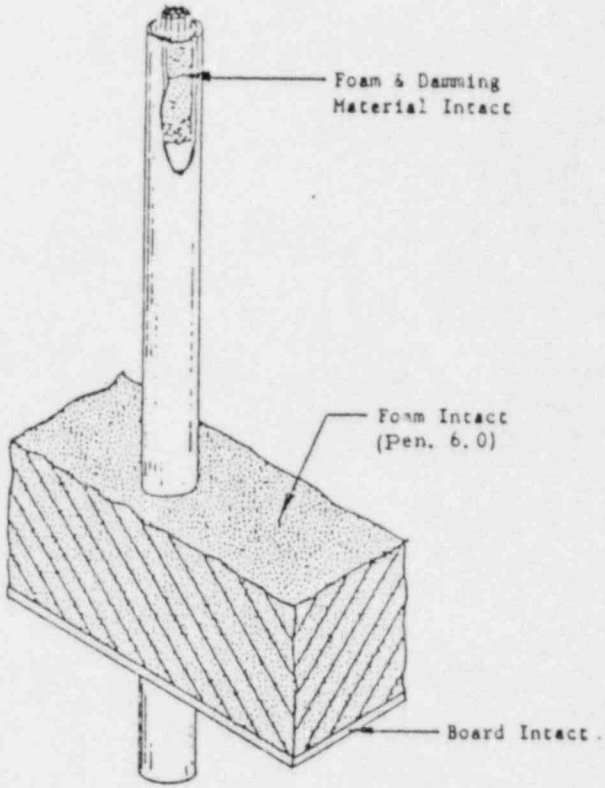


Figure 62. Penetration 6.4 After Test

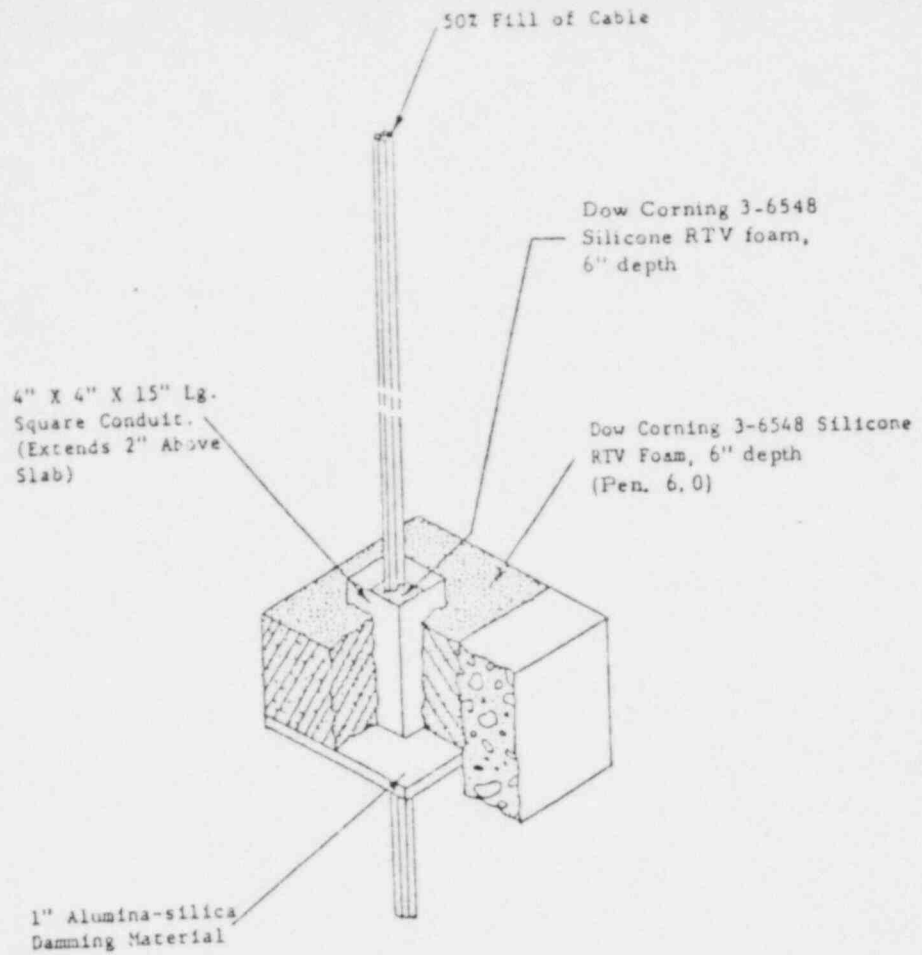


Figure 34. Penetration 6.5

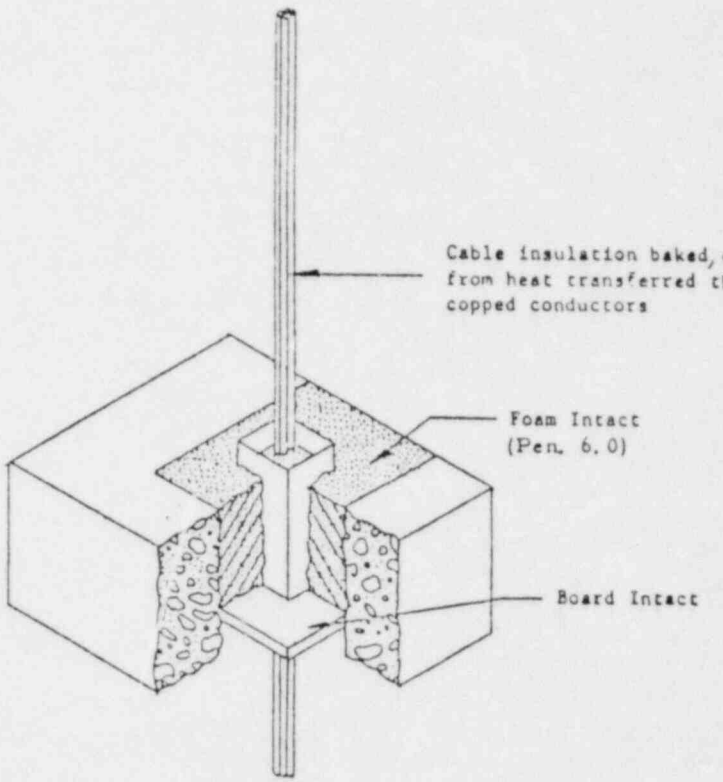


Figure 63. Penetration 6.5 After Test

ATTACHMENT 3

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J Carney, Vice President

August 25, 1980

Mr. L. Charles Spriggs
Quality Assurance Manager
B&B Insulation, Inc.
Post Office Box 2531
Houston, Texas 77001

Dear Charlie:

This will confirm the items discussed during your visit of August 22 to Farmington. Southwest Research Institute Reports of the 3 hour fire endurance and hose stream tests conducted on May 20, and May 27, 1980, which included various electrical and mechanical floor penetrations in test slabs 1A and 2 have been reviewed and are acceptable to American Nuclear Insurers for Insurance Purposes. ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance forms have been issued.

As we discussed, a maximum 6" annular space in Mechanical Penetrations is acceptable based on the successful test of Blockout No. 3 in Slab 1A which was sealed with 6" of Dow Corning 3-6548 Silicone Foam and 1" of B&W 'M' Board or Type 126 Ceraboard damming.

It is understood that you will be forwarding to us the sample of B&B Insulation Penetration sign-off sheet for addition to your Q.C. program in the near future.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

RFM:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX. No. 643-029

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/27/80 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	42" X 46"	4" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	Hi-density leaded matrix Density: 150 lbs./cu. ft.	Same as for cable
Fire Stop Thickness	Cable trays and 4" conduit: 12" Hi-density leaded matrix Conduit 3" or less: 6" leaded matrix + 1" damming.	12" Hi-Density leaded matrix
Form Material	Cable trays + 4" conduit: Non-combustible forming used and removed. Conduit 3" or less: Cerafiber or Kaowool.	Noncombustible forming used and removed.

SPECIAL LIMITATIONS

Tray Types: OPEN LADDER + SOLID BOTTOM Cable Construction: NO LIMITATIONS
% Cable Loading: 100% Tray, 100% Conduit Max. Conduit Sleeve Size: 4"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/condui

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. S. Carney (for)
John S. Carney

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B & B INSULATION, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 5/27/80 | HOUR RATING: 3

GENERAL DATA

	PIPE ~~CABLE~~ PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	2" pipe in 10" sleeve	6" pipe in 12" sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	CHR No. 1032 Silicone Boot seals both sides filled with flexible rad seal matrix # 12 of # 14	Keene PE 2141 or CHR No. 1032 boot seals both side filled wit cerablanket or Dow Corning DC 3-6548 silicone RTV foam.
Fire Stop Thickness	20" flexible rad seal matrix Density: 150 lbs./cu. ft.	12" cerablanket 20" silicone foam Density: 14-20 lbs./cu. ft.
Form Material	N/A	N/A

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/condui

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 May 1, 1981
Date Issued

J. J. Carney (REM)
John J. Carney

FIRE QUALIFICATION TEST ON PENETRATION SEALS

SLAB 2

PROJECT NO. 03-6004-004

by
Michael D. Pish
Larry J. Poirier

FINAL REPORT

B & B INSULATION INC.
P.O. BOX 2531
HOUSTON, TEXAS 77001

JULY 25, 1980

Reviewed:

George K. Wolfe, P.E.
Manager, Special Projects
Ocean Engineering and Structural Design

Approved:

Edward M. Briggs, Director
Ocean Engineering
and Structural Design

B & B INSULATION, INC.

EXCERPTS FROM FINAL REPORT

FULL REPORT AVAILABLE UPON REQUEST FROM:

B & B INSULATION, INC.
P. O. Box 2531
Houston, TX 77001

SUMMARY

On 27 May 1980, twenty block-out and pipe sleeve penetrations designed by B & B Insulation Incorporated were exposed to a three-hour fire endurance test following the ASTM E119-76 time/temperature curve.

The purpose of the test was to qualify electrical and mechanical radiation seals per current regulatory requirements and guidelines of the American Nuclear Insurers (ANI): Nuclear Mutual Limited, (NML), and The Institute of Electrical and Electronic Engineers, (IEEE). In addition, a hose stream test as described in Section 5.3.12 of IEEE 634 and Section 2.B.2 of NEL-PIA/MAERP Standard Method of Fire Tests was to be applied. These standards are reproduced in Appendix VI. The test was performed to provide documented evidence that the penetrations as described herein will satisfactorily withstand an ASTM E119 fire exposure and shall conclusively demonstrate that thest seal designs will provide an effective fire barrier for a three hour ANI acceptance rating.

Penetration seal construction consisted of various loaded cable tray and pipe seal openings sealed with proprietary B & B Insulation sealing materials and Dow Corning Silicone RTV Foam. In some cases, alumina-silica material such as Kaowool and Ceraboard was used as damming material. The test slab, laboratory facilities, and cable loading was provided by Southwest Research Institute and cable seal material and installation was furnished by B & B Insulation. Quality Assurance functions were performed by B & B's parent company, INSULCO Incorporated.

TEST ATTENDEES

Conducting the test:

Mr. Jesse Beitel, Test Engineer
Mr. Michael D. Pish, Project Manager
Dr. Frank Farese, Consultant
Mr. A.L. Schraeder, Test Coordinator

Witnessing for INSULCO Incorporated:

Mr. L. Charles Spriggs

DESCRIPTION

A series of two blockout openings and twelve pipe sleeves were cast into the test slab. One blockout consisted of a 45" x 42" cable tray opening, and the other blockout was a 26" x 42" opening. Four of the pipe sleeves were 4" diameter, and the remaining eight sleeves were 12" diameter. A detailed description of each opening is contained in the discussion of the test slab construction, and the slab layout is shown in Figures 1 and 2.

All openings were cast into an 8' x 10' x 12" thick concrete slab. Once cured, the various penetration seal materials, cables, and mechanical penetrators as described in Appendix I were installed. Penetration identification is shown in Figure 3. Cable loading and pipe or sleeve penetration sizes is shown in Figure 4. The penetration seal materials were allowed to cure prior to the fire exposure test.

The test slab was placed on a horizontal furnace and exposed to the standard ASTM E119 time/temperature curve. After three hours the test slab was lifted in a horizontal position of the hose stream test and then moved to an area adjacent to the furnace, where it was put on blocks to cool and view.

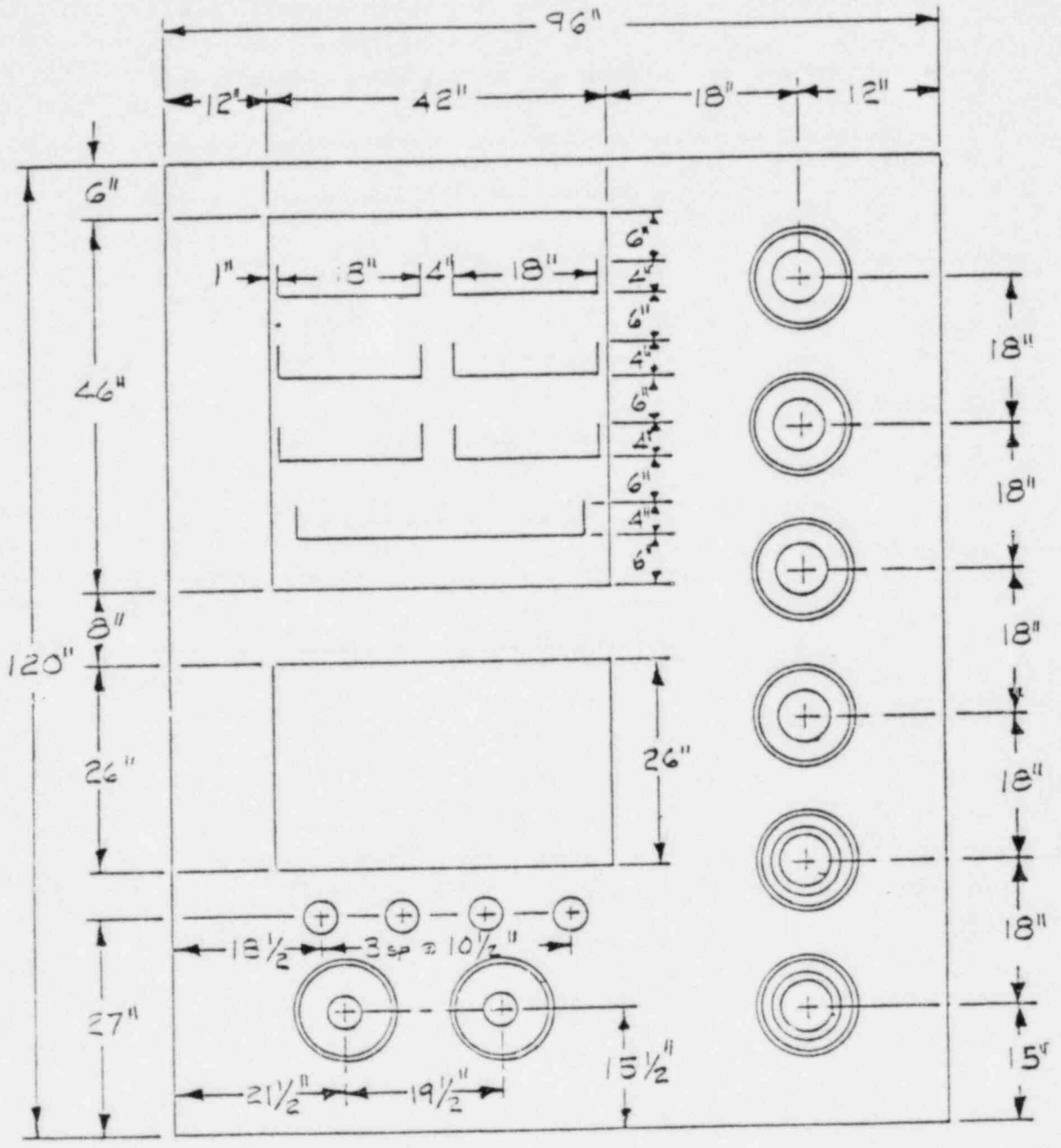


Figure 1. Slab Layout

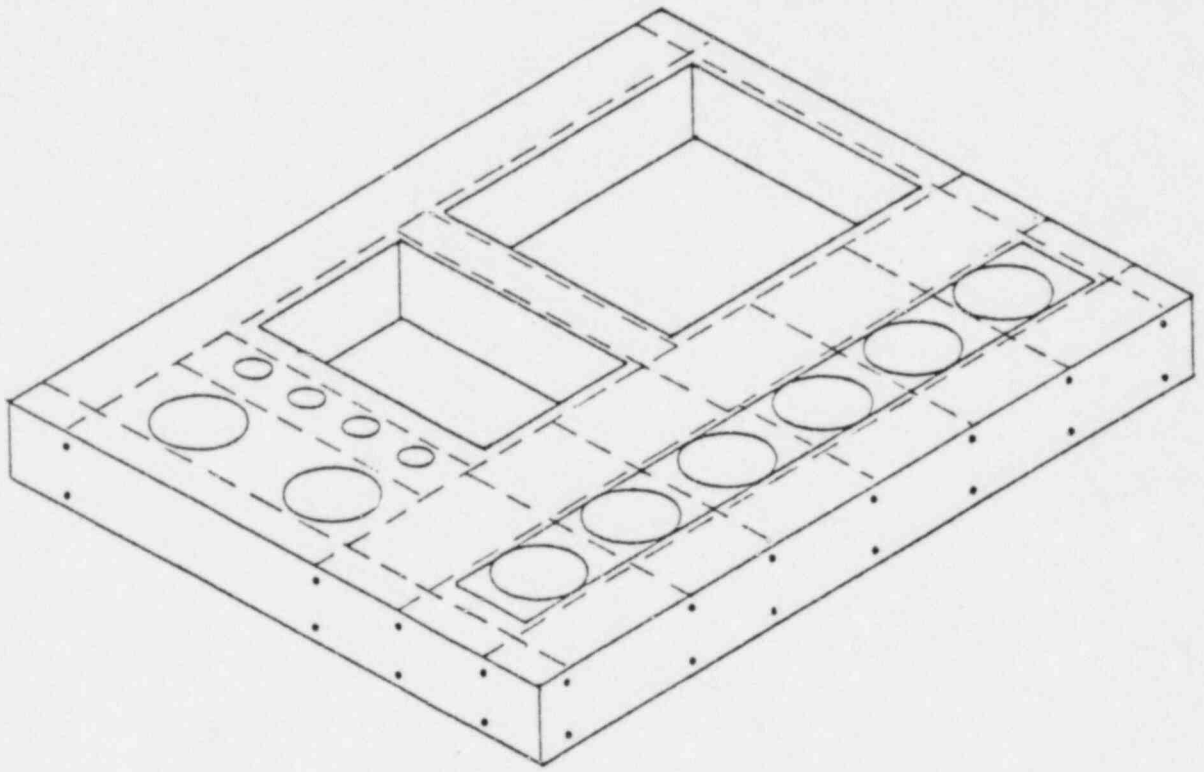


Figure 2. Reinforcement Detail

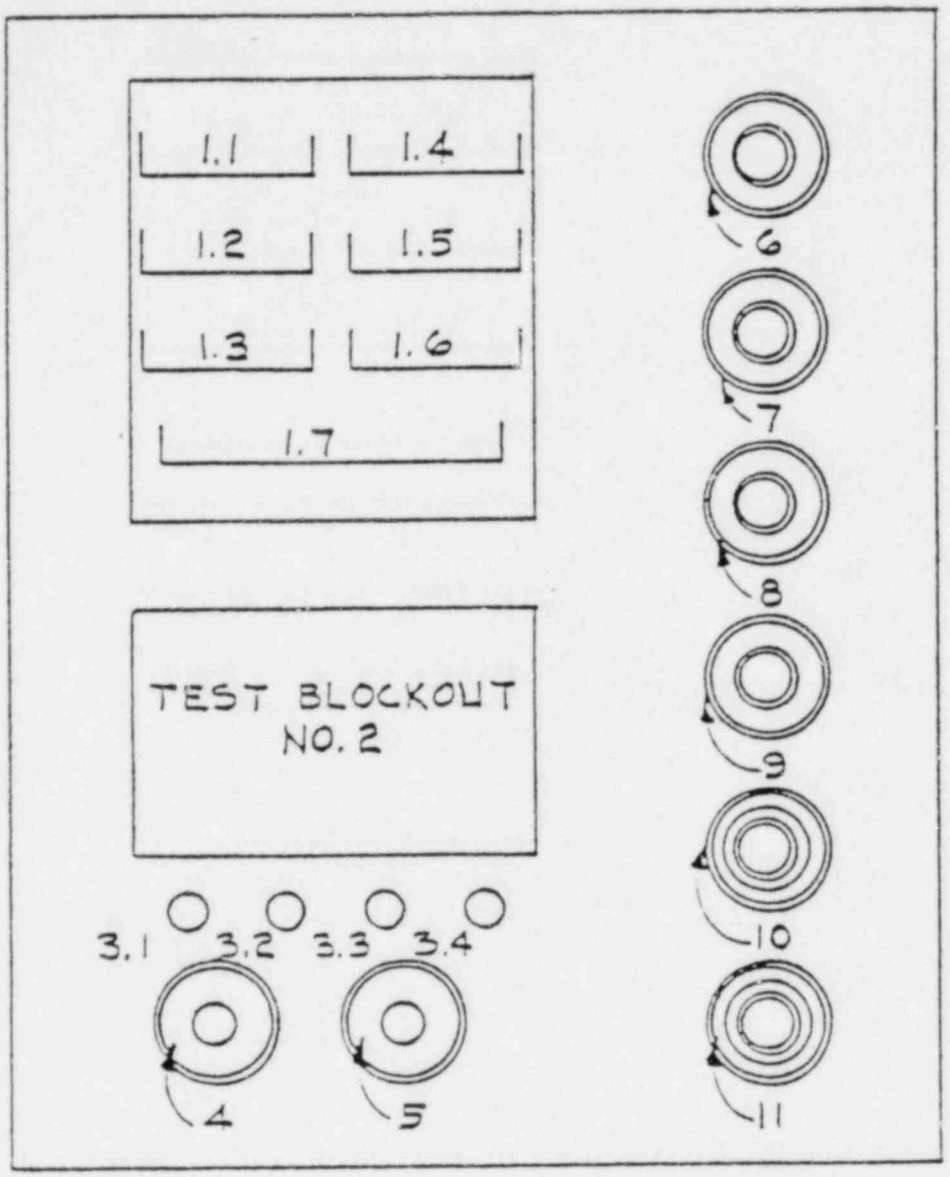


Figure 3. Penetration Identification

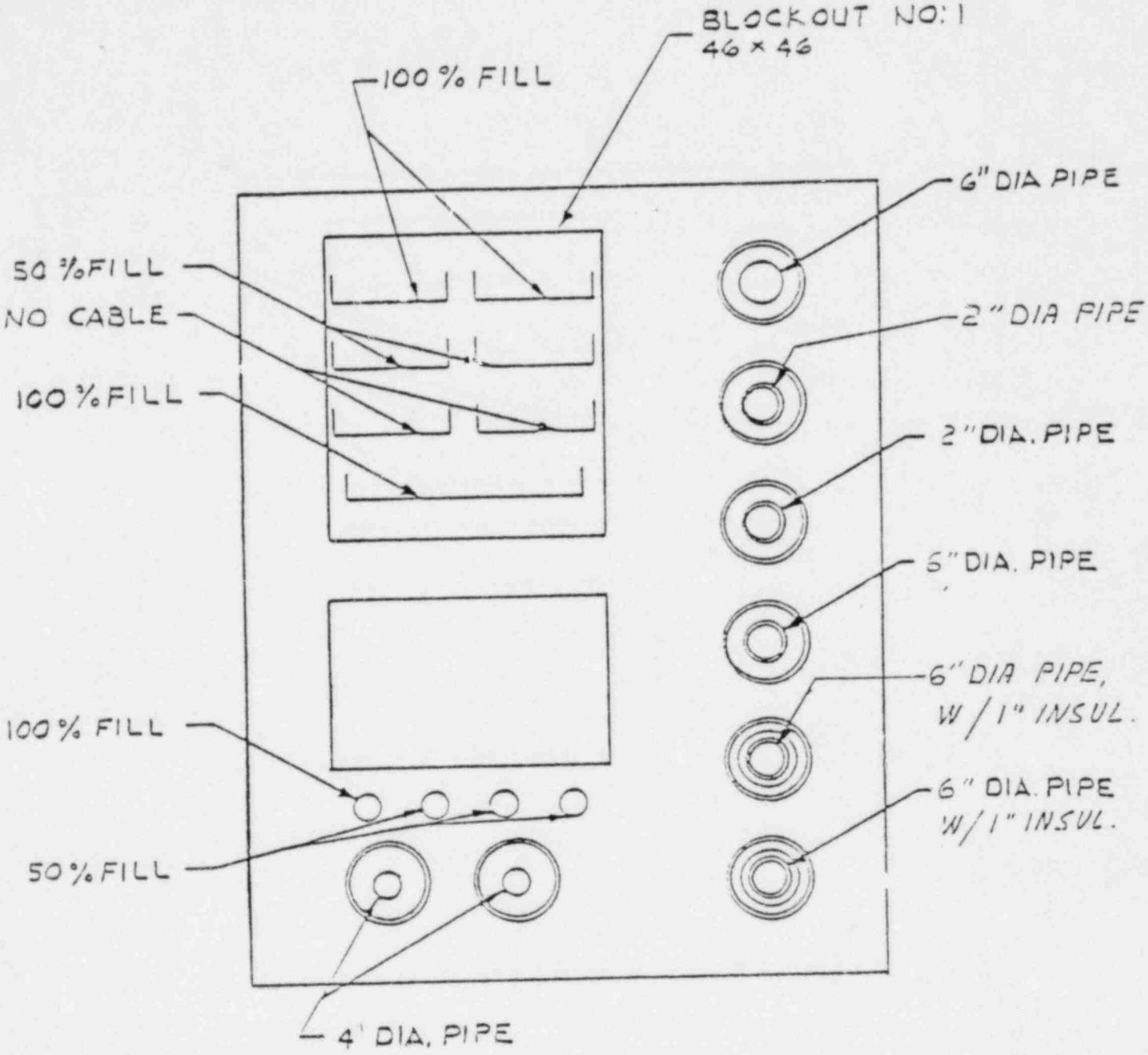


Figure 4. Cable Loading

TEST SLAB

A. Construction

A floor section form (8' x 10' x 12" thick was constructed of 12" steel channel with a double mat of " rebar on 12 x " centers. A series of 14 penetration openings were cast into the slab. Two of the openings were cable tray blockouts, the first being 46" x 42", and the second being 26" x 42", and are identified as blockouts one and two respectively. The remaining twelve openings were pipe sleeves, eight of them being 12" diameter, and four of them being 4" diameter.

The concrete (f_s=3000 psi) was poured on 26 March 1980 and cured for one week at 400°F, using an enclosure constructed for this purpose. After the concrete had cured, cable tray supports were welded to the basic framework. Details of the steel framing and slab layout are shown in Figure 5.

B. Penetration Loading

The penetrations were loaded as defined by the B&B Insulation Inc. Procedure CTP-1002, Revision 1, dated 15 April 1980, which is reproduced in Appendix I. The type and number of cables used in the cable penetrations is listed in Table 1.

C. Sealing of Penetrations

Seal installation was performed by B & B personnel using the materials defined in the referenced Procedure. Material exigencies required some deviation from the basic plan. A detailed listing of the seal installation

appears in the Quality Control Documentation furnished by INSULCO, reproduced in Appendix III. Drawings of the penetration assemblies appear in Figures 6 through 26.

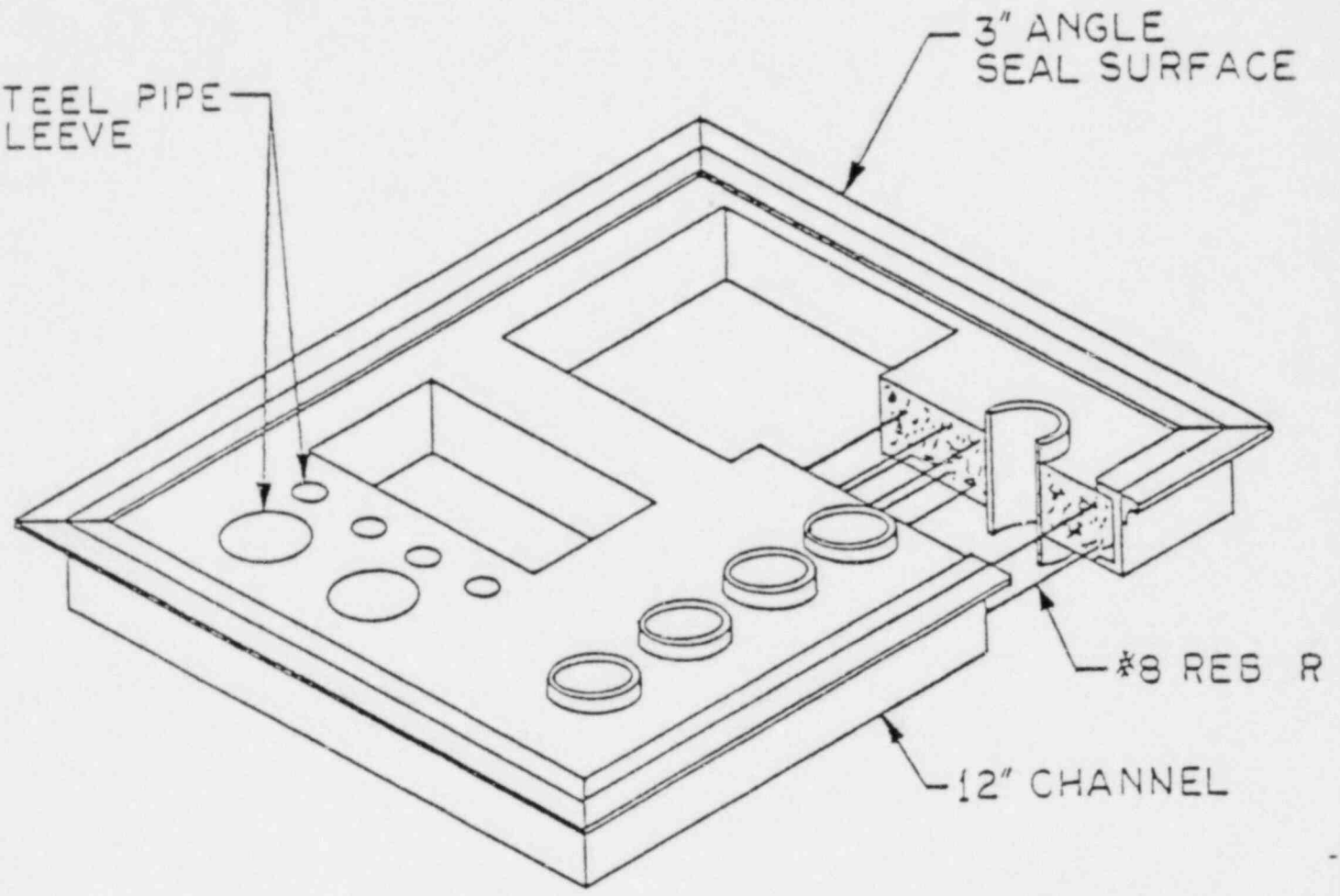


Figure 5. Schematic of Slab Layout

TABLE 1
SIZE AND TYPE OF CABLE PER PENETRATION
SLAB NUMBER TWO

PENETRATION NUMBER	FILL %	300 MCM (1 COND.)	12 AWG (7 COND.)	16 AWG (2 COND.)
1.1	100	12	24	120
1.2	50	6	12	60
1.3	0	--	--	--
1.4	100	12	24	120
1.5	50	6	12	60
1.6	0	--	--	--
1.7	100	24	48	240
2.1	0	--	--	--
3.1	100	1	3	16
3.2	50	--	2	8
3.3	50	1	2	20
3.4	50	1	2	20

NOTE: Penetrations 4 through 11 - no cable
Pipe sleeve penetrants

All cables - Polyethylene insulation with PVC jacket,
600 volt rating, (See Spec. sheet, App. I, page 25)

TEST FACILITY & TEST PROCEDURE

B & B INSULATION, INC.

TEST FACILITY

The floor penetration assembly fire resistance test was conducted using a horizontal furnace with an open area of 8 x 10 feet. (See Figure 27). A flue gas opening was provided on one end. Eight Maxon self-aspirating burners were mounted in the sides of the furnace. Eight furnace temperature thermocouples were located 2 1/2 ft. inside each wall at 2 foot centers with the first pair of thermocouples 1 1/2 ft. from the flue end of the furnace at the 24 inch elevation. Seventy-nine thermocouples on the unexposed side and imbedded in the seal materials of the penetration seals were connected to multi-point temperature recorders with a range of zero to 2000°F. (See Appendix IV and V). All gas flow to the burners was controlled manually and continuously indicated by the average of six furnace temperature thermocouple readings taken at 12 inches from the exposed specimen surface. These average temperatures are shown in Figure 28 and Table 2. The temperatures recorded from the imbedded and unexposed side thermocouples are shown in Appendix IV.

Since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E119 standards. This structure was adequate to prevent excessive air currents over the unexposed surface of the slab. The outside temperature was approximately 85 degrees at the start of the test.

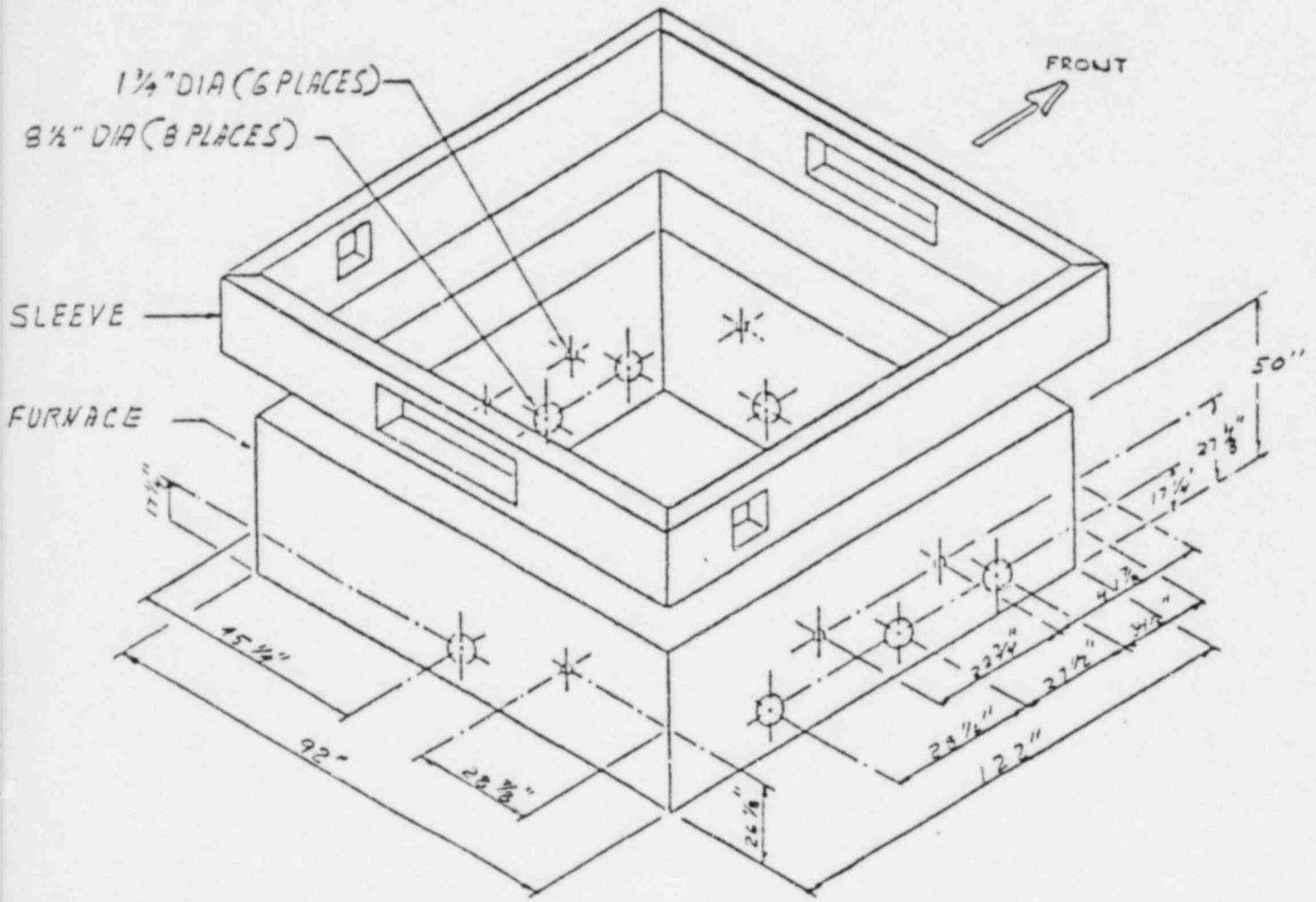


Figure 27. Test Furnace

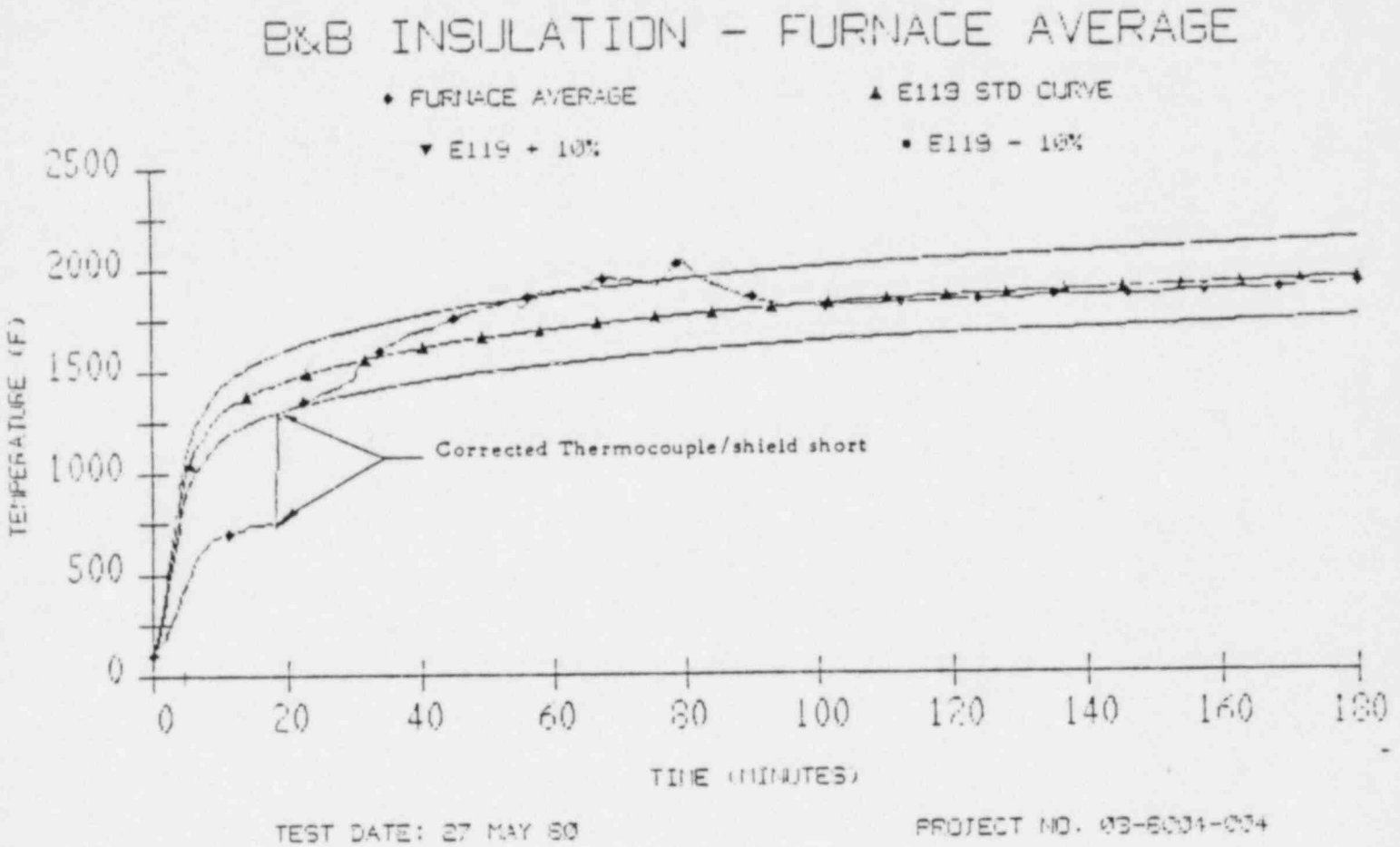


Figure. 28 Furnace Temperature

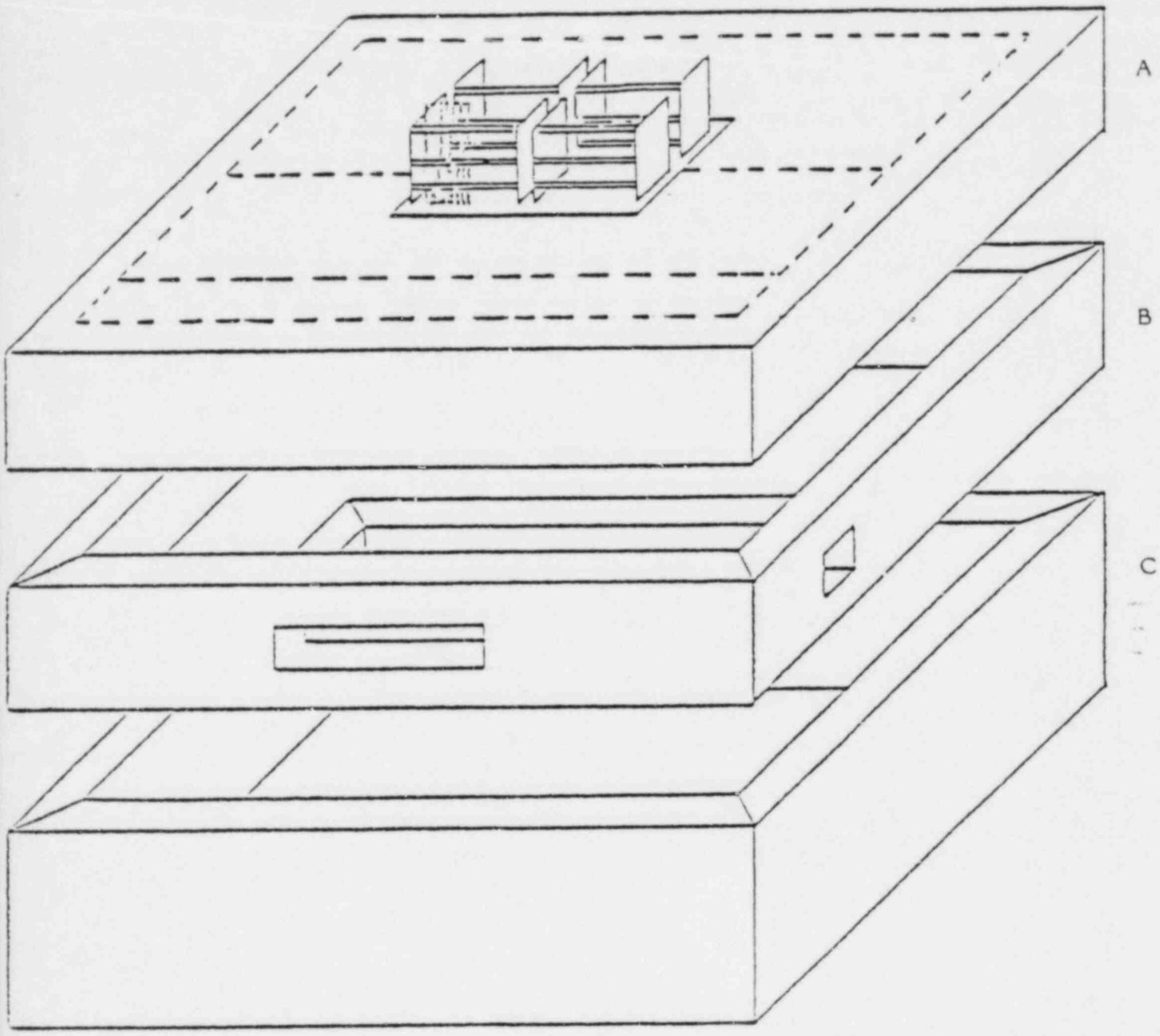
TABLE 2

ASTM E119 Time/Temperature Curve

Time	Standard Curve	-10%	Actual	+10%	Time
0	70	63	85	77	0
1	200	180		220	1
2	400	360		440	2
3	600	540		660	3
4	800	720		880	4
5	1000	900	460	1100	5
6	1100	990		1212	6
7	1150	1035		1265	7
8	1200	1080		1320	8
9	1250	1125		1375	9
10	1300	1170	691	1430	10
11	1320	1188		1452	11
12	1350	1206		1474	12
13	1360	1224		1496	13
14	1380	1242		1518	14
15	1399	1259	745	1539	15
16	1414	1274		1555	16
17	1429	1286		1572	17
18	1435	1291		1579	18
19	1450	1305		1595	19
20	1462	1316	1316	1608	20
21	1474	1327		1621	21
22	1486	1337		1635	22
23	1498	1348		1648	23
24	1500	1350		1650	24
25	1510	1359	1393	1661	25
26	1520	1368		1672	26
27	1528	1375		1681	27
28	1537	1363		1691	28
29	1541	1387		1695	29
30	1550	1395	1467	1705	30
35	1584	1425	1626	1742	35
40	1613	1452	1697	1774	40
45	1630	1467	1757	1793	45
50	1661	1495	1808	1827	50
55	1681	1513	1850	1849	55
60	1700	1530	1880	1870	60
65	1718	1546	1906	1890	65
70	1735	1561	1935	1909	70
75	1750	1575	1919	1925	75
80	1765	1589	2021	1941	80
85	1779	1601	1903	1957	85
90	1792	1613	1844	1971	90
95	1804	1624	1803	1984	95
100	1815	1633	1805	1994	100
105	1826	1643	1811	2009	105
110	1835	1651	1817	2019	110
115	1843	1659	1821	2027	115
120	1850	1665	1827	2035	120
130	1862	1676	1831	2048	130
140	1875	1687	1845	2063	140
150	1888	1699	1850	2077	150
160	1900	1710	1865	2090	160
170	1912	1721	1875	2103	170
180	1925	1733	1895	2117	180

TEST PROCEDURE

The prepared floor penetration slab with fire stop materials in place was placed in position on top of the furnace. The temperature multi-point recorders were turned on, natural gas was supplied to the burners, ignited, and the test clock was started. The unexposed surface was continuously observed for penetration by flame or hot gases and its temperature monitored, by using the multipoint recorders. At the end of the three hour fire exposure period, the fuel gas was shut off and the enclosure building was removed. The test slab was lifted from the furnace, remaining in a horizontal position. A 15° spray stream supplied from a 1 1/2 inch fire hose with a spray stream setting and 75 psi nozzle pressure and 75 gpm delivery was then directed at the floor penetration fire stops from a distance of 10 feet to conduct the hose stream test. This hose stream test is identified in Section 5.3.12 of IEEE 634-1978 and Section 2.B.2 of NEL-PIA/MAERP Standard Method of Fire Tests, both of which are reproduced in Appendix VI. The required hose stream application time for penetrations installed in a 10 x 8 ft. slab was 2 minutes. The time/temperature record of the test is shown in Figure 28 and Table 2. Figure 29 shows an exploded view of the test setup.



A) Test Slab (Typical)

B) Furnace Extension Sleeve

C) Furnace

Figure 29. Furnace Assembly

TEST RESULTS

TEST RESULTS

A. Observations

The following are observations made during the fire exposure test, the hose stream test, and the post-test inspection.

TABLE 3. TEST OBSERVATIONS

Test Time	Event		
-0:05	Furnace loaded, systems ready. Very light wind, temperature approximately 85°F.		
0:00	Burners on. Timer on. Recorders on. Start Test.		
0:05	Temp.	460°F	
0:10	Temp.	691°F	Heavy smoke, exposed side
0:15	Temp.	745°F	Low, increase burners
0:20	Temp.	1316°F	On curve
0:25	Temp.	1393°F	Exposed cables flaming
0:30	Temp.	1467°F	Black smoke, no penetration
0:35	Temp.	1626°F	Burners stable
0:40	Temp.	1697°F	Slightly above norm, on curve
0:50	Temp.	1808°F	
1:00	Temp.	1880°F	
1:10	Temp.	1935°F	
1:20	Temp.	2021°F	Holding above norm. Reduce gas
1:30	Temp.	1844°F	Cool smoke from cable trays
1:40	Temp.	1805°F	On curve
1:50	Temp.	1817°F	
2:00	Temp.	1827°F	All stable
2:10	Temp.	1831°F	
2:20	Temp.	1845°F	
2:30	Temp.	1850°F	
2:40	Temp.	1865°F	
2:50	Temp.	1875°F	
3:00	Temp.	1895°F	
3:01	End of Fire Exposure Test		
3:08	Protective cover removed		
3:10	Slab hooked up for lift		
3:14	Start Hose Stream Test		
3:16	End of Hose Streat Test		
3:20	Slab settled for examination		

Post Test Observations

1. There was no passage of flame through any penetration during the fire exposure test.
2. There was some passage of light smoke through the seals, but the smoke was cool to the touch.
3. There was no passage of water through any penetration during the hose stream test.

B. Summary of Test Results

In order to be considered as an acceptable fire stop for the ANI and/or IEEE, a penetration seal must have met the following requirements:

ANI

1) Fire shall not propagate to the unexposed side of the test assembly or shall any visible flaming be observed.
2) No individual thermocouple of the unexposed surface (field) of the fire stop shall exceed 325°F above ambient temperature.
3) No opening develops that permits a project of water from the stream beyond the unexposed surface during the hose stream test.

IEEE 63A (Paragraph 6.1)

1) The fire stop shall have withstood the fire endurance test without permitting the passage of flame, or the occurence of flaming on any element of the unexposed surface of the assembly for a period equal to the hourly classification for the fire stop.

2) The fire stop shall have withstood the fire endurance test and hose stream test without developing an opening that would permit a projection of water from the stream beyond the unexposed surface.

3) The transmission of heat through the fire stop during the fire endurance test for any recorded temperature on its unexposed surface shall not exceed 700°F on penetrations involving cable.

Accordingly, Table 4 shows the performance of the penetrations for the test period of three hours as documented in the test observation and Appendix IV.

To verify the condition of the penetration seals after the test, an examination was made to determine the char depth, the depth of any remaining insulation material, and the condition of the penetrants. The results of this examination are shown in Figures 30 through 49. Photographs of the fire exposure period, the hose stream test, and the post test condition of the penetrations can be found in Appendix II.

TABLE 4

TEST RESULTS

Penetrations Number	ANI TEST RESULTS			IEEE TEST RESULTS		
	Cond.1	Cond.2	Cond.3	Cond.1	Cond.2	Cond.3
1.1	Pass	Pass	Pass	Pass	Pass	Pass
1.2	Pass	Pass	Pass	Pass	Pass	Pass
1.3	Pass	Pass	Pass	Pass	Pass	Pass
1.4	Pass	Pass	Pass	Pass	Pass	Pass
1.5	Pass	Pass	Pass	Pass	Pass	Pass
1.6	Pass	Pass	Pass	Pass	Pass	Pass
1.7	Pass	Pass	Pass	Pass	Pass	Pass
2.1	Pass	Fail	Pass	Pass	Pass	Pass
3.1	Pass	Pass	Pass	Pass	Pass	Pass
3.2	Pass	Pass	Pass	Pass	Pass	Pass
3.3	Pass	Pass	Pass	Pass	Pass	Pass
3.4	Pass	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass			
5	Pass	Pass	Pass			
6	Pass	Pass	Pass	IEEE		
7	Pass	Pass	Pass			
8	Pass	Pass	Pass	Electrical only		
9	Pass	Pass	Pass			
10	Pass	Pass	Pass			
11	Pass	Pass	Pass			

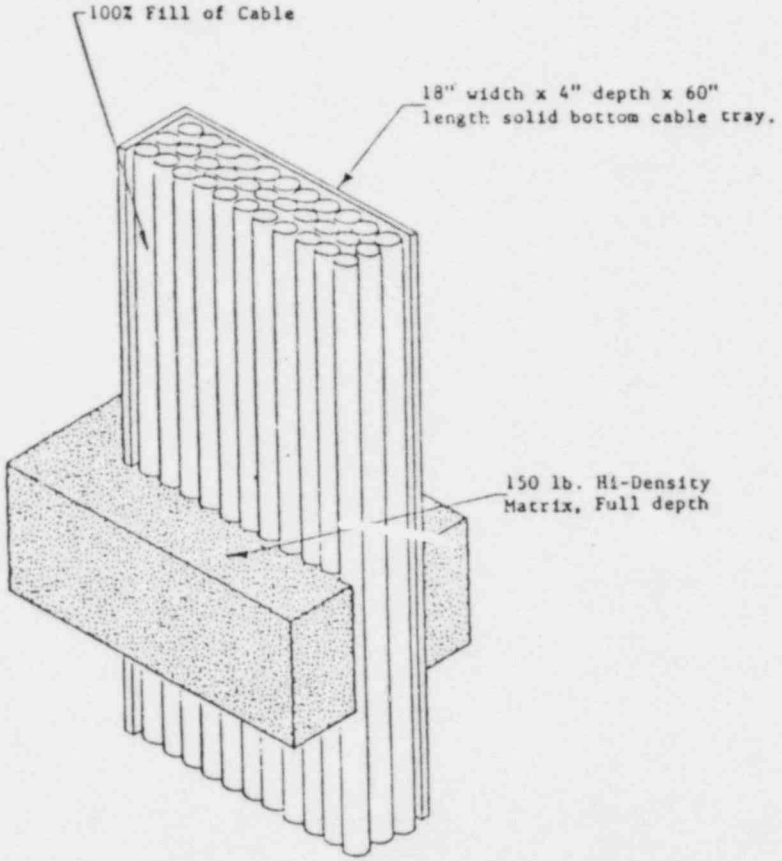


Figure 6. Penetration 1.1

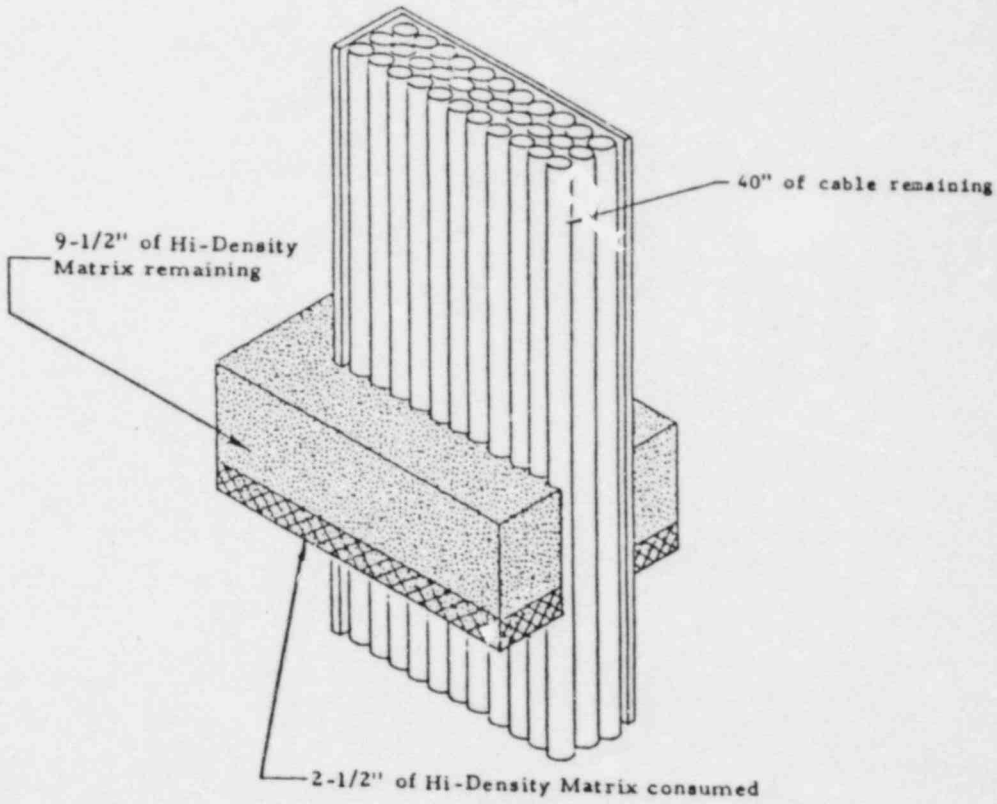


Figure 30. Penetration 1.1 after test

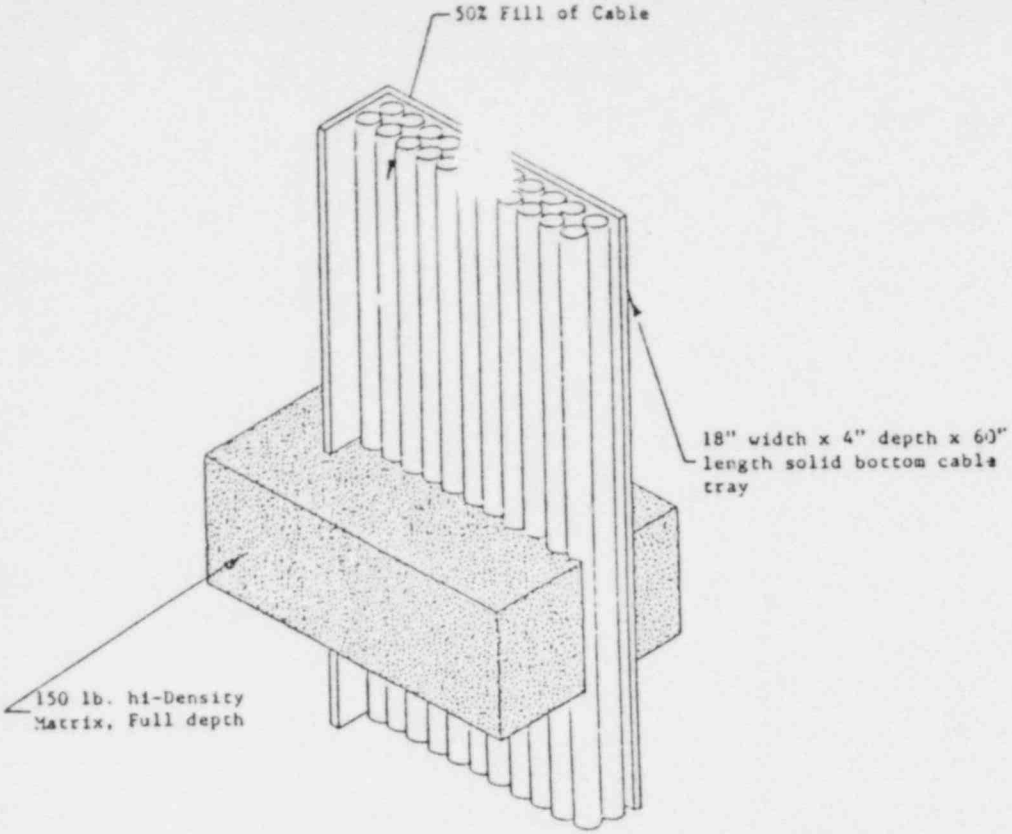


Figure 7. Penetration 1.2

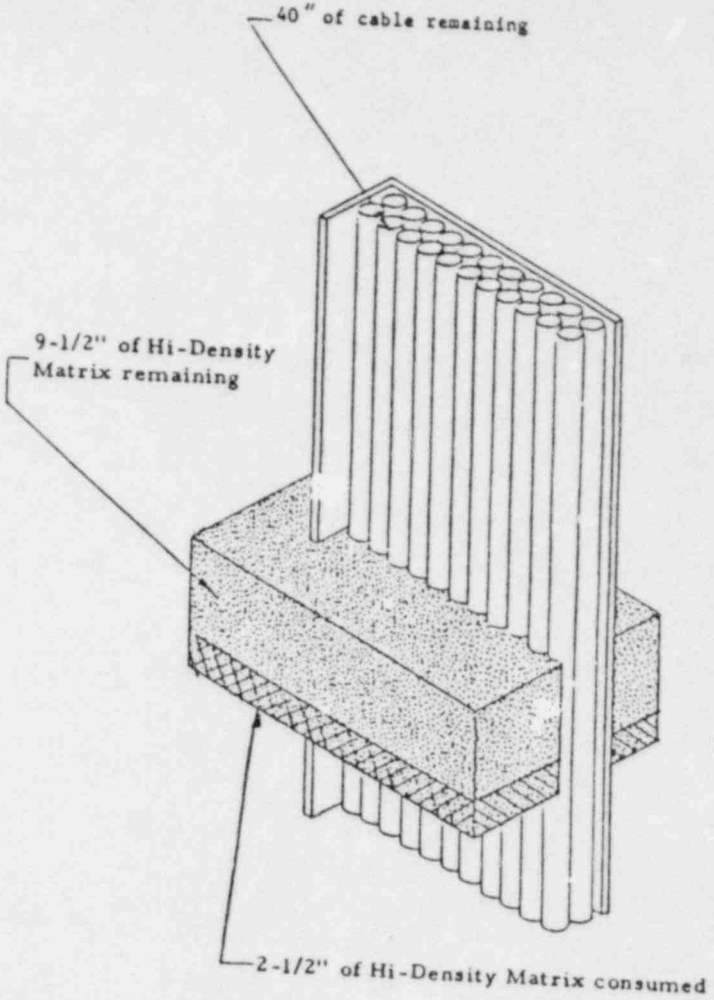


Figure 31. Penetration 1.2 after test

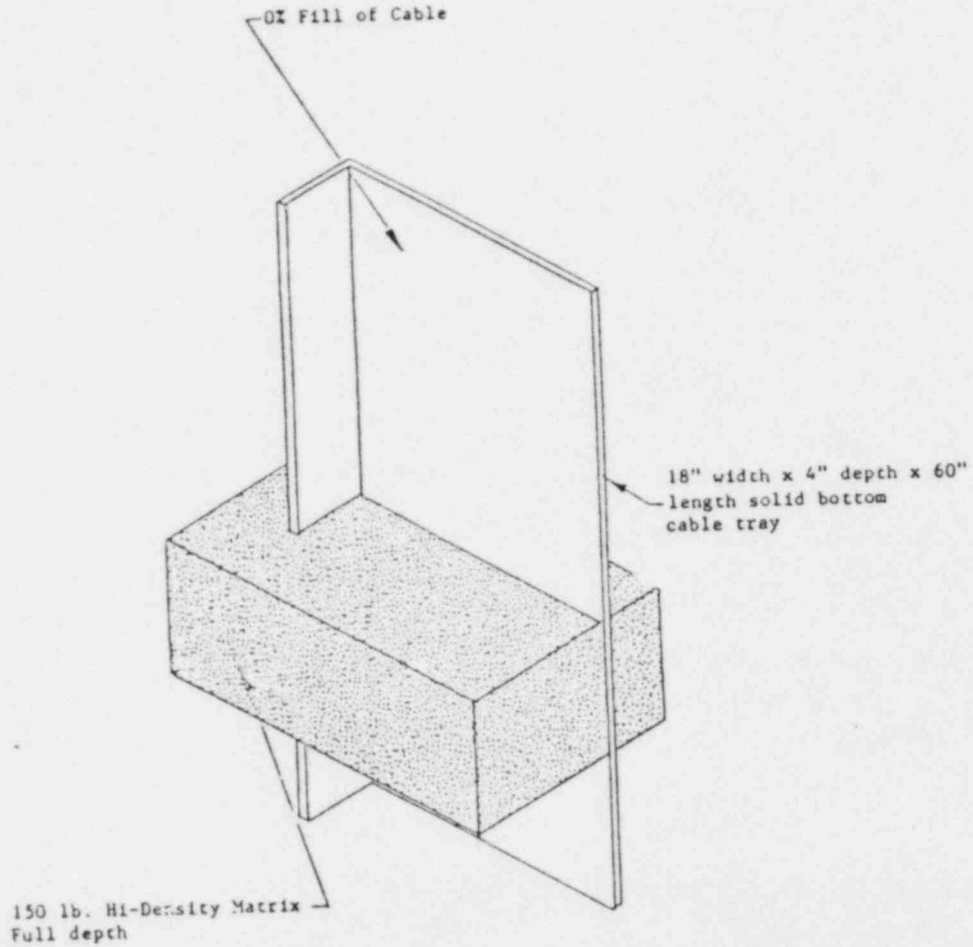


Figure 8. Penetration 1.3

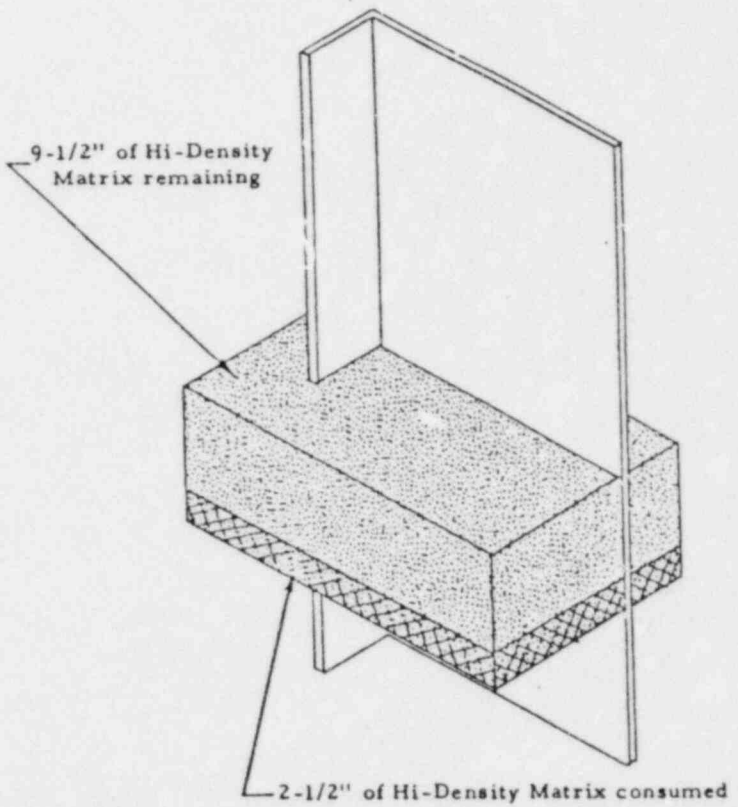


Figure 32. Penetration 1.3 after test

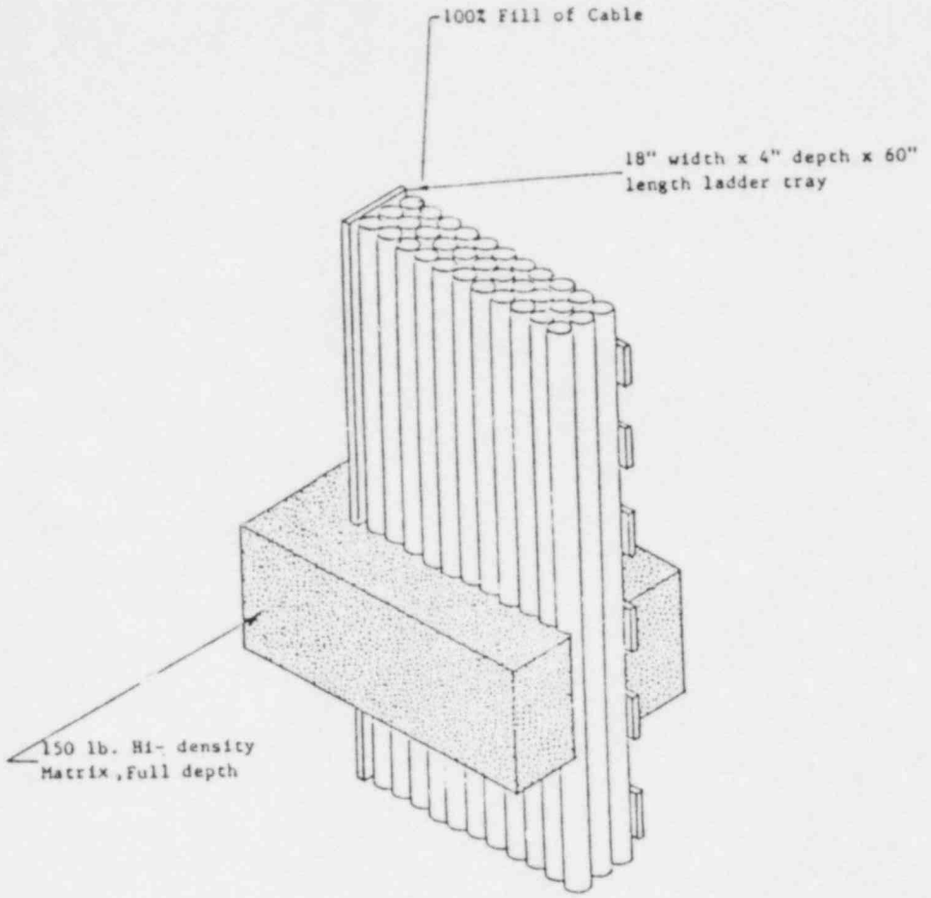


Figure 9. Penetration 1.4

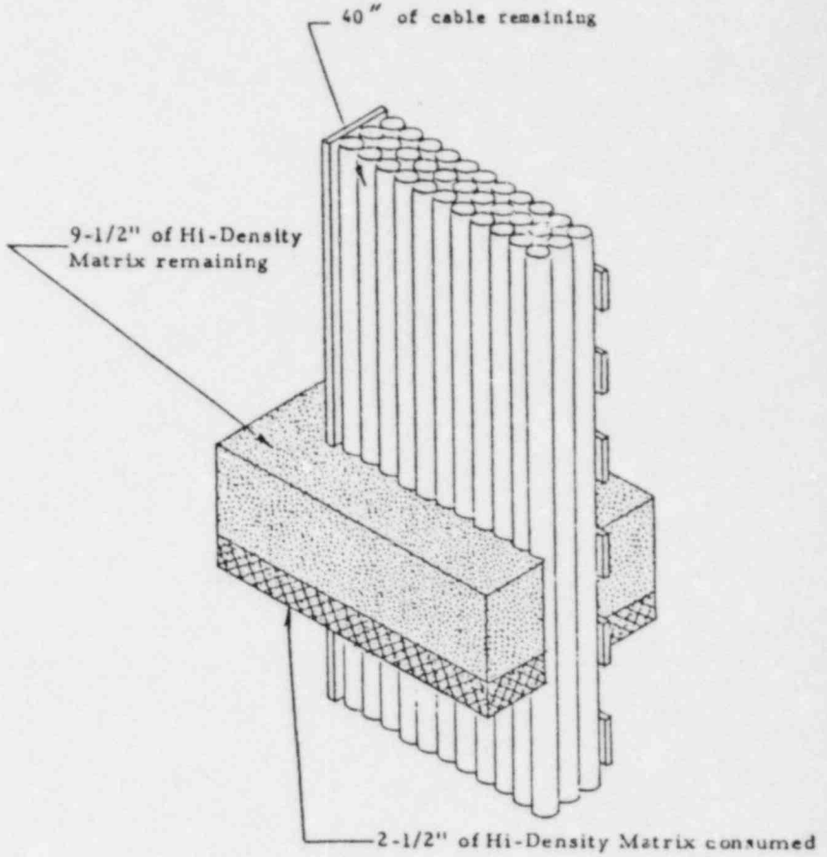


Figure 33. Penetration 1.4 after test

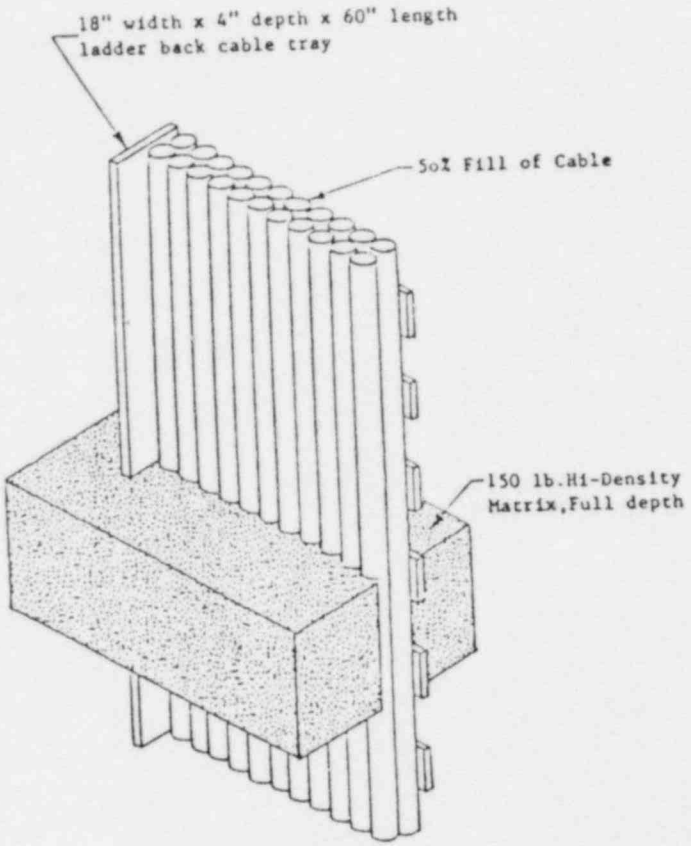


Figure 33. Penetration 1.5

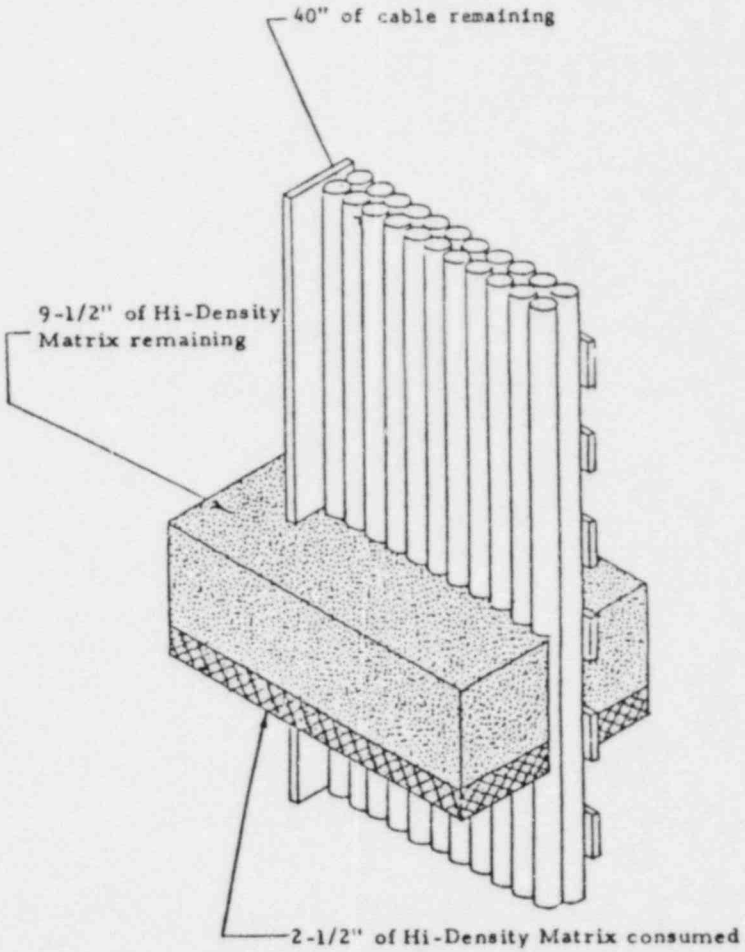


Figure 34. Penetration 1.5, after test

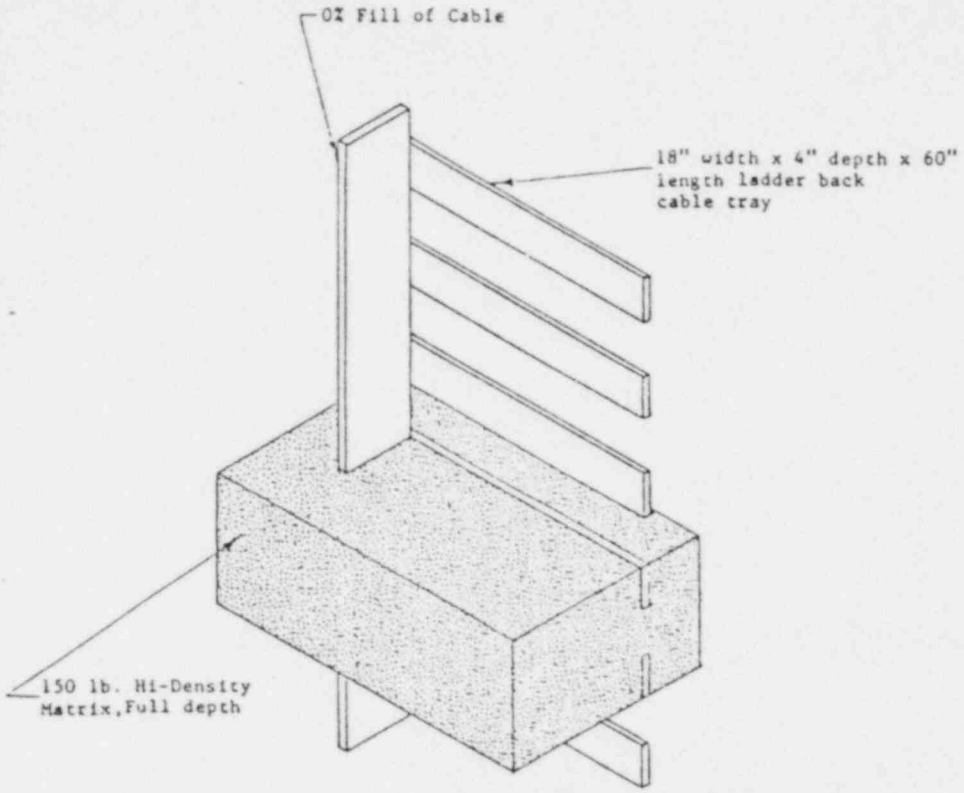


Figure 11. Penetration 1.6

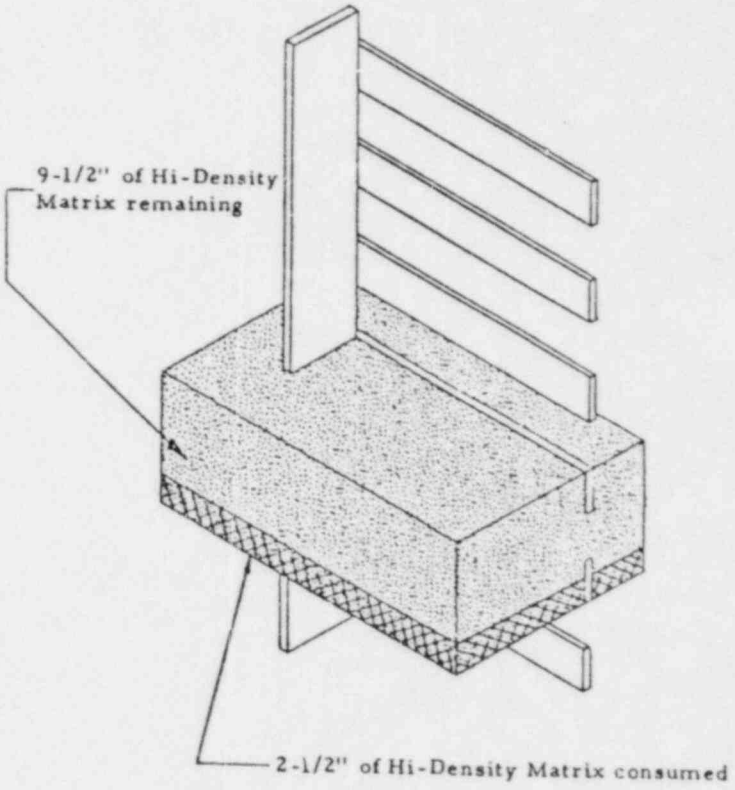


Figure 35. Penetration 1.6 after test

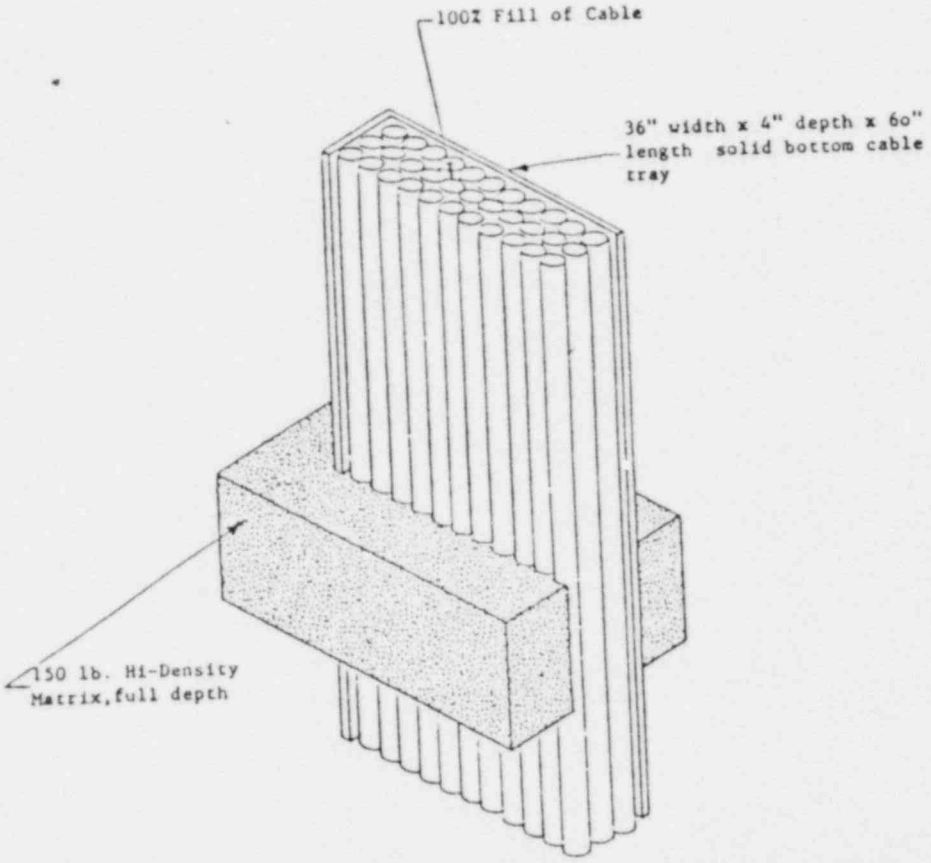


Figure 12. Penetration 1.7

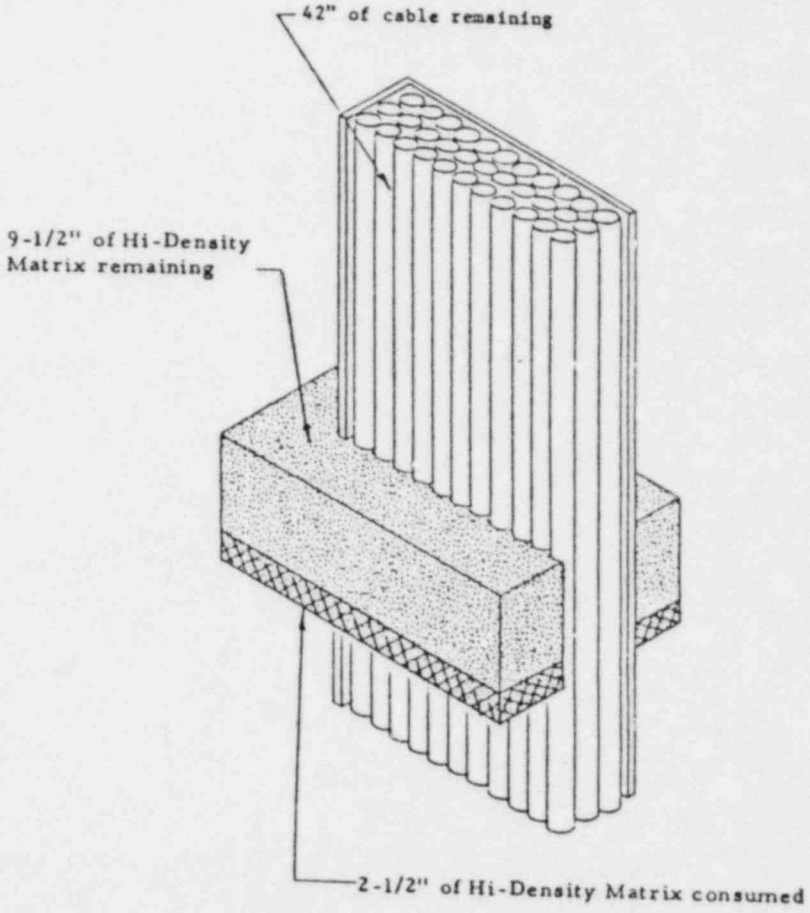


Figure 36. Penetration 1.7 after test

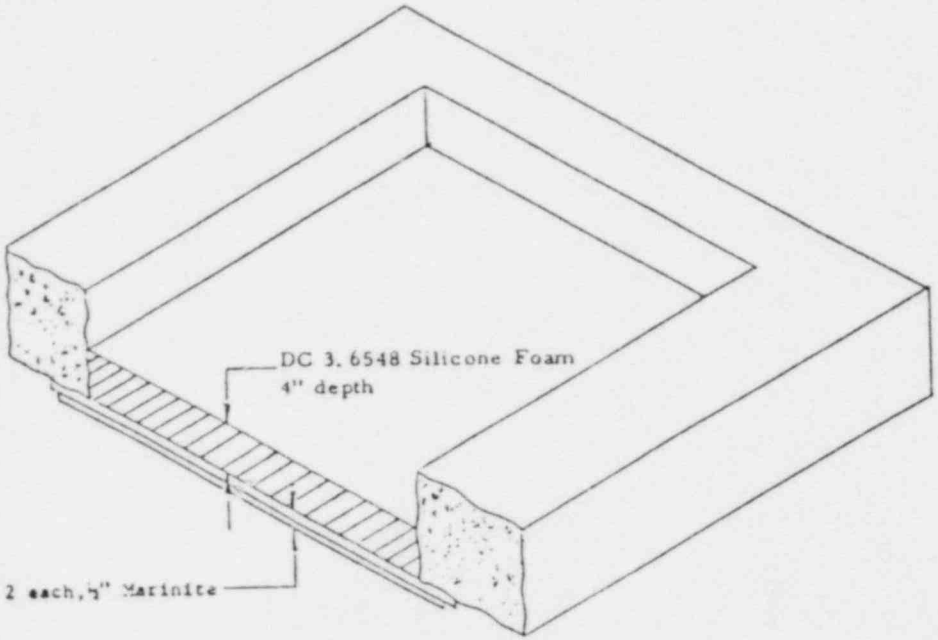


Figure 13. Penetration 2. 1

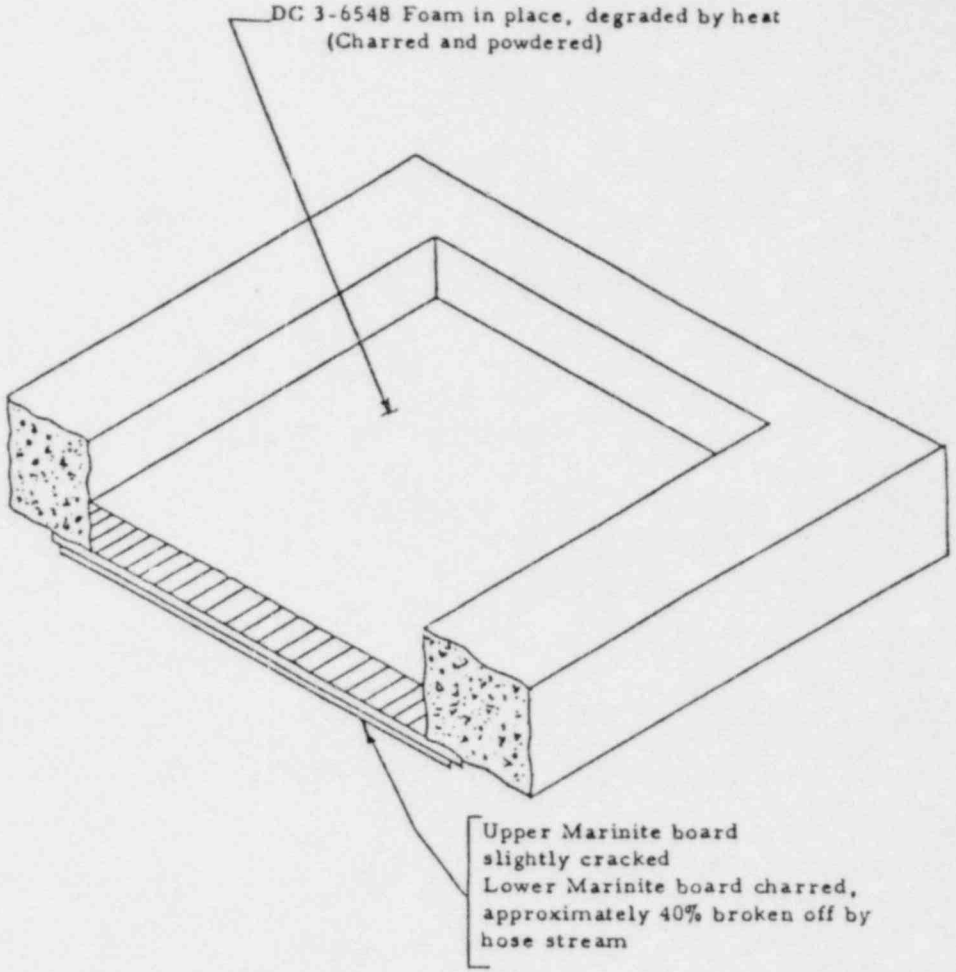


Figure 37. Penetration 2. 1, after test

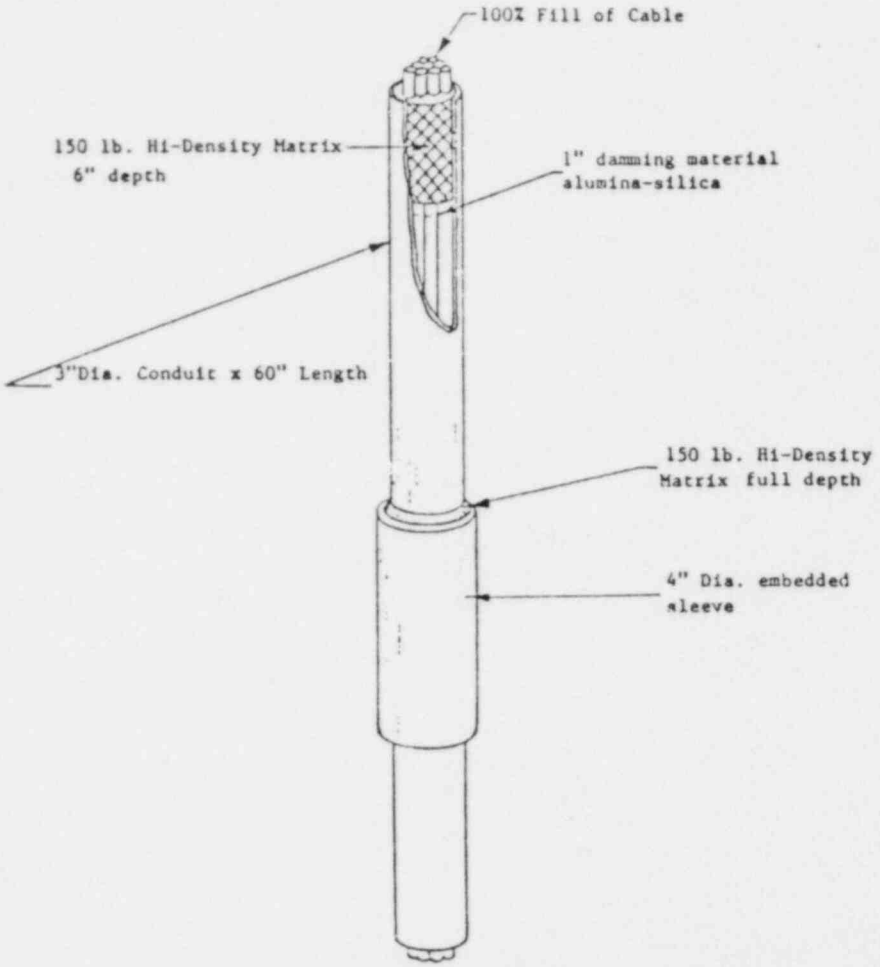


Figure 14. Penetration 3.1

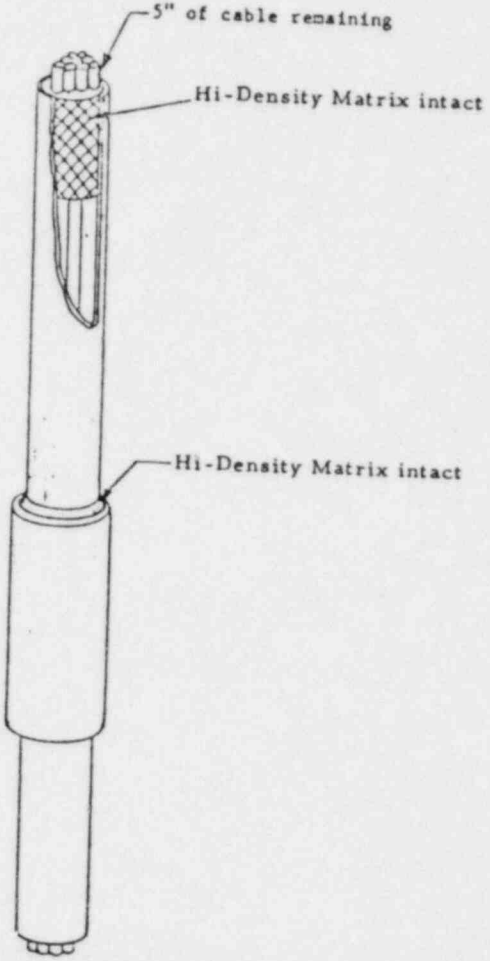


Figure 38. Penetration 3.1 after test

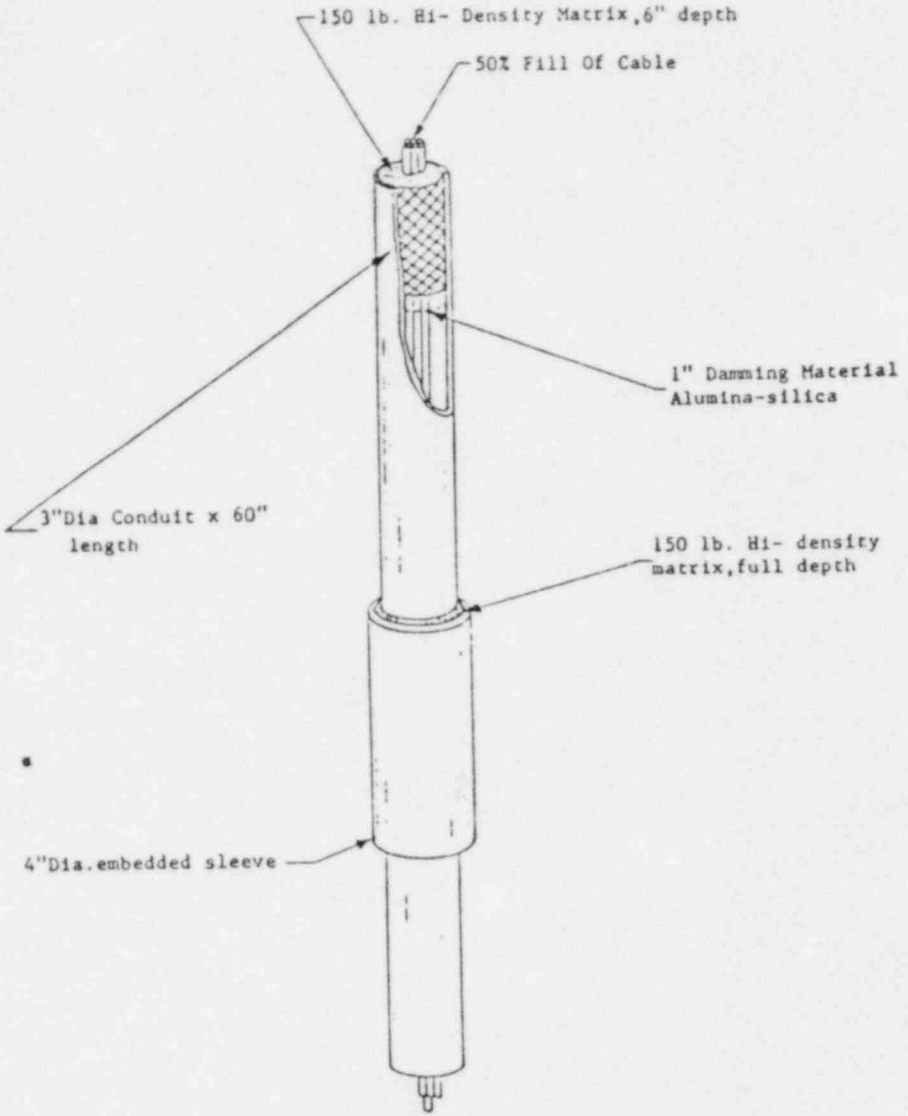


Figure 15. Penetration 3.2

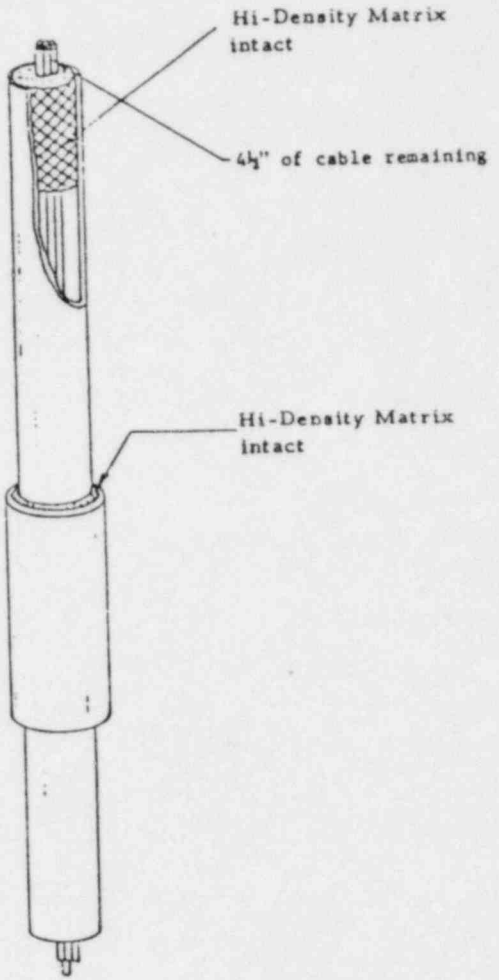


Figure 39. Penetration 3.2 after test

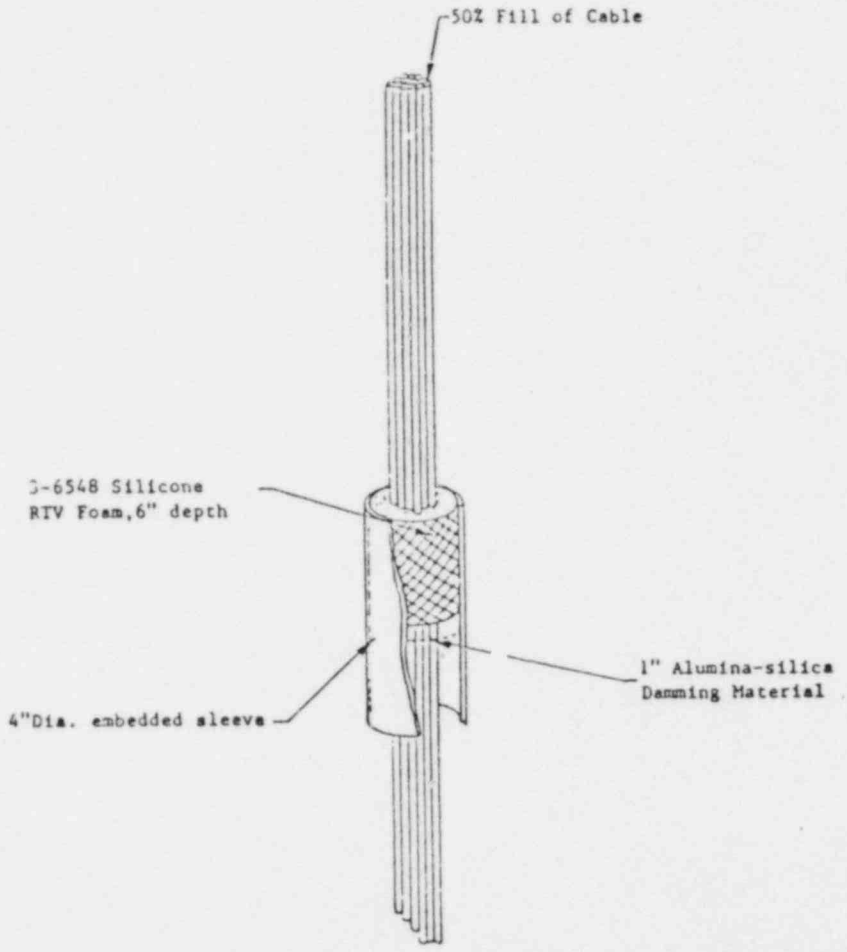


Figure 16. Penetration 3.3

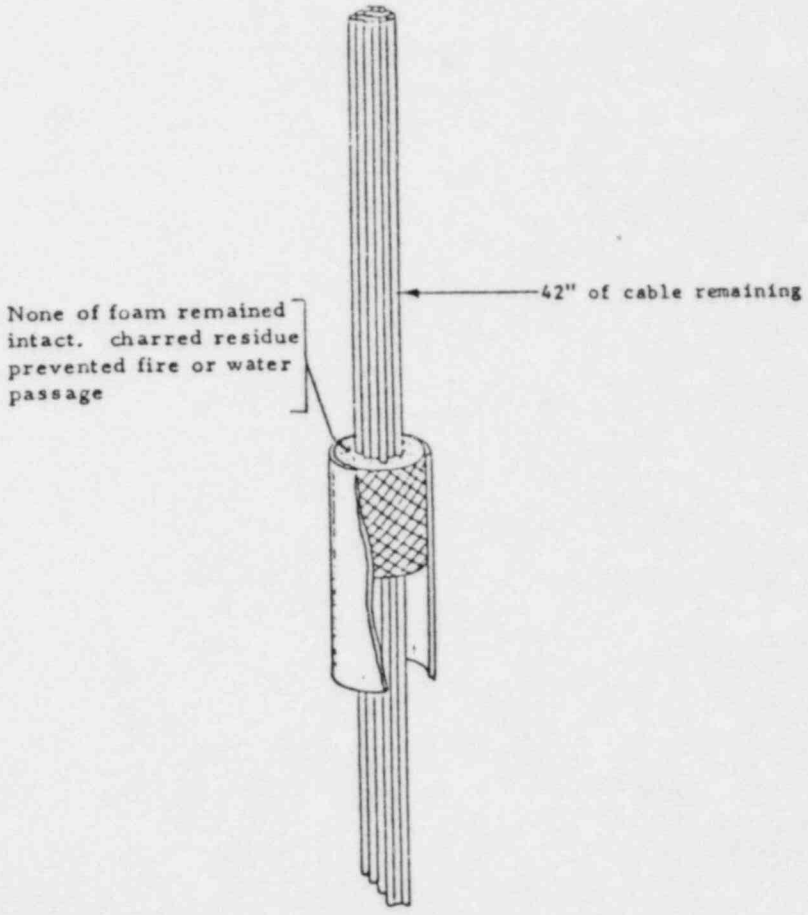


Figure 40. Penetration 3.3, after test

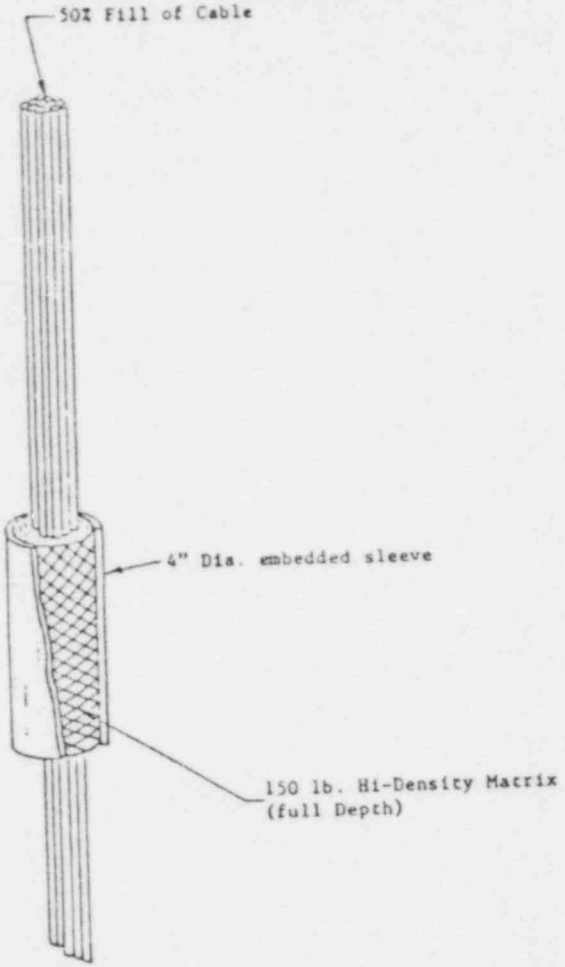


Figure 17. Penetration 3.4

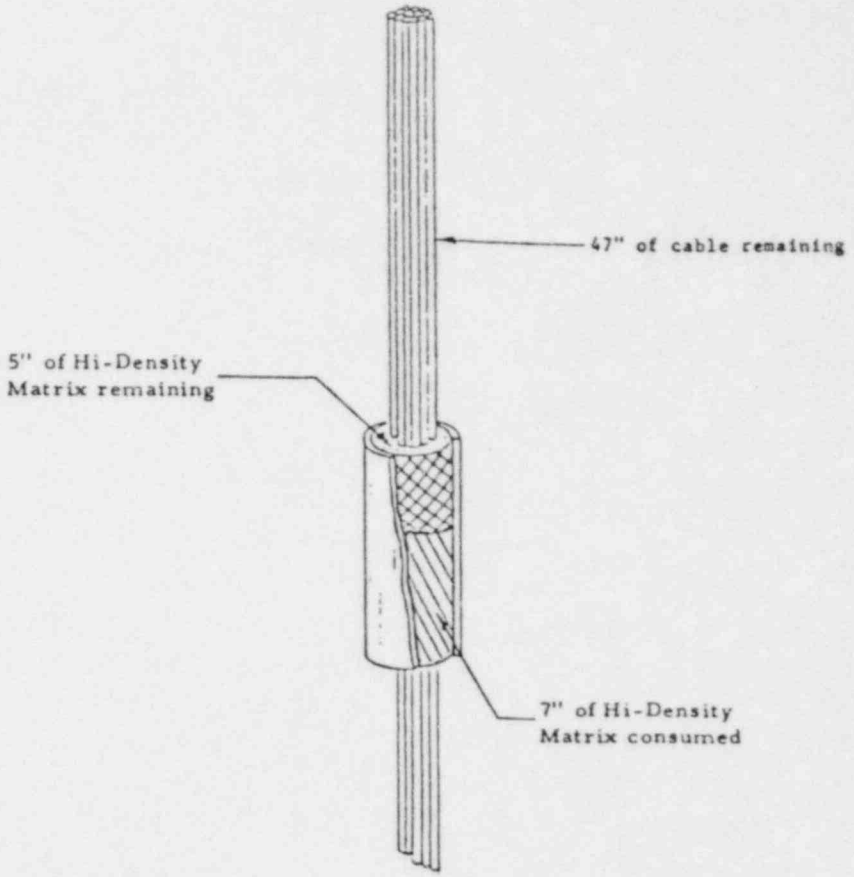


Figure 41. Penetration 3.4 after test

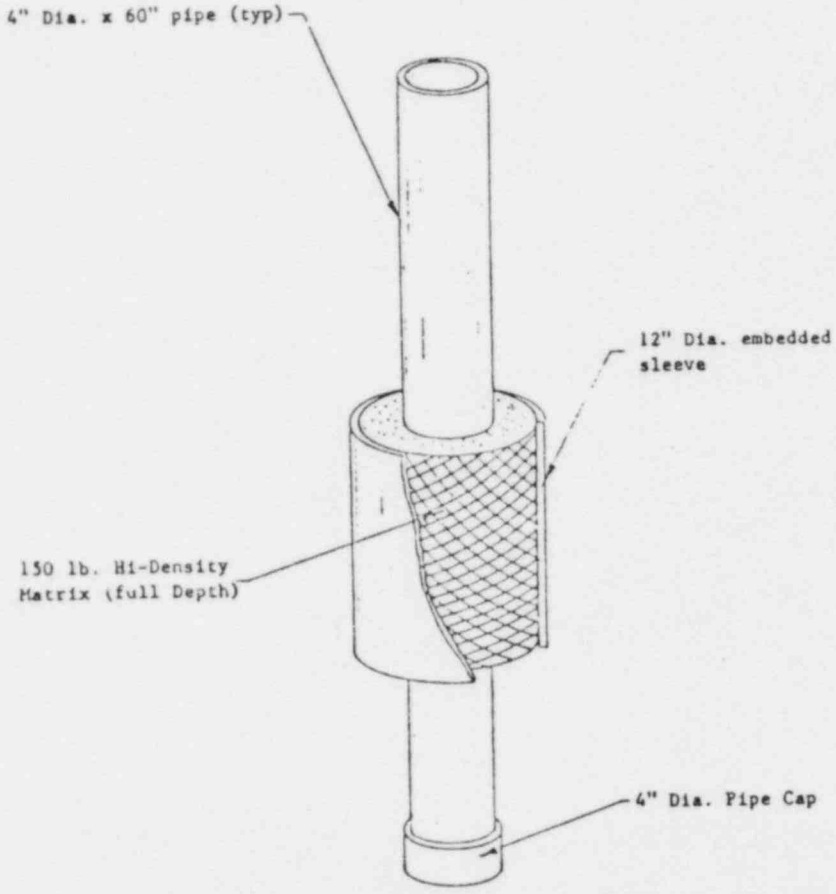


Figure 18. Penetration 4

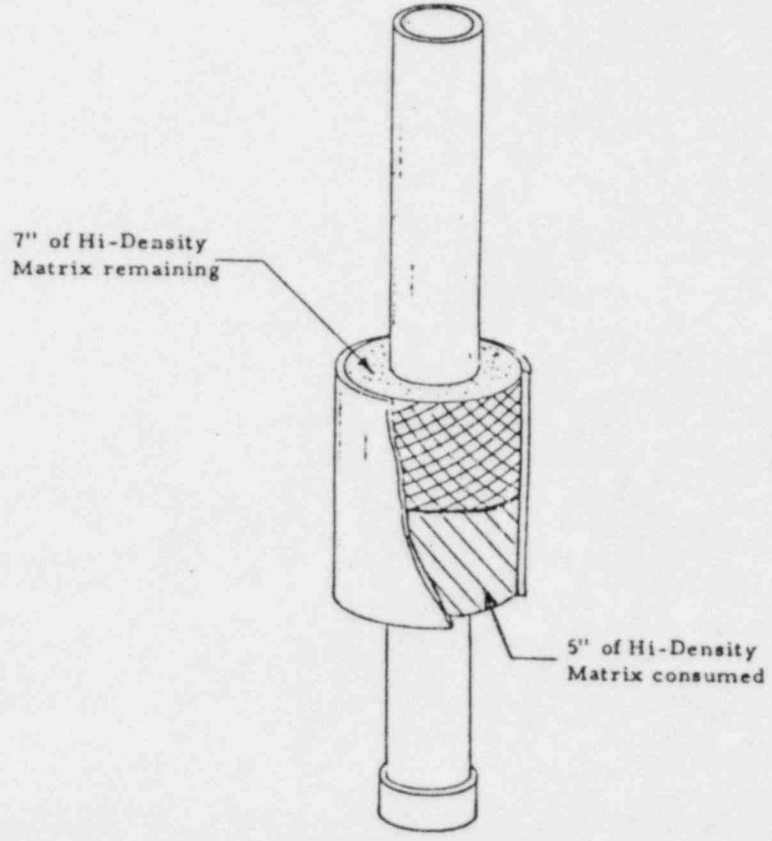


Figure 42. Penetration 4 after test

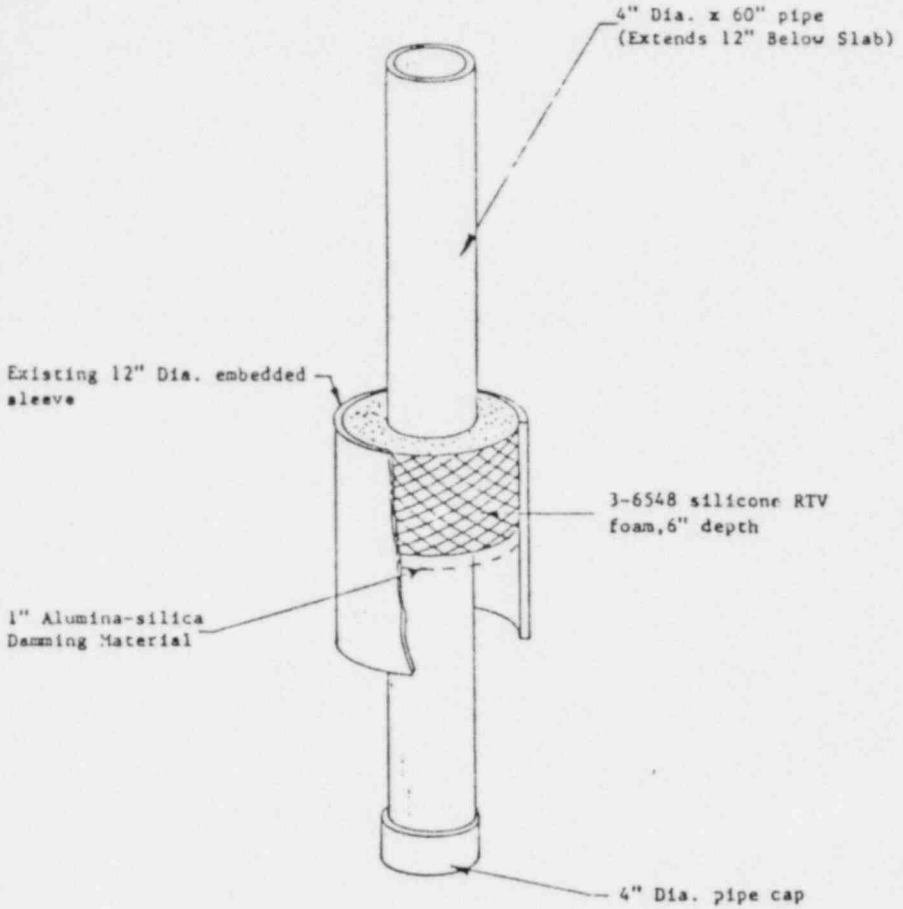


Figure 19. Penetration 5

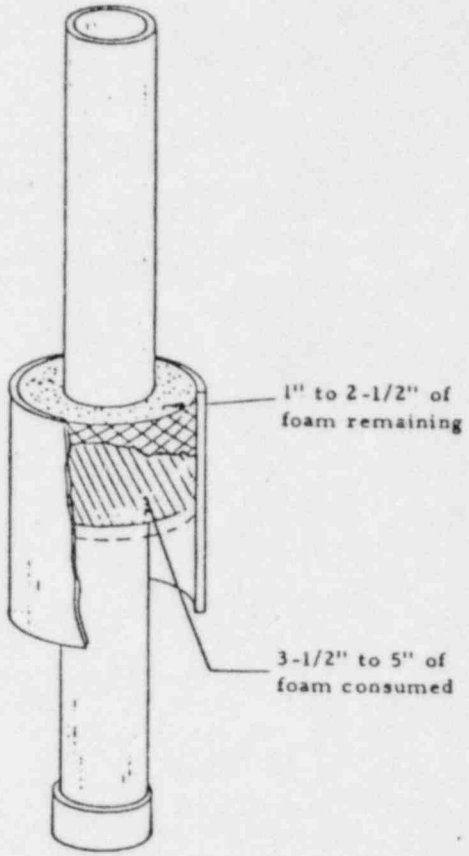


Figure 43. Penetration 5, after test

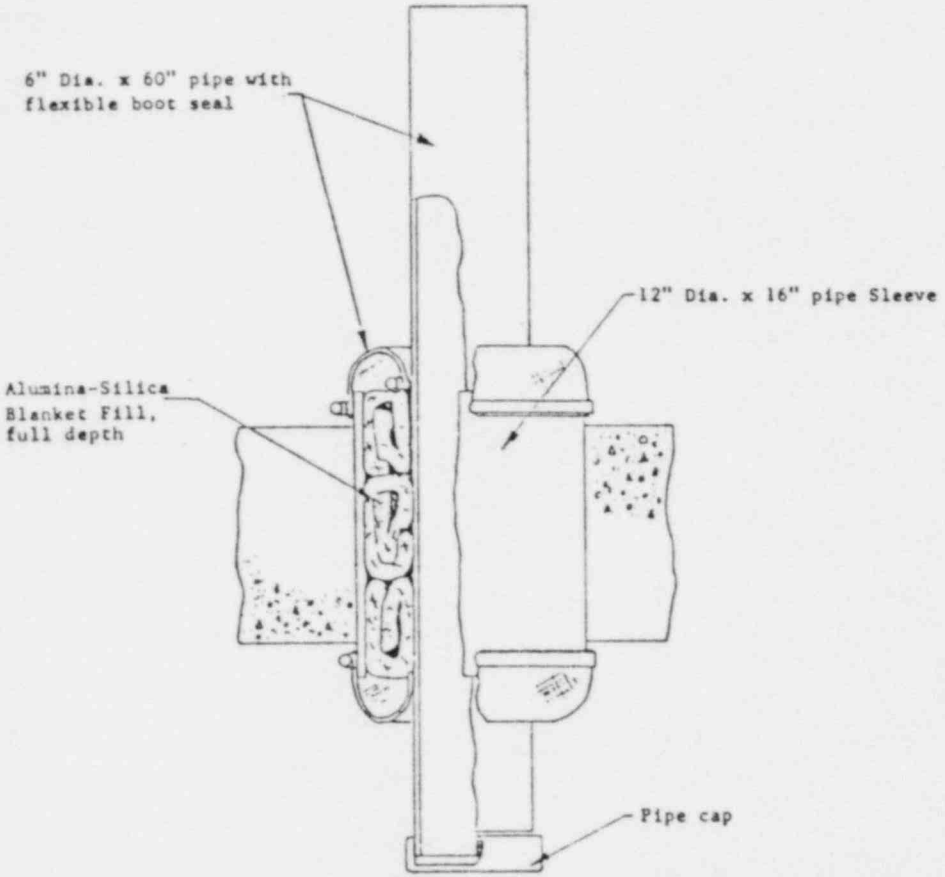


Figure 20. Penetration 6

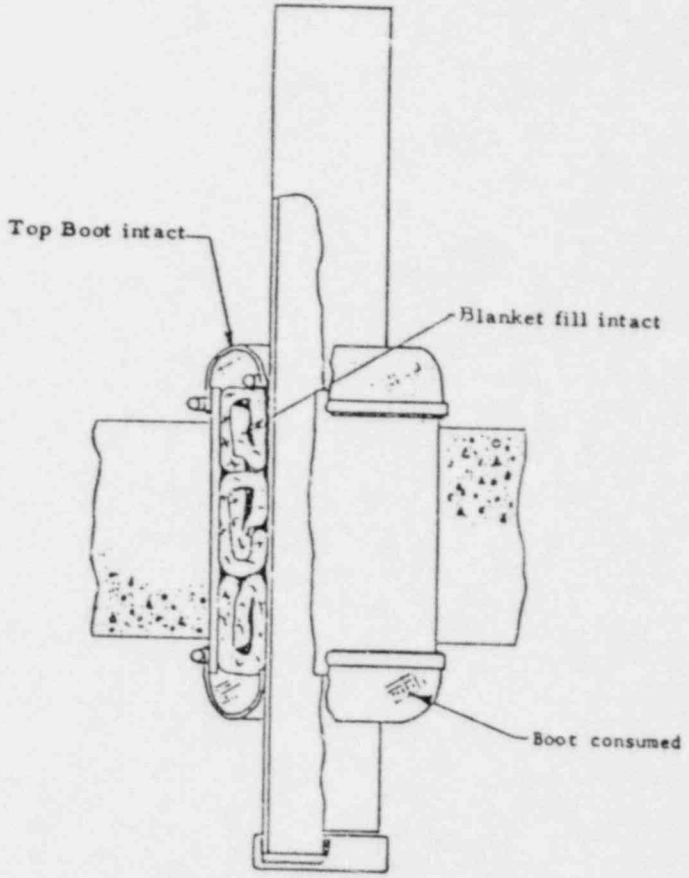


Figure 44. Penetration 6 after test

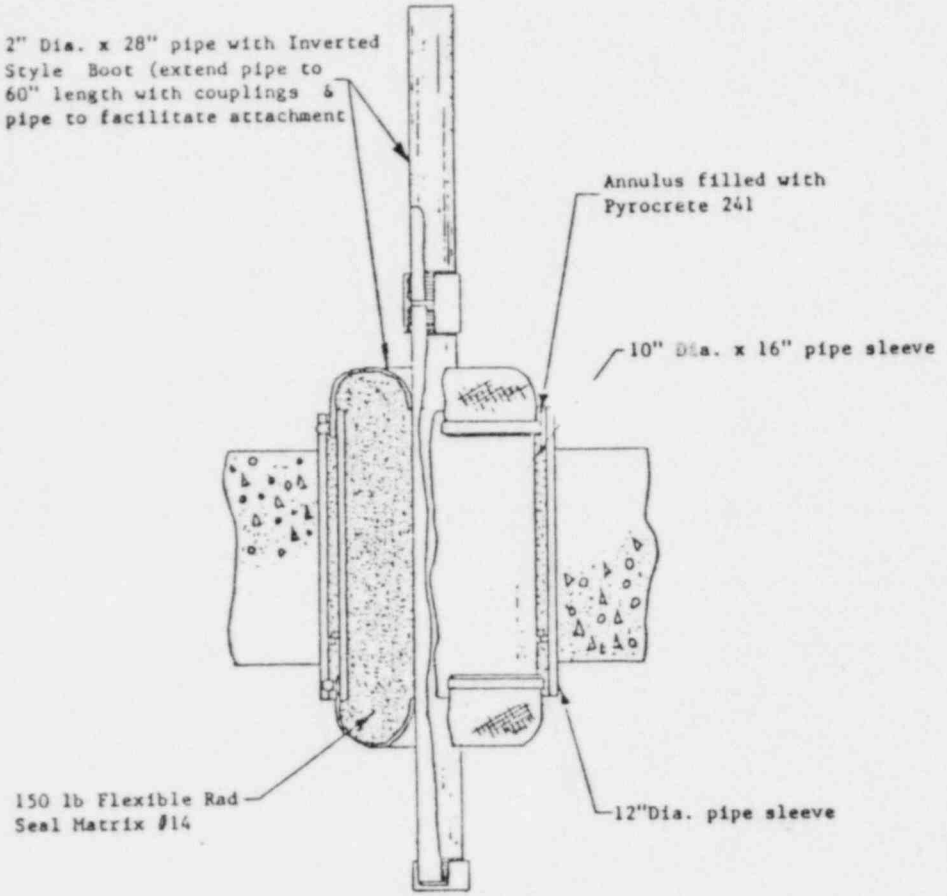


Figure 21. Penetration 7

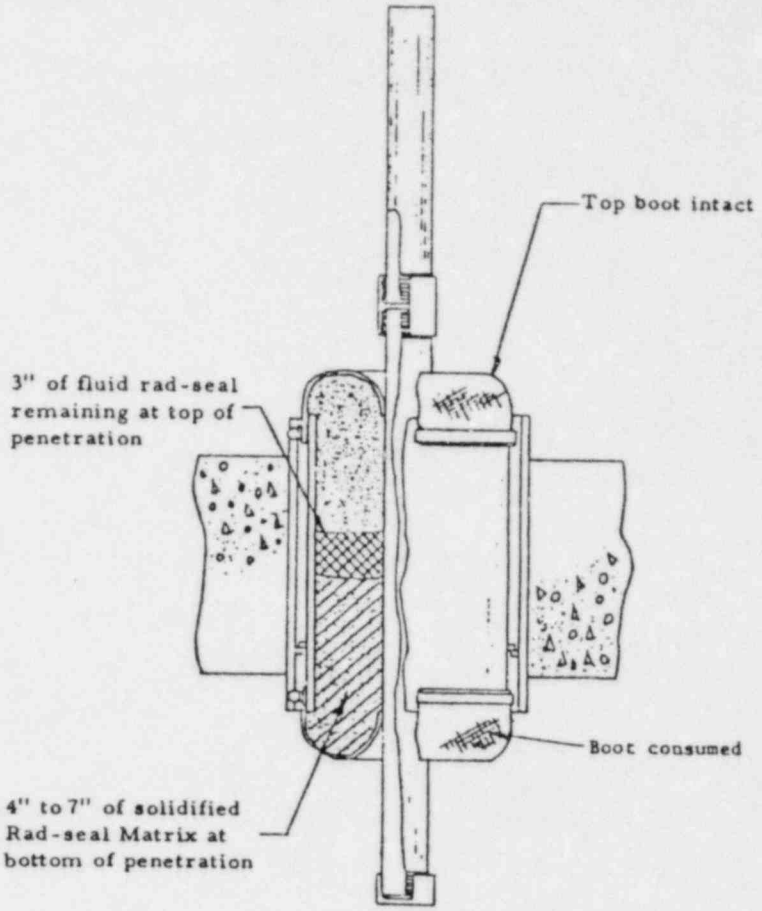


Figure 45. Penetration 7 after test (Flexible Rad Seal # 14)

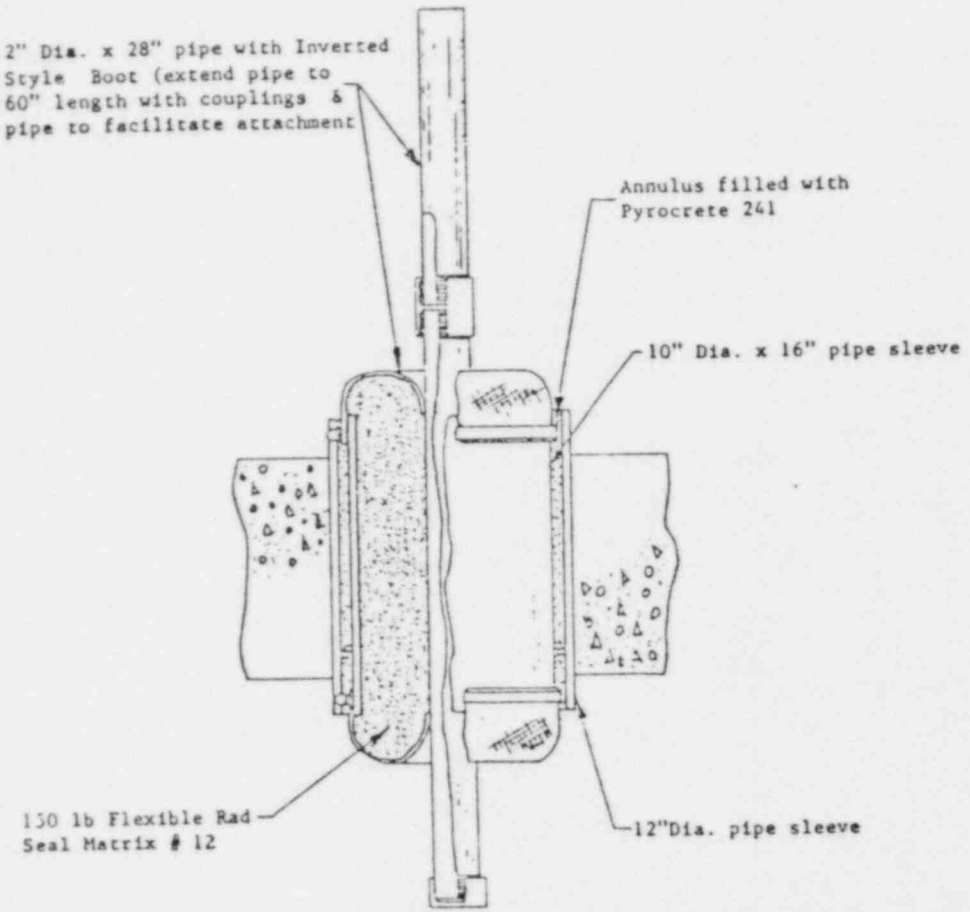


Figure 22. Penetration 8

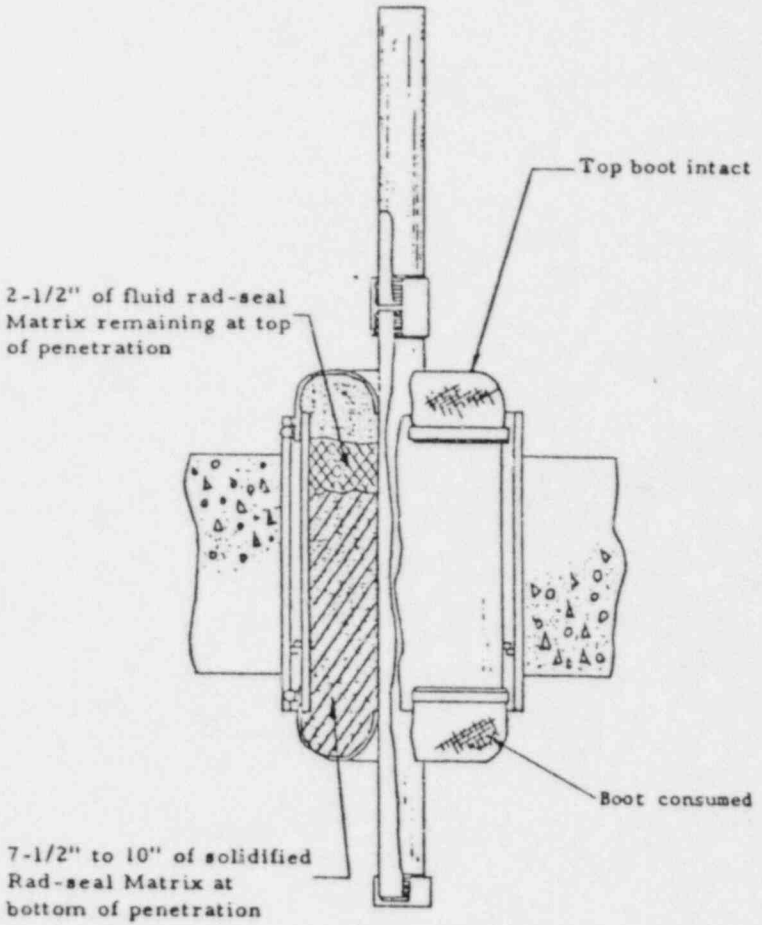


Figure 46. Penetration 8 after test (Flexible Rad Seal # 12)

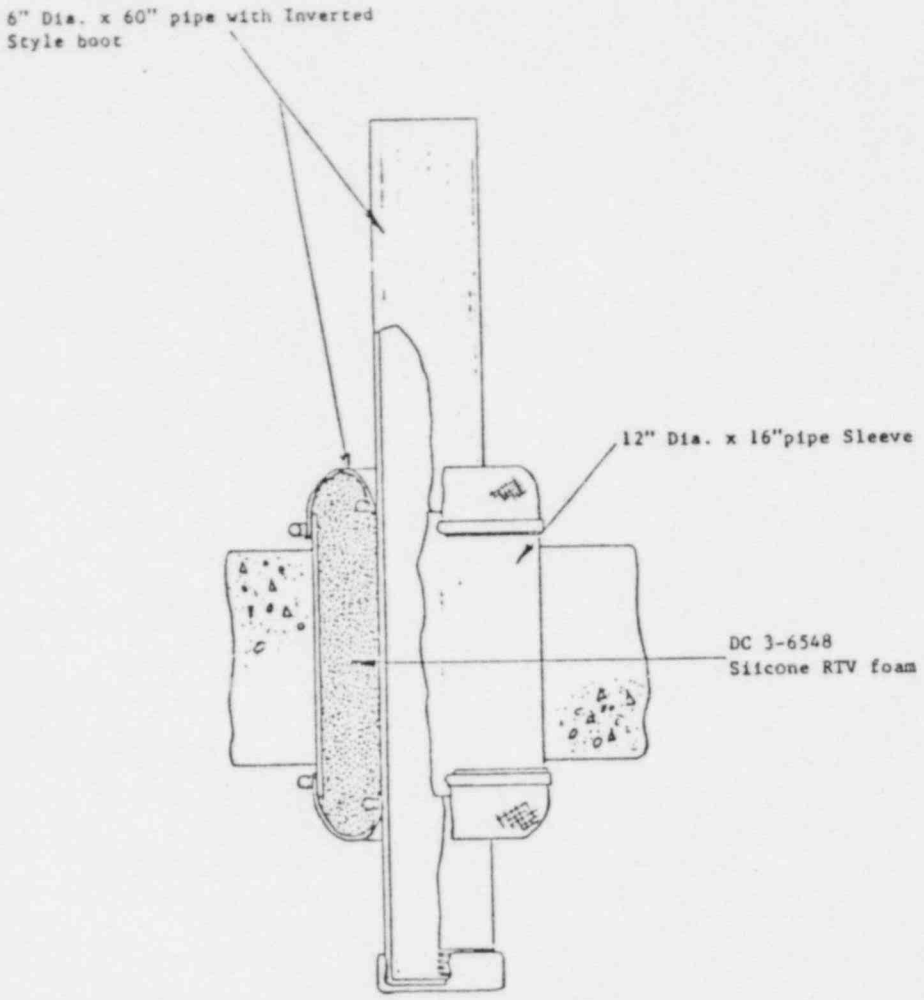


Figure 23. Penetration 9

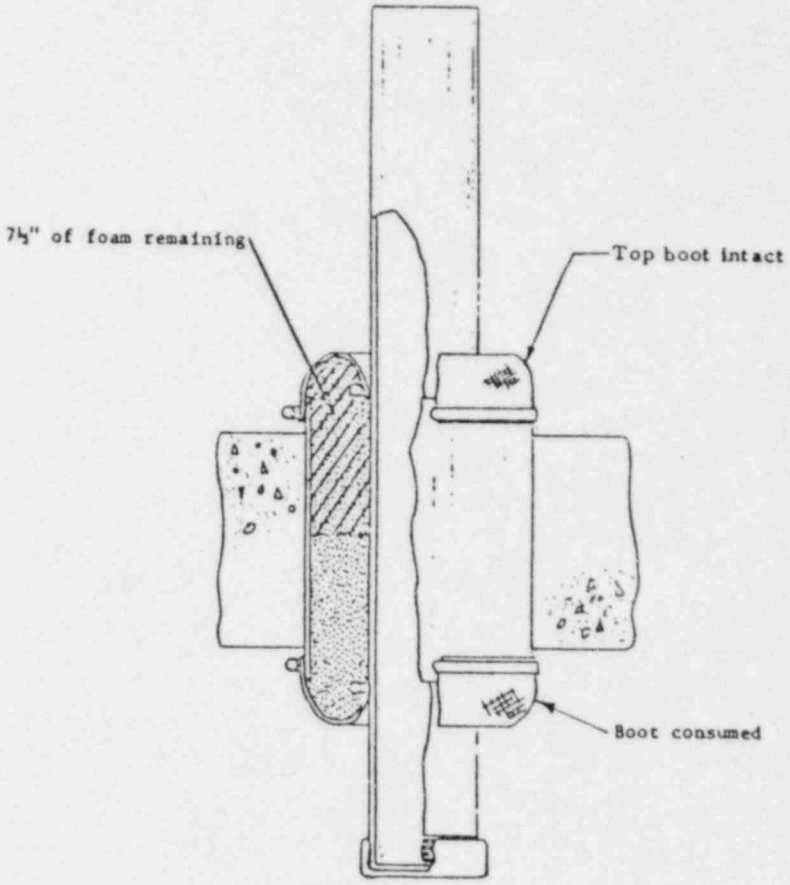


Figure 47. Penetration 9 after test

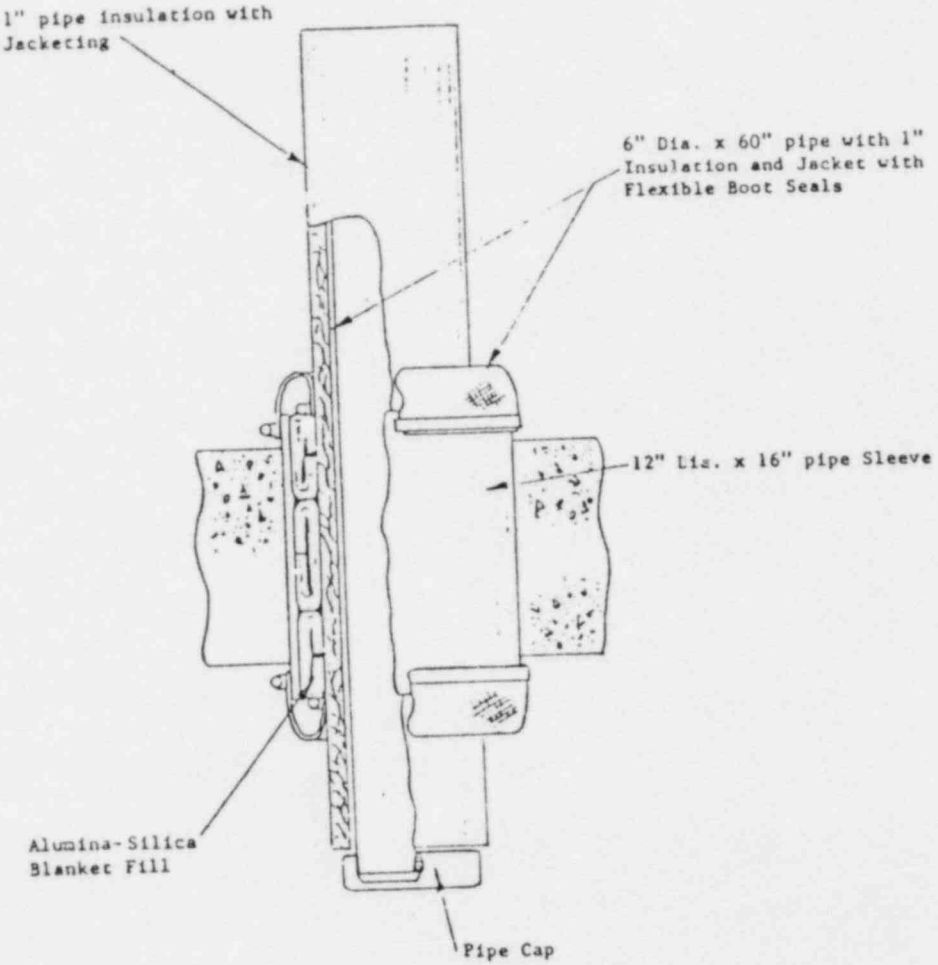


Figure 24. Penetration 10

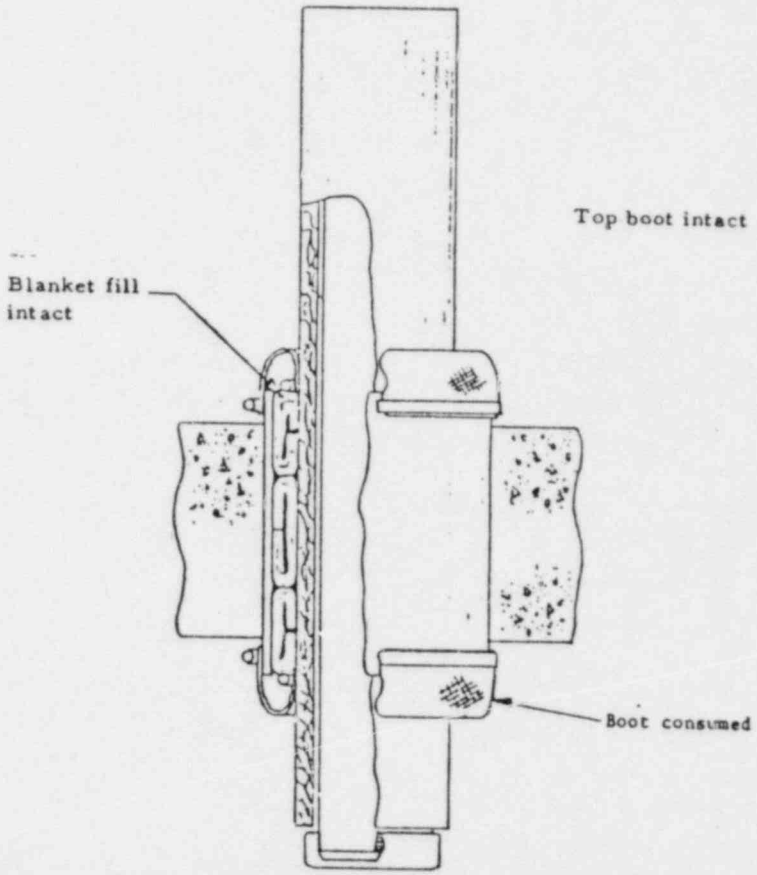


Figure 48. Penetration 10 after test

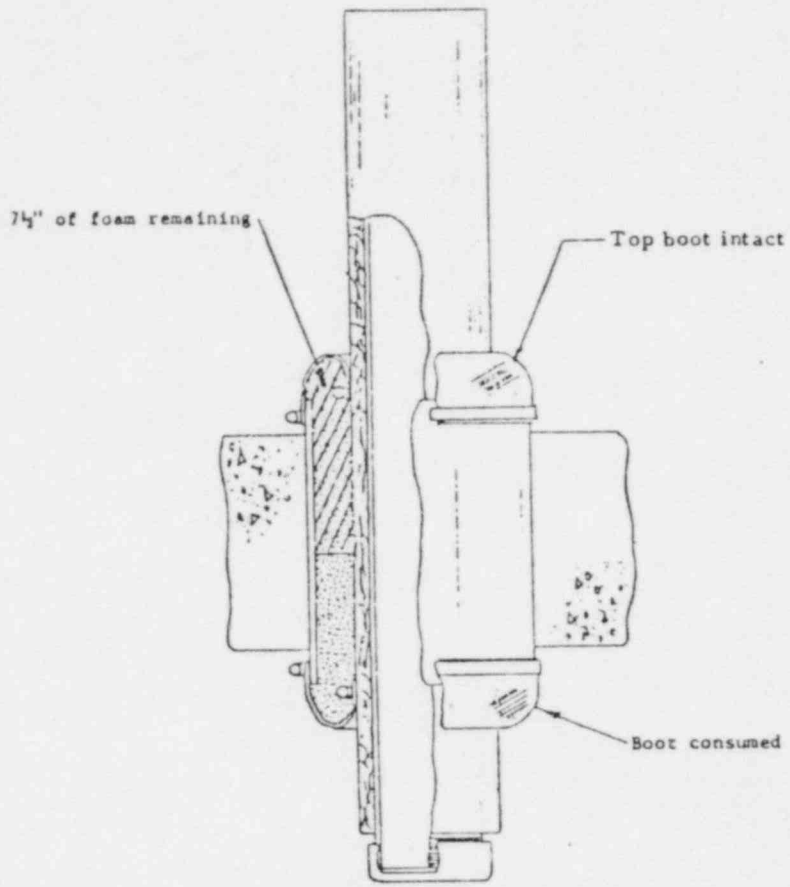


Figure 49. Penetration 11 after test

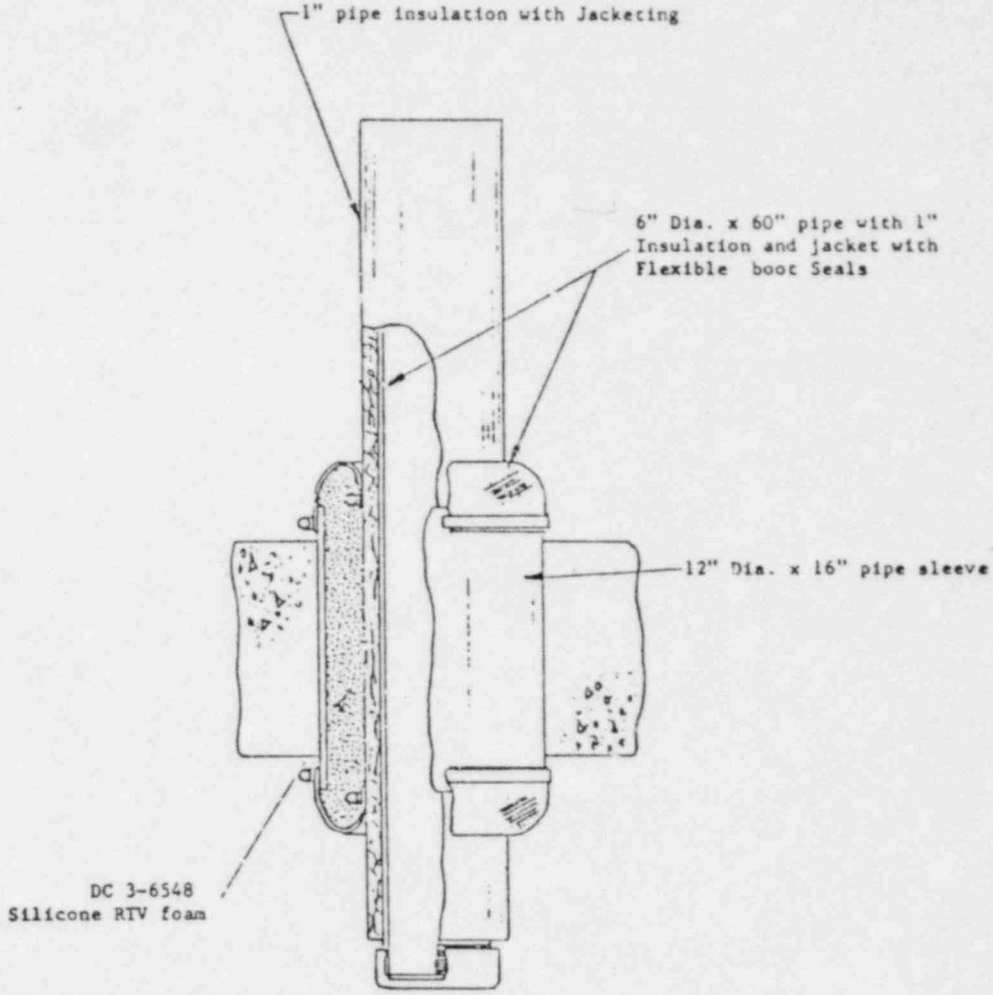


Figure 25. Penetration 11

ATTACHMENT 4

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J. Carney, Vice President

August 12, 1982

Mr. L. Charles Spriggs
Quality Assurance Manager
Fire Safety Division
B&B Insulation, Inc.
P.O. Box 2531
Houston, Texas 77001

Dear Mr. Spriggs:

We have reviewed the B&B Insulation, Inc. Fire Qualification Test on Penetration Seals Test Slab No. 4. These tests were conducted on April 21, 1982 at Southwest Research Institute. Enclosed are two copies each of the ANI/MAERP Fire Stop System Acceptance form for the configurations sealed with Light Density Silicone Elastomer or B&B FIREFLEX that successfully passed tests CTP-1024 and CTP-1025.

In addition, B&B Type 1 and Type 4 sleeve extenders were tested with a 2" pipe in a 6" corebore or 10" embedded sleeve sealed with alumina-silica blanket or Radflex seal. These Type 1 and Type 4 sleeve extenders are acceptable to American Nuclear Insurers for Insurance Purposes Only.

A 2" pipe in a 10" sleeve with an annulus reducer of High Density Leaded Elastomer (HDLE-A) min. density of 147 lbs./cu. ft. was also tested to facilitate pipe movement up to 1/2" in lateral direction with flexible boot seals on both ends and alumina-silica blanket inserted within the boots. This annulus reducer is also acceptable to ANI for Insurance Purposes.

A comparison test of 8" HDLE-A previously tested, with HDLE modified with the addition of accelerators or a metal filler other than lead to obtain the same minimum density of 147 lbs./cu. ft. was also tested and is acceptable to American Nuclear Insurers for Insurance Purposes Only.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

R. F. MacMillan
Project Engineer

RFM:dm

The Exchange Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX No. 643-029

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TEST CTP-1025

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:

B&B Insulation, Inc.
Houston, Texas

TESTING ORGANIZATION:

Southwest Research Institute
San Antonio, Texas

TEST DATE: 4/21/82

HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	4" dia. cable bundle in 12" sleeve	2" pipe in 12" sleeve*
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	B&B "FIREFLEX" Density: Min. 50 lbs./cu. ft.	B&B "FIREFLEX" Density: Min. 50 lbs./cu. ft.
Fire Stop Thickness	6" FIREFLEX + 1" damming	6" FIREFLEX + 1" damming * pipe manipulated to assimilate a 1" lateral and a 2" axial movement
Form Material	JM ceraboard or B&W M Board	JM ceraboard or B&W M Board

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: No limitations
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81

August 12, 1982
Date Issued

J. J. Carney (RFM)
John J. Carney

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TEST CTP-1025

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B&B Insulation, Inc.
Houston, Texas

TESTING ORGANIZATION:
Southwest Research Institute
San Antonio, Texas

TEST DATE: 4/21/82

HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	9" ladder tray + 2" conduit in 14" steel sleeve	2" pipe in 14" sleeve with insulation + stainless jacket
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	B&B "FIREFLEX" Density: Min. 50 lbs./cu. ft.	B&B "FIREFLEX" Density: Min. 50 lbs./cu. ft.
Fire Stop Thickness	6" FIREFLEX + 1" damming	6" FIREFLEX + 1" damming
Form Material	JM ceraboard or B&W M Board	JM ceraboard or B&W M Board

SPECIAL LIMITATIONS

Tray Types: 9" open ladder only Cable Construction: No limitations
% Cable Loading: 100% visual Tray, 100% visual Conduit Max. Conduit Sleeve Size: 2"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 August 12, 1982
Date Issued

J. J. Carney (REA)
John J. Carney

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TEST CTP-1024

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B&B Insulation, Inc.
Houston, Texas

TESTING ORGANIZATION:
Southwest Research Institute
San Antonio, Texas

TEST DATE: 4/21/82

HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	Min. 1/4" clearance PIPE PENETRATIONS
Max. Penetration Size	9" ladder tray + 2" conduit in 14" steel sleeve	2-2" pipes in 14" sleeve with or without insulation + stainless jacket
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	B&B light density silicone elastomer Density: 55-65 lbs./cu. ft.	B&B light density silicone elastomer Density: 55-65 lbs./cu. ft.
Fire Stop Thickness	4" LDSE + 1" damming 4" cerafiber - top of conduit	4" LDSE + 1" damming
Form Material	JM ceraboard or B&W M Board	JM ceraboard or B&W M Board

SPECIAL LIMITATIONS

Tray Types: 9" open ladder only
Cable Construction: No limitations
% Cable Loading: 100% visual Tray, 100% visual Conduit
Max. Conduit Sleeve Size: 2"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81

August 12, 1982
Date Issued

J. J. Carney (REM)
John J. Carney

AMERICAN NUCLEAR INSURERS

MAERP
MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
B&B Insulation, Inc.
Houston, Texas

TESTING ORGANIZATION:
Southwest Research Institute
San Antonio, Texas

TEST DATE: 4/21/82 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	Min. 1/4" clearance PIPE PENETRATIONS
Max. Penetration Size	4" dia. cable bundle in 12" sleeve	2-2" pipes in 12" sleeve with or without insulation + stainless jacket
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	B&B light density silicone elastomer Density: 55-65 lbs./cu. ft.	Dow Corning sylgard 170 silicone elastomer Density: 84 lbs./cu. ft.
Fire Stop Thickness	4" LDSE + 1" damming	4" silicone elastomer + 1" damming
Form Material	JM ceraboard or B&W M Board	JM ceraboard or B&W M Board

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: No limitations
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81

August 12, 1982
Date Issued

J. J. Carney (corp)
John J. Carney

REF#4(A)
Test Slab #4

FIRE QUALIFICATION TEST ON PENETRATION SEALS

B&B TEST SLAB NO: 4
SWRI PROJECT NO: 01-6763-212

B&B INSULATION, INC.
CTP 1022 CTP 1023
CTP 1024 CTP 1025

JUNE 16, 1982

FINAL REPORT

B & B INSULATION INC.
P.O. BOX 2531
HOUSTON, TEXAS 77001

CONTROLLED ISSUE DOCUMENT

CONTROL NO: 16 ISSUE DATE: 8-13-82

ISSUED TO: Ashwin Shah - Ebasco Services

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO HOUSTON

B & B INSULATION, INC.

EXCERPTS FROM FINAL REPORT

FULL REPORT AVAILABLE UPON REQUEST FROM:

B & B INSULATION, INC.
P. O. Box 2531
Houston, TX 77001

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 · 6220 CULEBRA ROAD · SAN ANTONIO, TEXAS 78284 · (512) 684-5111

DEPARTMENT OF
FIRE TECHNOLOGY

TELEX: 767357
TWX: 910-871-1084

June 16, 1982

Mr. L. Charles Spriggs
Systems Engineering
Fire Safety Division
B & B Insulation, Incorporated
8011 Blankenship Road
Houston, Texas 77055

Subject: SwRI Project No. 01-6763-212 FINAL REPORT
"Fire Evaluation of Penetration Seals:
Nos. CTP 1022, CTP 1023, CTP 1024 and CTP 1025"

Dear Mr. Spriggs:

This letter constitutes our final report on the above referenced project. This report includes a description of the test arrangement, procedures, and results.

OBJECTIVE

The objective of this program was to evaluate the fire endurance of penetration seals according to the following procedures:

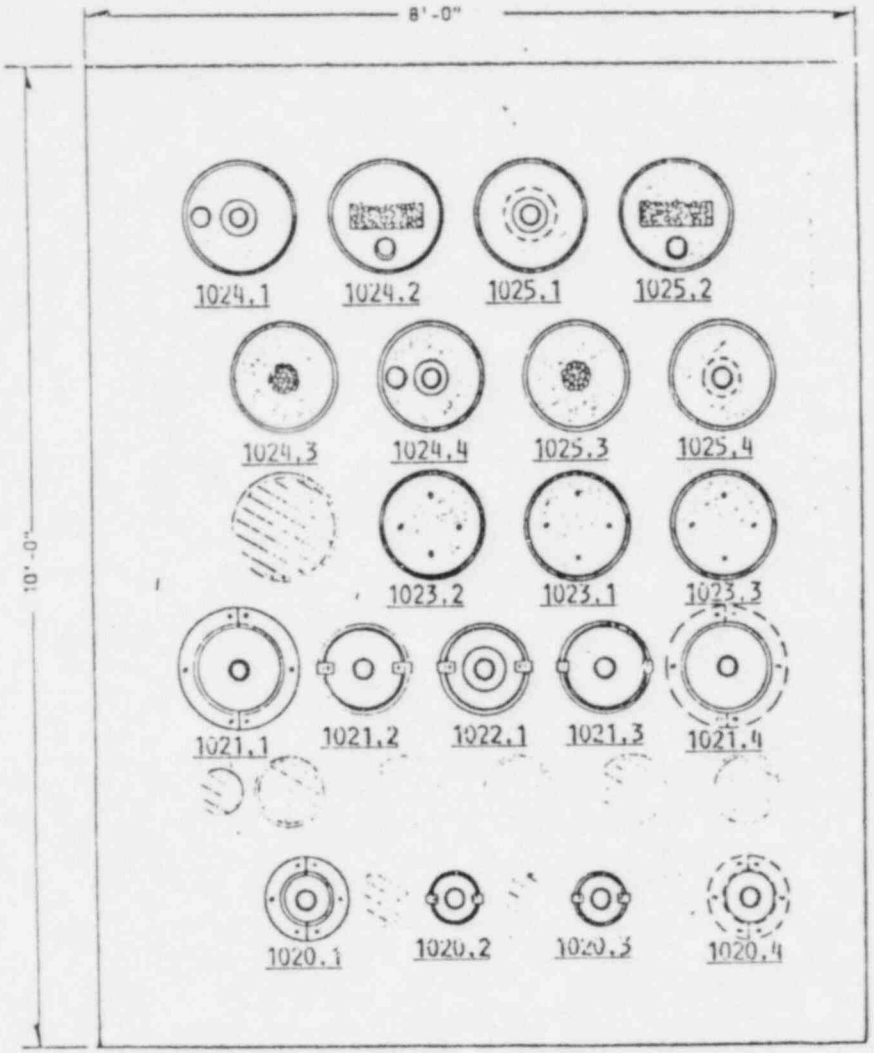
1. ASTM E119-80;
2. ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops; and,
3. IEEE Standard 634-1978 Cable Penetration Fire Stop Qualification Test.

EXPERIMENTAL

The penetration seals to be fire evaluated were installed in a concrete slab with various size openings. A diagram of the test slab is provided in Figure 1 along with seal identification numbers.

The slab was fabricated and cured at SwRI prior to installation of the penetration seals.

The penetration seals were installed approximately one week prior to test date by personnel from B & B Insulation, Incorporated, operating under their normal QA/QC procedures. Details of these procedures will be provided by B & B Insulation, Incorporated.



GENERAL SLAB LAYOUT
AND GUIDE TO TEST PENETRATIONS

TEST SLAB NO. 4
B&B CORPORATE TEST PROCEDURE

CTP-1020	TYPE 1 AND TYPE 4 SLEEVE EXTENDERS FOR CONESORE MECHANICAL PENETRATIONS. -FLEXIBLE CERAMIC BLANKET FIRE SEAL AND "RAD FLEX" FLEXIBLE RADIATION SEAL
CTP-1021	TYPE 1 AND TYPE 4 SLEEVE EXTENDERS FOR SLEEVED PENETRATIONS. -FLEXIBLE CERAMIC BLANKET FIRE SEAL AND "RAD FLEX" FLEXIBLE RADIATION SEAL
CTP-1022	HDLE-A ANNULUS REDUCER WITH BOOTS AND CERAMIC BLANKET FILL
CTP-1023	COMPARISON TEST-- HDLE-A (STANDARD), HDLE-A MODIFIED W/ ACCELERATORS, HDLE-C NON LEAD FILLER
CTP-1024	QUALIFICATION TEST - ELECTRICAL AND MECHANICAL "B&B LIGHT DENSITY SILICONE ELASTOMER (LDSE)"
CTP-1025	QUALIFICATION TEST - ELECTRICAL AND MECHANICAL "B&B FIRE FLEX FLEXIBLE FIRE SEAL"

REVISIONS		
NO	DATE	BY
1	5/21/82	LCS
2		
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B&B INSULATION, INC.

GENERAL SLAB LAYOUT - SLAB NO. 4
CTP 1020 TO CTP 1025

DRAWN BY: LCS	SCALE: nts	MATERIAL: --
CHK'D: RC	DATE: 3/11/82	DRAWING NO: B-257
TRACED	APP'D	

Figure 1

A summary of the seals is provided in Table I. Figures 2, 3, 4, and 5 provide details of the test seals as provided by B & B Insulation, Incorporated.

After the test seals were installed, thermocouples were installed on the seals to monitor temperatures attained during the fire test. The thermocouples used were Type K, 22-gauge thermocouples traceable to NBS standards.

Thermocouple locations are shown in Figures 2, 3, 4, and 5. Table II provides a description of the thermocouple locations.

On the day of the test, April 21, 1982, the test slab was placed in position on top of SwRI's horizontal furnace. Six thermowells inside the furnace and 12 in. from the exposed face of the test slab were used to monitor the furnace temperature and they were arranged so that an average furnace temperature was provided.

Immediately prior to test, the pipe in Penetration 1025.4 was moved up and down 2 in. and from side to side 1 in. in each direction.

The furnace was then fired and the specified ASTM E119 time/temperature curve was followed for the 3-hour test duration.

Environmental conditions at the time of the test were:

1. Temperature - 60°F
2. Relative Humidity - 52%
3. Barometric Pressure - 30.21
4. Winds - NNE-21 mph (A wind shield was installed over the test slab.)

Immediately after the 3-hour test period, the test slab was removed from the furnace and a hose stream test was performed.

The water stream was delivered through a 1-1/2-in. nozzle set at a discharge angle of 15° with a nozzle pressure of 75 psi and a minimum discharge of 75 gallons per minute with the tip of the nozzle a maximum of 10 ft from the exposed surface.

The hose stream was performed for a duration of 2 minutes 5 seconds.

TEST DATA

The average furnace temperature data obtained during the test is provided in Appendix A.

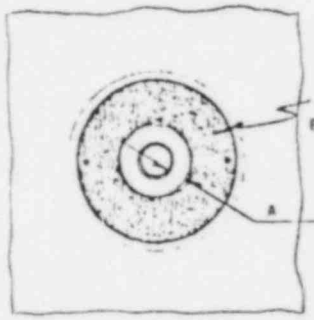
The temperature data pertaining to seal Nos. CTP 1022, CTP 1023, CTP 1024 and CTP 1025 obtained during the test are provided in Appendix B.

TABLE I

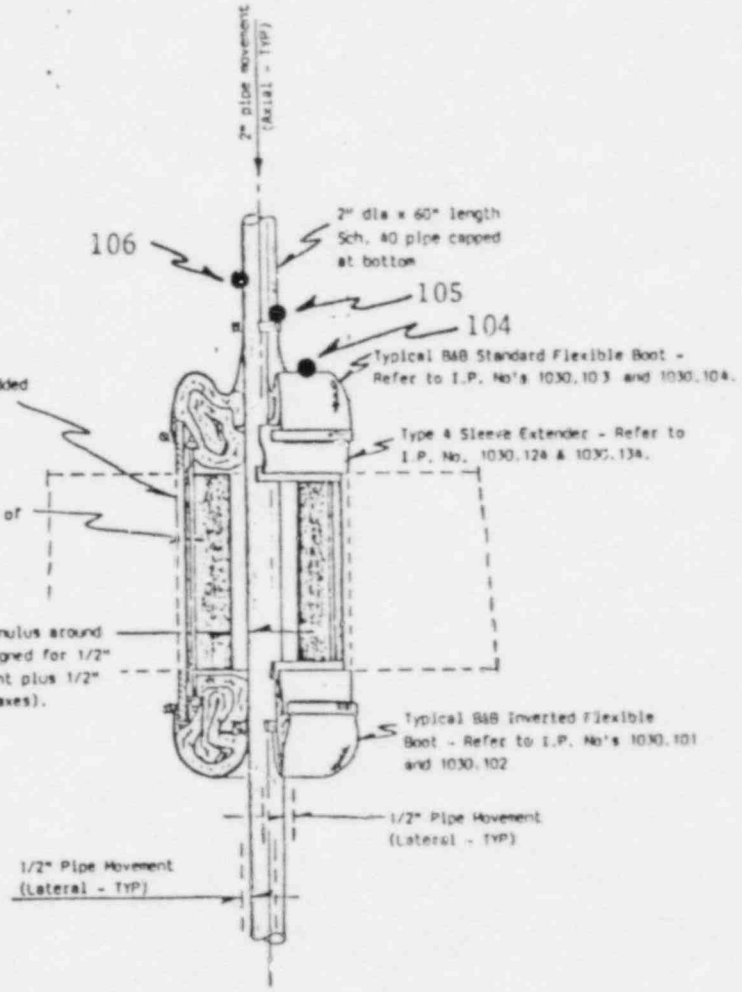
PENETRATION NUMBER	PENETRATION #	PENETRANTS	SLEEVE EXTENDERS	BOOTS	SEAL MATERIAL	DRAWING REFERENCE
1022.1	10" Ø embedded sleeve 12" Depth Slab	2" Ø x 5' pipe (non-insulated)	Type A Top/Bottom	Top-Keene (STD) Bottom-CHR (INV)	HOLE-A 147lb/ft^3 Min. Density to reduce annulus to 1" around pipe. Boots to be filled with Alumina-Silica Blanket	B&B Drg. B-264, B-263 & B-256
1023.1	12" Ø embedded sleeve 12" Depth Slab	4 @ 8½" length sections of 3/8" re-bar or threaded rod shall be inserted into penetration prior to installation of seal material.	NONE	NOT REQUIRED	8" depth HOLE-A as previously tested (ANI Accepted).	B&B Drg. B-265 & B-266
1023.2	12" Ø embedded sleeve 12" Depth Slab	4 @ 8½" length sections of 3/8" re-bar or threaded rod shall be inserted into penetration prior to installation of seal material.	NONE	NOT REQUIRED	8" depth HOLE-A modified w/the addition of up to 1½% by weight of accelerator(s).	B&B Drg. B-256 & B-266
1023.3	12" Ø embedded sleeve 12" Depth Slab	4 @ 8½" length sections of 3/8" re-bar or thread rod shall be inserted into penetration prior to installation of seal material.	NONE	NOT REQUIRED	8" depth HOLE-C	B&B Drg. B-256 & B-266
1024.1	14" Ø embedded sleeve 12" Depth Slab	1 @ ~~2"Ø~~ 2"Ø x 5' non-insulated pipe. 1 @ 2"Ø x 5' pipe w/1" Cal-Temp Insulation with Stainless Jacketing	NONE	NOT REQUIRED	4" depth LIGHT DENSITY SILICONE ELASTOMER (LDSE) as formulated by B&B. Seal Flush w/bottom of slab	B&B Drg. B-267 & B-268
1024.2	14" Ø embedded sleeve 12" Depth Slab	9" width ladder back cable tray w/100% VISUAL fill of PE/PVC cable. Mix per ANI Requirements. 2" conduit with 100% visual fill.	NONE	NOT REQUIRED	4" depth LIGHT DENSITY SILICONE ELASTOMER (LDSE) as formulated by B&B. Seal flush w/bottom of slab.	B&B Drg. B-267 & B-268
1024.3	12" Ø embedded sleeve 12" Depth Slab	4" Ø bundle of PE/PVC cable. Mix per ANI requirements.	NONE	NOT REQUIRED	4" depth LIGHT DENSITY SILICONE ELASTOMER (LDSE) as formulated by B&B. Seal flush w/bottom of slab.	B&B Drg. B-267 & B-268
1024.4	12" Ø embedded sleeve 12" Depth Slab	1 @ 2"Ø x 5' non-insulated pipe. 1@ 2"Ø x 5' pipe w/1" Cal-temp insulation w/stainless jacketing	NONE	NOT REQUIRED	4" depth SYLGARD 170 Silicone Elastomer as manufactured by Dow Corning Corporation Seal Flush w/bottom of slab.	B&B Drg. B-267 & B-268
1025.1	14" Ø embedded sleeve 12" depth slab	2"Ø x5' pipe w/1" Cal-Temp Insulation & Stainless Jacketing	NONE	NOT REQUIRED	6" depth-"FIRE FLEX" flexible fire seal as formulated by B&B	B&B Drg. B-269 & B-270
1025.2	14" Ø embedded sleeve 12" depth slab	9" width ladder back cable tray w/100% VISUAL fill of PE/PVC cable. Mix per ANI/MAERP requirements. 2" conduit with 100% visual fill.	NONE	NOT REQUIRED	6" depth-"FIRE FLEX" flexible fire seal as formulated by B7b.	B&B Drg. B-269 & B-270
1025.3	12" Ø embedded sleeve 12" depth slab	4" Ø bundle of PE/PVC cable. Mix per ANI requirements.	NONE	NOT REQUIRED	6" depth-"FIRE FLEX" flexible fire seal as formulated by B&B	B&B Drg. B-269 & B-270
1025.4	12" Ø embedded sleeve 12" depth slab	2"Ø x 5' non-insulated pipe	NONE	NOT REQUIRED	6" depth-"FIRE FLEX" flexible fire seal as formulated by B&B	B&B Drg. B-269 & B-270

NOTES:

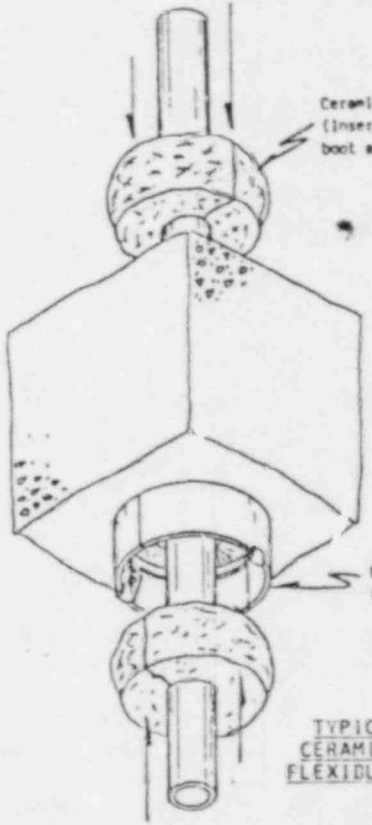
1. All penetrants shall extend 36" above top of slab and 12" below bottom of slab. (Total length = 60").
2. Testing organization shall provide attachment of penetrants as required.
3. Installation of sleeve extenders, flexible boot seals and seal material shall be by B&B Personnel per referenced procedures.
4. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures by B&B QC Personnel.
5. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/ANSI/ASTM STANDARD METHOD OF FIRE TESTS.
6. Flexible Boot Seals similar to those shown except without sleeve extenders have previously been subjected to ASTM E119 Qualification Testing. ANI Acceptances dated 5/1/80 and Test Report SwRI No. 03-6004-004 did 7/25/80.
7. B&B Standard and Inverted boot designs are represented in this test. The choice of design is primarily at customer discretion, but Inverted design is required for all penetrations to be filled with RAD-FLEX.



PLAN VIEW
SHOWING ANNULUS REDUCER



PENETRATION 1022.1
FIRE RATED RADIATION SEAL
FOR MOVING PIPING W/
ANNULUS REDUCER OF HDLE-A



TYPICAL ILLUSTRATION OF CERAMIC BLANKET FILL IN FLEXIBLE BOOTS. BOOTS N SHOWN.

IMPORTANT
Sleeve extenders as shown on this drawing are primarily a means to attach flexible boots to existing test slab. This seal design may be used with extenders (Type 1 or Type A) when necessary on penetrations with flush sleeves and without extenders when penetration is furnished with sleeve protrusions.

REVISIONS		
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IS²B INSULATION, INC.

FIRE RATED RADIATION SEAL FOR MOVING PIPING ANNULUS REDUCER OF HI DENSITY LEADED MAT. ANI QUALIFICATION TEST - CTP 1022

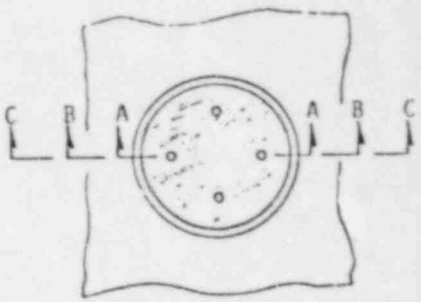
DRAWN BY LCS	SCALE nts	MATERIAL as noted
CHK'D	DATE 3/8/82	DRAWING NO B-264
TRACED	APP'D	

CTP-1022 TEST SLAB NO. 4

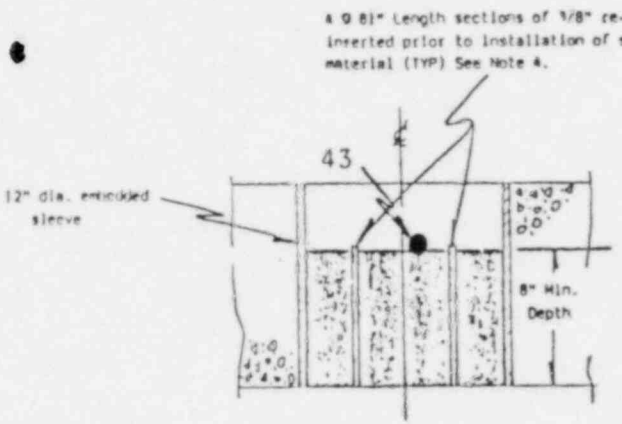
Figure 2

NOTES:

1. Penetrants are not required for this test. Electrical and mechanical penetrants have previously been tested with B&B HI DENSITY LEADED MATRIX. (CTP-1002, CTP-1010, CTP-1012 and CTP-1014) with ANI Acceptances dated 5/10/80 and 9/17/81.
2. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
3. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/NAERP STANDARD METHOD OF FIRE TESTS.
4. The 3/8" re-bar as referenced herein is representative of devices intended for use only as support for damming materials and due to curing of seal material must remain in place. Inclusion in this test is only to provide evidence that fire rating is not effected.

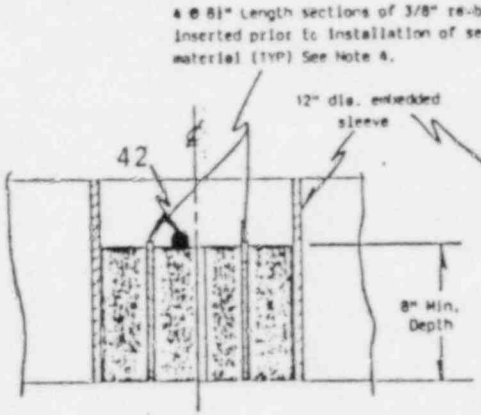


PLAN VIEW



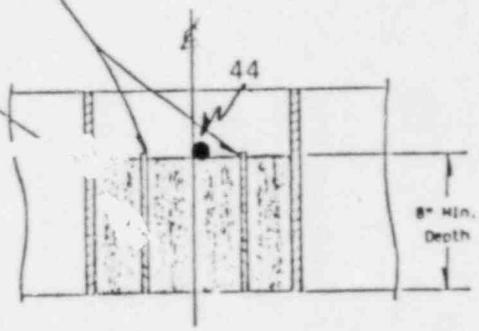
SECTION A-A
PENETRATION 1023.1

B&B HDLE-A AS PREVIOUSLY TESTED
ANI ACCEPTED



SECTION B-B
PENETRATION 1023.2

B&B HDLE-A AS PREVIOUSLY TESTED
MODIFIED WITH ADDITION OF
CURE ACCELERATOR



SECTION C-C
PENETRATION 1023.3

B&B HDLE-C W/
NON LEAD FILLER

CTP 1023 TEST SLAB NO. 4

REVISIONS			B&B INSULATION, INC.
NO	DATE	BY	CATALYZED III DENSITY LEADED MATRIX COMPARISON TEST ANI QUALIFICATION - CTP 1023
1			
2			
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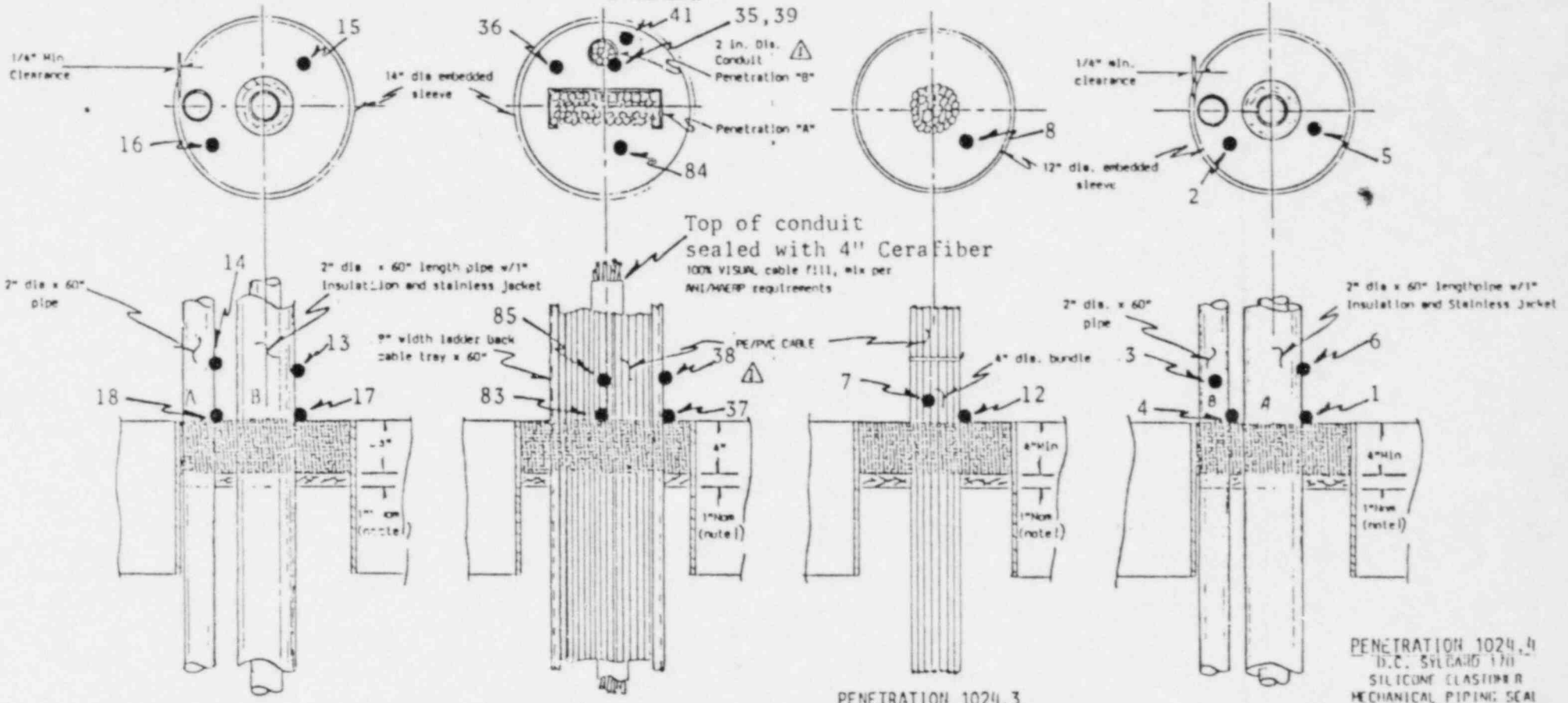
DRAWN BY LCS	SCALE 11" = 1"	MATERIAL as noted
CHK'D	DATE 3/9/82	DRAWING NO B-266
TRACED	APP'D	

Figure 3

NOTES:

1. Damming Materials - 1" nominal alumina-silica in board, blanket or loose fiber. Remains in place as integral part of seal.
2. Alumina-silica loose fiber used to separate cables at point of damming where possible to facilitate flow of seal material.
3. All penetrants shall extend 36" above top of slab and 12" below bottom of slab. (Total length = 60").
4. Testing organization shall provide attachment of penetrants as required.
5. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
6. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/NAERP STANDARD METHOD OF FIRE TESTS.



PENETRATION 1024,1
LIGHT DENSITY SILICONE ELASTOMER
MECHANICAL PIPING SEAL
AND PENETRATING CONDUIT SEAL

PENETRATION 1024,2
LIGHT DENSITY SILICONE ELASTOMER
ELECTRICAL CABLE TRAY SEAL

PENETRATION 1024,3
LIGHT DENSITY SILICONE ELASTOMER
ELECTRICAL CABLE BUNDLE SEAL

PENETRATION 1024,4
D.C. SYLGARD 170
SILICONE ELASTOMER
MECHANICAL PIPING SEAL

SEAL MATERIAL SPECIFICS

A) Designed density range for Light Density Silicone Elastomer is 55 to 65 lb/ft^3.
B) Proto-type formulating and installation Procedures for this material are utilized for test purposes. Specific procedures will be finalized upon test completion.

CTP 1024 TEST SLAD NO. 4

REVISIONS		
NO	DATE	BY
1	5/26/82	LCS
2		
3		
4		
5		

IS&B INSULATION, INC.

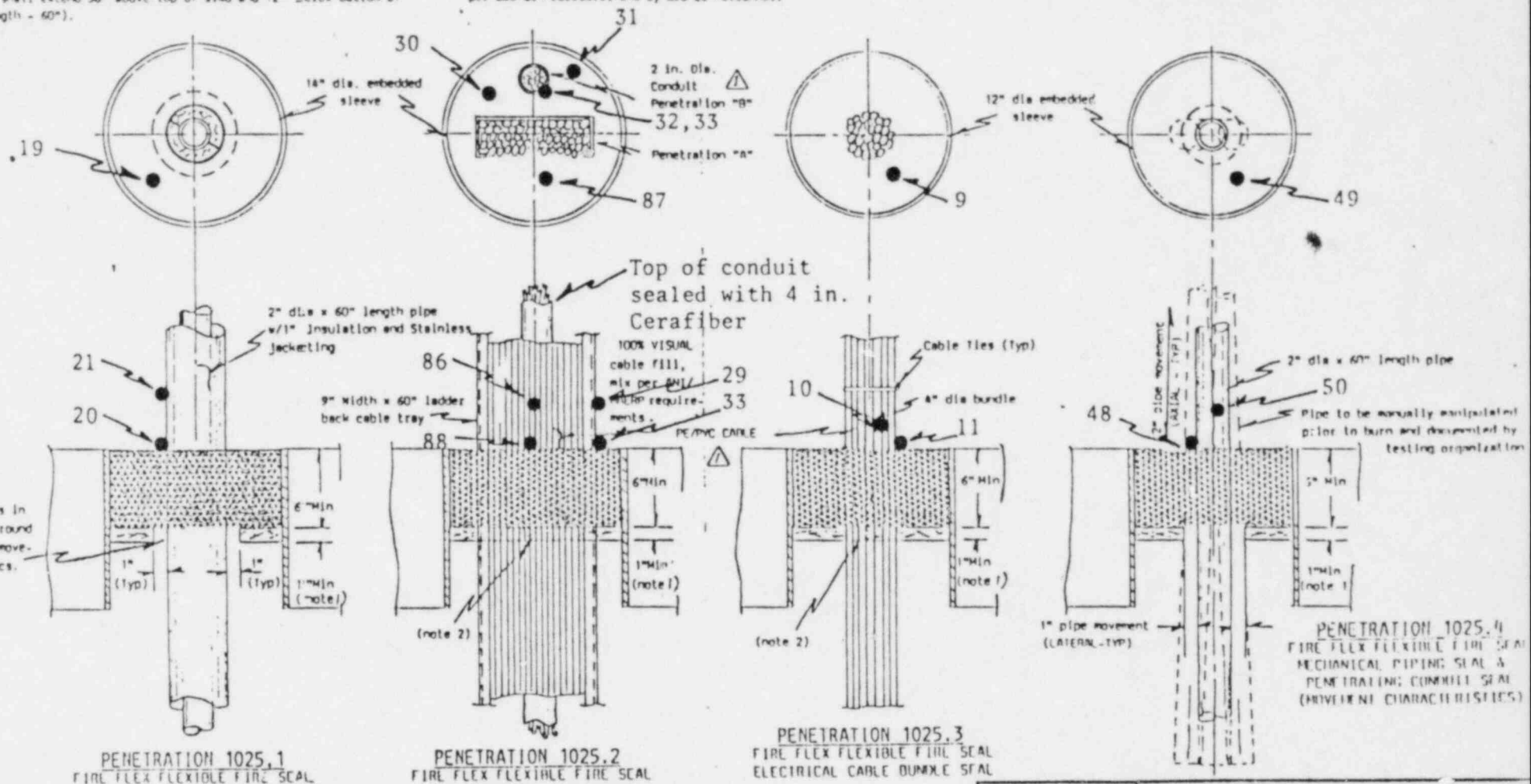
LIGHT DENSITY SILICONE ELASTOMER
ANI QUALIFICATION TEST - CTP 1024

DRAWN BY LCS	SCALE 1½ = 1'	MATERIAL as noted
CHK'D	DATE 3/10/82	DRAWING NO B-268
TRACED	APP'D	

Figure 4

NOTES:

1. Damming Materials - 1" nominal alumina-silica board, in blanket or loose fiber. Remains in place as integral part of seal.
2. Alumina-silica loose fiber used to separate cables at point of damming where possible to facilitate flow of seal material.
3. All penetrants shall extend 36" above top of slab and 12" below bottom of slab (Total length = 60").
4. Testing organization shall provide attachment of penetrants as required. Mounting may be rigid on upper end EXCEPT for Pene. 1025.4 where upper mounting must allow for manual manipulation.
5. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
6. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/ANSI/UL STANDARD METHOD OF FIRE TESTS.



SEAL MATERIAL SPECIFICS

A) Designed density range for "FIRE FLEX" is 35 to 65 lb/ft^3.

B) Proto-type formulating and installation Procedures for this material are utilized for test purposes. Specific procedures will be finalized upon test completion.

CTP 1025 TEST SLAB NO. 4

REVISIONS			
NO	DATE	BY	
1	5/24/92	LCS	
2			
3			
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B&B INSULATION, INC.

"FIRE FLEX" FLEXIBLE FIRE SEAL
ANI QUALIFICATION TEST - CTP1025

DRAWN BY LCS	SCALE 1½" = 1"	MATERIAL as noted
CHK'D RQ	DATE 3/10/92	DRAWING NO B-270
TRACED	APP'D	

Figure 5

B & B Insulation, Inc.
SwRI Project No. 01-6763-212
June 16, 1982

TABLE II. THERMOCOUPLE LOCATIONS

LOCATION	CHANNEL I.D.
1022.1 - On unexposed surface of seal	CH 104 - Field
1022.1 - Interface of pipe and seal material	CH 105 - Interface
1022.1 - On pipe, 2 in. above seal material	CH 106 - Penetrant
1023.1 - On unexposed surface of seal	CH 43 - Field
1023.1 - Engineering, 2 in. up	CH 58
1023.1 - Engineering, 4 in. up	CH 55
1023.1 - Engineering, 6 in. up	CH 57
1023.1 - Engineering, top	CH 56
1023.2 - On unexposed surface of seal	CH 42 - Field
1023.2 - Engineering, 2 in. up	CH 54
1023.2 - Engineering, 4 in. up	CH 52
1023.2 - Engineering, 6 in. up	CH 51
1023.2 - Engineering, top	CH 53
1023.3 - On unexposed surface of seal	CH 44 - Field
1023.3 - Engineering, 2 in. up	CH 60
1023.3 - Engineering, 4 in. up	CH 61
1023.3 - Engineering, 6 in. up	CH 62
1023.3 - Engineering, top	CH 59
1024.1 - On unexposed surface of seal	CH 16 - Field-A
1024.1 - Interface of pipe and seal material	CH 18 - Interface-A
1024.1 - On pipe, 2 in. above surface of seal	CH 14 - Penetrant-A
1024.1 - On unexposed surface of seal	CH 15 - Field-B
1024.1 - Interface of pipe and seal material	CH 17 - Interface-B
1024.1 - On pipe, 2 in. above seal material	CH 13 - Penetrant-A
1024.1 - Engineering, bottom	CH 22
1024.1 - Engineering, 2 in. up	CH 24
1024.1 - Engineering, top	CH 23
1024.2 - On unexposed surface of seal	CH 36 - Field-A
1024.2 - On unexposed surface of seal	CH 84 - Field-A-Cable
1024.2 - Interface of tray and seal material	CH 37 - Interface-A
1024.2 - Interface of cables and seal material	CH 83 - Interface-A-Cable
1024.2 - On tray, 2 in. above seal material	CH 38 - Penetrant-A
1024.2 - On cable, 2 in. above seal material	CH 85 - Penetrant-A-Cable
1024.2 - On unexposed surface of seal	CH 41 - Field-B
1024.2 - Interface of conduit and seal material	CH 35 - Interface-B
1024.2 - On conduit, 2 in. above seal material	CH 39 - Field-B
1024.3 - On unexposed surface of seal	CH 8 - Field
1024.3 - Interface of cables and seal material	CH 12 - Interface
1024.3 - On cable, 2 in. above seam material	CH 7 - Penetrant

B & B Insulation, Inc.
SwRI Project No. 01-6763-212
June 16, 1982

TABLE II. THERMOCOUPLE LOCATIONS (Cont'd)

LOCATION	CHANNEL I.D.
1024.4 - On unexposed surface of seal	CH 5 - Field-A
1024.4 - Interface of insulated pipe and seal material	CH 1 - Interface-A
1024.4 - On insulated pipe, 2 in. above seal material	CH 6 - Penetrant-A
1024.4 - On unexposed surface of seal	CH 2 - Field-B
1024.4 - Interface of pipe and seal material	CH 4 - Interface-B
1024.4 - On pipe, 2 in. above seal material	CH 3 - Penetrant-B
1024.4 - Engineering, bottom	CH 46
1024.4 - Engineering, 2 in. up	CH 45
1024.4 - Engineering, top	CH 47
1025.1 - On unexposed surface of seal	CH 19 - Field
1025.1 - Interface of pipe and seal material	CH 20 - Interface
1025.1 - On pipe, 2 in. above seal material	CH 21 - Penetrant
1025.1 - Engineering, bottom	CH 28
1025.1 - Engineering, 2 in. up	CH 25
1025.1 - Engineering, 4 in. up	CH 27
1025.1 - Engineering, top	CH 26
1025.2 - On unexposed surface of seal	CH 30 - Field-A
1025.2 - On unexposed surface of seal	CH 87 - Field-A-Cable
1025.2 - Interface of tray and seal material	CH 33 - Interface-A
1025.2 - Interface of cable and seal material	CH 88 - Interface-A-Cable
1025.2 - On tray, 2 in. above seal material	CH 29 - Penetrant-A
1025.2 - On cable, 2 in. above seal material	CH 86 - Penetrant-A-Cable
1025.2 - On unexposed surface of seal	CH 31 - Field-B
1025.2 - Interface of tray and seal material	CH 32 - Interface-B
1025.2 - On conduit, 2 in. above seal material	CH 34 - Penetrant-B
1025.3 - On unexposed surface of seal	CH 9 - Field
1025.3 - Interface of cables and seal material	CH 11 - Interface
1025.3 - On cable, 2 in. above seal material	CH 10 - Penetrant
1025.4 - On unexposed surface of seal material	CH 49 - Field
1025.4 - Interface of pipe and seal material	CH 48 - Interface
1025.4 - On pipe, 2 in. above seal material	CH 50 - Penetrant

B & P Insulation, Inc.
SwRI Project No. 01-6763-212
June 16, 1982

TEST RESULTS

The following observations were made regarding seal Nos. CTP 1022, CTP 1023, CTP 1024 and CTP 1025:

1. There was no passage of flame through the seals during the 3-hour fire endurance test.

2. There was no visible flame or burning of the cables or fire stops on the unexposed sides of the seals.

3. There was no passage of water through the seals during the hose stream test.

Maximum temperatures attained during the test are provided in Table III.

Figures 6, 7, 8, and 9 provide diagrams of the post-test condition of seal Nos. CTP 1022, CTP 1023, CTP 1024 and CTP 1025.

Should you have any questions or if I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Jesse J. Beitel, Manager
Fire Performance Evaluations
and Fire Protection Systems

Enclosures
JJB/cjm

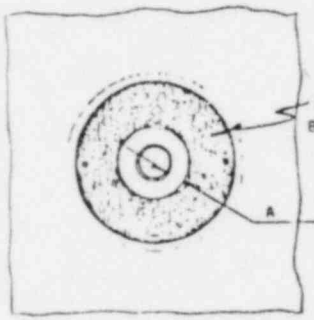
B & B Insulation, Inc.
SwRI Project No. 01-6763-212
June 16, 1982

TABLE III. MAXIMUM TEMPERATURES ATTAINED

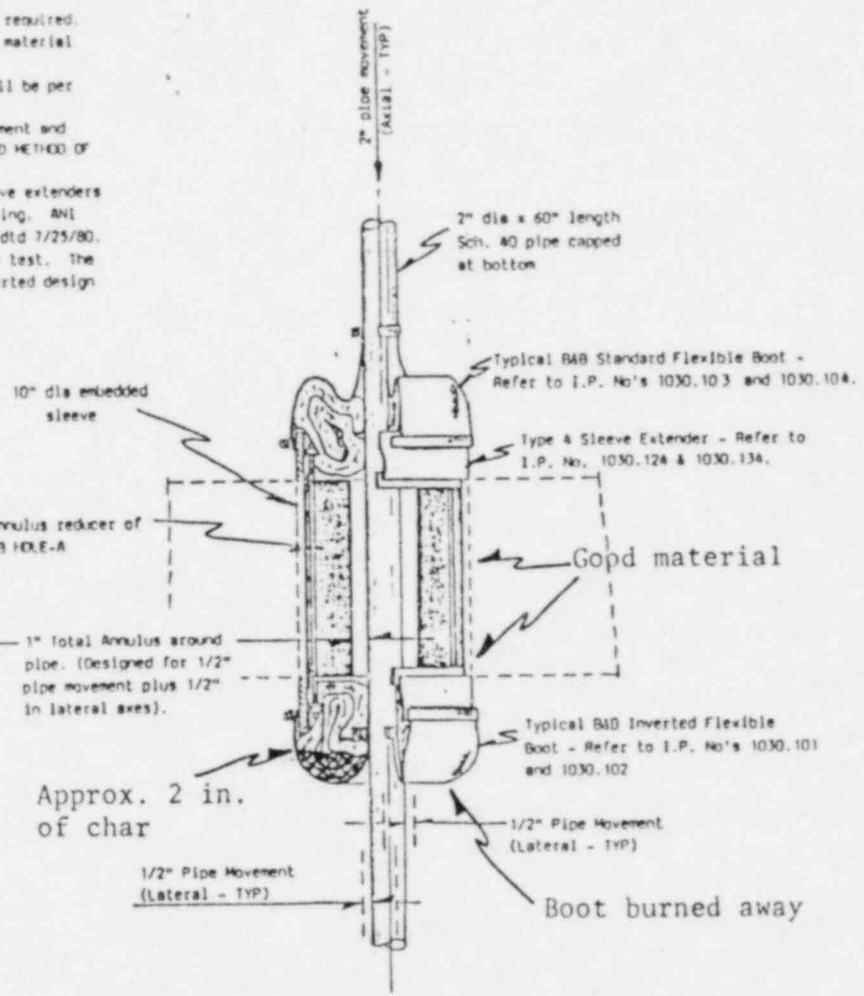
CHANNEL NO.	THERMOCOUPLE	TEMPERATURE (°F)
104	1022.1 - Field	100.2
105	1022.1 - Interface	143.7
106	1022.1 - Penetrant	116.5
43	1023.1 - Field	124.5
42	1023.2 - Field	183.9
44	1023.3 - Field	145.8
16	1024.1 - Field-A	146.1
18	1024.1 - Interface-A	463.6
14	1024.1 - Penetrant-A	257.2
15	1024.1 - Field-B	142.1
17	1024.1 - Interface-B	276.1
13	1024.1 - Penetrant-B	219.3
36	1024.2 - Field-A	207.1
84	1024.2 - Field-A-Cable	179.0
37	1024.2 - Interface-A	383.0
83	1024.2 - Interface-A-Cable	340.1
38	1024.2 - Penetrant-A	252.6
85	1024.2 - Penetrant-A-Cable	215.6
41	1024.2 - Field-B	192.5
35	1024.2 - Interface-B	379.1
39	1024.2 - Penetrant-B	359.9
8	1024.3 - Field	167.0
12	1024.3 - Interface	340.4
4	1024.3 - Penetrant	240.9
5	1024.4 - Field-A	170.0
1	1024.4 - Interface-A	360.2
6	1024.4 - Penetrant-A	211.3
2	1024.4 - Field-B	309.5
4	1024.4 - Interface-B	425.6
3	1024.4 - Penetrant-B	325.6
19	1025.1 - Field	131.9
20	1025.1 - Interface	266.8
21	1025.1 - Penetrant	200.0
30	1025.2 - Field-A	243.4
87	1025.2 - Field-A-Cable	214.6
33	1025.2 - Interface-A	307.8
88	1025.2 - Interface-A-Cable	387.8
29	1025.2 - Penetrant-A	188.6
86	1025.2 - Penetrant-A-Cable	257.4
31	1025.2 - Field-B	186.7
32	1025.2 - Interface-B	490.2
34	1025.2 - Penetrant-B	336.2
9	1025.3 - Field	163.2
11	1025.3 - Interface	312.5
10	1025.3 - Penetrant	243.6
49	1025.4 - Field	163.9
48	1025.4 - Interface	400.3
50	1025.4 - Penetrant	287.9

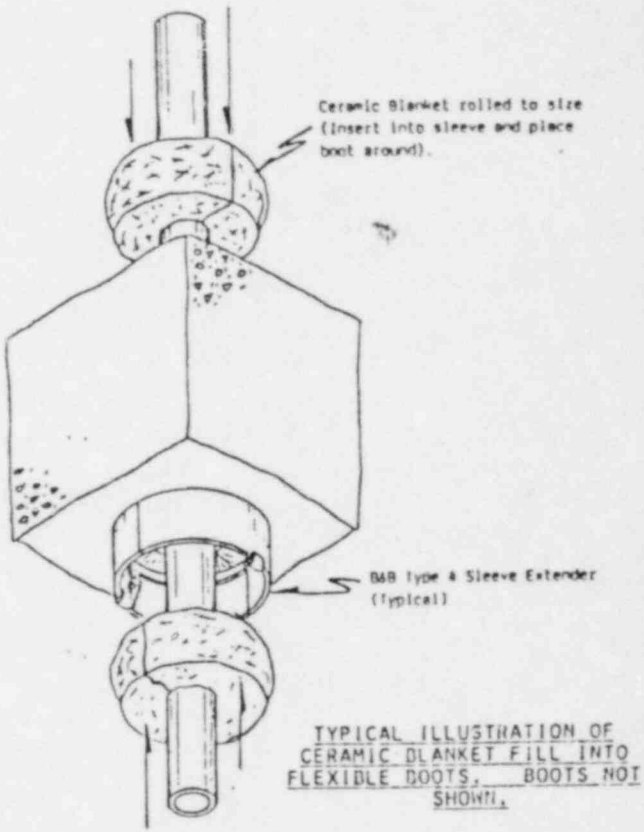
NOTES:

1. All penetrants shall extend 36" above top of slab and 12" below bottom of slab. (Total length - 60").
2. Testing organization shall provide attachment of penetrants as required.
3. Installation of sleeve extenders, flexible boot seals and seal material shall be by BAB Personnel per referenced procedures.
4. Quality Control surveillance, inspection and documentation shall be per BAB QC Procedures by BAB QC Personnel.
5. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/ANSI/NFPA STANDARD METHOD OF FIRE TESTS.
6. Flexible Boot Seals similar to those shown except without sleeve extenders have previously been subjected to ASTM E119 Qualification Testing. ANI Acceptance dated 5/1/80 and Test Report SwRI No. 03-6004-004 dtd 7/25/80.
7. BAB Standard and inverted boot designs are represented in this test. The choice of design is primarily at customer discretion, but inverted design is required for all penetrations to be filled with RAD-FLEX.



PLAN VIEW
SHOWING ANNULUS REDUCER





TYPICAL ILLUSTRATION OF CERAMIC BLANKET FILL INTO FLEXIBLE BOOTS. BOOTS NOT SHOWN.

IMPORTANT

Sleeve extenders as shown on this drawing are primarily a means to attach flexible boots to existing test slab. This seal design may be used with extenders (Type I or Type A) when necessary on penetrations with flush sleeves and without extenders when penetration is furnished with sleeve protrusions.

PENETRATION 1022.1
FIRE RATED RADIATION SEAL
FOR MOVING PIPING W/
ANNULUS REDUCER OF HDLE-A

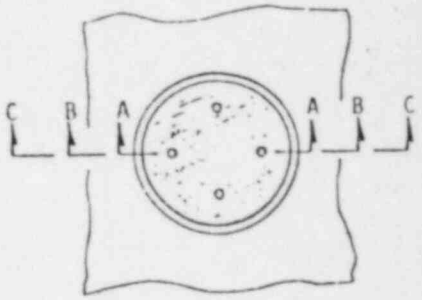
REVISIONS			IS/IB INSULATION, INC.
NO	DATE	BY	
1			FIRE RATED RADIATION SEAL FOR MOVING PIPING W/ ANNULUS REDUCER OF HI DENSITY LEADED MATRIX ANI QUALIFICATION TEST - CTP 1022
2			
3			DRAWN BY LCS · SCALE nts · MATERIAL as noted
4			CHK'D · DATE 3/8/82 · DRAWING NO B-264
5			TRACED · APP'D

CTP-1022 TEST SLAB NO. 4

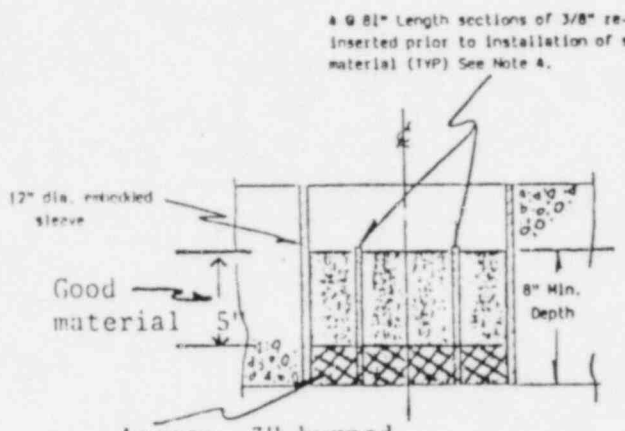
Figure 6

NOTES:

1. Penetrants are not required for this test. Electrical and mechanical penetrants have previously been tested with B&B III DENSITY LEADED MATRIX. (CTP-1002, CTP-1010, CTP-1012 and CTP-1014) with ANI Acceptances dated 5/10/80 and 9/17/81.
2. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
3. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/NAERP STANDARD METHOD OF FIRE TESTS.
4. The 3/8" re-bar as referenced herein is representative of devices intended for use only as support for damming materials and due to curing of seal material must remain in place. Inclusion in this test is only to provide evidence that fire rating is not effected.

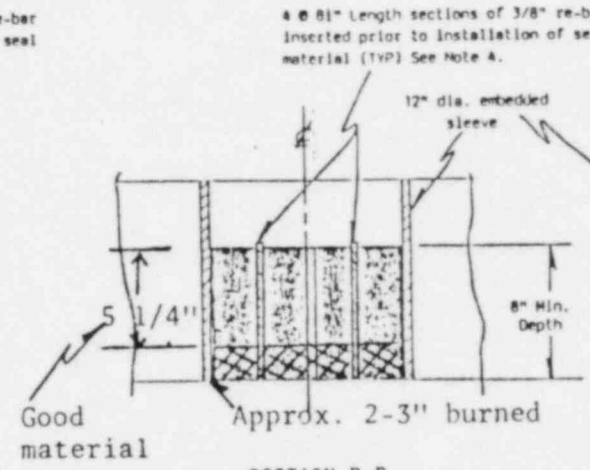


PLAN VIEW



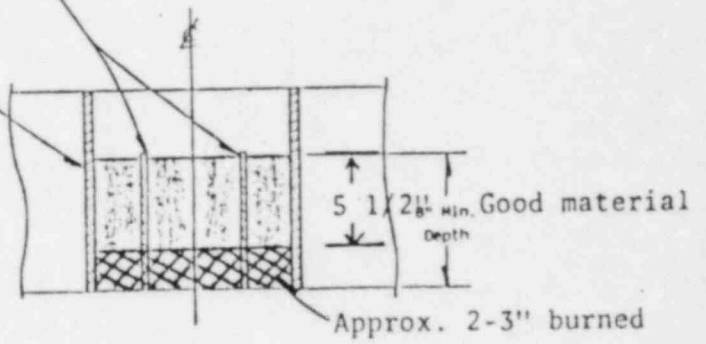
SECTION A-A
PENETRATION 1023.1

B&B HDLE-A AS PREVIOUSLY TESTED
ANI ACCEPTED



SECTION B-B
PENETRATION 1023.2

B&B HDLE-A AS PREVIOUSLY TESTED
MODIFIED WITH ADDITION OF
CURE ACCELERATOR



SECTION C-C
PENETRATION 1023.3

B&B HDLE-C W/
NON LEAD FILLER

CTP 1023 TEST SLAB NO. 4

REVISIONS		
NO	DATE	BY
1		
2		
3		
4		
5		

B&B INSULATION, INC.

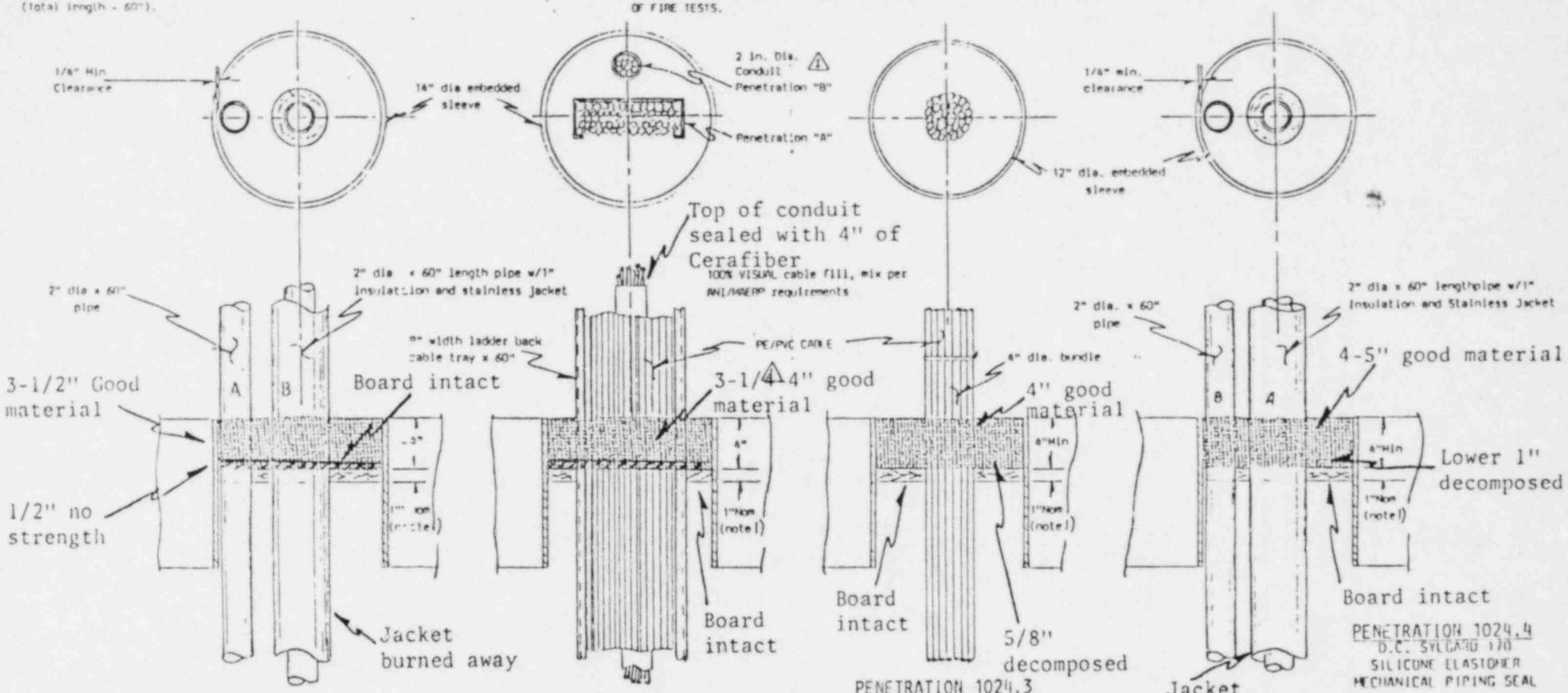
CATALYZED III DENSITY LEADED MATRIX
COMPARISON TEST
ANI QUALIFICATION - CTP 1023

DRAWN BY LCS	SCALE 1½" = 1"	MATERIAL as noted
CHK'D	DATE 3/9/82	DRAWING NO B-266
TRACED	APP'D	

Figure 7

NOTES:

1. Damming Materials - 1" nominal alumina-silica in board, blanket or loose fiber. Remains in place as integral part of seal.
2. Alumina-silica loose fiber used to separate cables at point of damming where possible to facilitate flow of seal material.
3. All penetrants shall extend 36" above top of slab and 12" below bottom of slab. (total length - 60").
4. Testing organization shall provide attachment of penetrants as required.
5. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
6. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/MAERP STANDARD METHOD OF FIRE TESTS.



PENETRATION 1024.1
LIGHT DENSITY SILICONE ELASTOMER
MECHANICAL PIPING SEAL
AND PENETRATING CONDUIT SEAL

PENETRATION 1024.2
LIGHT DENSITY SILICONE ELASTOMER
ELECTRICAL CABLE TRAY SEAL

PENETRATION 1024.3
LIGHT DENSITY SILICONE ELASTOMER
ELECTRICAL CABLE BUNDLE SEAL

PENETRATION 1024.4
D.C. SYLGARD 170
SILICONE ELASTOMER
MECHANICAL PIPING SEAL

SEAL MATERIAL SPECIFICS

A) Designed density range for Light Density Silicone Elastomer is 55 to 65 lb/ft^3.
B) Proto-type formulating and installation Procedures for this material are utilized for test purposes. Specific procedures will be finalized upon test completion.

CTP 1024 TEST SLAB NO. 4

REVISIONS		
NO	DATE	BY
1	5/26/82	LCS
2		
3		
4		
5		

B&B INSULATION, INC.

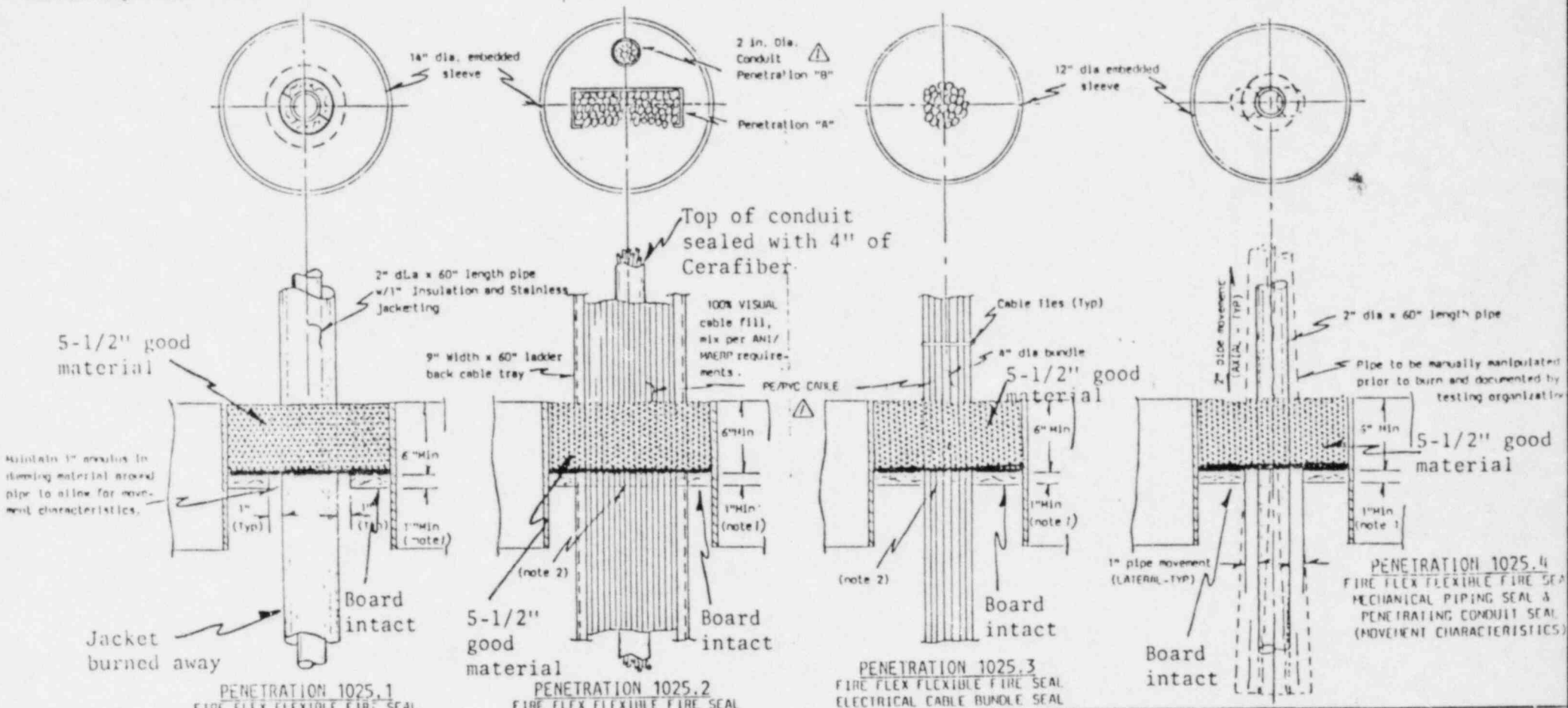
LIGHT DENSITY SILICONE ELASTOMER
ANI QUALIFICATION TEST - CTP 1024

DRAWN BY LCS	SCALE 1½ = 1'	MATERIAL as noted
CHK'D	DATE 3/10/82	DRAWING NO B-268
TRACED	APP'D	

Figure 8

NOTES:

1. Damming Materials - 1" nominal alumina-silica board, in blanket or loose fiber. Remains in place as integral part of seal.
2. Alumina-silica loose fiber used to separate cables at point of damming where possible to facilitate flow of seal material.
3. All penetrants shall extend 36" above top of slab and 12" below bottom of slab (total length = 60").
4. Testing organization shall provide attachment of penetrants as required. Mounting may be rigid on upper end EXCEPT for Pene. 1025.4 where upper mounting must allow for manual manipulation.
5. Quality Control surveillance, inspection and documentation shall be per B&B QC Procedures and by B&B QC Personnel.
6. Testing organization shall provide adequate thermocouple placement and shall perform fire test/hose stream test per ANI/NAERP STANDARD METHOD OF FIRE TESTS.



PENETRATION 1025.1
FIRE FLEX FLEXIBLE FIRE SEAL
MECHANICAL PIPING SEAL - INSULATED

PENETRATION 1025.2
FIRE FLEX FLEXIBLE FIRE SEAL
ELECTRICAL CABLE TRAY SEAL

PENETRATION 1025.3
FIRE FLEX FLEXIBLE FIRE SEAL
ELECTRICAL CABLE BUNDLE SEAL

PENETRATION 1025.4
FIRE FLEX FLEXIBLE FIRE SEAL
MECHANICAL PIPING SEAL & PENETRATING CONDUIT SEAL
(MOVEMENT CHARACTERISTICS)

SEAL MATERIAL SPECIFICS

A) Designed density range for "FIRE FLEX" is 55 to 65 lb/ft^3.

B) Proto-type formulating and installation Procedures for this material are utilized for test purposes. Specific procedures will be finalized upon test completion.

REVISIONS		
NO	DATE	BY
1	5/26/82	LCS
2		
3		
4		
5		

B&B INSULATION, INC.

"FIRE FLEX" FLEXIBLE FIRE SEAL
ANI QUALIFICATION TEST - CTP1025

DRAWN BY LCS	SCALE 1½" = 1"	MATERIAL as noted	
CHK'D	DATE 3/10/82	DRAWING NO B-270	
TRACED	APP'D		

CTP 1025 TEST SLAB NO. 4

Figure 9

APPENDIX A

FURNACE TEMPERATURE DATA

FURNACE AVERAGE

DATE OF TEST...21 APR 92 PROJECT NO.:..01-6763-211
DATA FILE.....D&B DISK.....JB-3

TIME MIN	SEC	FURN AVG
0	0	95
0	0	292
1	0	970
5	0	1227
8	0	1371
10	0	1436
12	0	1463
14	0	1477
16	0	1485
18	0	1493
20	0	1497
22	0	1500
24	0	1508
26	0	1531
28	0	1542
30	0	1549
32	0	1571
34	0	1598
36	0	1601
38	0	1614
40	0	1627
42	0	1635
44	0	1647
46	0	1653
48	0	1661
50	0	1672
52	0	1681
54	0	1695
56	0	1700
58	0	1693

FURNACE AVERAGE

DATE OF TEST...21 APR 92 PROJECT NO.:..01-6763-211
DATA FILE.....B&B DISK.....JB-3

TIME MIN	SEC	FURN AVG
60	0	1710
62	0	1725
64	0	1729
66	0	1731
68	0	1734
70	0	1739
72	0	1753
74	0	1759
76	0	1764
78	0	1767
80	0	1768
82	0	1769
84	0	1772
86	0	1780
88	0	1793
90	0	1802
92	0	1811
94	0	1817
96	0	1819
98	0	1824
100	0	1829
102	0	1832
104	0	1835
106	0	1839
108	0	1844
110	0	1847
112	0	1849
114	0	1851
116	0	1857
118	0	1861

FURNACE AVERAGE

DATE OF TEST...21 APR 82 PROJECT NO.:..01-6763-211
DATA FILE.....D&D DISK.....JB-3

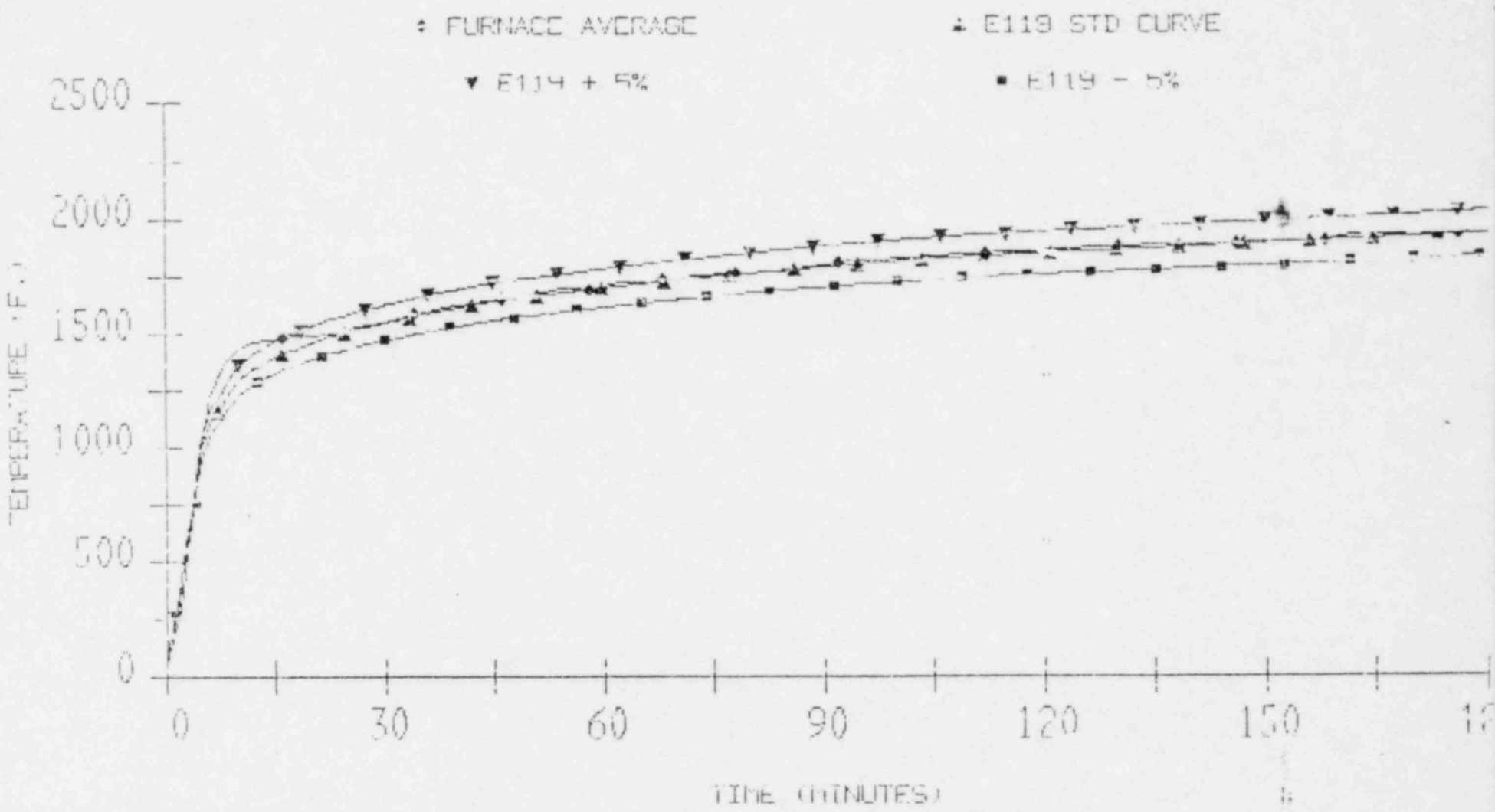
TIME MIN	SEC	FURN AVG
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1867
121	0	1867
125	0	1873
128	0	1871
130	0	1876
132	0	1879
134	0	1883
135	0	1885
138	0	1885
140	0	1885
142	0	1886
144	0	1886
146	0	1889
148	0	1890
150	0	1893
152	0	1895
154	0	1897
156	0	1897
158	0	1897
200	0	1909
202	0	1922
164	0	1927
166	0	1925
168	0	1918
170	0	1916
172	0	1921
174	0	1926
176	0	1929
178	0	1928

FURNACE AVERAGE

DATE OF TEST...21 APR 82 PROJECT NO.:..01-6763-211
DATA FILE.....B&B DISK.....JB-3

TIME MIN	SEC	FURN AVG
100	0	1929

B & B SLAB



TEST DATE: 21 APR 82

PROJECT NO.: 01-8763-211