CONSTRUCTION QUALITY ASSURANCE
FINAL REPORT
ON-SITE DISPOSAL FACILITY, PHASE I AND LEACHATE CONVEYANCE SYSTEM

REVISION 0
JANUARY 1998
VOLUME VI

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

Prepared by

GEOSYNTEC CONSULTANTS
1100 Lake Hearn Drive, NE, Suite 200
Atlanta, Georgia 30342

under

Fluor Daniel Fernald
Subcontract 95PS005028

Leachate Conveyance System

- HDPE Pipe and Fittings

77 R11

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	Please sign & date ORIGINAL FILE COPY Return to CDC ms/44	REMARKS
1		[redacted]	64		REVIEW COORDINATOR
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	1	Parsons	Bin		
	1	Rick McGuire	64		
	1	Mike Godber	64		
	1	Tracy Russell	64		

RECEIVED BY: James C. Jenkins DATE: 9/15/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 9/15/97

REVIEW COORDINATOR

1268

000004

1268

VBS-DRI 017
Rev 0

ISCO

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

September 3, 1997

Description: 6" X 10" Dual Contained Cleanouts, 4" X 8" Auxiliary Connection Tee, and 10"/6" Horizontal Monitoring Well Tee and Lateral

Ship Address: Village Building Services
Trailer No. 502
7400 Willey Road
Fernald, Ohio 45030

This letter is to certify that the cleanouts described above have been fabricated by ISCO Industries, Inc. in accordance with the following requirements:

ASTM D1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials

ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene Plastic Fitting for Polyethylene Plastic Piping and Tubing

The cleanouts are fabricated in accordance with dimensions and configuration as shown on approved submittal drawing SK-0197-006 (sheets 1 through 10). The cleanouts have been leak tested in the shop prior to shipment to Fernald. All extrusion welds were extruded with a wire under the weld and the weld was then spark tested. The spark test will detect any void which water may pass through. Filling the cleanouts with water sometimes fails to show small voids and potential leakage areas; therefore, ISCO has established this spark testing procedure for all extrusion welded fabrications. This testing procedure is a superior method to ensure that no leakage will occur now or in the future. Please contact me at (513)871-9512 with any additional questions, thank you.

Scott Hoff
Regional Sales Manager

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204
P 502 583.6591
F 502 584.9713
HTTP //www.isco-pipe.com

POLYETHYLENE PIPE AND FITTINGS
HDPE FABRICATION
CULVERT LINERS
GOLF COURSE IRRIGATION SUPPLIES

EDC
CONTROLLED
COPY
NO.
000005
76002

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2960 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3065

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
3"IPS DR 26	1000	07/30/96

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 82-6-0719 Melt Index of 0.10 61-6-0719 Melt Index of 0.10. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.08 avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3600
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

June 25, 1996

JHV# 12631-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	8260719
P.O. Number:	REL 133
Date Shipped:	06/24/96
Package:	PSPX 6009
Quantity:	175100 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Tensile @ yield:	3436.000 PSI
Tensile @ break:	4448. PSI
Elongation:	700. %
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

3 0226
7/30/96

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3660
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

June 28, 1996

JHV# 12971-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	6160719
P.O. Number:	REL 136
Date Shipped:	06/27/96
Package:	PSPX 2574
Quantity:	178050 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Tensile @ yield:	3331.000 PSI
Tensile @ break:	4489. PSI
Elongation:	700. %
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

3 OR 26
7/30/96

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
4"IPS DR 17	1000	01/22/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1773 Melt Index of 0.12. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 Avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3686
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 31, 1996

JHV# 25605-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161773
P.O. Number:	REL 285
Date Shipped:	12/28/96
Package:	PSPX 6336
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.13 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

4" DR17
22 Jan 97

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2960 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
4"IPS DR 26	1000	06/11/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0521 Melt Index of 0.10 . The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 Avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

1268

RECEIVED
MAY 15 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 12, 1997

JHV# 9426-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170521
P.O. Number:	REL 107
Date Shipped:	05/09/97
Package:	PSPX 3016
Quantity:	194250 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6/9/97 [illegible]

4 DR 26
11 June 97

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
6"IPS DR 26	1000	04/14/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0367 Melt Index of 0.11 71-7-0359 Melt Index of 0.11 71-7-0346 Melt Index of 0..12. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 Avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3686
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED APR 4 1997

April 01, 1997

JHV# 6524-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170367
P.O. Number:	REL 67
Date Shipped:	03/31/97
Package:	PSPX 6364
Quantity:	179700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26
4/14/97

1268

RECEIVED
MAR 31 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 27, 1997

JHV# 6228-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170359
P.O. Number:	REL 63
Date Shipped:	03/26/97
Package:	PSPX 5977
Quantity:	180200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6" 26

6" DR 26
4/14/97

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 24, 1997

JHV# 5880-97

FAX: 864-439-7918

MAR 27 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170346
P.O. Number:	REL 60
Date Shipped:	03/21/97
Package:	PSPX 6148
Quantity:	179250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26
4/14/97

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3096

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
6"IPS DR 26	1000	07/13/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0527 Melt Index of 0.10 81-7-0595 Melt Index of 0.09. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.07 avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

TOTAL P.06

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

June 03, 1997

JHV# 10936-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170527
P.O. Number:	REL 121
Date Shipped:	06/02/97
Package:	PSPX 3127
Quantity:	193300 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.945 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

June 10, 1997

JHV# 11460-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8170595
P.O. Number:	REL 126
Date Shipped:	06/09/97
Package:	PSPX 8149
Quantity:	194100 LBS.
Melt Index, ASTM D1238:	.09 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 DR 26
7/13/97

TOTAL P.02

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
8"IPS DR 26	1000	06/22/96

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 61-6-0587 Melt Index of 0.11 61-6-0586 Melt Index of 0.10. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.08 avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 24, 1996

JHV# 10301-96

FAX: 864-439-7918

UPDATED COPY

(June 20, 1996)

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	6160587
P.O. Number:	REL 107
Date Shipped:	05/23/96
Package:	PSPX 2197
Quantity:	175600 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Tensile @ yield:	3420.0 PSI
Tensile @ break:	4995.0 PSI
Elongation:	700.0 %
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8:06 AM
6/22/96

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 23, 1996

JHV# 10190-96

FAX: 864-439-7918

UPDATED COPY

(June 20, 1996)

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	6160586
P.O. Number:	REL 106
Date Shipped:	05/22/96
Package:	PSPX 6689
Quantity:	175900 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Tensile @ yield:	3386.0 PSI
Tensile @ break:	5067.0 PSI
Elongation:	700.0 %
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8" 2R26
6/22/96

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
8"IPS DR 26	1000	08/19/96

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 61-6-0587 Melt Index of 0.10 61-6-0586 Melt Index of 0.10. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.07 avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 24, 1996

JHV# 10301-96

FAX: 864-439-7918

UPDATED COPY

(June 20, 1996)

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	6160587
P.O. Number:	REL 107
Date Shipped:	05/23/96
Package:	PSPX 2197
Quantity:	175600 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Tensile @ yield:	3420.0 PSI
Tensile @ break:	4995.0 PSI
Elongation:	700.0 %
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8" DR 26
8/19/96

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3660
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 23, 1996

JHV# 10190-96

FAX: 864-439-7918

UPDATED COPY

(June 20, 1996)

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	6160586
P.O. Number:	REL 106
Date Shipped:	05/22/96
Package:	PSPX 6689
Quantity:	175900 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Tensile @ yield:	3386.0 PSI
Tensile @ break:	5067.0 PSI
Elongation:	700.0 %
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8 DR 26
8/19/96

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2960 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
8"IPS DR 17	1000	10/11/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-4-0817 Melt Index of 0.10 71-4-0825 Melt Index of 0.09. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 Avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 13, 1994

JHV# 17757-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Quality Control

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7140817
P.O. Number:	REL 169
Date Shipped:	09/12/94
Package:	PSPX 2015
Quantity:	178050 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

10/11/94

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3866
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 26, 1994

JHV# 17758-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Quality Control

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7140825
P.O. Number:	REL 179
Date Shipped:	09/23/94
Package:	PSPX 6089
Quantity:	181450 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8" DR 26
10/11/94

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

09/05/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
8"IPS DR 26	1000	10/19/96

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1349 Melt Index of 0.11 71-6-1333 Melt Index of 0.12 71-6-1332 Melt Index of0.11 71-6-1338 Melt Index of 0.11. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 avg. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 01, 1996

JHV# 19784-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161349
P.O. Number:	REL 213
Date Shipped:	09/30/96
Package:	PSPX 6707
Quantity:	176250 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

10/19/96

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED
SEP 1996

September 26, 1996

JHV# 19441-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-4802
Lot Number:	7161333
P.O. Number:	REL 208
Date Shipped:	09/25/96
Package:	PSPX 5907
Quantity:	177750 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8 D 6 26
10/19/96

1268

SEP 27 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 25, 1996

JHV# 19306-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161332
P.O. Number:	REL 207
Date Shipped:	09/24/96
Package:	PSPX 2396
Quantity:	177700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

S 2R 26
10/4/96

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 30, 1996

JHV# 19657-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161338
P.O. Number:	REL 210
Date Shipped:	09/27/96
Package:	PSPX 6545
Quantity:	177200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

8 DC 26
10/19/96

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1000, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

September 3, 1997

TO: ISCO Industries
3766 Ashworth Drive No.3
Cincinnati, OH 45208
Attn: Scott Hoff

Product	Production Date
10" DR-26 1000	11/03/96, 11/04/96 & 12/14/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 7161467 and 7161681 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test results of 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A. Supervisor

LDK/jdk
cc: Certification File

WP/meltindx

RECEIVED OCT 2 5 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 392 - PHONE 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Division Chemical Company

October 22, 1996

JHV# 21215-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161467
P.O. Number:	REL 251
Date Shipped:	10/21/96
Package:	PSPX 6556
Quantity:	176650 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Division Chemical Complex

December 09, 1996

JHV# 24332-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161681
P.O. Number:	REL 296
Date Shipped:	12/06/96
Package:	PSPX 2231
Quantity:	176750 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
RT. 3, BOX 68-J • M.A.I.P. 84
PRYOR, OKLAHOMA 74361
(918) 825-0384

QUALITY CERTIFICATION

CUSTOMER: Irrigation Supply Company

ATTENTION: Scott Hoff

CUSTOMER ORDER NO:
PHILLIPS ORDER NO:
SHIPPING DATE:
QUANTITY: FT
DATE(S) EXTRUDED: 02/02/97

PRODUCT: 4" IPS SDR-17 DRISCOPIPE 1000 PE3408 ASTM F714 (40 FT JOINTS)

This letter certifies Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin. The resin has a cell class of PE 345444C (1997) according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which is meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and 800 psi at 60°C based on TR/3 as derived from ASTM D-2837 test methodology.

The polyethylene material designation code is PE 3408 CDD

The dimensional characteristics and pressure capabilities of Driscopipe 1000 are established in accordance with the guidelines set forth in ASTM F714, D3035 and D3261. These standards are referenced in the print line, and repeated every two feet along the entire length of pipe.

R. E. PRITCHETT
SERVICES SUPERVISOR

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
RT. 3, BOX 69-3 • MAIL #4
PRYOR, OKLAHOMA 74361
(918) 825-0394

QUALITY CERTIFICATION

CUSTOMER: Irrigation Supply Company

ATTENTION: Scott Hoff

CUSTOMER ORDER NO:
PHILLIPS ORDER NO:
SHIPPING DATE:
QUANTITY: FT
DATE(S) EXTRUDED: 6/10/97

PRODUCT: 10" IPS SDR-11 DRISCOPIPE 1000 PE3408 ASTM F714 (40 FT JOINTS)

This letter certifies Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin. The resin has a cell class of PE 345444C (1997) according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which is meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and 800 psi at 60°C based on TR/3 as derived from ASTM D-2837 test methodology.

The polyethylene material designation code is PE 3408 CDD

The dimensional characteristics and pressure capabilities of Driscopipe 1000 are established in accordance with the guidelines set forth in ASTM F714, D3035 and D3261. These standards are referenced in the print line, and repeated every two feet along the entire length of pipe.

R. E. PRITCHETT
SERVICES SUPERVISOR

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
RT. 3, BOX 68-B • M.A.I.P. 64
PRYOR, OKLAHOMA 74361
(918) 825-0884

QUALITY CERTIFICATION

CUSTOMER: Irrigation Supply Company

ATTENTION: Scott Hoff

CUSTOMER ORDER NO:
PHILLIPS ORDER NO:
SHIPPING DATE:
QUANTITY: FT
DATE(S) EXTRUDED: 12/19/96

PRODUCT: 12" IPS SDR-13.5 DRISCOPIPE 1000 PE3408 ASTM F714 (40 FT JOINTS)

This letter certifies Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin. The resin has a cell class of PE 345444C (1997) according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which is meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and 800 psi at 60°C based on TR/3 as derived from ASTM D-2837 test methodology.

The polyethylene material designation code is PE 3408 CDD

The dimensional characteristics and pressure capabilities of Driscopipe 1000 are established in accordance with the guidelines set forth in ASTM F714, D3035 and D3261. These standards are referenced in the print line, and repeated every two feet along the entire length of pipe.

R. E. PRITCHETT
SERVICES SUPERVISOR

RECEIVED SEP 03 1997

77 R10

#171 R10

1063

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	[redacted]	[redacted]			REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	GeoSyntec	38		
	1	Parsons	Bin		
	1	Rick McGuire	64		
	1	Mike Godber	64		
	1	Tracy Russell	64		

RECEIVED BY: James C. Jenkins DATE: 8/29/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 8/29/97

REVIEW COORDINATOR

000040

1268

VBS-DRI-015 Rev 0

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

This letter is to certify that the Fina resin used to make the Prime Plastics welding rod used in the extrusion gun and the Marlex resin used to make Phillips Driscopipe are compatible and can be used together. These products have been used together by Isco to manufacture HDPE fabrications for over 15 years. Please feel free to call me if you have any questions or comments, thank you.

Scott Hoff
Regional Sales Manager

INFORMATION ONLY

VBS-DRI-016 Rev. 0

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

This letter is to notify you that the 6" wyes in the 6"x10" cleanout fabrications will be sdr 17 instead of sdr 26 since the delivery time on the sdr 26 wyes was mid to late September. After speaking with Dave Bonnet of Geosyntec, it was determined that this would be acceptable if we shave the inside of the ends of the wyes so that they match up with the wall thickness of the sdr 26 pipe that they will be fused to. This will be done. Thank you for your patience in this matter. Please call with any questions or comments.

Scott Hoff
Regional Sales Manager

INFORMATION ONLY

FERMCO SUBMITTAL DISTRIBUTION

#7799

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	GeoSyntec	38		
	1	Parsons	Bin		
	1	Rick McGuire	64		
	1	Tracy Russell	64		
	6	Village Bicks	Bin		

RECEIVED BY: James C. Jenkins

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 8/15/97

RECEIVED AUG 25 1997 1063

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS

☐ COMMENTS RECEIVED

J. C. Jenkins

REVIEW COORDINATOR

DATE: 8/15/97

000043

1268

1268
VBS-DRI-014 Rev 0

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

August 4, 1997

CUSTOMER: Irrigation Supply Co., Inc.
P.O. Box 4545
Louisville, KY 40204
Attn: Scott Hoff

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sign: [illegible] Date 8/15/97

Phillips Order No: 12705

Product	Production Dates
10"-DR 26-1000	12, 13, 14, Dec. 1996-BW14

This is to certify that the product described above and shipped on the above order from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 7161674, 7161681, and 7161656 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/MIN. The melt index on the In-process Inspection and Testing was also tested with the test results of 0.10 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes by Bud McCorkle
Leo D. Karnes,
Q.A.Supervisor

LDK/cc

cc: Certification File
Shipping

INFORMATION ONLY

RECEIVED DEC 1 0 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 04, 1996

JHV# 24038-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161674
P.O. Number:	REL 292
Date Shipped:	12/03/96
Package:	PSPX 6206
Quantity:	177800 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-1656
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 09, 1996

JHV# 24332-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161681
P.O. Number:	REL 296
Date Shipped:	12/06/96
Package:	PSPX 2231
Quantity:	176750 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

RECEIVED DEC 0 6 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501 0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 03, 1996

JHV# 23936-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161656
P.O. Number:	REL 291
Date Shipped:	12/02/96
Package:	PSPX 1024
Quantity:	178800 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

#77 R8

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J Jenkins	621	Approved	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	641		
	1	D. Rodine	38		
	1	P. Hayne	BIN		
	1	M. Godber	641		
	1	T. Russell	641		
	6	Village Blds	BIN		

RECEIVED BY: James C. Jenkins DATE: 8/15/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

Please sign & date
ORIGINAL FILE COPY
Return to CDC ms/44

FORWARD COMMENTS TO REVIEW COORDINATOR

RECEIVED AUG 25 1997 OCB

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 8/15/97

REVIEW COORDINATOR

000048

1268

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

07/30/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 ASHWORTH #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
6" IPS DR 26	04/13/97 04/12/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0367 Melt Index of 0.11 71-7-0359 Melt Index of 0.11 71-7-0346 Melt Index of 0.12 . The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 71-7-0367 Melt Index of 0.10 71-7-0359 Melt Index of 0.10 71-7-0346 Melt Index of 0.10 G/10 MIN. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

INFORMATION ONLY

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Date 8/15/97

VBS-DRI-013

PHILLIPS 66
PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

April 01, 1997

JHV# 6524-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170367
P.O. Number:	REL 67
Date Shipped:	03/31/97
Package:	PSPX 6364
Quantity:	179700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26

RECEIVED
MAR 31 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 27, 1997

JHV# 6228-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170359
P.O. Number:	REL 63
Date Shipped:	03/26/97
Package:	PSPX 5977
Quantity:	180200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6" 26

PHILLIPS 66
PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3866
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 24, 1997

JHV# 5880-97

FAX: 864-439-7918

MAR 27 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170346
P.O. Number:	REL 60
Date Shipped:	03/21/97
Package:	PSPX 6148
Quantity:	179250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26

FERMCO SUBMITTAL DISTRIBUTION

#77R7

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J. Jenkins	64	Approver	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	D. Bodine	38		
	1	P. Payne	Bin 1		
	1	T. Russell	64		
	1	M. Godber	64		
	6	Village Building	Bin		

RECEIVED BY: Jessie C. Jenkins

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 7/31/97

Please DELETE and ORIGINAL FILE COPY Return to CDC ms/44

FORWARD COMMENTS TO REVIEW COORDINATOR

CGB

☒ NO COMMENTS

☐ COMMENTS RECEIVED

J. C. Jenkins

REVIEW COORDINATOR

DATE: 7/31/97

1268

000053

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

07/17/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 ASHWORTH #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
6" IPS DR 26	04/10/97 & 04/14/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0367 Melt Index of 0.11 71-7-0359 Melt Index of 0.11 71-7-0346 Melt Index of 0.12 . The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 71-7-0367 Melt Index of 0.10 71-7-0359 Melt Index of 0.10 71-7-0346 Melt Index of 0.10 G/10 MIN. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

INFORMATION ONLY

Services Supervisor

cc: Certification File

VBS-DRI-010

Date 7/31/97

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

April 01, 1997

JHV# 6524-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170367
P.O. Number:	REL 67
Date Shipped:	03/31/97
Package:	PSPX 6364
Quantity:	179700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26

1268

RECEIVED
MAR 31 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 27, 1997

JHV# 6228-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170359
P.O. Number:	REL 63
Date Shipped:	03/26/97
Package:	PSPX 5977
Quantity:	180200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6" 26

✓2

TOTAL P.05

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 24, 1997

JHV# 5880-97

FAX: 864-439-7918

MAR 27 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170346
P.O. Number:	REL 60
Date Shipped:	03/21/97
Package:	PSPX 6148
Quantity:	179250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 24

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2850 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

07/10/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
6" IPS DR 26	04/08/97 04/11/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0367 Melt Index of 0.11 71-7-0359 Melt Index of 0.11 71-7-0346 Melt Index of 0.12. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 71-7-0367 Melt Index of 0.10 71-7-0359 Melt Index of 0.10 71-7-0346 Melt Index of 0.10 G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

April 01, 1997

JHV# 6524-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170367
P.O. Number:	REL 67
Date Shipped:	03/31/97
Package:	PSPX 6364
Quantity:	179700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6-26

RECEIVED
MAR 31 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 27, 1997

JHV# 6228-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170359
P.O. Number:	REL 63
Date Shipped:	03/26/97
Package:	PSPX 5977
Quantity:	180200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6" 26

✓2

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 24, 1997

JHV# 5880-97

FAX: 864-439-7918

MAR 27 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170346
P.O. Number:	REL 60
Date Shipped:	03/21/97
Package:	PSPX 6148
Quantity:	179250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 24

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

July 9, 1997

TO: ISCO Industries
3766 Ashworth Drive No.3
Cincinnati, OH 45208
Attn: Scott Hoff

Product	Production Date
10" DR-26 1000	03/22/97 & 03/23/97

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 7170184 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test results of 0.10 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk
cc: Certification File

WP/Meltindx

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS PRODUCTS
Houston Chemical Complex

February 26, 1997

JHV# 3981-97

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170184
P.O. Number:	REL 51
Date Shipped:	02/25/97
Package:	DSPX 9061
Quantity:	180100 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

tested at

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

07/10/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
10" IPS DR 26	06/18/97 06/19/97 03/20/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 81-7-0199 Melt Index of 0.11 71-7-0526 Melt Index of 0.10 81-7-0582 Melt Index of 0.10. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 81-7-0199 Melt Index of 0.08 71-7-0526 Melt Index of 0.07 81-7-0582 Melt Index of 0.0910 G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED MAR 6 1997

March 03, 1997

JHV# 4273-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8170199
P.O. Number:	REL 45
Date Shipped:	02/28/97
Package:	ACFX 99740
Quantity:	166900 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

10" 26

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3600
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED MAY 23 1997

May 20, 1997

JHV# 10044-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

#8 6-11-97

Type:	HHM TR-480Z
Lot Number:	7170526
P.O. Number:	REL 111
Date Shipped:	05/19/97
Package:	PSPX 3071
Quantity:	193950 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

10 26

cc: QA-File-RC

MAY 0 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3665
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

May 26, 1997

JHV# 10380-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8170582
P.O. Number:	REL 115
Date Shipped:	05/23/97
Package:	PSPX 8156
Quantity:	190400 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

10" 26

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

7/24/97

To: ISCO INDUSTRIES
Scott Hoff
3766 Ashworth #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
10" IPS DR 26	3/19/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 81-7-0199 Melt Index of 0.11. The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.08 G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

TOTAL P.01

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED
MAR 6 1997

March 03, 1997

JHV# 4273-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8170199
P.O. Number:	REL 45
Date Shipped:	02/28/97
Package:	ACFX 99740
Quantity:	166900 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS ** 3/20/97

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

10" Mar 19

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1080, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6661

July 23, 1997

TO: ISCO Industries
3766 Ashworth Drive No.3
Cincinnati, OH 45208
Attn: Scott Hoff

Product	Production Date
10" DR-26 6400	09/25/95

This is to certify that the product described and shipped on the above order from the brownwood plant, has been sampled according to statistical sampling plans in compliance with the "recommended in-plant quality control program for plastic pipe, tubing and fittings intended for use in natural gas distribution systems" as definded in appendix A.4 of ASTM Specification D2513 and/or D2683 or D3261. The product meets the applicable requirements for pipe, tubing and/or fittings made from pe3408 resin. This product was produced from resin lot 6150855 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Melt6400

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3656
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 13, 1995

JHV# 13393-95

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6150855
P.O. Number:	REL 162
Date Shipped:	09/12/95
Package:	PSPX 6407
Quantity:	177400 LBS.
Melt Index:	.11 G/10 MIN
Density:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

Ms. Ruby Baker
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
3800 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3065

07/30/97

TO: ISCO INDUSTRIES
Scott Hoff
3766 ASHWORTH #3
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
6" IPS DR 26	04/13/97 04/12/97

This is to certify that the product described above and shipped from the Startex, South Carolina Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-7-0367 Melt Index of 0.11 71-7-0359 Melt Index of 0.11 71-7-0346 Melt Index of 0.12 . The MI specification range from this resin is 0.07-0.14 G.10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 71-7-0367 Melt Index of 0.10 71-7-0359 Melt Index of 0.10 71-7-0346 Melt Index of 0.10 G/10 MIN. G/10 MIN. The specification for this test is a maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Services Supervisor

cc: Certification File

PART OF VBS-DRI-010

INFORMATION ONLY

X A - For CPC submittals only - Conforms w/Requests.
] B - Minor Comment - Resubmit as-CPC/INP/REC
] C - Revise and Resubmit
] D - Accepted for INP/REC - Conforms w/Requests.

SIGN-DATE:

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3066
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

April 01, 1997

JHVS 6524-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7170367
P.O. Number:	REL 67
Date Shipped:	03/31/97
Package:	PSPX 6364
Quantity:	179700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vadan
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 26

TOTAL P.05

RECEIVED
MAR 31 1997

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3600
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Company

March 27, 1997

JHV# 6228-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HDM TR-480E
Lot Number:	7170359
P.O. Number:	REL 63
Date Shipped:	03/26/97
Package:	PSPX 5977
Quantity:	180200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6-26

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 768 • PHONE 713 475-3000
PASADENA TEXAS 77501-0768

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 24, 1997

JHV# 5880-97

FAX: 864-439-7918

MAR 27 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	MHM TR-480Z
Lot Number:	7170346
P.O. Number:	REL 60
Date Shipped:	03/21/97
Package:	PSPX 6148
Quantity:	179250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

6 24

VBS-DRI-011

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

This letter is to certify that the 4" x 8" dual contained fittings which do not have letters of certification from Phillips have been fabricated by ISCO Industries, Inc. in accordance with the following requirements:

ASTM D1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Material

ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials

ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene Plastic Fitting for Polyethylene Plastic Piping and Tubing

The pipe used to fabricate the dual contained fittings in question has been manufactured in accordance with all specifications; however, we are not able to provide run dates and resin certification due to the fragmented print line on these fittings. Phillips does not allow any pipe to leave their plants unless it meets all quality tests outlined in previous submittals. Thank you.

INFORMATION ONLY

Scott Hoff
Regional Sales Manager

PRIME
PLASTICS

prime plastics incorporated • 3782 gulf stream drive • norton, ohio 44203 • (216) 825-8481 • fax (216) 825-3366

July 9, 1997

ISCO INDUSTRIES, INC.
P.O. Box 4545
Louisville, KY 40204

ATTENTION: Scott (FAX NO. 513-871-9514)

We certify that the 5/32" x 40# REELS HDPE 3407B PRIMEWELD ARE manufactured from PINA High Density Polyethylene 3407B.

PRIME PLASTICS, INC.

Robert L. Miller
President

mn

INFORMATION ONLY

VBS-DRI-012

FINA® High Density Polyethylene

3407B
BLACK

Basin Properties[1]	Typical Value	ASTM Method
Melt Flow Index, g/10 min		D 1238
190° C, 5 kg	0.38	
190° C, 21.6 kg (HLMI)	11.0	
Density, g/cm³	0.957	D 792
Melting Point, °F	258	D 3417
Carbon Black Content, %	2.5	D 1603
Mechanical Properties[1]		
Notched Izod Impact Strength, ft lb/in notched	8	D 256, A 1/8 in thick specimen
Tensile Strength at Yield, psi	>3,300	D 638, Type IV specimen, 2 in/min
Elongation at Break, %	>800	D 638, Type IV specimen, 2 in/min
Secant Modulus of Elasticity, psi @ 2% strain	115,000	D 638, Type IV specimen, 2 in/min
Flexural Modulus @ 2% Strain, psi	125,000	D 790
Rockwell Hardness, L Scale	49	D 785
Shore Hardness, D Scale	63	D 2240
ESCR[3], hrs	>6,000, no failures	D 1693, cond. C
Thermal Properties[1,2]		
Vicat Softening Temperature, °F	255	D 1525
Brittleness Temperature, °F	-180	D 746
Heat Distortion Temperature, °F	172	D 648
Thermal Expansion, in/in/°F	1x10⁻⁴	D 696
Pipe Properties		
Hydrostatic Design Basis, psi	1,600	D 2837, 100,000 hrs 73° (23°C)
Compressed Ring ESCR[3], hrs 50°C/25% Igepal	>1,000, no failures	F 1248
Classification Type/Class/Cat./Grade	III/C/5/P34	D 1248
Cell Classification	345434C	D 3350
PPI Recommended Designation	PE 3408[4]	

(1) Data developed under laboratory conditions and are not to be used as specifications, maxima or minima.
(2) This data was developed on press molded test specimens and may, therefore, vary from specimens taken from pipes.
(3) Environmental Stress Crack Resistance (ESCR)
(4) Previously listed as Hostalen® GM 5010 T2

HIGH MOLECULAR WEIGHT HDPE PIPE GRADE

Characteristics
- Outstanding high temperature creep rupture strength
- Excellent compressed ring ESCR
- Field performance history since 1987[4]
- NSF approved[4] for potable water

Applications
- Industrial and mining
- Gas distribution
- Potable water
- Sewer and sewer relining
- Gas and oil gathering
- Fiberoptic innerduct
- General pipe relining

FINA
FINA OIL AND CHEMICAL COMPANY
1-800-344-FINA
8350 North Central Expressway
P.O. Box 2159
Dallas, TX 75221
Phone: 214-750-2400
Fax: 214-750-2392

Rev. 93/94

All tests were run under laboratory conditions. ASTM [illegible] being presented. The data are offered as a general guide only and do not necessarily represent results that may be obtained elsewhere. The use of FINA products must be guided by the user's own research and judgment. Fina Oil and Chemical Company disclaims any responsibility for results or consequences of its products. FINA MAKES NO WARRANTY OF MERCHANTABILITY AND THERE IS NO WARRANTY THAT GOODS SUPPLIED SHALL BE FIT FOR ANY PARTICULAR PURPOSE. [illegible]

77R6

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	[redacted]	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	GeoSynter	38		
	1	Parsons	Bin		
	1	Rick McGuire	64		
	1	mike Godber	64		
	1	Tracy Russell	64		
	6	Village Elders	Bin		

RECEIVED BY: Jeff Ellis

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 6/26/97

RECEIVED JUN 30 1997

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED

Jeff Ellis for JCJ

REVIEW COORDINATOR

DATE: 6/26/97

FILE COPY

1268

000079

1268

VBS-DRI-009 R/O

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 06, 1997

JHV# 258-97

FAX: 864-439-7918

RECEIVED [redacted] -8 1997

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

|X| A - Conforms to the Subcontract Requirements
| | B - Minor Comment - Incorporate and Resubmit
| | C - Revise and Resubmit
By [signature] Date: 6/26/97

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6161550
P.O. Number:	REL 2
Date Shipped:	01/03/97
Package:	PSPX 2311
Quantity:	171250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

INFORMATION ONLY

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

TOTAL P.02

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

June 18, 1997

TO: Scott Hoff
3766 Ashworth Drive No.3
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	01/28/96 & 10/31/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 6151379 and 7161455 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test results of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltindx

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 709 • SUITE 713 475-3866
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 16, 1996

JHV# 927-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6151379
P.O. Number:	REL 7
Date Shipped:	01/15/96
Package:	PSPX 6789
Quantity:	174300 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

Entered

Shanta Ludwick
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

OCT 2 1 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 18, 1996

JHV# 21059-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161455
P.O. Number:	REL 248
Date Shipped:	10/17/96
Package:	PSPX 5987
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

✓

June 18, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, Ohio 45216

Dear Mayur:

This letter is to inform you that the 4" carrier tee in the transition tee welded by MDM is a Phillips Driscopipe molded 4" tee with an SDR rating of 17. SDR 17 is the thinnest wall that the 4" molded tee is manufactured with, therefore, you can be sure that this fitting meets or exceeds all specifications for this project. Please contact me at (513)871-9512 with any additional questions, thank you.

Sincerely,

Scott Hoff
Regional Sales Manager

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204
P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

CENTRAL PLASTICS COMPANY
P.O. BOX 3129 SHAWNEE, OK USA 74802-3129

June 19, 1997

Scott Hoff
Irrigation Supply Co.

Dear Mr. Hoff:

I am responding to your questions regarding Central's PE 3408 (high density polyethylene) electrofusion couplings. In particular your questions were for the 4"IPS and 8"IPS electrofusion couplings.

The 4"IPS and 8"IPS electrofusion couplings have been fully tested in accordance with ASTM F1055 "Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing." Since these fittings have been tested and successfully passed the criteria under ASTM F1055, they should meet or exceed your specifications for electrofusion fittings.

If I can be of further assistance, please feel free to contact me.

Best Regards,

Clay Hamilton
Engineering Manager
Technical Services

Designers & Manufacturers

1901 W. Independence Shawnee, OK 74801 PHONE: (405) 273-6302 FAX: (405) 878-4904

FERMCO SUBMITTAL DISTRIBUTION #77 R5

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	GeoSyntec (Boeline)	60		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	60		
	1	M. Godber	60		
	1	T. Russell	60		
	1	J. Jenkins	60	Approver	
	10	Village Blds	BJD		

RECEIVED BY: James C. Jenkins DATE: 6/19/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

RECEIVED JUN 24 1997 DKB

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 6/19/97

REVIEW COORDINATOR

1268

000086

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2990 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3086

June 11 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

INFORMATION ONLY

PRODUCT		PRODUCTION DATE
4" DR 17	1000	01/20/97 01/21/97 01/22/97 01/23/97 01/24/97

This is to certify that the product described above and shipped from the Startex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1673 Melt Index of 0.11 G/10 MIN. 71-6-1669 Melt Index 0.11 G/10 MIN. 71-6-1672 Melt Index 0.11 G/10 MIN. 71-6-1636 Melt Index 0.10 G/10 MIN. 71-6-1662 Melt Index 0.08 G/10 and 71-6-1661 with the Melt Index of 0.08 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.08 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q.A. Supervisor

cc: Certification File

Date 6/19/97

VBS-DRI-008

477 e5

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 30, 1996

JHV# 19657-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161338
P.O. Number:	REL 210
Date Shipped:	09/27/96
Package:	PSPX 6545
Quantity:	177200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268

SEP 27 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 25, 1996

JHV# 19306-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161332
P.O. Number:	REL 207
Date Shipped:	09/24/96
Package:	PSPX 2396
Quantity:	177700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3600
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED
SEP 1996

September 26, 1996

JHV# 19441-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161333
P.O. Number:	REL 208
Date Shipped:	09/25/96
Package:	PSPX 5907
Quantity:	177750 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268

RECEIVED

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 01, 1996

JHV# 19784-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161349
P.O. Number:	REL 213
Date Shipped:	09/30/96
Package:	PSPX 6707
Quantity:	176250 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

May 30, 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
8" DR 26 1000	10/19/96

This is to certify that the product described above and shipped from the Startex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1349 Melt Index of 0.11 G/10 MIN., 71-6-1333Melt Index of 0.12 G/10 MIN 71-6-1332 Melt Index of 0.11 G/10 MIN. and 71-6-1338 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q. A. Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3698
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 04, 1996

JHV# 24039-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161661
P.O. Number:	REL 264
Date Shipped:	12/03/96
Package:	PSPX 5865
Quantity:	178100 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792
PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 05, 1996

JHV# 24135-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161662
P.O. Number:	REL 265
Date Shipped:	12/04/96
Package:	PSPX 2456
Quantity:	177630 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

November 22, 1996

JHV# 23486-96

FAX: 864-439-7918

RECEIVED NOV 25 1996

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161636
P.O. Number:	REL 255
Date Shipped:	11/21/96
Package:	PSPX 7007
Quantity:	~~177400 LBS.~~
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

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DEC 12 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 09, 1996

JHV# 24335-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161672
P.O. Number:	REL 267
Date Shipped:	12/06/96
Package:	PSPX 5708
Quantity:	175850 LBS
Melt Index, ASTM D1238:	.21 G/10 MIN
Density, ASTM D1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268

DEC 12 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 09, 1996

JHV# 24336-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161669
P.O. Number:	REL 268
Date Shipped:	12/06/96
Package:	PSPX 5983
Quantity:	176800 LBS
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 10, 1996

JHV# 24454-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161673
P.O. Number:	REL 270
Date Shipped:	12/09/96
Package:	PSPX 2511
Quantity:	179950 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

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		Rick McGuire			
		Parsons			
		Geosyntec			
		Mike Godber			
		Tracy Russell			

RECEIVED BY: James C Jenkins DATE: 5/9/97

(SIGN / DATE AND RETURN A COPY TO CDC, M344)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE 5/9/97

REVIEW COORDINATOR

1268

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1268

1 of 2

X A - For CPC submittals only - Conforms w/Reqmts.
] B - Minor Comment - Resubmit as-CPC/INP/REC
] C - Revise and Resubmit
] D - Accepted for INP/REC - Conforms w/Reqmts.
GN-DATE: 5/9/97

Monday, April 28, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, OH 45216

Dear Mayur:

This letter is in response to two particular situations regarding the HDPE Dual Containment pipe that we have supplied for the **Leachate Conveyance System** at Fernald, OH.

The first area of change was in regards to the spacer intervals. The spacers were provided at 4' 6" intervals which were in accordance with the Manufacturers recommended spacing for supported pipe lines (see chart on page 32 of the Phillips Driscopipe's Systems Design Manual).

The second area of change is in regards to the 6" stub of the carrier pipe from the containment pipe. This was omitted due to the fact during installation the carrier pipe slides in the containment, therefore if they were not the same length there would be a pipe length discrepancy between the carrier and containment.

I ask that these changes be review and accepted. Should you have any further questions or concerns please contact me at (502) 583-6591.

Sincerely,

Chris Gilmore
Regional Sales Manager

CC: Scott Hoff

FOR INFORMATION ONLY

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204
P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

POLYETHYLENE PIPE AND FITTING
HDPE FABRICATION
CULVERT LINERS
GOLF COURSE IRRIGATION SUPPLIES

DRISCOPIPE

STEP FIVE: INSTALLATION DESIGN

Driscopipe has been installed in many applications above and below ground crossing land, lakes, deserts, bogs and arctic tundra. Each installation requires thorough consideration of the effect of the environment on the pipe. Previous Design Steps analyzed pipeline stresses developed by internal flow and pressure. This design section discusses the stresses imposed on a pipeline by external forces.

Most typical pipe installations can be categorized as one of seven types. The following pages discuss design details for each type of installation.

TYPE 1: Supported Pipelines
TYPE 2: Overland Pipelines
TYPE 3: Buried Pipelines
TYPE 4: Marine Pipelines
TYPE 5: Water Surface Pipelines
TYPE 6: Marsh Pipelines
TYPE 7: Slipline Pipelines

Driscopipe recommends reading the *Systems Installation* brochure for additional information regarding installation practices for each type of pipeline.

Type 1: Supported Pipelines

Introduction: The forces which affect the installation of a horizontally supported pipeline are those developed by the weight of the pipe and its contents between supports. An examination of this type of installation shows that if the sag or deflection between supports is minimized, then the degree of stress and strain within the pipe wall is controlled within safe limits. The design basis for supported or suspended horizontal pipelines is based upon support-spacing which minimizes the mid-span deflection to ¼" using a simple, continuous beam analysis. A side benefit of using maximum deflection as a design criteria is that the relevant support spacing allows the user to control thermal expansion and contraction. It is important that the suspended pipeline be installed at or near its operation temperature (or in the hottest weather) such that the pipeline is thermally expanded. At that point, the clamps and supports can be bolted into position restraining the pipe from further movement. The tendency of Driscopipe to stress-relieve itself will counteract any stresses developed within the pipe as seasonal temperatures become cooler. As a seasonally cool pipe begins to warm, it merely expands to near its original length at installation. In this way, thermal expansion is controlled, sag is minimized and adequate support is provided.

Pipe Support Spacing: Charts 19 through 23 give the design support spacing for various SDRs and pipe diameters. The distance between supports is based upon a continuous beam analysis and a mid-span deflection of ¼" when the pipe is totally full of water

Chart 19

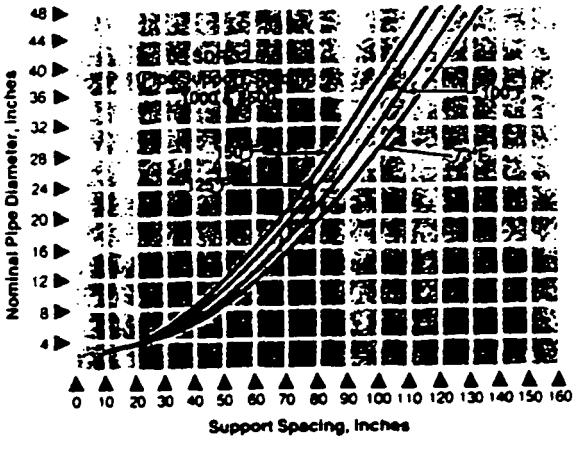


Chart 20

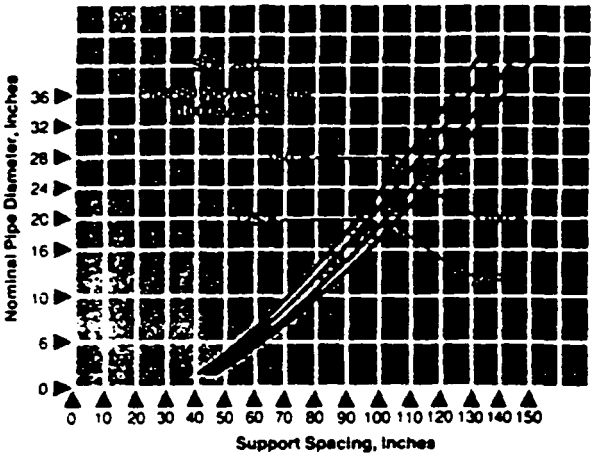
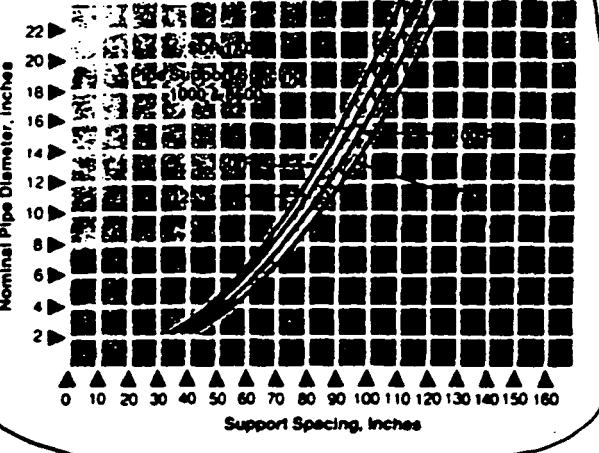


Chart 21



- 1268
VBS-DRI-003 R/2
P 1 of 1

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2929 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 83-3666
RICHARDSON, TEXAS 75083 • 214/783-2666

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] D - Accepted for INP/REC - Conforms w/Requms.
SIGN-DATE: 5/9/97

April 28, 1997

Village Building Services

Subject: 6400 series vs. 1000 series

Dear Mayur Kadakia:

Our 1000 series and 6400 series products are manufactured from the same feedstock and carry the same PPI and ASTM material designation of PE 3408 They have the same cell classification of PE345434C (defined by ASTM D3350) Other similarities include:

Property	Test Method	1000 series	6400 series
Density	ASTM D-1505	0.955	0.955
Melt Index	ASTM D-1238	0.11	0.11
Flex Modus	ASTM D-790	135,000	135,000
Tensile Strength	ASTM D-638	3200	3200
ESCR	ASTM D-1693	>5000	>5000
HDB @ 73 deg F	ASTM D-2837	1600	1600
Hardness	ASTM D-2240	65	65
Modulus of Elasticity	ASTM D-638	130,000	130,000

The only difference between 1000 series and 6400 series is the test method used to certify the pipe. 1000 series is made in accordance with ASTM F714 which allows for a +/- 0.057" O.D variance. 6400 series is made in accordance with ASTM D-2513 which allows for a +/- 0.050" O.D variance.

If you have any further questions please do not hesitate to call me at (317) 844-6949
Thank you for specifying Phillips Driscopipe.

Sincerely:

Blair Nicol
Regional Sales Manager
Phillips Driscopipe

FOR INFORMATION ONLY

000102

1. **Document Control**

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under *o:\manual\prodspec* for viewing and printing.

1.2.1. **Brownwood Plant**
1.2.2. **Hagerstown Plant**
1.2.3. **Pryor Plant**
1.2.4. **Startex Plant**
1.2.5. **Watsonville Plant**
1.2.6. **Williamstown Plant**

FOR INFORMATION ONLY

2. **Scope**

2.1. Driscopipe 6400 is used primarily in gas gathering pressure rated systems. The pipe is produced to meet the requirements of ASTM D2513 and API 15LE. This section covers the materials and inspection procedures to be followed when producing Driscopipe 6400.

3. **Reference Documents**

3.1. ASTM D2513 Standard specification for Thermoplastic Gas Pressure Piping Systems.

3.2. API 15LE American Petroleum Institute Specification for Polyethylene Line Pipe (PE).

4. **Materials**

4.1. The resins to be used for the extrusion of Driscopipe 6400 shall be as follows:

TR - 480 compound
TR - 480 natural with M5252a concentrate
TR - 480 natural (H480Z H420) with M362 concentrate
Hoescht or Fina GM 5010T2
Novacor HD 2007H natural with DX1637 concentrate

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. The mixing of regrind types is not permissible.

4.3. No regrind shall be used in sizes smaller than 2" IPS.

4.4. Other resins or blends may be used with documented authorization of Corporate Quality.

5. **In-Process Inspection and Testing**

All tests are performed in accordance with the Driscopipe Test Methods Manual unless otherwise noted.

5.1. Melt Flow

5.1.1. Frequency

Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change. Where regrind is used the melt flow shall be run on the regrind feed once every 24 hours.

5.1.2. Specifications
The melt flow must not exceed a melt index of .18. The melt flow of the finished product also must not vary by more than 100% from the base resin melt flow

5.1.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

5.2. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Out-of-Round, Ovality, and Toe-In.

5.3. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for outside diameter, wall thickness and eccentricity once per hour or once every coil/joint, whichever is less frequent. Test for out of round, toe-in and ovality three times per 24 hours.

5.4. Conditioned Outside Diameter Specifications

5.4.1. Conditioned Out-of-Round Specifications

5.4.1.1. Pipe Units (IPS sizes)
- The specifications for IPS sizes are shown in ASTM D2513 Tables 1 and 2. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

5.4.1.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

5.4.1.3. For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

5.5. Conditioned Wall Thickness Specifications

5.5.1. Pipe Units (IPS sizes)
The minimum and maximum wall thickness are shown in ASTM D2513 Tables 2 and 3.1.

5.5.2. ISO Units (mm sizes)
The minimum wall thickness specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7. The maximum wall thickness shall be 112% of the minimum wall thickness.

5.5.3. Special Sizes
For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ration (may also be called SDR)

The maximum wall thickness shall be set as 112% of the minimum wall thickness.

5.6. Conditioned Eccentricity Specification
Eccentricity must not exceed 12% (ASTM D2513 section 5.3.1.4).

5.7. Conditioned Ovality Specification
Ovality must not exceed 5%. Best Practices recommend that the ovality be limited to 3%.

5.8. Conditioned Toe-In Specifications
Toe-in must not exceed 1.5% (ASTM D2513 section 5.3.1.2).

5.9. Failure Requirements

5.9.1. Joints
Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

5.9.2. Coils
Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

6. Joint Length

6.1. Frequency

6.1.1. Joint length is measured once per day on each extrusion outlet.

6.1.2. Test findings should be referenced in the remarks column.

6.2. Specifications
Joint length must be no less than the specified joint length.

6.3. Failure Requirements
If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

7. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller, the Quick Burst test method must be used. For all sizes, the ring tensile test must be performed.

7.1. Frequency
The hoop strength shall be tested on startup and after a major process interruption.

7.2. After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every eight hours, or once every joint/coil, whichever is less frequent.

7.3. ASTM D2513 section A4.2.3 describes an alternate testing frequency that may be used in place of the once per 24-hour testing frequency. If this test frequency is used, the QC record must document justification for the multilevel sampling.

7.4. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi

S = hoop stress in psi

DR = dimension ratio (also called SDR)

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

7.5. Ring Tensile Testing Specifications

7.5.1. The ring tensile test specimens must exceed a ring stress of 2520 psi.

7.5.2. Best Practices note that the ring stress failure level is reduced if the specimen preparation is poor. Therefore, Best Practices recommend that care be taken to have a very smooth surface at the reduced test sites on the specimen.

7.6. Failure Requirements

7.6.1. At start up and after a major process interruption the product that is produced prior to a passing specimen shall be directed to regrind.

7.6.2. If a failure occurs on the once per eight hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production

back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

8. **Reverse Bend Test**

8.1. Frequency

The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

8.2. Reverse Bend Specifications

The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

8.3. Failure Requirements

All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

9. **Workmanship and Appearance**

9.1. Frequency

The workmanship and appearance shall be inspected once every 24 hours.

9.2. Specifications

9.2.1. Where present, the depth of die lines must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter surface or .002 inch if it is on the outside diameter surface.

9.2.2. There shall be no blisters or gels.

9.2.3. If present, dents must be no larger in diameter the wall thickness of the pipe. The dents also must not be deeper than 5% of the wall thickness and not result in violation of the pipe minimum wall thickness.

9.2.4. There shall be no voids visible to the unaided eye.

9.2.5. Best Practices note that appearance and workmanship are the most visible representations of the quality of our products. Best Practices recommend that any unusual appearance be corrected or rejected.

9.3. Failure Requirements

All product that is rejected shall be directed to regrind.

10. **Print Requirements**

10.1. Frequency

The print string shall be visually inspected at startup and once every 12 hours thereafter.

10.2. Specifications

10.2.1. Type

Print shall be either offset print or hot foil type. If hot foil print is used, indicate depth of print with wall thickness at printline in the remarks column at above stated frequencies.

10.2.2. Color

The print string for Driscopipe 6400 shall be white. Where offset print is used, Best Practices recommend Matthews type 615 White I-0002-920-65.

10.2.3. Size

All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 5/32" high. Best Practices recommend that the print be 5/16" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8". Best Practices recommend Matthews style 4S print.

10.2.4. Print String

Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet. Best Practices recommend a print string interval of two feet. A printline example for Driscopipe 6400 is shown on page 7A.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: SDR 11 or DR 17
Product - Example: Driscopipe 6400
Material Class -For Driscopipe 6400 it is PE3408 CDC
ASTM Basis - ASTM D2513
Special Logos -

For Driscopipe 6400, the print line should include the API monogram followed by "15LE" and the plant API license number.

The API license number is
0005 for Brownwood
0005.1 for Pryor
0005.2 for Startex
0005.3 for Watsonville (license renewal discontinued in 1995)
0005.4 for Williamstown (license renewal discontinued in 1995)

Plant Identification -
BW for Brownwood
P for Pryor
ST for Startex
WA for Watsonville
WT for Williamstown
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - H for Hoescht or Fina,

N for Novacor
P for Phillips Singapore
S for Solvay

10.3. Failure Requirements
Product that fails the print specifications must be corrected prior to shipment.

11. **Carbon Black Content**

11.1. Frequency

11.1.1. This test is required for all blended production of natural resin and concentrate.

11.1.2. The blend percentage for each extrusion line shall be tested two times during a 24-hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line.

11.2. Specifications
The requirement for carbon black percentage is 2.0% to 3.5%.

11.3. Failure Requirements
If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Pipe Printline • Example •

6400 series Pipe DR

Example: 6" DR-11 Driscopipe® 6400 series Pipe made at Brownwood, TX.

6" IPS	DR 11	Driscopipe 6400	PE3408 CDC	ASTM D2513	Gas	AF	15LE	0005.0	BW 6	02 May 94	12A	P
Iron Pipe Size	Dimension Ratio or Schedule #	Mfr. Name and Prod. Series	Material Class	Classification Basis	Denotes End Use Application "Gas Gathering"	American Petroleum Institute Logo	API Specification	Individual Plant API License #	Plant Code & Extruder #	Prod. Date	Oper. # and Shift Code	Resin Code

VBS-PR7-005 K 2
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P 1 of 8

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2820 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 83-0888
RICHARDSON, TEXAS 75083 • 214/783-2000

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[ ] C - Revise and Resubmit
[ ] D - Accepted for INF/REC - Conforms w/Reqmts.
SIGN-DATE: C Jackson 5/9/97

May 5, 1997

Mayur Kadakia
Village Building Services

Subject: Resin Certification Letters

Dear Mr. Kadakia:

The copy of the resin certification, which accompanies the pipe certification letter does not have a signature because it is primarily for internal usage. The resin certification accompanies each rail car of resin shipped by our resin supplier at HCC (Houston Chemical Complex).

HCC, like Driscopipe, is a division of Phillips Petroleum Company. Therefore this internal certification does not require a signature. Driscopipe keeps these certifications on file and makes them available to customers as required.

If you have any questions or require further information please contact me at (317) 844-6949. Thank you for specifying Phillips Driscopipe.

Sincerely,

Blair Nicol
Regional Sales Manager
Phillips Driscopipe

CC: S.Hoff

FOR INFORMATION
ONLY

VBS-DRI-005 R/2

2 of 7

mc

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3866
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 16, 1996

JHV# 927-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6151379
P.O. Number:	REL 7
Date Shipped:	01/15/96
Package:	PSPX 6789
Quantity:	174300 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

Shanta Ludwick
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

1268

VBS.DRI.005 R/2

3 of 8

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3886
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

February 27, 1996

JHV# 3868-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7160189
P.O. Number:	REL 44
Date Shipped:	02/26/96
Package:	PSPX 6322
Quantity:	179850 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI-005 R/2 4 of 8

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PHILLIPS 66

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 18, 1996

JHV# 21059-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161455
P.O. Number:	REL 248
Date Shipped:	10/17/96
Package:	PSPX 5987
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI:005 5 of 8 C/2 1268

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PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 22, 1996

JHV# 21216-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161463
P.O. Number:	REL 252
Date Shipped:	10/21/96
Package:	PSPX 2053
Quantity:	176450 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI-005 e/2 1268 of 8

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21659-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161476
P.O. Number:	REL 258
Date Shipped:	10/28/96
Package:	PSPX 1142
Quantity:	177100 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI-005 R/2

1268

7 of 8

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21660-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161480
P.O. Number:	REL 259
Date Shipped:	10/28/96
Package:	ACFX 99558
Quantity:	175000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 479-3000
PASADENA, TEXAS 77501-0797

PHILLIPS PLASTICS RESINS
Houston Chemical Company

August 09, 1996

JHV# 16140-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8160941
P.O. Number:	REL 184
Date Shipped:	08/08/96
Package:	PSPX 9009
Quantity:	176400 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268 VBS-DRI-0061
1 of 4

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

X A - For CPC submittals only - Conforms w/Reqmts.
] B - Minor Comment - Resubmit as-CPC/INF/REC
] C - Revise and Resubmit
] D - Accepted for INF/REC - Conforms w/Reqmts.
SIGN-DATE: C. Gilmore 5/9/97

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
4" DR-17 1000	08/22/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 8160941 with the Melt Index of 0.12 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes
Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

FOR INFORMATION ONLY

WP/Meltind2

0001

1268
VBS DRI-006 R/2 2 of 4

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	01/28/96
8" DR-26 1000	10/31/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 7161455 and 6151379 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 6400	11/09/96 & 11/10/96

This is to certify that the product described and shipped on the above order from the brownwood plant, has been sampled according to statistical sampling plans in compliance with the "recommended in-plant quality control program for plastic pipe, tubing and fittings intended for use in natural gas distribution systems" as definded in appendix A.4 of ASTM Specification D2513 and/or D2683 or D3261. The product meets the applicable requirements for pipe, tubing and/or fittings made from pe3408 resin. This product was produced from resin lots 7161463,7161480 and 7161476 with the Melt Index of 0.12 G/10 MIN., 0.11 G/10 MIN. and 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN., 0.09 G/10 MIN. and 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

VBS-DRI-006 R/a 1268 4 of 4

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	03/26/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 7160189 with the Melt Index of 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltindx

1268
VBS-DRI-007 R.0
P1 of 10

ISCO

REGIONAL OFFICE
3110 LINWOOD AVE.
CINCINNATI, OHIO 45208
800-546-4726
513-871-9512
FAX 513 871-9614

X A - For CPC submittals only - Conforms w/Reqmts.
] B - Minor Comment - Resubmit as-CPC/INP/REC
] C - Revise and Resubmit
] D - Accepted for INP/REC - Conforms w/Reqmts.
SIGN-DATE C. Jenkins 5/9/97

Monday, April 14, 1997

Howard Milliron
Village Building Services Inc.
7311 Vine Street
Cincinnati OH 45216

Dear Howard:

This letter is in regards to several questions you have regarding the LCS Project at Fernald.

First, the Phillips Quality Assurance Plan and the resin quality assurance letter that was submitted was for the 4100 Series which should have been for the 1000 Series. The 4100 Series meets all the characteristics of the 1000 Series (PE 345434C according to ASTM D3350). The 1000 Series Quality Assurance Plan and resin quality assurance letter will be sent over as soon as I receive it.

Second, Phillips Driscopipe plants are ISO 9000 certified and that is why the Quality Assurance Plan has an expiration date of when it is printed. This is a control document that must be updated as changes are made to it.

Lastly, in regards to the pipe that is shipping, we certify that it was made to all specifications required by the specification identified under Section 02805 - 1.04 B1,B2,& B3 and C2 of the LCS project.

It is worth noting that Phillips Driscopipe manufactures the resin it uses in the production of the pipe.

Sincerely,

Chris Gilmore
Regional Sales Manager

POLYETHYLENE PIPE
FITTINGS & FABRICATIONS

GEOTEXTILE FABRICS

UTILITY & INDUSTRIAL

IRRIGATION SUPPLIES

FOR INFORMATION
ONLY

- 1268

P. 2 of 10

VBS DRI-007 R/O

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2929 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 00-0000
RICHARDSON, TEXAS 75083 • 214/783-2000

March 30, 1997

Chris Gilmore
ISCO Industries
3110 Linwood Ave.
Cincinnati, OH 45208

Post-it® Fax Note 7671	Date	# of pages ▶ 9
To Chris Gilmore	From P. Lauzon	
Co./Dept. ISCO	Co.	
Phone # 513-871-9574	Phone #	
Fax #	Fax #	

RE: Driscopipe 1000 Series Pipe

Dear Mr. Gilmore

This letter is being written at your request concerning Driscopipe 1000 series pipe. Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin and does not include any post-consumer-reclaim resin. The resin has a cell class of PE 345434C according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and also 35°C/1300 psi based on TR/3 as derived from ASTM D-2487 test methodology.

Sincerely,

Peter A. Lauzon
Quality Assurance Engineer

PAL:sl

Quality	Driscopipe 1000	Phillips Driscopipe A Division of Phillips Petroleum Company
Assurance		Date of Issue: June 01, 1994
Manual	Page 1 of 8	Revision Date: January 9, 1997

1. **Document Control**

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under *o:\manual\prodspec* for viewing and printing.

1.2.1. Brownwood Plant
1.2.2. Hagerstown Plant
1.2.3. Pryor Plant
1.2.4. Startex Plant
1.2.5. Watsonville Plant
1.2.6. Williamstown Plant

2. **Scope**

2.1. Driscopipe 1000 is a general purpose pipe series used either in gravity flow or pressure rated applications. The piping systems are manufactured to the requirements of ASTM F714 for sizes larger than 3" IPS (90 mm). Smaller sizes are manufactured to the requirements of ASTM D3035. This section covers the materials to be used and the quality assurance procedures to be followed when producing Driscopipe 1000 pipe.

3. **Reference Documents**

3.1. ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

3.2. ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

4. **Materials**

4.1.1. The resin to be used for the extrusion of Driscopipe 1000 is :
4.1.1.1. TR-480 compound
4.1.1.2. TR-480 natural (TR480N) with M5252a concentrate
4.1.1.3. TR-480 natural (TR480Z) with M362 concentrate
4.1.1.4. Hoescht or Fina GM5010T2
4.1.1.5. Novacor HD-2007H with DX1637 concentrate.

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. Mixing of regrind types is not permissible.

4.3. The use of regrind is not permitted in sizes smaller than 2" IPS.

5. **In-Process Inspection and Testing**

5.1. All tests are performed in accordance with the Driscopipe Test Methods Manual or referenced ASTM test methods unless otherwise noted.

6. **Melt Flow**

6.1. Frequency

6.1.1. Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change.

6.1.2. Where regrind is used, melt flow must be run on the incoming regrind supply once every 24 hours.

6.2. Specifications

6.2.1. The melt flow must not exceed the following values:

6.2.1.1. Driscopipe 1000 - Melt Index maximum of .18 1.15

6.2.2. Additionally, the melt flow of the finished product must not vary by more than 100% from the base resin melt flow.

6.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

7. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Ovality, and Toe-In.

7.1. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for Conditioned Outside Diameter, Wall Thickness, and Eccentricity once per shift on every production run.

7.2. Conditioned Outside Diameter Specifications
Pipe Units (IPS sizes)
Shown in ASTM F714, Table 6 are specifications for IPS sizes larger than 3". The specifications for IPS sizes smaller 3" and smaller are shown in ASTM D3035 Table 1. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

7.3. Conditioned Minimum Wall Thickness Specifications
7.3.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The minimum and maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The minimum wall thickness are shown in ASTM F714 Table 8.

7.3.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7.

7.3.3. Special Sizes
For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ratio (may also be called SDR)

7.4 Conditioned Maximum Wall Thickness Specifications

7.4.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The maximum wall thickness are 120% of the minimum wall thickness.

7.4.2. ISO Units (mm sizes)
Sizes through 1372 mm
The maximum wall thickness are 120% of the minimum wall thickness.

7.5. Conditioned Eccentricity
For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, eccentricity must not exceed 12% (ASTM F714 section 5.2.4). There are no eccentricity specifications for other sizes.

7.6. Conditioned Ovality Specifications
Ovality must not be more than 5%.

7.7. Conditioned Toe-In Specifications
For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, toe-in must not exceed 1.5% (ASTM F714 section 5.2.4). There are no toe-in specifications for others sizes.

7.8. Failure Requirements
Joints
Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

Coils
Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

8. Joint Length

8.1. Frequency

8.1.1. Joint length is measured once per day on each extrusion outlet. Test findings should be referenced in the remarks column.

8.2. Specifications

8.2.1. Joint length must be no less than 99.5% or 101% longer than the specified joint length

8.3. Failure Requirements

If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

9. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller the Quick Burst test method must be used. For sizes larger than 4" IPS (115 mm), either test may be used.

9.1. Frequency - The hoop strength shall be tested once on startup and after a major process interruption.

After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every 24 hours.

> 3000

9.2. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi
S = hoop stress in psi
DR = dimension ratio (also called SDR)

Table 1

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

9.3. Ring Tensile Testing Specifications
The ring tensile test specimens must exceed a ring stress of 2520 psi.

9.4. Failure Requirements
At start up and after a major process interruption the product that is produced prior to passing requirements, shall be directed to regrind. If a failure occurs on the once per 24 hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

10. Reverse Bend Test

10.1. Frequency
The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

10.2. Reverse Bend Specifications
The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

10.3. Failure Requirements
All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

11. Workmanship and Appearance

11.1. Frequency
The workmanship and appearance shall be inspected once every 24 hours.

11.2. Specifications
Where die lines are present, the depth of the line must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter or .002 inch if it is on the outside diameter surface. Product exceeding this requirement may be accepted with prior approval of the customer.

The inside and outside diameter surfaces must be free of blisters and gels.

Where Dents are present they must be no larger in diameter than 5% of the pipe minimum wall thickness. They also must not be deeper than 5% of the wall thickness and must not violate the pipe minimum wall thickness.

There must be no voids visible to the unaided eye.

There must be no chatter marks on the outside diameter of the pipe. Chatter marks on the inside diameter of the pipe must be no more than 1/4" or must have a wavelength no less than 6".

11.3. Failure Requirements
All product that is rejected shall be directed to regrind.

12. Print Requirements

12.1. Frequency
The print string shall be visually inspected at startup and once every 12 hours thereafter.

12.2. Specifications

12.2.1. Type
Print may be either offset or hot foil type.

12.2.2. Color
The print string for Driscopipe 1000 shall be green. Best Practices recommends Matthews type 625 Light Green 1-0002-909-65.

12.2.3. Size
All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 5/32" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8

12.2.4. Print String
Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: DR 11 or DR 17

Product - Example: Driscopipe 1000
Cell Class - For Driscopipe 1000 it is PE345434C unless less than 3" diameter, then PE 3408.

ASTM Basis - For sizes larger than 3" IPS(90 mm) it is ASTM F714. For IPS sizes 3" and smaller, it is ASTM D3035. For metric sizes smaller than 90 mm, it should be omitted.
Pipe Test Category - For Driscopipe 1000 it is C3
Plant Identification -
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - P for Phillips.

A printline example for Driscopipe 1000 larger than 3" IPS is shown in Figure 1, and 3" IPS and smaller is shown in Figure 2.

12.3. Failure Requirements - Product that fails the print specifications must be corrected prior to shipment.

13. Carbon Black Content

13.1. Frequency - This test is required for all blended production of natural resin and concentrate. Unless otherwise directed by the corporate quality manager, the blend percentage for each extrusion line shall be tested three times during a 24 hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line. The corporate quality manager may set a different test frequency by issuing a letter stating the new frequency and the effective time period.

13.2. Specifications -The requirement for carbon black percentage is 2.0% to 3.5%.

13.3. Failure Requirements - If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Figure 1

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe larger than 3" IPS

Example: 14" DR-21 Driscopipe® 1000 series Pipe made in Startex, SC.

14" IPS	DR 21	Driscopipe 1000	PE345434C	ASTM F714	C3	ST 5	08 April 94	14 A	P
Iron Pipe Size	Dimension Ratio	Mfr. Name and Prod. Series	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder #	Prod Date	Oper. # and Shift Code	Resin Code

Figure 2

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe 3" IPS and smaller

Example: 2" DR-11 Driscopipe® 1000 series Pipe made in Startex, SC.

2" IPS	DR 11	Driscopipe 1000	PE3408	ASTM D3055	C3	ST 5	08 April 94	14 A	P
Iron Pipe	Dimension Ratio	Mfr. Name and Prod.	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder	Prod. Date	Oper. # and Shift	Resin Code

COMPANY CONFIDENTIAL

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SIGN-DATE: 5/6/97

Monday, April 28, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, OH 45216

Dear Mayur:

This letter is in response to two particular situations regarding the HDPE Dual Containment pipe that we have supplied for the **Leachate Conveyance System** at Fernald, OH.

The first area of change was in regards to the spacer intervals. The spacers were provided at 4' 6" intervals which were in accordance with the Manufacturers recommended spacing for supported pipe lines (see chart on page 32 of the Phillips Driscopipe's Systems Design Manual).

The second area of change is in regards to the 6" stub of the carrier pipe from the containment pipe. This was omitted due to the fact during installation the carrier pipe slides in the containment, therefore if they were not the same length there would be a pipe length discrepancy between the carrier and containment.

I ask that these changes be review and accepted. Should you have any further questions or concerns please contact me at (502) 583-6591.

Sincerely,

Chris Gilmore
Regional Sales Manager

CC: Scott Hoff

INFORMATION ONLY

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204

P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

POLYETHYLENE PIPE AND FITTING

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DRISCOPIPE

STEP FIVE: INSTALLATION DESIGN

Driscopipe has been installed in many applications above and below ground crossing land, lakes, deserts, bogs and arctic tundra. Each installation requires thorough consideration of the effect of the environment on the pipe. Previous Design Steps analyzed pipeline stresses developed by internal flow and pressure. This design section discusses the stresses imposed on a pipeline by external forces.

Most typical pipe installations can be categorized as one of seven types. The following pages discuss design details for each type of installation.

TYPE 1: Supported Pipelines
TYPE 2: Overland Pipelines
TYPE 3: Buried Pipelines
TYPE 4: Marine Pipelines
TYPE 5: Water Surface Pipelines
TYPE 6: Marsh Pipelines
TYPE 7: Slipline Pipelines

Driscopipe recommends reading the *Systems Installation* brochure for additional information regarding installation practices for each type of pipeline.

Type 1: Supported Pipelines

Introduction: The forces which affect the installation of a horizontally supported pipeline are those developed by the weight of the pipe and its contents between supports. An examination of this type of installation shows that if the sag or deflection between supports is minimized, then the degree of stress and strain within the pipe wall is controlled within safe limits. The design basis for supported or suspended horizontal pipelines is based upon support-spacing which minimizes the mid-span deflection to ¼" using a simple, continuous beam analysis. A side benefit of using maximum deflection as a design criteria is that the relevant support spacing allows the user to control thermal expansion and contraction. It is important that the suspended pipeline be installed at or near its operation temperature (or in the hottest weather) such that the pipeline is thermally expanded. At that point, the clamps and supports can be bolted into position restraining the pipe from further movement. The tendency of Driscopipe to stress-relieve itself will counteract any stresses developed within the pipe as seasonal temperatures become cooler. As a seasonally cool pipe begins to warm, it merely expands to near its original length at installation. In this way, thermal expansion is controlled, sag is minimized and adequate support is provided.

Pipe Support Spacing: Charts 19 through 23 give the design support spacing for various SDRs and pipe diameters. The distance between supports is based upon a continuous beam analysis and a mid-span deflection of ¼" when the pipe is totally full of water.

Chart 20

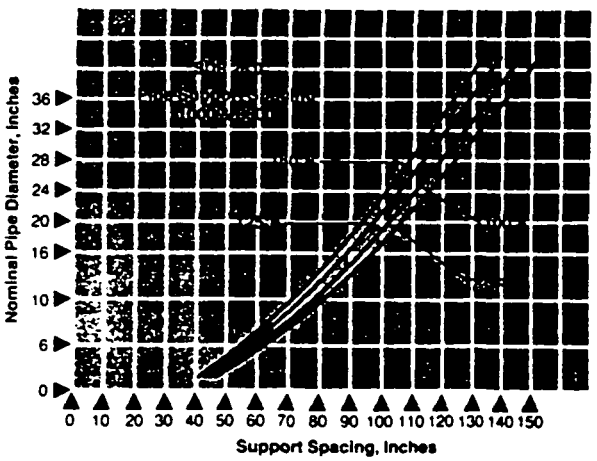


Chart 19

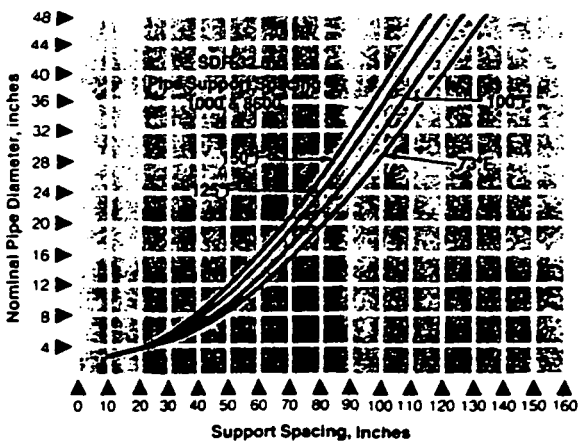
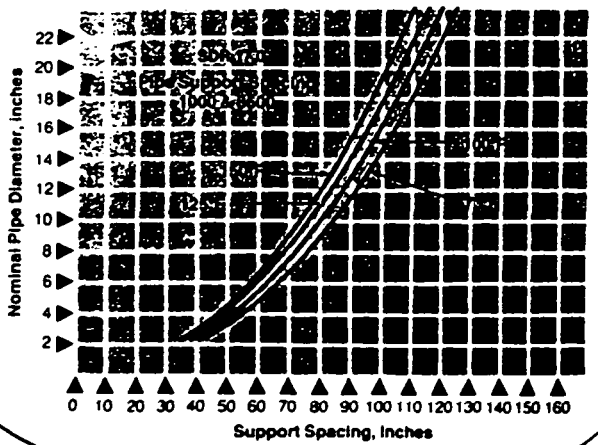


Chart 21



VBS-DRI-003 R/3
P 1 of 1

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
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P.O. BOX 53-3666
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SIGN-DATE: J. C. Jackson 5/6/97

April 28, 1997

Village Building Services

Subject: 6400 series vs. 1000 series

Dear Mayur Kadakia:

Our 1000 series and 6400 series products are manufactured from the same feedstock and carry the same PPI and ASTM material designation of PE 3408. They have the same cell classification of PE345434C (defined by ASTM D3350). Other similarities include:

Property	Test Method	1000 series	6400 series
Density	ASTM D-1505	0.955	0.955
Melt Index	ASTM D-1238	0.11	0.11
Flex Modus	ASTM D-790	135,000	135,000
Tensile Strength	ASTM D-638	3200	3200
ESCR	ASTM D-1693	>5000	>5000
HDB @ 73 deg F	ASTM D-2837	1600	1600
Hardness	ASTM D-2240	65	65
Modulus of Elasticity	ASTM D-638	130,000	130,000

The only difference between 1000 series and 6400 series is the test method used to certify the pipe. 1000 series is made in accordance with ASTM F714 which allows for a +/- 0.057" O.D variance. 6400 series is made in accordance with ASTM D-2513 which allows for a +/- 0.050" O.D variance.

If you have any further questions please do not hesitate to call me at (317) 844-6949
Thank you for specifying Phillips Driscopipe.

Sincerely:

Blair Nicol

Blair Nicol
Regional Sales Manager
Phillips Driscopipe

INFORMATION ONLY

Quality		Phillips Driscopipe A Division of Phillips 66 Company
Assurance	Driscopipe 6400 Pipe	Issue Date: June 1, 1994
Manual	Page 1 of 8	Revision Date: January 02, 1997

1. **Document Control**

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under ***o:\manual\prodspec*** for viewing and printing.

1.2.1. **Brownwood Plant**
1.2.2. **Hagerstown Plant**
1.2.3. **Pryor Plant**
1.2.4. **Startex Plant**
1.2.5. **Watsonville Plant**
1.2.6. **Williamstown Plant**

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2. **Scope**

2.1. Driscopipe 6400 is used primarily in gas gathering pressure rated systems. The pipe is produced to meet the requirements of ASTM D2513 and API 15LE. This section covers the materials and inspection procedures to be followed when producing Driscopipe 6400.

3. **Reference Documents**

3.1. ASTM D2513 Standard specification for Thermoplastic Gas Pressure Piping Systems.

3.2. API 15LE American Petroleum Institute Specification for Polyethylene Line Pipe (PE).

4. **Materials**

4.1. The resins to be used for the extrusion of Driscopipe 6400 shall be as follows:

TR - 480 compound
TR - 480 natural with M5252a concentrate
TR - 480 natural (H480Z H420) with M362 concentrate
Hoescht or Fina GM 5010T2
Novacor HD 2007H natural with DX1637 concentrate

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. The mixing of regrind types is not permissible.

4.3. No regrind shall be used in sizes smaller than 2" IPS.

4.4. Other resins or blends may be used with documented authorization of Corporate Quality.

5. **In-Process Inspection and Testing**

All tests are performed in accordance with the Driscopipe Test Methods Manual unless otherwise noted.

5.1. Melt Flow

5.1.1. Frequency

Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change. Where regrind is used the melt flow shall be run on the regrind feed once every 24 hours.

5.1.2. Specifications
The melt flow must not exceed a melt index of .18. The melt flow of the finished product also must not vary by more than 100% from the base resin melt flow

5.1.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

5.2. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Out-of-Round, Ovality, and Toe-In.

5.3. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for outside diameter, wall thickness and eccentricity once per hour or once every coil/joint, whichever is less frequent. Test for out of round, toe-in and ovality three times per 24 hours.

5.4. Conditioned Outside Diameter Specifications
5.4.1. Conditioned Out-of-Round Specifications
5.4.1.1. Pipe Units (IPS sizes)
The specifications for IPS sizes are shown in ASTM D2513 Tables 1 and 2. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

5.4.1.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

5.4.1.3. For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

5.5. Conditioned Wall Thickness Specifications
5.5.1. Pipe Units (IPS sizes)
The minimum and maximum wall thickness are shown in ASTM D2513 Tables 2 and 3.1.

5.5.2. ISO Units (mm sizes)
The minimum wall thickness specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7. The maximum wall thickness shall be 112% of the minimum wall thickness.

5.5.3. Special Sizes
For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ration (may also be called SDR)

The maximum wall thickness shall be set as 112% of the minimum wall thickness.

5.6. Conditioned Eccentricity Specification
Eccentricity must not exceed 12% (ASTM D2513 section 5.3.1.4).

5.7. Conditioned Ovality Specification
Ovality must not exceed 5%. Best Practices recommend that the ovality be limited to 3%.

5.8. Conditioned Toe-In Specifications
Toe-in must not exceed 1.5% (ASTM D2513 section 5.3.1.2).

5.9. Failure Requirements

5.9.1. Joints
Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

5.9.2. Coils
Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

6. Joint Length

6.1. Frequency

6.1.1. Joint length is measured once per day on each extrusion outlet.

6.1.2. Test findings should be referenced in the remarks column.

6.2. Specifications
Joint length must be no less than the specified joint length.

6.3. Failure Requirements
If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

7. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller, the Quick Burst test method must be used. For all sizes, the ring tensile test must be performed.

7.1. Frequency
The hoop strength shall be tested on startup and after a major process interruption.

7.2. After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every eight hours, or once every joint/coil, whichever is less frequent.

7.3. ASTM D2513 section A4.2.3 describes an alternate testing frequency that may be used in place of the once per 24-hour testing frequency. If this test frequency is used, the QC record must document justification for the multilevel sampling.

7.4. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi

S = hoop stress in psi

DR = dimension ratio (also called SDR)

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

7.5. Ring Tensile Testing Specifications

7.5.1. The ring tensile test specimens must exceed a ring stress of 2520 psi.

7.5.2. Best Practices note that the ring stress failure level is reduced if the specimen preparation is poor. Therefore, Best Practices recommend that care be taken to have a very smooth surface at the reduced test sites on the specimen.

7.6. Failure Requirements

7.6.1. At start up and after a major process interruption the product that is produced prior to a passing specimen shall be directed to regrind.

7.6.2. If a failure occurs on the once per eight hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production

back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

8. **Reverse Bend Test**

8.1. Frequency

The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

8.2. Reverse Bend Specifications

The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

8.3. Failure Requirements

All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

9. **Workmanship and Appearance**

9.1. Frequency

The workmanship and appearance shall be inspected once every 24 hours.

9.2. Specifications

9.2.1. Where present, the depth of die lines must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter surface or .002 inch if it is on the outside diameter surface.

9.2.2. There shall be no blisters or gels.

9.2.3. If present, dents must be no larger in diameter the wall thickness of the pipe. The dents also must not be deeper than 5% of the wall thickness and not result in violation of the pipe minimum wall thickness.

9.2.4. There shall be no voids visible to the unaided eye.

9.2.5. Best Practices note that appearance and workmanship are the most visible representations of the quality of our products. Best Practices recommend that any unusual appearance be corrected or rejected.

9.3. Failure Requirements

All product that is rejected shall be directed to regrind.

10. **Print Requirements**

10.1. Frequency

The print string shall be visually inspected at startup and once every 12 hours thereafter.

10.2. Specifications

10.2.1. Type

Print shall be either offset print or hot foil type. If hot foil print is used, indicate depth of print with wall thickness at printline in the remarks column at above stated frequencies.

10.2.2. Color

The print string for Driscopipe 6400 shall be white. Where offset print is used, Best Practices recommend Matthews type 615 White I-0002-920-65.

10.2.3. Size

All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 5/32" high. Best Practices recommend that the print be 5/16" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8". Best Practices recommend Matthews style 4S print.

10.2.4. Print String

Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet. Best Practices recommend a print string interval of two feet. A printline example for Driscopipe 6400 is shown on page 7A.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: SDR 11 or DR 17
Product - Example: Driscopipe 6400
Material Class -For Driscopipe 6400 it is PE3408 CDC
ASTM Basis - ASTM D2513
Special Logos -

For Driscopipe 6400, the print line should include the API monogram followed by "15LE" and the plant API license number.

The API license number is
0005 for Brownwood
0005.1 for Pryor
0005.2 for Startex
0005.3 for Watsonville (license renewal discontinued in 1995)
0005.4 for Williamstown (license renewal discontinued in 1995)

Plant Identification -
BW for Brownwood
P for Pryor
ST for Startex
WA for Watsonville
WT for Williamstown
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - H for Hoescht or Fina,

N for Novacor
P for Phillips Singapore
S for Solvay

10.3. Failure Requirements
Product that fails the print specifications must be corrected prior to shipment.

11. **Carbon Black Content**

11.1. Frequency

11.1.1. This test is required for all blended production of natural resin and concentrate.

11.1.2. The blend percentage for each extrusion line shall be tested two times during a 24-hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line.

11.2. Specifications
The requirement for carbon black percentage is 2.0% to 3.5%.

11.3. Failure Requirements
If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Pipe Printline • Example •

6400 series Pipe DR

Example: 6" DR-11 Driscopipe® 6400 series Pipe made at Brownwood, TX.

6" IPS	DR 11	Driscopipe 6400	PE3408 CDC	ASTM D2513	Gas	AP	15LE	0005.0	BW 6	02 May 94	12A	P
Iron Pipe Size	Dimension Ratio or Schedule #	Mfr. Name and Prod. Series	Material Class	Classifica-tion Basis	Denotes End Use Application "Gas Gathering"	American Petroleum Institute Logo	API Specifica-tion	Individual Plant API License #	Plant Code & Extruder #	Prod. Date	Oper. # and Shift Code	Resin Code

VBS-DRI-005 R/3

1 of 7

PHILLIPS 66

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 16, 1996

JHV# 927-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

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SIGN-DATE: 5/6/97

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6151379
P.O. Number:	REL 7
Date Shipped:	01/15/96
Package:	PSPX 6789
Quantity:	174300 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

INFORMATION ONLY

Shanta Ludwick
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

2 of 7

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

February 27, 1996

JHV# 3868-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7160189
P.O. Number:	REL 44
Date Shipped:	02/26/96
Package:	PSPX 6322
Quantity:	179850 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

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PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 18, 1996

JHV# 21059-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161455
P.O. Number:	REL 248
Date Shipped:	10/17/96
Package:	PSPX 5987
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

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PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 22, 1996

JHV# 21216-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161463
P.O. Number:	REL 252
Date Shipped:	10/21/96
Package:	PSPX 2053
Quantity:	176450 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21659-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161476
P.O. Number:	REL 258
Date Shipped:	10/28/96
Package:	PSPX 1142
Quantity:	177100 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

60467

PHILLIPS 66

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21660-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161480
P.O. Number:	REL 259
Date Shipped:	10/28/96
Package:	ACFX 99558
Quantity:	175000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3600
PASADENA, TEXAS 77501-0797

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

August 09, 1996

JHV# 16140-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	8160941
P.O. Number:	REL 184
Date Shipped:	08/08/96
Package:	PSPX 9009
Quantity:	176400 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268
VBS-DRI-006R
1 of 4

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

[X] A - For CPC submittals only - Conforms w/Reqmts.
[ ] B - Minor Comment - Resubmit as-CPC/INF/REC
[ ] C - Revise and Resubmit
[ ] D - Accepted for INF/REC - Conforms w/Reqmts.
SIGN-DATE: C. Jenkins 5/6/97

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
4" DR-17 1000	08/22/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 8160941 with the Melt Index of 0.12 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes
Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

INFORMATION ONLY

WP/Meltind2

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	01/28/96
8" DR-26 1000	10/31/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 7161455 and 6151379 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 6400	11/09/96 & 11/10/96

This is to certify that the product described and shipped on the above order from the brownwood plant, has been sampled according to statistical sampling plans in compliance with the "recommended in-plant quality control program for plastic pipe, tubing and fittings intended for use in natural gas distribution systems" as definded in appendix A.4 of ASTM Specification D2513 and/or D2683 or D3261. The product meets the applicable requirements for pipe, tubing and/or fittings made from pe3408 resin. This product was produced from resin lots 7161463,7161480 and 7161476 with the Melt Index of 0.12 G/10 MIN., 0.11 G/10 MIN. and 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN., 0.09 G/10 MIN. and 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	03/26/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 7160189 with the Melt Index of 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltindx

77 R2

SUPPLIER SUBMITTAL

WORK ORDER NO.: 1700	SUBCONTRACT NO.: 589	SUPPLIER SUBMITTAL NO.: 77 R2	DATE: 04/29/97

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216

SIGNATURE: Mayur P. Kadakia

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

RECEIVED BY: Melissa Crews DATE: 1/06/97

DOCUMENT FAMILY X RESUBMITTAL X SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C	D
8	VBS-DRI-002	0							X		X	ISCO's letterd dated 04/28/97 (2 pages)	X		X		Section 02605		X		
8	VBS-DRI-003	0							X		X	Driscopipe's letter dated 04/28/97 (1 page)		X	X		Section 02605	X			
8	VBS-DRI-004	0							X		X	Quality Assurance Manual 6400 Series (8 pages)	X		X		Section 02605	X			
8	VBS-DRI-005	0							X		X	Resin Cert. of Comp. (6 pages)		X	X		Section 02605		X		
8	VBS-DRI-006	0							X		X	Manufacturer's Cert. of Compliance (4 pages)		X	X		Section 02605				
												(Manufacturer's Cert. of Comp. for the rest of the									
												pipe will be submitted, as the run date is									
												available from the Village's personnel at the site)									

REMARKS: → Spacers at 4'6" will be accepted only FOR FORCEMAIN SDR 17 piping
The stub of the carrier pipe is only necessary for proper field installation and therefore VBS will need to cut 8" containment pipe as necessary

DOCUMENT FAMILY CODE: (BY SUPPLIER)	SUBMITTAL ACTION CODE: (BY SUPPLIER)	SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL	CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD	A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
CON - CONSTRUCTION PRO - PROCUREMENT	INF - INFORMATION	B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL	CFC - CERTIFIED FOR CONSTRUCTION	C - REVISE AND RESUBMIT
OTHER: APPROPRIATE DOCUMENT FAMILY ABOVE	APPRORIATE SUBMITTAL ACTION CODE	D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREMENTS

→ One Resin Cert Missing All must be signed — to perform proper weld and as approved by QC
ISCO/VBS to fax per ISCO telephone call — Meeting by QC & field people to discuss.
Lot # 8160941 for 4" pipe. S. Bolinger 1 May 97 — I will prepare a DCN.

1268

VBS-DRI-003

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2929 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 83-3866
RICHARDSON, TEXAS 75083 • 214/783-2686

April 28, 1997

Village Building Services

Subject: 6400 series vs. 1000 series

Dear Mayur Kadakia:

Our 1000 series and 6400 series products are manufactured from the same feedstock and carry the same PPI and ASTM material designation of PE 3408. They have the same cell classification of PE345434C (defined by ASTM D3350). Other similarities include:

Property	Test Method	1000 series	6400 series
Density	ASTM D-1505	0.955	0.955
Melt Index	ASTM D-1238	0.11	0.11
Flex Modus	ASTM D-790	135,000	135,000
Tensile Strength	ASTM D-638	3200	3200
ESCR	ASTM D-1693	>5000	>5000
HDB @ 73 deg F	ASTM D-2837	1600	1600
Hardness	ASTM D-2240	65	65
Modulus of Elasticity	ASTM D-638	130,000	130,000

The only difference between 1000 series and 6400 series is the test method used to certify the pipe. 1000 series is made in accordance with ASTM F714 which allows for a +/- 0.057" O.D variance. 6400 series is made in accordance with ASTM D-2513 which allows for a +/- 0.050" O.D variance.

If you have any further questions please do not hesitate to call me at (317) 844-6949
Thank you for specifying Phillips Driscopipe.

Sincerely:

Blair Nicol

Blair Nicol
Regional Sales Manager
Phillips Driscopipe

(This letter and the QA Manual for 1000 Pipe obtained from submittal #77P1 and attached to 77P2 RGB)

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2929 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 00-0000
RICHARDSON, TEXAS 75083 • 214/783-2666

March 30, 1997

Chris Gilmore
ISCO Industries
3110 Linwood Ave.
Cincinnati, OH 45208

Post-it® Fax Note 7671	Date	# of pages ▶ 9
To Chris Gilmore	From P. Lauzon	
Co./Dept. ISCO	Co.	
Phone # 513-871-9574	Phone #	
Fax #	Fax #	

RE: Driscopipe 1000 Series Pipe

Dear Mr. Gilmore

This letter is being written at your request concerning Driscopipe 1000 series pipe. Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin and does not include any post-consumer-reclaim resin. The resin has a cell class of PE 345434C according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and also 35°C/1300 psi based on TR/3 as derived from ASTM D-2487 test methodology.

Sincerely,

Peter A. Lauzon

Peter A. Lauzon
Quality Assurance Engineer

PAL:sl

Quality		Phillips Driscopipe A Division of Phillips Petroleum Company
Assurance	Driscopipe 1000	Date of Issue: June 01, 1994
Manual	Page 1 of 8	Revision Date: January 9, 1997

1. **Document Control**

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under *o:\manual\prodspec* for viewing and printing.

1.2.1. **Brownwood Plant**
1.2.2. **Hagerstown Plant**
1.2.3. **Pryor Plant**
1.2.4. **Startex Plant**
1.2.5. **Watsonville Plant**
1.2.6. **Williamstown Plant**

2. **Scope**

2.1. Driscopipe 1000 is a general purpose pipe series used either in gravity flow or pressure rated applications. The piping systems are manufactured to the requirements of ASTM F714 for sizes larger than 3" IPS (90 mm). Smaller sizes are manufactured to the requirements of ASTM D3035. This section covers the materials to be used and the quality assurance procedures to be followed when producing Driscopipe 1000 pipe.

3. **Reference Documents**

3.1. ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

3.2. ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

4. **Materials**

4.1.1. The resin to be used for the extrusion of Driscopipe 1000 is :
4.1.1.1. TR-480 compound
4.1.1.2. TR-480 natural (TR480N) with M5252a concentrate
4.1.1.3. TR-480 natural (TR480Z) with M362 concentrate
4.1.1.4. Hoescht or Fina GM5010T2
4.1.1.5. Novacor HD-2007H with DX1637 concentrate.

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. Mixing of regrind types is not permissible.

4.3. The use of regrind is not permitted in sizes smaller than 2" IPS.

5. **In-Process Inspection and Testing**

5.1. All tests are performed in accordance with the Driscopipe Test Methods Manual or referenced ASTM test methods unless otherwise noted.

6. **Melt Flow**

6.1. Frequency

6.1.1. Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change.

6.1.2. Where regrind is used, melt flow must be run on the incoming regrind supply once every 24 hours.

6.2. Specifications

6.2.1. The melt flow must not exceed the following values:

6.2.1.1. Driscopipe 1000 - Melt Index maximum of .18 1.15

6.2.2. Additionally, the melt flow of the finished product must not vary by more than 100% from the base resin melt flow.

6.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

7. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Ovality, and Toe-In.

7.1. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for Conditioned Outside Diameter, Wall Thickness, and Eccentricity once per shift on every production run.

7.2. Conditioned Outside Diameter Specifications
Pipe Units (IPS sizes)
Shown in ASTM F714, Table 6 are specifications for IPS sizes larger than 3". The specifications for IPS sizes smaller 3" and smaller are shown in ASTM D3035 Table 1. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

7.3. Conditioned Minimum Wall Thickness Specifications
7.3.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The minimum and maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The minimum wall thickness are shown in ASTM F714 Table 8.

7.3.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7.

7.3.3. Special Sizes

For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ratio (may also be called SDR)

7.4. Conditioned Maximum Wall Thickness Specifications

7.4.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The maximum wall thickness are 120% of the minimum wall thickness.

7.4.2. ISO Units (mm sizes)
Sizes through 1372 mm
The maximum wall thickness are 120% of the minimum wall thickness.

7.5. Conditioned Eccentricity

For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, eccentricity must not exceed 12% (ASTM F714 section 5.2.4). There are no eccentricity specifications for other sizes.

7.6. Conditioned Ovality Specifications

Ovality must not be more than 5%.

7.7. Conditioned Toe-In Specifications

For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, toe-in must not exceed 1.5% (ASTM F714 section 5.2.4). There are no toe-in specifications for others sizes.

7.8. Failure Requirements

Joints
Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

Coils
Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

8. Joint Length

8.1. Frequency

8.1.1. Joint length is measured once per day on each extrusion outlet. Test findings should be referenced in the remarks column.

8.2. Specifications

8.2.1. Joint length must be no less than 99.5% or 101% longer than the specified joint length

8.3. Failure Requirements

If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

9. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller the Quick Burst test method must be used. For sizes larger than 4" IPS (115 mm), either test may be used.

9.1. Frequency - The hoop strength shall be tested once on startup and after a major process interruption.

After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every 24 hours.

> 3000

9.2. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi
S = hoop stress in psi
DR = dimension ratio (also called SDR)

Table 1

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

9.3. Ring Tensile Testing Specifications
The ring tensile test specimens must exceed a ring stress of 2520 psi.

9.4. Failure Requirements
At start up and after a major process interruption the product that is produced prior to passing requirements, shall be directed to regrind. If a failure occurs on the once per 24 hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

10. Reverse Bend Test

10.1. Frequency
The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

10.2. Reverse Bend Specifications
The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

10.3. Failure Requirements
All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

11. Workmanship and Appearance

11.1. Frequency
The workmanship and appearance shall be inspected once every 24 hours.

11.2. Specifications
Where die lines are present, the depth of the line must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter or .002 inch if it is on the outside diameter surface. Product exceeding this requirement may be accepted with prior approval of the customer.

The inside and outside diameter surfaces must be free of blisters and gels.

Where Dents are present they must be no larger in diameter than 5% of the pipe minimum wall thickness. They also must not be deeper than 5% of the wall thickness and must not violate the pipe minimum wall thickness.

There must be no voids visible to the unaided eye.

There must be no chatter marks on the outside diameter of the pipe. Chatter marks on the inside diameter of the pipe must be no more than 1/4" or must have a wavelength no less than 6".

11.3. Failure Requirements
All product that is rejected shall be directed to regrind.

12. Print Requirements
12.1. Frequency
The print string shall be visually inspected at startup and once every 12 hours thereafter.

12.2. Specifications
12.2.1. Type
Print may be either offset or hot foil type.

12.2.2. Color
The print string for Driscopipe 1000 shall be green. Best Practices recommends Matthews type 625 Light Green 1-0002-909-65.

12.2.3. Size
All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 5/32" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8

12.2.4. Print String
Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: DR 11 or DR 17

Product - Example: Driscopipe 1000
Cell Class - For Driscopipe 1000 it is PE345434C unless less than 3" diameter, then PE 3408.

ASTM Basis - For sizes larger than 3" IPS(90 mm) it is ASTM F714. For IPS sizes 3" and smaller, it is ASTM D3035. For metric sizes smaller than 90 mm, it should be omitted.
Pipe Test Category - For Driscopipe 1000 it is C3
Plant Identification -
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - P for Phillips,

A printline example for Driscopipe 1000 larger than 3" IPS is shown in Figure 1, and 3" IPS and smaller is shown in Figure 2.

12.3. Failure Requirements - Product that fails the print specifications must be corrected prior to shipment.

13. Carbon Black Content

13.1. Frequency - This test is required for all blended production of natural resin and concentrate. Unless otherwise directed by the corporate quality manager, the blend percentage for each extrusion line shall be tested three times during a 24 hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line. The corporate quality manager may set a different test frequency by issuing a letter stating the new frequency and the effective time period.

13.2. Specifications -The requirement for carbon black percentage is 2.0% to 3.5%.

13.3. Failure Requirements - If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Figure 1

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe larger than 3" IPS

Example: 14" DR-21 Driscopipe® 1000 series Pipe made in Startex, SC.

14" IPS	DR 21	Driscopipe 1000	PE345434C	ASTM F714	C 3	ST 5	08 April 94	14 A	P
Iron Pipe Size	Dimension Ratio	Mfr. Name and Prod. Series	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder #	Prod. Date	Oper. # and Shift Code	Resin Code

Figure 2

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe 3" IPS and smaller

Example: 2" DR-11 Driscopipe® 1000 series Pipe made in Startex, SC.

2" IPS	DR 11	Driscopipe 1000	PE3408	ASTM D3055	C 3	ST 5	08 April 94	14 A	P
Iron Pipe	Dimension Ratio	Mfr. Name and Prod.	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder	Prod. Date	Oper. # and Shift	Resin Code

926 Baxter Avenue
P. O. Box 4545
Louisville, Kentucky 40204
(502) 583-6591

To: Village Building Services

Attention: Mayur K.

Fax Number: (513) 761-1896

Your P. O. 4177 Shipped 4/14/97 should receive 4/15/97

Shipped To: 7400 Willey Road

Cincinatti, Ohio 45030

From Louisville, Kentucky

VIA:

UPS: Ground Red Blue 3-Day

Tracking #

Truckline: Freight Transport

Pro #:

Other:

Complete: X Partial Back Ordered Items:

Please pass this information on to the person most interested in timely receipt of this shipment. For your convenience, should the shipment be delayed, you will find the carrier data included for your direct tracing needs. We appreciate your business and thank you.

1. **Document Control**

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under ***o:\manual\prodspec*** for viewing and printing.

1.2.1. **Brownwood Plant**
1.2.2. **Hagerstown Plant**
1.2.3. **Pryor Plant**
1.2.4. **Startex Plant**
1.2.5. **Watsonville Plant**
1.2.6. **Williamstown Plant**

2. **Scope**

2.1. Driscopipe 6400 is used primarily in gas gathering pressure rated systems. The pipe is produced to meet the requirements of ASTM D2513 and API 15LE. This section covers the materials and inspection procedures to be followed when producing Driscopipe 6400.

3. **Reference Documents**

3.1. ASTM D2513 Standard specification for Thermoplastic Gas Pressure Piping Systems.

3.2. API 15LE American Petroleum Institute Specification for Polyethylene Line Pipe (PE).

4. **Materials**

4.1. The resins to be used for the extrusion of Driscopipe 6400 shall be as follows:

TR - 480 compound
TR - 480 natural with M5252a concentrate
TR - 480 natural (H480Z H420) with M362 concentrate
Hoescht or Fina GM 5010T2
Novacor HD 2007H natural with DX1637 concentrate

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. The mixing of regrind types is not permissible.

4.3. No regrind shall be used in sizes smaller than 2" IPS.

4.4. Other resins or blends may be used with documented authorization of Corporate Quality.

5. **In-Process Inspection and Testing**

All tests are performed in accordance with the Driscopipe Test Methods Manual unless otherwise noted.

5.1. Melt Flow

5.1.1. Frequency

Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change. Where regrind is used the melt flow shall be run on the regrind feed once every 24 hours.

5.1.2. Specifications
The melt flow must not exceed a melt index of .18. The melt flow of the finished product also must not vary by more than 100% from the base resin melt flow

5.1.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

5.2. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Out-of-Round, Ovality, and Toe-In.

5.3. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for outside diameter, wall thickness and eccentricity once per hour or once every coil/joint, whichever is less frequent. Test for out of round, toe-in and ovality three times per 24 hours.

5.4. Conditioned Outside Diameter Specifications

5.4.1. Conditioned Out-of-Round Specifications

5.4.1.1. Pipe Units (IPS sizes)
The specifications for IPS sizes are shown in ASTM D2513 Tables 1 and 2. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

5.4.1.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

5.4.1.3. For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

5.5. Conditioned Wall Thickness Specifications

5.5.1. Pipe Units (IPS sizes)
The minimum and maximum wall thickness are shown in ASTM D2513 Tables 2 and 3.1.

5.5.2. ISO Units (mm sizes)
The minimum wall thickness specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7. The maximum wall thickness shall be 112% of the minimum wall thickness.

5.5.3. Special Sizes
For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ration (may also be called SDR)

The maximum wall thickness shall be set as 112% of the minimum wall thickness.

5.6. Conditioned Eccentricity Specification
Eccentricity must not exceed 12% (ASTM D2513 section 5.3.1.4).

5.7. Conditioned Ovality Specification
Ovality must not exceed 5%. Best Practices recommend that the ovality be limited to 3%.

5.8. Conditioned Toe-In Specifications
Toe-in must not exceed 1.5% (ASTM D2513 section 5.3.1.2).

5.9. Failure Requirements

5.9.1. Joints
Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

5.9.2. Coils
Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

6. Joint Length

6.1. Frequency

6.1.1. Joint length is measured once per day on each extrusion outlet.

6.1.2. Test findings should be referenced in the remarks column.

6.2. Specifications
Joint length must be no less than the specified joint length.

6.3. Failure Requirements
If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

7. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller, the Quick Burst test method must be used. For all sizes, the ring tensile test must be performed.

7.1. Frequency
The hoop strength shall be tested on startup and after a major process interruption.

7.2. After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every eight hours, or once every joint/coil, whichever is less frequent.

7.3. ASTM D2513 section A4.2.3 describes an alternate testing frequency that may be used in place of the once per 24-hour testing frequency. If this test frequency is used, the QC record must document justification for the multilevel sampling.

7.4. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi

S = hoop stress in psi

DR = dimension ratio (also called SDR)

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

7.5. Ring Tensile Testing Specifications

7.5.1. The ring tensile test specimens must exceed a ring stress of 2520 psi.

7.5.2. Best Practices note that the ring stress failure level is reduced if the specimen preparation is poor. Therefore, Best Practices recommend that care be taken to have a very smooth surface at the reduced test sites on the specimen.

7.6. Failure Requirements

7.6.1. At start up and after a major process interruption the product that is produced prior to a passing specimen shall be directed to regrind.

7.6.2. If a failure occurs on the once per eight hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production

back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

8. **Reverse Bend Test**

8.1. Frequency

The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

8.2. Reverse Bend Specifications

The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

8.3. Failure Requirements

All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

9. **Workmanship and Appearance**

9.1. Frequency

The workmanship and appearance shall be inspected once every 24 hours.

9.2. Specifications

9.2.1. Where present, the depth of die lines must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter surface or .002 inch if it is on the outside diameter surface.

9.2.2. There shall be no blisters or gels.

9.2.3. If present, dents must be no larger in diameter the wall thickness of the pipe. The dents also must not be deeper than 5% of the wall thickness and not result in violation of the pipe minimum wall thickness.

9.2.4. There shall be no voids visible to the unaided eye.

9.2.5. Best Practices note that appearance and workmanship are the most visible representations of the quality of our products. Best Practices recommend that any unusual appearance be corrected or rejected.

9.3. Failure Requirements

All product that is rejected shall be directed to regrind.

10. **Print Requirements**

10.1. Frequency

The print string shall be visually inspected at startup and once every 12 hours thereafter.

10.2. Specifications

10.2.1. Type

Print shall be either offset print or hot foil type. If hot foil print is used, indicate depth of print with wall thickness at printline in the remarks column at above stated frequencies.

10.2.2. Color

The print string for Driscopipe 6400 shall be white. Where offset print is used, Best Practices recommend Matthews type 615 White I-0002-920-65.

10.2.3. Size

All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 5/32" high. Best Practices recommend that the print be 5/16" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8". Best Practices recommend Matthews style 4S print.

10.2.4. Print String

Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet. Best Practices recommend a print string interval of two feet. A printline example for Driscopipe 6400 is shown on page 7A.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: SDR 11 or DR 17
Product - Example: Driscopipe 6400
Material Class -For Driscopipe 6400 it is PE3408 CDC
ASTM Basis - ASTM D2513
Special Logos -

For Driscopipe 6400, the print line should include the API monogram followed by "15LE" and the plant API license number.

The API license number is
0005 for Brownwood
0005.1 for Pryor
0005.2 for Startex
0005.3 for Watsonville (license renewal discontinued in 1995)
0005.4 for Williamstown (license renewal discontinued in 1995)

Plant Identification -
BW for Brownwood
P for Pryor
ST for Startex
WA for Watsonville
WT for Williamstown
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - H for Hoescht or Fina,

N for Novacor
P for Phillips Singapore
S for Solvay

10.3. Failure Requirements
Product that fails the print specifications must be corrected prior to shipment.

11. **Carbon Black Content**

11.1. Frequency

11.1.1. This test is required for all blended production of natural resin and concentrate.

11.1.2. The blend percentage for each extrusion line shall be tested two times during a 24-hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line.

11.2. Specifications
The requirement for carbon black percentage is 2.0% to 3.5%.

11.3. Failure Requirements
If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Pipe Printline • Example •

6400 series Pipe DR

Example: 6" DR-11 Driscopipe® 6400 series Pipe made at Brownwood, TX.

8" IPS	DR 11	Driscopipe 6400	PE3408 CDC	ASTM D2513	Gas	AF	15LE	0005.0	BW 6	02 May 94	12A	P
Iron Pipe Size	Dimension Ratio or Schedule #	Mfr. Name and Prod. Series	Material Class	Classification Basis	Denotes End Use Application "Gas Gathering"	American Petroleum Institute Logo	API Specification	Individual Plant API License #	Plant Code & Extruder #	Prod. Date	Oper. # and Shift Code	Resin Code

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2829 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 83-3886
RICHARDSON, TEXAS 75083 • 214/783-2666

May 5, 1997

Mayur Kadakia
Village Building Services

Subject: Resin Certification Letters

Dear Mr. Kadakia:

The copy of the resin certification, which accompanies the pipe certification letter does not have a signature because it is primarily for internal usage. The resin certification accompanies each rail car of resin shipped by our resin supplier at HCC (Houston Chemical Complex).

HCC, like Driscopipe, is a division of Phillips Petroleum Company. Therefore this internal certification does not require a signature. Driscopipe keeps these certifications on file and makes them available to customers as required.

If you have any questions or require further information please contact me at (317) 844-6949. Thank you for specifying Phillips Driscopipe.

Sincerely,

Blair Nicol
Regional Sales Manager
Phillips Driscopipe

CC: S.Hoff

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

August 09, 1996

JHV# 16140-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z ✓ 4" SDR 17
Lot Number:	8160941
P.O. Number:	REL 184
Date Shipped:	08/08/96
Package:	PSPX 9009
Quantity:	176400 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI-005

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 16, 1996

JHV# 927-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

8" SDR 26 1000

Type:	HHM TR-480Z
Lot Number:	6151379
P.O. Number:	REL 7
Date Shipped:	01/15/96
Package:	PSPX 6789
Quantity:	174300 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

Shanta Ludwick
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

February 27, 1996

JHV# 3868-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7160189
P.O. Number:	REL 44
Date Shipped:	02/26/96
Package:	PSPX 6322
Quantity:	179850 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

8" 1000

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

RECEIVED OCT 2 2 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 18, 1996

JHV# 21059-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161455
P.O. Number:	REL 248
Date Shipped:	10/17/96
Package:	PSPX 5987
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

8" 1000

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

RECEIVED OCT 2 5 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 22, 1996

JHV# 21216-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161463
P.O. Number:	REL 252
Date Shipped:	10/21/96
Package:	PSPX 2053
Quantity:	176450 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

8" 6400

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

VBS-DRI-006

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21659-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z 8" 6400
Lot Number:	7161476
P.O. Number:	REL 258
Date Shipped:	10/28/96
Package:	PSPX 1142
Quantity:	177100 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 29, 1996

JHV# 21660-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161480 8 6400
P.O. Number:	REL 259
Date Shipped:	10/28/96
Package:	ACFX 99558
Quantity:	175000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
4" DR-17 1000	08/22/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 8160941 with the Melt Index of 0.12 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltind2

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 23, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	01/28/96
8" DR-26 1000	10/31/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 7161455 and 6151379 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 6400	11/09/96 & 11/10/96

This is to certify that the product described and shipped on the above order from the brownwood plant, has been sampled according to statistical sampling plans in compliance with the "recommended in-plant quality control program for plastic pipe, tubing and fittings intended for use in natural gas distribution systems" as definded in appendix A.4 of ASTM Specification D2513 and/or D2683 or D3261. The product meets the applicable requirements for pipe, tubing and/or fittings made from pe3408 resin. This product was produced from resin lots 7161463, 7161480 and 7161476 with the Melt Index of 0.12 G/10 MIN., 0.11 G/10 MIN. and 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN., 0.09 G/10 MIN. and 0.11 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

April 25, 1997

TO: Chris Gilmore
3110 Linwood Av.
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	03/26/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lot 7160189 with the Melt Index of 0.10 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.10 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltindx

1268

VBS-DRI-002

Monday, April 28, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, OH 45216

Dear Mayur:

This letter is in response to two particular situations regarding the HDPE Dual Containment pipe that we have supplied for the **Leachate Conveyance System** at Fernald, OH.

The first area of change was in regards to the spacer intervals. The spacers were provided at 4' 6" intervals which were in accordance with the Manufacturers recommended spacing for supported pipe lines (see chart on page 32 of the Phillips Driscopipe's Systems Design Manual).

OK for

The second area of change is in regards to the 6" stub of the carrier pipe from the containment pipe. This was omitted due to the fact during installation the carrier pipe slides in the containment, therefore if they were not the same length there would be a pipe length discrepancy between the carrier and containment.

I ask that these changes be review and accepted. Should you have any further questions or concerns please contact me at (502) 583-6591.

Sincerely,

Chris Gilmore
Regional Sales Manager

CC: Scott Hoff

'SCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204

P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

POLYETHYLENE PIPE AND FITTING

HDPE FABRICATION

CULVERT LINERS

GOLF COURSE IRRIGATION SUPPLIES

DRISCOPIPE

STEP FIVE: INSTALLATION DESIGN

Driscopipe has been installed in many applications above and below ground crossing land, lakes, deserts, bogs and arctic tundra. Each installation requires thorough consideration of the effect of the environment on the pipe. Previous Design Steps analyzed pipeline stresses developed by internal flow and pressure. This design section discusses the stresses imposed on a pipeline by external forces.

Most typical pipe installations can be categorized as one of seven types. The following pages discuss design details for each type of installation.

TYPE 1: Supported Pipelines
TYPE 2: Overland Pipelines
TYPE 3: Buried Pipelines
TYPE 4: Marine Pipelines
TYPE 5: Water Surface Pipelines
TYPE 6: Marsh Pipelines
TYPE 7: Slipline Pipelines

Driscopipe recommends reading the *Systems Installation* brochure for additional information regarding installation practices for each type of pipeline.

Type 1: Supported Pipelines

Introduction: The forces which affect the installation of a horizontally supported pipeline are those developed by the weight of the pipe and its contents between supports. An examination of this type of installation shows that if the sag or deflection between supports is minimized, then the degree of stress and strain within the pipe wall is controlled within safe limits. The design basis for supported or suspended horizontal pipelines is based upon support-spacing which minimizes the mid-span deflection to ¼" using a simple, continuous beam analysis. A side benefit of using maximum deflection as a design criteria is that the relevant support spacing allows the user to control thermal expansion and contraction. It is important that the suspended pipeline be installed at or near its operation temperature (or in the hottest weather) such that the pipeline is thermally expanded. At that point, the clamps and supports can be bolted into position restraining the pipe from further movement. The tendency of Driscopipe to stress-relieve itself will counteract any stresses developed within the pipe as seasonal temperatures become cooler. As a seasonally cool pipe begins to warm, it merely expands to near its original length at installation. In this way, thermal expansion is controlled, sag is minimized and adequate support is provided.

Pipe Support Spacing: Charts 19 through 23 give the design support spacing for various SDRs and pipe diameters. The distance between supports is based upon a continuous beam analysis and a mid-span deflection of ¼" when the pipe is totally full of water.

Chart 20

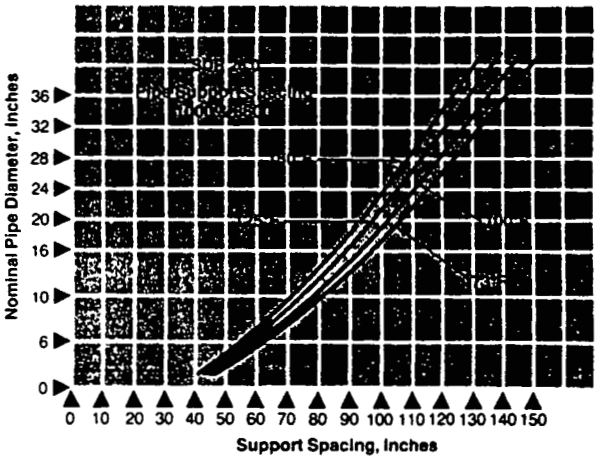


Chart 19

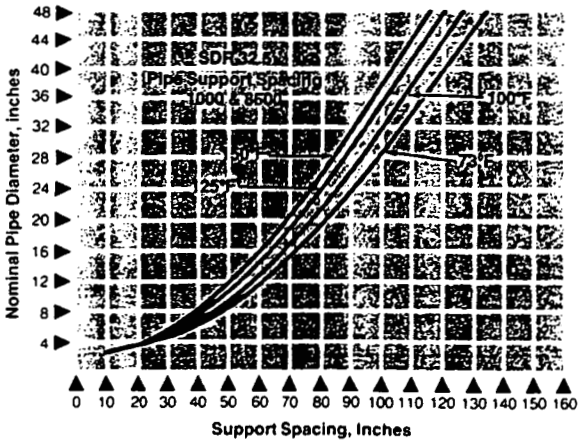
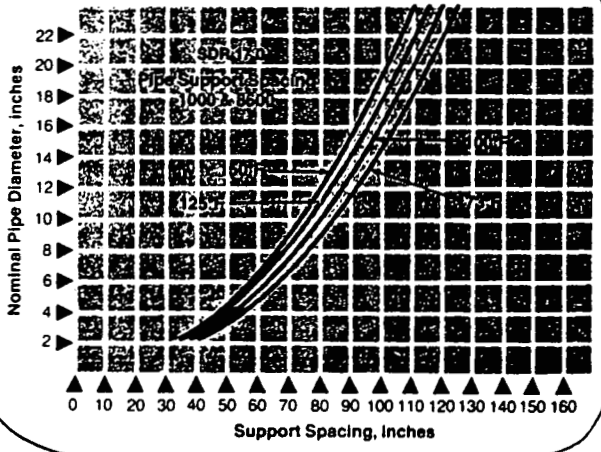


Chart 21



1268

#77R2

Scott Hoff
ISCO INDUSTRIES,INC.
3544 A Brookstone Drive
Cincinnati, OH 45209

Phone # (513) 871-9512
Fax # (513) 871-9514

DATE: 5/6/97

TO: DAN BOONE

Number of Pages: 2

Comments: HERE IS THE RESIN SHEET. PLEASE CALL IF YOU NEED ANY OTHER INFO. THANKS FOR YOUR PATIENCE,

SH

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204

P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

POLYETHYLENE PIPE AND FITTING

HDPE FABRICATION

CULVERT LINERS

GOLF COURSE IRRIGATION SUPPLIES

#77 R1

SUPPLIER SUBMITTAL

WORK ORDER NO.: 1700	SUBCONTRACT NO.: 589	SUPPLIER SUBMITTAL NO.: 77	DATE: 04/16/97

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216
SIGNATURE: Mayur P. Kadakia

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

RECEIVED BY: Teresa Schwab DATE: 4-16-97

DOCUMENT FAMILY X RESUBMITTAL X SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C	D
8	VBS-DRI-000	1							X	X		Driscopipe Quality Assurance Manual		X			Section 02605				
8	VBS-DRI-001	1							X	X		Certificate no reclaimed polymer is added to resin			X		Section 02605	X			
												(This submittal supersedes									
											NK	previous submittal no. 77									
												Rev. 0)									
												Certify field values in accordance								X	
												with Table 02605-2									

REMARKS: Must submit minimum Manufacturer certifiable values in accordance with submittal requirement Spec. Section 1.04 A 8, ie. meeting Table 02605-2. Submittal #24 did not do that. After pipe manufactured submit run data showing that quality products were produced

DOCUMENT FAMILY CODE: (BY SUPPLIER)	SUBMITTAL ACTION CODE: (BY SUPPLIER)	SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL	CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD	A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
CON - CONSTRUCTION PRO - PROCUREMENT	INF - INFORMATION	B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL	CFC - CERTIFIED FOR CONSTRUCTION	C - REVISE AND RESUBMIT
APPROPRIATE DOCUMENT FAMILY ABOVE	APPRORIATE SUBMITTAL ACTION CODE	D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREMENTS

1268

000091

ORIGINAL FILE COPY

per the specification as stated in submittal #24.

R. Bodine 17 April

ENTERED

FROM SPEC 02605

QA Manual ✓

6. documentation demonstrating that the Manufacturer has adequate quality control procedures to ensure that fabrication of the HDPE manholes complies with the requirements of this Section;

In QA Manual

7. origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used;

NEED

8. minimum Manufacturer certifiable values and the corresponding test procedures for HDPE material properties listed in Tables 02605-1 and 02605-2; submit values that are specific to the resin used in manufacture.

B. Submit to the Construction Manager for review at least 30 calendar days prior to shipment, the following documentation on the resin used to manufacture the HDPE manholes, pipes, fittings, supports, and gussets.

NEED

1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the HDPE products for this Subcontract. Need

NEED

2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the HDPE products assigned to the project.
3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the HDPE products to be used for this project.

or recycled

C. Submit at least 30 calendar days prior to installation of any material covered by this Section, Manufacturer's written certification of compliance with these Specifications for that material. Include in this certification of compliance a final inspection and a written record of this inspection. The inspection shall include the following:

1. HDPE manholes, including attached pipes, fittings, supports, gussets, and appurtenances;
   a. dimensional check;
   b. material quality check;
   c. weld quality; and
   d. leak check;

NEED

2. HDPE pipes, fittings, and appurtenances:
   a. dimensional check; and
   b. material quality check.

D. Submit at least 14 calendar days prior to installation documentation of training and certification of personnel qualified for performing HDPE manhole installation and HDPE pipe joining operations.

TABLE 02605-2

REQUIRED HDPE PIPE AND FITTINGS PROPERTIES
ASTM D 3350 CELL CLASSIFICATION PROPERTIES AND RANGES

Properties	Cell Range	Qualifiers	Units	Specified Values	Test Method
Specific Gravity	3	minimum	N/A	0.94	ASTM D 1505
Melt Flow Index	4 or 5	maximum	g/10 min	<0.15	ASTM D 1238 (Condition E)
Flexural Modulus	5	minimum	lb/in^2	110,000	ASTM D 790
Tensile Strength	4 or 5	minimum	lb/in^2	3,000	ASTM D 638
Environmental Stress Crack	3	minimum	hrs	F_{20} > 192	ASTM D 1693
Hydrostatic Design Basis at 73°F	4	minimum	lb/in^2	1,600	ASTM D 2837
UV Stabilizer	C	minimum	% Carbon Black	2	ASTM D 1603

[END OF SECTION]

For FDF - Further Clarification

Comments on Submittal No. 77 (Dated 14 April)

Reference: Submittal No. 24 (No. 77 is supposed to be response to comments on No. 24)

Submittal No. 24 indicated that the pipe run data would be submitted to assure quality products per the specification. That is still requested. Also we would like a copy of the Quality Assurance Manual for the type pipe and day the pipe run is made. The QA manual for revison date January 9, 1997, and no longer valid after 04/15/97, indicates that Driscopipe 1000 pipe may not meet specification requirements. If this is the valid QA manual please confirm.

Specifications (1.04 A8) require submittal of minimum Manufacturer certifiable values for HDPE materials listed in Tables 02605-1 and 02605-2. Table 2 is for the pipe and fittings and is attached. Submittal No. 24 provided "Typical" physical properties which met the specifications, but also noted that specimens taken from the pipe or for that matter specimens made from the run material, may differ from those in the table. Submittal No. 77 stated that the distributor (we also assume the manufacturer) certifies that the pipe being shipped

was made to specifications under Section 02605 Section 1.04 B1, B2, B3 and C2. This is good, and we assume the requested paper (copies of QC certificates for the resin etc and tests conducted by the Manufacturer to verify quality) will be coming before pipe is put into the ground. What about certifiable values in accordance with table 2 (Specification 1.04 A8)? See also Specification section 2.02 B last sentence "Furnish material having minimum certifiable property values listed in Table 02605-2." This is the bottom line and they must certify and submit certifiable values that meet the properties listed in the table.

(2)

SCO

REGIONAL OFFICE
3110 LINWOOD AVE.
CINCINNATI, OHIO 45208
800-546-4726
513-871-9512
FAX 513 871-9614

Monday, April 14, 1997

Howard Milliron
Village Building Services Inc.
7311 Vine Street
Cincinnati OH 45216

Dear Howard:

This letter is in regards to several questions you have regarding the **LCS Project** at Femald.

First, the Phillips Quality Assurance Plan and the resin quality assurance letter that was submitted was for the 4100 Series which should have been for the 1000 Series. The 4100 Series meets all the characteristics of the 1000 Series (PE 345434C according to ASTM D3350). The 1000 Series Quality Assurance Plan and resin quality assurance letter will be sent over as soon as I receive it.

Second, Phillips Driscopipe plants are ISO 9000 certified and that is why the Quality Assurance Plan has an expiration date of when it is printed. This is a control document that must be updated as changes are made to it.

Lastly, in regards to the pipe that is shipping, we certify that it was made to all specifications required by the specification identified under **Section 02605 - 1.04 B1,B2,& B3 and C2** of the LCS project.

It is worth noting that Phillips Driscopipe manufactures the resin it uses in the production of the pipe.

Sincerely,

Chris Gilmore
Regional Sales Manager

POLYETHYLENE PIPE
FITTINGS & FABRICATIONS

GEOTEXTILE FABRICS

UTILITY & INDUSTRIAL

IRRIGATION SUPPLIES

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2929 NORTH CENTRAL EXPRESSWAY, SUITE 300
P.O. BOX 00-0000
RICHARDSON, TEXAS 75083 • 214/783-2660

March 30, 1997

Chris Gilmore
ISCO Industries
3110 Linwood Ave.
Cincinnati, OH 45208

Post-it® Fax Note 7671	Date	# of pages ▶ 9
To Chris Gilmore	From P. Lauzon	
Co./Dept. ISCO	Co.	
Phone # 513-871-9574	Phone #	
Fax #	Fax #	

RE: Driscopipe 1000 Series Pipe

Dear Mr. Gilmore

This letter is being written at your request concerning Driscopipe 1000 series pipe. Driscopipe 1000 series pipe is manufactured from Phillips Marlex TR-480 feedstock resin and does not include any post-consumer-reclaim resin. The resin has a cell class of PE 345434C according to ASTM D3350. This is a high density, high molecular weight polyethylene resin which meets the criteria for a Type III, Class C, Category 5, Grade P34 piping material in accordance with ASTM D-1248. Driscopipe 1000 pipe, has a Plastic Pipe Institute recommended hydrostatic basis of 1600 psi at 23° C and also 35°C/1300 psi based on TR/3 as derived from ASTM D-2487 test methodology.

Sincerely,

Peter A. Lauzon
Quality Assurance Engineer

PAL:sl

Quality	Driscopipe 1000	Phillips Driscopipe A Division of Phillips Petroleum Company
Assurance		Date of Issue: June 01, 1994
Manual	Page 1 of 8	Revision Date: January 9, 1997

1. Document Control

1.1. Changes to this document are authorized by the Division Quality Manager.

1.2. This document is also available on the LAN system under *o:\manual\prodspec* for viewing and printing.

1.2.1. **Brownwood Plant**
1.2.2. **Hagerstown Plant**
1.2.3. **Pryor Plant**
1.2.4. **Startex Plant**
1.2.5. **Watsonville Plant**
1.2.6. **Williamstown Plant**

2. Scope

2.1. Driscopipe 1000 is a general purpose pipe series used either in gravity flow or pressure rated applications. The piping systems are manufactured to the requirements of ASTM F714 for sizes larger than 3" IPS (90 mm). Smaller sizes are manufactured to the requirements of ASTM D3035. This section covers the materials to be used and the quality assurance procedures to be followed when producing Driscopipe 1000 pipe.

3. Reference Documents

3.1. ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

3.2. ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

4. Materials

4.1.1. The resin to be used for the extrusion of Driscopipe 1000 is :
4.1.1.1. TR-480 compound
4.1.1.2. TR-480 natural (TR480N) with M5252a concentrate
4.1.1.3. TR-480 natural (TR480Z) with M362 concentrate
4.1.1.4. Hoescht or Fina GM5010T2
4.1.1.5. Novacor HD-2007H with DX1637 concentrate.

4.2. Clean uncontaminated regrind of like materials produced in a Phillips Driscopipe manufacturing plant may be used. Mixing of regrind types is not permissible.

4.3. The use of regrind is not permitted in sizes smaller than 2" IPS.

5. In-Process Inspection and Testing

5.1. All tests are performed in accordance with the Driscopipe Test Methods Manual or referenced ASTM test methods unless otherwise noted.

6. Melt Flow

6.1. Frequency

6.1.1. Melt Flow is run on all sizes of pipe. Test the samples for every production run at startup and on every resin lot change.

6.1.2. Where regrind is used, melt flow must be run on the incoming regrind supply once every 24 hours.

6.2. Specifications

6.2.1. The melt flow must not exceed the following values:

6.2.1.1. Driscopipe 1000 - Melt Index maximum of .18 1.15

6.2.2. Additionally, the melt flow of the finished product must not vary by more than 100% from the base resin melt flow.

6.3. Failure Requirements
If a failure is encountered, all product back to the last passing test is rejected to junk.

7. Conditioned Dimensions
Conditioned Dimensions include Outside Diameter, Minimum Wall Thickness, Maximum Wall Thickness, Eccentricity, Ovality, and Toe-In.

7.1. Frequency
Conditioned Dimensions are run on all pipe sizes. Test for Conditioned Outside Diameter, Wall Thickness, and Eccentricity once per shift on every production run.

7.2. Conditioned Outside Diameter Specifications
Pipe Units (IPS sizes)
Shown in ASTM F714, Table 6 are specifications for IPS sizes larger than 3". The specifications for IPS sizes smaller 3" and smaller are shown in ASTM D3035 Table 1. For sizes not shown in the ASTM standards, the tolerance will be the same as the next smaller listed size.

ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 5.

For sizes not shown in the table, the minimum diameter will be the nominal diameter requested by the customer. The maximum diameter will be 100.9% of the minimum diameter.

7.3. Conditioned Minimum Wall Thickness Specifications
7.3.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The minimum and maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The minimum wall thickness are shown in ASTM F714 Table 8.

7.3.2. ISO Units (mm sizes)
The specifications for ISO sizes 90 mm and larger are shown in ASTM F714 Table 7.

7.3.3. Special Sizes

For sizes not shown in the tables, the minimum wall thickness is calculated by the following equation:

$$t = OD / DR$$

where:

t = minimum wall thickness
OD = nominal outside diameter
DR = design ratio (may also be called SDR)

7.4. Conditioned Maximum Wall Thickness Specifications

7.4.1. Pipe Units (IPS sizes)

Sizes 3" IPS and smaller
The maximum wall thickness are shown in ASTM D3035 Table 2.

Sizes larger than 3" IPS
The maximum wall thickness are 120% of the minimum wall thickness.

7.4.2. ISO Units (mm sizes)
Sizes through 1372 mm
The maximum wall thickness are 120% of the minimum wall thickness.

7.5. Conditioned Eccentricity

For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, eccentricity must not exceed 12% (ASTM F714 section 5.2.4). There are no eccentricity specifications for other sizes.

7.6. Conditioned Ovality Specifications

Ovality must not be more than 5%.

7.7. Conditioned Toe-In Specifications

For IPS sizes larger than 3" and for ISO sizes 90 mm and larger, toe-in must not exceed 1.5% (ASTM F714 section 5.2.4). There are no toe-in specifications for others sizes.

7.8. Failure Requirements

Joints

Check preceding and following joints until all failures are isolated. Direct all failures to regrind.

Coils

Isolate the following coil and all preceding coils to the last sample that met specifications. Direct all failures to regrind.

8. Joint Length

8.1. Frequency

8.1.1. Joint length is measured once per day on each extrusion outlet. Test findings should be referenced in the remarks column.

8.2. Specifications

8.2.1. Joint length must be no less than 99.5% or 101% longer than the specified joint length

8.3. Failure Requirements

If a joint length test fails, all affected production should be isolated. The affected production can be reworked if possible. The affected production can be sold to the customer if written authorization has been received from the customer, end user, or market manager. If it is not possible to rework or to sell the product, the affected production shall be directed to regrind.

9. Hoop Strength Tests: Quick Burst and Ring Tensile

Both the Quick Burst and the Ring Tensile tests measure the hoop strength of the pipe. For pipe sizes 4" IPS (115 mm) and smaller the Quick Burst test method must be used. For sizes larger than 4" IPS (115 mm), either test may be used.

9.1. Frequency - The hoop strength shall be tested once on startup and after a major process interruption.

After the product has passed the startup or major process interruption test, the sampling frequency is one specimen every 24 hours.

> 3000

9.2. Quick Burst Testing Specifications

The specimens must burst at a minimum of 2900 psi hoop stress. The specimen burst also must be ductile or semi-ductile. Pressure is calculated from the hoop stress by the following formula.

$$P = (2 \times S) / (DR - 1)$$

where:

P = pressure in psi
S = hoop stress in psi
DR = dimension ratio (also called SDR)

Table 1

Minimum Burst Pressures for Selected DR's (psi)

Dimension Ratio	Required Burst Pressure
32.5	184
26	232
21	290
19	320
17	363
15.5	400
13.5	465
11	580
9.3	699
9	725
8.3	806
7.3	921

9.3. Ring Tensile Testing Specifications
The ring tensile test specimens must exceed a ring stress of 2520 psi.

9.4. Failure Requirements
At start up and after a major process interruption the product that is produced prior to passing requirements, shall be directed to regrind. If a failure occurs on the once per 24 hour test, a second test can be made on a pipe specimen produced immediately adjacent to the failed test specimen. If a second specimen is not available, or if the second specimen also fails the test, then all production back to the last successful test shall be isolated. The isolated production and the joint or coil immediately following the test specimen shall be directed to regrind. If the second specimen passes the test, the product has passed the hoop strength test requirements. The results of the second specimen shall be recorded.

10. Reverse Bend Test

10.1. Frequency
The reverse bend test shall be run on all product 8" IPS (200 mm) and larger. The test shall be run on every production run on startup and once every 24 hours thereafter.

10.2. Reverse Bend Specifications
The tested specimen must show no signs of surface separation, cracking, partial or complete fracture except those originating from a rough edge of the specimen.

10.3. Failure Requirements
All product back to the last passing test specimen shall be isolated. The isolated product and the joint immediately following the failed test specimen shall be directed to regrind.

11. Workmanship and Appearance

11.1. Frequency
The workmanship and appearance shall be inspected once every 24 hours.

11.2. Specifications
Where die lines are present, the depth of the line must not cause the minimum wall thickness of pipe to be violated. The depth of the line also must not exceed .01 inch if it is on the inside diameter or .002 inch if it is on the outside diameter surface. Product exceeding this requirement may be accepted with prior approval of the customer.

The inside and outside diameter surfaces must be free of blisters and gels.

Where Dents are present they must be no larger in diameter than 5% of the pipe minimum wall thickness. They also must not be deeper than 5% of the wall thickness and must not violate the pipe minimum wall thickness.

There must be no voids visible to the unaided eye.

There must be no chatter marks on the outside diameter of the pipe. Chatter marks on the inside diameter of the pipe must be no more than 1/4" or must have a wavelength no less than 6".

11.3. Failure Requirements
All product that is rejected shall be directed to regrind.

12. Print Requirements
12.1. Frequency
The print string shall be visually inspected at startup and once every 12 hours thereafter.

12.2. Specifications
12.2.1. Type
Print may be either offset or hot foil type.

12.2.2. Color
The print string for Driscopipe 1000 shall be green. Best Practices recommends Matthews type 625 Light Green 1-0002-909-65.

12.2.3. Size
All pipe sizes 1-1/4" IPS (40 mm) and larger shall be a minimum of 3/32" high. The print size for product smaller than 1-1/4" IPS (40 mm) shall be 1/8

12.2.4. Print String
Except where it is shown to be optional, the following information shall be printed on the pipe in the sequence listed. The pipe must be printed at each end and at intervals of no more than five feet.

Size - Example: 4" IPS or 630 mm
Dimension Ratio - Example: DR 11 or DR 17

Product - Example: Driscopipe 1000
Cell Class - For Driscopipe 1000 it is PE345434C unless less than 3" diameter, then PE 3408.

ASTM Basis - For sizes larger than 3" IPS(90 mm) it is ASTM F714. For IPS sizes 3" and smaller, it is ASTM D3035. For metric sizes smaller than 90 mm, it should be omitted.
Pipe Test Category - For Driscopipe 1000 it is C3
Plant Identification -
Extruder Number
Date - Example: 02 Apr 93
Operator Number
Shift Letter - This is optional.
Resin Supplier Code - P for Phillips.

A printline example for Driscopipe 1000 larger than 3" IPS is shown in Figure 1, and 3" IPS and smaller is shown in Figure 2.

12.3. Failure Requirements - Product that fails the print specifications must be corrected prior to shipment.

13. Carbon Black Content

13.1. Frequency - This test is required for all blended production of natural resin and concentrate. Unless otherwise directed by the corporate quality manager, the blend percentage for each extrusion line shall be tested three times during a 24 hour period unless that blend percentage has been shown to be in statistical process control. The test frequency for extrusion lines documented to be in statistical process control is once per 24 hours per extrusion line. The corporate quality manager may set a different test frequency by issuing a letter stating the new frequency and the effective time period.

13.2. Specifications -The requirement for carbon black percentage is 2.0% to 3.5%.

13.3. Failure Requirements - If a test fails the specifications, a second test shall be conducted from the same piece of pipe. If the second test also fails, the pipe shall be sent to regrind.

Figure 1

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe larger than 3" IPS

Example: 14" DR-21 Driscopipe® 1000 series Pipe made in Startex, SC.

14" IPS	DR 21	Driscopipe 1000	PE345434C	ASTM F714	C 3	ST 5	08 April 94	14 A	P
Iron Pipe Size	Dimension Ratio	Mfr. Name and Prod. Series	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder #	Prod Date	Oper. # and Shift Code	Resin Code

Figure 2

Pipe Printline • Example •

1000 series Industrial & Municipal Pipe 3" IPS and smaller

Example: 2" DR-11 Driscopipe® 1000 series Pipe made in Startex, SC.

2" IPS	DR 11	Driscopipe 1000	PE3408	ASTM D3055	C 3	ST 5	08 April 94	14 A	P
Iron Pipe	Dimension Ratio	Mfr. Name and Prod.	Cell Class	ASTM Basis	Pipe Test Category	Plant Code & Extruder	Prod. Date	Oper. # and Shift	Resin Code

926 Baxter Avenue
P. O. Box 4545
Louisville, Kentucky 40204
(502) 583-6591

To: Village Building Services

Attention: Mayur K.

Fax Number: (513) 761-1896

Your P. O. 4177 Shipped 4/14/97 should receive 4/15/97

Shipped To: 7400 Willey Road

Cincinatti, Ohio 45030

From Louisville, Kentucky

VIA:

UPS: Ground Red Blue 3-Day

Tracking #

Truckline: Freight Transport

Pro #:

Other:

Complete: X Partial Back Ordered Items:

Please pass this information on to the person most interested in timely receipt of this shipment. For your convenience, should the shipment be delayed, you will find the carrier data included for your direct tracing needs. We appreciate your business and thank you.

024

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	1	P. Payne	Bin		
	1	R. McGuire	64		
	1	M. Gordber	64		
	1	T. Russell	64		
	6	U. Builders	Bin		

RECEIVED BY: James C. Jenkins DATE: 8/14/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☐ NO COMMENTS ☒ COMMENTS RECEIVED J.C. Jenkins DATE: 8/14/97

REVIEW COORDINATOR

1268

0002007

SUPPLIER SUBMITTAL

DATE: 08/05/97

WORK ORDER NO.: 1700 | SUBCONTRACT NO.: 589 | SUPPLIER SUBMITTAL NO.: 024 R/3

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216

RECEIVED BY: E. Jarrett DATE: 8/6/97

SIGNATURE: Mayur P. Kadakia

DOCUMENT FAMILY X RESUBMITTAL X

SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C
8	SK-0197-008	1							X	X		HDPE Fittings for LCS/LDS Manholes (10 sheets)			X		Section 02605	X		

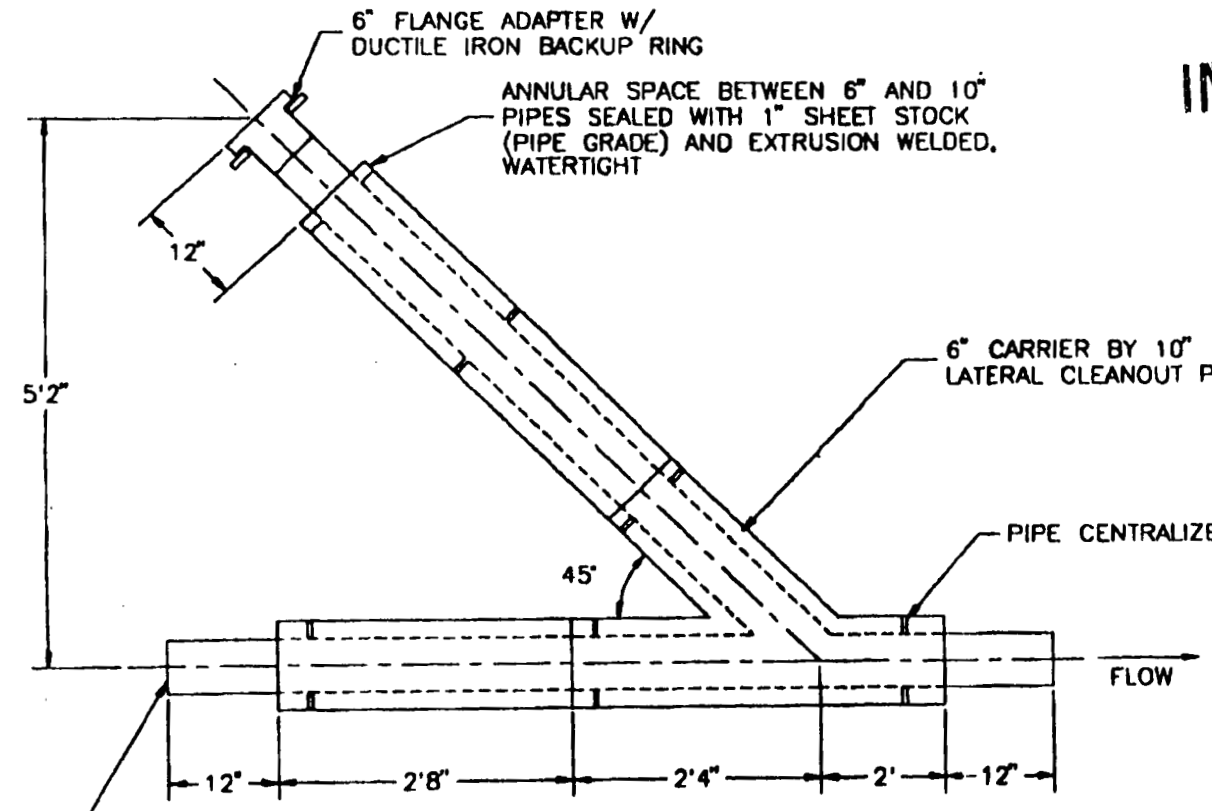
REMARKS: Notes Sheet 8 gives typical pipe connection detail where sleeves are being used. This detail should be used for all sleeve connections and corrected or noted that butt fusion ~~or electrofusion is~~ may be used for 6 inch pipe if possible. Note Sleeve SDR for 12" is SDR 13.5 (ID of 10.86"), SDR 15.5 (ID 11.10") may need to be used. [redacted] Ideal Fit. D. Baldino

DOCUMENT FAMILY CODE: (BY SUPPLIER)
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL
CON - CONSTRUCTION PRO - PROCUREMENT
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL
~~APPROPRIATE DOCUMENT FAMILY ABOVE~~

SUBMITTAL ACTION CODE: (BY SUPPLIER)
CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD
INF - INFORMATION
~~CFC - CERTIFIED FOR CONSTRUCTION~~
APPRORIATE SUBMITTAL ACTION CODE

SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
C - REVISE AND RESUBMIT
D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREM

1298



INFORMATION ONLY

6" PIPE TO BE ELECTROFUSED FOR CONNECTION TO MANHOLE
10" PIPE TO BE CONNECTED USING 12" SLEEVE WITH EXTRUSION WELDS

SHT M4A – SECT A

• ALLPIPING TO BE SDR 26
SERIES 100 DRISCOPIPE
UNLESS NOTED OTHERWISE

Reference Contract
Dwg. No.: 90X-6000-M-00063
Section-A

ISCO

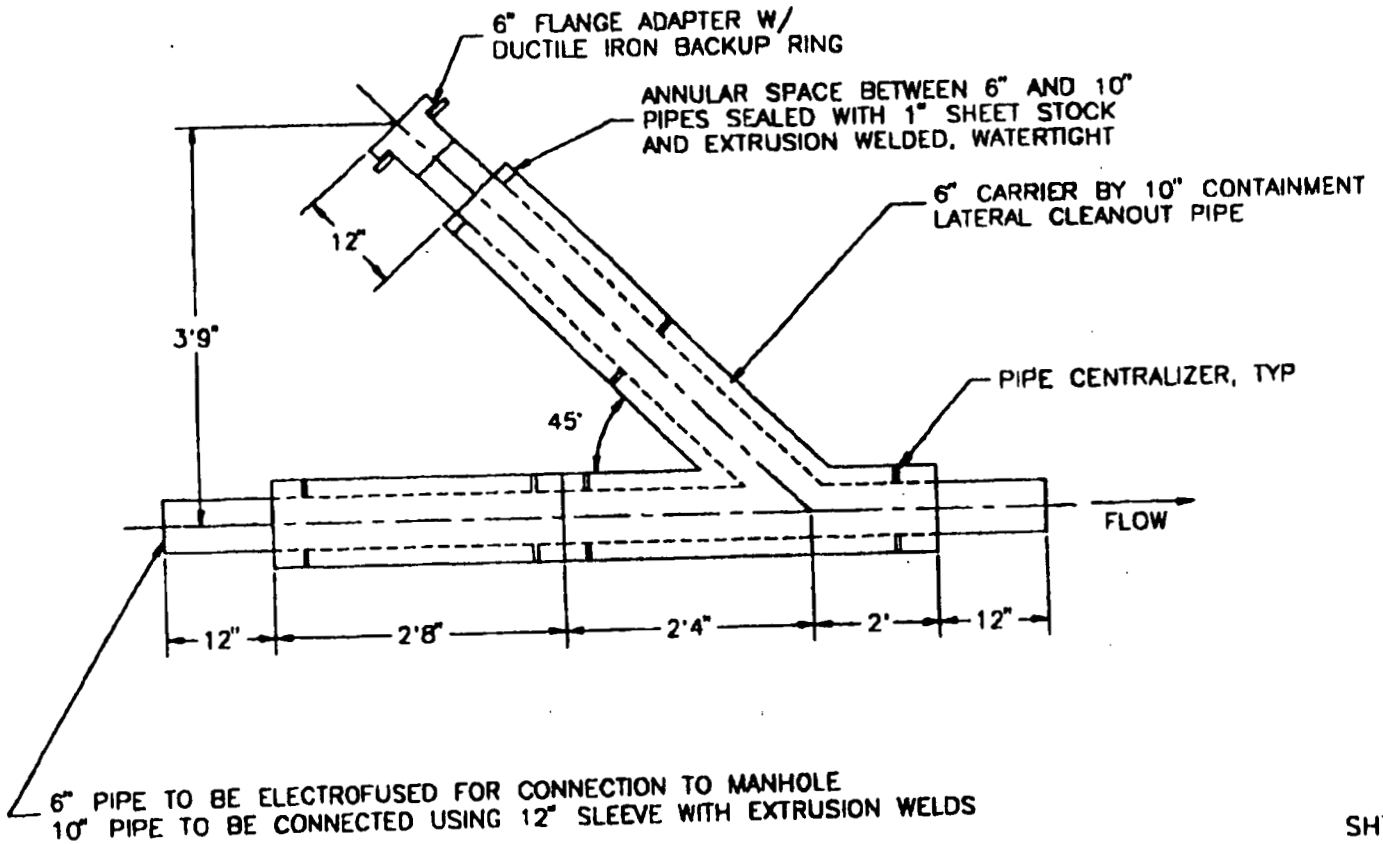
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-6591

VILLAGE BUILDING SERVICES	
LDS 10"/6" CLEANOUT	
CELLS 1 THROUGH 3	
DATE: 6/17/97	SPH
SK-0197-006	R1

Sheet 1 of 1ø

1268

000209



SHT M5A – SECT A

• ALL PIPING TO BE SDR 26
SERIES 1000 DRISCOPIPE
UNLESS NOTED OTHERWISE

Reference Contract
Dwg. No.: 90X-6000-M-00064
Section-A

ISCO

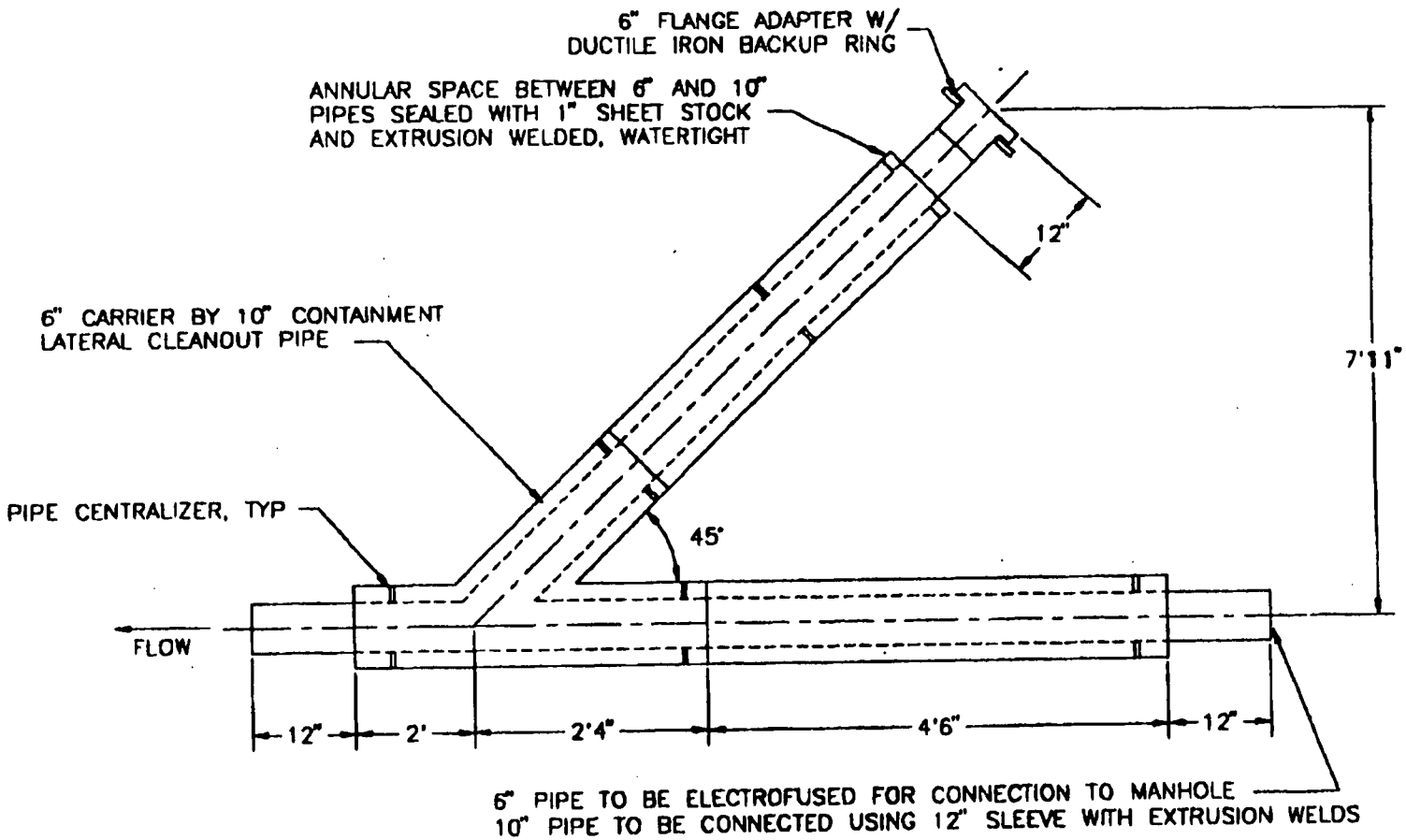
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4543
LOUISVILLE, KY. 40204
(502)583-8591

VILLAGE BUILDING SERVICES	
LCS 10"/6" CLEANOUT	
CELLS 1 THROUGH 3	
DATE: 6/17/97	SPH
SK-0197-006 R1	

Sheet 2 of 10

1268

000210



SHT M5A - SECT C

• ALL PIPING TO BE SDR 26 SERIES 1000 DRISCOPIPE UNLESS NOTED OTHERWISE.

Reference Contract
Dwg. No.: 90X-6000-M-00064
Section-C

ISCO

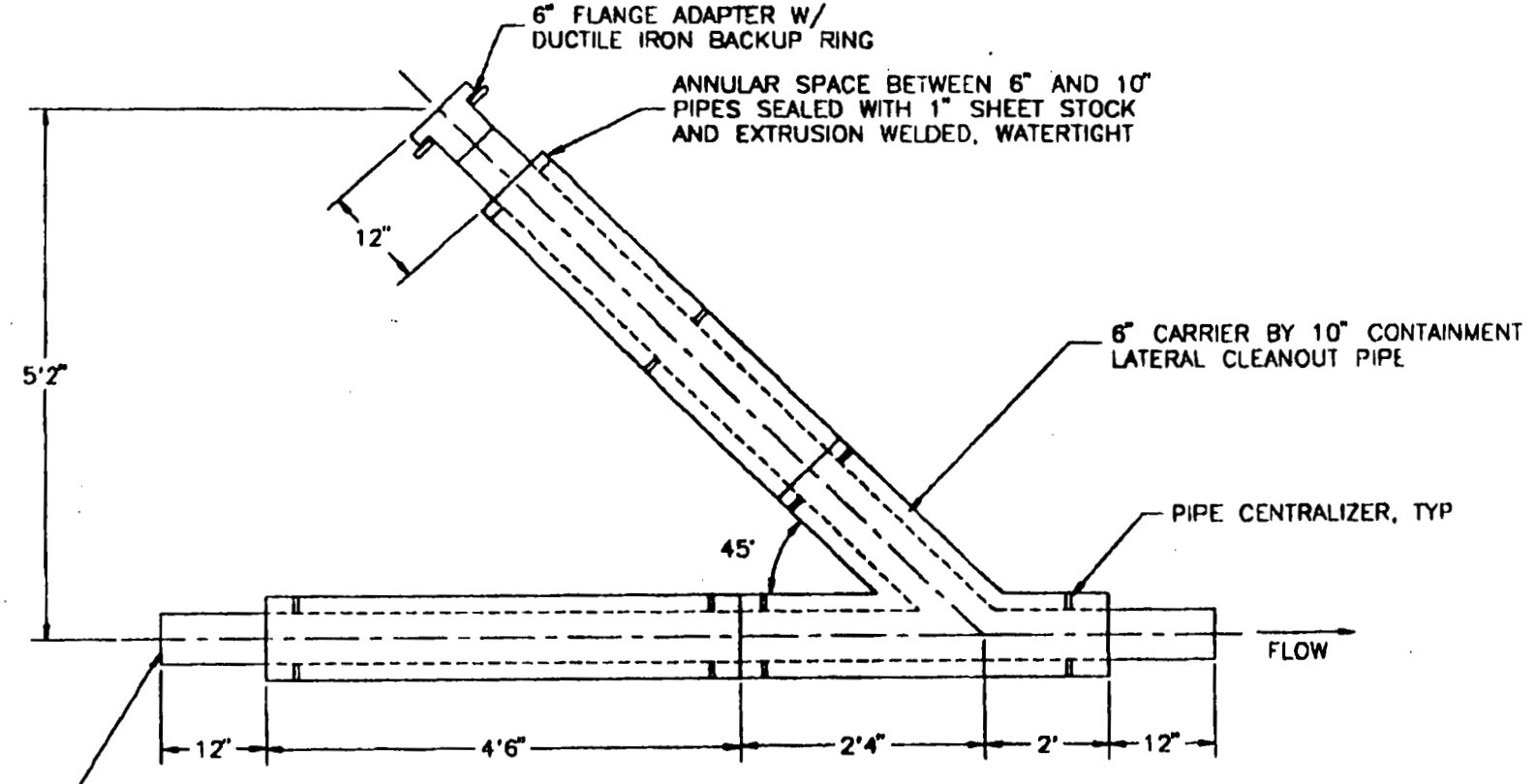
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-6591

VILLAGE BUILDING SERVICES	
LTS 10"/6" CLEANOUT	
CELLS 2 AND 3	
DATE: 6/17/97	SPH
SK-0197-006	R1

Sheet 3 of 10

1268

000211



6" PIPE TO BE ELECTROFUSED FOR CONNECTION TO MANHOLE
10" PIPE TO BE CONNECTED USING 12" SLEEVE WITH EXTRUSION WELDS

SHT M5A – SECT B

• ALL PIPING TO BE SDR 26 SERIES 1000 DRISCOPIPE UNLESS NOTED OTHERWISE.

Reference Contract
Dwg. No.: 90X-6000-M-00064
Section-B

ISCO

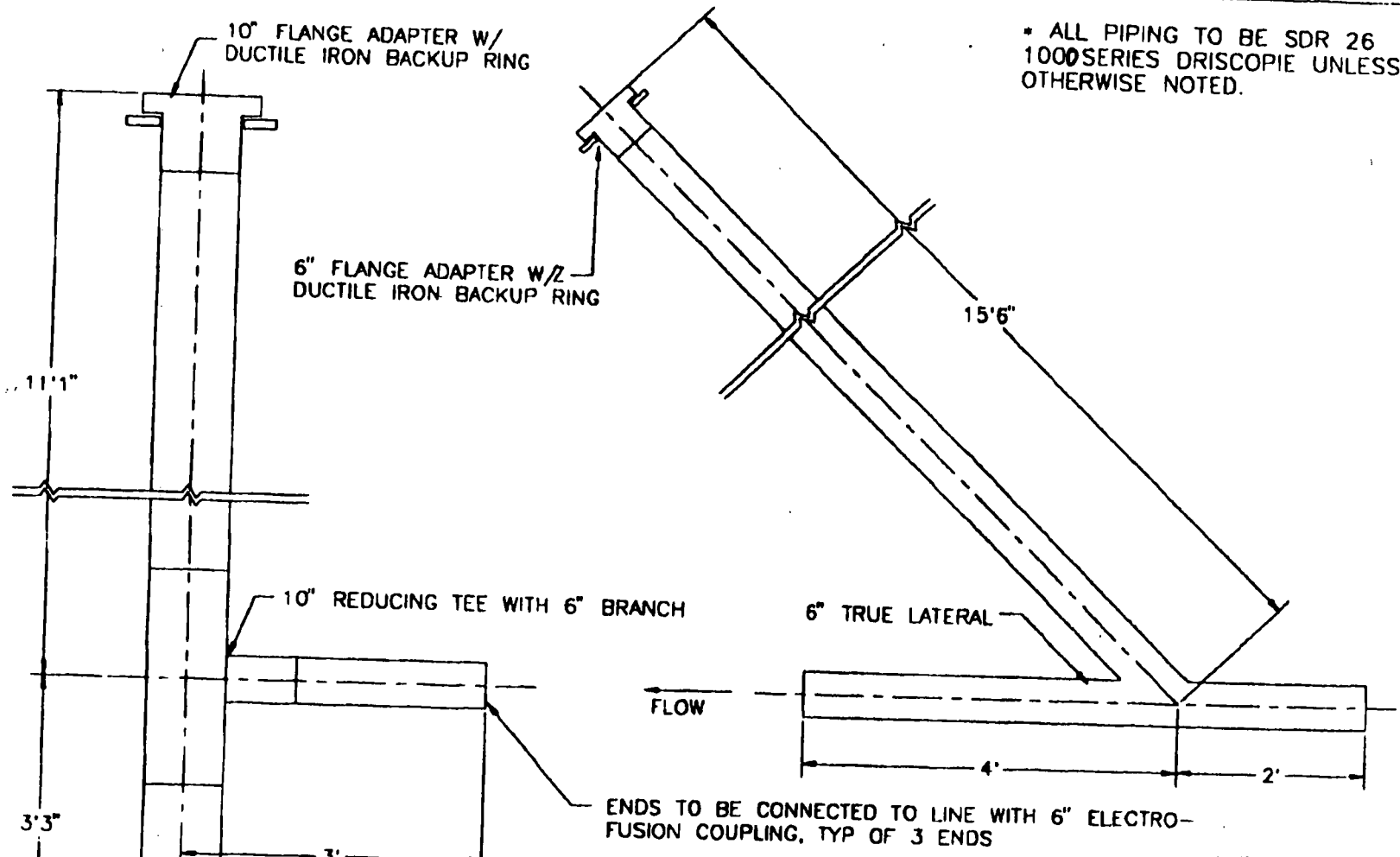
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-8591

VILLAGE BUILDING SERVICES	
LCS 10"/6" CLEANOUT	
CELLS 1 THROUGH 3	
DATE: 6/17/97	SPH
SK-0197-006 R1	

Sheet 4 of 10

1268

000212



* ALL PIPING TO BE SDR 26
1000 SERIES DRISCOPIE UNLESS
OTHERWISE NOTED.

Reference Contract
Dwg. No.: 90X-6000-M-00066
Detail-32

SHT M6B – DET 32

ISCO

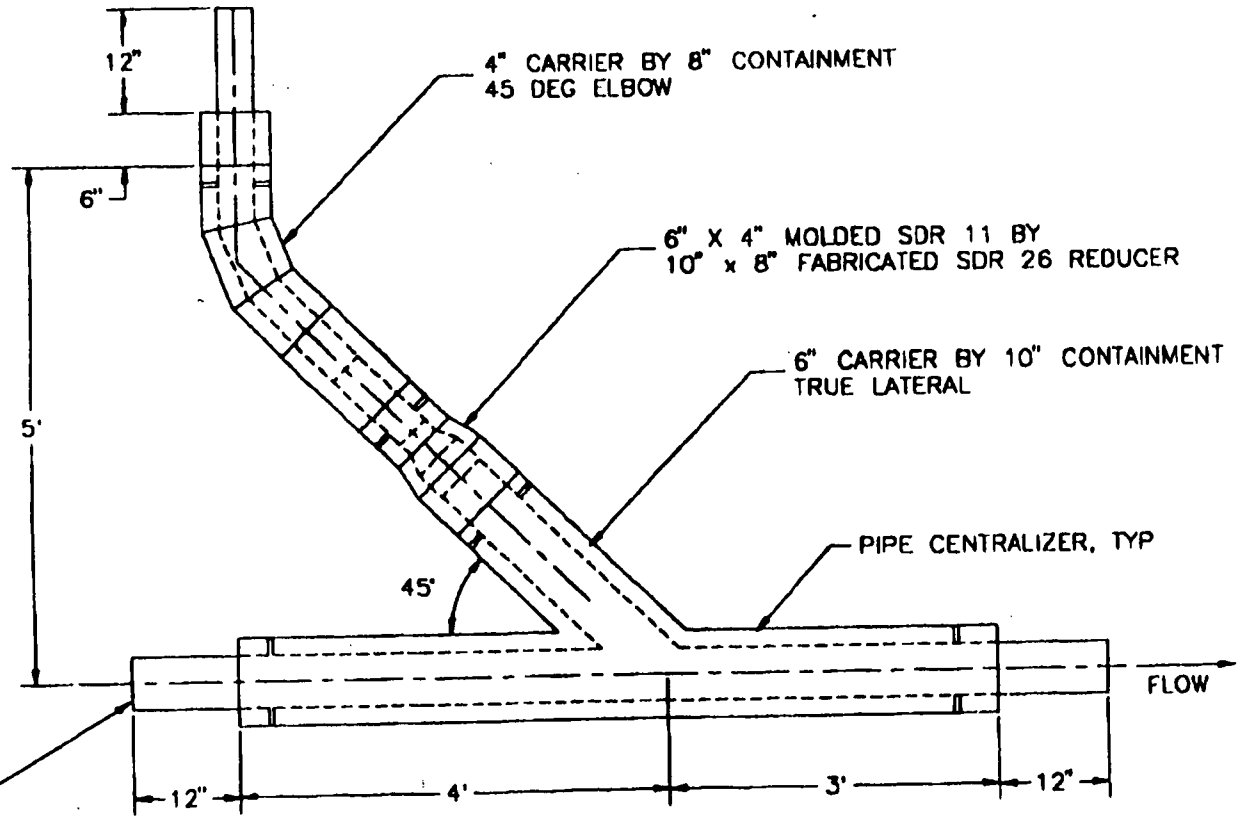
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY 40204
(502)583-6591

VILLAGE BUILDING SERVICES
HORIZ. MONITORING WELL
DATE: 6/18/97 SPH
SK-0197-006 R1

Sheet 5 of 10

000213

2968



CARRIER PIPE TO BE ELECTROFUSED FOR CONNECTION TO LINE
CONTAINMENT PIPE TO BE CONNECTED USING SLEEVE WITH
EXTRUSION WELDS, TYP 3 PLACES
SEE SLEEVE DETAIL

SHT M6B – DET 34

• ALL PIPING TO BE SDR 26
SERIES 1000 DRISCOPIPE
UNLESS NOTED OTHERWISE

Reference Contract
Dwg. No.: 90X-6000-M-00066
Detail-34

ISCO

ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-6591

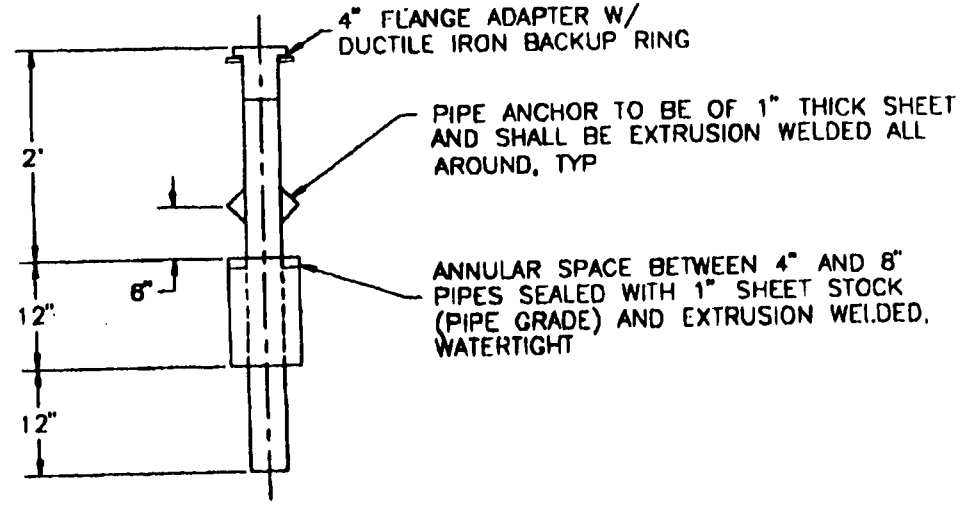
VILLAGE BUILDING SERVICES	
8"/4" TEMP. CLEANOUT	
DATE: 8/18/97	SPH
SK-0197-006	R1

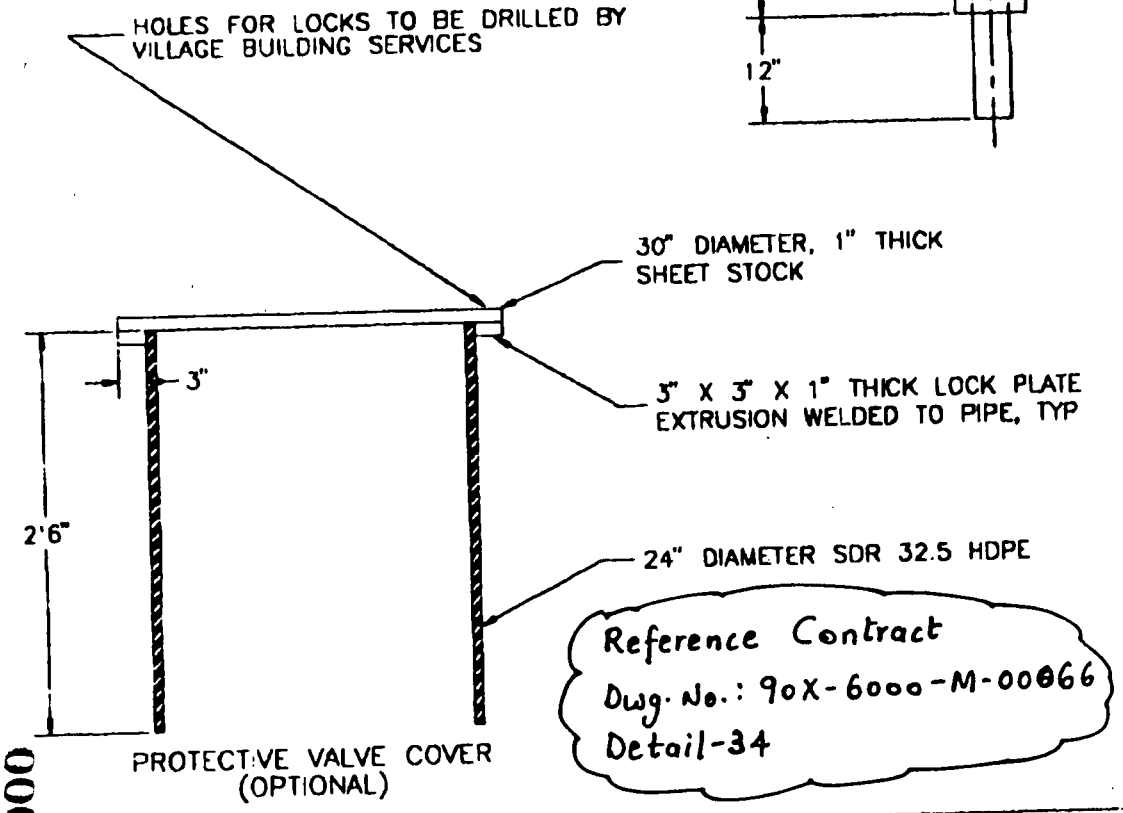
Sheet 6 of 10

000214

1268

* ALL PIPING TO BE SDR 26 SERIES 1000 DRISCOPIPE UNLESS NOTED OTHERWISE





Reference Contract
Dwg. No.: 90X-6000-M-00066
Detail-34

SHT M6B – DET 34

ISCO

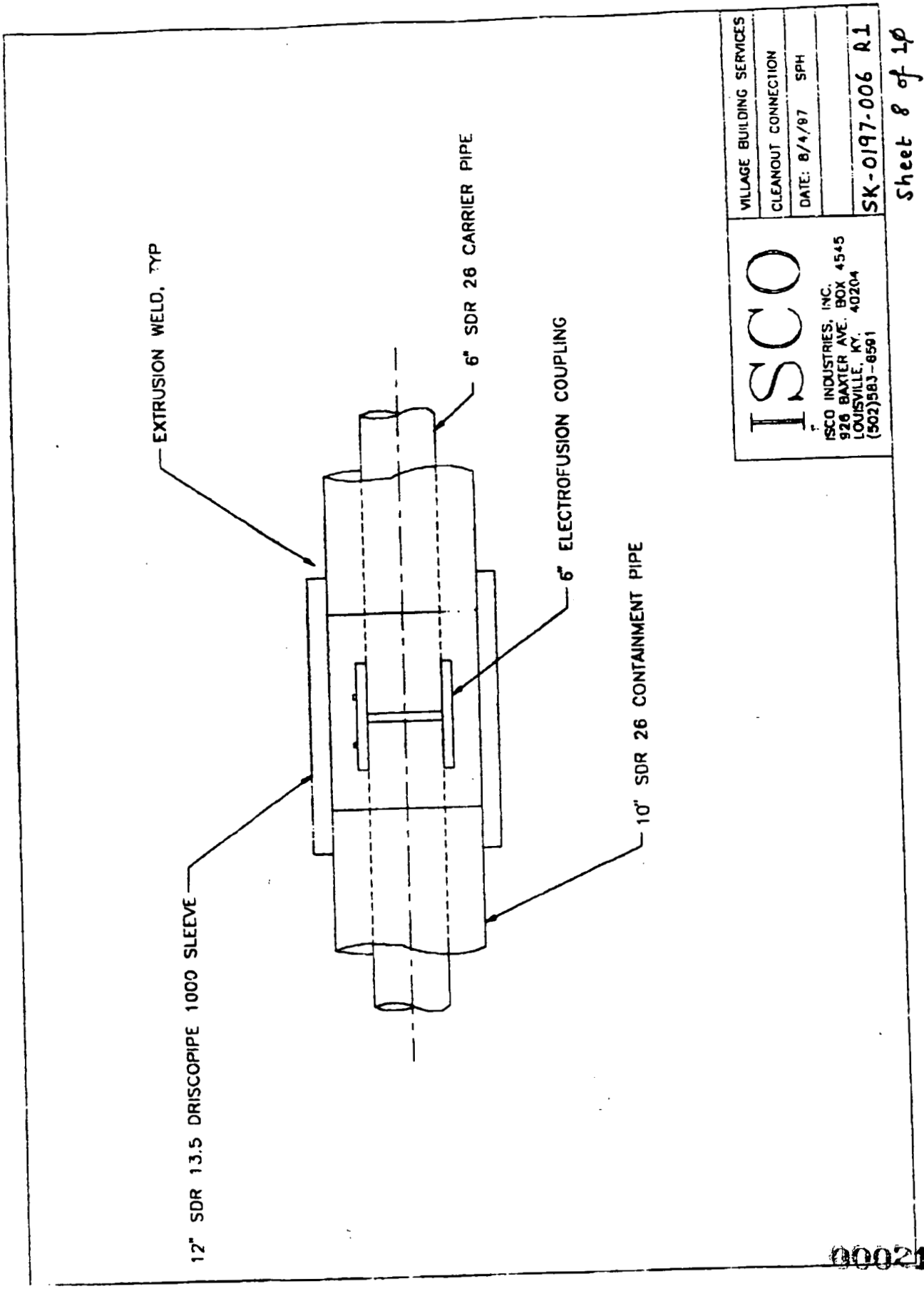
ISCO INDUSTRIES, INC.
928 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-8591

VILLAGE BUILDING SERVICES	
8"/4" TEMP. CLEANOUT TOP	
DATE: 6/18/97	SPH
SK-0197-006	R1

Sheet 7 of 10

1268

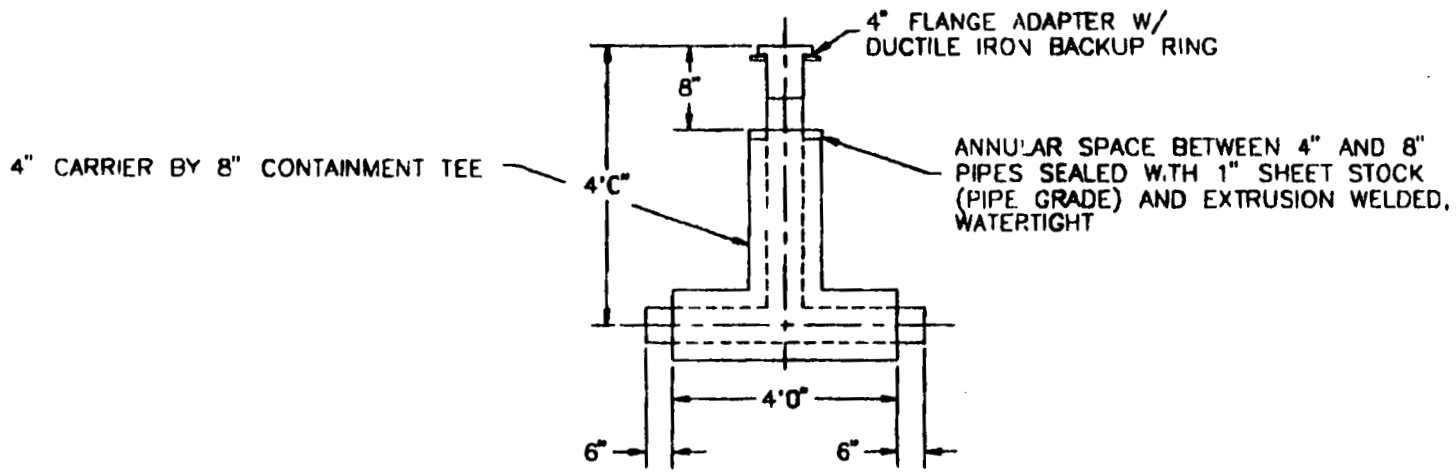
000215


EXTRUSION WELD, TYP
6" SDR 26 CARRIER PIPE
6" ELECTROFUSION COUPLING
10" SDR 26 CONTAINMENT PIPE
12" SDR 13.5 DRISCOPIPE 1000 SLEEVE
ISCO
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-8501
VILLAGE BUILDING SERVICES
CLEANOUT CONNECTION
DATE: 8/4/97 SPH
SK-0197-006 R1
Sheet 8 of 10

* ALL PIPING TO BE
SERIES 1000 DRISCOPIPE
UNLESS NOTED OTHERWISE

4" SDR 17

8" SDR 26



SHT M9A – SECT A

Reference Contract
Dwg. No.: 90X-6000-M-00067
Section-A

ISCO

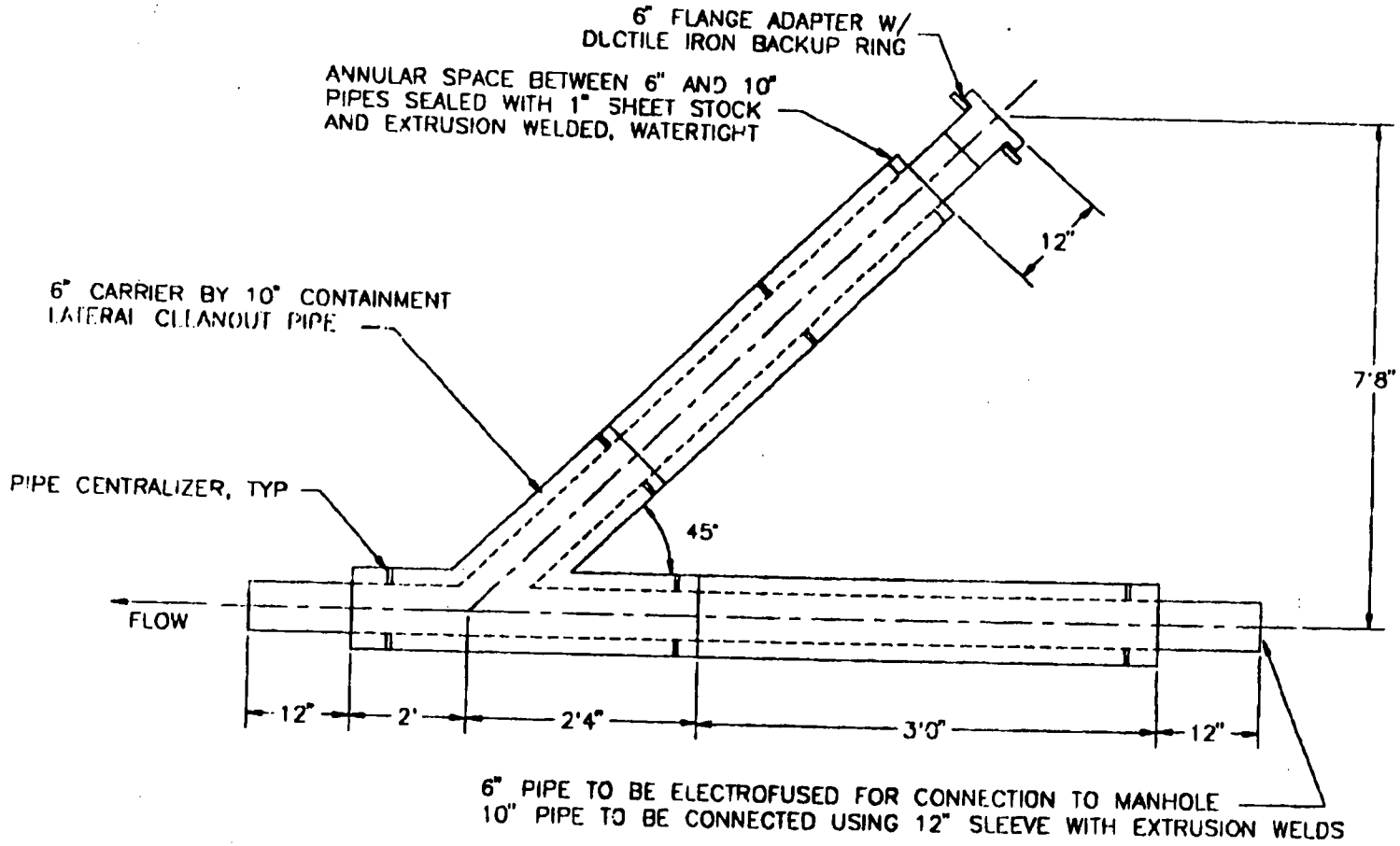
ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-6591

VILLAGE BUILDING SERVICES
8"/4" AUX. CONNECTION
DATE: 8/4/97 SPH
SK-0197-006 RØ

Sheet 9 of 10

1268

000117



* ALL PIPING TO BE SDR 26 SERIES 1000 DR SCOPIPE UNLESS NOTED OTHERWISE.

Reference Contract
Dwg. No.: 90X-6000-M-00067
Section-A

SHT M9A – SECT A

ISCO

ISCO INDUSTRIES, INC.
926 BAXTER AVE. BOX 4545
LOUISVILLE, KY. 40204
(502)583-6591

VILLAGE BUILDING SERVICES	
10"/6" CLEANOUT	
PERM. LIFT STATION	
DATE: 8/4/97	SPH
SK-0197-006	RØ

Sheet 1Ø of 1Ø

FERMCO SUBMITTAL DISTRIBUTION #24 R1

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	Please sign & date ORIGINAL FILE COPY Return to CDC ms/44 MENT	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	GeoSyntec	64		
	1	Parsons	Bin		
	1	Rick McGuire	64		
	1	Mike Godber	64		
	1	Tracy Russell	64		
	6	Village Bldrs	Bin		

RECEIVED BY: James C. Jenkins DATE: 6/19/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

RECEIVED JUN 24 1997

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 6/19/97

REVIEW COORDINATOR

ORIGINAL FILE COPY

000219

1268

VBS-HDP-000 1268
R/1

IRRIGATION SUPPLY CO., INC.

REGIONAL OFFICE
3110 LINWOOD AVE.
CINCINNATI, OHIO 45208
800-546-4726
513-871-9512
FAX 513-871-9514

A - Conforms to the Subcontract Requirements
B - Minor Comment - Incorporate and Resubmit
C - Revise and Resubmit
Date: 6/19/97

Tuesday, February 18, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati OH 45216

Dear Mayur:

Attached are the submittals that are required for the **Leachate Conveyance System** at Fernald. They are in the following order:

- **Typical Physical Properties sheet - page 1**
- **Dual Containment Details - page 2 & 3**
- **Flange Adapter Details - page 4**
- **Ductile Iron Back Up Rings - page 5**
- **Electrofusion Couplings (If Necessary) - page 6**

I will, also, supply the run data on the pipe once it has run to assure quality products are provided per the specifications.

Please let me know if there are any further questions regarding this information.

Sincerely,

Chris Gilmore
Territory Sales Manager

ATTCH.

INFORMATION ONLY

POLYETHYLENE PIPE
FITTINGS & FABRICATIONS

GEOTEXTILE FABRICS

UTILITY & INDUSTRIAL

IRRIGATION SUPPLIES

DRISCOPIPE 1000 series

Typical Physical Properties⊕

Property		Specification	Unit	Nominal Value
Material Designation		PPI / ASTM		PE 3408
Material Classification		ASTM D-1248		III C 5 P34
Cell Classification		ASTM D-3350		3 4 5 4 3 4 C
Density	(3)	ASTM D-1505	gm/cm^3	0.955
Melt Index	(4)	ASTM D-1238 (216 kg/190°C)	gm/10 min.	0.11 ◆
Flex Modus	(5)	ASTM D-790	psi	135,000
Tensile Strength	(4)	ASTM D-638	psi	3,200
ESCR	(3)	ASTM D-1693	F_o, Hours	> 5,000**
HDB @73° F	(4)	ASTM D-2837	psi	1,600
U-V Stabilizer	(C)	ASTM D-1603	% C	2.5
Hardness		ASTM D-2240	Shore "D"	65
Compressive Strength (yield)		ASTM D-695	psi	1,600
Tensile Strength @ Yield (Type IV Spec.)		ASTM D-638 (2" / min.)	psi	3,200
Elongation @ Yield		ASTM D-638	%, minimum	8
Tensile Strength @ Break (Type IV Spec.)		ASTM D-638	psi	5,000
Elongation @ Break		ASTM D-638	%, minimum	750
Modulus of Elasticity		ASTM D-638	psi	130,000
ESCR				
(Cond. A,B,C: Mold. Slab)		ASTM D-1693	F_o, Hours	> 5,000
(Compressed Ring • pipe)		ASTM F-1248	F_o, Hours	> 3,500
Slow Crack Growth		Battelle Method	Days to Failure	> 64
Impact Strength (IZOD) (.125" Thick)		ASTM D-256 (Method A)	ln-lb / in notch	42
Linear Thermal Expansion Coef.		ASTM D-696	in / in /°F	1.2×10^{-4}
Thermal Conductivity		ASTM D-177	BTU-in/ft²/hrs/°F	2.7
Brittleness Temp.		ASTM D-746	°F	< -180
Vicat Soft. Temp.		ASTM D-1525	°F	257
Heat Fusion Cond.			psi @ °F	75 @ 400

⊕ This list of typical physical properties is intended for basic characterization of the material and does not represent specfic determinations of specifications. The physical properties values reported herein were determined on compression molded specimens prepared in accordance with Procedure C of ASTM D 1928 and may differ from specimens taken from pipe.

** Tests were discontinued because no failures and no indication of stress crack initiation.

◆ Average Melt Index value with a standard deviation of 0.01

Distributed by: IRRIGATION SUPPLY CO., INC.
926 BAXTER AVE.
P. O. BOX 4545
LOUISVILLE, KY 40204
502-583-6591

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To secure product information or leave a message for a sales engineer or technical service representative:
Phone: 1-800-527-0662
Phone: 1-214-783-2666
Fax: 1-214-783-2689

DRISCOPIPE Dual Wall Fittings

List/Net Worksheet

1000 Series

Dual Wall 90 Degree Ells

Effective: 3-1-94

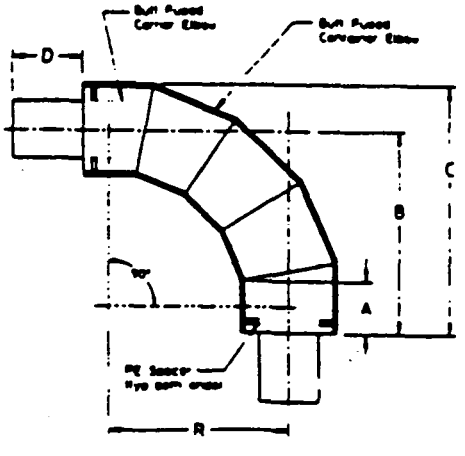
Carrier Pipe	x	Container Pipe	psi	Part Number	Stock	Worksheet Price: List Price		Dimensions, (inches) A	B	C	D	R	Wt. lbs	UPS
2" SDR $\frac{11}{17}$	x	4" SDR 26	$\frac{120}{75}$	10F2X4$\frac{110}{170}$DW90B	N N	$271		5.0	17.3	19.6	6.0	14.8	$\frac{6}{5}$	yes
3" SDR $\frac{11}{17}$	x	6" SDR 26	$\frac{120}{75}$	10F3X6$\frac{110}{170}$DW90B	N N	309		6.0	21.4	24.7	6.0	18.4	$\frac{13}{11}$	yes
4" SDR $\frac{11}{17}$	x	8" SDR 26	$\frac{120}{75}$	10F4X8$\frac{110}{170}$DW90B	N N	362		6.0	22.4	26.7	6.0	19.4	$\frac{22}{19}$	no
6" SDR $\frac{11}{17}$	x	10" SDR 26	$\frac{120}{75}$	10F6X0$\frac{110}{170}$DW90B	N N	521		6.0	23.5	28.8	8.0	20.5	$\frac{48}{40}$	no
8" SDR $\frac{11}{17}$	x	12" SDR 26	$\frac{120}{75}$	10F8X2$\frac{110}{170}$DW90B	N N	750		8.0	30.5	36.9	8.0	26.5	$\frac{93}{77}$	no
12" SDR $\frac{11}{17}$	x	16" SDR 26	$\frac{120}{75}$	10F2X6$\frac{110}{170}$DW90B	N N	929		10.0	38.1	46.1	8.0	33.1	$\frac{186}{148}$	no

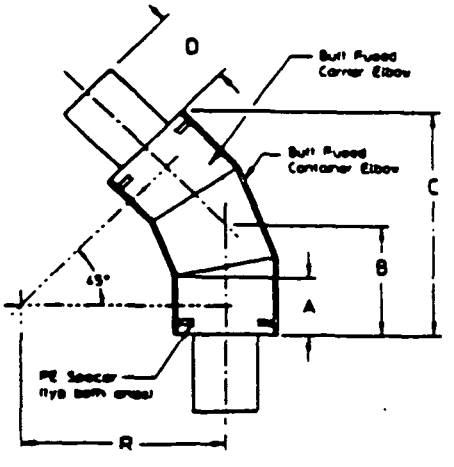
Dual Wall 45 Degree Ells

Effective: 3-1-94

Carrier Pipe	x	Container Pipe	psi	Part Number	Stock	Worksheet Price: List Price		Dimensions, (inches) A	B	C	D	R	Wt. lbs	UPS
2" SDR $\frac{11}{17}$	x	4" SDR 26	$\frac{120}{75}$	10F2X4$\frac{110}{170}$DW45B	N N	$250		5.0	8.6	16.3	6.0	14.8	$\frac{5}{4}$	yes
3" SDR $\frac{11}{17}$	x	6" SDR 26	$\frac{120}{75}$	10F3X6$\frac{110}{170}$DW45B	N N	272		6.0	10.6	20.5	6.0	18.4	$\frac{9}{7}$	yes
4" SDR $\frac{11}{17}$	x	8" SDR 26	$\frac{120}{75}$	10F4X8$\frac{110}{170}$DW45B	N N	342		6.0	11.0	21.9	6.0	19.4	$\frac{14}{12}$	yes
6" SDR $\frac{11}{17}$	x	10" SDR 26	$\frac{120}{75}$	10F6X0$\frac{110}{170}$DW45B	N N	400		6.0	11.5	23.4	8.0	20.5	$\frac{30}{25}$	no
8" SDR $\frac{11}{17}$	x	12" SDR 26	$\frac{120}{75}$	10F8X2$\frac{110}{170}$DW45B	N N	605		8.0	15.0	30.1	8.0	26.5	$\frac{59}{48}$	no
12" SDR $\frac{11}{17}$	x	16" SDR 26	$\frac{120}{75}$	10F2X6$\frac{110}{170}$DW45B	N N	735		10.0	18.7	37.6	8.0	33.1	$\frac{121}{96}$	no

Container pipe is SDR 26 (outside pipe). Carrier Pipe (inside pipe) psi @ 73.4° F





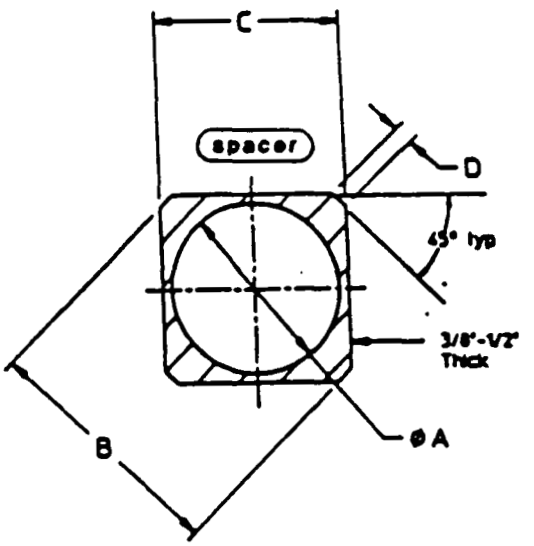
DRISCOPIPE

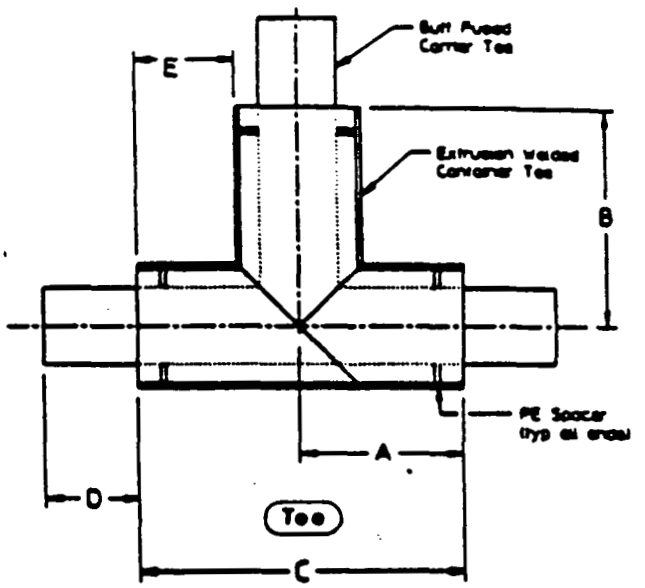
Dual Wall Tees

Worksheet Prices — Effective: 3-1-94

Carrier Pipe	x	Container Pipe	psi	Part Number	Stock	List Price		Dimensions, (inches) A	B	C	D	E	Lbs.	UPS
2" SDR 11	x	4" SDR 26	120	10F2X4110DWTEB	N	$556		8.0	8.0	16.0	6.0	5.8	7	yes
3" SDR 11/17	x	6" SDR 26	120/75	10F3X6110/170DWTEB	N N	684		8.5	8.5	17.0	6.0	5.2	9 8	yes
4" SDR 11/17	x	8" SDR 26	120/75	10F4X8110/170DWTEB	N N	743		14.0	19.5	28.0	6.0	9.7	28 24	no
6" SDR 11/17	x	10" SDR 26	120/75	10F6X0110/170DWTEB	N N	960		14.0	19.5	28.8	8.0	8.6	53 43	no
8" SDR 11/17	x	12" SDR 26	120/75	10F8X2110/170DWTEB	N N	1214		15.0	19.5	30.0	8.0	8.6	83 67	no
12" SDR 11/17	x	16" SDR 26	120/75	10F2X6110/170DWTEB	N N	1350		16.0	19.5	32.0	8.0	8.0	150 117	no

Container pipe (outside pipe) is SDR 26. Carrier Pipe (inside pipe) is psi @ 73.4° F.





Dual Wall Spacers

Worksheet prices — Effective: 3-1-94

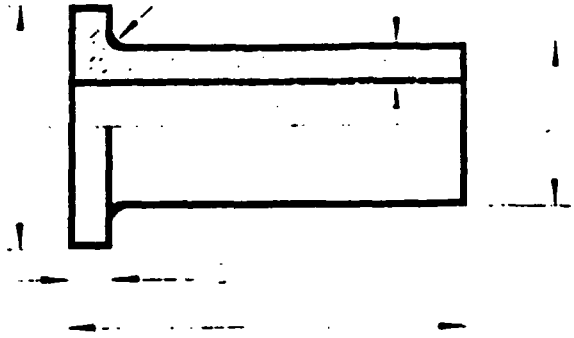
Nominal Size	Part Number	Stock	List Price		Dimensions, inches A	B	C	D	Lbs	UPS
2 x 4 SDR 26	10F2X42600WSPB	N	$30		2.5	4.2	3.3	0.5	1	yes
3 x 6" SDR 26	10F3X62600WSPB	N	23		3.6	6.2	4.6	0.4	1	yes
4 x 8" SDR 26	10F4X82600WSPB	N	26		4.6	8.0	5.9	0.4	1	yes
6 x 10" SDR 26	10F6X02600WSPB	N	41		6.8	10.1	7.5	0.5	1	yes
8 x 12" SDR 26	10F8X22600WSPB	N	56		8.8	11.8	9.5	1.6	1	yes
2 x 4 SDR 11	10F2X41100WSPB	N	$30		2.5	3.7	3.3	0.9	1	yes
3 x 6" SDR 11	10F3X61100WSPB	N	23		3.6	5.5	4.6	1.1	1	yes
4 x 8" SDR 11	10F4X81100WSPB	N	26		4.6	7.1	5.9	1.3	1	yes
6 x 10" SDR 11	10F6X01100WSPB	N	41		6.8	8.9	7.5	1.7	1	yes
8 x 12" SDR 11	10F8X21100WSPB	N	56		8.8	10.5	9.5	2.9	1	yes

Due to pipe tolerances, "B" dimensions may be slightly larger than the ID of the container pipe.

DRISCOPIPE

1000 Series
Effective 1/1/97

Flange Adapters



Nominal Size	s or ns	Dimension Ratio	Type	WPR* psi @ 73.4°F	Part Number	List Price	Dimension, inches L	A	D1	D2	Weight Lbs	UPS
1	s	9.3	molded	190	10M010093ADFLB	$51	4.0	0.2	1.0	2.4	0.5	yes
	s	11		160	110	$51					0.5	
1-1/4	s	9.3	molded	190	10M012093ADFLB	$62	4.0	0.3	1.25	2.8	0.5	yes
	s	11		160	110	$62		0.2			0.5	
1-1/2	s	9.3	molded	190	10M014093ADFLB	$51	4.0	0.3	1.5	3.1	0.5	yes
	s	11		160	110	$51		0.2			0.5	
2	s	7	molded	267	10M020070ADFLB	$26	6.0	0.4	2.0	4.0	1	yes
	s	11		160	110	$22					1	
3	s	7	molded	267	10M030070ADFLB	$28	6.0	0.6	3.0	5.0	2	yes
	s	11		160	110	$27					2	
	s	17		100	170	$27					2	
4	s	7	molded	267	10M040070ADFLB	$34	6.0	0.8	4.0	6.6	3	yes
	s	11		160	110	$30					3	
	s	17		100	170	$30					3	
6	s	7	molded	267	10M060070ADFLB	$71	8.0	1.2	6.0	8.5	8	yes
	s	11		160	110	$45		0.8			7	
	s	17		100	170	$45					7	
	s	26		64	260	$45					7	
8	s	7	molded	267	10M080070ADFLB	$88	11.0	1.6	8.0	10.6	11	yes
	s	11		160	110	$72		0.8			10	
	s	17		100	170	$72					10	
	s	26		64	260	$72					10	
10	s	7	molded	267	10M100070ADFLB	$129	12.0	1.9	10.0	12.8	19	yes
	s	11		160	110	$98		1.3			18	
	s	17		100	170	$98		0.9			17	
	s	26		64	260	$98		0.8			17	
12	s	7	molded	267	10M120070ADFLB	$194	12.0	2.3	12.0	15.0	25	yes
	s	11		160	110	$146		1.5			24	
	s	17		100	170	$146		1.0			23	
	s	26		64	260	$146		0.8			22	
14	s	7	molded	267	10M140070ADFLB	$305	11.0	2.6	14.0	17.5	55	yes
	s	11		160	110	$256		1.7			40	
	s	17		100	170	$256		1.1			38	
16	s	7	molded	267	10M160070ADFLB	$391	12.0	3.0	16.0	20.0	80	no
	s	11		160	110	$308		1.9			60	yes
	s	17		100	170	$308		1.8			45	
	s	26		64	260	$308		0.8			43	

* WPR = Working Pressure Rating

s or ns = Stocked or Non-Stocked Item

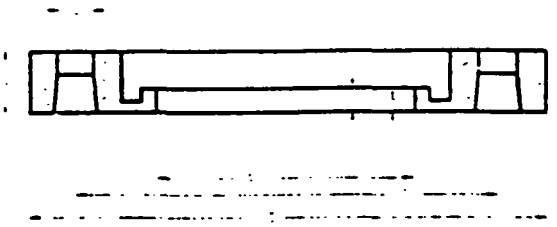
NOTE: Contact your Driscopipe representative for delivery and availability of sizes not listed.

DRISCOPIPE

Ductile Iron Back-Up Rings

The rings will mate with the following flanges:

- Forged steel flanges, Class 150, per ANSI B16.5
- Plate steel flanges, 150 lb. per AWWA C207
- Cast iron flanges, 125 lb. per ANSI B16.1



Convoluted back-up rings, 150# conform to the vital dimensions of ANSI B16.5 such as outside diameter, bolt circle, bolt hole number and size.

The term "convoluted" refers to the cross sectional shape of the ring. The shape allows the usage of less material which affects its original cost as well as shipping and handling costs.

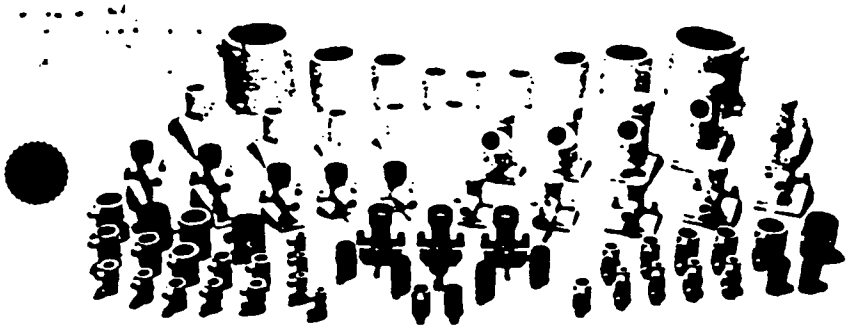
Ductile Iron Material: ASTM 536-80, Grade range from 60/40/18 to 65/45/12.

Finish: Zinc Chromate Primer

(Dimensions are in inches)

Nominal Pipe Size	s or ns	Part Number	List Price	O Nominal Outside Dia. of Ring	Q Minimum Thickness of Ring	W Minimum Diameter of Bore	Y/Y1 Nominal Length thru Hub	n Num. of bolt Holes	C Min. Dia. of bolt Holes	D Dia of Bolt Circle
1-1/4ns	ns	98O0120000FLDSX	$8.30	4.63	0.63	1.72	0.22	4	0.63	3.50
2	s	98O020000FLDSX	$10.50	6.00	0.75	2.63	0.23	4	0.75	4.75
3	s	98O030000FLDSX	$13.50	7.50	0.94	3.75	0.25	4	0.75	6.00
4	s	98O040000FLDSX	$22.80	9.00	0.94	4.75	0.25	8	0.75	7.50
5	s	98O050000FLDSX	$26.10	10.00	0.94	5.81	0.27	8	0.88	8.50
6	s	98O060000FLDSX	$27.50	11.00	1.00	6.880	0.280	8	0.88	8.50
8	s	98O080000FLDSX	$35.00	13.50	1.12	8.880	0.320	8	0.88	11.75
10	s	98O100000FLDSX	$56.60	16.00	1.19	11.000	0.490	12	1.00	14.25
12	s	98O120000FLDSX	$83.70	19.00	1.25	13.130	0.630	12	1.00	17.00
14	s	98O140000FLDSX	$101.00	21.00	1.38	14.380	0.700	12	1.13	18.75
16	s	98O160000FLDSX	$132.90	23.50	1.44	16338	0.7	16	1.13	21.25
18	s	98O180000FLDSX	$173.30	25.00	1.56	1/8.38	0.75	16	1.25	22.75
20	ns	98O200000FLDSX	$236.10	27.50	1.69	20.38	0.88	20	1.25	25.00
21.5/22	ns	98O220000FLDSX	$251.10	29.50	1.79	21.88	0.75	20	1.38	27.25
24	ns	98O240000FLDSX	$289.50	32.00	1.75	24.380	1.000	20	1.38	29.50
28	ns	98O280000FLDSX	$416.90	36.50	1.88	28.380	1.000	28	1.38	34.00
32 (800mm)	ns	98O320000FLDSX	$522.20	41.75	1.88	32.120	1.000	28	1.63	38.50
36	ns	98O360000FLDSX	$661.20	46.00	1.88	36.380	1.000	32	1.63	42.75
40 (1000mm)	ns	98O400000FLDSX	$1,056.60	53.00	1.88	40.000	1.500	36	1.63	49.50
42	ns	98O420000FLDSX	$1,056.60	53.00	1.88	42.380	1.100	36	1.63	49.50
48 (1200mm)	ns	98O480000FLDSX	$1,056.60	59.50	1.88	48.000	1.350	44	1.63	56.00

s or ns = Stocked or Non-Stocked Item



Electrofusion Fittings

Metric Sizes Available
Contact manufacturer for price and delivery

Couplings

Nominal Size (inches)	Part Number	Sugg. Resale
1/2" CTS	575-0035	$7.00
1/2" IPS	575-0036	7.00
3/4" IPS	575-0037	7.55
1" CTS	575-0038	7.55
1" IPS	575-0039	7.55
1 1/4" IPS	575-0040	9.35
1 1/2" IPS	575-0105	15.35
2" IPS	575-0042	9.44
3" IPS	575-0043	17.50
4" IPS	575-0044	30.33
6" IPS	575-0045	90.00
8" IPS	575-0046	105.00

10" & 12" AVAILABLE SOON

Reducers

Nominal Size (inches)	Part Number	Sugg. Resale
3/4" x 1/2" CTS	575-0080	$8.00
1" x 1/2" CTS	575-0081	8.00
1" x 1/2" IPS	575-0082	8.00
1" x 3/4" IPS	575-0083	8.00
1" x 1" CTS	575-0084	8.00
1 1/4" x 1" IPS	575-0085	10.35
1" x 1 1/4" CTS	575-0089	8.00
3" x 2 1/2"	575-0088	P.O.R.

Self-Tapping Tees

Main vs. Outlet (inches)	Part Number	Price
1 1/4" IPS	575-0138	$26.25
(SF) 2" X 3/4" IPS	575-0072	21.05
2" X 1" IPS	575-0059	21.05
(SF) 3" X 3/4" IPS	575-0073	23.20
3" X 1" IPS	575-0060	23.20
(SF) 4" X 3/4" IPS	575-0074	23.20
4" X 1" IPS	575-0061	23.20
6" X 1" IPS	575-0062	31.65
1/4" FMT Pressure Test Cap	692-0338	19.40

High Volume Self-Tapping Tees

Main vs. Outlet (inches)	Part Number	Price
2" X 2"	575-0159	$66.50
3" X 2"	575-0112	68.00
4" X 2"	575-0113	73.50
6" X 2"	575-0114	78.00
1/4" FMT H.V. Pressure Test Cap	575-0320	30.00

* Punch Size: 1 1/4

Branch Saddle

Main vs. Outlet (inches)	Part Number	Price
2" X 2"	575-0158	$34.00
3" X 2"	575-0094	34.75
4" X 2"	575-0095	37.00
6" X 2"	575-0097	40.25
4" X 4"	575-0055	82.50
6" X 4"	575-0056	125.00

Tees, Elbows, Reducers, and End Caps

Conventional/Electrofusion

Reducers

Nominal Size (inches)	Price
1 1/4" X 1" IPS	P.O.R.
2" X 1 1/4" IPS	P.O.R.
3" X 2" IPS	P.O.R.
4" X 2" IPS	P.O.R.
4" X 3" IPS	P.O.R.
6" X 4" IPS	P.O.R.
8" X 6" IPS	P.O.R.

Elbows

Nominal Size (inches)	Price (45°)	Price (90°)
3/4" IPS	-	P.O.R.
1" IPS	-	P.O.R.
1 1/4" IPS	-	P.O.R.
2" IPS	-	P.O.R.
3" IPS	-	P.O.R.
4" IPS	P.O.R.	P.O.R.
6" IPS	P.O.R.	P.O.R.

Tees

Nominal Size (inches)	Price
3/4" IPS	P.O.R.
1" CTS	P.O.R.
1" IPS	P.O.R.
1 1/4" IPS	P.O.R.
2" IPS	P.O.R.
3" IPS	P.O.R.
4" IPS	P.O.R.
6" IPS	P.O.R.

End Caps

Nominal Size (inches)	Price
3/4" IPS	P.O.R.
1" CTS	P.O.R.
1" IPS	P.O.R.
1 1/4" IPS	P.O.R.
2" IPS	P.O.R.
3" IPS	P.O.R.
4" IPS	P.O.R.
6" IPS	P.O.R.
8" IPS	P.O.R.

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- Cleanouts

14 R5

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
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	1	P. Payne	BIN	~~Geo~~ Parsons	
	1	M. Godber	64	~~Pm~~	
	1	T. Russell	64	info	
	6	Village Building	Bin		

RECEIVED BY: James C. Jenkins DATE: 8/01/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

Please Sign/date
ORIGINAL FILE COPY
Return to CDC ms/44

FORWARD COMMENTS TO REVIEW COORDINATOR

OGB

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 8/01/97

REVIEW COORDINATOR

1268

000228

July 8, 1997

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, Ohio 45216

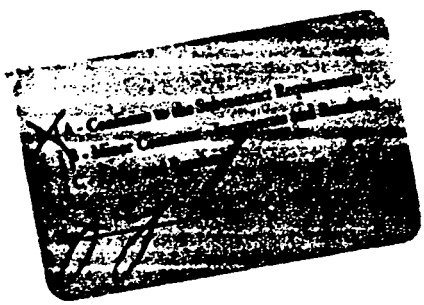
Dear Mayur:

This letter is to inform you that the certification letter dated June 18, 1997 for the 8" SDR 26 series 1000 pipe dated 1/28/96 & 10/31/96 corresponds to the pipe that was used to fabricate the cleanouts. Please contact me at (513)871-9512 with any additional questions, thank you.

Sincerely,

Scott Hoff
Regional Sales Manager

INFORMATION
ONLY



VBS-CC-CERT2

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 1060, CAMP BOWIE INDUSTRIAL PARK
BROWNWOOD, TEXAS 76804
(915) 646-6561

June 18, 1997

TO: Scott Hoff
3766 Ashworth Drive No.3
Cincinnati, OH 45208

Product	Production Date
8" DR-26 1000	01/28/96 & 10/31/96

This is to certify that the product described above and shipped from the Brownwood, TX. Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and has a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 6151379 and 7161455 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test results of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Leo D. Karnes

Leo D. Karnes,
Q.A.Supervisor

LDK/ldk

cc: Certification File

WP/Meltindx

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 476-3866
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 16, 1996

JHV# 927-96

FAX: 915-643-4302

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

ATTN: Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6151379
P.O. Number:	REL 7
Date Shipped:	01/15/96
Package:	PSPX 6789
Quantity:	174300 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM 1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

Entered

Shanta Ludwick
Phillips Driscopipe
P.O. Box 83-3866
Richardson, TX 75083

RECEIVED OCT 2 1 1996

PHILLIPS 66

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 18, 1996

JHV# 21059-96

FAX: 915-643-4102

Phillips Driscopipe
P. O. Box 1060
Brownwood, TX 76801

Leo Karnes

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161455
P.O. Number:	REL 248
Date Shipped:	10/17/96
Package:	PSPX 5987
Quantity:	177000 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

✓

#74 v-4

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	1	M. Godber	64		
	1	P. Pauni	Bin	Parsons	
	1	D. Bodine	38	Geo Syntec	
	1	T. Russell	64	info	
	6	Village Building			

RECEIVED BY: James C. Jenkins

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 8/01/97

Please sign & return
ORIGINAL FILE COPY
Return to CDC MS44

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS

☐ COMMENTS RECEIVED

J. C. Jenkins
REVIEW COORDINATOR

DATE: 8/01/97

1268

000233

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3986
PASADENA TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

January 06, 1997

JHV# 258-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	6161550
P.O. Number:	REL 2
Date Shipped:	01/03/97
Package:	PSPX 2311
Quantity:	171250 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

INFORMATION ONLY

#74R3

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		Parsons			
		Rick McGuire			
		Mike Godber			
		Tracy Russell			
	4	Village Bldrs			

RECEIVED BY: James C. Jenkins
(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 7/10/97

RECEIVED JUL 15 1997 OGB

FORWARD COMMENTS TO REVIEW COORDINATOR

☐ NO COMMENTS

☒ COMMENTS RECEIVED J. C. Jenkins
REVIEW COORDINATOR

DATE: 7/10/97

1268

000235

VQ00

VBS-CO-Test R/O

June 19, 1997

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
By: J. C. [illegible] Date: 7/10/97

Mayur P. Kadakia
Village Building Services Inc.
7311 Vine Street
Cincinnati, Ohio 45216

Dear Mayur:

This letter is to inform you that the cleanouts have been leak tested in the shop prior to shipment to Fernald. All extrusion welds were extruded with a wire under the weld and the weld was then spark tested. The spark test will detect any void which water may pass through. Filling the cleanouts with water sometimes fails to show small voids and potential leakage areas; therefore, ISCO has established this spark testing procedure for all extrusion welded fabrications. This testing procedure is a superior method to ensure that no leakage will occur now or in the future. Please contact me at (513)871-9512 with any additional questions, thank you.

Sincerely,

Scott Hoff
Regional Sales Manager

ISCO INDUSTRIES, Inc.
976 Baxter Avenue
Box 4545
Louisville, KY 40204
P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

FERMCO SUBMITTAL DISTRIBUTION #74 R2

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
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	1	R. McGuire	64		
	1	Grossman	64	Boeline	
	1	M. Godber	64		
	1	T. Russell	64		
	6	Village Bldrs	BIN		

RECEIVED BY: James C. Jenkins

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 6/19/97

RECEIVED JUN 24 1997

FORWARD COMMENTS TO REVIEW COORDINATOR

☐ NO COMMENTS

☒ COMMENTS RECEIVED

J. C. Jenkins

REVIEW COORDINATOR

DATE: 6/19/97

1268

000237

VBS-CO-CERT
#74 R2

ISCO

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

INFORMATION ONLY

Description: 24" Diameter Cleanouts with 4" X 8" Dual Contained Pipe Stubs (Cleanouts 1A, 2, 3, 6, 7, 8 and 9)

Ship Address: Village Building Services
Trailer No. 502
7400 Willey Road
Fernald, Ohio 45030

Ship Date: June 6, 1997

This letter is to certify that the cleanouts described above have been fabricated by ISCO Industries, Inc. in accordance with the following requirements:

ASTM D1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials

ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene Plastic Fitting for Polyethylene Plastic Piping and Tubing

The cleanouts are fabricated in accordance with dimensions and configuration as shown on approved submittal drawing SK-0197-002.

Steve A. Thompson

Steve Thompson
Fabrication Manager

ISCO INDUSTRIES, Inc.
926 Baxter Avenue
Box 4545
Louisville, KY 40204
P 502.583.6591
F 502.584.9713
HTTP //www.isco-pipe.com

ISCO

CERTIFICATION LETTER

Mayur Kadakia
Village Building Services
7311 Vine Street
Cincinnati, Ohio 45216

Description: 24" Diameter Cleanouts with 4" X 8" Dual Contained Pipe Stubs with Wye (cleanouts 10 and 12)

Ship Address: Village Building Services
Trailer No. 502
7400 Willey Road
Fernald, Ohio 45030

Ship Date: June 6, 1997

This letter is to certify that the cleanouts described above have been fabricated by ISCO Industries, Inc. in accordance with the following requirements:

ASTM D1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials

ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene Plastic Fitting for Polyethylene Plastic Piping and Tubing

The cleanouts are fabricated in accordance with dimensions and configuration as shown on approved submittal drawing SK-0197-002.

S. A. Thompson

Steve Thompson
Fabrication Manager

ISCO INDUSTRIES, Inc.
926 Boser Avenue
Box 6545
Louisville, KY 40206
P 502 583 6591
F 502 584 9713
HTTP://www.iscopipe.com

ATTN. ~~Scott Hoff / Jamie Sneed~~
MAYOR

052005 - Village Building Service

6/24/97 SP

CLEANOUT RUN DATA = *

4" IPS DR17 DRISCOPIPE 1000 PE 345434C
ASTM F 714 C3ST9 23 JAN 97 16 P ← *

8" IPS DR 26 DRISCOPIPE 1000 PE 345434C
ASTM F 714 C3ST10 19 OCT 96 36 P ← *

24" IPS DR 26 DRISCOPIPE 1000 PE 345434C
ASTM F-714 03 ST2 29 APR 96 54 P ← *

24" IPS DR 26 DRISCOPIPE 1000 PE 345434C
ASTM F-714 C3ST5 21 NOV 96 3P ← *

King Plastic Corp. Pipe Grade 1" Black JS 3-27-97 Sheet 3,10

King Plastic Corp. Pipe Grade 1/2" Black TC 8-12-96 Sheet 7

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2800 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3088

June 12, 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

PRODUCT		PRODUCTION DATE
4" DR 17	1000	01/23/97

This is to certify that the product described above and shipped from the Starnex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1667 Melt Index of 0.10 G/10 MIN. 71-6-1777 Melt Index 0.13 G/10 MIN 71-6-1873 Melt Index 0.11 G/10 MIN. 71-6-1774 Melt Index 0.11 G/10 MIN. 71-6-1783 Melt Index 0.11 G/10 and 61-6-1550 with the Melt Index of 0.12 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q. A. Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3665
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 06, 1996

JHV# 24243-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	MHM TR-480Z
Lot Number:	7161667
P.O. Number:	REL 266
Date Shipped:	12/05/96
Package:	PSPX 6171
Quantity:	176600 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 798 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 31, 1996

JHV# 25608-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HDM TR-480Z
Lot Number:	7161777
P.O. Number:	REL 288
Date Shipped:	12/30/96
Package:	PSPX 5934
Quantity:	178700 LBS.
Melt Index, ASTM D1238:	.13 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

CC: QA-File-RC

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 10, 1996

JHV# 24454-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HDM TR-480E
Lot Number:	7161673
P.O. Number:	REL 270
Date Shipped:	12/09/96
Package:	PSPX 2511
Quantity:	179950 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 476-[illegible]
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 31, 1996

JHV# 25606-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161774
P.O. Number:	REL 286
Date Shipped:	12/28/96
Package:	PSPX 2151
Quantity:	177800 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3555
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Operations Company

January 03, 1997

JHV# 145-97

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HDM TR-480Z
Lot Number:	7161783
P.O. Number:	REL 1
Date Shipped:	01/02/97
Package:	PSPX 6598
Quantity:	178450 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3088

May 30, 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
8" DR 26 1000	10/18/98

This is to certify that the product described above and shipped from the Startex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1349 Melt Index of 0.11 G/10 MIN., 71-6-1333Melt Index of 0.12 G/10 MIN 71-6-1332 Melt Index of 0.11 G/10 MIN. and 71-6-1338 with the Melt Index of 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.09 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q. A. Supervisor

cc: Certification File

TOTAL P.06

1268

RECEIVED

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3668
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 01, 1996

JHV# 19784-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161349
P.O. Number:	REL 213
Date Shipped:	09/30/96
Package:	PSPX 6707
Quantity:	176250 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3686
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

RECEIVED
SEP 1996

September 26, 1996

JHV# 19441-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161333
P.O. Number:	REL 208
Date Shipped:	09/25/96
Package:	PSPX 5907
Quantity:	177750 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

1268

RECEIVED SEP 27 1996

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3000
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 25, 1996

JHV# 19306-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161332
P.O. Number:	REL 207
Date Shipped:	09/24/96
Package:	PSPX 2396
Quantity:	177700 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3625
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

September 30, 1996

JHV# 19657-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161338
P.O. Number:	REL 210
Date Shipped:	09/27/96
Package:	PSPX 6545
Quantity:	177200 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

June 12, 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
24" DR 26 1000	04/29/96

This is to certify that the product described above and shipped from the Startex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-0247 Melt Index of 0.13 G/10 MIN. 71-6-0246 Melt Index 0.13 G/10 MIN 71-6-0251 Melt Index 0.13 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.08 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q.A. Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 27, 1996

JHV# 6028-96

FAX: 803-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	7160247
P.O. Number:	REL 64
Date Shipped:	03/26/96
Package:	PSPX 6445
Quantity:	169650 LBS.
Melt Index, ASTM D1238:	.13 G/10 MIN
Tensile @ yield:	3477.000 PSI
Tensile @ break:	4896. PSI
Elongation:	700. %
Density, ASTM 1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

1268

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 799 • PHONE 713 475-3966
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 26, 1996

JHV# 5951-96

FAX: 803-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	7160246
P.O. Number:	REL 63
Date Shipped:	03/25/96
Package:	PSPX 2340
Quantity:	179600 LBS.
Melt Index, ASTM D1238:	.12 G/10 MIN
Tensile @ yield:	3395.000 PSI
Tensile @ break:	5112. PSI
Elongation:	700. %
Density, ASTM 1505:	.942 G/CC
ESCR, P/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3568
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

March 29, 1996

JHV# 6253-96

FAX: 803-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

ATTN: Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480N
Lot Number:	7160251
P.O. Number:	REL 66
Date Shipped:	03/28/96
Package:	PSPX 7081
Quantity:	179350 LBS.
Melt Index, ASTM D1238:	.13 G/10 MIN
Tensile @ yield:	3406.000 PSI
Tensile @ break:	4466. PSI
Elongation:	700. %
Density, ASTM 1505:	.942 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS DRISCOPIPE
A DIVISION OF PHILLIPS PETROLEUM COMPANY
2950 NAZARETH ROAD
WELLFORD, SOUTH CAROLINA 29385
(864) 439-3066

June 12, 1997

TO: ISCO INDUSTRIES
Chris Gilmore
3110 Lindwood Ave.
Cincinnati, OH 45208

PRODUCT	PRODUCTION DATE
24" DR 26 1000	11/21/96

This is to certify that the product described above and shipped from the Startex, SC Plant, has been sampled according to statistical sampling plans in compliance with "Recommended In-Plant Quality Assurance Program for Plastic Pipe." Manufactured from resin that meets the Polyethylene Plastics Standard in ASTM D-1248 and was manufactured to the specifications of ASTM F-714 and had a cell classification of 345434C as specified in ASTM D-3350. This product was produced from resin lots 71-6-1498 Melt Index of 0.10 G/10 MIN. 71-6-1504 Melt Index 0.11 G/10 MIN. The MI specification range for this resin is 0.07-0.14 G/10 MIN. The melt index on the In-Process Inspection and Testing was also tested with the test result of 0.07 G/10 MIN. The specification for this test is maximum of 0.18 G/10 MIN. If you have any questions, please do not hesitate to give me a call.

Q. A. Supervisor

cc: Certification File

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

November 05, 1996

JHV# 22178-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161498
P.O. Number:	REL 239
Date Shipped:	11/04/96
Package:	PSPX 5755
Quantity:	177350 LBS.
Melt Index, ASTM D1238:	.10 G/10 MIN
Density, ASTM D1505:	.943 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 478-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

November 06, 1996

JHV# 22306-96

FAX: 864-439-7918

Phillips Driscopipe
Startex Plant
2950 Nazareth Road
Wellford, SC 29385

Dave Nettles

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-480Z
Lot Number:	7161504
P.O. Number:	REL 240
Date Shipped:	11/05/96
Package:	PSPX 6213
Quantity:	177350 LBS.
Melt Index, ASTM D1238:	.11 G/10 MIN
Density, ASTM D1505:	.944 G/CC
ESCR, F/20:	>192 HOURS **

J. H. Vaden
Quality Assurance Manager

For COA questions call Sharon Robinette, 713-475-3625

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

FERMCO SUBMITTAL DISTRIBUTION

#7481

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J. Jenkins	64	Approver	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	M. Godber	64		
	2	Parsons	BIN		
	1	B. Boding	64	GEOSYN	
	1	T. Russell	64	INFO	

RECEIVED BY: James C. Jenkins DATE: 5/13/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 5/13/97

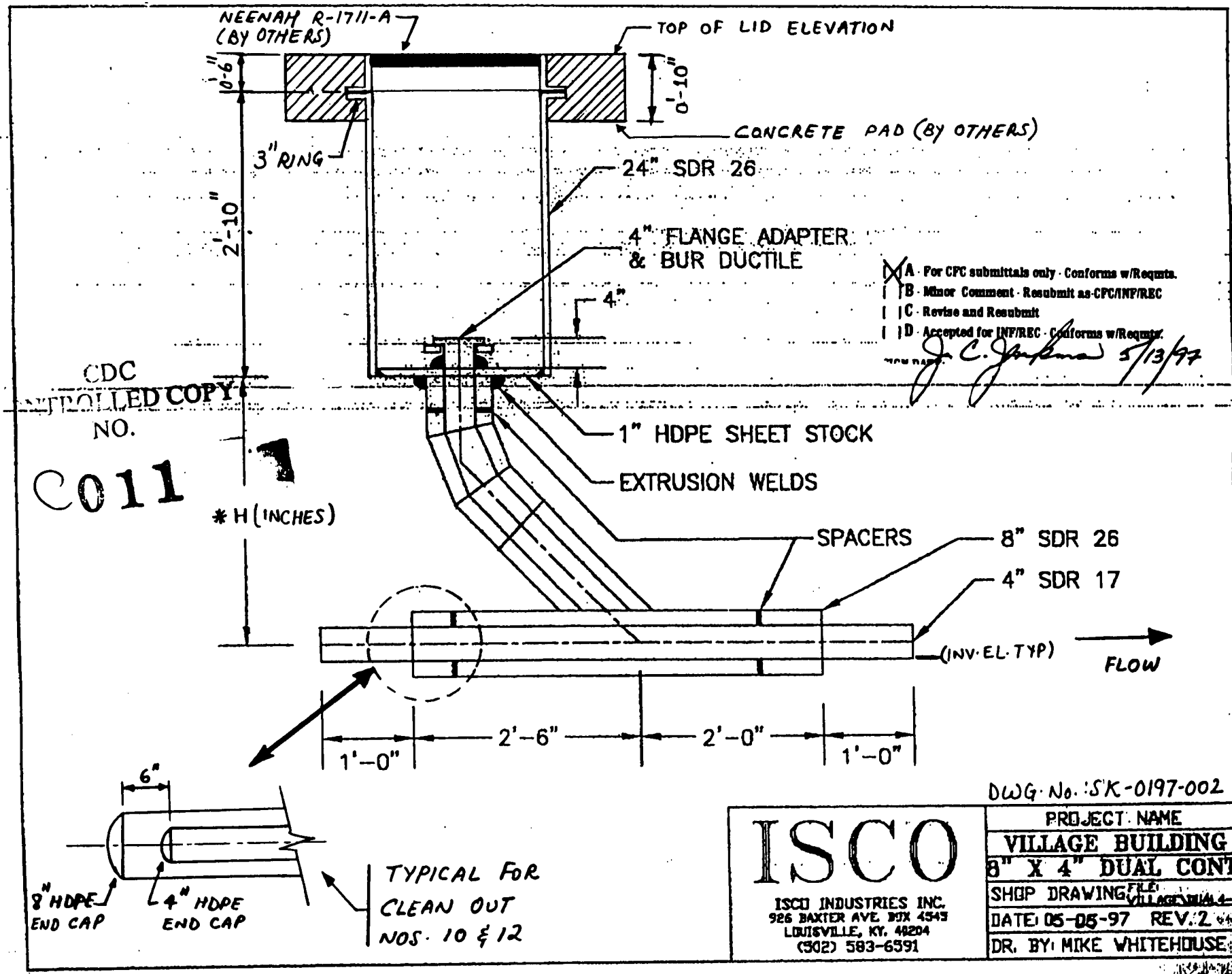
REVIEW COORDINATOR

ORIGINAL FILE COPY

1268

000259

SK-0197-002



A - For CFC submittals only - Conforms w/Reqmts.
B - Minor Comment - Resubmit as-CFC/INF/REC
C - Revise and Resubmit
D - Accepted for INF/REC - Conforms w/Reqmts.

J. C. Jackson 5/13/97

CDC
CONTROLLED COPY
NO.
C011

1268

000260

Leachate [illegible]yance System
Subcontr[illegible] [illegible]SC No.: 589
VBS Job No.: 0197

Cleanout Manholes (Submittal No.: 57)

	MH No.	TOP OF LID ELEV.	MH INV. ELEV.	HEIGHT DIFF (FT)	HEIGHT DIFF (IN)	TOP OF MH FACT.	("H" dim.) HEIGHT OF RISER	BASE FACTOR	BASE TO INV. FAC.	OD OF CARRIER	ID OF CARRIER	DEDUCT FROM "H"	("H1" dim.) C.L OF PIPE
	1	582.00	575.16	6.84	82.08	10.00	72.08	8.00	12.00	4.50	3.938	21.97	50.11
del.	~~1A~~	581.00	573.67	7.33	87.96	10.00	77.96	8.00	12.00	4.50	3.938	21.97	55.99
del.	~~2~~	582.00	575.67	6.33	75.96	10.00	65.96	8.00	12.00	4.50	3.938	21.97	43.99
del.	~~3~~	577.50	570.67	6.83	81.96	10.00	71.96	8.00	12.00	4.50	3.938	21.97	49.99
	4	577.00	567.33	9.67	116.04	10.00	106.04	8.00	12.00	4.50	3.938	21.97	84.07
	5	581.00	574.67	6.33	75.96	10.00	65.96	8.00	12.00	4.50	3.938	21.97	43.99
del.	~~6~~	577.00	570.67	6.33	75.96	10.00	65.96	8.00	12.00	4.50	3.938	21.97	43.99
del.	~~7~~	575.50	566.67	8.83	105.96	10.00	95.96	8.00	12.00	4.50	3.938	21.97	73.99
del.	~~8~~	574.00	565.67	8.33	99.96	10.00	89.96	8.00	12.00	4.50	3.938	21.97	67.99
del.	~~9~~	575.50	568.67	6.83	81.96	10.00	71.96	8.00	12.00	4.50	3.938	21.97	49.99
del.	~~10~~	577.25	567.16	10.09	121.08	10.00	111.08	8.00	12.00	4.50	3.938	21.97	89.11
	11	577.83	570.83	7.00	84.00	10.00	74.00	8.00	12.00	4.50	3.938	21.97	52.03
del.	~~12~~	579.00	570.58	8.42	101.04	10.00	91.04	8.00	12.00	4.50	3.938	21.97	69.07

Clean-Outs (Submittal No.: 74)

CO No.	H1 dim. from COMH	Add Conc. thickness	Top of CO Lid	Deduct MH frame	Deduct 24" Riser	"H" dim. ISCO dwg.	
~~1~~	~~50.11~~	~~10.00~~	~~60.11~~	~~6.00~~	~~34.00~~	~~20.11~~	N/A
1A	55.99	10.00	65.99	6.00	34.00	25.99	
2	43.99	10.00	53.99	6.00	34.00	13.99	
3	49.99	10.00	59.99	6.00	34.00	19.99	
~~4~~	~~84.07~~	~~10.00~~	~~94.07~~	~~6.00~~	~~34.00~~	~~54.07~~	N/A
~~5~~	~~43.99~~	~~10.00~~	~~53.99~~	~~6.00~~	~~34.00~~	~~13.99~~	N/A
6	43.99	10.00	53.99	6.00	34.00	13.99	
7	73.99	10.00	83.99	6.00	34.00	43.99	
8	67.99	10.00	77.99	6.00	34.00	37.99	
9	49.99	10.00	59.99	6.00	34.00	19.99	
10	89.11	10.00	99.11	6.00	34.00	59.11	
~~11~~	~~52.03~~	~~10.00~~	~~62.03~~	~~6.00~~	~~34.00~~	~~22.03~~	N/A
12	69.07	10.00	79.07	6.00	34.00	39.07	

[X] A - For CPC submittals only - Conforms w/Reqmts.
[ ] B - Minor Comment - Resubmit as-CPC/INF/REC
[ ] C - Revise and Resubmit
[ ] D - Accepted for INF/REC - Conforms w/Reqmts.

SIGN-DATE: J. C. Jenkins 5/13/97

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- **Manholes and Permanent Lift Station**

#60

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	2	Parsons	Bin		
	2	Geo Synter	64		
	1	Rick McGuire	64		
	1	Mike Godber	64		
	1	Tracy Russell	64	Info	

RECEIVED BY: Tom Bodine

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 24 Mar 89

FORWARD COMMENTS TO REVIEW COORDINATOR

☐ NO COMMENTS

☐ COMMENTS RECEIVED _____

REVIEW COORDINATOR

DATE: _____

1268

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1268
VBS-PLC-001

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

March 14, 1997

Ms. Gladys Miller
Workman Developments, Inc.
Forks of Coal Industrial Park
Alum Creek, WV 25003

RE: Village Building Services
Fernald Environmental Mangement Project
Leachate Conveyance System

Dear Ms. Miller,

Please find below the submittal information that you requested.

Section 02605: High Density Polyethylene (HDPE) Manholes, Pipes, and Fittings

1.04 Submittals

Section A

✓1. Shop Drawings - previously submitted. ✓
✓2. Not Applicable. (Bill of Material listed on Shop Drawings) ✓
✓3. Not Applicable. (Supplier is Plexco via Workman Developments. Delivery Schedule by VBS)
✓4. Not Applicable. (VBS to supply (may be later) See spec. section 3.07)
✓5. List of completed facilities - attached list.
6. Evidence of Quality Control Procedures - attached Plexco Technical Supplements D-1, D-2 and D-3.
✓7. Resin Origin and Identification - Plexco's manholes, tanks, and structures are produced from pressure rated High Density Polyethylene Material (PE3408) as supplied by Chevron Chemical Company. These materials meet or exceed the ASTM D3350 cell classification of 335434C. The typical physical properties are outlined in Spirolite Bulletin #910. OK Meet Tables 02605-1 and 02605-2 Test Method ASTM D1603 Carbon Black, Referenced in ASTM D1248-8
8. Manufacturer Certifiable Values - This information is contained within Spirolite

Bulletin 910 and Plexco Bulletin 104, six copies of which are being sent overnight to your attention by Muriel Cease in the General Office. OK DGB

Section B

1. Will be provided when fabrication has begun, within the limitations of Number 7 in Section A. OK
2. Will be provided when fabrication has begun. OK
3. Plexco pipe and structures include *rework* material as defined in ASTM F412 and allowed in ASTM F894, ASTM F714, ASTM D3035, AWWA C901, and AWWA C906. Plexco uses no recycled materials.

Section C

1. Will be submitted after fabrication. OK
2. Will be submitted after fabrication. OK

Section D

Not Applicable. Applicable To VBS

In addition to this submittal information, there are some concerns regarding the specifications that you sent. Plexco's Technical Department has reviewed the specifications, and has the following comments:

Section 2.03 I - Permanent lift station shall not have lifting lugs, but must be lifted with nylon straps. OK

Section 2.09 - Manhole foundation and backfill should also meet the following manufacturer's recommendations:

Foundation: Minimum of Class I Material (per ASTM D2321) compacted to a minimum of 95% standard proctor density (as defined by ASTM D698).
Backfill: Class I or II material (per ASTM D2321) compacted to a minimum of 90% standard proctor density (as defined by ASTM D698).

See Shop Drawing

Section 3.09 - Hydrostatic pipe testing to be done in accordance with Plexco's recommendations as outlined in Application Note #8 "System Testing". Please note that this pertains only to the piping and not to the manhole structures themselves. Six copies of this brochure are also being sent to your attention. OK

Section 3.07 - The subcontractor shall not substitute air testing in lieu of hydrostatic testing for manholes or Dual Containment vessels. **Plexco does not recommend pneumatic pressure testing of pipes, manholes or dual containment vessels.** OK Neither does Gwinnett

Please note that Plexco only reviewed those specifications which were sent by Workman Developments. If I can be of any further assistance, please do not hesitate to call. Thank you.

Sincerely,

Steve Reist
Fabrication Manager

cc: Ron Brown
Muriel Cease
Bryan Rabenau

Submittal 1.04..5

List of completed PLEXCO HDPE facilities installed successfully in ground:

1. RCC Landfill, Johnstown, Pa. 96" Leachate manhole, installed by RCC in summer of 1995. 25 feet deep

2. Franklin Ash Landfill, Franklin NH, 1 20,000 gallon 96" diameter horizontal tank, 35 feet long, installed by Pike Industries Oct. , 1995

3. Middleton Municipal Landfill, Middleton, Ma. Two 40,000 gallon tanks, installed horizontally by Mirra Industries. Ten foot diameter tanks were each 30 feet long. Installed in March, 1994

4. BFI Landfill, Detroit, Mi. One eight foot inside of a ten foot dual containment sump structure. This 21 ft. structure was installed vertically in 1992. Installed by Michigan Pipe and BFI jointly.

PLEXCO TECHNICAL SUPPLEMENTS

Reference No.:	D-1	Date Issued:	02/02/94
Subject:	Quality Assurance	Date Superseded:	
Sub-Subject:	Quality Assurance of Polyethylene Pipe	Page:	1 of 6

QUALITY ASSURANCE OF POLYETHYLENE PIPE

American industry increasingly recognizes the value of an effective Quality Assurance/Quality Control Program. The benefits can include optimized raw material usage, more efficient utilization of production time, and improved delivery time, as well as assured quality of the finished product. To be most effective, such a program must be a "team effort" involving both manufacturing and quality control personnel. This presentation details the program developed by PLEXCO, one of the major producers of polyethylene pipe and fittings for the gas distribution industry, and illustrates how the philosophy, "Quality-An Ounce of Prevention", benefits both customers and manufacturers.

Recognition of the chemical inertness and corrosion resistance of polyethylene piping has led to its increasing usage in energy-related industries. In recent years, polyethylene pipe has become widely used in such areas as:

Gas Distribution
Gas Gathering
Power Generation - fly ash disposal, process water, electrical conduit, oil and gas production
Mining - process water, wastewater and slurry lines
Fire Mains, Potable Water

As the acceptance and usage of polyethylene pipe has increased, pipe users have developed more and more stringent product specifications. Pipe may be made out of only a few special polyethylene resins having certain well-characterized properties. Physical dimensions must be closely controller, and the final product must meet minimum physical property standards. The development of an effective quality control program is necessary in order to insure the manufacture of pipe that meets the customer's requirements.

Another consideration is the cost of producing polyethylene pipe. Polyethylene resins are made from petrochemical raw materials. Any dramatic increase in the price of oil will result in a rise in the costs of pipe-grade resins. This, in addition to increased labor and overhead costs, makes necessary a quality program that promotes efficient resin usage and production practices.

A common sense analysis of the aforementioned situations leads to the development of the following list of objectives for our Quality Program:

1. Assure that incoming resin meets all specification criteria.
2. Assure usage of correct resin for a given product.
3. Save on materials due to more efficient use of resin.
4. Optimize extrusion rates for each resin used.
5. Comply with customer specifications.
6. Reduce scrap due to material contamination.

7. Reduce dimensional variances.
8. Reduce scrap due to out-of-specification dimensions.
9. Improve delivery time.
10. Improve product traceability.
11. Assure quality of finished product.

The program that has evolved to meet these objectives involves manufacturing and quality control personnel working together toward a common goal. For purposes of discussion, it can be divided into three phases:

Phase I - Incoming Raw Material Evaluation
Phase II - Pipe Production Quality Control
Phase III - Quality Control/Quality Assurance Department

I. INCOMING RAW MATERIAL

As a independent manufacturer of polyethylene pipe and fittings, PLEXCO does not manufacture resin, but must purchase polyethylene from others. The decision to purchase a specific resin is a long involved process requiring a complete characterization of the raw material. Once the characterization has been completed and detailed specifications have been negotiated with the resin supplier, then Quality Assurance tests on incoming material are scheduled. The pipe compound we receive is in a pellet form; it has been monitored throughout its production by the resin manufacturer. The two basic properties that must be controlled are density and molecular weight (as determined by a melt index test). These tests are run numerous times during the manufacturing process and again on a composite lot basis. A lot number is assigned to the material shipped to PLEXCO.

Each supplier is required to send us a certification at the time of shipment delivery. This certification must contain the results of final density and melt index testing, as well as other tests specified by PLEXCO for a particular resin. These other tests include methods for evaluating molecular weight, molecular weight distribution, environmental stress crack resistance and elevated temperature sustained pressure performance. Complete specification checks are made periodically on randomly selected lots of resin. The specification check is made on the stabilizer systems as well as the physical properties of the resin. The resin is purchased with the supplier's guarantee that all lots meet the agreed specifications.

Nevertheless, problems with resins are sometimes found. Contamination with burn and foreign material sometime occurs as do melt flow rate (melt index) and density problems. If these surface after unloading the material into our feed system, massive and expensive problems may occur. Optimum production depends on receiving material with the correct melt flow properties. Also, quality pipe and fittings cannot be produced from a substandard resin.

Our regular orders are supplied in bulk and shipped to us in railroad hopper cars. These cars contain 170,000 to 185,000 pounds of pelletized polyethylene. Each car is divided into four compartments, with several top hatches and several bottom unloading tubes. When a railcar is received on our siding, a quality control technician checks these access points to be sure all locking seals are in place. This assures us nothing could have fallen inside or been removed. Seal numbers and lot numbers are checked against shipping papers and certification papers for proper identification, and are recorded.

The next step is to open all top hatches and visually inspect for foreign material, objects and pieces of burned material. The bottom tubes are then opened to check for standing water or wet resin. Resin samples are taken at various levels from the top to the bottom of a compartment and are brought back to the laboratory. Small quantities of pellets are placed on a lighted surface to check for proper color and the presence of imbedded foreign material.

Each sample is then melt index tested by our laboratory to establish that the flow rate is as certified by the supplier. The melt index strand is used for density testing. Depending on the resin involved, other tests such as environmental stress crack resistance and high load melt flow, may be run on samples obtained from the railcar. Only after all inspection and testing is complete and found to be acceptable do we unload a railcar.

In addition to the routine testing, resin samples are periodically submitted to an independent laboratory for a complete material analysis. This enables us to watch for subtle changes in the resin that might not be detectable by a melt index or density test, but might affect the end use properties of the pipe.

II. PRODUCTION QUALITY ASSURANCE

Quality Assurance starts before a product is offered for sale. Each specific piece of extrusion equipment operates slightly different. Even extruders that are seemingly identical have differences that may become important in production of quality polyethylene pipe; therefore, each extruder has to be "qualified" to extrude each of the resins used to produce pipe.

The extrusion qualification test is periodically performed by the QA/QC Department. Twice each year samples taken from recent production are placed on a long-term sustained pressure test. One lot of pipe or tubing in the 2" IPS and smaller size range, along with one lot of a size greater than 2" IPS, are selected for this test. Samples from each lot are held under a specific pressure for a minimum of 1000 hours. Failures in this test are usually indicative of problems either in the extrusion process or with resin. A similar program is conducted for molded fittings, so that fittings from each mold cavity are qualified before they are offered for sale.

In order to assure compliance with the long-term strength characteristics of the material, a series of room temperature and elevated temperature sustained pressure tests are periodically performed on commercial production. Pipe from each resin used is tested in accordance with the procedures listed in ASTM D2837 to generate the data necessary for hydrostatically pressure rating of pipe as extruded by PLEXCO.

III. PIPE PRODUCTION QUALITY CONTROL

Quality assurance starts before the receipt of a specific order. Since a significant number of gas utilities have packaging restrictions and test requirements specific to that utility, all customer specifications are reviewed by Technical Services, Manufacturing and Sales Departments before forwarding to the production plants. Also, many of our objectives are not only product quality, but are related to minimizing production costs through improved efficiency. When an order is forwarded to the plant, it is reviewed by all functional departments before being scheduled for production or shipment from inventory.

To assure that the order is run to the proper specifications, we use a Pipe and Tubing Production Sheet. This document lists all pertinent information needed by the set-up person to produce the specified product.

Gas distribution pipe is produced either in coils (sizes up to 4" IPS) or in straight lengths (all sizes). A sample is taken from each coil produced, and approximately three samples per hour are taken during straight length production. The samples are cooled a predetermined length of time, and then the outside diameter and wall thickness are measured. Visual inspection of print and finish also takes place at this time. All data is recorded on a "Production Control Record". Each coil or length is given a serial number and the dimensions recorded for each.

In addition, dimensions are charted once an hour on the "Pipe Wall Dimensional Control Chart" and the "Pipe Diameter Control Chart". The objective here is two-fold: to optimize material usage, as well as to produce quality product. Control limits are established for each chart. The dimensions are plotted once an hour by the hourly production set-up person. The charts are given to the foreman every morning. Updating is done daily or when improved process capability is demonstrated. Changes are based on a 24-hour or 24-data point cycle.

Immediate process control changes are made if the control limits are exceeded at any time. Assistance in maintaining wall thickness control is obtained with ultrasonic and nuclear gamma ray backscatter units. These devices rotate 360 degrees around the pipe, measuring and recording wall thicknesses.

Since field use of tubing frequently requires the use of mechanical fittings, each coil of tubing is checked with a stiffener to insure proper fit of the stiffener.

The final check on the samples is done by a production pipe inspector. This individual measures and records all dimensions on at least one sample per hour. All pertinent quality and production data are recorded. If found acceptable, the samples are presented to the Quality Control/Quality Assurance Department.

IV. QUALITY CONTROL/QUALITY ASSURANCE

The samples from the previous day's production run are brought to the laboratory each morning. These samples are then conditioned prior to dimensional and physical testing. Upon completion of the conditioning period, the samples are subjected to another complete visual and dimensional inspection. Dimensional checks previously made are performed again. These dimensions are final dimensions; they are recorded with the operator data on the "Production Control Record". Visual data, such as finish and print line lot numbers, are also recorded.

At least one sample per shift is now selected for a quick burst pressure test. This test involves pressurizing the sample so that it fails within a prescribed minimum-maximum time period. Flaws that are a result of the manufacturing extrusion process are detected here, as well as major flaws due to contamination.

All production dimensions are now examined and comparisons of final results made. Pipe is dispositioned accordingly, based on product and customer specifications. If all are met, the pipe is released to the shipping department. Out-of-specification materials is scrapped. All dimension and test results are now attached together and filed under the lot number of the run. This provides traceability of product for future reference.

A technique for accelerated testing of production quality is to pressure test pipe samples at elevated temperatures. At PLEXCO, we have the capability of performing hydrostatic pressure tests on pipe at temperatures up to 90°C. Elevated temperature testing of this type has proven to be an excellent method for finding flaws in polyethylene pipe caused by extrusion difficulties or by resin deficiencies. The technique is widely used in Europe, and is also gaining acceptance in this country as a quality control tool for the plastic pipe industry.

Several years ago, PLEXCO began using the Compressed Ring ESCR test as a quality assurance technique. This test is run to ensure that process conditions have not had a deteriorating effect on the performance characteristics of the pipe.

In addition to the production of polyethylene pipe and tubing, PLEXCO also manufacturers a complete line of fittings (tees, elbows, saddle fittings, etc.) for use with our piping. These are either injection molded or, in the case of large tees and elbows, fabricated from miter-cut pipe sections. They undergo the same quality control regimen as the pipe, from resin testing through production quality monitoring to QC/QA Department evaluation. One additional test of fittings is an X-ray radiograph examination to check for voids or cavities inside the wall of the part.

All fitting lots are statistically samples for X-ray evaluation. Where voids are found, entire lots will be examined by X-ray to identify bad parts so that they can be removed from inventory and scrapped. Some fitting types that experience has shown to be particularly susceptible to void formation are checked 100% by X-ray before being released to inventory.

SUMMARY

In these days of intense competition, common sense says a team effort is more important than ever before. Sales, Manufacturing and Quality Control must work together to create an effective Quality Program. When they do, costs are reduced considerably, delivery times are shortened, and the customer receives a quality product.

The importance of a thorough quality program cannot be overstated. It is not possible to produce quality pipe from a substandard resin; however, use of a quality resin does not assure the manufacture of quality pipe. All three areas, incoming resin evaluation, production quality control, and QC/QA Department evaluation, are equally important in achieving the ultimate goal - efficient and economical production of top quality polyethylene pipe and fittings.

PLEXCO TECHNICAL SUPPLEMENTS

Reference No.:	D-2	Date Issued:	02/02/94
Subject:	Quality Assurance	Date Superseded:	02/01/84
Sub-Subject:	In-Plant Blending	Page:	1 of 2

IN-PLANT BLENDING

HISTORY

PLEXCO first employed in-plant blending for extruded coatings in 1960. In the late 70's, the process was further improved and refined for extruded pressure pipe. In-plant blending has been employed for PLEXCO polyethylene pipe since 1981.

PERFORMANCE

PPI hydrostatic design basis ratings for PLEXCO P24BC medium density, and PLEXCO P34CH high density materials were developed on in-plant blended, production pipes. These long term stress ratings are not dependent upon the resin supplier's PPI ratings.

PLEXCO has developed and refined the in-plant blending process over the past 30 years. However, the engineering details of the process are proprietary. As a simplified explanation, natural resin pellets and color concentrate (master batch) pellets are mixed, dried, fed into the extruder, and blended into a homogeneous melt before entering the extrusion die. This same process is used by the resin supplier to produce pre-compounded pellets. The evident advantage of in-plant blending is the elimination of the pre-compounding step. That is, the material in in-plant blended pipe has one less heat history compared to pipe manufactured from pre-compounded resin. To put it another way, pipe made from pre-compounded materials has the same number of heat histories as in-plant blended pipe made from 100% rework material.

Plastic extrusion machines are highly developed screw conveyors. A rotating screw within a heated barrel, melts plastic pellets and delivers that melt under pressure to a die which shapes the pipe. When plastic pellets enter the extruder, they are melted against the surface of the barrel. The melted plastic is scraped off the barrel, and moved forward by flights on a rotating screw. The scraping or shearing of the material off the barrel ID tends to reduce molecular weight by cutting the long polyethylene molecules. Every time the material is processed, the overall molecular weight is reduced. This is crucially important to product performance.

While PLEXCO has made every reasonable effort to ensure accuracy in the preparation of these Technical Supplements, it does not constitute a guarantee or warranty for piping installations. These supplements are intended to be used as a guide to support the designer of piping systems. These supplements may not be complete particularly with respect to special or unusual applications; are not intended to be used as installation instructions, and should not be used in place of the advice of a professional engineer.

PLEXCO TECHNICAL SUPPLEMENTS

Reference No.:	D-2	Date Issued:	02/02/94
Subject:	Quality Assurance	Date Superseded:	02/01/84
Sub-Subject:	In-Plant Blending	Page:	2 of 2

Pipe grade polyethylene performance is due largely to high molecular weight. Please see the discussion **POLYETHYLENE FUNDAMENTALS** in the Plexco/Spirolite Engineering Manual, 1. Engineering Properties. Note that lots of good things come with higher molecular weight. In particular, resistance to cracking while under stress (ESCR and SCG) is improved with higher molecular weight. Slit or crack failure is the long term failure mode for polyethylene, so improving stress cracking resistance will also improve long term performance as a pressure pipe. Since extrusion processing reduces molecular weight, anything we can do to offset processing's negative effect will be beneficial to product performance. Thus, by eliminating one heat history, PLEXCO in-plant blending minimizes processing effects on molecular weight, and maximizes product performance.

IMPROVED PRODUCTS

In-plant blending provides the opportunity to improve additives and stabilizers. For the resin supplier, pipe grade polyethylene is about 7% of all polyethylene sold, a small fraction of the overall polyethylene resin market. A pipe manufacturer using pre-compounded materials must take a resin product that is, for most resin suppliers, a lower volume, higher cost product. Unless the pipe manufacturer is willing to pay a premium for an enhanced additive package, pre-compounded pipe materials will have an "industry standard" package. Obviously, a premium package will make a pipe manufacturer less competitive in a highly competitive market.

In contrast, PLEXCO uses the advantages of the in-plant blending process to provide a premium additive package without the premium cost. Master batch, a small percentage of the overall resin mix, is custom formulated to a proprietary recipe. This allows us to maximize product performance without the premium price.

QUALITY CONTROL and QUALITY ASSURANCE

PLEXCO runs a very efficient operation, as one must do to be competitive in today's market. We have become a leading industry supplier of polyethylene pipe by integrating quality controls into materials, processes, and process controls. Quality control is as much an inseparable part of the process as the resin.

Over the past 30 years, PLEXCO has developed and refined specific procedures to insure the initial and long term quality and performance of in-plant blended PLEXCO pipe. Quality control procedures include pre-production checks of resin and master batch physical properties, production checks of blend ratio, blend homogeneity, ESCR, and physical properties, and post production tests of long term sustained pressure performance.

PLEXCO in-plant blended polyethylene pipe sets the industry standard for quality and performance in polyethylene pipe.

PLEXCO TECHNICAL SUPPLEMENTS

Reference No.:	D-3	Date Issued:	02/02/94
Subject:	Quality Assurance	Date Superseded:	05/13/88
Sub-Subject:	Marking Codes for PLEXCO Pipe & Fittings	Page:	1 of 2

MARKING CODES FOR PLEXCO PIPE & FITTINGS

Pipe and fittings are identified with a lot number that identifies the product and provides reference to permanent quality records.

PIPE

The lot number is marked on the printline with a fourteen digit code. The first four digits (a letter and three numerals) identify the material and the production run. The fifth through eighth (a letter and three numerals) identify the manufacturing plant and the operator. The last six digits are a date code. See enclosed exhibit.

MOLDED FITTINGS

The fitting lot number is six digits, with optional seventh, eighth, and ninth digits. The first four numerals are a date code, followed by two numerals for shift and machine. An optional seventh letter identifies material, and optional eighth and ninth numerals are an operator number. Depending upon the optional codes, the lot number may be six, seven, eight or nine digits.

FABRICATED FITTINGS

Lot codes are imprinted on a pressure sensitive metal foil label affixed to the part. The lot number is a nine digit code. The first three numerals are a manufacturing sequence number, and the last six numbers are a date code.

While PLEXCO has made every reasonable effort to ensure accuracy in the preparation of these Technical Supplements, it does not constitute a guarantee or warranty for piping installations. These supplements are intended to be used as a guide to support the designer of piping systems. These supplements may not be complete particularly with respect to special or unusual applications; are not intended to be used as installation instructions, and should not be used in place of the advice of a professional engineer.

PLEXCO PIPE MARKINGS
(TYPICAL)

TRADEMARK & TYPE	SIZE	SDR/DR	RESIN CLASS	STD. SPECIFICATION	LOT NUMBER[5]	DATE	COIL NO.
PLEXCO® YELLOWPIPE[3]	2" IPS	SDR 11	PE2406 CEC[1]	ASTM D 2513	F101K185	010289	COIL 125
PLEXCO® YELLOWSTRIPE[3]	2" IPS	SDR 11	PE3408 CDC[1]	ASTM D2513	H101K185	110289	COIL 131
PLEXCO® EHMW	4" IPS	DR 11	PE3408	ASTM F 714 C3[2]	H114K185	022889	
PLEXCO® BLUESTRIPE[4]	2" IPS	SDR 17	PE3408	ASTM D 3035 C3[2]	H114K185	031589	COIL 115

PE PIPE CATEGORY PER ASTM D 2513-90C:

1 CEC; C = 140°F, E = 1000 PSI HDB, C = MELT INDEX
CDC; C = 140°F, D = 800 PSI HDB, C = MELT INDEX

2 FOR WATER PIPE STANDARDS SUCH AS: F 714, D 2737, D 2447, D 3035
THE TEST CATEGORY SYMBOL MUST BE PLACED IN THE PRINTLINE.
THE SYMBOL FOR PLEXCO PE3408 OR PE3406 PIPE IS "C3".

3 ALL GAS PIPE SHALL CONTAIN THE PHRASE "GAS USE ONLY".

4 PIPE APPROVED BY THE NATIONAL SANITITATION FOUNDATION (NSF)
SHALL CONTAIN THE FOLLOWING MARK:

NSF-pw

5 PIPE LOT NUMBER DESIGNATION H 114 K 185
RESIN MFG. / RUN NO. / PLANT / OPERATOR

RESIN MANUFACTURE CODE

G = CHEVRON 9300
U = UNION CARBIDE 2480
W = UNION CARBIDE 2400
F = CHEVRON 9301
H = FINA 3344
K = SOLTEX K38
V = CHEVRON PE3408 (9346, 9348)
C = CHEVRON PE3408 (9326, 9308)

PLANT DESIGNATIONS

A = ABBEVILLE
F = FAIRFIELD
C = CORSICANA
K = KNOXVILLE
W = COLTON
R = RENO

000277

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VBS-PLE-002

Chevron

Plexco®
Performance Pipe Division - Chevron Chemical Company
1050 Busse Highway, Suite 200 • Bensenville, IL 60106
(630) 350-3753 (630) 350-2148

March 14, 1997

Gladys
WORKMAN DEVELOPMENTS INC.
U.S. 119 South ,
Forks of Coal Industrial Park
50 Rocky Branch Road
Alum Creek, WV 25003-9622

Attention Mayer

RE: Partial submittal for Manholes and Permanent Lift Station
Project: FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Dear Gladys,

Please find enclosed the support documentation for the specifications of the above referenced project. The enclosures should accompany PLEXCO's comments on Section 02605 of the "High Density Polyethylene Manhole pipe and fittings" specifications which you shall be receiving from Steve Reist (from our Waxahachie plant).

The following brochures are enclosed:

- (6) Application Note No. 8 "System Testing", which refers to PLEXCO's guidelines for pressure testing of conventionally extruded outside diameter controlled pipe only. Please note that it is important that the customer realizes that PLEXCO does not recommend pressure testing of SPIROLITE products. (This brochure addresses 3.07-C "HDPE Pipe and Fittings Hydrostatic Testing", Pg. 02605-12 of the specifications)
- (6) Bulletin No. 104 "Industrial Piping System".
  (To address 1.04-A-8 SUBMITTALS, Pg. 02605-3 of the specifications).
- (6) Bulletin No. 910 "ASTM F-894 HDPE Pipe Product Data".
  (To address 1.04-A-8 SUBMITTALS, Pg. 02605-3 of the specifications).

If you have any questions please don't hesitate to call.

Sincerely,

Muriel Cease

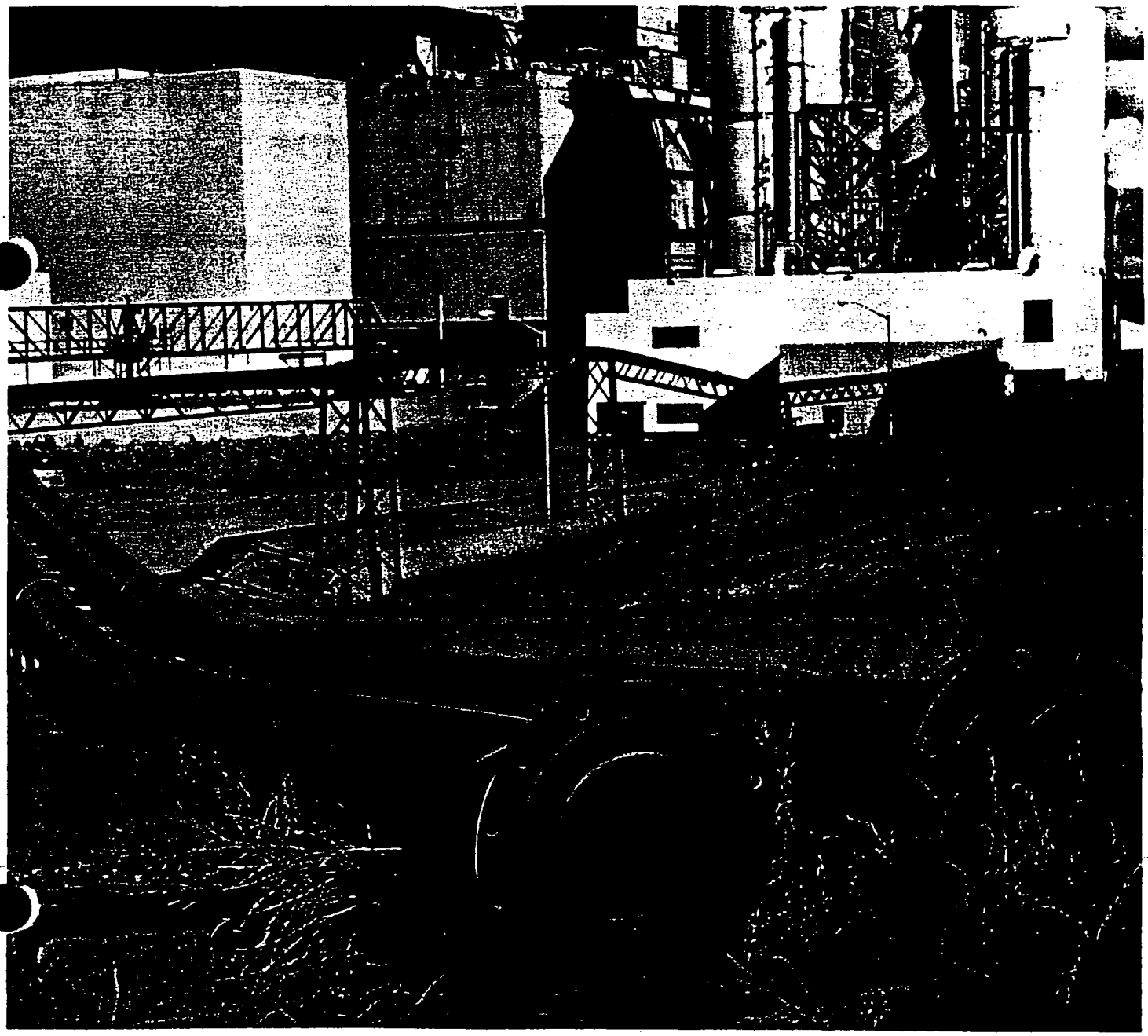
Muriel Cease
Engineer

encl.
wrknmdcs.ltr

VBS-PLC-004 1268

Industrial Piping System

Chevron Plexco®



Bulletin No. 164

000279

PE 3408 Extra High Molecular Weight (EHMW) High Density Polyethylene Industrial Piping System

PLEXCO is a leading producer of polyethylene pipe systems and extruded seamless polyethylene coating for underground metal pipe

PLEXCO, Incorporated was founded in 1931 as Pipe Line Service Company, and brings more than 55 years of experience to the many pipe-using industries in the United States and abroad.

PLEXCO's original line of business was applying bituminous protective coatings to steel pipe. By 1960, this product line was expanded to include a seamless, high density polyethylene pipe coating system.

In 1970, PLEXCO entered the polyethylene pipe market to serve the pipe and fittings requirements of gas distribution, gas gathering, and production industries throughout the United States. Today, PLEXCO is one of the leading suppliers to these users.

PLEXCO has continued to grow in response to the demand for high quality piping products. Today, PLEXCO operates nine manufacturing plants for pipe coatings, polyethylene pipe, molded and fabricated fittings, custom polyethylene fabrications, and custom extruded and molded plastic parts. The PLEXCO polyethylene pipe product line includes pipe and tubing from ⅝" OD through 54" OD PE 3408 pipe, molded fittings and standard fabricated fittings through 54" OD, and custom pipe fabrications such as manholes, catch basins, headers, and distribution manifolds. All PLEXCO products — pipe, moldings, standard and custom fabrications — are engineered to meet the full performance requirements of the system, and are manufactured in-house under stringent PLEXCO quality standards.

PLEXCO's growth and preeminence in the polyethylene piping market today reflects the response to a product backed by research, quality, and service. PLEXCO's commitment and objective is to serve the industry's piping needs today — and tomorrow.

This bulletin is intended to be used as a guide to support the designer of industrial piping systems. It is not intended to be used as installation instructions, and should not be substituted in place of the advice of a professional design engineer.

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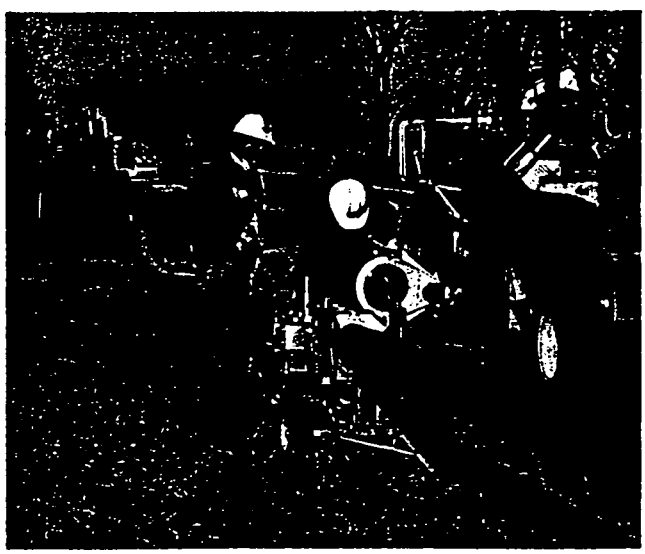
Some of the industries using high density polyethylene pipe systems and their varied applications are:

Industries
Agricultural (irrigation)
Chemical
Dredging
Fertilizer
Gas distribution
General industrial
Landfill reclamation
Metals extraction
Mining
Oil and gas production
Power generation
Pulp and paper
Sewage
Water distillation

Special Services
Fire protection*
Potable water**
Hazardous wastes
Duct

Factory Mutual Certification Available
***NSFpw Certification Available*

Applications
Acid lines
Coal bed methane drainage
Condensate lines
Corrosive wastes
De-watering
Drainage lines
Fiber optic innerduct
Fly ash disposal
Ground source heat pumps
Irrigation lines
Landfill (leachate control and methane recovery)
Natural gas and oil lines
Process water lines
Relining (chemical lines and sewers)
Salt water intakes
Sanitary & force mains (gravity and pressure)
Sludge lines
Slurry lines
Tailings lines
TV cable conduit



Fusing a string of pipe for continuous laying operation

PLEXCO polyethylene pipe has the excellent physical properties that are ideal for many varied industrial applications. Made from high density, extra high molecular weight materials, PLEXCO EHMW PE 3408 pipe has excellent abrasion resistance, superb impact resistance, and extraordinary toughness afforded by these materials. The smooth, nonwetting bore offers low resistance to the flow of fluids and slurries, and resists the adherence of scale and deposits. PLEXCO polyethylene pipe is resistant to a broad range of corrosive chemicals, and does not support biological growth.

Strong, lightweight PLEXCO EHMW PE 3408 pipe does not require the heavy handling and laying equipment common to steel and concrete pipes. Standard laying lengths of 40 feet or longer reduce the number of joints and speed installation. PLEXCO polyethylene pipe is flexible, allowing it to follow the contour of rolling terrain, thus reducing the requirements for fittings. It may be permanently cold bent to a radius of 20 to 25 times the pipe diameter without damage or effect upon physical properties. In sections where a fitting is present, the bending radius should be 100 times the pipe diameter.

Surge pressures and subfreezing temperatures are well tolerated by the PLEXCO EHMW PE 3408 pipe system. Operating service temperatures may be −50°F and lower, to 140°F for pressure service, and up to 180°F for nonpressure service. Water within the pipe may freeze solid without damage to the pipe which retains working flexibility even in harsh climates, and under extremely adverse conditions. Unstable soils and seasonal freeze/thaw conditions have little effect on this flexible, elastic piping system. System pressures due to surge or water hammer of up to 1½ times the rated system operating pressure are well within the limits of the PLEXCO polyethylene piping system, which has burst pressures greater than four times the system pressure rating. For moderate flow velocity systems, it is generally unnecessary to include a surge allowance within the pressure rating of the system. Surface or suspended pipelines will be subject to expansion and contraction from changing temperatures. An approximate allowance is 1″ per 10°F temperature change per 100 feet of pipe. Thermal effects may be controlled with anchoring or restraints, or snaking the pipeline back and forth.

PLEXCO polyethylene pipe and fittings may be joined by heat fusion processes which produce homogeneous, sealed, leaktight joints. A leakage allowance common to gasketed bell jointed pipes is unnecessary with the PLEXCO piping system. Flanged stub end connectors and mechanical connectors may also be used to join the system or to connect to other piping materials.

Open trench laying transmission pipe

PLEXCO Extra High Molecular Weight/ High Density PE 3408 Pipe System

Physical Properties

PLEXCO's industrial polyethylene pipe and fittings are made from a high density, extra high molecular weight material with a broad range molecular weight distribution designated as a PE 3408 with an ASTM D 3350-83 cell classification number of 345434C.

Polyethylene pipe resins generally are designated by a code which combines density, grade and hydrostatic design stress; i.e., PE 2406 or PE 3408. The first digit refers to product density or Type II or III (medium or high, respectively) which are the most common used for piping materials. The addition of the second digit, expressed as follows in ASTM D 1248, refers to material grade P24 or P34 which defines tensile strength, elongation, brittleness temperature, and environmental stress crack resistance.

The last two digits of the code, 06 or 08 (630 psi and 800 psi, respectively, at 73.4°F), indicate the material's hydrostatic design stress which is the estimated maximum hoop stress (tensile stress in the wall of the pipe in the circumferential orientation) due to internal hydrostatic pressure that can be applied continuously with a high degree of certainty that failure of the pipe will not occur. PLEXCO EHMW PE 3408 has the highest hydrostatic design stress currently attainable by commercially available pipe grade PE resins. PLEXCO EHMW PE 3408 meets all specifications and test values which define it as PE 3408.

To more adequately define a pipe grade polyethylene, ASTM developed Specification D 3350 which describes pipe materials by a cell classification numbering system. This sytem provides for more specific identification of the PE compound, using cell classification limits for each of the properties covered. Following is an analysis of the cell classification defining PLEXCO EHMW PE 3408 which is 345434C per ASTM D 3350.

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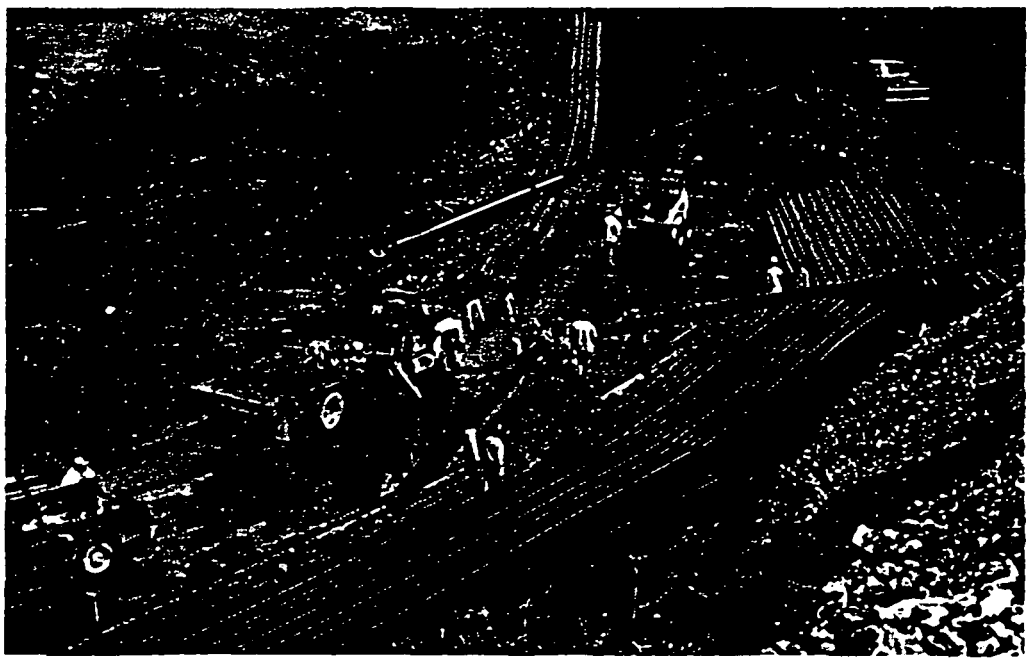
Cell Classification Descriptions*

Cell Classification for PLEXCO EHMW PE 3408	Property	Cell Classification Limits	Typical Value for PLEXCO EHMW PE 3408 (P34CH Compound)
3	Density per ASTM D-1505, gm/cm³	0.941 - 0.955	0.955
4	Melt Index per ASTM D-1238, gm/10 min	<0.15	0.10
5	Flexural Modulus per ASTM D-790, psi	110,000 - 160,000	133,000
4	Tensile Strength per ASTM D-638, psi	3000 - 3500	3200 - 3500
3	Environmental Stress Crack Resistance per ASTM D-1693, $Failure_{\%}$ = hours	F_{20} > 192	F > 5000†
4	Hydrostatic Design Basis per ASTM D-2387, psi	1600	1600
C	Color & Ultraviolet Stabilizer ASTM D 1603	>2% Carbon Black	2% to 3% Carbon Black

*Base resin. Pipe values may vary. †Test discontinued because of no failure and no indication of stress initiation (molded specimen).

PPI listed (PPI-TR4), high performance PE 3408 materials meeting stringent PLEXCO specifications are used for manufacture of PLEXCO polyethylene products. These materials are extruded or molded into pipe or fittings. These critical thermal processes must be properly performed or a substandard product may result. To assure process conversion into quality pipe and fittings, PLEXCO has obtained PPI verification that the PE 3408 material rating is retained after processing into pipe and fittings. This post-conversion PPI listing as "PLEXCO P34CH," PE 3408 material demonstrates the PLEXCO commitment to unsurpassed quality.



Mine tailings

High density **for strength, stiffness, chemical resistance**

Extra high molecular weight **for toughness, durability, impact resistance, abrasion resistance**

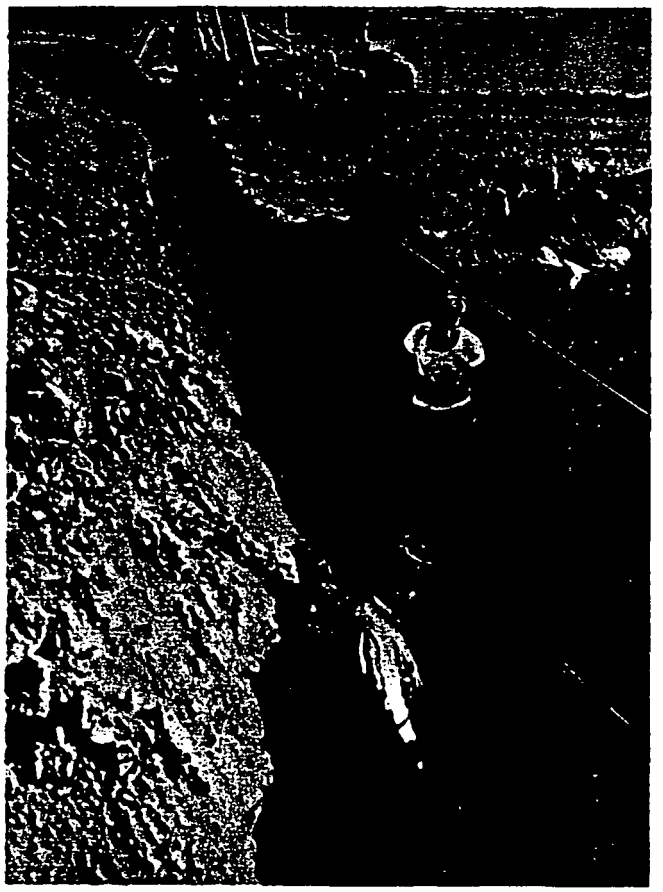
Broad molecular weight distribution **for fusibility and ease of joining**

Outstanding ESCR **for durability and resistance to aggressive soils and fluids**

User Benefits

Density

As a material's density increases, its tensile strength, or resistance to being stretched to the failure point, increases; surface hardness increases, providing improved abrasion resistance; stiffness (flexural modulus) increases, giving the pipe increased ability to retain its shape under loading; and higher density increases resistance to softening and distortion at elevated temperatures, and provides increased chemical resistance. PLEXCO EHMW PE 3408 high density polyethylene pipe and fittings provide the user with all these benefits of a Type III polyethylene resin, the highest density classification of any pipe grade compound commercially available.



Sand dredging

Melt Index

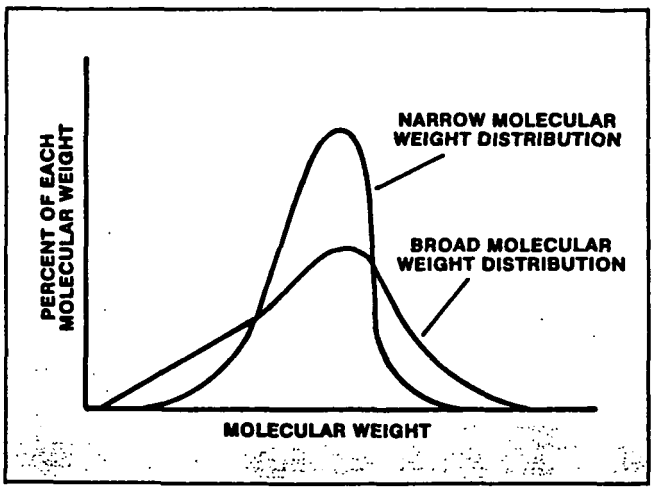
Melt index describes the flow behavior of a polyethylene resin at a specified temperature and pressure. It is a measure of the flow resistance of the molten resin when manufacturing pipe or fusing pipe sections. Although melt index is commonly used for classifying polyethylene resins, it is not always a reliable guide to specific end-product properties. The melt index must be used in conjunction with other yardsticks to properly describe the mechanical properties of a pipe resin. Generally speaking, a polyethylene resin of high molecular weight has a low melt index, and vice versa.

Molecular Weight and Molecular Weight Distribution

In addition to its extra high molecular weight, the molecular weight distribution of PLEXCO EHMW PE 3408 pipe resin has been engineered to make the pipe and fittings readily joinable by butt, socket and saddle fusion techniques.

This combination of extra high molecular weight and broad molecular weight distribution gives PLEXCO EHMW PE 3408 Industrial Pipe and Fittings exceptional strength and toughness, combined with ease of joining by butt, socket and saddle fusion.

Schematic representation of molecular weight distribution



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By industry practice, the molecular weight of polyethylenes is broken into four distinct classifications. They are:

Medium Molecular Weight .....less than 100,000
High Molecular Weight 110,000-250,000
Extra High Molecular Weight 250,000-1,500,000
Ultra High Molecular Weight ...1,500,000 & greater

The molecular weights of the higher molecular weight polyethylene resins are usually determined by Gel Permeation Chromatography (GPC), Scanning Electron Chromatography (SEC), or Relative Specific Viscosity (RSV) measurements. Reasonably accurate measurements of the Extra High and Ultra High Molecular Weight resins usually are obtainable by SEC or GPC.

PLEXCO EHMW PE 3408 Industrial Pipe is manufactured using a High Density, Extra High Molecular Weight polyethylene resin.

GPC and SEC measurements of the molecular weight of PLEXCO EHMW PE 3408 Industrial Pipe have classified the resin as an Extra High Molecular Weight Polyethylene with a value of approximately 330,000.

GPC AND RSV measurements made on finished pipe and fittings products indicate that PLEXCO EHMW products' molecular weight is as high or higher than any PE industrial pipe and fitting system commercially available.

Every polyethylene resin consists of a mixture of large and small molecules, that is, molecules of high and low weight. The average of these molecular weights can be measured by any of several different methods. The molecular weight distribution gives a general picture of the ratio of the large, medium and small molecules in a resin. The distribution is called narrow if the resin is of molecules close to the average weight; it is called broad if the resin is of molecules with a wide variety of weights. The accompanying figure shows this in graph form.

Environmental Stress Crack Resistance

The highest cell classification for environmental stress crack resistance requires that 80% of the samples tested in accordance with ASTM D 1693, Condition C, exceed 192 hours of testing without failures (as determined by statistical analysis). The PLEXCO EHMW PE 3408 pipe resin has exceeded 5000 hours under these test conditions without failure. This outstanding resistance to environmental stress cracking means that PLEXCO EHMW PE 3408 industrial pipe can carry aggressive materials in hostile environments where other pipe materials cannot.

Color and Ultraviolet Stabilizer

PLEXCO EHMW PE 3408 Industrial Pipe is stabilized with both UV stablizers and a minimum of 2% carbon black to protect against degradation due to ultraviolet light. This stabilizer system permits above ground use without fear of loss of pressure rating and other important properties due to ultraviolet light degradation.

Sewer slip lining

Some of the more demanding applications where PE 3408 polyethylene pipe system have been successfully used are:

Slurry Transport with PLEXCO PE 3408 Pipe

PLEXCO EHMW PE 3408 High Density Polyethylene (HDPE) Pipe has been shown to be superior to many other types of piping where corrosion and erosion problems exist. In slurry pipelining where moderate pressure exists and where large, heavy particles and high water velocities are encountered, PLEXCO EHMW PE 3408 Pipe shows exceptional wear characteristics. It has been laboratory tested and field proven to outlast steel by 3 to 1 and, in many cases, even 5 to 1.

In addition to its excellent abrasion resistance, PLEXCO EHMW PE 3408 HDPE Pipe offers other major advantages over other piping systems:

- lightweight and exceptional flexibility provide ease of installation, even over difficult terrain
- excellent resistance to aggressive media and soils
- low wall friction losses
- joining either by simple heat fusion process or by mechanical connectors

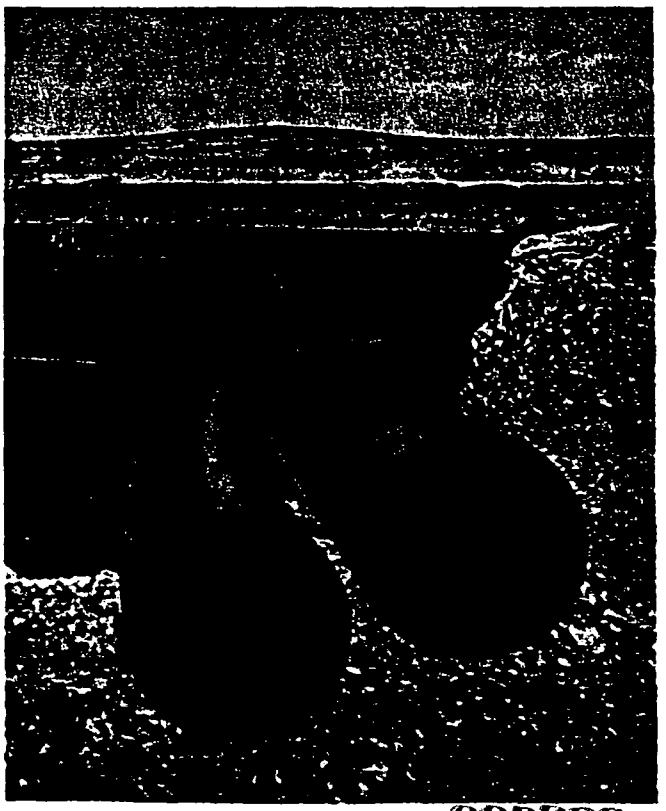
This combination of properties makes PLEXCO PE 3408 Industrial Pipe the preferred choice for slurry piping applications.

Transportation of Quartz Sand/Water Slurries

PLEXCO EHMW PE 3408 HDPE pipe is used in a sand works for the transportation of a quartz sand/water slurry extracted from a flooded gravel pit. The slurry is 30% sand by volume, with an average grain diameter of approximately 300 microns. The slurry is conveyed through the 10-in. nominal outside diameter pipe at flow velocities of 7.5 to 13 fps at 85 to 90 psi. At an annual production rate of 400,000 tons of sand, the EHMW HDPE pipe has lasted more than five years without evidence of appreciable wear.

Polyethylene Pipe for Coal and Pyrite Slurries

For more than 4½ years, the slurry obtained during coal preparation at a lignite mine has been transported in a 9800-ft above ground PLEXCO EHMW PE 3408 HDPE pipeline. The 10-in. nominal OD, SDR 11 line carries a coal, pyrite and water slurry with a 10% by volume solids content and a grain size of 500 microns. The operating temperature is around 70°F, with a delivery pressure of nearly 60 psi and a flow velocity of 10.5 fps. Abrasion in the pipe and pipe bends under these conditions has been about .001 in. or less. In the steel bends inserted for comparison purposes, the reduction in wall thickness at an initial thickness of 0.256 in. averaged 40-50%.



Mine dewatering

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Product Information

Sizes ½" IPS through 54" IPS are available in standard pressure ratings from 255 psi to 50 psi (SDR 7.3 to SDR 32.5). Special diameters and wall thicknesses are available, for example 10" IPS DR 4.3 (485 psi at 73°F) for a high pressure coal slurry, or 13.375" OD x 0.200 wall for insulation jacketing.

Sizes 3" IPS through 54" IPS are manufactured to ASTM specification F-714; ½" IPS through 6" IPS are manufactured to ASTM specification D-3035.

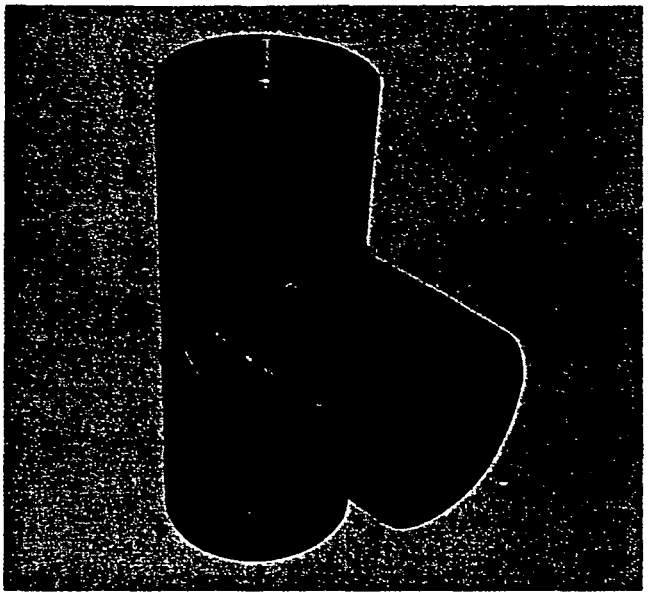
PLEXCO EHMW PE 3408 pipe is rated for pressure service from -50°F and lower, to 140°F. Nonpressure service to 180°F is permissible. Standard pressure ratings are for service to 73°F. Higher temperatures and some chemicals can significantly change pressure ratings. The Hydrostatic Design Basis granted by the Plastics Pipe Institute for PLEXCO EHMW PE 3408 polyethylene pipe is 1600 psi at 73.4°F, and 800 psi at 140°F, the highest ratings available for PE 3408 pipe.

PLEXCO FITTINGS ARE DESIGNED FOR THE FULL PRESSURE REQUIREMENTS OF THE SYSTEM, AND ARE MANUFACTURED FROM THE SAME EHMW PE 3408 MATERIAL USED FOR PIPE.

Fittings 8" IPS and smaller are molded. Larger fittings, elbows and tees, are fabricated from heavy wall pipe — the outlet ends are machined to match the system piping. Miter fusion fittings fabricated from the same thickness pipe as the system pipe must be rated at lower pressures, and, therefore, reduce the overall operating pressure of the system. These lower pressure rated fittings are available on special order. ALL STANDARD FITTINGS ARE FULLY PRESSURE RATED THE SAME AS THE SYSTEM PIPING. Elbows, straight and reducing tees, and reducers are available for ½" IPS to 54" IPS pipe sizes. Flange adapters are available for 2" IPS to 54" IPS pipe sizes.

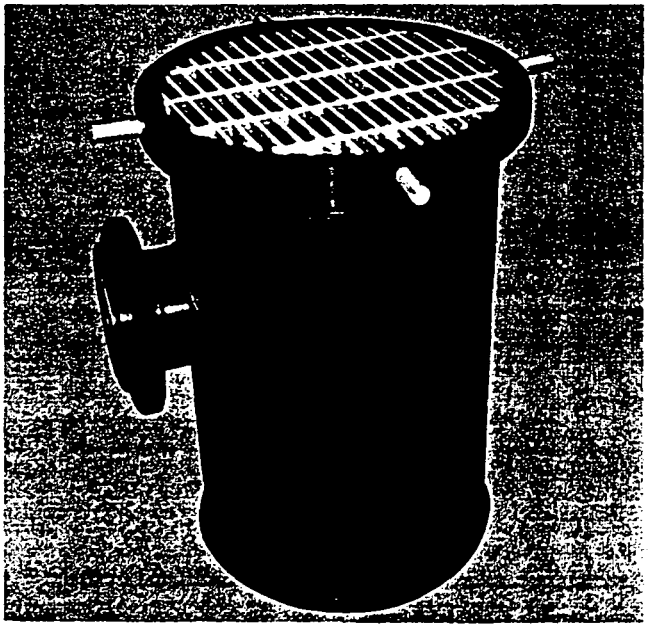
Molded butt fittings are manufactured to ASTM specifications D-3261.

Factory fabricated pressure manifolds and header assemblies manufactured to customer dimensions and specifications are available along with special fabrications such as catch basins, waterstops, manholes, and manhole liners. PLEXCO fabrication engineers can assist you with your specific needs.



Fabricated Tee

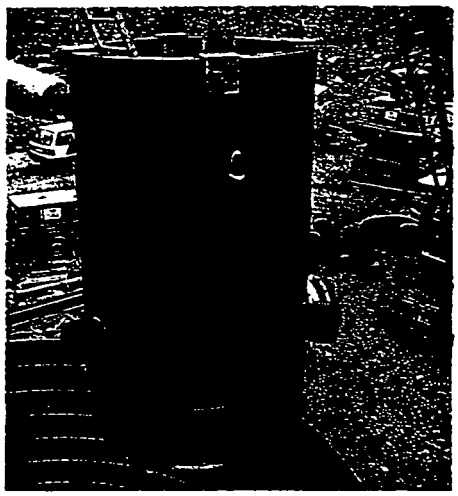
PLEXCO standard ***FULL PRESSURE RATED ELBOWS AND TEES***



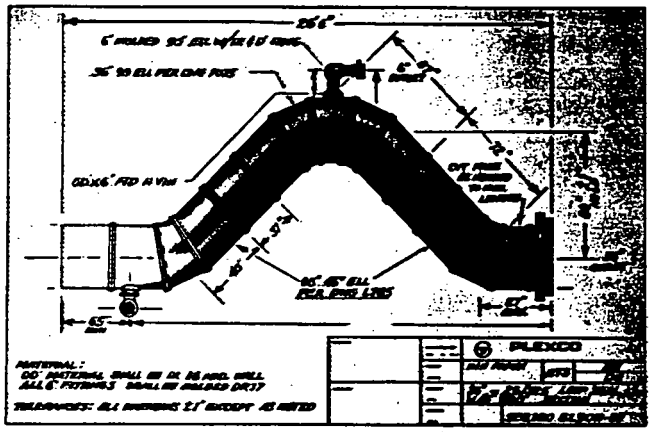
Catch basin

PLEXCO special fabrications, catch basins and water stops — for pressure and nonpressure applications. ***ALL FACTORY FABRICATED.***

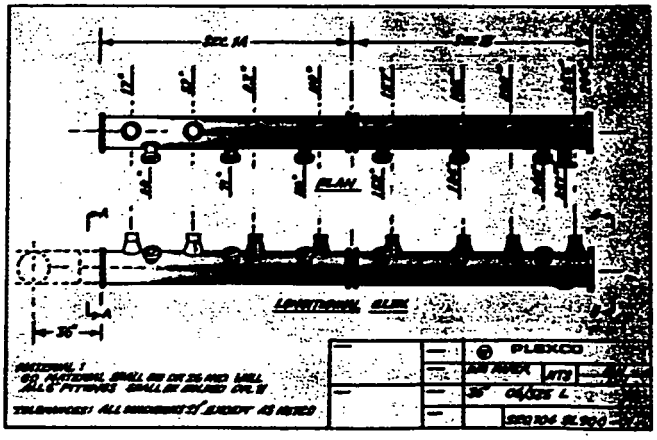
Special Fabrications



PLEXCO - Spirolite manhole



PLEXCO custom manifolds, headers and piping assemblies



Quality Control/ Technical Assistance

PLEXCO recognizes the need for total service and quality products produced to industry standards. A technical service department provides installation training, technical advice, and assistance; and on-site support aids customers in fusion procedures that achieve the high quality, long-life piping systems. PLEXCO PRODUCTS SHOULD BE HEAT FUSION JOINED USING PLEXCO FUSION PROCEDURES. PLEXCO maintains a substantial testing program to assure the manufacture of quality products produced to industry standards and specifications. Assurance testing of pipe and fittings is an ongoing program. PLEXCO's technical personnel also actively participate in industry associations, professional organizations, and technical committees involved in development, specification and design of plastic piping systems. When you buy PLEXCO polyethylene piping systems, you reap the benefits of industry leadership.

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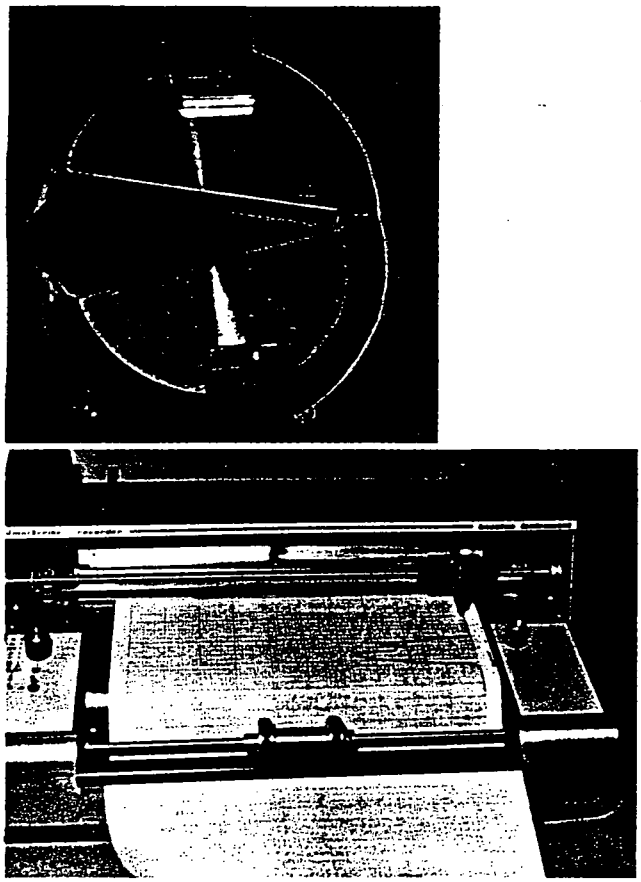
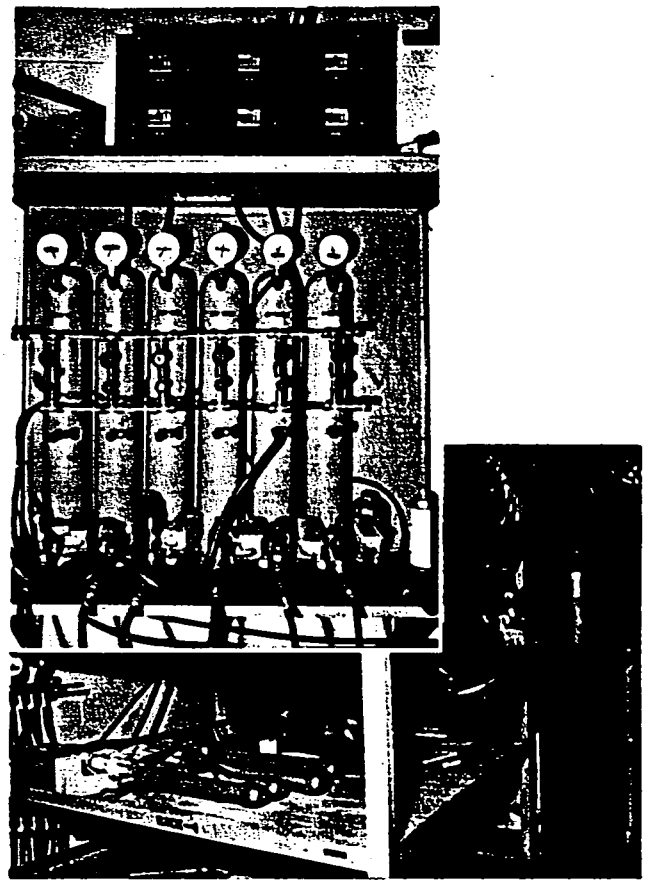
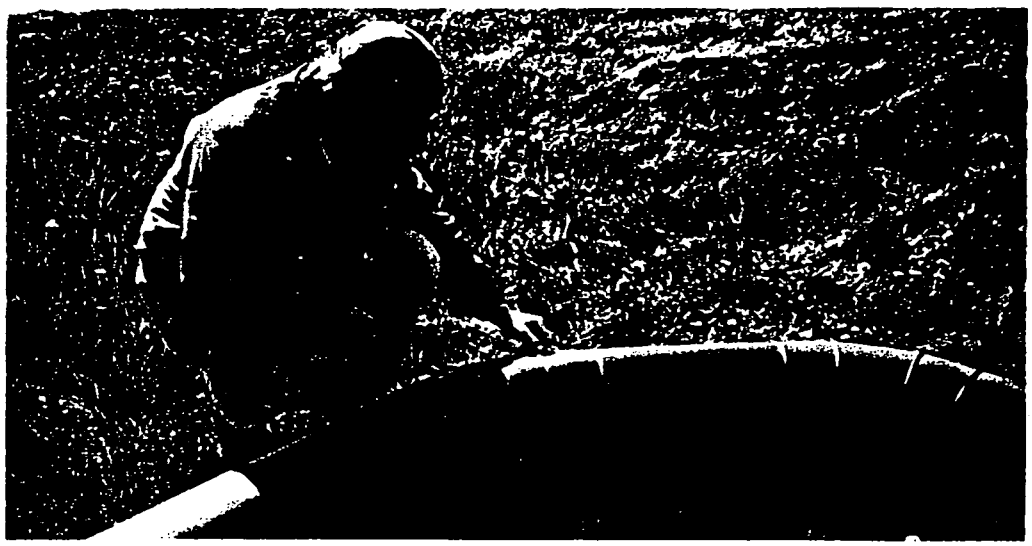


Tensile yield test at break point and recording instrument



1000-hour pressure test



Inspection of field fusion

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(803) 446-2139 (fax)

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(515) 472-1658 (fax)

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(972) 937-4530 (fax)

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1050 IL Route 83, Suite 200
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(630) 350-2704 (fax)

If you'd like to know more about PLEXCO products, call our General Office or your nearest Plant Location, or write for these additional brochures:

PLEXCO Product Literature

Fusion Procedures Joining PLEXCO Polyethylene Pipe & Fittings
Bulletin No. 101

Butt Fusion Procedures Extra High Molecular Weight High Density Polyethylene PE3408 Pipe
Bulletin No. 108

Municipal Piping System Extra High Molecular Weight High Density Polyethylene
Bulletin No. 112

Pipe Data & Pressure Ratings Chart
Bulletin No. 301

Dimensions For Molded Fittings
Bulletin No. 320

Dimensions For Fabricated Fittings
Bulletin No. 321

BLUESTRIPE™ AWWA Pipe Meets AWWA C-901 & C-906 For Potable Water Service
Bulletin No. 351

Technical Advantages of HTPE
Bulletin No. 354

FM Manual
Factory Mutual Approved for Firewater Systems
Bulletin No. 365

BLUESTRIPE-FM™
NSF and FM Approved Systems for Combined Firewater/Potable Water Systems
Bulletin No. 370

Perforated Piping System
Bulletin No. 450

DCS™ Dual Containment System
Bulletin No. 610

Landfill Applications—Polyethylene Piping Systems
Bulletin No. 620

Application Note No. 1
Pipe Behavior Under Earth Loading

Application Note No. 2
External Hydraulic Overpressure Negative Pressure Considerations

Application Note No. 3
Recommended Support Spacings

Application Note No. 4
Liquid Flow Through PLEXCO Piping Systems

Application Note No. 5
Water Hammer & Pressure Surge Considerations

Application Note No. 6
Chemical and Environmental Considerations

Application Note No. 7
Pipe Embedment & Final Backfilling

Application Note No. 8
System Testing

Application Note No. 9
Weighting Submerged Polyethylene Pipelines

Application Note No. 10
Safe Pull Space for PLEXCO Polyethylene Pipe

Application Note No. 11
Gas Flow Through PLEXCO Polyethylene Pipe

Application Note No. 12
Renewing Sewers with PLEXCO Polyethylene Pipe

Application Note No. 13
PE Piping for Flotation

SPIROLITE® Product Literature

ASTM F894 High Density Polyethylene Pipe Product Data
Bulletin No. 910

Manholes
Bulletin No. 915

Installation Guide

Renewing Sewers with SPIROLITE

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Rev. 10/96 - supercedes all previous editions

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VBS-PLL-004

ASTM F-894 HIGH-DENSITY POLYETHYLENE PIPE PRODUCT DATA

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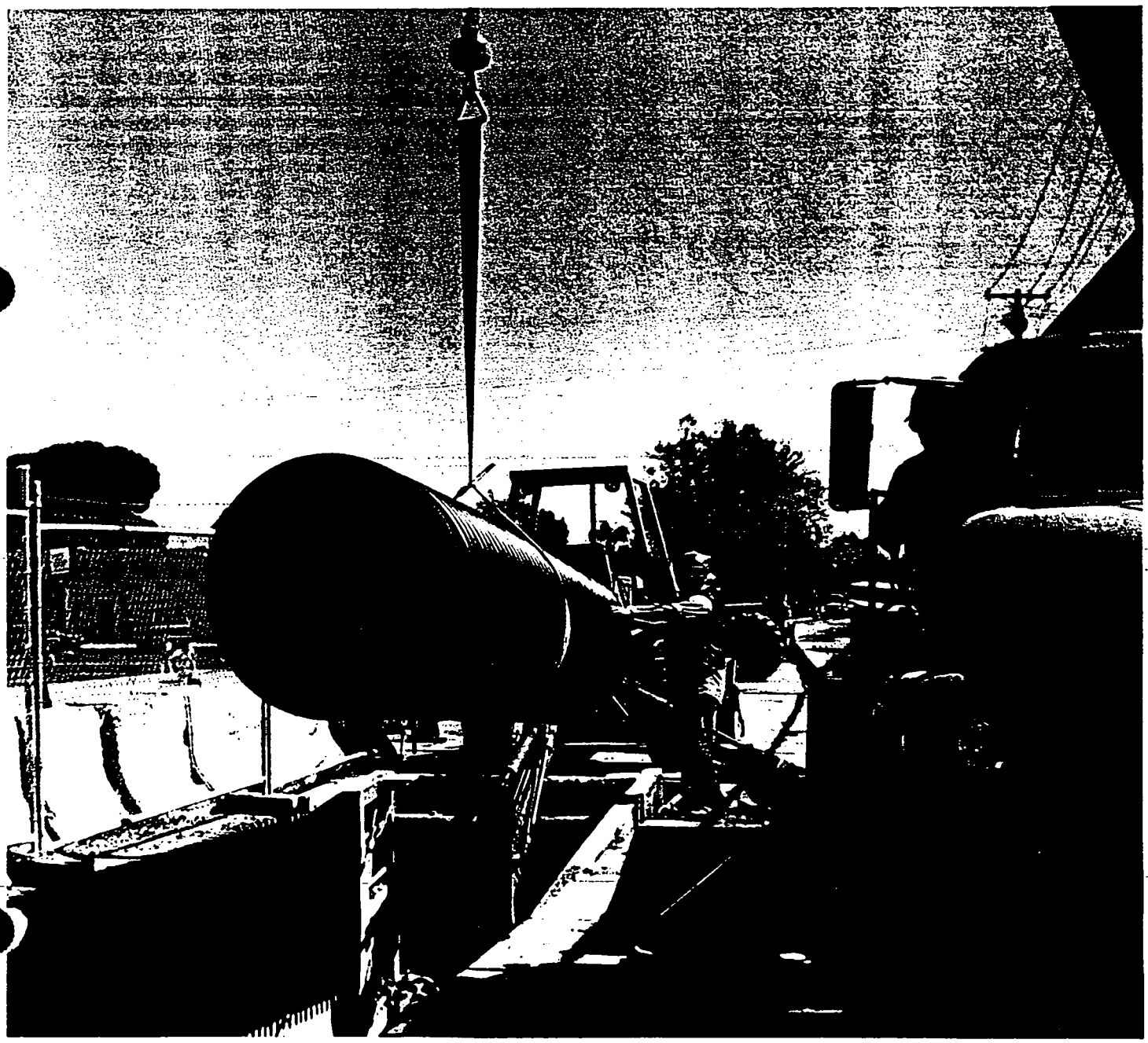


Bulletin No. 910

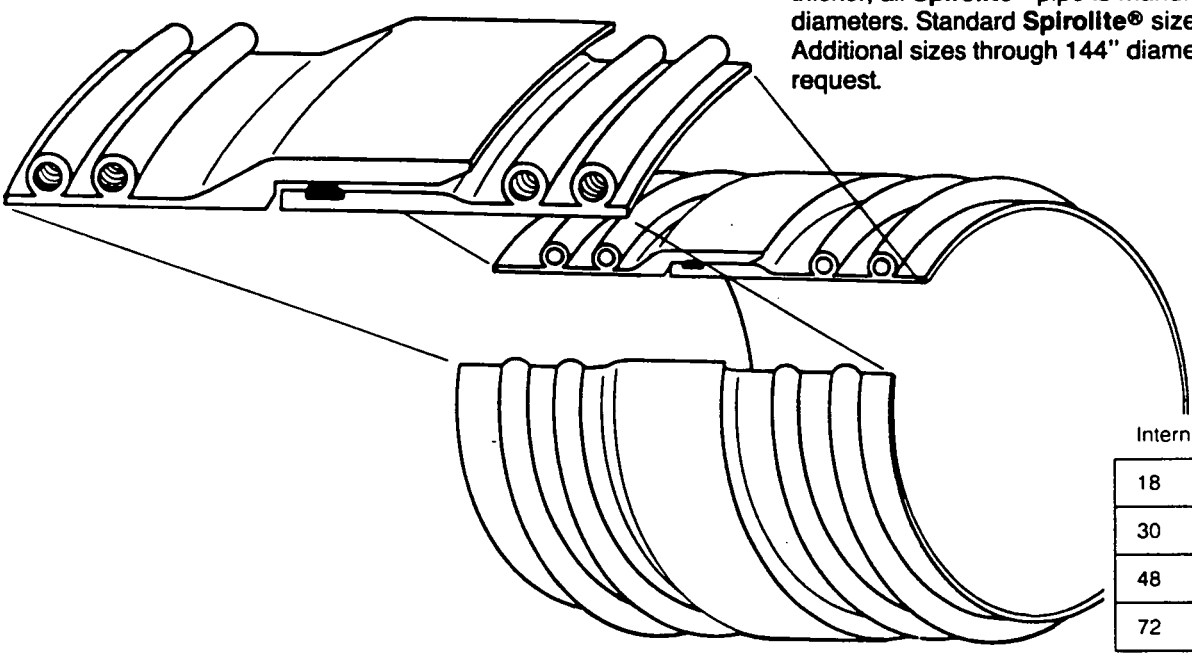
000291

The leader in large

Spirolite®, the leader in plastic pipe technology, manufactures thermoplastic pipe in diameters through 120 inches. Spirolite® pipe, because of the unique process through which it is manufactured, is the only high density polyethylene system in the United States that truly offers a cost competitive alternative to traditional piping materials for gravity sanitary sewer and industrial waste applications. Lightweight Spirolite® offers both the ease of a bell and spigot joint design that reduces installation time and the corrosion resistance to assure long-term, trouble-free service. Spirolite® pipe also meets the requirements of ASTM F-894.

SIZE RANGE

Unlike many conventionally extruded thermoplastic pipes, where inside diameter is decreased as the wall is made thicker, all **Spirolite®** pipe is manufactured to constant internal diameters. Standard **Spirolite®** sizes are listed below. Additional sizes through 144" diameter are available on request.



Internal Diameter Inches

18	21	24	27
30	33	36	42
48	54	60	66
72	84	96	120

*Other sizes available upon request.

PROFILE WALL CONCEPT: MAXIMUM EFFICIENCY

Spirolite® is manufactured through an exclusive process by which a profile extrusion is continuously wound upon a mandrel. This innovative wall construction takes advantage of a geometrically efficient hollow rib design to minimize pipe weight while maximizing stiffness. The result is a pipe with an outstanding stiffness to weight ratio. Each size of **Spirolite®** pipe is available in several standard classes, allowing the engineer to choose the profile/class which is the most economical for his specific application. The **Spirolite®** profile wall concept has been proven by more than 20 years of successful field experience worldwide.

This bulletin is intended to be used as a guide to support the designer in the use of Spirolite Pipe. It is not intended to be used as installation instructions, and should not be used in place of a professional design engineer. The information contained herein cannot be guaranteed because the conditions of use are beyond our control. The user of this bulletin assumes all risk associated with its use.

000292

diameter plastic pipe.

PIPE MATERIAL

Spirolite® is manufactured from a high density, high molecular weight polyethylene especially designed for engineered piping applications. This material has been used successfully to make pipe for over 30 years. The resin selected for **Spirolite®** offers the optimum combination of strength, stiffness, toughness and long-term reliability (see Figure 1). The material is classified by ASTM D-1248-84 *Standard Specification for Polyethylene Plastics Molding and Extrusion Materials* as Type III, Class C, Category 5, Grade P34. Other grades of HDPE and materials may also be selected based on application requirements.

ESCR

Some grades of polyethylene may crack or craze when under stress and in contact with certain chemical substances. This phenomenon is known as environmental stress cracking. **Spirolite®** pipe is made from stress-crack resistant materials which, when tested under the most severe ESCR test conditions (ASTM D-1693, Condition C), produce a result that far exceeds the ASTM D-1248-84 requirements for the highest-rated pipe materials.

WEATHERABILITY

Although **Spirolite®** pipe has been primarily designed for buried applications, it is weather resistant—it may be stored or used for years in direct exposure to the natural elements. The pipe compound contains a minimum of 2% carbon black, as specified by ASTM D-1248-84 for weather resistant (Class C) grades. This additive screens out the sun's potentially damaging ultraviolet rays and preserves the pipe's properties.

CHEMICAL AND CORROSION RESISTANCE

The outstanding chemical and corrosion resistance of **Spirolite®** pipe makes it ideal for sanitary sewer and a wide variety of industrial waste disposal applications. It will not rust or decay or support bacteriological growth and is not subject to electrolytic or galvanic corrosion. **Neither hydrogen sulfide nor the resulting sulfuric acid commonly found in sanitary sewers has any effect on the physical properties of Spirolite® pipe.** A comprehensive chemical resistance brochure is available on request.

Spirolite®
Meets ASTM F-894

FIGURE 1: CELL CLASSIFICATION DESCRIPTIONS PER ASTM D-3350*

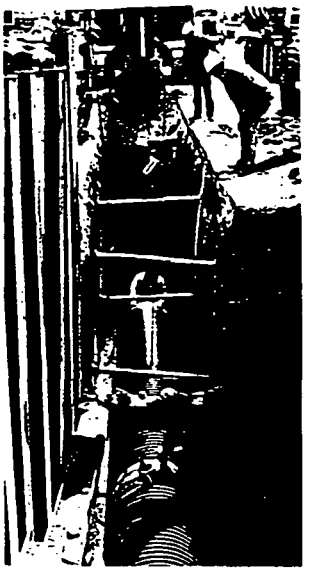
CELL CLASSIFICATION FOR SPIROLITE BASE RESIN PE 3408	PROPERTY	CELL CLASSIFICATION LIMITS
3	Density per ASTM D-1505, gm/cm³	0.941 - 0.955
3	Melt Index per ASTM D-1238, gm/10 min	< 0.4 - 0.15
5	Flexural Modulus per ASTM D-790, psi	110,000 - 160,000
4	Tensile Strength per ASTM D-638, psi	3000 - 3500
3	Environmental Stress Crack Resistance per ASTM D-1693, Failure = hours	F_{20} > 192
4	Hydrostatic Design Basis per ASTM D-2387, psi	1600
C	Color & Ultraviolet Stabilizer ASTM D 1603 Test method	> 2% Carbon Black

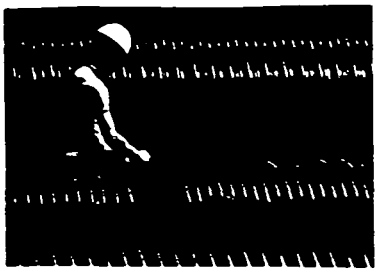
***Base resin. Pipe values may vary. HDB established when compounded with the proper color concentrate. Cell classifications are minimum cell values. Resins with higher cell values may be used.**

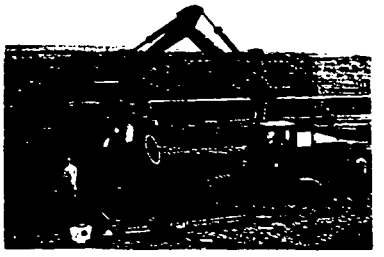
TEMPERATURE

Spirolite® material has been selected to satisfy the broadest range of commonly encountered operating temperatures. Its working temperature range depends on specific circumstances, but generally extends from about -40°F to 140°F. As with all thermoplastics, an increase in temperature tends to reduce stiffness and strength but improves ductility. With decreasing temperature, the opposite effects occur. When working outside the ambient temperature range, these effects should be taken into consideration by the designer.

A characteristic of polyethylene is its relatively high coefficient of thermal expansion/contraction. However, for buried applications, exposure to variable temperatures is generally not a design concern because of the restraining action of the surrounding soil and the inherent stress absorbing capabilities of the pipe material.







LONG LENGTHS

Spirolite® pipe is produced in standard 20' laying lengths up to 72" I.D.* This allows the contractor to operate at maximum efficiency by reducing the number of joints that have to be assembled. The benefits can be significant. Many contractors have found that they can install 20%-30% more **Spirolite®** pipe per day than a similar size pipe made from traditional materials. The dramatic difference in the number of joints is also important when you consider the cost of jobsite testing. As shown in Figure 2 below, the number of **Spirolite®** joints which must be laid and tested, and remain infiltration free for the life of the piping system, is substantially lower than that of other pipes supplied in shorter lengths.

By request, **Spirolite®** may be produced in shorter lengths for projects where severe ground conditions may limit the amount of trench that can be held open.

FIGURE 2: FEWER JOINTS PER INSTALLED LENGTH

Project Length (Ft.)	Number of Joints			
	20' Lgth.	13' Lgth.	8' Lgth.	4' Lgth.
5000	250	385	625	1250
10000	500	770	1250	2500
15000	750	1154	1875	3750

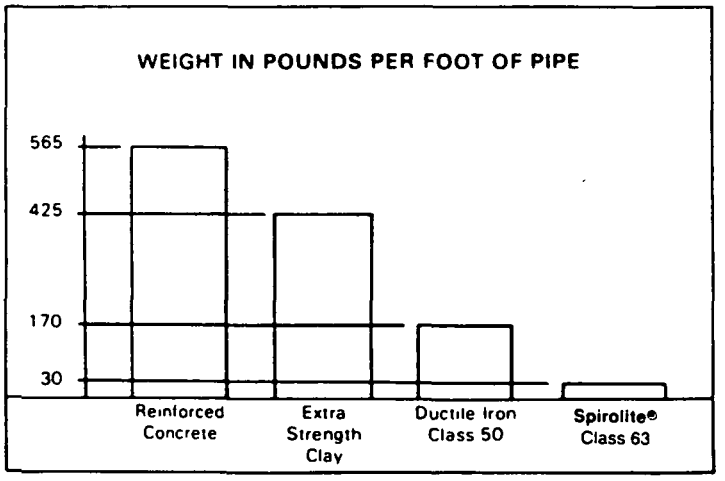
*Over 72" I.D. is produced in 19' laying lengths.

LIGHTWEIGHT

The unit weight of **Spirolite®** pipe is considerably less than that of traditional pipe products. The savings resulting from the use of a lightweight piping system can be significant. Shipping costs are reduced. Installation equipment may be lighter and thus less expensive to operate. Jobsite handling efficiency is also increased. Many contractors have found it possible to drastically reduce, or in some cases, even eliminate the need for expensive lifting equipment to lower the pipe into the trench.

A comparison of various pipe materials and their respective weights is shown in Figure 3.

FIGURE 3: TYPICAL WEIGHT OF 36 INCH SEWER PIPE



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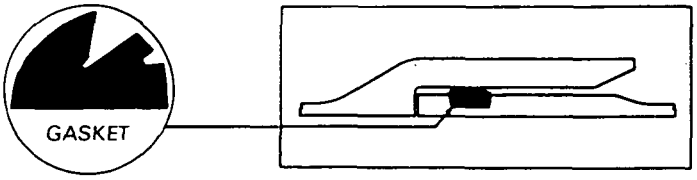
TOUGH AND DURABLE

Spirolite® is rugged. It withstands stresses that would normally damage conventional piping products. Its resistance to cracking and breakage through customary jobsite handling eliminates the need to order extra pipe.

JOINING

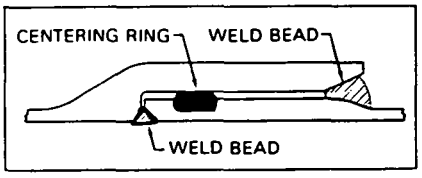
Spirolite® pipe may be joined by two alternative techniques, each employing the ease of bell and spigot assembly. These are rubber gasket and thermal welding. Together, they allow the specifier the option of selecting that method which is best suited to the application.

RUBBER GASKET JOINT



The **Spirolite®** gasket is designed to meet ASTM F-477. This easily assembled joint is perfect for sanitary sewer and most industrial waste applications and is available in 8" through 84" diameter **Spirolite®**. The gasket will not "fishmouth" or roll out of its grove when homed. Because of its unique profile shape, the gasket provides dual sealing; a compression seal against exfiltration and a combination of compression and hydraulic seal against infiltration. This provides double protection. The hydraulic seal is energized by external pressure, thus, it becomes tighter with increasing infiltration pressure. This unique design is superior to an O-ring seal which provides only a compression seal. The **Spirolite®** joint passes standard air or hydrostatic field testing with ease and is designed in accordance with ASTM D-3212 *Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.* **Infiltration rates not to exceed 50 gallons/inch of diameter/mile/day may be specified for the Spirolite gasket joint.** Recommended assembly procedures for the gasket joint are given in Spirolite Technical Bulletin TB-100.

THERMAL WELDED JOINT

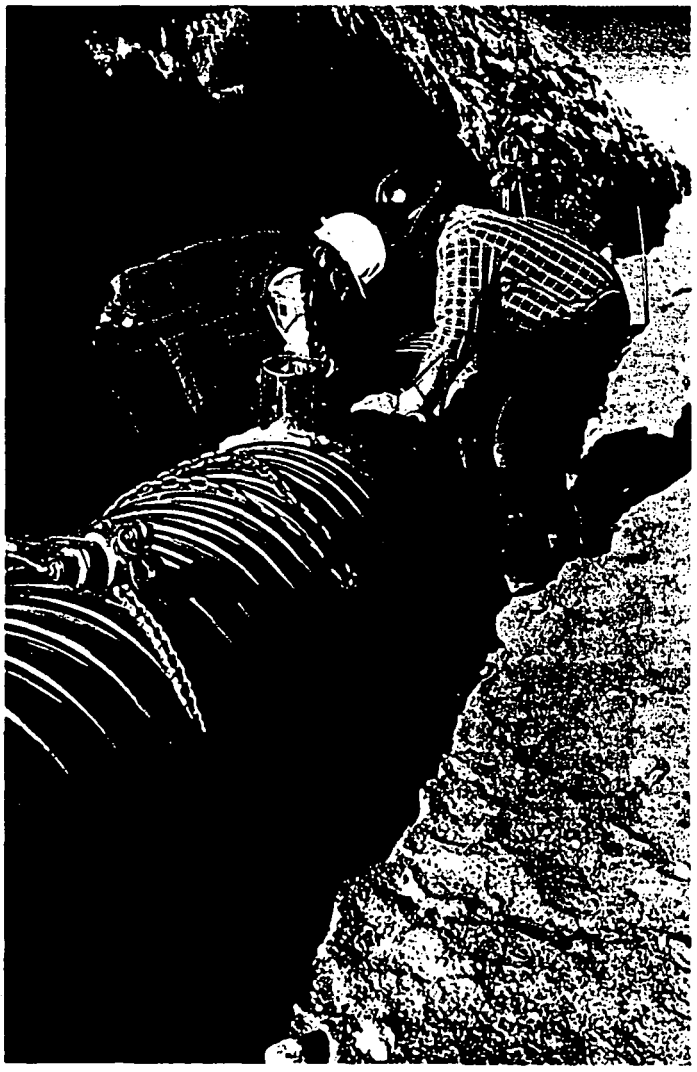


The **Spirolite®** thermal welded joint is used primarily for applications where contact with exotic effluents is anticipated. Using a portable field extruder, a bead of polyethylene is extruded and fused to the juncture of the bell and spigot to form a homogenous joint which is absolutely leak proof. The weld bead may be placed on the inside or outside of the pipe or both.

MANHOLES AND FITTINGS

For complete corrosion-resistant systems, **Spirolite®** manholes are available. These manholes can be fabricated to permit connection to **Spirolite®** pipe, as well as traditional piping materials. **Spirolite®** pipe can also be connected to traditional types of manholes. See Spirolite Technical Bulletin TB-101 for available connection options.

A full range of fittings is available for use with **Spirolite®** pipe. All standard fittings are designed with bell and spigot end configurations for easy assembly to **Spirolite®** pipe in the field. In addition to standard fittings such as elbows, wyes, tees, flanges, and lateral taps, Spirolite® also has the capability to custom fabricate those one-of-a-kind pieces that may be required for special job conditions.



Assembling a **Spirolite®** Joint

Being made of high-density polyethylene, all **Spirolite®** products result in excellent hydraulics, superior to those of conventional materials. **Spirolite®** products minimize flow disturbance due to sedimentation and slime build-up by providing a smooth, non-polar and anti-adhesive inner surface.

Thus, **Spirolite®** pipe offers the potential for use of smaller diameters and/or reduced slopes to accomplish given flow requirements. The Manning coefficient of **Spirolite®** pipe for clean water at ambient temperature is 0.009.

EQUATION 1

$$Q = \frac{1.486}{N} \bullet AR^{2/3} \bullet S^{1/2}$$

Where Q = flow (ft. ³/sec.)
n = Manning roughness coefficient
A = flow area of pipe (ft. ²)
R = hydraulic radius (ft.) = D/4
where D = pipe inside diameter (ft.)
S = slope (feet/foot)

—EXAMPLE—

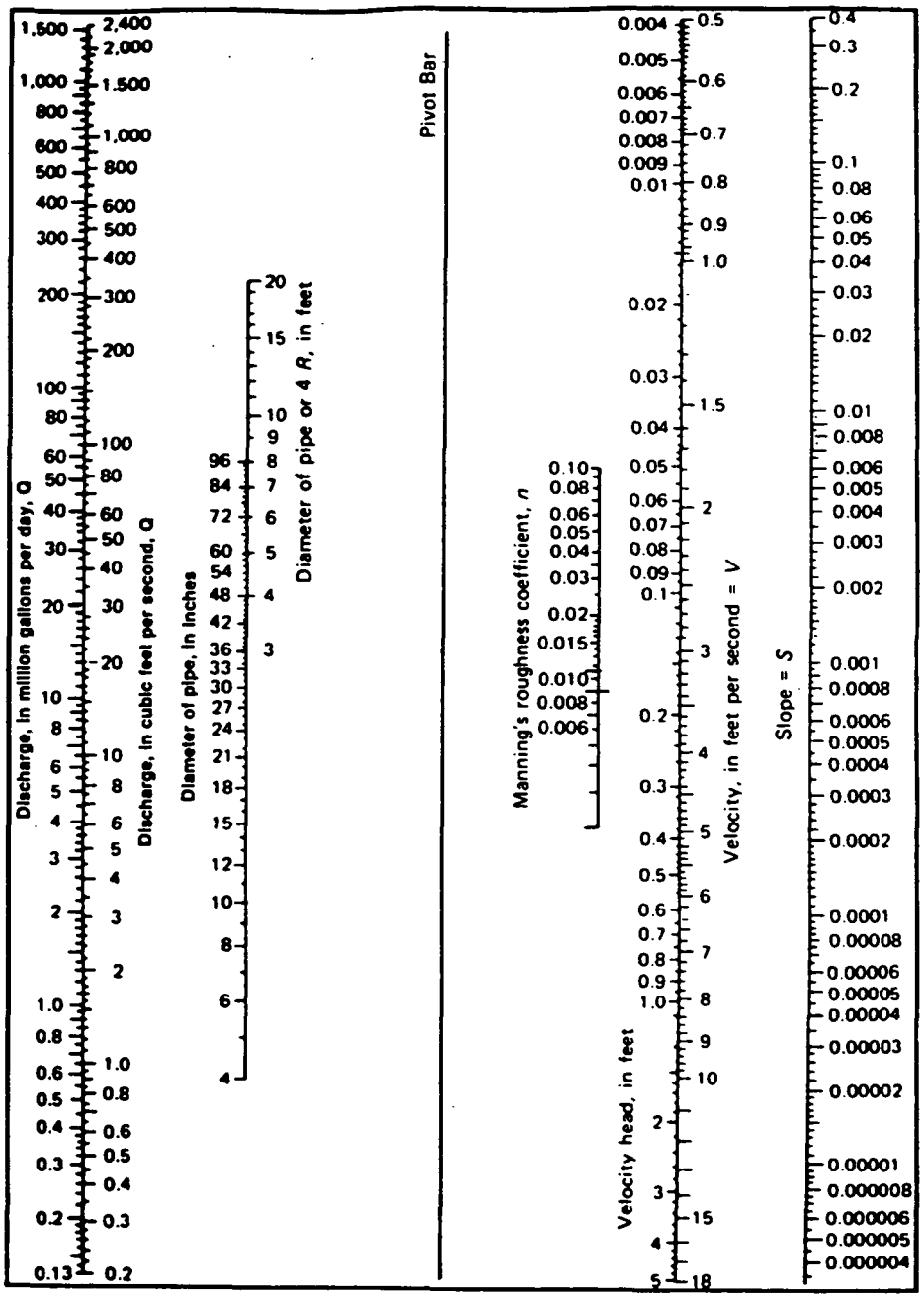
The nomogram in Figure 4 can be used to determine discharge, diameter, velocity, or slope. For example, to determine the diameter of pipe needed to handle 50 million gallons of discharge per day, first determine the slope of the line and whether it will be handling storm drainage or sewer flow. For this example, the line will carry storm drainage at a slope of 0.00045. Find this slope in the column on the far right. Using a scale, mark a line from 0.00045 through 0.009 (the coefficient for water) to the pivot bar.

Now find the anticipated discharge (50 million gallons) in the column on the far left and mark a line from there through the diameter line to the point where the first line crossed the pivot bar.

The point of intersection with the diameter line shows the diameter of pipe needed; in this case, 60 inch **Spirolite®**.

NOTE: In order to determine discharge, diameter, velocity, or slope, you must have two data points on one side of the pivot bar and one on the other side.

FIGURE 4: MANNING FLOW CHART



Spirolite®

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PIPE SELECTION

Spirolite pipe is manufactured in four standard ring stiffness classes. In preparing a specification, the designer selects a class of pipe appropriate for the application. The following tables may be used to assist the designer in making that selection. It is important that the designer perform all necessary calculations to verify the adequacy of a given class of pipe and be acquainted with all assumptions and installation requirements. Other design methods may be applicable.

The design of HDPE pipe for subsurface applications is typically based on the following performance limits: (1) wall crush strength, (2) constrained buckling resistance, and (3) deflection. Equations for these performance limits are given in the Appendix and were used to produce Table 1 and Table 2. The suitability of a class of pipe for installation at a given depth depends on the installation achieving the design E' and on the pipe being installed in accordance with ASTM D-2321 and the Spirolite Installation Guide. The designer is advised to review the applicability of these equations to each use of Spirolite.

The classes and depths shown in the tables are based on a design soil weight (dry or saturated) of 120 lbs/ft³ and an applied H-20 live load. (Where live load is present, Spirolite pipe normally requires a minimum depth of cover of one pipe diameter or three feet whichever is greater. Where this condition can not be met, please consult PLEXCO.) The earth load for calculating crush resistance was found using the arching coefficients given in Figure 10. The prism load was used for buckling and deflection calculations. Deflection was calculated using 75% of the E' value given at the top of the respective column, a deflection lag factor of 1.5, and a deflection limit of 5 percent. Buckling was calculated using the E' value listed and a long-term pipe modulus value of 28,250 psi. Buckling resistance was considered only for pipe subjected to ground water, as buckling is normally not a controlling factor for dry ground installations in the range of depths given in the tables. A safety factor of two was applied to the crush and buckling values.

BURIAL ABOVE GROUND WATER LEVEL

Table 1 is based on calculations made assuming the ground water level is always below pipe grade elevation. For other sizes, and burial depths or conditions not listed, consult with PLEXCO.

Table 1: SPIROLITE PIPE CLASS SELECTION FOR BURIAL *ABOVE* THE GROUND WATER LEVEL

Pipe Diameter		18 INCH			21 INCH			24 INCH			27 INCH			30 INCH			33 INCH			36 INCH			42 INCH		
E'		1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000
Depth of Cover (ft.)	2	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	4	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	6	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	8	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	10	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	12	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	14	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	16	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	18	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	20	63	40	40	100	40	40	100	40	40	100	40	40	160	40	40	160	63	63	160	63	63	160	63	63
	22	160	40	40	160	40	40		40	40		40	40		40	40		63	63		63	63		63	63
	24		40	40		40	40		40	40		63	63		63	63		63	63		100	100		100	100
	26		40	40		40	40		63	63		63	63		100	100		100	100		100	100		100	100
	28		40	40		40	40		63	63		63	63		100	100		100	100		100	100		160	160
	30		40	40		40	40		100	100		100	100		100	100		100	100		100	100		160	160
	32		40	40		100	100		100	100		100	100		160	160		160	160		160	160		160	160
	34		40	40		100	100		100	100		160	160		160	160		160	160		160	160		160	160
	36		40	40		100	100		100	100		160	160		160	160		160	160		160	160		160	160
	38		100	100		100	100		100	100		160	160		160	160								160	160

Note: See text, page 6, regarding minimum depth of cover requirement when live load is present.

Table 1: SPIROLITE PIPE CLASS SELECTION FOR BURIAL *ABOVE* THE GROUND WATER LEVEL (Continued)

Pipe Diameter		[illegible] INCHES			[illegible] INCHES			[illegible] INCHES			[illegible] INCHES			[illegible] INCHES			[illegible] INCHES			[illegible] INCHES		
E'		1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000
Depth of Cover (ft.)	2	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	4	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	6	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	8	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	10	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	12	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	14	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	16	40	40	40	63	63	63	63	63	63	63	63	63	63	63	63	40	40	40	63	63	63
	18	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
	20		100	100		100	100		100	100		63	63		63	63		63	63		63	63
	22		100	100		100	100		100	100		100	100		100	100		63	63		63	63
	24		100	100		100	100		100	100		100	100		100	100		100	100		63	63
	26		160	160		100	100		100	100		100	100		100	100		100	100		100	100
	28		160	160		100	100		160	160		100	100		100	100		100	100		100	100
	30		160	160		160	160		160	160		160	160		100	100		100	100		100	100
	32		160	160		160	160		160	160		160	160		160	160		100	100		100	100
	34		160	160		160	160		160	160		160	160		160	160		100	100		100	100
	36		160	160		160	160		160	160		160	160		160	160		160	160		100	100
	38					160	160			160			160			160			160			160

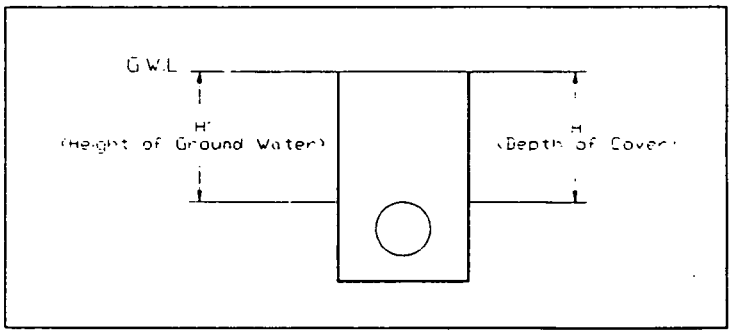
Note: See text, page 6, regarding minimum depth of cover requirement when live load is present.

BURIAL BELOW GROUND WATER LEVEL

Table 2 is based on calculations assuming the ground water level is at the ground surface. Table 2 is included as a guide for the designer. The designer normally uses the 100 year flood for a design maximum ground water level. Where that level is below the ground surface, considerable savings may result in using the exact depth of the water for design calculations rather than assuming it is at the ground surface as in Table 2.

Where the ground water is above the pipe, the designer normally checks the adequacy of the weight of the soil backfill to prevent upward flotation or upward buckling of the pipe. For other sizes, and burial depths or conditions not listed, consult with PLEXCO.

FIGURE 5:



Note: See text regarding live load. Designer should consider buoyancy of pipe in shallow applications.

Maximum permissible ground water level for Table 2 is H.

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Table 2: SPIROLITE PIPE CLASS SELECTION FOR BURIAL *BELOW* THE GROUND WATER LEVEL

Pipe Diameter		18 INCH			21 INCH			24 INCH			27 INCH			30 INCH			33 INCH			36 INCH			42 INCH		
E'		1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000
Depth of Cover (ft.)	2	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	4	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	6	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	8	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	63	40	40
	10	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	63	40	40
	12	40	40	40	40	40	40	40	40	40	63	40	40	63	40	40	40	40	40	63	40	40	100	40	40
	14	40	40	40	40	40	40	63	40	40	63	40	40	63	40	40	63	40	40	100	40	40	100	40	40
	16	40	40	40	40	40	40	63	40	40	100	40	40	100	40	40	100	40	40	100	40	40	100	63	40
	18	40	40	40	63	40	40	100	40	40	100	40	40	100	63	40	100	40	40	160	63	40	160	63	40
	20	63	40	40	100	40	40	100	40	40	100	63	40	160	63	40	160	63	63	160	63	63	160	100	63
	22	160	40	40	160	40	40		63	40		63	40		63	40		63	63		100	63		100	63
	24		40	40		40	40		63	40		63	63		63	63		100	63		100	100		100	100
	26		40	40		40	40		63	63		63	63		100	100		100	100		100	100		100	100
	28		40	40		40	40		63	63		100	63		100	100		100	100		100	100		160	160
	30		40	40		63	40		100	100		100	100		100	100		100	100		100	100		160	160
	32		40	40		100	100		100	100		100	100		160	160		160	160		160	160		160	160
	34		40	40		100	100		100	100		160	160		160	160		160	160		160	160		160	160
	36		40	40		100	100		100	100		160	160		160	160		160	160		160	160		160	160
	38		100	100		100	100		100	100		160	160		160	160								160	160

Note: (a) See text, page 6, regarding minimum depth of cover requirement when live load is present.
(b) Depth of cover values given above may not be adequate to prevent flotation of submerged pipe. See text page 7.

Table 2: SPIROLITE PIPE CLASS SELECTION FOR BURIAL *BELOW* THE GROUND WATER LEVEL (Continued)

Pipe Diameter		48 INCH			54 INCH			60 INCH			66 INCH			72 INCH			84 INCH			96 INCH		
E'		1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000
Depth of Cover (ft.)	2	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	4	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
	6	40	40	40	40	40	40	63	40	40	63	40	40	63	40	40	100	40	40	63	40	40
	8	63	40	40	63	40	40	63	40	40	100	40	40	100	40	40	100	40	40	100	63	40
	10	63	40	40	100	40	40	100	40	40	100	40	40	100	63	40	100	63	40	160	63	40
	12	100	40	40	100	40	40	100	63	40	160	63	40	160	63	40	160	100	63	160	100	63
	14	100	63	40	160	63	40	160	63	40	160	100	63	160	100	63		100	63		100	63
	16	160	63	40	160	100	63	160	100	63	160	100	63		100	63		100	100		160	100
	18	160	100	63	160	100	63		100	63		100	63		100	100		160	100		160	100
	20		100	100		100	100		100	100		160	100		160	100		160	100		160	160
	22		100	100		100	100		160	100		160	100		160	100		160	160			160
	24		100	100		160	100		160	100		160	100		160	100			160			160
	26		160	160		160	100		160	100		160	100		160	160			160			160
	28		160	160		160	100		160	160			160			160			160			160
	30		160	160		160	160			160			160			160			160			
	32		160	160		160	160			160			160			160						
	34		160	160			160			160			160			160						
	36			160			160			160			160									
	38						160			160												

Note: (a) See text, page 6, regarding minimum depth of cover requirement when live load is present.
(b) Depth of cover values given above may not be adequate to prevent flotation of submerged pipe. See text page 7.

PIPE PROPERTIES

The following tables provide nominal dimensions and properties for **Spirolite®** pipe. Figure 6 shows a typical cross section of each profile and its derived properties.

NOTE: "Se" is the effective wall thickness required in a solid wall section yielding the same moment of inertia.

FIGURE 6: CROSS SECTION OF SPIROLITE PIPE

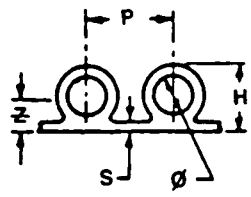


TABLE 3: SPIROLITE PIPE NOMINAL DIMENSIONS AND PROPERTIES *CLASS 40*

I.D. (In.)	Allowable Crush Load (Lb./Ft.²)*	P (Period) (In.)	H (Wall Height) (In.)	S (Wall) (In.)	Ø (Core Dia.) (In.)	I (Wall Moment) (In.⁴/In.)*	Se (Effective Wall) (In.)	A (Average Profile Area) (In²/In.)*	Z (Centroid) (In.)
18	2854	5.50	1.47	0.21	1.18	0.031	0.808	0.260	0.30
21	2498	5.50	1.47	0.21	1.18	0.031	0.808	0.260	0.30
24	2221	5.50	1.47	0.21	1.18	0.031	0.808	0.260	0.30
27	2125	5.00	1.49	0.21	1.18	0.038	0.859	0.277	0.33
30	2032	5.00	1.53	0.21	1.18	0.047	0.916	0.295	0.36
33	1867	5.70	1.85	0.22	1.57	0.077	1.073	0.299	0.42
36	1784	5.70	1.86	0.23	1.57	0.078	1.079	0.309	0.42
42	1810	5.60	1.92	0.27	1.57	0.095	1.143	0.361	0.44
48	1706	5.50	1.96	0.27	1.57	0.119	1.215	0.386	0.49
54	1579	5.60	2.27	0.27	1.96	0.169	1.375	0.403	0.55
60	1554	5.60	2.32	0.30	1.96	0.194	1.432	0.446	0.57
66	1612	5.40	2.37	0.33	1.96	0.227	1.503	0.496	0.60
72	1577	5.00	2.39	0.33	1.96	0.266	1.570	0.527	0.65
84	1737	5.00	2.55	0.43	1.96	0.369	1.745	0.673	0.72
96	1731	4.20	2.59	0.43	1.96	0.474	1.891	0.762	0.81

TABLE 4: SPIROLITE PIPE NOMINAL DIMENSIONS AND PROPERTIES *CLASS 63*

I.D. (In.)	Allowable Crush Load (Lb./Ft.²)*	P (Period) (In.)	H (Wall Height) (In.)	S (Wall) (In.)	Ø (Core Dia.) (In.)	I (Wall Moment) (In.⁴/In.)*	Se (Effective Wall) (In.)	A (Average Profile Area) (In²/In.)*	Z (Centroid) (In.)
18	2854	5.50	1.47	0.21	1.18	0.031	0.808	0.260	0.30
21	2586	5.40	1.49	0.21	1.18	0.035	0.842	0.270	0.32
24	2486	5.10	1.53	0.21	1.18	0.048	0.912	0.293	0.36
27	2455	4.70	1.57	0.21	1.18	0.061	0.985	0.322	0.41
30	2233	5.70	1.88	0.25	1.57	0.081	1.091	0.329	0.42
33	2237	5.70	1.92	0.27	1.57	0.094	1.137	0.359	0.44
36	2155	5.50	1.94	0.27	1.57	0.107	1.182	0.374	0.47
42	2134	4.60	1.98	0.27	1.57	0.146	1.303	0.427	0.55
48	2018	5.08	2.34	0.32	1.96	0.194	1.432	0.460	0.56
54	1950	5.70	2.39	0.33	1.96	0.238	1.519	0.500	0.61
60	1956	4.80	2.41	0.33	1.96	0.294	1.622	0.552	0.68
66	2147	4.70	2.52	0.42	1.96	0.356	1.729	0.664	0.71
72	2138	4.40	2.56	0.42	1.96	0.427	1.828	0.718	0.77
84	2287	4.00	2.70	0.52	1.96	0.577	2.013	0.890	0.86
96	2637	4.00	2.98	0.80	1.96	0.766	2.208	1.170	0.91

PIPE PROPERTIES

TABLE 5: SPIROLITE PIPE NOMINAL DIMENSIONS AND PROPERTIES *CLASS 100*

I.D. (In.)	Allowable Crush Load (Lb./Ft.²)*	P (Period) (In.)	H (Wall Height) (In.)	S (Wall) (In.)	Ø (Core Dia.) (In.)	I (Wall Moment) (In.⁴/In.)*	Se (Effective Wall) (In.)	A (Average Profile Area) (In²/In.)*	Z̄ (Centroid) (In.)
18	3147	4.90	1.51	0.21	1.18	0.044	0.893	0.288	0.35
21	3089	4.30	1.55	0.21	1.18	0.059	0.980	0.324	0.41
24	3334	3.80	1.61	0.25	1.18	0.077	1.066	0.395	0.44
27	2686	5.60	1.92	0.27	1.57	0.097	1.143	0.361	0.44
30	2666	4.80	1.94	0.27	1.57	0.119	1.224	0.394	0.50
33	2627	4.70	1.98	0.27	1.57	0.144	1.296	0.423	0.54
36	2692	4.40	2.02	0.29	1.57	0.171	1.363	0.470	0.58
42	2472	5.20	2.37	0.33	1.96	0.234	1.518	0.504	0.61
48	2470	4.50	2.41	0.33	1.96	0.305	1.648	0.569	0.70
54	2705	4.20	2.52	0.42	1.96	0.387	1.777	0.696	0.74
60	2712	4.00	2.58	0.42	1.96	0.485	1.905	0.770	0.83
66	2830	4.00	2.69	0.51	1.96	0.571	2.006	0.880	0.86
72	2987	4.00	2.82	0.62	1.96	0.678	2.120	1.010	0.89
84	3385	4.00	3.14	0.94	1.96	0.921	2.342	1.330	0.98
96	3663	4.00	3.45	1.25	1.96	1.210	2.560	1.640	1.08

TABLE 6: SPIROLITE PIPE NOMINAL DIMENSIONS AND PROPERTIES *CLASS 160*

I.D. (In.)	Allowable Crush Load (Lb./Ft.²)*	P (Period) (In.)	H (Wall Height) (In.)	S (Wall) (In.)	Ø (Core Dia.) (In.)	I (Wall Moment) (In.⁴/In.)*	Se (Effective Wall) (In.)	A (Average Profile Area) (In²/In.)*	Z̄ (Centroid) (In.)
18	3982	4.80	1.63	0.25	1.18	0.071	1.033	0.369	0.42
21	4249	3.80	1.67	0.27	1.18	0.096	1.135	0.440	0.48
24	3257	5.10	1.96	0.27	1.57	0.124	1.238	0.397	0.50
27	3227	4.70	2.00	0.27	1.57	0.157	1.327	0.436	0.56
30	3425	3.70	2.02	0.29	1.57	0.194	1.422	0.508	0.62
33	3034	5.30	2.37	0.33	1.96	0.232	1.510	0.500	0.61
36	3041	4.70	2.39	0.33	1.96	0.276	1.594	0.541	0.66
42	3358	4.30	2.52	0.42	1.96	0.380	1.767	0.689	0.74
48	3363	4.00	2.59	0.43	1.96	0.491	1.913	0.780	0.83
54	3661	4.00	2.76	0.58	1.96	0.616	2.056	0.950	0.87
60	3937	4.00	2.94	0.74	1.96	0.764	2.204	1.130	0.92
66	4223	4.00	3.14	0.94	1.96	0.921	2.342	1.330	0.98
72	4466	4.00	3.34	1.14	1.96	1.100	2.482	1.530	1.04
84	4751	4.00	3.70	1.50	1.96	1.497	2.741	1.890	1.18
96	4946	4.00	4.05	1.85	1.96	1.995	3.006	2.240	1.33

*Properties are based on minimum profile dimensions

DEFLECTION CONTROL

A realistic approach to deflection control in flexible pipe installations involves assessment of the deflection occurring during installation and due to the service loads, i.e. soil and superimposed loading.

The placement and compaction of bedding material tend to deform plastic pipe, at times causing more deflection than the service load. The lateral forces acting on a pipe during the compaction of the embedment material between the pipe's invert and springline tend to produce a slight increase in the pipe's vertical diameter ("rise"). Rise can offset service load deflection.

Because a flexible conduit interacts with the surrounding soil, the nature of the pipe embedment material and the quality of its placement are important to the control of deflection. Some conduit deflection is natural, and is essential to the development of necessary soil support. The maximum deflection at any point along a pipe must be limited to safeguard its performance capabilities (such as joint tightness) and to protect pipe walls from excessive straining. One of the key objectives in the selection and installation of a flexible pipe is deflection control. **Spirolite®** can withstand large amounts of deflection because of its ductility and ability to relieve stress under load. Common design practice is to limit long term deflection to 7.5%.

The primary contributor to deflection control is the support provided by the embedment material. Support is the result of mobilization of passive resistance in the embedment material during horizontal deflection of the pipe. The amount of support is measured by and directly proportional to a constant known as the modulus of soil reaction (E'). Values of the modulus of soil reaction are given in Figure 8. In situ soil stiffness may influence the modulus of soil reaction value. The designer should consider this for applications in soils having a low capacity for lateral resistance.

The effect of pipe deflection of various levels of side support versus pipe ring stiffness is illustrated in Figure 7. Note that, with a modulus of soil reaction of 1000 psi at a burial depth of 10 feet, there is virtually no difference in the amount of anticipated deflection regardless of pipe class. A Class 100 pipe buried to a depth of 10 feet may, depending on the quality of the pipe's embedment (E'), deflect substantially more than a Class 40 pipe buried to a depth of 16 feet. The greater E' enables the more flexible pipe, under substantially greater load, to see considerably less deflection. Studies and extensive field experience show this to be the case and indicate that the vertical deflection of buried flexible pipes is about equal to the vertical compression (soil strain) of the pipe's sidefill.

FIGURE 7

	VERTICAL DEFLECTION (%)*		
	E' = 1000	E' = 2000	E' = 3000
Depth of Cover = 10'	%	%	%
Class 40	2.8	1.4	.9
Class 63	2.8	1.4	.9
Class 100	2.7	1.4	.9
Depth of Cover = 16'	%	%	%
Class 40	4.0	2.0	1.4
Class 63	4.0	2.0	1.3
Class 100	4.0	2.0	1.3

*(1) 36" Pipe *(2) Soil Weight = 120 lb./ft.³ *(3) With H 20 loading

FIGURE 8: **VALUES OF E' FOR SPIROLITE PIPE**

Class ASTM D-2321	Soil type for pipe bedding material (Unified Classification System*1)	Dumped	Slight <85% Std. Proctor*3 <40% Rel. Den.*4	Moderate 85-95% Std. Proctor 40-70% Rel. Den.	High >95% Std. Proctor >70% Rel. Den.
I	Crushed Rock Manufactured angular, granular material with little or no fine. (¼"-1½")	1,000	3,000	3,000	3,000
II	Coarse-grained Soils with Little or no Fines GW, GP, SW, SP*2 containing less than 12 percent fines (maximum particle size 1½")	NR	1,000	2,000	3,000
III	Coarse-grained Soils with Fines GM, GC, SM, SC*2 containing more than 12 percent fines (maximum particle size 1½")	NR	NR	1,000	2,000
IV(a)	Fine-grained Soil (LL<50) Soils with medium to no plasticity CL, ML, ML-CL, with more than 25 percent coarse-grained particles	NR	NR	1,000*5	2,000*5
IV(b)	Fine-grained Soils (LL>50) Soils with high plasticity CH, MH, CH-MH Fine-grained Soils (LL<50) Soils with medium to no plasticity CL, ML, ML-CL with less than 25 percent coarse-grained particles	NR	NR	NR	NR
	Accuracy in terms of Percentage Deflection	± 2	± 2	± 1	± 0.5

*1. ASTM Designation D-2487, USBR Designation E-3.
*2. Or any borderline soil beginning with some of these symbols (i.e., GM, GC, GC-SC).
*3. Percent Proctor based on laboratory maximum dry density from test standards using about 12,500 ft. - lb./ft.³ (598,000 joules/m³)(ASTM D-698, AASHTO-99, USBR Designation E-11).
*4. Relative Density per ASTM D-2049.
*5. Under some circumstances Class IV(a) soils are suitable as primary initial backfill. They are not suitable under heavy dead loads, dynamic loads, or beneath the water table. Compact with moisture content at optimum or slightly dry of optimum. Consult a Geotechnical Engineer before using.

NOTES:
1. Organic soils OL, OM, and PT as well as soils containing frozen earth, debris, and large rocks are not recommended for initial backfill.
2. NR = Use not recommended per ASTM D-2321.
3. LL = Liquid Limit.
4. For shovel-sliced Class I material, E' typically equals 1000.

Figure 8 based on: Bureau Of Reclamation Values Of E' For Iowa Equation

INSTALLATION

INTRODUCTION

Given similar trench conditions, a rigid pipe is generally subjected to a considerably greater load than a flexible pipe. With rigid pipe, the predominant source of support is the pipe itself. If not properly installed, failure can occur due to stress concentrations. Therefore, the failure of a rigid pipe is often catastrophic. **Spirolite®** is a flexible conduit. It can sustain controlled deformation without harmful effect. For burial installations, the beneficial features of flexible conduit are well recognized. Soil support forces are mobilized, greatly enhancing the pipe's load carrying capabilities, and excessive and concentrated loads are relieved. Requirements for achieving satisfactory construction of flexible pipe/soil systems are not very different from those utilized with traditional piping products. General guidelines presented by ASTM D-2321 *(Standard Recommended Practice for Underground Installation of Flexible Sewer Pipe)* are applicable to **Spirolite®** pipe. The strength of flexible pipe/soil systems has been repeatedly demonstrated by numerous laboratory tests and confirmed by extensive field experience.

The following summarizes general installation guidelines for plastic pipe. For specific applications, the installer should consult the Plexco/Spirolite Installation Guide prior to installing Spirolite pipe.

INSTALLATION

The key to a successful installation is achieving stable and permanent support of the pipe. For flexible pipe, adequate side support is as important as proper bedding. Bedding and initial backfill materials should be stable and compactible. Uniform and proper placement of materials around the pipe is necessary to obtain permanent support.

BEDDING

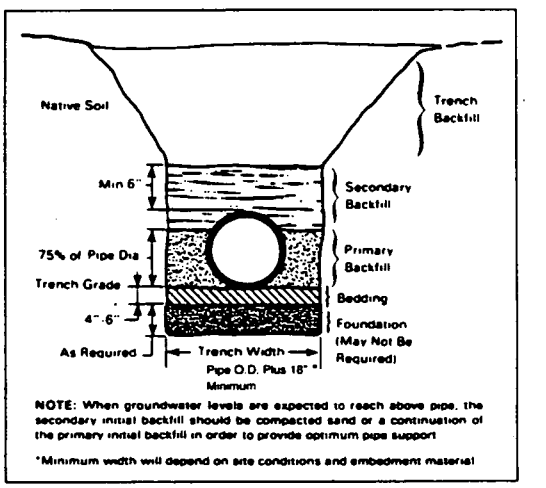
Pipe should be installed in a dry trench. All large rocks and clumps should be removed from the trench bottom. Bedding should be of the same material as the initial backfill and should be compacted to the same density as required for the initial backfill and extended to at least six inches over the top of the pipe. Bedding thickness is typically 4"-6". In unstable soils, additional bedding (or foundation) may be required to obtain a stable trench bottom.

HAUNCHING AND INITIAL BACKFILL

Proper placement and densification of embedment material in the haunching area is a key step toward proper installation. As indicated in Figure 8, only Class I, II, and III embedment materials are normally suitable for use with **Spirolite®** pipe. Proper installation requires even placement and compaction of these materials on both sides of the pipe from trench wall to trench wall, and normally from the trench floor to 6" above the crown of the pipe. This should be done in lifts which permit optimum consolidation of the backfill. Compaction levels of a minimum of 85% Standard Proctor Density for Class I and II materials and 90% Standard Proctor Density for Class III materials are required.

The initial backfill is divided into the primary zone and the secondary zone. (See Figure 9.) Primary zone materials contribute significantly to pipe support and are normally materials recommended in Figure 8. For most applications, above the ground water level it is only necessary to bring the primary zone material to a height equal to ¾ of the pipe diameter. The remainder of the initial backfill or the secondary fill can be any compactible material, including native soil. If the pipe is located beneath the water table, the secondary fill should consist of the same material as the primary initial backfill and both secondary and primary fill should be mechanically compacted with an impact tamper or vibratory sled. The second fill should extend above the pipe to the height noted in the Installation Guide.

FIGURE 9



Every precaution must be taken to ensure the long-term stability of the backfill system. This requires adherence to the recommended embedment procedure, as well as the availability of stable foundation, bedding, and trench wall conditions. Where unstable trench wall conditions exist, or where there is a possibility of ground movement, soil migration, or high water tables, special installation procedures may be required.

FINAL BACKFILL

Any material consistent with applicable job requirements can be used for final backfill. If the final backfill material contains large clumps or rocks which might cause point loading of the pipe crown, then a 2 foot layer of compacted select material must be added above the pipe before beginning final backfill.

APPENDIX

This section provides a detailed approach to selection of the proper class of pipe for a specific subsurface installation. An example of this approach is also included.

The following considerations apply in the selection of **Spirolite®** as well as other flexible pipes: resistance to crush, resistance to buckling, and resistance to deflection due to construction and service loads.

Selection of a class of **Spirolite®** pipe generally depends on the crushing resistance of the pipe wall rather than on the anticipated deflection of the pipe. In cases where the pipe is buried beneath the ground-water table, the constrained buckling resistance of the pipe must also be considered. Pipe class has little influence on long term service load deflection in most installations. Deflection is controlled by the enveloping soil stiffness, as shown in the section "Deflection Control."

The class of **Spirolite®** pipe selected for a given application should have allowable crush and buckling loads in excess of the service load. The service load includes traffic loads, earth load, and surcharge load.

WALL CRUSH STRENGTH

The allowable crushing load for a confined conduit is determined by the compressive strength of its walls. The allowable crushing loads for all **Spirolite®** sizes and classes are listed in Tables 3-6. These values have been calculated using the following equation.

EQUATION 2

$$P_c = \frac{288\ AS_c}{ND_o}$$

Where P_c = allowable crushing load (lbs./ft.²)
S_c = long term compressive stress (psi) — 1600 psi at 73.4°F.
N = safety factor (generally taken as 2)
A = average profile area (in ²/in.)—See Tables 3-6
D_o = pipe outside diameter (in.) = pipe inside diameter +2 times wall height—See Tables 3-6

NOTE: The constant in this equation includes the appropriate units conversion factor.

CONSTRAINED BUCKLING RESISTANCE

Occasionally, when pipe is buried below the groundwater table, wall buckling resistance will govern the class selection of **Spirolite®** pipe. Constrainment of pipe in a trench greatly increases its resistance to wall buckling under hydrostatic load. For a constrained pipe buried to a depth of cover greater than 4 feet, the following equation[1] may be used to determine the allowable buckling pressure.

EQUATION 3

$$P_{wc} = \frac{5.65}{N} \bullet \sqrt{\frac{R\,B'\,E'\,EI}{D_m^3}}$$

$$\text{Where } B' = \frac{1}{1 + 4e^{(-.065H)}}$$

P_{wc} = allowable constrained buckling pressure (psi)
H = height of cover (ft.)
R = buoyancy reduction factor = (1 - .33 H'/H) for H' < H
N = safety factor (generally taken as 2)
E' = modulus of soil reaction (psi)
H' = height of groundwater surface above pipe (ft.)
E = modulus of elasticity of pipe material (psi) (for pipe permanently beneath the water table, E typically equals 28,250 psi. When hydrostatically loaded for less than 3 months out of the year, E may be taken as 42,200 psi.)
I = moment of inertia of wall section (in. ⁴/in.)
D_m = (D_i + 2 $\bar{z}$) mean diameter (in.)
D_i = inside pipe diameter (in.)
$\bar{z}$ = distance from inner pipe surface to the centroid of the wall section (in.)—See Tables 3-6

HYDROSTATIC COLLAPSE RESISTANCE

In the special case of underwater installations where the pipe is submerged directly in water or other fluids, the pipe's allowable hydrostatic collapse pressure may be determined by the following equation:

EQUATION 4

$$P_w = \frac{24EI}{(1 - \mu^2)\,D_m^3} \bullet \frac{C}{N}$$

Where P_w = allowable hydrostatic collapse pressure of unconstrained pipe (psi)
E = modulus of elasticity of pipe material (psi) (Ranges from 113,000 psi for short term loading at 73.4°F. to 25% of that value for continuous long term loading)
I = moment of inertia of wall section (in. ⁴/in.) —See Tables 3-6
μ = Poisson's ratio for pipe material (ranges from about 0.35 for short term loading to 0.48 for long term loading.)
D_m = (D_i + 2 $\bar{z}$) mean diameter (in.)
D_i = inside pipe diameter (in.)
$\bar{z}$ = distance from inner pipe surface to the centroid of the wall section (in.)—See Tables 3-6
C = ovality correction factor as follows:

Ovality	C
1%	0.91
2%	0.84
3%	0.76
4%	0.70
5%	0.64

N = safety factor (generally taken as 2.5)

[1] "Recommendations for Elastic Buckling Design Requirements for Buried, Flexible Pipe," **Proceedings**, Part 1, AWWA 1982 Annual Conference, "Better Water [illegible]

RING STIFFNESS CONSTANT (RSC)

Pipe's sensitivity to deflection rise during installation is controlled by the pipe's ring stiffness. Ring stiffness is defined in terms of the deflection resulting from the load applied between parallel plates. The Ring Stiffness Constant (RSC) is the value obtained by dividing the parallel plate load in pounds per foot of pipe length by the resulting deflection in percent, at 3% deflection. (As described in ASTM F-894.)

EQUATION 5

$$RSC = \frac{6.44\ EI}{D_m^2}$$

Where RSC = ring stiffness constant (parallel plate load in pounds per foot of pipe which causes a 1% reduction in diameter)
I = moment of inertia of wall section (in.⁴/in.)—See Tables 3-6
E = short term modulus of pipe material (113,000 psi @ 73.4°F.)
D_m = (D_i + 2 Z̄) mean diameter (in.)
D_i = inside pipe diameter (in.)
Z̄ = distance from inner pipe surface to the centroid of the wall section (in.)—See Tables 3-6

The nominal ring stiffness constant of a specific **Spirolite®** pipe can be directly related to the pipe's class designation. That is, a Class 40 pipe has a nominal ring stiffness constant of 40, the RSC of Class 63 is 63, and so forth. The minimum RSC for any diameter of pipe within a class is 90% of the class nominal value.*

The classes are shown in Tables 3-6. All sizes of pipe in the same class will deflect uniformly under parallel plate load, i.e. the same parallel plate load will produce approximately the same percent of deflection in all pipe of a given class. For example, any Class 40 pipe will deflect approximately 2% under an 80 lb./lineal ft. load.

To further illustrate this, consider a Class 40 pipe, which is the most flexible **Spirolite®** pipe. Although the exact force applied to a flexible pipe during compaction is not easily calculated, it is known that, for ordinary levels of compactive effort, Class 40 pipe possesses adequate stiffness to achieve a beneficial amount of rise while not impeding the installation or creating significant stresses in the pipe wall. Field observation indicates a typical rise of one or two percent in the vertical diameter. However, variations in embedment materials, their placement, and in compactive techniques make it difficult to estimate rise prior to the actual installation.

Beyond initial installation, pipe stiffness plays an insignificant role in controlling deflection.

*The minimum value of RSC for **Spirolite®** pipe is approximately the same as the minimum value for flexible culverts given in the AASHTO Interim Design Specification, 1981.

ESTIMATING DEFLECTION

Total deflection of a flexible pipe includes both the deflection incurred during installation and the deflection due to soil and superimposed loads. Most proposed relationships for estimating deflection deal only with the latter loads. However, sufficient empirical data exists to make reasonable estimates of total deflection.

A well known relationship for calculating the average vertical deflection in a buried flexible pipe resulting from soil loading only is Spangler's Modified Iowa Equation. This equation, as shown below is modified and expressed in terms of RSC values and assumes a bedding constant of K=0.1 (for typical bedding support).

The U.S. Bureau of Reclamation (USBR) and others have investigated the load/deflection relationship of buried flexible pipe. As a result of hundreds of field measurements, and computer analysis, a series of soil reaction (E′) values were developed for use with the above Equation. These E′ values are useful in estimating the initial deflection resulting from soil loading. They are presented in Figure 8 in terms of the embedment materials.

EQUATION 6

$$\frac{Y}{D_i} = \frac{P}{144} \bullet \frac{(.1)\ L}{(1.24\ (RSC) / D_i) + 0.061\ E'}$$

Where
Y = vertical pipe deformation (in.)
D_i = inside pipe diameter (in.)
P = load on pipe (lbs./linear ft.²)
RSC = ring stiffness constant (lbs./linear ft.)—See Tables 3-6
E′ = modulus of soil reaction (psi)—See Figure 8
L = deflection lag factor (Typical values range from 1.0 to 1.50)

NOTE: The constant in this equation includes the appropriate units conversion factor.

LIVE AND DEAD LOADS

In the design of buried pipelines, both earth loads and live loads must be considered for the proper selection of pipe classes.

Thus, the total load on a pipe is expressed by the following equation:

EQUATION 7

Total Load = Soil Load + Live Load

SOIL LOADS

The work of Marston and recent developments with finite element analysis have shown that at a given depth, the vertical soil pressure at the crown of a buried flexible pipe is generally less than the pressure in the soil if no pipe were present (prism condition). This phenomena occurs because the flexible pipe deflects under load and allows part of the load to be absorbed by soil frictional forces (soil arching).

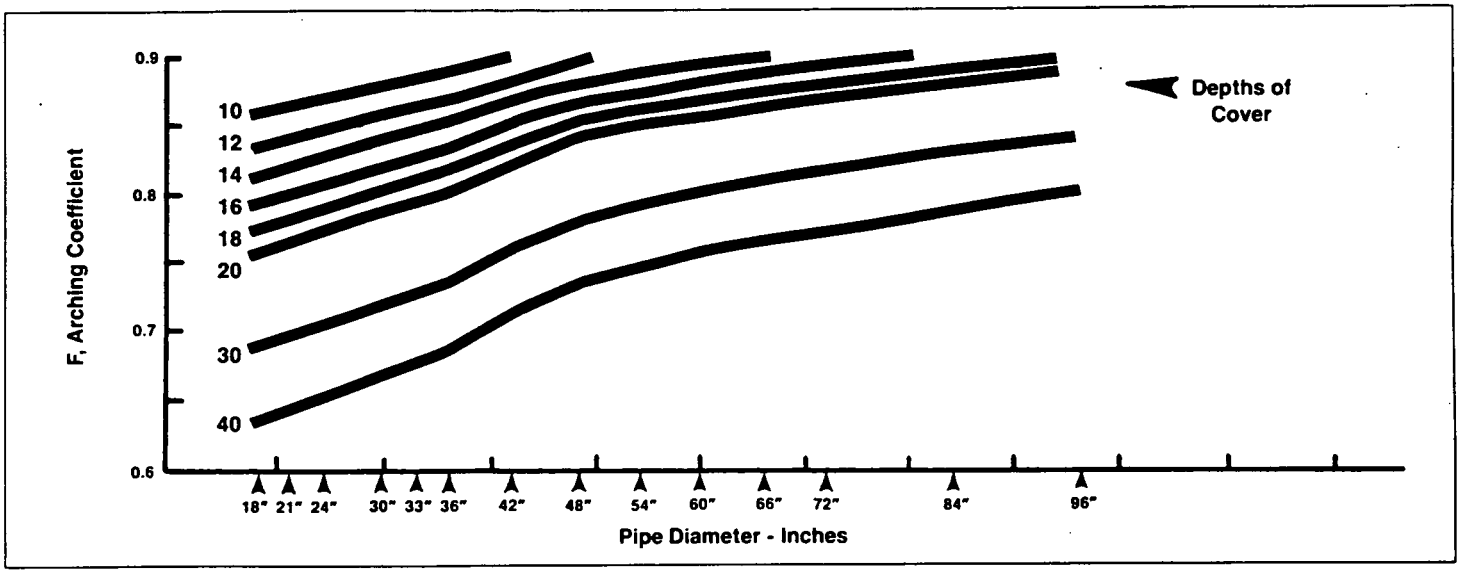
Spirolite® recommends the use of the soil arching concept for calculating the soil load for analysis of **Spirolite®** wall crush strength. The soil load as defined in Equation 8 is the product of the prism load and the arching coefficient. The arching coefficient reduces the prism load to a conservative arched soil load value. Figure 10 provides a graphical solution for the arching coefficient.

For evaluations involving the Constrained Buckling and Spangler's Iowa Equation the value for the modulus of soil reaction (E') was derived using the prism load. Therefore, for evaluations employing the Spangler and Constrained Buckling Equation an arching coefficient, F, of 1.0 should be used.

EQUATION 8

Total Load = (Prism Load) *Arching Coefficient + Live Load
= WHF + L
Where P = Total load (lbs./ft)
W = design unit weight of soil (lbs./ft)
H = height of cover (ft.)
F = Arching Coefficient (See Figure 10)
L = Live load (See Figure 11)

FIGURE 10: Graphical Solution to Marston Soil Arching Concept



The values in Figure 10 were obtained as follows:

(1) The Marston Load is calculated. Since specific soil conditions are not always known, ordinary clay (ku = 0.13) was assumed for the calculations. The assumed trench width was ID + 3' for 18" - 42" and ID + 4' for 48" - 96" (Marston's formula is given in ASCE Manual No. 60, Gravity Sanitary Sewer Design and Construction.)

(2) The prism load is calculated. The prism load equals the product of the unit weight of soil and the depth of cover (ft.)

(3) Add 40% of the difference between the prism load and the Marston load to the Marston load.

(4) The arching coefficient is obtained by dividing the quantity obtained in Step 3 by the prism load.

(5) If the arching coefficient exceeds 0.9 use 1.0 instead.

For example, a 36" Spirolite® pipe with 18' of cover in a 6 ft. wide trench with a 120 lb./ft³ soil design weight. Therefore, the arching coefficient equals.

$$F = \frac{1500 \text{ psf} + 0.4\,(2160-1500)}{2160 \text{ psf}} = 0.82$$

TRAFFIC LOADS

Figure 11 is provided as a tabular method of determining the amount of load transferred to the pipe by a 20 ton truck passing over the pipe (H-20 loading).

Spirolite® recommends, where traffic loads are present, a minimum depth of cover of 3 feet or one pipe diameter (whichever is greater). Where these depths of cover are not possible, please consult with **Spirolite** personnel.

Figure 11: Traffic Loadings Transferred to the Pipe (lb/ft²)

Cover (ft)	Transferred Load (lb/ft²)
1	1800
2	800
3	600
4	400
5	250
6	200
7	175
8	100
10	**

Notes: (1) Simulates 20 ton truck traffic + impact
(**) Negligible live load influence

Source: Handbook of PVC Pipe

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EXAMPLE CALCULATION

This example provides a step-by-step approach for determining which class of **Spirolite®** is suitable for a specific installation. The example utilizes the three basic pipe properties of wall crush, constrained buckling resistance and deflection to select the proper class of pipe for this particular installation. For this example we will select a 60" **Spirolite®** pipe for installation with 18 feet of cover. The pipe will be 9 feet beneath the permanent water table. The native soil is clayey with a design unit weight of 120 pcf. The embedment material chosen for the job is coarse graded sand that is classified Class II per ASTM D-2321. The embedment material will be compacted to 90% Standard Proctor Density with an average E' value of 2000 psi (See Figure 8).

SELECT THE CLASS OF PIPE

1. First determine the total load on the pipe. Use the following values for this example:

Unit weight of soil	W = 120 pcf
Height of cover	H = 18 ft.
Live Load	L = 0 psf
Soil Arching Factor	F = .86 (See Figure 10)

Use Equation 8 to calculate the total load on the pipe:

$$P = WHF + L$$
$$= (120)(18)(.86) + 0$$
$$= 1858 \text{ psf}$$

2. Determine the pipe wall compressive strength requirement by evaluating the cross sectional area of the pipe wall. First, rearrange the terms in Equation 2:

$$A = \frac{N D_o P}{288 S_c}$$

Before solving this equation an outside diameter of the pipe must be determined. To compute D_o assume that Class 63 pipe will be used. (A small error in assuming D_o will have minimal effect on pipe selection.)

$$A = \frac{(2)[(60 \text{ in.} + (2)(2.41)](1858)}{(288)(1600)}$$

Area Required = 0.523 in.^{2}

Using Tables 3-6 for 60" pipe search for a class of pipe sufficient to provide the required area. 60" Class 63 has an area of 0.552 which is greater than the required area of 0.523. Therefore, Class 63 is chosen to satisfy the wall compressive load.

3. Determine the pipe's constrained wall buckling resistance with Equation 3 by evaluating the required moment of inertia of the pipe wall. If the pipe is above the water table it is not normally required to check for buckling.

Rearrange the terms in Equation 3:

$$I = \frac{(P_{wc})^2 N^2 D_m^3}{(5.65^2) RB' E' E}$$

where:

H = 18 ft.
H = 9 ft.
R = (1-.33 (9/18)) = 0.835

$$B' = \frac{1}{1 + 4e^{(-0.065H)}}$$

N = 2
E' = 2000 psi
E = 28250 psi
D_m = 60 + (2) (0.68) = 61.36 in.

P = WHF + L

Note: Use F = 1.0 for this evaluation - prism load

= (120) (18) (1.0) + 0 = 2160 psf (In psi: 2160/144 = 15 psi)

$$I = \frac{(15^2)(2^2)(61.36^3)}{(5.65^2)(0.835)(0.446)(2000)(28250)}$$

Required Moment of Inertia = 0.310 in.^{4}/in.

Again using Tables 3-6, search the 60" Moment of Inertia column (I) for a Moment of Inertia greater than or equal to 0.310 in/in. A pipe of Class 100 (I = 0.485) is required to satisfy the constrained wall buckling resistance equation.

4. The final design evaluation calculates the average initial pipe deflection. Use Spangler's Iowa Equation (Equation 6):

$$\frac{Y}{D_i} = \frac{P}{144} \cdot \frac{0.1L}{(1.24)(RSC)/D + .061 E'}$$

Where:

P = WHF + Live Load (Note: Use F = 1.0 for this evaluation - prism load)
= (120) (18) (1) + 0 = 2160 psf

RSC = 100 (highest value selected from Steps 1-2)
L = 1.0
D = 60"
E' = 2000 psi
Y = Vertical pipe deformation (in.)

$$\frac{Y}{D_i} = \frac{2160}{144} \cdot \frac{(0.1)(1)}{(1.24)(100/60) + .061(2000)}$$

$$\frac{Y}{D} = 1.2\% \text{ Average Deflection}$$

SUMMARY

In this example 60" Class 63 was adequate to provide for the required wall crush strength for this particular application. However, 60" Class 100 was required to meet the requirements of the constrained buckling equation. Therefore, the constrained buckling requirements govern the design and Class 100 is required for this application.

Actual safety factors for crush and buckling may be determined, if desired, by using the pipe properties of the required class using the above formulas and solving for safety factors.

SPECIFICATIONS

SECTION 1 - GENERAL

SECTION 1.1 SCOPE:

1.1.1. This specification covers the requirements of **Spirolite®** High Density Polyethylene gravity sewer pipe and fittings in nominal sizes of 18-through 120-inch with integral bell joints, per ASTM F-894.

SECTION 1.2 DEFINITIONS:

Under this standard, the following definitions apply:

1.2.1. Purchaser: The person, firm, corporation or government agency engaging in a contract or agreement to purchase pipe according to this standard.

1.2.2. Inspector: The authorized representative of the purchaser entrusted with the duty of inspecting pipe produced and witnessing tests performed under these standards.

1.2.3. Inspection: Inspection of the pipe and the tests by the inspector:

1.2.4. Pipe Design: The pipe shall be manufactured by the continuous winding of a special profile onto suitably sized mandrels. It shall be produced to constant internal diameters. The pipe wall profile shall be in accordance with the manufacturer's recommendation.

1.2.5. Joints: The pipe shall be produced with bell and spigot end construction. Joining will be accomplished by rubber gasket, or thermal welding, as determined by the design engineer in accordance with the manufacturer's recommendations.

The integral bell and spigot gasketed joint is designed so that when assembled, the elastometric gasket, contained in a machined groove on the pipe spigot, is compressed radially in the pipe bell to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendations.

SECTION 2 - BASIC MATERIALS

SECTION 2.1 BASIC MATERIALS:

2.1.1. Pipe and Fittings: The pipe shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D-1248-84 *Standard Specification for Polyethylene Plastics Molding and Extrusion Materials*. Clean rework material generated by the manufacturer's own production may be used so long as the pipe or fittings produced meet all the requirements of this specification.

2.1.2. Gaskets: Rubber gaskets shall comply in all respects with the physical requirements specified in the non-pressure requirements of ASTM Specification F-477. They shall be molded or produced from an extruded shape approved by the manufacturer and spliced into circular form.

2.1.3. Lubricant: The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

SECTION 3 - REQUIREMENTS

SECTION 3.1 WORKMANSHIP:

3.1.1. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

SECTION 3.2 DIMENSIONS:

3.2.1. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size. Standard laying lengths shall be 20 feet ±2".

3.2.2. Fitting Dimensions: Fittings such as couplings, wyes, tees, adaptors, etc. for use in laying **Spirolite®** HDPE gravity sewer pipe shall have laying length dimensions as recommended by the manufacturer.

SECTION 3.3 FLATTENING:

3.3.1. There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Section 4.3.1.

SECTION 3.4 RING STIFFNESS CONSTANT

3.4.1. Ring Stiffness Constant (RSC) values for the pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.) The minimum RSC is 90% of the nominal when tested in accordance with section 4.3.2.

SECTION 4 - INSPECTION AND TESTING

SECTION 4.1 INSPECTION REQUIREMENTS:

4.1.1. Notification: If inspection is specified by the purchaser, the manufacturer shall notify the purchaser in advance of the date, time and place of testing of the pipe in order that the purchaser may be represented at the test.

4.1.2. Access: The inspector shall have free access to the inspection area of the manufacturer's plant. The manufacturer shall make available to the inspector, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this specification.

4.1.3. Certification: As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance to these specifications upon request. When prior agreement is being made in writing between the purchaser and the manufacturer, the manufacturer will furnish other conformance certification in the form of affidavit of conformances, test results, or copies of test reports.

SECTION 4.2 PHYSICAL TEST REQUIREMENTS:

4.2.1. Sampling: The selection of the sample or samples of pipe shall be as agreed upon by the purchaser and the manufacturer. In case of no prior agreement, any sample selected by the manufacturer shall be deemed adequate.

4.2.1.1. Sample size for flattening test will be one sample per size and class of pipe per project.

4.2.2. Conditioning: Conditioning of samples prior to and during tests shall be as agreed upon by the purchaser and manufacturer. In case of no prior agreement, the conditioning procedure used by the manufacturer shall be deemed adequate.

SECTION 4.3 TEST METHODS:

4.3.1. Flattening: Three specimens of pipe, a minimum of 12 inches long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. Remove the load, and examine the specimens for splitting, cracking or breaking.

4.3.2. Pipe Ring Stiffness Constant: The pipe ring stiffness constant shall be determined utilizing procedures similar to those outlined in ASTM D-2412. The stiffness of **Spirolite®** HDPE Pipe is defined in terms of the load, applied between parallel plates, which causes a 1% reduction of pipe diameter. Test specimens shall be a minimum of two pipe diameters or 4 feet in length, whichever is less.

SECTION 5 - MARKING AND DELIVERY

5.1.1. Each standard and random length of pipe in compliance with this standard shall be clearly marked with the following information.

Pipe Size
Class & Profile Number
Production Code

SECTION 5.2 DELIVERY:

5.2.1. All pipe, couplings and fittings shall, unless otherwise specified, be prepared for standard commercial shipment.

PLEXCO® Plants

Abbeville, SC 29620-0249
P.O. Box 608
State Highway 32
(864) 446-2136
(864) 446-2139 (fax)

Colton, CA 92324-3530
1280 Jefferson Lane
(909) 420-5500
(909) 370-3841 (fax)

Fairfield, IA 52556-2151
1806 West Stone Avenue
(515) 472-3137
(515) 472-1658 (fax)

Knoxville, TN 37933-1530
P.O. Box 23530
10420 Lexington Drive
(423) 966-5822
(423) 675-9412 (fax)

Reno, NV 89506-2608
14381 Lear Blvd.
(702) 677-1700
(702) 677-1712 (fax)

Waxahachie, TX 75165-4709
1601 West 287 Bypass
(972) 937-0852
(972) 937-4530 (fax)

General Office

Bensenville, IL 60106-1048
1050 Busse Hwy. Suite 200
(630) 350-3700
(630) 350-2704 (fax)
info@plexco.com

If you'd like to know more about PLEXCO products, call our General Office or your nearest Plant Location, visit our web site (http://www.plexco.com), or write for these additional brochures:

PLEXCO Product Literature

Fusion Procedures
Joining PLEXCO Polyethylene Pipe & Fittings
Bulletin No. 101

Industrial Piping Systems
Extra High Molecular Weight PE3408 High Density Polyethylene
Bulletin No. 104

Butt Fusion Procedures
Extra High Molecular Weight High Density Polyethylene PE3408 Pipe
Bulletin No. 108

Municipal Piping System
Extra High Molecular Weight High Density Polyethylene
Bulletin No. 112

Pipe Data & Pressure Ratings Chart
Bulletin No. 301

Dimensions For Molded Fittings
Bulletin No. 320

Dimensions For Fabricated Fittings
Bulletin No. 321

BLUESTRIPE® HDPE Potable Water Piping System
Meets AWWA C-901 & C-906
Bulletin No. 351

Technical Advantages of HTPE
Bulletin No. 354

FM Manual
Factory Mutual Approved for Firewater Systems
Bulletin No. 365

BLUESTRIPE-FM™
NSF and FM Approved Systems for Combined Firewater/Potable Water Systems
Bulletin No. 370

Perforated Piping System
Bulletin No. 450

DCS™ Dual Containment System
Bulletin No. 610

Landfill Applications—Polyethylene Piping Systems
Bulletin No. 620

SPIROLITE® Product Literature

Installation Guide
Bulletin No. 914

Guidelines For Grout Encasement
Technical Bulletin TB-140

Manholes and Buried Structures
Bulletin No. 915

Municipal and Industrial Odor Control Piping
Bulletin No. 916

Available Options to Connect SPIROLITE Pipe to Manholes
Technical Bulletin TB-101

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Rev. 2/97—supersedes all previous issues.

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VBS-PLE 1268 333

Chevron Plexco

System Testing

Application Note No. 8

Pressure Testing Considerations

1.0 Guidelines for All Test Methods

Leak testing may be conducted if specified by the responsible Project Engineer or Owner.

Joints may be exposed to inspect for leakage. Heat fusion joints must be properly cooled before pressure testing. See PLEXCO Bulletins 101 and 108 for fusion joining procedures.

Testing may be conducted on the full system, or in sections. The test section size is determined by test equipment capability. If the pressurizing or pumping equipment is too small, it may not be possible to complete the test within allowable testing time limits. If so, higher capacity test equipment, or a smaller test section may be necessary.

Expansion joints and expansion compensators should be temporarily restrained, or isolated, or removed during the pressure test.

The temperature of the test medium and the pipe test section should be the same, and should be at ambient temperature. Before applying test pressure, allow time for the test medium and the pipe test section to equalize. At temperatures above 100°F (38°C), test pressure must be reduced. Contact PLEXCO for technical assistance with elevated temperature pressure testing.

WARNING: Pipe system pressure testing is performed to discover unacceptable faults in a piping system, pressure testing may cause such faults to fail by leaking or rupturing. This may result in catastrophic failure. Piping system rupture may result in the sudden, forcible, uncontrolled movement of system piping, or components, or parts of components.

WARNING: Pipe Restraint. The pipe system section under test and any closures in the test section should be restrained against sudden uncontrolled movement from catastrophic failure. Test equipment should be examined before pressure is applied to insure that it is tightly connected. All low pressure filling lines and other items not subject to the test pressure should be disconnected or isolated.

WARNING: Personal Protection. Take suitable precautions to eliminate hazards to personnel near lines being tested. Keep personnel a safe distance away from the test section during testing.

1.1 References

The following reference publications provide pressure testing information: ASME B31.1 *Power Piping*, Section 137, Pressure Tests; PPI TR-31, *Underground Installation of Polyolefin Piping*, Section 7. System Testing; and ASTM F 1417, *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.* PLEXCO Technical Personnel should be

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more than one-half the test pressure, then increased in small increments until the required test pressure is reached. Test pressure should be maintained for ten (10) to sixty (60) minutes, then reduced to the design pressure rating, and held for such time as required to examine the system for leaks.

3.3 Low Pressure Procedure

For pipe and components rated for gravity flow, intermittent low pressure, or low pressure service, the required test pressure should be maintained for ten (10) minutes to sixty (60) minutes, but not more than sixty (60) minutes.

Leakage inspections may be performed during this time. If the test pressure remains steady (within 5% of the target value) for the test time, no leakage is indicated.

Test pressure ratings must not be exceeded. See ASTM F 1417, *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air* for more information.

4.0 Initial Service Testing

4.1 Guidelines

An initial service test may be acceptable when other types of tests are not practical, or when leak tightness can be demonstrated by normal service, or when performing initial service tests of other equipment An initial service test may apply to systems where isolation or temporary closures are impractical, or where checking out pumps and other equipment affords the opportunity to examine the system for leakage prior to full scale operations.

4.2 Procedure

The piping system should be gradually brought up to normal operating pressure, and held at operating pressure for at least ten (10) minutes. During this time, joints and connections should be examined for visual evidence of leakage.

5.0 Non-Testable Systems

5.1 Guidelines

Some systems may not be suitable for pressure testing. These systems may contain non-isolatable components, or temporary closures may not be practical. Such systems should be carefully inspected during and after installation. Inspections such as visual examination of joint appearance, mechanical checks of bolt for joint tightness, and other relevant examinations should be performed.

PLEXCO®
1050 Busse Hwy. Suite 200
Bensenville, IL 60106
(708) 350-3700 (voice)
(708) 350-2704 (fax)

Rev. 3/95—supersedes all previous issues

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060 R6

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J. Jenkins	[redacted]	Approver	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	M. Godber	64		
	1	P. Payne	B10		
	1	D. Bodine	38		
	1	T. Russell	64		

RECEIVED BY: James C. Jenkins DATE: 8/18/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 8/18/97

REVIEW COORDINATOR

1268

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Plexco
Performance Pipe Division - Chevron Chemical Company

VBS-PLE-011

QUALITY CERTIFICATION

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comments - Incorporate and Resubmit
[ ] C - Review and Resubmit

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208189 P.O. 0032754
SHIP DATE.	8/12/97
PRODUCT:	84" ID -CL- 160/96" ID CL 315 DCS HORIZ TANK 22'
LOT NUMBERS:	9606361051497
QUANTITY:	1 PC.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)
(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)
( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution
( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution
(X) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter
( ) NSF-61 - Drinking Water System Components - Health Effects
( ) NSF-14 - Plastic Piping Components and Related Materials
( ) Factory Mutual
(X) OTHER: Dimensions, Appearance, and Configuration checked per Dwg. # 90D-693 R3

DATE: 8/12/97

Robert Caldwell
QA/QC Supervisor
Waxahachie, TX.

Chevron

February 3, 1997

Doris Caton
Plexco
1601 West 287 Bypass
Waxahachie, TX 75165

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Phone 409 886 7491

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9348	Lot Number:	F061629
Chevron Order #:	129597	Destination:	Waxahachie
Package:	GOCX058907	Weight (lbs):	183,050
Customer Order #:	107802	Ship Date:	1/31/97

This is to confirm that Chevron HDPE HiD 9348 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D4976. In addition, Chevron HiD 9348 when used with the proper color concentrate meets or exceeds the minimum requirements of cell classification 335434C in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.13	gms/10 min
HLMI	17.3	gms/10 min
MFR	133.0	
Density	0.9476	gms/cc
ESCR Condition C	0	Failures/20

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 214-923-1632

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

Southwest Chemical Services

DATE: JANUARY 29, 1997

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525289

COMPARTMENT		B	CB	CA	A
LOT NUMBER:		139343-1	-2	-3	-4
CUSTOMER P/O #:		107700			
POUNDS SHIPPED	SPECS	186,900			
CARBON BLACK	34 - 36%	34.8	34.8	35.0	35.1
GM/100 PELLET	2.4-3.2%	2.7	2.7	2.9	2.8
MELT INDEX 10X	9 - 15%	12.6	11.8	13.0	12.1
MOISTURE	.10% MAX	0.05	0.04	0.06	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 478 (Highway 146)
4 Miles South of La Porte
Seabrook, Texas 77586
(281) 474-2831

126896

Chevron

February 3, 1997

Doris Cates
Plexco
1601 West 287 Bypass
Waxahachie, TX 75165

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Fax: 409 886 7471

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9348	Lot Number:	F081639
Chevron Order #:	129697	Destination:	Waxahachie
Package:	GOCX058807	Weight (lbs):	183,050
Customer Order #:	107802	Ship Date:	1/31/97

This is to confirm that Chevron HDPE HID 9348 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D4976. In addition, Chevron HID 9348 when used with the proper color concentrate meets or exceeds the minimum requirements of cell classification 335434C in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.13	gms/10 min
HLMI	17.3	gms/10 min
MFR	133.0	
Density	0.9476	gms/cc
ESCR Condition C	0	Failures/20

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Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 214-923-1632

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Molding Applications: 1-800-231-3828

Southwest Chemical Services

DATE: JANUARY 29, 1997

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX.

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525289

COMPARTMENT		B	CB	CA	A
LOT NUMBER:		139343-1	-2	-3	-4
CUSTOMER P/O #:		107700			
POUNDS SHIPPED	SPECS	186,900			
CARBON BLACK	34 - 36%	34.8	34.8	35.0	35.1
GM/100 PELLET	2.4-3.2%	2.7	2.7	2.9	2.8
MELT INDEX 10X	9 - 15%	12.6	11.8	13.0	12.1
MOISTURE	.10% MAX	0.05	0.04	0.06	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 476 (Highway 146)
4 Miles South of La Porte
Seabrook, Texas 77586
(281) 474-2831

UNION CARBIDE CORPORATION
P.O. Box 186, Port Lavaca, TX 77979

Fax: 1214.937.4530

Plexco / Spirolite
Division of Chevron Chem. Co.
Hwy 31 East
Corsicana, TX 75110
Attn: K. Gill

PRODUCT CERTIFICATE OF ANALYSIS

01/13/97

Product Name: DGDB-2480 NT 3408

Customer Order No.: 107606
Internal Order No.: 442590

Shipped To: Plexco/Spirolite
Div. of Chevron Chemical Co.
1001 W Hwy 287 Bypass
Waxahachie, TX 75196

Blend	Quantity	Container Id	Ship Date
170095	195220	DGLA10691	01/09/97

All shipments of this product to customer must meet the following:
Plexco-Spirolite Requirements for DGDB-2480 NT 3408, dated Nov. 4, 1994.
This is to confirm that DGDB-2480 NT 3408 is a Type III, Class A, Grade P34, Category 5 Natural Polyethylene resin under ASTM D1248, with a cell classification of PE345434A under ASTM D3350. When properly mixed with 6.5% of DFWF-0092 BK the product meets the requirements of ASTM D3350.

The following test data was obtained :

Blend : 170095
Sample Id : PE960671
Date of Manufacture : 12/31/96

Test Description	Unit	Minimum	Maximum	Results
Melt Index	g/10min	.06	.1	.070
Melt Flow Index (190C/21.6kg)	g/10min	8	12	10.9
Melt Flow Ratio (21.6/2.16 kg)		120	155	139.7
Density	g/cu cm	.943	.947	.9456
OIT @ 210C	min	13		21
Oxidative Induction Temp.	C	240		242
Tens.Stress@Yield,2"/M,50-150C/M	psi	3000		3435
Elongation Orig,2"/M, 50-150C/M	%	600		825
ESCR 192HRS/100%Igepal/100C	% Fail		0	0

Paul Guerra, Lab Supervisor

Quality Assurance Department

Southwest Chemical Services

DATE: DECEMBER 11, 1996

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525390

COMPARTMENT		B	CB	CA	A
LOT NUMBER:		179229-1	-2	-3	-4
CUSTOMER P/O #:		107406			
POUNDS SHIPPED	SPECS	193,700			
CARBON BLACK	34 - 36%	35.4	34.8	35.0	34.7
GM/100 PELLET	2.4 - 3.2	2.9	2.7	2.7	2.9
MELT INDEX 10X	9 - 15	10.2	10.9	11.0	10.7
MOISTURE	.10% MAX	0.04	0.04	0.04	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 478 (Highway 146)
4 Miles South of La Porte
Seabrook, Texas 77586
(713) 474-2831

1268

1" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-5080

June 13, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxachie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25628 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

000321

1268

2" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-5080

June 18, 1997

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Jackie

Jackie Cramer

1" Flat Sheet

000322

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

HITEC® HIGH DENSITY POLYETHYLENE

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.70	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	68	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	220,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack	hrs.	—	D 1693
Resistance, F50	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	78	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Photo Courtesy of:
Plastinetics, Inc.

HITEC® BLACK PIPE GRADE HIGH DENSITY POLYETHYLENE

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,5,P34	D 1248
Cell Classification	—	346,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indices 190°C/5kg	g/10 min.	0.4	D 1238
Melt Flow Indices 109°C/21.6kg (HM1)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressed Ring ESCR (50°C/25% Igepal)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	49	D 785
Shore Hardness	Shore D	63	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A§
Tensile Strength @ Yield	psi	>3,300	D 638‡
Elongation @ Break	%	>800	D 638‡
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638‡
Flexural Modulus @ 2% Strain	psi	125,000	D 3350
Vicat Softening Temperature	°F	255	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	1x10⁻⁴	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. ‡Type IV specimen, 2 in/min. §1/8" thick specimen. FDA Registered. N550 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Black±0.5%

COMPRESSION POLYMERS GROUP
801 COREY STREET
MOOSIC, PA 18507
TEL: 717-346-8254
FAX: 717-346-4122

Warranty
All sheeting guaranteed void free, the limit of our warranty is your money refunded or defective material replaced; no other warranties are expressed or implied.

* Physical properties of plastic sheeting are presented as "Typical." Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied, for which the Compression Polymers Group assumes any legal responsibility. Our warranties are limited to those expressly stated in formal contracts or in conditions of sale on our invoices and order acceptances. Conditions and methods of use vary and are beyond the control of Compression Polymers Group, therefore, Compression Polymers Group disclaims any liability incurred as a result of the use of its products in accordance with the data contained on our physical property charts. No information herein shall be construed as an offer of indemnity for infringement or as a recommendation to use the products in such a manner as to infringe any patent, domestic or foreign.

The "Typical" properties of our plastic sheet cannot be automatically used when engineering finished fabricated components; and the fabricator or end user is responsible for insuring the suitability of our products for their specific application or end use.

Fabrication Run Plan Checklist

Standard Manhole

Part # _____ Product Desc. 84" R160 / 96" R315 MS Tank Date 5-10-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 60" } KC
OD 79" } DCS KC

B. Check class of riser wall 72" R250 KC

II. Check length of riser prior to final cut. 4' 10 1/4 KC

III. Check lay out of holes.

Circumference point	0 Riser	height point	8' 3"	From ~~Top/Bottom~~ end	KC
Circumference point		height point	9"	~~Top/Bottom~~ end	KC
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	60/72	length	4' 9 3/4	KC
Size & Connection	2"	length	12"	KC
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		

V. Inspect all welds, dimensions, and angles.

A. Welds top KC

bottom

through pipe/stub outs KC

ladder N/A

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles. KC

D. Check lifting lugs. N/A

E. All appropriate labeling. _____

101794

		PROCESS DESCRIPTION		
8/5	430	84" Gussets on Bottoms	Ray	485/430
8/6	477	Weld Bottoms on 96"	Elvern	485/481-477
8/6	430/909	Weld 84" Together	Tracy	4/2/430-480/48
8/7	907/430	Weld 96" Together	Tracy	481/431 - 482/430
8/7	477/907	Weld Cross Ison 84"	Elvern	485/430 - 485/435
8/8	430/909/862	Weld Gussets on 84"	Tracy	480/485 / 482/438
8/8	477/907	Line Holes OD	Elvern	—
8/9	477/485	Weld End on 96"	Ray	482/430/482/430
8/9	479/482	Weld Ends on 96"	Tom	480/430/482/430
8/10	477/885	Weld 60" to 84"	Ray	480/430/482/422
8/10	479/482	Weld 72" to 96"	Tom	485/422/485/425
8/11	433/485	Weld lolt end seal / 4/x end seal	Ray	482/427/480/476
8/11	486-479	Weld Box v Valve Box Plate		480/457 485/426

1268

See Attached for Lot #'s

Lot Number 051497 to 051497 Pc 1 Completed Date 8/11/97

Start Weight _____ Finished Weight _____ Test Piece: Yes ___ No ✓

Operator Comments:

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS 315	WEIGHT	DESCRIPTION
1	17-9"	Ft-in	W 726	96"	365/[redacted]	10028#	96" PEXPE Wound Pipe
2	3'	Ft	W 727	96"	365/160	5562#	96" PEXPE Wound Pipe
3	196'	Ft	W 6[illegible]	84	[redacted]250	7027	84" PEXPE Wound
4	76'	Ft	W 723	84"	[redacted]250	2860	84" PEXPE Wound
5	7'	FT	W 807	72"	250		72" PE X PE WOUND
6	7	FT	[redacted] W 605	60"	160		60" PEX PE WOUND
7	4'	FT	U-609	10"	DR 11		3408 FEED STOCK
8	4'	FT	V-943	6"	DR 11		3408 FEED STOCK
9	2'	FT	U-713	8"	DR 11		3408 Feed Stock
10	3'	FT	U-698	4"	DR 11		3408 Feed Stock
11	32	Doff	3/4	1"			SHEET STOCK
12	320	Doff	H-7 3/4	2"	[redacted]		SHEET STOCK
13							
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30							

TOTAL P.15

000322

1268

Plexco
Performance Pipe Division Chevron Chemical Company

VBS-PLT-012

QUALITY CERTIFICATION

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208714 P O 0327541
SHIP DATE:	8/12/97
PRODUCT:	42" IPS 32.5 MANHOLE X 5'
LOT NUMBERS:	#2 - 4209467071097 #3 - 4209466071097 #4 - 4209465071097
QUANTITY:	3 PCS.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)

(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)

( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution

( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution

(X) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter

( ) NSF-61 - Drinking Water System Components - Health Effects

( ) NSF-14 - Plastic Piping Components and Related Materials

( ) Factory Mutual

(X) OTHER: Dimensions, Appearance and Configuration checked per Dwg # 90D-693 R3

DATE: 8/12/97

Robert Caldwell
QA/QC Supervisor
Waxahachie, TX

Union Carbide Chemicals and Plastics Company, Inc.
P.O. Box 168, Port Lavaca, TX 77979

Fax: 1803-444-2139

Pioneer / Spiralite
Division of Chevron Chem. Co.
Abbeville Industrial Park
Abbeville, SC 29620
Attn: J. F. Kay

PRODUCT QUALITY REPORT

05/14/94

Product Name: UCDU-2480 A1

Customer Order No.: 101703
Internal Order No.: 352893

Shipped To: Pioneer/Spiralite
Div. of Chevron Chemical Co.
Abbeville Industrial Park
Abbeville, SC 29620

Blend	Quantity	Container Id	Ship Date
462978	193334	UNBX1F336/00	05/11/94

The following test data was obtained :

Blend : 462978
Sample Id : PE129861
Date of Manufacture : 05/13/94

Test Description	Unit	Results
Melt Index	g/10min	.059
Melt Flow Index (190C/21.6kg)	g/10min	9
Melt Flow Ratio (21.6/2.16 kg)		152.5
Density	g/cc cm	.9455
ESCR @ 210C	min	16
Tens.Stress@Yield,2"/M,50C15C/M	psi	3440
Tens.Strength Orig,2"/M,50C15/M	psi	5900
Elongation Orig,2"/M, 5C 15C/M	%	730
ESCR 100MHz/1000kgmsat/100C	% fail	0

Wayne Daggs

Wayne Daggs

Quality Assurance Department

Union Carbide Chemicals and Plastics Company, Inc.
P.O. Box 100, Port Lavaca, TX 77979

Fax: 1803-446-2139

Plexco / Spirolite
Division of Chevron Chem. Co.
Abbeville Industrial Park
Abbeville, SC 29620
Attn: J. F. Ray

PRODUCT CERTIFICATE OF ANALYSIS

06/08/94

Product Name: DGDS-2480 NT 3408

Customer Order No.: 101405
Internal Order No.: 177399

Shipped To: Plexco/Spirolite
Div. of Chevron Chemical Co.
Abbeville Industrial Park
Abbeville, SC 29620

Blend	Quantity	Container Id	Ship Date
[illegible]	[illegible]	[illegible]	[illegible]

Plexco-Spirolite Specifications, dated August 28, 1985.

The following test data was obtained :

Blend : [illegible]
Sample Id : [illegible]
Date of Manufacture : 05/13/94

Test Description	Unit	Minimum	Maximum	Results
Melt Index	g/10min	.05	.14	.065
Melt Flow Index (190C/21.6kg)	g/10min	9	13	10.9
Melt Flow Ratio (21.6/2.16 kg)		110	155	122.2
Density	g/cc cm	.943	.946	.9440
OIT @ 210C	min	13		24
Izod Impact	ft-lb/"	2		0.8
Tens.Stress@Yield,2"/M,50TSC/M	psi	3000		3417
Elongation Orig,2"/M, 50 TSC/M	%	600		736
ESCR,10%WS/100%Igepal/100C	% Fail		0	0
Brittleness @ -76C	% Fail		0	0

Jack Davis

Quality Assurance Department

1268 42"

UNION CARBIDE CHEMICALS AND PLASTICS COMPANY INC.

P.O. BOX 670, BOUND BROOK, NJ 08805
TELEPHONE: (908) 563-5000

Fax No. 8-883-446-2137
FLEXCO/Spirolite
A Div. of Chevron Chemical
Abbeville, SC 29629

6/28/94

Attn: Mr. J. F. Kay

Gentlemen:

This is to certify that DFNF-0098 BK was produced in accordance with our standard formula and process, and conforms with our specifications for this product.

The following test data were obtained on this blend:

TEST	DATA	
Blend(s)	662932	662943
Quantity (lbs)	6000	36000
Customer Order No.	101793	
Process No.	354286	
Hopper Car No. (if appropriate)	N/A	
Ship Date	6/27/94	

Typical Melt Index of Base Resin DFH-2076	0.25	
Carbon Black Content, Wt %	35.30	35.61
Flow Index @ 190°C, g/10 min	12.20	12.48

Very truly yours

Quality Assurance Dept.

Fax. No. 8-708-350-2148
FLEXCO/Spirolite
A Div. of Chevron Chemical
Bensenville, IL 60131
Attn: Mr. W. Walker

1268

1" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxachie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25628 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

1268

2" Flat Sheet

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Thank You,

Jackie

Jackie Cramer

1" Flat Sheet

000333

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

Hitec® High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.70	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	68	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	220,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack Resistance, F50	hrs.	—	D 1693
	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	78	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Photo Courtesy of: Plastinetics, Inc.

Hitec® Black Pipe Grade High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,5,P34	D 1248
Cell Classification	—	345,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indices 190°C/5kg	g/10 min.	0.4	D 1238
Melt Flow Indices 109°C/21.6kg (HM1)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressed Ring ESCR (50°C/25% Igepal)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	49	D 785
Shore Hardness	Shore D	63	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A§
Tensile Strength @ Yield	psi	>3,300	D 638‡
Elongation @ Break	%	>800	D 638‡
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638‡
Flexural Modulus @ 2% Strain	psi	125,000	D 3350
Vicat Softening Temperature	°F	256	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	1x10⁻⁴	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. ‡Type IV specimen, 2 in/min. §1/8" thick specimen. FDA Registered. N550 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Black±0.5%

COMPRESSION POLYMERS GROUP

801 COREY STREET
MOOSIC, PA 18507
TEL: 717-346-8254
FAX: 717-346-4122

Warranty
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The "typical" properties of our plastic sheet cannot be automatically used when engineering finished fabricated components; and the fabricator or end user is responsible for insuring the suitability of our products for their specific application or end use!

000334

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # 944274 Product Desc. HDPE 325 MAN HOLE #2 Date 8/11/97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID _____

OD _____

B. Check class of riser wall DR 325

II. Check length of riser prior to final cut. 58"

III. Check lay out of holes.

Circumference point	0°	height point	26"	From Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	1"	length	36 1/4
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

inside

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs. _____

E. All appropriate labeling. _____

101994

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER	7:00 & 1:00 AM,PM AIR&EXTUATE TEMP
		42" DR32.5		
8/11	823/485	WELD Botton on 42"	Soy	482/487/480/476
8/11	479/482	WELD Top on 42"	Tim	480/487 485 476

1268

6208714 Lot Date 2-13-97

Quantity 1

Final Bin

Approval for Shrx: 946273

Inv Item

Description 42 IRB-32.5 MANTLE #2 5'

Act Qty By/Date Prod Lot No.

See Attached for Lot #'s

Lot Number 4209467 to 071097 Qty 1

Start Weight: 5003#

Finished Weight: 1643

Operator Comments

QC Approval Date: 6 6 97

Test Passed: Yes ___ No X

Passed
Vline Sorrel

To ITS 32.5 Manhole #2

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	3	FT	[illegible]	42"	32.5		Feed Stock 901158
2	1.2	FT	580300-063	30"	9/63		Feed Stock 580300-063-XC
3	27.2	SQ	700291	1"		11.5 #	Sheet Stock 700291
4	136	SQ	700527	2"		146 #	Sheet Stock 700527
5	159	SQ	" "	2"		172 #	Sheet Stock
6	3.2	FT	[illegible]	1"	DR-11		Feed Stock 904966
7	1	EA		1"	DR-11		EA.
8	1	EA	900991	1"			LTF 900991
9	2	FT	[illegible]	2"	DR-11		Feed Stock 920624
10	2	EA	989015	2"	DR-11		Molded Butt Ell
11	.25	SQ FT	700291	1"		2 #	Sheet Stock # 92020151-4
12							
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Fabrication Run Plan Checklist

Standard Manhole

Part # 944274 Product Desc. 48 ID 325 MAN HOLE #3 Date 8/4/97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID _____ _____

OD _____ _____

B. Check class of riser wall DR 325 _____

II. Check length of riser prior to final cut. 58" _____

III. Check lay out of holes.

				From	
Circumference point	0°	height point	20"	Top/Bottom	[illegible]
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	1" Dew	length	36 1/4	[illegible]
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		

V. Inspect all welds, dimensions, and angles.

A. Welds top _____

bottom _____

through pipe/stub outs _____

ladder _____

B. Dimensions - inspect all dimensions not previously checked. _____

C. Recheck angles. _____

D. Check lifting lugs. _____ _____

E. All appropriate labeling. _____ _____

101994

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER	7:00 & 1:00 AM,PM AIR&EXTUATE TEMP
		42" DR32.5		
8/11	823/485	WELD Bottom on 42"	Coy	482/427 / 480/476
8/11	479/482	WELD Top on 42"	Tim	480/457 485 476

1268

Operator: Waekman

Standard Bill of Material for Stock 94074

Inv Item | Description | Act Qty | By/Date | Prod Lot No.

47TBS-32.5 HANDLE 43.5"

Pat Date: 2-13-97

Quantity: 1

Prod Lot

See Attached for Lot #'s

Lot Number: U209466 071097

Start Weight: 200#

Finished Weight: 193

Operator Comments:

Approval Date: 8 18 97 OK

Test Piece: Yes ___ No X

Passed Ultra Sound

42" PS 32.5 Manhole #3

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	5	Ft	45381	42"	32.5		Feed stock 901158
2	1.2	Ft	SR3X0-063-SW	30"	C/63		Spical Feed stock
3	22	SQ	700891	1"		11.5#	Flat Sheet 700291
4	13.6	SQ	702587	2"		146#	Flat Sheet 700291
5	15.9	SQ	" "	2"		172#	Flat Sheet
6	22	Ft	V812	1"	DRILL		Feed Stock 909Kato
7	1	EA		1"	DRILL		FLA
8	1	EA	900891	1"			LSF 900291
9	2	Ft	11532	2"	DRILL		Feed Stock 920624
10	2	EA	989015	2"	DRILL		molded 90° Bell & LL LOT # 97020151-H
11	25	SQ	700891	1"		2#	Sheet Stock
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

000342

Exhibit 161A

Fabrication Run Plan Checklist

Standard Manhole

Part # 944274 Product Desc. DR 325 MANHOLE #4 Date 8/11/97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID _____ _____

OD _____ _____

B. Check class of riser wall DR 325 _____

II. Check length of riser prior to final cut. 58" _____

III. Check lay out of holes.

					From	
Circumference point	0°	height point	20"		Top/Bottom	[illegible]
Circumference point		height point			Top/Bottom	
Circumference point		height point			Top/Bottom	
Circumference point		height point			Top/Bottom	
Circumference point		height point			Top/Bottom	
Circumference point		height point			Top/Bottom	

IV. Check stub outs.

Size & Connection	1" pen	length	36"	[illegible]
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		
Size & Connection		length		

V. Inspect all welds, dimensions, and angles.

A. Welds top _____

bottom _____

through pipe/stub outs _____

ladder _____

B. Dimensions - inspect all dimensions not previously checked. _____

C. Recheck angles. _____

D. Check lifting lugs. _____ _____

E. All appropriate labeling. _____ _____

101994

1268

		MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER	7:00 & 1:00 AM,PM AIR&EXTUATE TEMP
		42" DR32.5		
8/11	823/485	WELD Bottom on 42"	Cox	485/427/486/476
8/11	47A/482	weld Top on 42"	Tim	486/457 485 476

1268

Workman

Standard Bill of Material for Stock 94075 42 lbs-32.5 MANILLA #4

Inv Item	Description	Act Qty	By/Date	Prog Lot No
	# 38 1/2" SDR 11			
	# 38 1/2" SDR 11			

See Attached for Lot #'s

Lot Number 42094465 to 970097 Qty 1 QC Approval Date 8 18 92

Cart Weight: 800# Finished Weight: 693 Test Panel Yes ___ No ✓

Inventory Comments

Pound Ultra Sound

000345

42" LTS 32.5 Manhole #4

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	5	FT	4881	42"	32.5		Feed Stock 900158
2	2	FT	58 0300-003 SW	30"	463		Feed Stock
3	0.2	SQ	700291	1"		11.5#	Sheet Stock 700291
4	1246	SQ	705527	2"		146#	Sheet Stock 705527
5	1547	SQ	" "	2"		172#	Sheet Stock
6	30	FT	4892	1"	DR-11		Feed Stock 904966
7	1	EA		1"	DR-11		F A
8	1	EA	900991	1"			L J F
9	2	FT	4592	2"	DR-11		Feed Stock 920624
10	2	EA	989815	3"	DR-11		Moulded Butt ELL LOT #-970210151-1
11	.05	SQ FT	700291	1"		2#	Sheet Stock
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

TOTAL P.29

1268

000346

#60R5

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	D. Bodine	38		
	1	P. Pauke	B10		
	1	M. Godber	64		
	1	T. Russell	64		

RECEIVED BY: James C. Jenkins DATE: 8/12/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

Please sign & date
ORIGINAL FILE COPY
Return to CDC ms/44

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J.C. Jenkins DATE: 8/12/97

REVIEW COORDINATOR

1268

000347

Plexco
Performance Pipe Division - Chevron Chemical Company

QUALITY CERTIFICATION

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208189 P.O. 0032754
SHIP DATE:	7/30/97
PRODUCT:	84" ID -CL- 100 Manhole LCS-3 X 9.5' 84" ID -CL- 100 Manhole LDS-3 X 9.5'
LOT NUMBERS:	LCS-3 #8406364051497 LDS-3 #8406367051497
QUANTITY:	2 PCS.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)
(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)
( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution
( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution
( ) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter
( ) NSF-61 - Drinking Water System Components - Health Effects
( ) NSF-14 - Plastic Piping Components and Related Materials
( ) Factory Mutual
(X) OTHER: Dimensions, Appearance, and Configuration checked per LCS-3 - Dwg. # 90D-689 R2 LDS-3 - Dwg. # 90D-689 R2 & Dwg.# 691 R1

DATE: 7/30/97

Robert Caldwell
QA/QC Supervisor
Waxahachie, TX.

February 3, 1997

Doris Cates
Pienco
1601 West 287 Bypass
Waxahachie, TX 75165

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Phone 409 883 7481

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9348	Lot Number:	F081629
Chevron Order #:	129697	Destination:	Waxahachie
Package:	GOC3058807	Weight (lbs):	183,050
Customer Order #:	107802	Ship Date:	1/31/97

This is to confirm that Chevron HDPE HID 9348 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D4976. In addition, Chevron HID 9348 when used with the proper color concentrate meets or exceeds the minimum requirements of cell classification 335434C in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.13	gms/10 min
HLMI	17.3	gms/10 min
MFR	133.0	
Density	0.9476	gms/cc
ESCR Condition C	0	Failures/20

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 214-923-1632

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

Southwest Chemical Services

84" Manhole

DATE: JANUARY 29, 1997

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525289

COMPARTMENT		B	CB	CA	A
LOT NUMBER		139343-1	-2	-3	-4
CUSTOMER P/O #		107700			
POUNDS SHIPPED	SPECS	186,900			
CARBON BLACK	34 - 36%	34.8	34.8	35.0	35.1
GM/100 PELLET	2.4-3.2%	2.7	2.7	2.9	2.8
MELT INDEX 10X	9 - 15%	12.6	11.8	13.0	12.1
MOISTURE	.10% MAX	0.05	0.04	0.06	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 478 (Highway 146)
1 Mile South of La Porte
Seabrook, Texas 77586
(281) 474-2831

EXHIBIT: B
APPROVAL BY: [illegible]
REVISED: [illegible]

REF: B - 4
PAGE: 4 OF 4

LINE: 316

FLEXCO - FAIRFIELD
DAILY LAB REPORT
MELT INDEX, DENSITY, AND CARBON ASH TESTING

SIZE: DE3408 Black Pelletized
LOT NUMBER: PU055
MATERIAL: 2480 - ACFX-38580
DATE OF RUN: 11-14-96
CONCENTRATE LOT #: 190109-07189
MATERIAL LOT #: 160065
DISPERSION: PASS / FAIL

PRODUCTION DATE	MI 2	MI 21.6	DENSITY	CARBON ASH	TESTED BY & DATE
11-14-96	.09	10.93	.954	2.12	JD 111496
11-15-96	.09		.953		JD 111596

1" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Carey Street • Moosic, PA 18507 • (717) 346-5797 • Fax: (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #809015, our invoice #25028 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

1½" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Carey Street • Moosic, PA 18507 • (717) 346-8797 • Fax (717) 346-5080

Plexco- Spiroflite
Chevron Chemical Co
1601 W 267 Bypass
Wanachie, TX 75165

June 13, 1997

ATTN: Doris

The material on your PO #201895, our invoice #21961 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA.

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1 1/2" FlatSheet

1268 Flat Sheet

COMPRESSION POLYMERS GROUP
801 Comly Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-5080

June 18, 1997

Phillips- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #85688 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1" Flat Sheet

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

Hitec® High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.70	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	66	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	200,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack Resistance, F50	hrs.	—	D 1693
	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	78	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Hitec® Black Pipe Grade High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,5,P34	D 1248
Cell Classification	—	346,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indices 190°C/5kg	g/10 min.	0.4	D 1238
Melt Flow Indices 190°C/21.6kg (HMI)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressed Ring ESCR (50°C/25% Igepal)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	49	D 785
Shore Hardness	Shore D	68	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A§
Tensile Strength @ Yield	psi	>3,300	D 638
Elongation @ Break	%	>600	D 638
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638
Flexural Modulus @ 2% Strain	psi	125,000	D 3350
Vicat Softening Temperature	°F	255	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	$1x10^{-4}$	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. §Type IV specimen, 2 in/min. ¶1/8" thick specimen. FDA Registered. N550 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Black±0.5%

Photo Courtesy of: Plastinetics, Inc.

COMPRESSION PIONEERS GROUP
801 CONCY STREET
MOOSIC, PA 18507
TEL: 717-346-8254
FAX: 717-346-4122

Warranty
All sheeting guaranteed vital free, the limit of our liability is your money refunded or defective material replaced; no other warranties are expressed or implied.

* Physical properties of plastic sheeting are presented as "Typical." Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied, for which the Compression Pioneers Group assumes any legal responsibility. Our validations are limited to those commonly used as a general guideline or to conditions of sale on our literature and price accreditations. Conditions and methods of use vary and are beyond the control of Compression Pioneers Group, therefore, Compression Pioneers Group disclaims any liability incurred as a result of the use of its products in accordance with the data described on our physical property charts, no statements herein shall be construed as an offer of, or warranty for infringement of, or as a recommendation to use the products in such a manner as to infringe any patent, domestic or foreign.

The "typical" properties of our plastic sheet cannot be automatically used when engineering finished fabricated components, and the fabricator or end user is responsible for testing the suitability of our products for their specific application or end use.

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No.: LCS-3 #8406364051497

PRODUCT CODE: 943793

DATE TESTED: 7/30/97

CUSTOMER: Workman Developments Inc.

TESTED BY: Larry Dunbar

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS: _____

Exhibit 161A

Fabrication Run Plan Checklist

Standard Manhole

Part # _____ Product Desc. LCS #3 Date: 7-23-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 84" KC

OD 89 1/4 KC

B. Check class of riser wall 100 KC

II. Check length of riser prior to final cut. 10' 1 1/2 KC

III. Check lay out of holes.

Circumference point 0°	height point 7'10"	w/o top on From Top/Bottom	KC
Circumference point 30.96°	height point 6'5 1/4	Top/Bottom	KC
Circumference point 45°	height point 3'8"	Top/Bottom	KC
Circumference point 90°	height point 5'4 1/2"	Top/Bottom	KC
Circumference point 180°	height point 7'10"	Top/Bottom	KC
Circumference point _____	height point _____	Top/Bottom	_____

IV. Check stub outs.

Size & Connection 10"	length 18"	KC
Size & Connection 8"	length 18"	KC
Size & Connection 10"	length 18"	KC
Size & Connection 10"	length 18"	KC
Size & Connection 10"	length 18"	KC
Size & Connection _____	length _____	_____

V. Inspect all welds, dimensions, and angles.

A. Welds top _____

bottom _____

through pipe/stub outs _____

ladder _____

B. Dimensions - inspect all dimensions not previously checked. _____

C. Recheck angles. _____

D. Check lifting lugs. _____ _____

E. All appropriate labeling. _____ _____

101994

1268

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER CS-3	4:00 & 1:00 AM,PM AIR&EXTUATE TEMP	
6-8	909	Cut Riser to length plane & prep ends			
				7	10
6-8	486/477	Gather flat sheet prep & weld external bottom		AIR 480 EXT 476	492 473
6-17	479	Build 36" containment vessel		AIR 493 EXT 473	
6-23	477/486	weld internal bottom to riser		496 EXT 470	497 469
7-1	486/867	weld ext bottom to riser make lugs & install		AIR 496 EXT 468	
7-6	830/867	gather & weld & cut top, build MANWAY		AIR 484 EXT 470	492 472
7-22	479/482	weld containment vessel in manhole		AIR 488 EXT 470	495 472
7-24	486 867	~~start welding stubout~~ cut holes prep		AIR 493 EXT 471	
7-28	477 486	finish weld in stubout & install VALVES		AIR 489 EXT 473	496 472
7-30	486-830	weld top on manhole clean & weigh		AIR 489 EXT 477	

Production Date / /
Customer: Workman

1268

Order No: [illegible]
Bit Date: 4-4-97
Quantity: 81
Prod Box: 97

Standard Bill of Material for Sterx 96398 [illegible] 20 CLASS 20 PINCHE ICS-3 9.5'

Inv Item	Description	Act Qty	By/Date	Pipe Lot No.
	[illegible] (See spec)	3"	197 7-29	V863

Bill of Materials - attached

Lot Number R406364 to 051497 Qty 1

QC Approval Date: 7/30/97

Start Weight: ____ Finished Weight: ____

Test Piece: Yes ___ No ✓

Operator Comments:

[redacted]

Passed Visual

000359

LCS-3

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	11	FT	W-725	84"	100	3262#	84" C/100 SW PE x PE 580840-100SW
2	8	FT	[redacted]4609	10"	DR-11	104#	Feed STOCK 921029 # 169590 # 17-922
3	2.1	FT	4713	8"	DR-11	18#	Feed STOCK 920931
4	12.3	FT	V943	6"	DR-11	62#	Feed STOCK 920798
5	7.3	FT	V113	3"	DR-11	11#	Feed STOCK 920659
6	1	EA	9606056044	6"	DR-11	13#	MOLDED 90° ELL 990622
7	2	EA	961114684	6"	DR-11	5#	MOLDED BUTT TEE 990737
8	1	EA	V943/V113	6x6x3	DR-11	13#	FAB BARNCH SADDLE Red Tee 901699
9	10	EA	37202400	6"	DR-11	40#	EA 989365
10	10	EA	B150/A536	6"		[redacted]138#	CONV SS LJF 907063
11	9.6	FT	4532	2"	DR-11	8#	FEED. STOCK 920624
12	2	[redacted]	SQ FT	1"		11#	SHEET STOCK 700291
13	2	EA	960909924	3"	DR-11	2#	EA. 990649
14	2	EA	A351/CF8M	3"		14#	CONV SS LJF 907209
15	21.8	SQ FT	6M-5	1"		113#	SHEET STOCK 700291
16	38.5	SQ FT	6M-5	1 1/2"		289#	SHEET STOCK 703195
17	69.9	SQ FT	6M-5	1 1/2"		525#	SHEET STOCK 703195
18	11.1	SQ FT	6M-5	2"		120#	SHEET STOCK 700527
19	42.6	SQ FT	6M-5	2"		460#	SHEET STOCK 700527
20	6	EA	N/A	6"x10"	DR-11	2#	DCS. Spiders 907308
21	2	EA	N/A	3" or 8"	DR-11	1#	DCS SPIDERS 907305
22	2	EA	V773	6"x10"	DR-11	8#	Fixed End Sen 908595
23	4	EA	341419368	1"		1#	NPT DRAIN 902074
24	2.8	SQ FT	6M-5	2"		35#	SHEET STOCK 700527
25	1	FT	4698	4"	DR-11	2#	[redacted] Feed STOCK 920704
26	1	ft	V863	8" OR 42	4.2	[redacted]	8" OR 4.2 pipe (for spacer)
27							
28							
29							
30							

1268

000360

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No.: LDS-3 #8406367051497

PRODUCT CODE: 943796

DATE TESTED: 7/30/97

CUSTOMER: Workman Development Inc.

TESTED BY: Larry Dunbe

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS: _____

Fabrication Run Plan Checklist

Standard Manhole

Part # _____ Product Desc. LDS-3 Date 7-9-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 84" KC

OD _____

B. Check class of riser wall 100

II. Check length of riser prior to final cut _____

III. Check lay out of holes.

Circumference point	90°	height point	5'2½"	From Top/Bottom KC
Circumference point	210.96°	height point	6'7¼"	Top/Bottom KC
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom

IV. Check stub outs.

Size & Connection	8"	length
Size & Connection	10"	length
Size & Connection		length
Size & Connection		length
Size & Connection		length
Size & Connection		length

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs. _____

E. All appropriate labeling. _____

101994

.TE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER 2-6-8 ... AM/PM	AIR&EXTUATE TEMP
6-8	477-486	gather sheets, router, plane scrape, weld 2 passes on 1st side, flip sheet over grind out to full penetration scrape & weld 2 passes cut bottom		100 - 615 AIR - 488 EXT - 476
6-9	9m / 909	CUT RISER TO LENGTH PLANE BOTH ENDS		EXT 470 730 PM AIR 488
6-9	[illegible] 486	grind internal bottom, cut 2" gussets, router & scrape gussets & bottom weld 2 passes, layout riser (holes) & cut holes, plane ends of riser		EXT 476 1:00 AM AIR 492
6-10		Welded bottom to Manhole		Air 489 6:30pm EXT. 489
6-10	479	Weld Bottom inside Weld sheet together Prep & Weld, Cut Bottom		Air 475 8:15 pm EXT. 485 AIR - 465 300 AM EXT - 485
6-11	485-830	Cut & Fit Perforated Pipe and Pipe support for Containment Vessel & Weld spacers on Containment Vessel		Air - 478 8:00am Ext 487
6/13	867	Weld		
7-26	485	Weld lifting lugs & Weld Bottom Plate on Manhole		Air 479 9:00am Ext 466 9:00am Air 481 5:00pm
7-27	485	Cut & Prep & Weld Internals	→	Ext 470 5:00pm Air Ext Air Ext

[illegible]

[illegible] page
7-29

		PROCESS DESCRIPTION	1268	AIR&EXTUATE TEMP
6-7	477/486	315 AM - 630 AM gather sheet stock, centered, planed, scraped & welded 1st side. flipped sheet, ground down to full penetration welded other side, did not cut!		
7-29	480	Prep & weld tops to risers inside & out!		AIR 446-489 EXT 473 480
7-30	486	Touch up		485 - AIR 474 EXT

DS

1268

Production Date: / /

Customer:

Standard Bill of Material for Silicon 96/96

Item | Description | Act. Qty | By/Date | Pipe Lot No.

Bill of Materials Attached

Lot Number 8406367 to 051497 Qty 1 QC Approval Date: 7/30/97

Start Weight: _____ Finished Weight: _____ Test Piece: Yes ___ No ✓

Operator Comments:

Passed Ultra Sonic

LD-3

BILL OF MATERIAL

ITEM (#)	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	11	FT	W725	84"	C/100	2984#	84" C/100 SW PE X PE 580840-100S
2	2.1	FT	U609	10"	DR-11	27	FEED STOCK 921029# 108590# 77-9229
3	1.8	FT	U713	8"	DR-11	17	FEED STOCK 920931
4	5.2	FT	U943	6"	DR-11	26	FEED STOCK 920798
5	5.4	FT	V113	3"	DR-11	10	FEED STOCK 920659
6	2	EA	960707334	6"	DR-11		MOLDED BUTT 90° ELL 990622
7	1	EA	U565	3" X 8"	DR-11		FIXED END SEAL
8	1	EA	960605da	3"	DR-11		MOLDED 90° ELL
9	1	EA	960606444	3" x 2"	DR-11		MOLDED BUTT Red
10	212	FT	U532	2"	DR-11	14	FEED STOCK 920624
11	~~[illegible]~~	~~EA~~				5#	
12.	1	SQ FT	6M-5	1"		5	SHEET STOCK 700291
13	4'	FT	V176	36"	DR-17	385	FEED STOCK
14	7.1	SQ FT	6M-5	1"		38	SHEET STOCK 700291
15	2	EA.	960909924	3"	DR-11	5	EA. 990649
16	2	EA	A351CF8M	3"		17	COND SS LJF 907209
17	21.8	SQ FT	6M-5	1"		113#	SHEET STOCK 700291
18	38.5	SQ FT	6M-5	1 1/2"		289#	SHEET STOCK 703195
19	68.9	SQ FT	6M-5	1 1/2"		525#	SHEET STOCK 703195
20	11.1	SQ FT	6M-5	2"		120#	SHEET STOCK 700527
21	42.6	SQ FT	6M-5	2"		460#	SHEET STOCK 700527
22	1	EA	N/A	6" x 10"	DR-11	2	DCS SPIDER 907308
23	1	EA	N/A	3" x 8"	DR-11	2	DCS SPIDER 907305
24	1	EA	U773	6" x 10"	DR-11	2	FIXED END SEAL 908595
25	1	EA	344419308	1/2"	DR-11	2	BRANCH SADDLE
26	2.8	SQ FT	6M-5	2"		14#	SHEET STOCK 700527
27	1	FT	U698	4"	DR-11	5	FEED STOCK 920704
28	1	SQ FT	6M-5	1"		5#	SHEET STOCK 700291

1298

0003366

FERMCO SUBMITTAL DISTRIBUTION

60 R4

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J. Jenkins	64	Approver	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	M. Godber	64		
	1	D. Boding	38		
	1	P. Payne	B110		
	1	T. Russell	64		
	6	Village Building			

Please sign & date
ORIGINAL FILE COPY
Return to CDC ms/44

RECEIVED BY: James C. Jenkins
(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

DATE: 8/01/97

FORWARD COMMENTS TO REVIEW COORDINATOR

DGB

☒ NO COMMENTS

☐ COMMENTS RECEIVED J. C. Jenkins
REVIEW COORDINATOR

DATE: 8/01/97

1268

000367

Chevron
Plexco
Performance Pipe Division - Chevron Chemical Company

QUALITY CERTIFICATION

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208189 P.O. 0032754
SHIP DATE:	7/25/97
PRODUCT:	84" ID -CL- 100 Manhole LCS-2 X 9.5' 84" ID -CL- 100 Manhole LDS-2 X 9.5'
LOT NUMBERS:	LCS-2 #8406363051497 LDS-2 #8406366051497
QUANTITY:	2 PCS.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)
(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)
( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution
( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution
( ) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter
( ) NSF-61 - Drinking Water System Components - Health Effects
( ) NSF-14 - Plastic Piping Components and Related Materials
( ) Factory Mutual
(X) OTHER: Dimensions, Appearance, and Configuration checked per LCS-2 - Dwg. # 90D-689 R2 LDS-2 - Dwg. # 90D-690 R2 & Dwg.# 691 R1

DATE: 7/25/97

Robert Caldwell
QA/QC Supervisor
Waxahachie, TX.

INFORMATION ONLY

VBS-PLE-009

[ ] A - Conforms to the contract requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Rejected and Resubmit

Chevron

February 3, 1997

Doris Cates
Pinnco
1601 West 287 Bypass
Waxahachie, TX 75165

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Phone 409 886 7401

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9348	Lot Number:	F081629
Chevron Order #:	129697	Destination:	Waxahachie
Package:	GOCX058807	Weight (lbs):	183,050
Customer Order #:	107802	Ship Date:	1/31/97

This is to confirm that Chevron HDPE HID 9348 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D4976. In addition, Chevron HID 9348 when used with the proper color concentrate meets or exceeds the minimum requirements of cell classification 335434C in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.13	gms/10 min
HLMI	17.3	gms/10 min
MFR	133.0	
Density	0.9476	gms/cc
ESCR Condition C	0	Failures/20

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 214-923-1632

For inquiry, contact Customer Service at the following number:
Film, Casing, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

Southwest Chemical Services

84" Manhole

DATE: JANUARY 29, 1997

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525289

COMPARTMENT		B	CB	CA	A
LOT NUMBER		139343-1	-2	-3	-4
CUSTOMER P/O #:		107700			
POUNDS SHIPPED	SPECS	186,900			
CARBON BLACK	34 - 36%	34.8	34.8	35.0	35.1
GM/100 PELLET	2.4-3.2%	2.7	2.7	2.9	2.8
MELT INDEX 10X	9 - 15%	12.6	11.8	13.0	12.1
MOISTURE	10% MAX	0.05	0.04	0.06	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 478 (Highway 146)
4 Miles South of La Porte
Seabrook, Texas 77586
(281) 474-2831

EXHIBIT: B
APPROVAL BY: [illegible]
REVISED: [illegible]

REF: B - 4
PAGE: 4 OF 4

LINE: 316

FLEXCO - FAIRFIELD
DAILY LAB REPORT
MELT INDEX, DENSITY, AND CARBON ASH TESTING

SIZE: DE3408 Black Pellotized LOT NUMBER: PU055

MATERIAL: 2480 - ACFX-38580 DATE OF RUN: 11-14-96

CONCENTRATE LOT #: 190109-07189 MATERIAL LOT #: 160265

DISPERSION: PASS / FAIL

PRODUCTION DATE	MI 2	MI 21.6	DENSITY	CARBON ASH	TESTED BY & DATE
11-14-96	.09	10.93	.954	2.12	JD 111496
11-15-96	.09		.953		JD 111596

JUN-09-1997 18:53 515 472 3137 94% TOTAL P.01 P.01

1" Flat Sheet
1268

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-6080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #303015, our invoice #25688 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

1½" Flat Mat

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-5797 • Fax (717) 346-5080

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

June 13, 1997

ATTN: Doris

The material on your PO #201895, our invoice #21961 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA.

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1 1/2" Flat Sheet

12682" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-6797 • Fax: (717) 346-6080

June 13, 1997

Plenco- Spinolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25688 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1" Flat Sheet

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

Hitec® High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.70	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	68	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	220,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack Resistance, F50	hrs.	—	D 1693
	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	78	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Photo Courtesy of: Plastinetics, Inc.

Hitec® Black Pipe Grade High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,5,P34	D 1248
Cell Classification	—	345,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indices 190°C/5kg	g/10 min.	0.4	D 1238
Melt Flow Indices 190°C/21.6kg (HMI)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressed Ring ESCR (50°C/25% Igepal)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	49	D 785
Shore Hardness	Shore D	63	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A§
Tensile Strength @ Yield	psi	>3,500	D 638‡
Elongation @ Break	%	>600	D 638‡
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638‡
Flexural Modulus @ 2% Strain	psi	125,000	D 790
Vicat Softening Temperature	°F	256	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	$1x10^{-4}$	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. ‡Type IV specimen, 2 in/min. §1/8" thick specimen. FDA Registered. N550 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Black≥0.5%

COMPRESSION POLYMERS GROUP
801 COREY STREET
MOOSIC, PA 18507
TEL: 717-346-6254
FAX: 717-346-4122

Warranty
All sheeting guaranteed well free, the full of our warranty is your money refunded or defective material replaced; no other warranties are expressed or implied.

* Physical properties of plastic sheeting are presented as "typical." Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied, for which the Compression Polymers Group assumes any legal responsibility. Our information are limited to those expressly stated in formal contracts or in conditions of sale on our invoices and other acceptances. Conditions and methods of use vary and are beyond the control of Compression Polymers Group, therefore, Compression Polymers Group disclaims any liability incurred as a result of the use of its products in accordance with the data contained on our physical property charts. No statements herein shall be construed as an offer of indemnity for infringement or as a representation to use the products in such a manner as to infringe any patent, domestic or foreign.

The "typical" properties of our plastic sheet cannot be automatically used when engineering finished fabricated components; and the fabricator or end user is responsible for insuring the suitability of our products for their specific application or end use.

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No.: LDS - 2 # 8406366051497

PRODUCT CODE: 943795

DATE TESTED: 7/21/97

CUSTOMER: Workman Development Inc.

TESTED BY: Dave Cates

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS: _____

Fabrication Run Plan Checklist
Standard Manhole

Part # _____ Product Desc. ~~Sta~~ LDS 2 Date 7-9-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.
A. Record ID & OD of riser.
ID 84" KC
OD 89½ KC
B. Check class of riser wall 100 KC

II. Check length of riser prior to final cut. 10' 3" KC

III. Check lay out of holes.

Circumference point	90°	height point	5' ½"	From Top/Bottom KC
Circumference point	210°	height point	6' 5¼"	Top/Bottom KC
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom

IV. Check stub outs.

Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	

V. Inspect all welds, dimensions, and angles.
A. Welds top
bottom
through pipe/stub outs
ladder
B. Dimensions - inspect all dimensions not previously checked.
C. Recheck angles.
D. Check lifting lugs.
E. All appropriate labeling.

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER	7:00 & 9:00 AM AIR&EXTUATE TE
6-7	477-486	11:15am - 300pm gathered		AIR 489
		shot stock, painted, planed		EXT 469
		scraped, welded 1st side.		
		Handle sheet, ground down		
		to full penetration welded		
		other side & cut internal		
		bottom 83½"		
6-9	907/969	CUT RISER TO LENGTH		
		PLAIN BOTH ENDS		
6-13	488	gather cutoffs and scrap		AIR 488
		welded left and bottom		EXT 476
				492 AIR
				474 EXT
6-14	485	Finish Welding Bottom		
		Cut circle + Weld Bottom		Air 487
		to Riser		Ext. 480
6-17	486	More CDS #1 & put 2 on		AIR 496
		roller [illegible] lugs		EXT 479
		layout holes & [illegible]		
		Weld gussets to internal		AIR 489
		bottom. both passes		EXT 480
7-9	486	prep internal bottom & [illegible]		AIR 498
		1st stack & weld 1st pass		EXT 472
		bottom of internal bottom		AIR 496
				EXT 474
7-14	502	Prepped & welded manway		air 495
		finished welding sheets to top		EXT 443
		welded (stored) manway to top.		
7-16	502	finished welding gussets on top		air 491
		gussets, prepped welded bottom		EXT 459
7-17	485-830	Weld Top to Riser		Air 492 7:30pm
				Ext 460 "
				Air 494 3:00pm
				Ext 495 "

Month Date ___/___/___
Owner: Workman

1268

Bat. Date: 4-6-97
Quantity: 8
Prod Box: 9

Road Bill of Material for Stock: 943755 — 36" ID CLASS 100 MANHOLE TDS-2 9.5' 4

Inv Item	Description	Act Qty	By/Date	Pipe Lot No.
WT.3400 84"	~~CL 150 SW SS 304~~	~~11.5'~~	~~907 6/6~~ ~~909 6/9~~	~~W725~~
	~~6" DR 11.0 PIPE~~	~~2' 7"~~	~~828 6/10~~	~~U596~~
	~~6" DR 11.0 Molded 90's~~	~~3~~	~~873 6/10~~ 873	~~9604128 H~~

Bill of Material - attached

Lot Number 18406366 to 03-14-97 Qty 1

QC Approval Date: 7-21-97 DC

Part Weight: ____ Finished Weight: 4070

Test Piece: Yes ___ No ✓

Operator Comments:

Passed Ultra Sound Weld Test

Seal All Openings For Shipment

BILL OF MATERIAL LDS-2

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1							
2	9.5'	FT	W725	84"	100	3,400#	S.W. 580840
3	27"	FT	11596	6"	11.0		#920798
4	3	pcs.	96101128H	6"	11.0		#96101128H
5	5'7"	FT.	11532	2"	11.0		#920624
6	18	Sq. FT.		1"			Flat Stock #25628
7	75	Sq. FT.		2"			Flat Stock # 25628
8							
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080080

1268

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No. : LCS-2#8406663051497

PRODUCT CODE: 943792

DATE TESTED: 7/25/97

CUSTOMER: Workman Development Inc.

TESTED BY: Doris Cates

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS: _____

Fabrication Run Plan Checklist

Standard Manhole

Part # 943792 Product Desc. 84" MH LCS-2 Date 7-17

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 84" [illegible]

OD 89" [illegible]

B. Check class of riser wall 100 SW [illegible]

II. Check length of riser prior to final cut. 10'3" [illegible]

III. Check lay out of holes.

Circumference point	0°	height point	7'10"	From Top/Bottom [illegible]
Circumference point	31°	height point	6' 5 1/4"	Top/Bottom [illegible]
Circumference point	45°	height point	3' 8"	Top/Bottom [illegible]
Circumference point		height point		Top/Bottom
Circumference point	90°	height point	5' 1/2"	Top/Bottom [illegible]
Circumference point		height point		Top/Bottom

IV. Check stub outs.

Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

101294

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
6-8	486-477	PROCESS DESCRIPTION	1268	AIR&EXTUATE TEMP
		gather, center, plane, scrape		700 - 1200
		weld 2 passes 1 side		AIR - 492
		turn over grind out to full		EXT 476
		penetration, scrape & weld		
		2 passes, cut bottom &		
		scrap (internal)		
6-10	486	gather & chute weld		700 AIR 496
		2 passes, flip & grind		EXT 480
		out weld 2 passes		AIR 489
		cut external bottom		EXT 479
		gather, prep weld		1120 492 AIR
		grind for full penetration		478 - EXT
		& weld 2 more passes		
		2" top		
7-18	486	cut riser to length		
		plane & prep edge		
		hoist manhole &		
		cell to 60		700 100
				✓
7-21	477/486	weld internal bottom		AIR 490 - 497
		install lugs &		EXT 478 - 472
7-23		weld external bottom		AIR 487 - 486
				EXT 480 - 478
7-24	480 486	install manway into		AIR 490 - 488
		& install internals		EXT 466 474
7-25	480 486	install top weld inside		AIR 497 489
		& out install 2" pipe		EXT 472 472
		clean & weigh		

ORIGINAL 05/14/97 07:52 AM

1268

Doc No: 6194
Order No: [illegible]
Est. Date: 6-6-97
Quantity: 1
Prod Rec: 97

olution Date / /
signer: Workman

ordered Bill of Material for Sales: 943792

Inv Item	Description	Act Qty	By/Date	Pipe Loc No.
	8" ID CLASS 100 MANHOLE LCS-2 9.5'			
	8" Cls-100 10'			3400

Bill of Materials - attached

t Number 8406363 to 051497 Qty 1

art Weight: _____ Finished Weight: _____

erator Comments:

QC Approval Date: 7/25/97-DC

Test Pieces: Yes ___ No ✓

Passed Ultra Sound 7-25-97

[redacted]

LCS-2

BILL OF MATERIAL

ITEM (#)	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	11'	FT	W725	84"	C/100	3400	SW PIPE 580840-100 SW
2	8'	FT	U609	10"	DR 11.0	104.8	PIPE 921029 #169590 #12-92
3	2.5	FT	~~[illegible]~~ U713	8"	DR 11.0	21	PIPE 920931
4	15'	FT	943	6"	DR 11.0	73	PIPE 920798
5	8.5	FT	U965	3"	DR 11.0	12	PIPE 920659
6	1	—	9609610428U	6"	DR 11.0	5	MOLDED 90° ELL 990622
7	2	—	96811163U	6"	DR 11.0	10	MOLDED TEES 990737
8	10	—	971527U4U8	6"	DR 11.0	49	F/A 989365
9	10	—	—	—	—	120	6" CORRUGATED SS LJF
10	10	FT	U532	2"	DR 11.0	6	PIPE 920624
11	24	Sq ft		1"	SHEET STOCK	126	SHEET STOCK 700291
12	2	—	9609409924	3"	DR 11.0	3	F/A 990649
13	2	—	—	3"	—	15	CORRUGATED SS LJF
14	108	Sq ft	—	1 1/2"	SHEET STOCK	886	SHEET STOCK 703195
15	57	Sq ft.	—	2"	SHEET STOCK	684	SHEET STOCK 700527
16	1	ft	U698	4"	DR 11.0	3	PIPE 920704
17	4	—	—	1"	—		NPT DRAIN
18	2	—	—	6/10	DR 11.0		PRESSURE END SEAL
19	6	—	—	6/10	DR 11.0	2	DCS SPIDER ASSY
20	2	—	—	3/8	DR 11.0	1	DCS SPIDER ASSY
21	1		—	6x6x3	DR 11.0		SADDLE REDUCING TEE.
22							
23							
24							
25							
26							
27							
28							
29							
30							

TOTAL P.19

12668

000385

FERMCO SUBMITTAL DISTRIBUTION

#60R3

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	J. Jenkins	64	Approver	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	64		
	1	M. Godber	64		
	1	D. Payne	Bin	Parsons	
	1	D. Bodine	38	GeoSyntec	
	1	T. Russell	64	INFO	
	6	Village Building	Bin		

RECEIVED BY: James C. Jenkins DATE: 8/01/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

Please sign & date
ORIGINAL FILE COPY
Return to CDC ms/44

FORWARD COMMENTS TO REVIEW COORDINATOR

RCB

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 8/01/97

REVIEW COORDINATOR

1268

000386

Plexco
Performance Pipe Division - Chevron Chemical Company

QUALITY CERTIFICATION

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208189 P.O. 0032754
SHIP DATE:	7/15/97
PRODUCT:	84" ID -CL- 100 Manhole LCS-1 x 9.5' 84" ID -CL- 100 Manhole LDS-1 X 9.5'
LOT NUMBERS:	LCS-1 #8406362051497 LDS-1 #8406365051497
QUANTITY:	2 PCS.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)
(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)
( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution
( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution
( ) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter
( ) NSF-61 - Drinking Water System Components - Health Effects
( ) NSF-14 - Plastic Piping Components and Related Materials
( ) Factory Mutual
(X) OTHER: Dimensions, Appearance, and Configuration checked per LCS-1 - Dwg. # 90D-688 R2 LDS-1 - Dwg. #90D-691 R1 & Dwg. #90D-690 R2

DATE: 7/15/97

Robert Caldwell
QA/QC Supervisor
Waxahachie, TX.

INFORMATION ONLY

VBS-PLE-008

84" Min hole

Chevron

February 3, 1997

Doris Cates
Plexco
1601 West 287 Bypass
Waxahachie, TX 75165

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Phone 409 886 7481

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9348	Lot Number:	F081629
Chevron Order #:	129697	Destination:	Waxahachie
Package:	GOCX058807	Weight (lbs):	183,050
Customer Order #:	107802	Ship Date:	1/31/97

This is to confirm that Chevron HDPE HiD 9348 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D4976. In addition, Chevron HiD 9348 when used with the proper color concentrate meets or exceeds the minimum requirements of cell classification 335434C in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
Melt Index	0.13	gms/10 min
HLMI	17.3	gms/10 min
MFR	133.0	
Density	0.9476	gms/cc
ESCR Condition C	0	Failures/20

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 214-923-1632

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

EXHIBIT: B
APPROVAL BY: [illegible]
REVISED: 09/23/94

REF: B - 4
PAGE: 4 OF 4

LINE: 316

FLEXCO - FAIRFIELD
DAILY LAB REPORT
MELT INDEX, DENSITY, AND CARBON ASH TESTING

SIZE: DE3408 Black Pelletized LOT NUMBER: PU055

MATERIAL: 2470 - ACFX-38580 DATE OF RUN: 11-14-96

CONCENTRATE LOT #: 190109-07189 MATERIAL LOT #: 160065

DISPERSION: PASS / FAIL

PRODUCTION DATE	MI 2	MI 21.6	DENSITY	CARBON ASH	TESTED BY & DATE
11-14-96	.09	10.93	.954	2.12	JD 111496
11-15-96	.09		.953		JD 111596

Southwest Chemical Services

84" Manhole

DATE: JANUARY 29, 1997

TO: PLEXCO
1050 BUSSE HUGHWAY
BENSONVILLE, IL 60160

PLEXCO
1001 W.287 BYPASS
WAXAHACHIE, TX

ATTN: BILLY WALKER

FROM: SOUTHWEST CHEMICAL SERVICES

RE: CERTIFICATE OF ANALYSIS

PRODUCT TYPE: *2139 BLACK PIPE PEC*

RAILCAR NUMBER NAHX 525289

COMPARTMENT		B	CB	CA	A
LOT NUMBER:		139343-1	-2	-3	-4
CUSTOMER P/O #:		107700			
POUNDS SHIPPED	SPECS	186,900			
CARBON BLACK	34 - 36%	34.8	34.8	35.0	35.1
GM/100 PELLET	2.4-3.2%	2.7	2.7	2.9	2.8
MELT INDEX 10X	9 - 15%	12.6	11.8	13.0	12.1
MOISTURE	.10% MAX	0.05	0.04	0.06	0.05

THANK YOU,

MARY IREY
CUSTOMER SERVICE
SOUTHWEST CHEMICAL

Continual Quality Progression

P.O. Box 478 (Highway 146)
4 Miles South of La Porte
Seabrook, Texas 77586

1" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25628 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

1268

2" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-6797 • Fax (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxachie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25628 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1" Flat Sheet

1½" Flat Sheet

COMPRESSION POLYMERS GROUP
801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax (717) 346-5080

June 13, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #201895, our invoice #21961 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA.

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1 1/2" Flat:Sheet

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

Hitec® High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.70	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	68	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	220,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack Resistance, F50	hrs.	—	D 1693
	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	76	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Photo Courtesy of: Plastmetics, Inc.

Hitec® Black Pipe Grade High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,3,P34	D 1248
Cell Classification	—	345,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indices 190°C/5kg	g/10 min.	0.4	D 1238
Melt Flow Indices 190°C/21.6kg (HMI)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressed Ring ESCR (50°C/25% Igepal)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	49	D 785
Shore Hardness	Shore D	68	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A5
Tensile Strength @ Yield	psi	>3,300	D 638‡
Elongation @ Break	%	>600	D 638‡
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638‡
Flexural Modulus @ 2% Strain	psi	125,000	D 2290
Vicat Softening Temperature	°F	295	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	1x10⁻⁴	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. ‡Type IV specimen, 2 in/min. §1/8" thick specimen. FDA Registered. N990 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Blacks0.5%

COMPRESSION POLYMERS GROUP
801 COREY STREET
MOOSIC, PA 18507
TEL: 717-346-8254
FAX: 717-346-4122

Warranty
All existing guaranteed void here. The limit of our warranty is your money, defective material replaced; no other warranties are expressed or implied.

* Physical properties of plastic shending are presented as "Typical." Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied, for which the Compression Polymers Group assumes any legal responsibility. Our warranties are limited to those expressly stated in formal contracts or in conditions of sale on our invoices and order acknowledgments. Conditions and methods of use may not comply with the control of Compression Polymers Group, therefore, Compression Polymers Group disclaims any liability incurred as a result of the use of its products in accordance with the data contained in our physical property charts. No information herein shall be construed as an offer of indemnity for infringement or as a recommendation to use the products in such a manner as to infringe any patent, domestic or foreign.

The "typical" properties of our plastic sheet cannot be automatically used when engineering finished fabricated components and we therefore or we cannot be responsible for insuring the suitability of our products for their specific application or end use.

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No. : LCS-1 8406362051497

PRODUCT CODE: 943791

DATE TESTED: 7/15/97

CUSTOMER: Workman Development Inc.

TESTED BY: Larry Donahoe

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS:

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # 943791 Product Desc. 84FRCL100 M/H LCS-1 9'6" Date 7-10-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser. ID 84" OD 89½" — CL / EL / CL / CL

B. Check class of riser wall 100

II. Check length of riser prior to final cut 10'3"

III. Check lay out of holes.

			From	
Circumference point 0	height point 7'10"		Top/Bottom	EL
Circumference point 90°	height point ~~[illegible]~~		Top/Bottom	EL
Circumference point 45°	height point 3'8"		Top/Bottom	EL
Circumference point 30.96°	height point 6'5¼"		Top/Bottom	EL
Circumference point 180°	height point 7'9¾"		Top/Bottom	EL
Circumference point	height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
6-6	477	PROCESS DESCRIPTION		AIR&EXTUATE TEMP
		Fit 3 Gather Flat & Heat		AIR 480° EXT 460°
		Cut & weld Full PEN		
		Inside Bottom 83 3/8"		
7-14-97	479	WELD GUSSETTS ON TOP		AIR 484° EXT 472°
	477	WELD BRACES		AIR 470 EXT 481
		Weld inside Bottom	To Riser	483 Air EXT 478
		Cut + Weld Out Side Bottom		Air 481 - 767 EXT
		Weld Out Side Bottom	To Riser	AIR 482 EXT 466
		Weld Stub outs		482° - 468°
		Lay out + Cut Top wed		AIR 472 EXT 460
		Weld Top To Riser		AIR 484 EXT 461

1268

Page: 1

ROUTING DOCUMENT
ORIGINAL 05/14/97 07:37 AM

Doc No: 6198
Order No: 6290[illegible]3818
Bill Date: 4-4-97
Quantity 41
Prod Bid 99

Production Date ___/___/___
Designer: Workman

Punched Bill of Material for Stock: 943791

Inv Item	Description	Act Qty	By/Date	Pipe Lot No.
WT. 34484	84" CL 100 SW W58284D 11½#		907/A094	W-725

Narratives:
90D-688 R7

Bill of Materials - attached

Lot Number 84 06362 to 051497 Qty +

QC Approval Date: 7/15/97 (EK)

Test Piece: Yes ___ No ✓

Start Weight: _____ Finished Weight: _____

Operator Comments:

Passed Hydro Bond

Seal All Openings For Shipment

000398

BILL OF MATERIAL

LCS-1

ITEM (#)	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	11	FT	W725	84"	C-100	3,400#	SW. PIPE 580840-160-SW
2	6.1	FT	U609	10"	DR-11	86#	Feed STOCK 921029 #169590 #17-9229
3	2.1	FT	U-713	8"	DR-11	17#	Feed STOCK 920931
4	12.7	FT	V-943	6"	DR-11	64#	Feed STOCK 920798
5	8.3	FT	V 113	3"	DR-11	16#	Feed STOCK 920659
6	2	EA	9609604284	6"	DR-11	9#	Molded 90° ELL 990622
7	2	EA	9611634	6"	DR11	14#	Molded Tee 990737
8	1	EA		6"x6"x3"	DR-11	116#	BRANCH SADDLE Reducer T
9	10	EA 31	941168	6"	DR11	40#	FLg ADAPTER 989365
10	10	EA		6"		130#	SS LJF CONV 907063
11	6.1	FT	U698	4"	DR-11	12#	Feed STOCK 920704
12	1	EA	9605049 U	4"	DR-11	2#	FLg ADAPTER 989314
13	1	EA		4"		8#	SSLJF CONV 906824
14	2	EA	9609092 U	3"	DR11	3#	Flange ADAPTER 990649
15	2	EA		3"		14#	SSLJF CONV 907209
16	21.8	SQ FT	(47)	1"		113#	Sheet STOCK 7W291
17	38.5	SQ FT	3.35	1 1/2"		288#	Sheet STOCK 703195
18	68.9	SQ FT		1 1/2"		528	Sheet STOCK
19	11.1	SQ FT	1.13	2"		118#	Sheet STOCK 760527
20	42.6	SQ FT		2"		460#	Sheet STOCK
21	4	EA		6"x10"	DR-11	2#	PCS SPIDERS 907308
22	2	EA		3"x8"	DR11	1#	PCS SPIDERS 907305
23	1	EA	9607704 U	6x4		8#	Molded BUTTRed 984302
24	2	EA	U609	6x10	DR11	44#	Fixed End SEAL 908595
25	4	EA		1"		2#	1 NPT DRAIN 902074
26	2.8	SQ FT		2"		305#	Sheet STOCK
27	2	EA	U698	4"	DR-11	6#	PIPE Support 926704
	9.6	FT	U532	2"	DR11	6#	Feed STOCK 920424
	2	EA	U689	1"		8#	Sheet STOCK PIPE SUPPORTS

6191

1268

0003399

Chevron
Plexco
A Division of Chevron Chemical Company
1601 W. 287 By-Pass • Waxahachie, TX 75165
214-937-0852 • FAX 214-937-4530

HYDROSTATIC TESTING REPORT

MANHOLE & CATCH BASIN/ STATION No.: LDS-1 #8406365051497

PRODUCT CODE: 943794

DATE TESTED: 7/14/97

CUSTOMER: Workman Devlopment Inc.

TESTED BY: Larry Donahue

PASS FAIL

ULTRASONIC WELD TEST: YES NO

PASS FAIL

REWORK: YES NO

RE-TEST: YES NO

PASS FAIL

COMMENTS:

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # 9243749 Product Desc. 84 SD CLASS 100 MH LOW I 9.5' Date 6/9

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser. ID 84 TC

OD 89½ TC

B. Check class of riser wall 100 TC

II. Check length of riser prior to final cut. 10'2½" TC

III. Check lay out of holes.

Circumference point 90	height point 5'5½" 1'1" x 2" TOP	From Top/Bottom	TC
Circumference point 210.96	height point 6'5½" x 2"	Top/Bottom	TC
Circumference point _____	height point _____	Top/Bottom	_____
Circumference point _____	height point _____	Top/Bottom	_____
Circumference point _____	height point _____	Top/Bottom	_____
Circumference point _____	height point _____	Top/Bottom	_____

IV. Check stub outs.

Size & Connection _____	length _____	_____
Size & Connection _____	length _____	_____
Size & Connection _____	length _____	_____
Size & Connection _____	length _____	_____
Size & Connection _____	length _____	_____
Size & Connection _____	length _____	_____

V. Inspect all welds, dimensions, and angles.

A. Welds top _____

bottom _____

through pipe/stub outs _____

ladder _____

B. Dimensions - inspect all dimensions not previously checked. _____

C. Recheck angles. _____

D. Check lifting lugs. _____ _____

E. All appropriate labeling. _____ _____

101994

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
		PROCESS DESCRIPTION		AIR&EXTUATE TEMP
6-7	477/486	700 pm-11 pm Gathered all sheets		AIR 488
		sorted, planed, scraped		EXT 470
		welded first side, flipped		
		sheet, brought down to full		
		penetration welded other		
		side & cut internal bottom		
		83½		
6-9	90A/907	CUT ENDS - PLAN	K.Cofer	— —
		CUT RISER TO LENGTH		
6/13	867	Weld Internal Bottom to		AIR 481
		Riser Scrape and weld 2 passes		EXT 473 8:00am
		Inside & Out		Air 488 3:30 PM
				EXT 476
6-15	477-482	Weld Stub n' + 36" Pipe		AIR 481 7:PM
		Prep + Weld Spacers		EXT 460 7PM
				AIR 478 1:PM
				EXT 466 1PM
6-16	485-477	Prep Top + Fit + Tack	K.Cofer	Air 479 7:30am
		Weld Top to Riser		Ext 463 7:30am
				Air 483 1:00pm
				Ext 467 1:00pm
6/12	867/927	Prep + Weld 2 pass inside Top		Air 482 11:00pm
		Prep + Weld all passes on outlet		EXT 465 11:00pm
				Air 476 3:00am
				EXT 468 3:00am

7-22-1997 3:33PM FROM PLEXCO 972 937 4536

ORIGINAL 05/14/97 07:53 AM

1 2668 616

Production Date 7/14/97
Dishover:

Order No: 629999
Est. Date: 6-6-97
Quantity
Prod Hrs

Standard Bill for Material for Work 93794

84" ID CLASS 100 MANDLE DD-1 9.5'

Inv Item	Description	Act Qty	By/Date	Pipe Loc No.
PW73696	84" CL 100 SW 580840 115'	909	6-9	W 725
	2" DRTA Pipe	657"	6-3	1532

Negatives:
900-680

Bill of Material - Attached

Lot Number 84B103 to 05149

QC Approval Date: 7/14/97 CB

Start Weight: _____ Finished Weight: _____

Test Piece: Yes ___ No ✓

Operator Comments:

Passed 7/14/97 Ultra Sound

Seal All Openings For Shipment

000407

LDS-1

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	24	sqft	—	1½			1½ sheet stock internal bottom 703195
2	[illegible]	11.5	U725	84 [illegible]	100	3696	# 580840-100-SW
3	25.1		U532	2" on 11 pipe			# 920624
4	3'		U609	12" on 11			# 921029
5	3'		U713	8" on 11			# 920931
6	7'		V943	6" on 11			# 920798
7	7'		V113	3" on 11			# 920659
8	2		96101128H				6" molded 90° ell #990622
9	[illegible]	.03		[illegible] pipe 4" sheet stock			3/8 Fiber Hand Seal # 702555
10	1		96101128H	3"			molded 90° ell #992222
11	1		95010009H	3X2 on 17			molded Reducer 989031
12	2	.04 sq ft	[redacted]	1" sheet stock			spacer support 970291
13	4'		V912	36" on 17			cont vessel 966307
14	8	sq ft		1" sheet stock			cont bottom —
15	2		96090924	3" on 17			F/A 990649
16	2			3" LJF			Convolute SS 907209
17	22	sq ft		1" sheet stock #25628			FAB manway —
18	39'	"	3.4	1½ sheet stock			Internal bottom 703195
19	70'	"		1½ sheet stock #21961			Extension bottom
20	11'	"	1.08	2" sheet stock #25628			Bottom gussets 700527
21	43'	"		2" sheet stock			Top —
22	1			6/10			DCS spider 907308
23	1			3/8			DCS spider 907305
24	1		3414M308	[illegible]			1" hpt screen spool 902074
25				2" sheet stock			Top Gussets
26							
27							
28							
29							
30							

1268

000404

#60R2

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	Please sign & date ORIGINAL FILE COPY Return to CDC ms/44	REMARKS
1	1	J. Jenkins JUN 18 1997	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	Lee Synke	64		
	1	Parsons	Bin		
	1	McGuire, P.	64		
	1	Godber, M.	64		
	1	Russell, T.	64		
	1	Village Bldrs	Bin		

RECEIVED BY: James C. Jenkins DATE: 6/19/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

RECEIVED JUN 24 1997

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 6/19/97

REVIEW COORDINATOR

ORIGINAL FILE COPY

1263

000405

VBS-PLE-007

Hitec®

HIGH DENSITY POLYETHYLENE

Typical Properties*

Hitec® High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category	—	IV,A,4	D 1248
Melt Index	g/10 min.	0.10	D 1238
Density	g/cm³	.960	D 1505
Hardness	Shore D	68	D 2240
Tensile Strength @ Break	psi	4,400	D 638
Elongation @ Break	%	>600	D 638
Flexural Modulus	psi	200,000	D 790
1% Secant Modulus	psi	—	D 790
Tensile Impact, (2)	ft-lb/in	100	D 1822
Environmental Stress Crack	hrs.	—	D 1693
Resistance, F50	hrs.	—	D 2561
Low Temperature Brittleness, F50	°C	<-76	D 746
Heat Deflection Temperature @ 66 PSI	°C	78	D 648
Vicat Softening Point	°C	125	D 1525

Hitec® meets the standard established by Food and Drug Regulation 21 CFR 177.52 for all food contact, USDA, and the Department of Canadian Agriculture.

Hitec® Black Pipe Grade High Density Polyethylene

Property	Units	Value	ASTM Method
ASTM Type, Class, Category, Grade	—	III,A,5,P34	D 1248
Cell Classification	—	345,434	D 3350
PPI Recommended Designation	PE 3408	—	—
Density	g/cm³	.957	D 792
Melting Point	°F	260	D 3417
Reduced Specific Viscosity (RSV)	dl/g	3.0	D 1601
Melt Flow Indicies 190°C/2kg	g/10 min.	0.4	D 1238
Melt Flow Indices 190°C/21.6kg (HLMI)	g/10 min.	10	D 1238
Hydrostatic Design Basis 100,000 hrs. 73°F (23°C)	psi	1,600	D 2837
Compressive Creep 1000 hrs (80°C/2.8% strain)	hrs.	>1,000 (no failures)	F 1248
Rockwell Hardness	L Scale	48	D 785
Shore Hardness	Shore D	65	D 2240
ESCR (100% Igepal)	hrs.	>5,000 (no failures)	D 1693C
Izod Impact Strength (Notched)	ft-lb/in	8	D 256A
Tensile Strength @ Yield	psi	>3,500	D 638
Elongation @ Break	%	>600	D 638
Secant Modulus of Elasticity @ 2% Strain	psi	115,000	D 638
Flexural Modulus @ 2% Strain	psi	130,000	D 790
Vicat Softening Temperature	°F	265	D 1525
Brittleness Temperature	°F	-180	D 746
Heat Distortion Temperature	°F	172	D 648
Thermal Expansion	in/in/°F	1.2×10^{-4}	D 696

The data listed above was determined on press molded test specimens and may, therefore, vary from the specimens taken from pipes and sheet. (Type IV specimen, 2 in/min. @ 1/8" thick specimen. FDA Registered. N550 Carbon Black. NSF Approved for potable water UV Stabilized 2.5% Carbon Blend 0.5%

Photo Courtesy of: Plastinetics, Inc.

INFORMATION ONLY

COMPRESSION MOLDERS GROUP
801 COREY STREET
MOOSIC, PA 18507
TEL: 717-346-8254
FAX: 717-346-4122

1268

COMPRESSION POLYMERS GROUP
801 Carey Street • Moosic, PA 18507 • (717) 346-8797 • Fax: (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #30901B, our invoice #35028 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1" Flat Sheet

1268

COMPRESSION POLYMERS GROUP
801 Coray Street • Moosic, PA 18507 • (717) 346-6797 • Fax (717) 346-5080

June 18, 1997

Plexco- Spiralite
Chevron Chemical Co
1601 W 287 Bypass
Waxahchie, TX 75165

ATTN: Doris

The material on your PO #202015, our invoice #25628 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA. Enclosed please find a Compression Polymers spec sheet on this material

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

2" Flat Sheet

1268

COMPRESSION POLYMERS GROUP

801 Corey Street • Moosic, PA 18507 • (717) 346-8797 • Fax (717) 346-5080

June 18, 1997

Plexco- Spirolite
Chevron Chemical Co
1601 W 287 Bypass
Waxahie, TX 75165

ATTN: Doris

The material on your PO #801895, our invoice #81961 is made from GM5010 black pipegrade. This material is produced at Compression Polymers in Scranton, PA.

If you need any further information regarding this material, please do not hesitate to call.

Thank You,

Jackie

Jackie Cramer

1 1/2" Flat Sheet

1268

UNION CARBIDE CORPORATION
P.O. Box 186, Port Lavaca, TX 77979
Fax: 1214-939-4530

Plexco / Spirolite
Division of Chevron Chem. Co.
Hwy 31 East
Corsicana, TX 75110
Attn: K. Bill

PRODUCT CERTIFICATE OF ANALYSIS

12/13/96

Product Name: DGDS-2480 NT 3408

Customer Order No.: 107444
Internal Order No.: 440345

Shipped To: Plexco/Spirolite
Div. of Chevron Chemical Co.
1001 W Hwy 287 Bypass
Waxahachie, TX 75156

Blend	Quantity	Container Id	Ship Date
109590	190820	ACFX38848	12/12/96

All shipments of this product to customer must meet the following: Plexco-Spirolite Requirements for DGDS-2480 NT 3408, dated Nov. 4, 1994. This is to confirm that DGDS-2480 NT 3408 is a Type III, Class A, Grade P34, Category 5 natural Polyethylene resin under ASTM D1248, with a cell classification of PE346404A under ASTM D3350. When properly mixed with 6.5% of BFAF-0092 BK the product meets the requirements of ASTM D3350.

The following test data was obtained :

Blend : 109590
Sample Id : PE532352
Date of Manufacture : 10/31/96

Test Description	Unit	Minimum	Maximum	Results
Melt Index	g/10min	.06	.1	.086
Melt Flow Index (190C/21.6kg)	g/10min	8	12	11.6
Melt Flow Ratio (21.6/2.16 kg)		120	155	132.6
Density	g/cu cm	.943	.947	.9453
OIT @ 210C	min	13		31
Oxidative Induction Temp.	C	240		247
Tens.Stress@Yield,2"/M,23C/50C/M	psi	3000		3351
Elongation Orig,2"/M, 23C 150C/M	%	600		885
ESCR 100%IGEPAL/100C	% Fail		0	0

Paul Guerra, Lab Supervisor

Quality Assurance Department

Customer: Workman

Approved Bill of Material for Work Order

Inv Item Description Act Qty By/Date Pipe Lot No.

#11

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	78	IN	V70501	5"	SR 26		Feed Stock #ED51257
2	48	IN	0713	8"	SR 11		Feed Stock #M0113
3	2			4"	SR 11		Flange Ring #169065
4	23.8	SQFT		3"			Flat Sheet (Bottom) #25628
5	23.8	SQFT		3"			Flat Sheet (Top) #25628
6	42	SQFT		3"			Flat Sheet (Gussets) #25628
7	12'	FT.	V621	4"	SDR 17		Feed Stock #169590
8							
9							
10							
11							
12							
13							
14							
15							
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29							
30							

Lot Number 540455 to 042497

Start Weight: 1500# Finished Weight: 1353

Operator Comments

Pipe Leak

QC Approval Date 6-4-97

Test Pieces Yes ___ No ✓

passed Ultra Sound

#5

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	16'	FT	V2030	54"	DR26		Pipe #F051257
2	8'	FT	4713	8"	DR11		Pipe #170113
3	6'	FT	0621	4"	DR 17		Pipe #169590
4	5	EA		4"			Flange set #169063
5	2	EA		4"			C3 4F
6	[illegible]	[illegible]	30 [illegible]	1"			Sheet stock #256628
7	[illegible]	[illegible]	31 [illegible]	2"			Sheet stock #256628
8							
9							
10							
11							
12							
13							
14							
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25							
26							
27							
28							

[redacted]

Set Weight: 54 [illegible] Original Weight: 1263

Quality Control:

Passed Ultra Sound

[redacted]

Standard Bill of Materials for Above Item

Description

Act. Qty Rj/Date

#4

BILL OF MATERIAL

ITEM #	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	196'	FT/FT	V2080	8"	DR 26		PIPE #F051257
2	12'	FT/FT	1178	8"	DR 11		PIPE #170113
3	3	EA.		4"	DR 17		FLANGEADP. #169065
4	12'	FT/FT	11621	4"	DR 17		PIPE #169590
5	3	EA.		4"			LJF CF
6	24'	SF/SF		1"			FLATSHEET #25628
7	5'	SF/SF		2"			FLATSHEET #25628
8							
9							
10							
11							
12							
13							
14							
15							
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27							
28							
29							
30							

Lot Number 54 05 453 to 0442497 Qty

Start Weight: 2597 Finished Weight: 1836

Quality Control

QC Approval Date: 6 16 197

Test Pieces: Yes ___ No ✓

Pound Villia

Bound

1268

72" V2039

#1

BILL OF MATERIAL

ITEM (B)	QTY.	UNIT MEAS.	LOT #	SIZE	SDR / CLASS	WEIGHT	DESCRIPTION
1	[illegible]	[illegible]	V2030	[illegible]	[illegible]		[illegible] Feed Stock #F051259
2	44	In	[illegible]	8"	[illegible]		8" Feed Stock #170115
3	86	In	U621	4"	DR 17		6" Feed Stock #169590
4	2	ea		4"	DR 17		Flange Adapter #169065
5	2	ea		4"			CS LTF Rings
6	21	[illegible]		1"			Flat Sheet Stock - Bottom #[illegible]
7	42	[illegible]		1½			Flat Sheet Stock - Bottom #[illegible]
8							
9							
10							
11							
12							
13							
14							
15							
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23							
24							
25							
26							
27							
28							
29							
30							

Date 6/4/97 [illegible]

Finished Weight [illegible]

Quality Control [illegible]

passed Ultra Sound [illegible]

FERMCO SUBMITTAL DISTRIBUTION 60 R1

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	B. Bodine	644	App/ Geo SIM	REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	R. McGuire	644		
	1	M. Godber	644		
	1	T. Russell	644	info	

RECEIVED BY: James C. Jenkins DATE: 6/16/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J C Jenkins DATE: 6/16/97

REVIEW COORDINATOR

1268

000415

Workman Developments

Linking Product and Customer.

U.S. 119 South
Forks-of-Coal Industrial Park
50 Rocky Branch Road
Alum Creek, West Virginia 25003-9622
Phone: (304) 756-9901

FAX COVER LETTER

DATE: June 10, 1997 TIME: _____ PAGES 14

TO: Mr. Mayur Kadakia COMPANY: VILLAGE BUILDING SERVICES

FAX NUMBER: _____ PHONE: _____

FROM: Gladys Miller FAX NUMBER: 304-756-9307

Please reference the attached pages sent to me from PLEXCO for the manholes shipped to you this past weekend.

Thank you, and have a great day. . .

Gladys

INFORMATION ONLY

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit

J. C. Jenkins Date 6/16/97

VBS-PLE-006

Plexco
Performance Pipe Division - Chevron Chemical Company

QUALITY CERTIFICATION

CUSTOMER:	Workman Developments Inc.
CUSTOMER ORDER NO.	6208189 P.O. 0032754
SHIP DATE:	6/06/97
PRODUCT:	54" IPS -26- CLEANOUT MANHOLE
LOT NUMBERS:	#1, #4, #5, #11
QUANTITY:	4 PCS.

This is to certify that the product described above and shipped on the above order has been produced in accordance with the applicable requirements of the specification(s) indicated below:

(X) ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials (Type III, Class B or C, Category 5, Grade P34)
(X) ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials (meets or exceeds cell classification of 345434C or E)
( ) AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in., for Water Distribution
( ) AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 in. through 3 in., for Water Distribution
( ) ASTM F714 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
( ) ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR -PR) Based on Controlled Outside Diameter
( ) NSF-61 - Drinking Water System Components - Health Effects
( ) NSF-14 - Plastic Piping Components and Related Materials
( ) Factory Mutual
(X) OTHER: Dimensions, Appearance, and Configuration checked per Dwg. # 90D-692 R4

DATE: 6/9/97

Robert Caldwell
Robert Caldwell
QA/QC Supervisor
Waxahachie, TX.

UNION CARBIDE
UNION CARBIDE CORPORATION
P.O. Box 186, Port Lavaca, TX 77979

Fax: 1972-937-4530

Plexco / Spirolite
Division of Chevron Chem. Co.
Hwy 31 East
Corsicana, TX 75110
Attn: K. Gill

PRODUCT CERTIFICATE OF ANALYSIS

02/06/97

Product Name: DGDB-2480 NT 3408

Customer Order No.: 107825
Internal Order No.: 444761

Shipped To: Plexco/Spirolite
Div. of Chevron Chemical Co.
1001 W Hwy 287 Bypass
Waxahachie, TX 75156

Blend	Quantity	Container Id	Ship Date
170113	195131	UMPX124110	02/04/97

All shipments of this product to customer must meet the following:
Plexco-Spirolite Requirements for DGDB-2480 NT 3408, dated Nov. 4, 1994.
This is to confirm that DGDB-2480 NT 3408 is a Type III, Class A, Grade P34, Category 5 natural Polyethylene resin under ASTM D1248, with a cell classification of PE345434A under ASTM D3350. When properly mixed with 6.5% of DFNF-0092 BK the product meets the requirements of ASTM D3350.

The following test data was obtained :

Blend : 170113
Sample Id : PE563485
Date of Manufacture : 01/02/97

Test Description	Unit	Minimum	Maximum	Results
Melt Index	g/10min	.06	.1	.074
Melt Flow Index (190C/21.6kg)	g/10min	8	12	10.9
Melt Flow Ratio (21.6/2.16 kg)		120	155	147.3
Density	g/cu cm	.943	.947	.9452
OIT @ 210C	min	13		21
Oxidative Induction Temp.	C	240		244
Tens.Stress@Yield,2"/M,SC15C/M	psi	3000		3382
Elongation Orig,2"/M, SC 15C/M	%	600		880
ESCR 192HRS/100%Igepal/100C	% Fail		0	0

Paul Guerra, Lab Supervisor

Quality Assurance Department

Chevron

May 24, 1996

Jim O'Neal
Mexeo
Highway 32
Abbeville, SC 29620

Chevron Chemical Company
P.O. Box 7400
Orange, TX 77631-7400
Phone 409 886 7491

Orange Plant

CERTIFICATE OF ANALYSIS

Product:	9346	Lot Number:	F051257
Chevron Order #:	101795	Destination:	Abbeville
Package:	CHVX889380	Weight (lbs):	182.250
Customer Order #:	106123	Ship Date:	5/23/96

This is to confirm that Chevron HDPE HID 9346 is a Type III, Class A, Grade P34, Category 5 resin, as classed by ASTM D1248. In addition, Chevron HID 9346 when used with the proper color concentrate meets or exceeds the requirement of cell classification 345434A in accordance with ASTM D3350.

Following is the data on the subject material as determined by the Quality Control Department:

Property	Value	Units
HLMI	8.6	gms/10 min
Density	0.9456	gms/cc
ESCR Condition C	0	Failures/20
MIS	0.31	gms/10 min
MPRS	27.7	

The data set forth herein has been carefully compiled by Chevron Chemical Company. However, there is no warranty of any kind, either expressed or implied, applicable to its use and the user assumes all risk and liability in connection therewith.

Sincerely,

G. G. Bertin
Supervisor
Quality Control

Customer Fax: 864-446-2139

For inquiry, contact Customer Service at the following number:
Film, Coating, Pipe Applications: 1-800-231-3826
Molding Applications: 1-800-231-3828

1268

EXHIBIT: B
APPROVAL BY:
REVISED: 08/23/96

REF: B - 4
PAGE: 4 OF 4

LINE: 316

PLEXCO - FAIRFIELD
DAILY LAB REPORT
MELT INDEX, DENSITY, AND CARBON ASH TESTING

SIZE: DE3408 Black Pelletized LOT NUMBER: PU055

MATERIAL: 2480 - ACFX-38580 DATE OF RUN: 11-14-96

CONCENTRATE LOT #: 190109-07189 MATERIAL LOT #: 1169065

DISPERSION: PASS / FAIL

PRODUCTION DATE	MI 2	MI 21.6	DENSITY	CARBON ASH	TESTED BY & DATE
11-14-96	.09	10.93	.954	2.12	JD 111496
11-15-96	.09		.953		JD 111596

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # 943727 Product Desc. 54" M.H. #1 7.7 Date 5-27-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 49½" KC

OD 54" KC

B. Check class of riser wall DR26 KC

II. Check length of riser prior to final cut. 72 9/16" KC

III. Check lay out of holes.

Circumference point	0°	height point	50 1/8"	From Top/Bottom	KC
Circumference point	180°	height point	50 1/8"	Top/Bottom	KC
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

CHEVRON PLEXCO

HYDROSTATIC TESTING REPORT

FOR: Certification of Analysis

MANHOLE/STA. No. #1, #4, #5, #11

DATE TESTED: 6/06/97

PRODUCT CODE: 943727

CUSTOMER: Workman Development Inc.

TESTED BY:

TOTAL TIME TESTED:
TIME TESTING START:
TIME TESTING END:

HEIGHT OF WATER N/A

5' ABOVE HIGHEST WELD:
6" BELOW TOP:
TOP OF RISER:

ULTRASONIC WELD TEST ? YES NO PASS FAIL

PASS FAIL

NOTE SIZES OF AIRBALLS/PLUGS USED:

REWORK: YES NO
RE-TEST: YES NO

TOTAL TIME TESTED:
TIME TESTING START:
TIME TESTING END:

HEIGHT OF WATER N/A

5' ABOVE HIGHEST WELD:
6" BELOW TOP:
TOP OF RISER:

PASS FAIL

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
		PROCESS DESCRIPTION		AIR&EXTUATE TEMP
5/21	485	Plane Bottom CK Temp	EXT 470-491	7:00am AIR 480-483
~	~	Weld Bottom CK Tap	EXT 475-49	12:30am AIR 477-[illegible]
5/31	485	Weld Bottom to pipe CK Temp	EXT 480 480	7:Am AIR 79-[illegible]
5/31	485	Weld Top to Pipe CK Temp	EXT 470-490	12:00 Am AIR 480-[illegible]
6/1	485	Weld Stub on CK Temp	EXT 470-48	7:Am AIR 482-484

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # 943728 Product Desc. 54" DR 26 CLEANOUT MH #4 Date 6-4-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 49 1/2" [initials]

OD 54 [initials]

B. Check class of riser wall DR 26 [initials]

II. Check length of riser prior to final cut. 8' 10 1/2" [initials]

III. Check lay out of holes.

			From	
Circumference point	0°	height point	84"	Top/Bottom [initials]
Circumference point	90°	height point	84"	Top/Bottom [initials]
Circumference point	180°	height point	84"	Top/Bottom [initials]
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom
Circumference point		height point		Top/Bottom

IV. Check stub outs.

Size & Connection	0°-8"	length	18 1/2" [initials]
Size & Connection	90°-8"	length	18 1/2" [initials]
Size & Connection	180°-8"	length	18 1/2" [initials]
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	

V. Inspect all welds, dimensions, and angles.

A. Welds top [initials]

bottom [initials]

through pipe/stub outs [initials]

ladder N/A

B. Dimensions - inspect all dimensions not previously checked. [initials]

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
		PROCESS DESCRIPTION		AIR&EXTUATE TEMP
6-4	DON STEVENSON	SCRAPED, ROUTED 2" SHOTS	[illegible]	AIR TEMP 485 - 479
		EOP TOP, WELD 1 SIDE	[illegible]	EXT TEMP 464-493
6-5	D. STEVENSON	SCRAPED, ROUTED, PREPED	[illegible]	AIR 484-494
		TOP AND WELD MANWAY	[illegible]	EXT. 474-492
6-5	ALT CASANOVA	ROUTER, PREP, holes + STUB-OUT	[illegible]	Air - 475-482
	J. Perez	PREP + Weld MANWAY + Top	[illegible]	EXT. 472 - 490
			[illegible]	AIR 490-482
			[illegible]	EXT 468-495
6-6	Clarence S.	Weld outside of stubouts	Tracy M	Air-470-492
		Weld Top to Riser + Weld	"	Ext. 467-485
		Lifting Lugs		

Exhibit 161A

Fabrication Run Plan Checklist

Standard Manhole

Part # 943729 Product Desc. 54" DR 26 CLEANOUT M/H #5 7.2' Date 6-3-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 49 1/2" — JBn

OD 54" — JBn

B. Check class of riser wall SDR 26 — JBn

II. Check length of riser prior to final cut. 67" — JBn

III. Check lay out of holes.

				From	
Circumference point	0°	height point	44"	Top/Bottom	JBn
Circumference point	180°	height point	44"	Top/Bottom	JBn
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	
Circumference point		height point		Top/Bottom	

IV. Check stub outs.

Size & Connection	0°-8"	length	JBn
Size & Connection	180°-8"	length	JBn
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	
Size & Connection		length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

DATE	EMPLOYEE	MANHOLE SIGN OFF SHEET PROCESS DESCRIPTION	SHIFT LEADER	7:00 & 3:00 AM,PM GUN TEMP & TIME
6-3	DON STEVENSON	CUT LUG HOLES	[illegible]	484 7:00 A.M.
		SCRAPED + WELD		
		WELD 1" SHEET STUB TOGETHER	[illegible]	492 3:00 PM
		(ROUTED AND SCRAPED)		
6-3	J. Stroope	Cut bottom, cut + prep	[illegible]	493° - 700-1000
		quarter weld 1st pass on		↓
		quarter.		
6-3	J. Stroope	Put 2nd PASS on quarter,	[illegible]	487 10:20-123
		Trim + prep stub out holes +		
		prep stub outs		
		back + weld stub outs 1st PASS	[illegible]	487° - 1:00 - 300
6-3	J. Stroope	scrape 1st pass + weld stub	[illegible]	493° - 320 - 500
		outs, 2nd PASS + fit quarter		
		to shell		
6-3	J. Stroope	Center + prep bottom + weld	[illegible]	490° - 515-630
6-4	D. Stevenson	SCRAPED + ROUTED 2 - 2"	[illegible]	AIR 485 - 479 2:16
		SHEETS FOR TOP (4+5	[illegible]	EXT. 468 - 483
6/4	[illegible]	Ground, Bevel - Plane INSIDE + OUT		
		Weld 1 PASS + 2 PASS OUT-SIDE		
		Weld 1 PASS INSIDE		
6-4	J. Stroope	flipped, ground out + prep	[illegible]	AIR 490° 700 PM 7:00
		fit flat sheet, + weld 1st pass	[illegible]	EXT 466
6-4	J. Stroope	weld 2nd pass set up + cut	[illegible]	AIR 498 1020-1030
		top ~~[illegible]~~	[illegible]	EXT 462
6-4	J. Stroope	cut MANWAY hole +	[illegible]	AIR 492 100-320
		MANWAY	[illegible]	EXT 466
		prep top + manway (cut manway)	[illegible]	AIR 476 330-500
		+ weld flange + manway	[illegible]	EXT 466
		on top		
6-5	Chance Simmons	Finish weld Bottom	[illegible]	
		Weld Top on + finish	Tracy M. [illegible]	AIR - 475 8:30
		welding manway and flange	[illegible]	EXT - 479 ~~[illegible]~~
			[illegible]	AIR 475 4:00 pm
			[illegible]	EXT - 480
6-5	J. PEREZ	SCRAPE OFF FILL IN WELDS	[illegible]	AIR 479 - 8:00 PM
		ON MANWAY FILL IN HOLES	[illegible]	EXT - 485 - 1:00 pm
		ON LUGS		

Exhibit 1.61A

Fabrication Run Plan Checklist

Standard Manhole

Part # _____ Product Desc. #11 Date 5-27-97

Shift Leader Initials

I. Check size & class of riser prior to cutting.

A. Record ID & OD of riser.

ID 49½ KC

OD 54" KC

B. Check class of riser wall DR 26 KC

II. Check length of riser prior to final cut. 23¾ KC

III. Check lay out of holes.

			From	
Circumference point	0°	height point 52⅜	Top/Bottom	KC
Circumference point	180°	height point 52⅜	Top/Bottom	KC
Circumference point		height point	Top/Bottom	
Circumference point		height point	Top/Bottom	
Circumference point		height point	Top/Bottom	
Circumference point		height point	Top/Bottom	

IV. Check stub outs.

Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	
Size & Connection	length	

V. Inspect all welds, dimensions, and angles.

A. Welds top

bottom

through pipe/stub outs

ladder

B. Dimensions - inspect all dimensions not previously checked.

C. Recheck angles.

D. Check lifting lugs.

E. All appropriate labeling.

		MANHOLE SIGN OFF SHEET	SHIFT LEADER	7:00 & 1:00 AM,PM
		PROCESS DESCRIPTION		GUN TEMP & TIME
1/5	867	Check Temp	[illegible]	493 8:00 AM
"		Check Temp	[illegible]	979 1:30 PM
"		Bevel Top Inside + Out	[illegible]	9:-10 AM
"		Tack Top + Cool	[illegible]	10:30 11:00
"		Grind Tacks + Weld	[illegible]	11:30-12:30
"		Grind Inside + Scrape	[illegible]	1:45-2:15
		Weld Inside	[illegible]	2:15-3:00
"		Weld Manway	[illegible]	3:15-400

25 r.1

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	D. Bodine	64		
	1	Parsons	64		
	1	R. McGuire	64		
	1	Mike Godber	64		
	1	T. Russell	64		

RECEIVED BY: Jess Ellis DATE: 4/22/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED James C. Jenkins DATE: 4/24/97

REVIEW COORDINATOR

FILE COPY

1268

000430

25 r.1

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	Jim Jenkins	64		REVIEW COORDINATOR
	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	D. Bodine	64		
	1	Parsons	64		
	1	R. McGuire	64		
	1	Mike Godber	64		
	1	T. Russell	64		

RECEIVED BY: [illegible signature] DATE: 4/22/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED James C. Jenkins DATE: 4/24/97

REVIEW COORDINATOR

FILE COPY

CONTROLLED

1268

000431

431-A

SUPPLIER SUBMITTAL

WORK ORDER NO.: 1700	SUBCONTRACT NO.: 589	SUPPLIER SUBMITTAL NO.: 25 R/1	DATE: 04/22/97

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216

SIGNATURE: Mayur P. Kadakia

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

RECEIVED BY: Melissa Crews DATE: 4/22/97

DOCUMENT FAMILY X RESUBMITTAL X SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C	D
8	VBS-HDM-000	1							X	X		LCS-1 to 3 & LDS-1 to 3 Manholes & Monit. Wells	X		X		Section 02605	X			
												(Plexco Shop Drawing No.: FP90D-688 R1									
												Plexco Shop Drawing No.: FP90D-689 R1									
												Plexco Shop Drawing No.: FP90D-690 R1									
												Plexco Shop Drawing No.: FP90D-691 R1)									

REMARKS:

DOCUMENT FAMILY CODE: (BY SUPPLIER)
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL
CON - CONSTRUCTION PRO - PROCUREMENT
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL
APPROPRIATE DOCUMENT FAMILY ABOVE

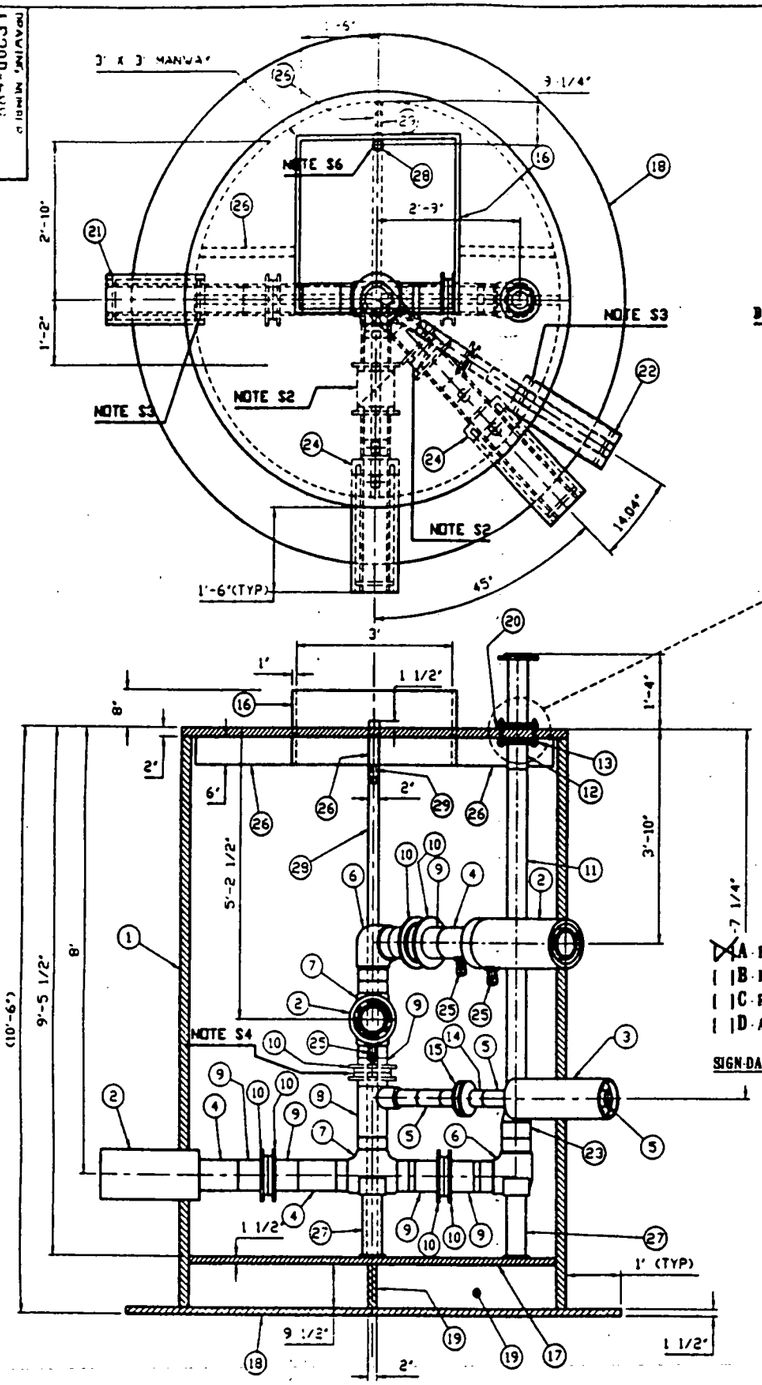
SUBMITTAL ACTION CODE: (BY SUPPLIER)
CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD
INF - INFORMATION
CFC - CERTIFIED FOR CONSTRUCTION
APPRORIATE SUBMITTAL ACTION CODE

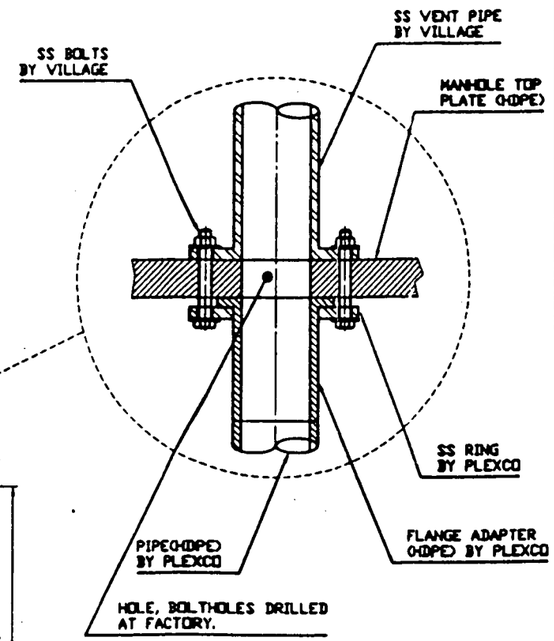
SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
C - REVISE AND RESUBMIT
D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREMENTS

ORIGINAL

FILE COPY

ENTERED





A - For CPC submittals only - Conforms w/Reqmts.
B - Minor Comment - Resubmit as-CPC/INF/REC
C - Revise and Resubmit
D - Accepted for INF/REC - Conforms w/Reqmts.

SIGN-DATE: J. C. [illegible] 4/24/97

BILL OF MATERIAL

ITEM #	QTY	UNIT MEAS	PART # / DWG #	SIZE	SDR / CLASS	DESCRIPTION
1	105	FT	47TP	34" ID	CLASS 100	COLORED PROFILE OF EQUAL RIBER (HDPE)
2	6.1	FT	-	10" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
3	21	FT	-	8" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
4	9.7	FT	-	6" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
5	7.3	FT	-	3" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
6	2	EA	70B-255	6" IPS	SDR 11	MOLDED BUTT 90° ELBOW - HDPE
7	2	EA	70B-256	6" IPS	SDR 11	MOLDED BUTT TEE - HDPE
8	1	EA	70D-268	6X6X3	SDR 11	FAB BRANCH SADDLE REDUCER TEE - HDPE
9	10	EA	70D-275	6" IPS	SDR 11	FLANGE ADAPTER - HDPE (NOTE S4)
10	10	EA	-	6"	-	CONVOLUTED SS LJF (NOTE S4)
11	6.1	FT	-	4" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
12	1	EA	70D-275	4" IPS	SDR 11	FLANGE ADAPTER - HDPE
13	1	EA	-	4"	-	CONVOLUTED SS LJF
14	2	EA	70D-275	3" IPS	SDR 11	FLANGE ADAPTER - HDPE
15	2	EA	-	3"	-	CONVOLUTED SS LJF
16	21.8	SQFT	-	1" THK	-	SHEET STOCK - HDPE (FAB MANWAY)
17	38.5	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (INTERNAL BOTTOM)
18	68.9	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (EXTENDED BOTTOM)
19	11.1	SQFT	-	2" THK	-	SHEET STOCK - HDPE (BOTTOM GUSSETTS)
20	42.6	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP)
21	4	EA	80B-158	6/10	SDR 11	DCS CENTRALIZER - HDPE
22	2	A	80B-158	3/9	SDR 11	DCS CENTRALIZER - HDPE
23	1	EA	70B-319	6X4	SDR 11	MOLDED BUTT REDUCER - HDPE
24	2	EA	80B-170	6/10	SDR 11	SF-DCS FIXED PRESSURE END SEAL - HDPE
25	4	EA	70A-485	1"	-	1" NPT DRAIN/ALARM ACCESS **(NOTE S7)**
26	2.8	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP GUSSETTS)
27	2	EA	-	4"	SDR 11	PIPE SUPPORT - HDPE (NOTE S5)
28	9.6	FT	-	2" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE (LEVEL TRANS. PIPE)
29	2	EA	-	1" THK	-	SHEET STOCK - HDPE (PIPE SUPPORTS)

NOTES:

1. EMBEDMENT FILL SHOULD BE PLACED IN MAXIMUM 8" LOOSE LIFTS AROUND THE MANHOLE RISER FOR THE FULL HEIGHT OF THE MANHOLE.
2. EMBEDMENT FILL SHALL EXTEND A MINIMUM OF THREE AND A HALF (3.5) FEET FROM THE RISER OR TO THE TRENCH WALL, WHICHEVER IS THE GREATER DISTANCE.
3. EMBEDMENT FILL AROUND MANHOLE RISER IS REQUIRED TO MEET NO. 89 COARSE AGGREGATE MATERIAL PER OHIO DOT SECTION 703. COMPACTED TO A MINIMUM OF 4 PASSES OF A VIBRATORY PLATE COMPACTER.
4. MANHOLES SHALL BE INSTALLED IN A DRY TRENCH WITH A STABLE FOUNDATION. THE FOUNDATION SHOULD CONSIST OF A MINIMUM OF 8" OF EMBEDMENT FILL COMPACTED MINIMUM OF 8 PASSES OF A VIBRTORY PLATE COMPACTOR.
5. WHEN VEHICLE LOADS ARE PRESENT, A CONCRETE CAP OR OTHER SUCH STRUCTURE DESIGNED TO WITHSTAND THESE LOADS SHOULD BE PLACED OVER THE MANHOLE SO THAT THE LOADS ARE TRANSMITTED INTO THE SURROUNDING SOIL AND NOT DIRECTLY INTO THE RISER.
6. THE FOLLOWING PARAMETERS WERE ASSUMED:
   A) MAXIMUM SOIL DENSITY OF 120 LBS/FT^3
   B) GROUND WATER NOT TO EXCEED 10 FEET ABOVE THE BASE OF THE MANHOLE. FLOTATION OF MANHOLE MAY NEED TO BE ADDRESSED. WHEN A POLYETHYLENE ANCHOR CONNECTION RING IS INCLUDED, IT MUST BE USED IN CONJUNCTION WITH A CONCRETE ANCHOR BY OTHERS. THE PE ANCHOR CONNECTION RING IS NOT DESIGNED TO RESTRAIN THE STRUCTURE BY ITSELF.
   C) AMBIENT (73.4° F) OPERATING TEMPERATURE.
   D) STRUCTURAL LOADS APPLIED TO HDPE MANHOLE NOT TO EXCEED 1000 LBS. LOAD TO BE EQUALLY DISTRIBUTED ABOUT CIRCUMFERENCE OF MANHOLE.
7. PLACE LIFTING LUGS PER B4088. (FOR PRODUCTION USE ONLY)

SPECIAL NOTES:

S1. CONTRACTOR TO VERIFY ALL DIMENSIONS.
S2. VALVES, BOLTS, NUTS, GASKETS AND WASHERS BY OTHERS INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.
S3. END CENTRALIZER SHALL BE PERFORATED WITH (6), 5/8"Ø HOLES EVENLY SPACED AT 60° APART.
S4: (FLGXFLG) JOINT REQUIRED.
S5. FOR DETAIL'S ON PIPE SUPPORT SEE DRAWING FP90D-691, DETAIL 2.
S6. SEE FP90D-691, DETAIL 1.
S7. VALVES, BOLTS, NUTS, GASKETS, WASHERS, AND ALL OTHER HARDWARE NECESSARY TO CONNECT TO 1" NPT, FOR ITEM 25, BY VILLAGE, INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.

QUOTE # S-1760
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-305
PRODUCT CAT: MANHOLE OTHER

ACAD13
PLOT DATE: 04/21/97

REVISED 1 04/21/97 CJ
REVISED MANWAY TO 7X3' (ITEM 16, EXTENDED BOTTOM TO 12"
REVISED NOTES 1, 2, 3, AND 4.
REVISED NOTE S4. ADDED SS/FLANGE DETAIL. ADDED NOTE S7.
REVISED QTY FOR ITEMS 12 & 13.

TOLERANCES (EXCEPT AS NOTED)
DECIMAL -
FRACTIONAL ± 1"
ANGULAR ± 1°

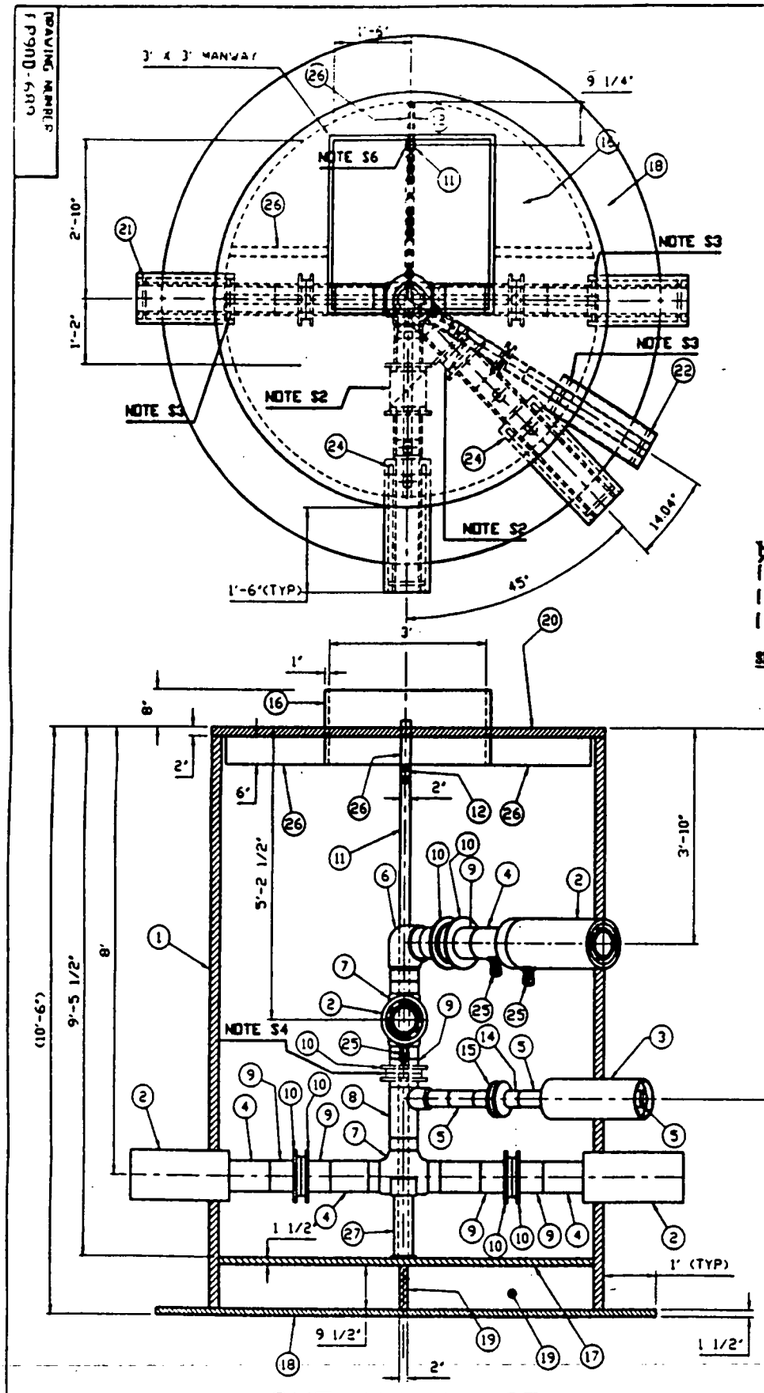
Plexco
SUBMITTAL
SCALE NONE
DATE 02/11/97
TITLE 34" I.D., CLASS 100 X 9.5' MANHOLE LCS-1
DRAWING NUMBER FP90D-688 R1
DRAWN BY CJ
CHECKED BY

APPROVALS 4-21-97

CONTROLLED COPY NO. 011

VBS-HDM-000 R/1

DRAWING NUMBER FP90D-689



CUT-AWAY VIEW

QUOTE # S-1760
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-305
PRODUCT CAT: MANHOLE OTHER

A - For CFC submittals only - Conforms w/Reqmts
B - Minor Comment - Resubmit as CFC/INF/REC
C - Revise and Resubmit
D - Accepted for INF/REC - Nonconforms w/Reqmts.

SIGN-DATE: J. C. Jenkins 4/24/97

BILL OF MATERIAL

ITEM #	LCS-2 QTY.	LCS-3 QTY	UNIT MEAS	PART # / DWG #	SIZE	SDR / CLASS	DESCRIPTION
1	10.5	10.5	FT	47[illegible]	84" ID	CLASS 100	DUDDED PROFILE OR EQUAL RISER (HDPE)
2	8	8	FT	-	10" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
3	2.1	2.1	FT	-	8" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
4	12.3	12.3	FT	-	6" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
5	7.3	7.3	FT	-	3" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
6	1	1	EA	70B-255	6" IPS	SDR 11	MOLDED BUTT 90° ELBOW - HDPE
7	2	2	EA	70B-256	6" IPS	SDR 11	MOLDED BUTT TEE - HDPE
8	1	1	EA	70D-268	6X6X3	SDR 11	FAB BRANCH SADDLE REDUCER TEE - HDPE
9	10	10	EA	70D-275	6" IPS	SDR 11	FLANGE ADAPTER - HDPE (NOTE S4)
10	10	10	EA	-	6"	-	CONVOLUTED SS LJF (NOTE S4)
11	9.6	9.6	FT	-	2" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE (LEVEL TRANS. PIPE)
12	2	2	EA	-	1" THK	-	SHEET STOCK - HDPE (PIPE SUPPORTS)
13	-	-	-	-	-	-	-
14	2	2	EA	70D-275	3" IPS	SDR 11	FLANGE ADAPTER - HDPE
15	2	2	EA	-	3"	-	CONVOLUTED SS LJF
16	21.8	21.8	SQFT	-	1" THK	-	SHEET STOCK - HDPE (FAB MANWAY)
17	38.5	38.5	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (INTERNAL BOTTOM)
18	68.9	68.9	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (EXTENDED BOTTOM)
19	11.1	11.1	SQFT	-	2" THK	-	SHEET STOCK - HDPE (BOTTOM GUSSETTS)
20	42.6	42.6	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP)
21	6	6	EA	80B-158	6/10	SDR 11	DCS CENTRALIZER - HDPE
22	2	2	A	80B-158	3/8	SDR 11	DCS CENTRALIZER - HDPE
23	-	-	-	-	-	-	-
24	2	2	EA	80B-170	6/10	SDR 11	SF-DCS FIXED PRESSURE END SEAL - HDPE
25	4	4	EA	70A-485	1"	-	1" NPT DRAIN/ALARM ACCESS (NOTE S7)
26	2.8	2.8	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP GUSSETTS)
27	1	1	EA	-	4"	SDR 11	PIPE SUPPORT - HDPE (NOTE S5)

NOTES:

1. EMBEDMENT FILL SHOULD BE PLACED IN MAXIMUM 8" LOOSE LIFTS AROUND THE MANHOLE RISER FOR THE FULL HEIGHT OF THE MANHOLE.
2. EMBEDMENT FILL SHALL EXTEND A MINIMUM OF THREE AND A HALF (3.5) FEET FROM THE RISER OR TO THE TRENCH WALL; WHICHEVER IS THE GREATER DISTANCE.
3. EMBEDMENT FILL AROUND MANHOLE RISER IS REQUIRED TO MEET NO. 89 COARSE AGGREGATE MATERIAL PER OHIO DOT SECTION 703. COMPACTED TO A MINIMUM OF 4 PASSES OF A VIBRATORY PLATE COMPACTER.
4. MANHOLES SHALL BE INSTALLED IN A DRY TRENCH WITH A STABLE FOUNDATION. THE FOUNDATION SHOULD CONSIST OF A MINIMUM OF 8" OF EMBEDMENT FILL COMPACTED MINIMUM OF 8 PASSES OF A VIBRTORY PLATE COMPACTOR.
5. WHEN VEHICLE LOADS ARE PRESENT, A CONCRETE CAP OR OTHER SUCH STRUCTURE DESIGNED TO WITHSTAND THESE LOADS SHOULD BE PLACED OVER THE MANHOLE SO THAT THE LOADS ARE TRANSMITTED INTO THE SURROUNDING SOIL AND NOT DIRECTLY INTO THE RISER.
6. THE FOLLOWING PARAMETERS WERE ASSUMED:
   A) MAXIMUM SOIL DENSITY OF 120 LBS/FT.^{3}
   B) GROUND WATER NOT TO EXCEED 10 FEET ABOVE THE BASE OF THE MANHOLE. FLOTATION OF MANHOLE MAY NEED TO BE ADDRESSED. WHEN A POLYETHYLENE ANCHOR CONNECTION RING IS INCLUDED, IT MUST BE USED IN CONJUNCTION WITH A CONCRETE ANCHOR BY OTHERS. THE PE ANCHOR CONNECTION RING IS NOT DESIGNED TO RESTRAIN THE STRUCTURE BY ITSELF.
   C) AMBIENT (73.4° F) OPERATING TEMPERATURE.
   D) STRUCTURAL LOADS APPLIED TO HDPE MANHOLE NOT TO EXCEED 1000 LBS. LOAD TO BE EQUALLY DISTRIBUTED ABOUT CIRCUMFERENCE OF MANHOLE.
7. PLACE LIFTING LUGS PER B4088. (FOR PRODUCTION USE ONLY)

SPECIAL NOTES:

S1. CONTRACTOR TO VERIFY ALL DIMENSIONS.
S2. VALVES, BOLTS, NUTS, GASKETS AND WASHERS BY OTHERS INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.
S3. END CENTRALIZER SHALL BE PERFORATED WITH (6), 5/8"ø HOLES EVENLY SPACED AT 60° APART.
S4. (FLGXFLG) JOINT REQUIRED.
S5. FOR DETAILS ON PIPE SUPPORT SEE DRAWING FP90D-691, DETAIL 2.
S6. SEE FP90D-691, DETAIL 1.
S7. VALVES, BOLTS, NUTS, GASKETS, WASHERS, AND ALL OTHER HARDWARE NECESSARY TO CONNECT TO 1" NPT, FOR ITEM 25, BY VILLAGE, INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.

CONTROLLED COPY NO. 011

APPROVALS
4-21-97

ACAD13
PLOT DATE: 04/21/97

REVISION 1: 04/21/97 C.U. REVISED MANWAY TO 3'X3', ITEM 18 EXTENDED BOTTOM TO 12" REVISED NOTES 1, 2, 3, AND 4 REVISED NOTE S4. ADDED NOTE S7

TOLERANCES EXCEPT AS NOTED: ± 1"

SCALE: NONE

Plexco SUBMITTAL

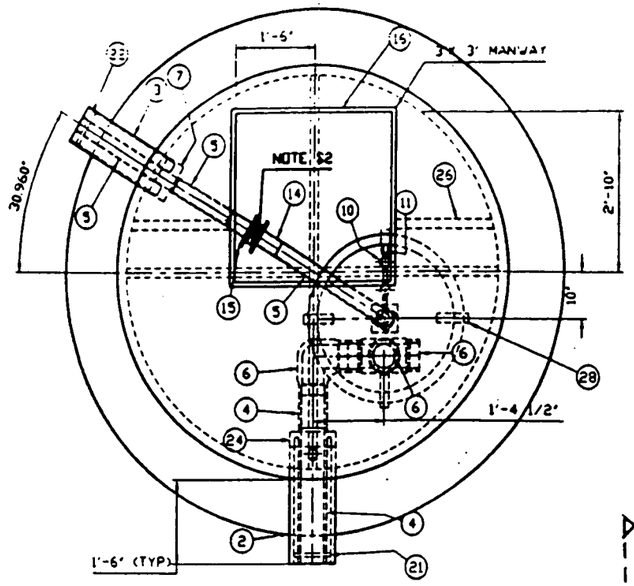
DRAWN BY: C.U.

TITLE: 84" I.D., CLASS 100 X 9.5' MANHOLE LCS-2 AND LCS-3.

DATE: 02/11/97

DRAWING NUMBER: FP90D-689 R1

DRAWING NUMBER FP90D-690



A - For CPC submittals only - Conforms w/Reqmts.
B - Minor Comment - Resubmit as CPC/INF/REC
C - Revise and Resubmit
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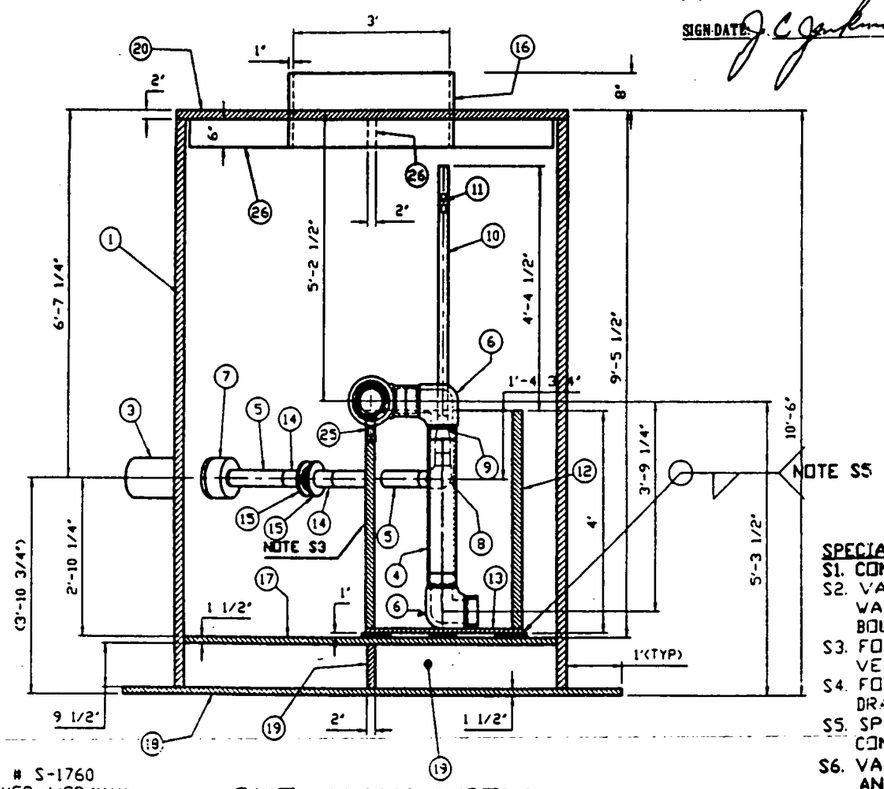
SIGN-DATE: J. C. Jenkins 4/24/97



CUT-AWAY VIEW

QUOTE # S-1760
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-305
PRODUCT CAT: MANHOLE OTHER

BILL OF MATERIAL

ITEM #	LDS-2 QTY	LDS-2 QTY	LDS-3 QTY	UNIT MEAS	PART # / DWG #	SIZE	SDR / CLASS	DESCRIPTION
1	10.5	10.5	10.5	FT	47[illegible]	84" ID	CLASS 100	CLOSED PROFILE DP EQUAL RISER (HDPE)
2	21	21	21	FT	-	10" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
3	1.8	1.8	1.8	FT	-	8" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
4	5.2	5.2	5.2	FT	-	6" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
5	5.4	5.4	5.4	FT	-	3" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
6	2	2	2	EA	70B-255	6" IPS	SDR 11	MOLDED BUTT 90° ELBOW - HDPE
7	1	1	1	EA	80B-170	3/8	SDR 11	SF-DCS FIXED PRESSURE END SEAL - HDPE
8	1	1	1	EA	70B-255	3" IPS	SDR 11	MOLDED BUT 90° ELBOW - HDPE
9	1	1	1	EA	70B-319	3"X2"	SDR 11	MOLDED BUTT REDUCER - HDPE
10	21.2	21.2	21.2	FT	-	2" IPS	SDR 11	PE3408 FEEDSTOCK - HDPE
11	5	5	5	EA	-	1" THK	-	SHEET STOCK - HDPE (LATERAL SPACER/SUPPORT)
12	4	4	4	FT	-	36" IPS	SDR 17	PE3408 FEEDSTOCK - HDPE (CONTAINMENT VESSEL)
13	7.1	7.1	7.1	SQFT	-	1" THK	-	SHEET STOCK - HDPE (CONTAINMENT BOTTOM)
14	2	2	2	EA	70D-275	3" IPS	SDR 11	FLANGE ADAPTER - HDPE
15	2	2	2	EA	-	3"	-	CONVOLUTED SS LJF
16	21.8	21.8	21.8	SQFT	-	1" THK	-	SHEET STOCK - HDPE (FAB MANWAY)
17	38.5	38.5	38.5	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (INTERNAL BOTTOM)
18	68.9	68.9	68.9	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (EXTENDED BOTTOM)
19	11.1	11.1	11.1	SQFT	-	2" THK	-	SHEET STOCK - HDPE (BOTTOM GUSSETTS)
20	42.6	42.6	42.6	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP)
21	1	1	1	EA	80B-158	6/10	SDR 11	DCS CENTRALIZER - HDPE
22	1	1	1	A	80B-158	3/8	SDR 11	DCS CENTRALIZER - HDPE
23	-	-	-	-	-	-	-	-
24	1	1	1	EA	80B-170	6/10	SDR 11	SF-DCS FIXED PRESSURE END SEAL - HDPE
25	1	1	1	EA	70B-544	1/2" IPS	SDR 11	BRANCH SERVICE SADDLE - HDPE (NOTE S6)
26	2.8	2.8	2.8	SQFT	-	2" THK	-	SHEET STOCK - HDPE (TOP GUSSETTS)
27	1	1	1	EA	-	4"	SDR 11	PIPE SUPPORT - HDPE - NOT SHOWN (NOTE S4)
28	.64	.64	.64	SQFT	-	1" THK	-	SHEET STOCK - HDPE (SPACER BLOCKS)

NOTES:

1. EMBEDMENT FILL SHOULD BE PLACED IN MAXIMUM 8" LOOSE LIFTS AROUND THE MANHOLE RISER FOR THE FULL HEIGHT OF THE MANHOLE.
2. EMBEDMENT FILL SHALL EXTEND A MINIMUM OF THREE AND A HALF (3.5) FEET FROM THE RISER OR TO THE TRENCH WALL; WHICHEVER IS THE GREATER DISTANCE.
3. EMBEDMENT FILL AROUND MANHOLE RISER IS REQUIRED TO MEET NO. 89 COARSE AGGREGATE MATERIAL PER OHIO DOT SECTION 703. COMPACTED TO A MINIMUM OF 4 PASSES OF A VIBRATORY PLATE COMPACTER.
4. MANHOLES SHALL BE INSTALLED IN A DRY TRENCH WITH A STABLE FOUNDATION. THE FOUNDATION SHOULD CONSIST OF A MINIMUM OF 8" OF EMBEDMENT FILL COMPACTED MINIMUM OF 8 PASSES OF A VIBRTORY PLATE COMPACTOR.
5. WHEN VEHICLE LOADS ARE PRESENT, A CONCRETE CAP OR OTHER SUCH STRUCTURE DESIGNED TO WITHSTAND THESE LOADS SHOULD BE PLACED OVER THE MANHOLE SO THAT THE LOADS ARE TRANSMITTED INTO THE SURROUNDING SOIL AND NOT DIRECTLY INTO THE RISER.
6. THE FOLLOWING PARAMETERS WERE ASSUMED:
   A) MAXIMUM SOIL DENSITY OF 120 LBS/FT.^{3}
   B) GROUND WATER NOT TO EXCEED 10 FEET ABOVE THE BASE OF THE MANHOLE. FLOTATION OF MANHOLE MAY NEED TO BE ADDRESSED. WHEN A POLYETHYLENE ANCHOR CONNECTION RING IS INCLUDED, IT MUST BE USED IN CONJUNCTION WITH A CONCRETE ANCHOR BY OTHERS. THE PE ANCHOR CONNECTION RING IS NOT DESIGNED TO RESTRAIN THE STRUCTURE BY ITSELF.
   C) AMBIENT (73.4° F) OPERATING TEMPERATURE.
   D) STRUCTURAL LOADS APPLIED TO HDPE MANHOLE NOT TO EXCEED 1000 LBS. LOAD TO BE EQUALLY DISTRIBUTED ABOUT CIRCUMFERENCE OF MANHOLE.
7. PLACE LIFTING LUGS PER B4099. (FOR PRODUCTION USE ONLY)

SPECIAL NOTES:

S1. CONTRACTOR TO VERIFY ALL DIMENSIONS.
S2. VALVES, BOLTS, NUTS, GASKETS AND WASHERS, BY OTHERS INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.
S3. FOR DETAILS ON PRIMARY CONTAINMENT VESSEL SEE DRAWING FP90D-691.
S4. FOR DETAILS ON PIPE SUPPORT SEE DRAWING FP90D-691 DETAIL 2.
S5. SPACERS WELDED TO MANHOLE BOTTOM. CONTAINMENT VESSEL WELDED TO SPACERS.
S6. VALVES, BOLTS, NUTS, GASKETS, WASHERS, AND ALL OTHER HARDWARE NECESSARY TO CONNECT TO 1" NPT, FOR ITEM 25, BY VILLAGE, INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.

ACAD13
PLOT DATE: 04/21/97

REVISED: 04/21/97 CU. REVISED MANWAY TO 3'X2' (ITEM 18. EXTENDED BOTTOM TO 12" REVISED NOTES 1, 2, 3, AND 4. ADDED ITEM 28. REVISED LOCATION(NOT) OF CONTAINMENT VESSEL. ADDED NOTE 26.

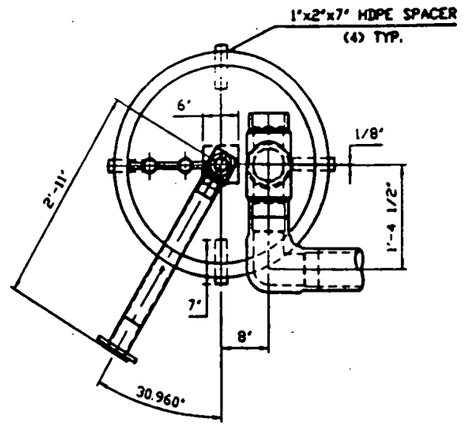
TOLERANCES EXCEPT AS NOTED
DECIMAL -
FRACTIONAL ± 1"
ANGULAR ± 1"

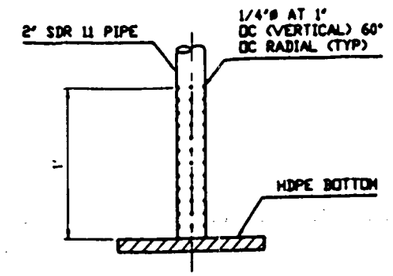
Plexco
SCALE NONE
SUBMITTAL
DRAWN BY CU.
CHECKED BY
TITLE 84" I.D., CLASS 100 X 9.5' MANHOLE LDS-1, LDS-2 AND LDS-3 W/PRIMARY CONTAINMENT
DATE 02/13/97
DRAWING NUMBER FP90D-690 R1

CONTROLLED COPY

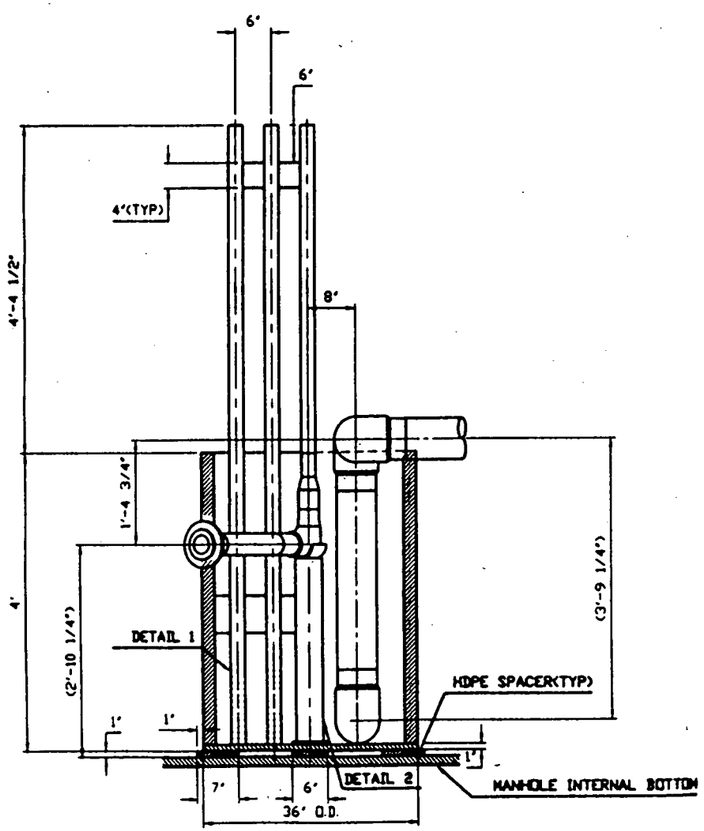
011

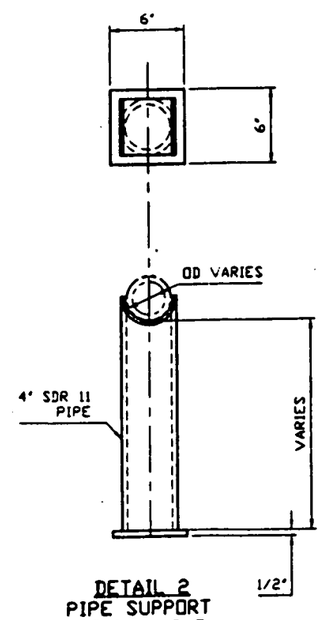
APPROVALS
4-21-97





DETAIL 1
PERFORATED PIPE
SCALE: NONE





DETAIL 2
PIPE SUPPORT
SCALE: NONE

CDC
CONTROLLED COPY
NO.
011

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[ ]C - Revise and Resubmit
[ ]D - Accepted for INF/REC - Conforms w/Reqmts.
SIGN-DATE: C Jenkins 4/24/97

NOTES:
1. CONTRACTOR TO VERIFY ALL DIMENSIONS.

APPROVALS
4-24-97

ACAD13
PLOT DATE: 04/17/97

REVISION 1: 04/17/97 CJJ
ADDED SPACERS TO VIEWS.
REVISED HEIGHT DIMENSIONS OF CONTAINMENT VESSEL.
TVT

TOLERANCES EXCEPT AS NOTED
DECIMAL -
FRACTIONAL ± 1"
ANGULAR ± 1°

Plexco
SUBMITTAL
SCALE NONE
DRAWN BY C.J.J.
CHECKED BY
TITLE 36" IPS SDR 17 PRIMARY CONTAINMENT VESSEL (QTY 3) AND DETAILS
DATE 02/13/97
DRAWING NUMBER FP90D-691 R1

QUOTE # S-1760
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-305
PRODUCT CAT: MANHOLE OTHER

CUT-AWAY VIEW

4 of 4

58r1

FERMCO SUBMITTAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
1	1	Jim Jenkins			REVIEW COORDINATOR
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	1	Mike Godber			
	1	Parsons			
	1	Tracy Russell			
	1	Rick McGuire			

RECEIVED BY: Todd Ellis DATE: 4/22/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J. C. Jenkins DATE: 4/24/97

REVIEW COORDINATOR

FILE COPY

12668

000436

SUPPLIER SUBMITTAL

000437

WORK ORDER NO.: 1700 | SUBCONTRACT NO.: 589 | SUPPLIER SUBMITTAL NO.: 58 R/1 | DATE: 04/22/97

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216

SIGNATURE: Mayur P. Kadakia

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

RECEIVED BY: Melissa Lewis DATE: 4/22/97

DOCUMENT FAMILY X RESUBMITTAL X

SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C	D
8	FP90D-693 R1 1of2	1							X	X		84" Lift Station Sheet 1 of 2	X		X		Section 02605				
8	FP90D-693 R1 2of 2	1							X	X		84" Lift Station Sheet 2 of 2	X		X		Section 02605				

REMARKS:

DOCUMENT FAMILY CODE: (BY SUPPLIER)
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL
CON - CONSTRUCTION PRO - PROCUREMENT
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL
APPROPRIATE DOCUMENT FAMILY ABOVE

SUBMITTAL ACTION CODE: (BY SUPPLIER)
CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD
INF - INFORMATION
CFC - CERTIFIED FOR CONSTRUCTION
APPRORIATE SUBMITTAL ACTION CODE

SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
C - REVISE AND RESUBMIT
D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREMENTS

ORIGINAL FILE COPY

DRAWING NUMBER FP90D-693

NOTES:

1. EMBEDMENT FILL SHOULD BE PLACED IN MAXIMUM 8 INCH LOOSE LIFTS AROUND THE MANHOLE RISER FOR THE FULL HEIGHT OF THE MANHOLE.
2. EMBEDMENT FILL SHALL EXTEND A MINIMUM OF THREE AND A HALF (3.5) FEET FROM THE RISER OR TO THE TRENCH WALL; WHICH EVER THE GREATER DISTANCE.
3. EMBEDMENT FILL AROUND MANHOLE RISER IS REQUIRED TO MEET NO. 89 COARSE AGGREGATE MATERIAL PER OHIO DOT SECTION 703 COMPACTED TO A MINIMUM. 4 PASSES OF A VIBRTORY PLATE COMPACTOR.
4. MANHOLES SHALL BE INSTALLED IN A DRY TRENCH WITH A STABLE FOUNDATION. THE FOUNDATION SHOULD CONSIST OF A MINIMUM OF 8" OF EMBEDMENT FILL COMPACTED MINIMUM OF 8 PASSES OF A VIBRATORY PLATE COMPACTOR.
5. WHEN VEHICLE LOADS ARE PRESENT, A CONCRETE CAP OR OTHER SUCH STRUCTURE DESIGNED TO WITHSTAND THESE LOADS SHOULD BE PLACED OVER THE MANHOLE SO THAT THE LOADS ARE TRANSMITTED INTO THE SURROUNDING SOIL AND NOT DIRECTLY INTO THE RISER. 3
6. THE FOLLOWING PARAMETERS WERE ASSUMED:
   A) MAXIMUM SOIL DENSITY OF 120 LBS/FT.
   B) GROUND WATER NOT TO EXCEED 14 FEET ABOVE THE BASE OF THE MANHOLE. FLOTATION OF MANHOLE MAY NEED TO BE ADDRESSED. WHEN A POLYETHYLENE ANCHOR CONNECTION RING IS INCLUDED, IT MUST BE USED IN CONJUNCTION WITH A CONCRETE ANCHOR BY OTHERS. THE PE ANCHOR CONNECTION RING IS NOT DESIGNED TO RESTRAIN THE STRUCTURE BY ITSELF.
   C) AMBIENT (73.4°) OPERATION TEMPERATURE.
   D) STRUCTURAL LOADS APPLIED TO HDPE MANHOLE NOT TO EXCEED 1000 LBS. LOAD TO BE EQUALLY DISTRIBUTED ABOUT CIRCUMFERENCE OF MANHOLE.
7. PLACE LIFTING LUGS PER 70B-664 (FOR PRODUCTION USE ONLY).
8. NUTS, BOLTS, AND GASKETS ARE NOT INCLUDED. ALL OTHER PIPING AND EQUIPMENT BY OTHERS.
9. ALL GUSSETTS TO BE WELDED TO INNER VESSEL.

BILL OF MATERIAL

ITEM ③	QTY	UNIT MEAS.	PART # / DWG #	SIZE	SDR / CLASS	DESCRIPTION
1	24.6	FT	-	96" ID	CL 315/365	SW PIPE - HDPE (PE X PE) (LAST 3' ON EACH END TO BE CLASS 365)
2	24.3	FT	-	84" I.D.	CLASS 160	SW PIPE - HDPE (PE X PE) (MAX O.D. - 89.60")
3	7	FT	-	72" I.D.	CLASS 250	SW PIPE - HDPE (PE X PE)
4	7.3	FT	-	60" I.D.	CLASS 160	SW PIPE - HDPE (PE X PE)
5	3.3	FT	-	10" IPS	SDR 11	PE3408 FEEDSTOCK
6	3.3	FT	-	6" IPS	SDR 11	PE3408 FEEDSTOCK
7	2	FT	-	8" IPS	SDR 11	PE3408 FEEDSTOCK
8	2.5	FT	-	4" IPS	SDR 11	PE3408 FEEDSTOCK
9	10.9	SQFT	-	1" THK	-	SHEET STOCK - HDPE (SQUARE MANWAY)
10	20.9	SQFT	-	2" THK	-	SHEET STOCK - HDPE (FLAT TOP)
11	30.2	FT	-	2" IPS	SDR 11	PE3408 FEEDSTOCK
12	100.6	SQFT	-	2" THK	-	SHEET STOCK - HDPE (96" END PLATES)
13	77	SQFT	-	2" THK	-	SHEET STOCK - HDPE (84" END PLATES)
14	52	SQFT	-	2" THK	-	SHEET STOCK - HDPE (RADIAL GUSSETTS)
15	25.7	SQFT	-	2" THK	-	SHEET STOCK - HDPE (END PLATES GUSSETTS)
16	10.1	SQFT	-	2" THK	-	SHEET STOCK - HDPE (INTERMEDIATE GUSSETTS)
17	13.2	SQFT	-	2" THK	-	SHEET STOCK - HDPE (LONGITUDINAL GUSSETTS)
18	10.6	SQFT	-	2" THK	-	SHEET STOCK - HDPE (RADIAL GUSSETT - RISER)
19	1	EA	80B-170	10"/6" IPS	SDR 11	FIXED END PRESSURE SEAL - HDPE
20	1	EA	70D-275	6" IPS	SDR 11	FLANGE ADAPTER - HDPE
21	1	EA	-	6"	-	316 SS CONVOLUTED LJF
22	2	EA	70B-256	4" IPS	SDR 11	MOLDED BUTT TEE - HDPE
23	1	EA	80B-170	8"/4" IPS	SDR 11	FIXED END PRESSURE SEAL - HDPE
24	2	EA	70B-255	4" IPS	SDR 11	90° MOLDED BUTT ELBOW - HDPE
25	3	EA	70D-275	4" IPS	SDR 11	FLANGE ADAPTER - HDPE
26	3	EA	-	4"	-	316 SS CONVOLUTED LJF
27	1	EA	70A-485	1" IPS	SDR 11	1"NPT DRAIN W/CAP **(SEE NOTE S1 - SHEET 1)**
28	10.9	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (FORM)
29	4.9	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (FORM LIP)
30	2	EA	70D-275	2" IPS	SDR 11	FLANGE ADAPTER - HDPE
31	.9	SQFT	-	1" THK	-	SHEET STOCK - HDPE (SUPPORT BRACKET)
32	1	EA	80B-158	4"/8" IPS	-	DCS CENTRALIZER
33	1	EA	80B-158	6"/10" IPS	-	DCS CENTRALIZER
34	2	EA	-	2"	-	316 SS CONVOLUTED LJF
35	1	SQFT	-	2" THK	-	SHEET STOCK - HDPE (SUPPORT PLATES)
36	.12	SQFT	-	1" THK	-	SHEET STCOK - HDPE (CONDUIT ANCHOR BLOCK)

SPECIAL NOTES:

S1. 8" OF REINFORCED CONCRETE TO BE POURED IN THE BOTTOM OF THE MANHOLE FOR ANCHORING OF PUMPS. (BY OTHERS) **DO NOT** POUR CONCRETE IN THE MANHOLE PRIOR TO PLACEMENT. LIFTING LUGS CANNOT ACCOMMODATE THE ADDITIONAL WEIGHT OF THE CONCRETE, AND SERIOUS INJURY AND/OR DAMAGE TO THE MANHOLE MAY RESULT.

CDC CONTROLLED COPY NO. C011

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[ ] C - Revise and Resubmit
[ ] D - Accepted for INF/REC - Conforms w/Reqmts.

SIGN-DATE: J. C. Jenkins 4/24/97

QUOTE # S-1759
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-288
PRODUCT CAT: SPIROL TANK

APPROVALS
J. J. 4-21-97

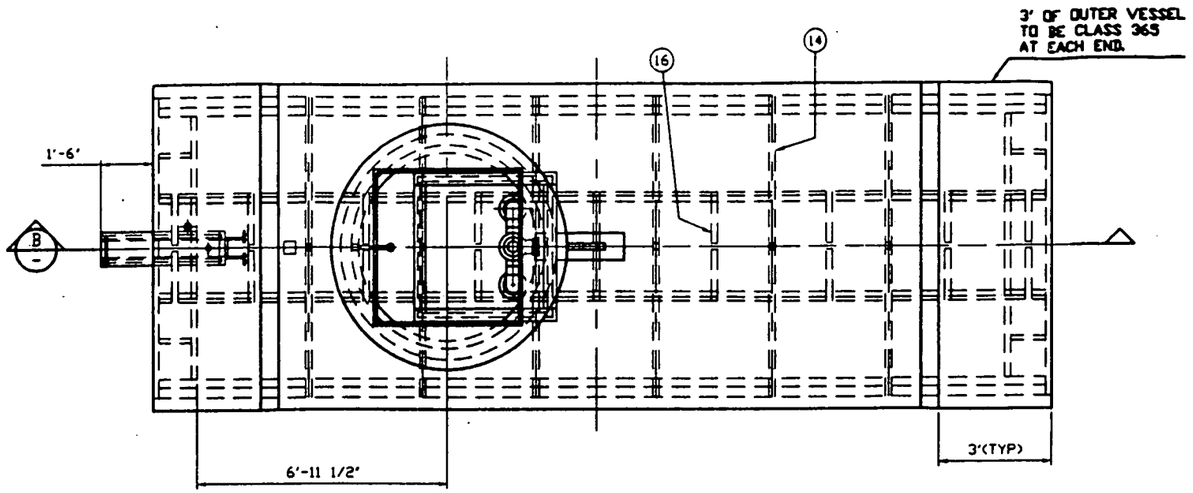
ACAD13
PLOT DATE: 4/21/97

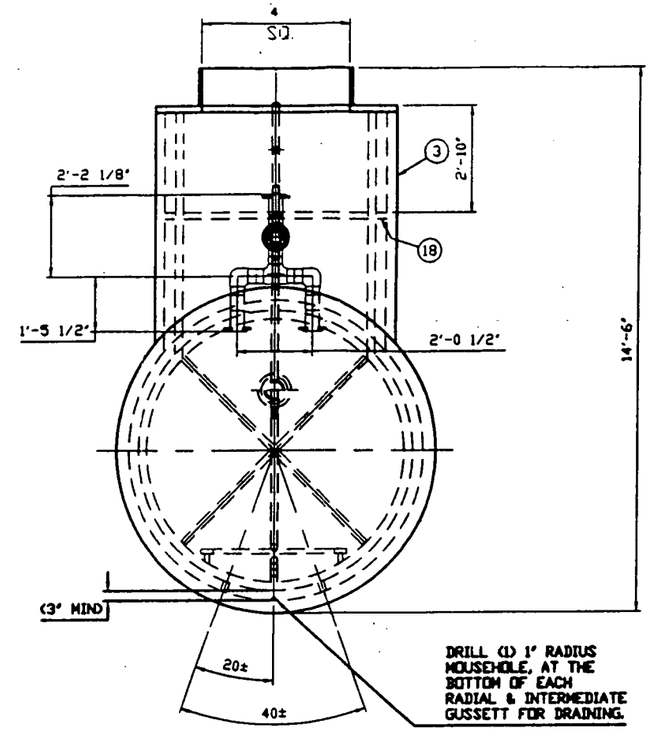
REVISION 1: 04/21/97 C.U.
SEE REVISIONS SHEET 1.

TOLERANCES EXCEPT AS NOTED
DECIMAL -
FRACTIONAL ± 1"
ANGULAR ± 1"

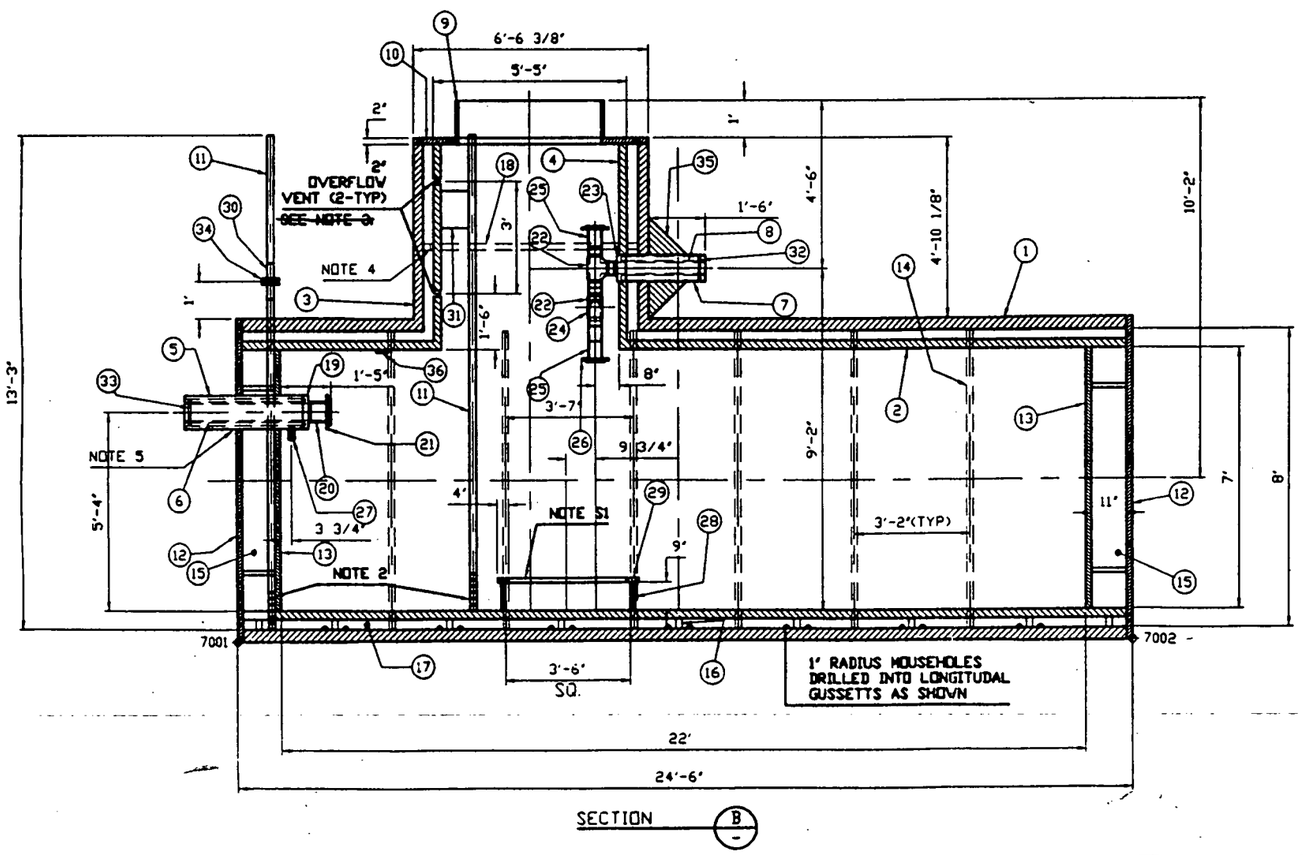
Chemtrol Plexco
SCALE NONE
SUBMITTAL
DRAWN BY CU
CHECKED BY
TITLE 84" I.D. CLASS 160/96"I.D. CLASS 315 x 22' DCS HORIZONTAL TANK
DATE 2/24/97
DRAWING NUMBER FP90D-693 R1
SHT 2

DRAWING NUMBER FP90D-693





VIEW A-A



SECTION B

NOTES:
1. FOR BILL OF MATERIALS SEE FP90D-693 SHEET 2.
2. ON LAST 12' IF 2' PIPE DRILL 1/4'Ø HOLES AT 1' OC (VERTICAL) 60° OC RADIAL HOLES (TYP). SEE DETAIL 1 ON FP90D-691.

DEL ~~3. POSITION AND PURPOSE OF 2' OVERFLOW VENTS~~
DEL ~~TO BE VERIFIED BY THE ENGINEER.~~

4. 1' RADIUS MOUSEHOLE TO BE DRILLED.
5. ADVISE IF GUSSETT NEEDED ON 6'X10' DSC STUB OUT.

SPECIAL NOTE:
S1. VALVES, BOLTS, NUTS, GASKETS, WASHERS, AND ALL OTHER HARDWARE NECESSARY TO CONNECT TO 1' NPT, FOR ITEM 27, BY VILLAGE, INSTALLED BY PLEXCO. BOLTS MUST BE TORQUED AT JOBSITE.

CDC CONTROLLED COPY NO.

C011

[X] A - For CPC submittals only - Conforms w/Reqmts.
[ ] B - Minor Comment - Resubmit as-CPC/INF/REC
[ ] C - Revise and Resubmit
[ ] D - Accepted for INF/REC - Conforms w/Reqmts.

SIGN-DATE: J. C. Jenkins 4/24/97

ACAD13
PLOT DATE: 04/21/97

QUOTE # S-1759
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-288
PRODUCT CAT: SPIROL TANK

APPROVALS
4-21-97

REVISION 1 04/21/97 C.U.
13'-3' WAS 16'-9 7/8'. ADDED ITEM 36. ADDED CONTROL POINTS. 12' WAS 9'. ADJUSTED LOCATION OF 4'X8' DCS STUB OUT. ADDED ITEM 35. ADJUSTED LOCATION OF 2' VENTS. 11' WAS 12'. OVERALL HEIGHT ADJUSTED TO 14'-6'. DEL NOTE 3. ADJUSTED LOCATION OF RISER RADIAL GUSSETT, AND RADIAL GUSSETT AT 84' AND 60' ADDED NOTE 5 AND S1.
TVT

TOLERANCES EXCEPT AS NOTED	Plexco SUBMITTALL	
DECIMAL -	SCALE NONE	DRAWN BY C.U. CHECKED BY
FRACTIONAL ± 1'	TITLE 84' I.D. CLASS 160/96' I.D. CLASS 315 X 22' DCS HORIZONTAL TANK	
ANGULAR ± 1'	DATE 02/24/97	DRAWING NUMBER FP90D-693 R1

#57 R&L

FERMCO SUB....TAL DISTRIBUTION

ORIG QTY.	COPY QTY.	DISTRIBUTION TO:	MS	DEPARTMENT	REMARKS
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	1	DYAN RHEA	44	CONSTRUCTION DOCUMENT CONTROL	FILE COPY
	1	GeoSyntec	64		
	1	Rick McGuire	64		
	1	Mike Godber	64		
	1	Tracy Russell	64		
	1	Parsons (H. Ketron)	Bin		

RECEIVED BY: James C. Jenkins DATE: 5/14/97

(SIGN/DATE AND RETURN A COPY TO CDC, MS44)

FORWARD COMMENTS TO REVIEW COORDINATOR

☒ NO COMMENTS ☐ COMMENTS RECEIVED J.C. Jenkins DATE: 5/14/97

REVIEW COORDINATOR

ORIGINAL FILE COPY

1268

000440

SUPPLIER SUBMITTAL

WORK ORDER NO.: 1700	SUBCONTRACT NO.: 589	SUPPLIER SUBMITTAL NO.: 57 R/3	DATE: 05/08/97

FROM: VILLAGE BUILDING SERVICES, INC.
7311 VINE STREET
CINCINNATI, OH 45216

SIGNATURE: Mayur P. Kadakia

TO: FLUOR DANIEL FERNALD CONSTRUCTION DOCUMENT CONTROL, MS44, T-57

RECEIVED BY: Melissa Crews DATE: 5/12/97

DOCUMENT FAMILY X RESUBMITTAL X

SUBMITTAL ACTION X SUPPLIER ACTION

QTY.	DOCUMENT NUMBER	REV	H&S	MED	PRO	QAC	TRG	CON	ENG	YES	NO	TITLE/ DESCRIPTION	CR	INF	CFC	REC	ASSOCIATED SPECIFICATION	A	B	C	D
8	FP90D-692 R4	4							X	X		54" OD SDR 26 Cleanout Manholes			X		Section 02605	X			
												(Changes in Table "A")									

REMARKS:

DOCUMENT FAMILY CODE; (BY SUPPLIER)
H&S - HEALTH & SAFETY TRG - TRAINING MED - MEDICAL
CON - CONSTRUCTION PRO - PROCUREMENT
ENG - ENGINEERING QAC QUALITY ASSURANCE/CONTROL
APPROPRIATE DOCUMENT FAMILY ABOVE

SUBMITTAL ACTION CODE: (BY SUPPLIER)
CR - COMPLIANCE REVIEW REC - CERTIFIED RECORD
INF - INFORMATION
CFC - CERTIFIED FOR CONSTRUCTION
APPRORIATE SUBMITTAL ACTION CODE

SUPPLIER ACTION CODE: (CDC) SUPPLIER ACTION ABOVE
A - CFC DOCUMENTS: CONFORMS WITH REQUIREMENTS
B - MINOR/NO COMMENTS: SUBMIT AS CFC, INF, OR REC
C - REVISE AND RESUBMIT
D - FOR INF/REC DOCUMENTS: CONFORMS WITH REQUIREMENTS

ORIGINAL FILE COPY

000441

DRAWING NUMBER FP90D-692

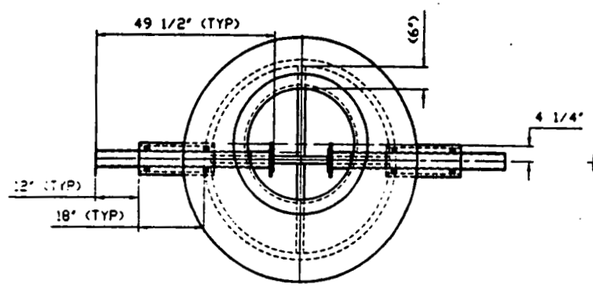
TABLE "A"

	COMH #	TOP OF LID ELEV.	INVERT ELEV. (TYP)	PLAN TYPE	"H" (IN.)	"HI" (IN.)	"HGT" (IN.)
	1	582.00	575.16	TYPE 5	72.08	50.11	82.08
DEL	~~1A~~	~~581.00~~	~~573.67~~	~~TYPE 1~~	~~97.96~~	~~75.99~~	
DEL	~~2~~	~~582.00~~	~~575.67~~	~~TYPE 1~~	~~85.96~~	~~63.99~~	
DEL	~~3~~	~~577.50~~	~~570.67~~	~~TYPE 1~~	~~91.96~~	~~69.99~~	
	4	577.00	567.33	TYPE 2	106.04	84.07	116.04
	5	581.00	574.67	TYPE 4	65.96	43.99	75.96
DEL	~~6~~	~~577.00~~	~~570.67~~	~~TYPE 1~~	~~85.96~~	~~63.99~~	
DEL	~~7~~	~~575.50~~	~~566.67~~	~~TYPE 1~~	~~115.96~~	~~93.99~~	
DEL	~~8~~	~~574.00~~	~~565.67~~	~~TYPE 1~~	~~109.96~~	~~87.99~~	
DEL	~~9~~	~~575.00~~	~~560.67~~	~~TYPE 1~~	~~85.96~~	~~63.99~~	
DEL	~~10~~	~~577.25~~	~~567.16~~	~~TYPE 3~~	~~131.00~~	~~109.11~~	
	11	577.83	570.83	TYPE 5	74.00	52.03	84
DEL	~~12~~	~~579.00~~	~~570.50~~	~~TYPE 3~~	~~111.04~~	~~89.07~~	

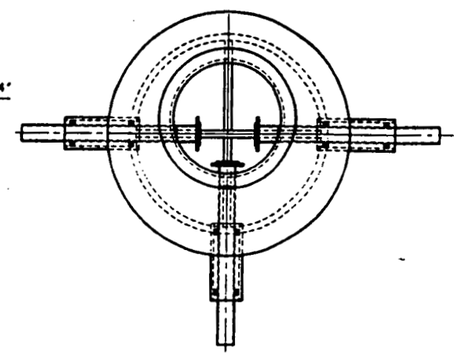
BILL OF MATERIAL

ITEM #	MH1 QTY.	DEL MH1A QTY	DEL MH2 QTY.	DEL MH3 QTY.	MH4 QTY.	MH5 QTY	DEL MH6 QTY	DEL MH7 QTY	DEL MH8 QTY	DEL MH9 QTY	DEL MH10 QTY	MH11 QTY	DEL MH12 QTY	UNIT MEAS.	PART # / DWG #	SIZE	SDR / CLASS	DESCRIPTION
1	6.1	8.2	7.2	7.7	8.94	5.5	7.2	9.7	9.2	7.2	10.9	6.2	9.3	FT	-	54" IPS	SDR 26	PE3408 FEEDSTOCK (RISER)
2	3.5	3.5	3.5	3.5	5.2	4.75	3.5	3.5	3.5	3.5	3.5	4.75	3.5	FT	-	8" IPS	SDR 26	PE3408 FEEDSTOCK
3	5.9	5.9	5.9	5.9	11	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	FT	-	4" IPS	SDR 17	PE3408 FEEDSTOCK
4	2	2	2	2	3	2	2	2	2	2	2	2	2	EA	70D-275	4" IPS	SDR 17	FLANGE ADAPTER - HDPE
5	2	2	2	2	3	2	2	2	2	2	2	2	2	EA	-	4"	-	CS LJF
6	21	21	21	21	23.8	23.8	21	-	21	21	-	23.8	-	SQFT	-	1" THK	-	SHEET STOCK - HDPE (EXTENED BOTTOM)
7	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	SQFT	-	2" THK	-	SHEET STOCK - HDPE (GUSSETTS)
■ 8	21	21	21	21	23.8	23.8	21	21	21	21	21	23.8	21	SQFT	-	2" THK	-	SHEET STOCK - HDPE (EXTENDED TOP)
9	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	SQFT	-	30" I.D.	CLASS 63	HDPE RISER (MANWAY)
10	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	SQFT		1" THK		SHEET STOCK - HDPE (MANWAY FLANGE)
11																		
12	4	4	4	4	6	4	4	4	4	4	4	4	4	EA	70D-269	4"/8"		DCS CENTERING SPIDER
13	-	-	-	-	21	-	-	21	-	-	21	-	21	SQFT	-	1 1/2" THK	-	SHEET STOCK - HDPE (EXTENED BOTTOM) NOTE 8

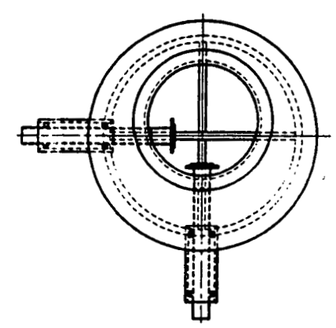
■ 1.75" SHEET STOCK NOT AVAILABLE, SUBSTITUTED 2" THICK SHEET.



TYPE 1, 4, & 5



TYPE 2



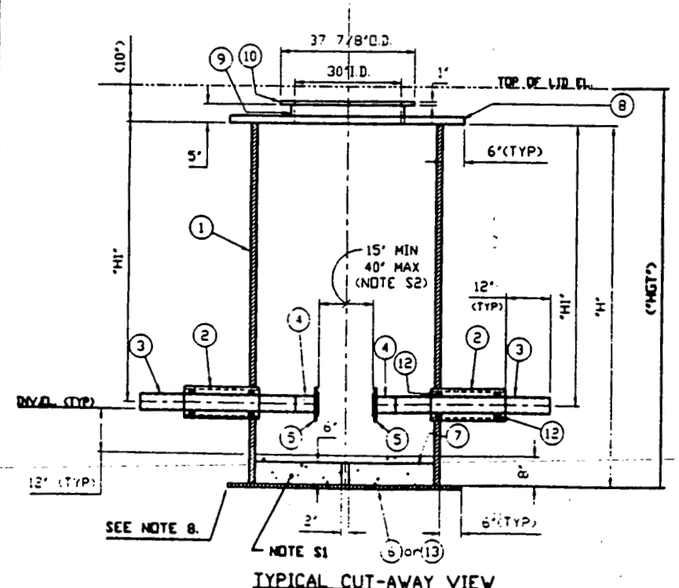
DEL TYPE 3

TYPICAL CLEANOUT MANHOLE PLANS
NTS
NOTE: SEE TABLE "A" FOR TYPE OF SPECIFIC COMH AND DIMENSIONS.

CDC
CONTROLLED COPY NO. C011

SIGN-DATE: 5-7-97

[X] A - For CPC submittals only - Conforms w/Reqmts.
[ ] B - Minor Comments - Resubmit as CPC/INP/REC
[ ] C - Revise and Resubmit
[ ] D - Accepted for INP/REC - Conforms w/Reqmts.



TYPICAL CUT-AWAY VIEW
CLEANOUT-MANHOLE (COMH)

SPECIAL NOTES:

S1. 8" OF REINFORCED CONCRETE TO BE POURED IN THE BOTTOM OF THE MANHOLE (BY OTHERS.)
DO NOT POUR CONCRETE IN THE MANHOLE PRIOR TO PLACEMENT. LIFTING LUGS CANNOT ACCOMMODATE THE ADDITIONAL WEIGHT OF THE CONCRETE, AND SERIOUS INJURY AND/OR DAMAGE TO THE MANHOLE MAY RESULT.

S2. 4" CARRIER SPOOL SHIPPED LOOSE. THE DIMENSION SHOWN FROM THE SPOOL FLANGE FACE TO FACE CAN BE FIELD ADJUSTED. THIS DIMENSION IS A REFERENCE DIMENSION THAT IS APPROXIMATED.

NOTES:

1. EMBEDMENT FILL SHOULD BE PLACED, IN MAXIMUM 8" LOOSE LIFTS, AROUND THE MANHOLE RISER FOR THE FULL HEIGHT OF THE MANHOLE.
2. EMBEDMENT FILL SHALL EXTEND A MINIMUM OF THREE AND A HALF (3.5) FEET FROM THE RISER OR TO THE TRENCH WALL; WHICHEVER IS THE GREATER DISTANCE.
3. EMBEDMENT FILL AROUND MANHOLE RISER IS REQUIRED TO MEET NO. 89 COARSE AGGREGATE MATERIAL PER ODOT 703. COMPACT WITH 4 PASSES OF VIBRATORY COMPACTOR.
4. MANHOLES SHALL BE INSTALLED IN A DRY TRENCH WITH A STABLE FOUNDATION. THE FOUNDATION SHOULD CONSIST OF A MINIMUM OF 8" OF EMBEDMENT FILL COMPACTED A MINIMUM OF 8 PASSES OF A VIBRATORY PLATE COMPACTOR.
5. WHEN VEHICLE LOADS ARE PRESENT, A CONCRETE CAP OR OTHER SUCH STRUCTURE DESIGNED TO WITHSTAND THESE LOADS SHOULD BE PLACED OVER THE MANHOLE SO THAT THE LOADS ARE TRANSMITTED INTO THE SURROUNDING SOIL AND NOT DIRECTLY INTO THE RISER.
6. THE FOLLOWING PARAMETERS WERE ASSUMED:
   A) MAXIMUM SOIL DENSITY OF 120 LBS/FT.^{3}
   B) GROUND WATER NOT TO EXCEED, "H" DIM. IN TABLE "A", FEET ABOVE THE BASE OF THE MANHOLE. FLOTATION OF MANHOLE MAY NEED TO BE ADDRESSED. WHEN A POLYETHYLENE ANCHOR CONNECTION RING IS INCLUDED, IT MUST BE USED IN CONJUNCTION WITH A CONCRETE ANCHOR BY OTHERS. THE PE ANCHOR CONNECTION RING IS NOT DESIGNED TO RESTRAIN THE STRUCTURE BY ITSELF.
   C) MANHOLE MAY BE SUBJECT TO FROST. MAXIMUM OPERATING TEMPERATURE OF MANHOLE NOT TO EXCEED 100°F.
   D) MANHOLE TOPS ARE NOT DESIGNED FOR LOADS BEYOND THE WEIGHT PERSONNEL AND HAND CARRIED EQUIPMENT.
7. PLACE LIFTING LUGS PER 70B-664. (FOR PRODUCTION USE ONLY)
8. **MANHOLES 4, 7, 10 AND 12 REQUIRE 1 1/2" THICK BOTTOM.**
9. **REFERENCE DCN 1700.014**

REVISION	DATE	BY	DESCRIPTION
4	5/7/97	HJV	ADDED "HGT" DIM TO MANHOLE AND TO TABLE "A". REVISED DIMENSIONS IN TABLE "A". REVISED BOM TO REFLECT CHANGES IN RISER HEIGHTS.
3	4/17/97	CJU	DR WAS 3E3. REVISED NOTE 3. 4" STUBOUTS EXTENDED TO 12".
2	3/20/97	CJU	DELETED MANHOLES 1A, 2, 3, 6, 7, 8, 9, 10 AND 12. UPDATED QTY FOR BOM ITEM 6 AND 8. ITEM 8 SIZE WAS 1 1/2" THICK. REVISED NOTES 1, 2, 3, 4, 5 AND 7. ADDED NOTE 9. DELETED TYPE 3 PLAN VIEW.
1	2/26/97	HJV	ADDED MANHOLE #9 TO TABLE "A" AND BILL OF MATERIAL. ADDED A FACE TO FACE DIMENSION TO INSIDE 4" SPOOL. ADDED NOTE S2. REVISED NOTE S1 TO EXCLUDE ANY PUMP REFERENCE.

ACAD13
PLOT DATE 5/7/97

QUOTE # S-1760
CUSTOMER: WORKMAN
PROJECT: FERNALD NUCLEAR
PRODUCT CODE: B-212
PRODUCT CAT: MANHOLE

APPROVALS

Chevron Plexco
SUBMITTAL

TOLERANCES EXCEPT AS NOTED	
DECIMAL	-
FRACTIONAL	± 1"
ANGULAR	± 1°
SCALE	NONE
DRAWN BY	CJU
CHECKED BY	
TITLE	54" O.D. SDR 26 CLEAN OUT MANHOLES
DATE	DATE
DRAWING NUMBER	FP90D-692

APPENDIX I:

GEOSYNTHETIC CONFORMANCE TEST RESULTS

Geosynthetic Clay Liner
- Hydraulic Conductivity Test Results
- Direct Shear Test Results
- Direct Shear Compliance Packages

Geomembrane
Geotextile

Geosynthetic Clay Liner

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97081502	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
18 AUG	35154 B.O.L # 4312 *	KW					16 AUG	12 SEPT	P	BN
	35155 *									
	35157 *									
	35158 *									
	35159 B.O.L # 4313 *						16 AUG	12 SEPT	P	BN
	35160 *		19 AUG	GCL-02		BN				
	* REMOVED FROM SITE 19 NOV. 97									
	13,950 ft²									

AVG. ROLL WIDTH: 15.5 ft. AVG. ROLL LENGTH: 150 ft

NUMBER OF ROLLS ABOVE: 6 ACCUMULATIVE NUMBER OF ROLLS: 6

CUMULATIVE AREA: 13,950 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 1

000445

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97062902	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
18AUG	29968 BOL # 4312	KW	19 AUG	GCL-03		BN	16 AUG	12 SEPT	P	BN
	1937.5 ft²									

000446

AVG. ROLL WIDTH: 15.5 ft AVG. ROLL LENGTH: 125 ft

NUMBER OF ROLLS ABOVE: 1 ACCUMULATIVE NUMBER OF ROLLS: 7

CUMULATIVE AREA: 15,887.5 ft² / NO. OF CONFORMANCE TESTS (page/total): 1 / 2

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97081402	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
18 AUG	35047 BOL #4312	KW					16 AUG	12 SEPT	F	BN
	35048									
	35049									
	35050									
	35051									
	35053									
	35059									
	35060									
	35061									
	35063									
	35065									
	37067									
	35029 BOL #4313						16 AUG	12 SEPT	P	BN
	35030									
	35031									
	35032									
	35033									
	35034									
	35035									
	35037									
	35038									
	35043									
	35044									
	35046		19 AUG	GCL-01		BN				
	35056			58.125112						

000447

AVG. ROLL WIDTH: 15.5 ft AVG. ROLL LENGTH: 150 ft

NUMBER OF ROLLS ABOVE: 25 ACCUMULATIVE NUMBER OF ROLLS: 32

CUMULATIVE AREA: 74,012.5 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 3

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97081402	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
18 AUG	35057 BOL # 4313	KW								
↓	35058	KW								
	4,650 ft² -	/	6277 ft² -							

000448

AVG. ROLL WIDTH: 15.5 ft AVG. ROLL LENGTH: 150 ft

NUMBER OF ROLLS ABOVE: 2 ACCUMULATIVE NUMBER OF ROLLS: 34

CUMULATIVE AREA: 78,662.5 ft² NO. OF CONFORMANCE TESTS (page/total): 0 / 3

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
25/8	BOL#4337 / 970820/2/35725	R.L					25 AUG	12 SEPT	P	BN
	35726									
	35727									
	35728									
	35729									
	BOL#4336 35730						25 AUG	12 SEPT	P	BN
	35731									
	35733									
	BOL#4337 35734									
	35735									
	35736									
	35737									
	35738									
	35739									
	35740									
	35741									
	35743									
	35744									
	35745									
	35746									
	BOL#4336 35748									
	35750						CUMULATIVE AREA FOR THIS LOT #970820/2012 = 58,125 SQ. FT.			
	35751									
	35752									
	35753			58,125 ft²	–					

000449

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 25 ACCUMULATIVE NUMBER OF ROLLS: 59

CUMULATIVE AREA: 136,787.5 ft² NO. OF CONFORMANCE TESTS (page/total): 0 / 3

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
25/8	BOL F 43360 / 97082012/35755	R.L.								
↓	35756	↓								
	35757		25/8	GCL-04		RL				
						ACCUMULATIVE NO. OF ROLLS FOR LOT # 97082012 = 28				
						CUMULATIVE AREA FOR LOT # 97082012 = 65,100 ft² ✓				
	6,975 ft²	✓ /	65100 ft²							

000450

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150. FT.

NUMBER OF ROLLS ABOVE: 3 ACCUMULATIVE NUMBER OF ROLLS: 62

CUMULATIVE AREA: 143,762.5 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 4

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
25/8	BOL# 4336/ 97082102/35807	R.L.					25 AUG	12 SEPT	P	BN
	35809									
	35810		25/8	GCL-05		RL				
	35811									
	35812									
	35813									
						ACCUMULATIVE NO. OF ROLLS FOR LOT # 97082102				
						CUMULATIVE AREA FOR LOT # 97082102 = 13,950 SQ FT.				
	13,950 ± 2									

000451

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 6 ACCUMULATIVE NUMBER OF ROLLS: 68

CUMULATIVE AREA: 157,712.5 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 5

GeoSyntec Consultants | FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082302	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/FAIL	QA ID
27/8	36045 BOL# 4371	R.L					27 AUG	12 SEPT	P	BN
	36046									
	36047									
	36048									
	36049									
	36050									
	36059 BOL#4370						25 AUG	12 SEPT	P	BN
	36060 BOL# 4371									
	36061									
	36062									
	36063									
	36064									
	36065									
	36066									
	36068 BOL# 4370									
	36069 BOL# 4371 (LENGTH 134.51 ft)									
	36073									
	36074		27/8	GCL-07		RL				
	39,525.00 2084.905 41,609.91 ft²									

ACCUMULATIVE NO. OF ROLLS ON THIS PAGE FOR LOT 97082302 = 18

CUMULATIVE AREA FOR LOT # 97082302 = 41,609.91 ft²

000452

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 18 ACCUMULATIVE NUMBER OF ROLLS: 86

CUMULATIVE AREA: 199,322.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 6

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082502	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
27/8	*36075 BOL#4371	RL					27 AUG	12 SEPT	P	BN
	*36076 BOL#4370						25 AUG	12 SEPT	P	BN
	*36077									
	*36078									
	*36080									
	*36081									
	*36082									
	*36083									
	*36084									
	*36085									
	*36094									
	*36095									
	*36096									
	*36104									
	*36110									
	*36114		27/8	GCL-06		RL				
	* REMOVED FROM SITE 01 DEC. 97 (BOL#6931)									
						ACCUMULATIVE NO. OF ROLLS ON THIS PAGE FOR LOT # 97082502 = 16				
						CUMULATIVE AREA FOR LOT # 97082502 = 37,200 SQ. FT				
	37,200 ft²									

000453

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 16 ACCUMULATIVE NUMBER OF ROLLS: 102

CUMULATIVE AREA: 236,522.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 7

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082602	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
28/8	36311 * BOL# 4467	RL					28 AUG	12 SEPT	P	BN
↓	36312 *	↓	28/8	GCL-08		RL				
	36313 *									
	36314 *									
	36315 *									
3 SEPT.	36249 * BOL# 4468	RL					26 AUG	12 SEPT	P	RL
↓	36270 *	↓								
	36271 *									
4 SEPT.	36262 * BOL# 4427	RL					4 SEPT	12 SEPT	P	RL
↓	36269 *	↓								
	36272 *									
10 SEPT.	36256 * BOL# 4467	RL					10 SEPT	12 SEPT	P	RL
↓	36261 *	↓								
	* REMOVED FROM SITE 11 DEC '97 BOL # 08035									
							ACCUMULATIVE NO. OF ROLLS FOR LOT# 97082602 = 5			
							CUMULATIVE AREA FOR LOT# 97082602			
	30,225 ft²								ft²	

000454

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 13 ACCUMULATIVE NUMBER OF ROLLS: 115

CUMULATIVE AREA: 266,747.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 8

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082702	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
28/8	36318 BOL# 4379	RL					28 AUG	12 SEPT	P	BN
	36322 BOL# 4380						28 AUG	12 SEPT	P	BN
	36323									
	36324									
	36325									
	36326									
	36328									
	36332 BOL# 4379									
	36333									
	36334									
	36335									
	36336									
	36337 (25 FT LONG)									
	36338									
	36339									
	36342									
	36343									
	36344		28/8	GCL-09		RL				
	36385 BOL# 4380									
	36387									
	36388									
	36389									
	36390									
	36391									
	36392		57,737.5 FT²							

ACCUMULATIVE NO. OF ROLLS = 25

CUMULATIVE AREA ON THIS PAGE = 57,737.5 FT²

000455

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 25 ✓ ACCUMULATIVE NUMBER OF ROLLS: 140

CUMULATIVE AREA: 324,484.9 FT² NO. OF CONFORMANCE TESTS (page/total): 1 / 9

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082702	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
28/AUG.	36394 BOL#4380	RL								
↓	36395	↓								
	36396									
	36397									
							ACCUMULATIVE NO. OF ROLLS = 29			
							CUMULATIVE AREA FOR LOT # 97082702			
							= 67,037.5 SQ. FT.			
	9300 ft² / 67,037.5 ft²									

000456

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 4 ACCUMULATIVE NUMBER OF ROLLS: 144

CUMULATIVE AREA: 333,784.9 ft² NO. OF CONFORMANCE TESTS (page/total): 0 / 9

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082812	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
2 SEPT.	36516 BOL# 4400 *	RL					29 AUG	12 SEPT	P	RL
	36533 *									
	36534 *									
	36537 *									
	36538 *									
	36539 *									
	36540 *									
	36542 *									
	36543 *									
	36544 *									
	36545 *									
	36546 *									
	36547 *									
	36548 *									
	36549 *									
	36550 *									
	36552 BOL# 4391 *						29 AUG	12 SEPT	P	RL
	36553 *									
	36554 *									
	36555 *						ACCUMULATIVE NO. OF ROLLS = 45			
	36556 *						CUMULATIVE AREA = 53,175 ft²			
	36557 *									
	36558 *									
	36559 *		2 SEPT.	GCL-10		RL				
	36560 *		25,125 ft²							

* Removed from site 29 Nov. '97 BOL #6930 & unaccounted landstar LIGON, INC

000457

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT

NUMBER OF ROLLS ABOVE: 25 ACCUMULATIVE NUMBER OF ROLLS: 169

CUMULATIVE AREA: 391,909.9 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 11

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082812	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
2 SEPT	36562 BOL# 4391 *	RL								
	36563 *									
	36564 *									
	36565 *									
	36566 *									
	36567 BOL# 4400 *									
	36568 BOL# 4391 *									
	36569 *									
	36570 (25 ft long) *									
	* REMOVED FROM SITE 20 NOV. 97 BOL # 6930 & UNNUMBERED LANDSTAR LIGON, INC.									
							ACCUMULATIVE NO. OF ROLLS = 99			
							CUMULATIVE AREA =		78,662.5 ft²	
	18,600 1,937.5 20,537.5					76,725 1,937.5				
			20,537.5 ft²							

000458

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 9 ACCUMULATIVE NUMBER OF ROLLS: 178

CUMULATIVE AREA: 412,447.4 FT² NO. OF CONFORMANCE TESTS (page/total): 0 / 10

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX AIS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090102	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
3 SEPT	36910 BOL# 4408 ø	RL					3 SEPT	12 SEPT	P	RL
	36911 *									
	36912 *									
	36913 ø									
	36914 ø									
	36915 ø									
	36916 ø									
	36918 *									
	36919 ø									
	36920 ø									
	36927 *									
	36928 ø									
	36929 *									
	36930 *									
	36931 BOL# 4497 *		3 SEPT	GCL-11		RL	3 SEPT	12 SEPT	P	RL
	36932 ø									
	36933 ø									
	36934 *									
	36935 ø									
	36937 ø									
	36942 *									
	36943 *									
	36944 ø									
	36945 ø									
	36947 *		58,125 ft²							

ø REMOVED FROM SITE 05 DEC '97 BOL #1059

* REMOVED FROM SITE 10 DEC 97 BOL # 2849

000459

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 25 ACCUMULATIVE NUMBER OF ROLLS: 203

CUMULATIVE AREA: 470,572.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 11

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090102	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
3 SEPT	36948 *	RL								
	36949 *						3 SEPT	12 SEPT	P	RL
	36950 *									
	36951 ø									
	36952 *									
	36953 ø			13,950 ft²						
4 SEPT	36903 BOL# 4421 *	RL					3 SEPT	12 SEPT	P	RL
	36904 *									
	36905 *									
	36906 ø									
	36907 ø									
	36908 *									
	36909 *									
				16,275 ft²						
	ø REMOVED FROM SITE 05 DEC '97 BOL # 1059									
	* REMOVED FROM SITE 10 DEC '97 BOL # 2849									
	30,225 ft²	✓								

000460

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 13 ACCUMULATIVE NUMBER OF ROLLS: 216

CUMULATIVE AREA: 500,797.4 ft² NO. OF CONFORMANCE TESTS (page/total): 0 / 11

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97082802	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
3 SEPT	36429 BOL# 4390	RL					28 AUG	12 SEPT	P	RL
	36430									
	36431									
	36432									
	36433									
	36435									
	36441									
	36442		3 SEPT	GCL-12		RL				
	36443									
	36445									
	36446									
	36447									
	36448									
	36449									
	36450									
	36459									
	37,200 FT²	✓								

000461

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 16 ACCUMULATIVE NUMBER OF ROLLS: 232

CUMULATIVE AREA: 537,997.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 12

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090302	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
4 SEPT	37071 BOL# 4424	RL					3 SEPT	12 SEPT	P	RL
	37089									
	37090 BOL# 4428						3 SEPT	12 SEPT	P	RL
	37092									
	37093									
	37094									
	37095									
	37096									
	37097									
	37098		4 SEPT	GCL-13		RL				
	37099									
	37104									
	37105									
	37106									
	37107									
	37108									
	37109									
	37120 LENGTH 62.34									
	37133 LENGTH 49.21									
	37135									
5 SEPT	37070 BOL# 4427	RL					4 SEPT	12 SEPT	P	RL
	44,175 -966.27 -762.76 1729.03		44,175 -1729.03 42,904.03							

000462

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 150.0 FT

NUMBER OF ROLLS ABOVE: 21 ACCUMULATIVE NUMBER OF ROLLS: 253

CUMULATIVE AREA: 583,901.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 13

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090402	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
4 SEPT.	37171 BOL# 4424	RL	✓				3 SEPT	12 SEPT	P	RL
	37172									
	37173									
	37174		4 SEPT	GCL-14		RL				
	37175									
	37176									
	37177			16,275 ft²						
5 SEPT	37260 BOL# 4427	RL					4 SEPT	12 SEPT	P	RL
	37269			4,650 ft²						
10 SEPT	37273 BOL# 4467	RL					10 SEPT	12 SEPT	P	RL
	37274									
	37275									
	37276									
	37277									
	37280									
	37281									
	37283									
	37286			20,925 ft²						
	41,850 FT²	✓								

000463

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT

NUMBER OF ROLLS ABOVE: 18 ACCUMULATIVE NUMBER OF ROLLS: 271

CUMULATIVE AREA: 625751.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 14

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090202	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
4 SEPT	37052 * BOLCE 4424 ✓	RL					3 SEPT	12 SEPT	P	RL
5 SEPT	37057 * BOLCE 4427 ✓	RL					4 SEPT	12 SEPT	P	RL
	37058 * ✓									
	37060 * ✓									
	37061 * ✓		5 SEPT	GCL-15		RL				
	37062 * ✓									
	37066 * ✓									
	37067 * ✓									
	37068 * ✓									
	* REMOVED FROM SITE 19 NOV 97 LANDSTAR LIGON, INC									
	20,925 FT.	✓								

000464

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT

NUMBER OF ROLLS ABOVE: 9 ACCUMULATIVE NUMBER OF ROLLS: 280

CUMULATIVE AREA: 646,676.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 15

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97081302	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
4 SEPT	34941 BOL# 4427 *	RL	10 SEPT	GCL-20		BN/RL	4 SEPT	12 SEPT	P	R
	* REMOVED FROM SITE 19 NOV. '97 LANDSTAR HIGON, INC.									
	2325 FT²									

000465

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 1 ACCUMULATIVE NUMBER OF ROLLS: 281

CUMULATIVE AREA: 649,001.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 16

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97080802	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
5 SEPT	34412 GCL # 4427	RL					4 SEPT	12 SEPT	P	RL
↓	34438	↓								
			4650 ft²							
10 SEPT	34405 GCL # 446-	RL					10 SEPT	12 SEPT	P	RL
↓	34406	↓								
	34407		10 SEPT	GCL-21		BN/RL				
	34408									
	34409									
	34410									
			13,950 ft²							
	18,600 ft²									

000466

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 8 ACCUMULATIVE NUMBER OF ROLLS: 289

CUMULATIVE AREA: 667,601.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 17

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04, 1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090502	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
8 SEPT	37357 BOLE 4436	RL					5 SEPT	12 SEPT	P	RL
↓	37359	↓								
↓	37360 *	↓	8 SEPT	GCL-16		RL				
	* REMOVED FROM SITE 01 DEC '97 BOL# 6931									
	6975 FT²									

000467

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 3 ACCUMULATIVE NUMBER OF ROLLS: 292

CUMULATIVE AREA: 674,576.4 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 18

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090512	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
8 SEPT	37380 BOL# 4436	RL					5 SEPT	12 SEPT	P	RL
	37381									
	37382									
	37383									
	37384									
	37385									
	37386		8/SEPT	GCL-17		RL				
	37387									
	37388									
	37389									
	37390 LENGTH 60.75 ft.									
	37391									
	37392									
	37393									
	30,225.00 + 940.85 = 31,165.85 ft²	✓		31,165.9						

000468

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT.

NUMBER OF ROLLS ABOVE: 14 ACCUMULATIVE NUMBER OF ROLLS: 306

CUMULATIVE AREA: 705,742.3 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 19

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.i

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 970906M	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
9 SEPT	37601 BOLE 4450	RL					8 SEPT	12 SEPT	P	RL
↓	37603 (LENGTH 177.95 FT)	↓								
	37604		9/SEPT	GCC-18		RL				
	37605									
	6975									
	1943									
	7558									

000469

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 156.0 FT.

NUMBER OF ROLLS ABOVE: 4 ACCUMULATIVE NUMBER OF ROLLS: 310

CUMULATIVE AREA: 714,700.5 ft² NO. OF CONFORMANCE TESTS (page/total): 1 / 20

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97090702	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
9 SEPT	37612 BOL# 4450	RL					8 SEPT	12 SEPT	P	RL
	37618									
	37619									
	37621									
	37622									
	37623									
	37624		9 SEPT	GCL-19		RL				
	37625									
	37626 (Length 1119.36 FT)									
	37627									
	37628									
	37629									
	37630									
	27,900.00 2,237.58 30,137.58									

000470

AVG. ROLL WIDTH: 15.5 FT. AVG. ROLL LENGTH: 150.0 FT

NUMBER OF ROLLS ABOVE: 13 ACCUMULATIVE NUMBER OF ROLLS: 323

CUMULATIVE AREA: 744,838.1 FT^2 NO. OF CONFORMANCE TESTS (page/total): 1 / 21

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04

DESCRIPTION: OSDF PHASE ONE YEAR: 1997

PRODUCT TYPE: BENTOFIX-NS (GCL) MANUFACTURER: BENTOFIX TECHNOLOGIES

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. 97101002	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
13/11	40652 ROLL 4757	BE					13/11	13/11	P	NM
	40659									
	40666									
	40674									
	40696									
	40701									
	40722									
	40723									
	40727									
	40728									
	40730									
	40731									
	40732									
	40733									
	40734									
	40735									
	(37200 SF)									

40698 * THIS ROLL WAS SAMPLED, FOR CONFORMANCE TESTING, BY DAVE PHILLIPS AT POINT OF MANUFACTURE. ROLL NOT SHIPPED TO SITE.

000471

AVG. ROLL WIDTH: 15.5 ft AVG. ROLL LENGTH: 150 ft

NUMBER OF ROLLS ABOVE: 16 ACCUMULATIVE NUMBER OF ROLLS: 339

CUMULATIVE AREA: 782038.1 ft² NO. OF CONFORMANCE TESTS (page/total): *1 / 22

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE ONE CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
19 NOV.	97101002-40665	N.M.					18 NOV	10 OCT	P	N.M.
	40667		9 OCT.	GCL-22		D.P.				
	40669									
	40670									
	40693									
	40700									
	40702									
	40703									
	40704									
	40706									
	40726									
	40729									
	40736									
	40737									
	40738									
	40739									
	39200									

000472

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 150 FT.

NUMBER OF ROLLS ABOVE: 16 ACCUMULATIVE NUMBER OF ROLLS: 355

CUMULATIVE AREA: 819238.1 ft² NO. OF CONFORMANCE TESTS (page/total): 1 /23

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
20 Nov.	97101002/40651	NM	11/21/97 HGM ~~9 OCT~~				20 Nov	20 Nov	P	NM
	40660									
	40662									
	40664									
	40668									
	40671									
	40672									
	40675									
	40676									
	40678									
	40679									
	40707									
	40708									
	40711									
	40712									
	40724									
	40725	39 525								
20 Nov.	97102302/41651	NM	24 OCT	GCL-24	P	DP	20 Nov.	20 Nov.	P	NM
	41667									
	41676		24 OCT	GCL-25	P	DP				
	41683									
	41686									
	41687									
	41689	16 275	55800.0							

000473

AVG. ROLL WIDTH: 15.5' AVG. ROLL LENGTH: 150'

NUMBER OF ROLLS ABOVE: 24 ACCUMULATIVE NUMBER OF ROLLS: 379

CUMULATIVE AREA: 875038.1 ft² NO. OF CONFORMANCE TESTS (page/total): 2 /25

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04.1

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX NS GCL MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO.	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
20 Nov.	97102302 / 41691	NM								
	41693									
	41694									
	111.55 x 15.5 41695									
	41696									
	41697									
	111.55 x 15.5 41698									
	41699									
	41700									
	41701									
	34,558.'									
	22058.1									

000474

AVG. ROLL WIDTH: 15.5' AVG. ROLL LENGTH: 150'

NUMBER OF ROLLS ABOVE: 10 ACCUMULATIVE NUMBER OF ROLLS: 389

CUMULATIVE AREA: 897,096.2 NO. OF CONFORMANCE TESTS (page/total): 0 /25

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: GCL BENTOFIX NS MANUFACTURER: BENTOFIX

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	LOT BATCH / ROLL NO. BOL # 4778	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
21 NOV	97102302 / 104.99 ft 41664	AM								
	/ 41662						22 NOV	23 NOV	P	NM
	/ 41669									
	/ 41670									
	/ 41671									
	/ 41673									
	/ 41674									
	/ 41675									
	/ 41677									
	/ 41678									
	/ 41679									
	/ 41680									
	/ 41682									
	/ 41684									
	/ 41688									
	/ 118.11 ft. 41690									
▼	▼ / 41692	▼								

000475

AVG. ROLL WIDTH: 15.5 AVG. ROLL LENGTH: 150

NUMBER OF ROLLS ABOVE: 17 ACCUMULATIVE NUMBER OF ROLLS: 406

CUMULATIVE AREA: 935429.2 NO. OF CONFORMANCE TESTS (page/total): 0 /25

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: GCL BENTOFIX NS MANUFACTURER: BENTOFIX

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. BOL # 4779	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
21 NOV	97102302/41626	BN					22 Nov.	23 Nov.	P	NM
	41627									
	116.47 FE 41628									
	41632									
	41633									
	41640									
	41643									
	41646									
	141.08 FE 41647 ⊛									
	41648 ⊛									
	41649									
	41661									
	41663									
	41665									
	41666									
	41668									
	41631									
	38,867.0									

⊛ ROLL LABEL AND BARCODE LABELING INCONSISTENT

ONE: 41647 41648

OTHER: 41648 41647

ASKED R. SCHAIRBAUM (PETRO) TO RESOLVE WITH MANUFACTURER

000476

AVG. ROLL WIDTH: 15.5' AVG. ROLL LENGTH: 150.0'

NUMBER OF ROLLS ABOVE: 17 ACCUMULATIVE NUMBER OF ROLLS: 423

CUMULATIVE AREA: 974,296.2 NO. OF CONFORMANCE TESTS (page/total): 0 /25

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE 1 CONSTRUCTION YEAR: 1997

PRODUCT TYPE: BENTOFIX-NS (GCL) MANUFACTURER: BENTOFIX TECHNOLOGIES, INC.

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. BOL 4786	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
1/12	97101002/040657	SQ					28 Nov.	28 Nov.	P	NM
	/040661	SQ								
	/040663	SQ								
	/040677	SQ								
	/040682	SQ								
	/040683	SQ								
	/040684	SQ								
	/040689	SQ								
	/040697	SQ	24 OCT	GCL-28*	P	DP				
	/040699	SQ	24 Oct	GCL-29*	P	DP				
	/040710	SQ								
	/040713	SQ								
	/040714	SQ								
	/040718 144.36 ft.	SQ								
	/040719	SQ								
	/040720	SQ								
	/040721	SQ								
	27600 2037.6 39437.6									
*	GCL-28 & GCL-29	ARE	ISOLATION (I.E., ROLL	SAMPLES NO. 40698	FOR IS	FAILED REJECTED)	SAMPLE	GCL-23 (ROLL	NO. NOT ON SITE	40698)

000477

AVG. ROLL WIDTH: 15.5' AVG. ROLL LENGTH: 150.0'

NUMBER OF ROLLS ABOVE: 17 ACCUMULATIVE NUMBER OF ROLLS: 440

CUMULATIVE AREA: 1,013,733.8 NO. OF CONFORMANCE TESTS (page/total): 2 / 27

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: G00166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION YEAR: 1997

PRODUCT TYPE: GCL - BENTOFIX N.S. MANUFACTURER: BENTOFIX

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	~~BATCH~~ LOT / ROLL NO. 97102302 BL#HTRS	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
5 DEC	41621	RP					03 DEC	03 DEC	P	NM
	41622									
	41623									
	41624									
	41625									
	L=124.7' 41630									
	41650									
	41653									
	41658									
	41659									
	22,857.9									
	97102402									
5 DEC	L=131.2' 41705	RP					03 DEC	03 DEC	P	NM
	41708									
	41712									
	41717									
	41718									
	41719									
	L=131.2' 41725									
	L=108.3' 41726									
	17,370.9									
	AREA= 40,228.8 FT²									

THESE ROLLS, FROM LOT NO. 97102402 (FURNISHED BY FDF), WERE NOT USED FOR CELL 1 CONSTRUCTION. STORED ON SITE FOR CELL 2 FUTURE CONSTRUCTION

HEM 12/9/97

000478

AVG. ROLL WIDTH: 15.5 FT AVG. ROLL LENGTH: 144.2

NUMBER OF ROLLS ABOVE: 18 ACCUMULATIVE NUMBER OF ROLLS: 458

CUMULATIVE AREA: 1,053,962.6 ft² NO. OF CONFORMANCE TESTS (page/total): 0 / 27

GEOSYNTEC CONSULTANTS

FLUOR DANIEL FERNALD

MATERIAL INVENTORY

PROJECT: ON-SITE DISPOSAL FACILITY (OSDF)

LOCATION: FERNALD, OHIO PROJECT NO: GQ0166 TASK NO.: 04

DESCRIPTION: PHASE I CONSTRUCTION CELL 1 YEAR: 1997

PRODUCT TYPE: 80-MIL HDPE TEXTURED GEOMEMBRANE MANUFACTURER: NATIONAL SEAL COMPANY

INVENTORY			Q.A. CONFORMANCE				Q.C. DOCUMENTS			
DATE (day/mo)	BATCH / ROLL NO. BOL#4797	QA ID	DATE SAMPLED (day/mo)	SAMPLE NO.	PASS/ FAIL	QA ID	DATE RECEIVED (day/mo)	DATE CHECKED (day/mo)	PASS/ FAIL	QA ID
5 DEC	97102402/	BE								
	41703 *						04 DEC	04 DEC	P	NM
	41704									
	41706									
	41707									
	41709									
	41711 *									
	41713 *									
	41714									
	41715									
	41721									
	41724									
	41727									
	41730									
	41731									
	41734									
	41743									
	41744 *									
	39525									

* THESE ROLLS, FROM LOT NO. 97102402 (FURNISHED BY FDF), WERE USED FOR CELL 1 CONSTRUCTION, ALL OTHERS WERE STORED ON SITE FOR CELL 2 CONSTRUCTION

HEM 12/9/97

CONFORMANCE SAMPLE NOS. GCL-26 & GCL-27 WERE OBTAINED AT BENTOFIX FACTORY BY D. PHILLIPS ON 24 OCTOBER 1997 FROM LOT NO. 97102402; ROLL NOS. 41729 & 41753 (HAVE NOT ARRIVED ON SITE AS OF 05 DECEMBER 1997).

000479

AVG. ROLL WIDTH: 15.5 LF AVG. ROLL LENGTH: 150.0 LF

NUMBER OF ROLLS ABOVE: 17 ACCUMULATIVE NUMBER OF ROLLS: 475

CUMULATIVE AREA: 1093,487.6 ft² NO. OF CONFORMANCE TESTS (page/total): 0 /27

- **Hydraulic Conductivity Test Results**

10 December 1997

Mr. Kenneth W. Cargill, P.E.
GeoSyntec Consultants
1100 Lake Hearn Drive, N.E., Suite 200
Atlanta, Georgia 30342

Subject: **DRAFT** Final Report - Geosynthetic Clay Liner Test Results
FDF-OSDF-Phase I Construction

Dear Mr. Cargill,

GeoSyntec Consultants (GeoSyntec) Geomechanics and Environmental Laboratory in Alpharetta, Georgia, is pleased to present the attached final test results (Table 1) for the above referenced project. A blank shown on the table indicates that the test was not performed, the parameter is not applicable, or that the test resulted in insufficient data to report the designated parameter. Attachment A presents the general information pertinent to the testing program, and the policy of GeoSyntec regarding the limitations and the use of the test results.

The Geomechanics and Environmental Laboratory appreciates the opportunity to provide testing services for this project. Should you have any questions regarding the attached test results or if you require additional information, please do not hesitate to contact either of the undersigned.

Sincerely,

Barry E. Sigmon, P.G.
Assistant Program Manager
Geotechnical Testing

Nader S. Rad, Ph.D., P.E.
Laboratory Director

Copy To: David Phillips
Attachments

GQ0166/F974G007.CD A

TAB

GEOSYNTHETIC CLAY LINER TEST RESULTS

FLUOR DANIEL FERNALD
FDF-OSDF-PHASE I CONSTRUCTION

Site Sample ID			Lab Sample No.	Microwave Moisture Content ASTM D 4643 (%)	Moisture Content ASTM D 2216 (%)	Free Swell USP-NF-XVII			Average Mass Per Unit Area ASTM D 3776		Hydraulic Conductivity [X]GRI GCL-2 [ ]ASTM D 5084 [ ]ASTM D 5887	
Sample No.	Roll No.	Lot No.				Weight of Bentonite (g)	Approx. Elapsed Time (hr)	Swell Volume (ml)	Moist (lbs/ft²)	Dry (lbs/ft²)	Hydraulic[1] Conductivity (cm/s)	Index Flux q [(m₁/m₂)/s]
GCL-01	35046	97081402	97I1317								1.4E-9	
GCL-02	35160	97081502	97I1321								2.3E-9	
GCL-03	29968	97062902	97I1322								1.8E-9	
GCL-04	35757	97082012	97I67								2.0E-9	
GCL-05	35810	97082102	97I35								1.7E-9	
GCL-06	36114	97082502	97I135								8.2E-10	
GCL-07	36074	97082302	97I136								1.2E-9	
GCL-08	36312	97082602	97I137								1.4E-9	
GCL-09	36344	97082702	97I83								1.2E-9	
GCL-10	36559	97082812	97I95								1.6E-9	
GCL-11	36931	97090102	97I96								2.0E-9	
GCL-12	36442	97082802	97I97								1.9E-9	
GCL-13	37098	97090302	97I98								2.6E-9	
GCL-14	37174	97090402	97I99.A								1.8E-9	
GCL-15	37061	97090202	97I33								2.1E-9	

Note:

1. The test specimens were consolidated at a consolidation pressure of 5 psi.

1268

000482

GQ0166/F974G007.CD A

GeoSyntec Consultants
Geomechanics and Environmental Laboratory

TABLE 1 (Continued)

GEOSYNTHETIC CLAY LINER TEST RESULTS

FLUOR DANIEL FERNALD
FDF-OSDF-PHASE I CONSTRUCTION

Site Sample ID			Lab Sample No.	Microwave Moisture Content ASTM D 4643 (%)	Moisture Content ASTM D 2216 (%)	Free Swell USP-NF-XVII			Average Mass Per Unit Area ASTM D 3776		Hydraulic Conductivity [X]GRI GCL-2 [ ]ASTM D 5084 [ ]ASTM D 5887	
Sample No.	Roll No.	Lot No.				Weight of Bentonite (g)	Approx. Elapsed Time (hr)	Swell Volume (ml)	Moist (lbs/ft²)	Dry (lbs/ft²)	Hydraulic[1] Conductivity (cm/s)	Index Flux q, [(m₁/m₂)/s]
GCL-16	37360	97090502	97J37								2.3E-9	
GCL-17	37386	97090512	97I138								1.3E-9	
GCL-18	37604	97090612	97J36								4.4E-9	
GCL-19	37624	97090702	97I139								1.7E-9	
GCL-20	34941	97081302	97J38								2.2E-9	
GCL-21	34407	97080802	97J34								2.0E-9	
GCL-22	40667	97101002	97J98								2.3E-9	
GCL-23	40698	97101002	97J99								2.1E-8	
			97J99.A								1.7E-8	
GCL-24	41651	97102302	97K06								1.6E-9	
GCL-25	41676	97102302	97K07								1.3E-9	
GCL-26	41729	97102402	97K08								1.6E-9	
GCL-27	41753	97102402	97K09								1.5E-9	
GCL-28	40697	97101002	97J258								9.3E-10	
GCL-29	40699	97101002	97J259								1.0E-9	

Note:

1. The test specimens were consolidated at a consolidation pressure of 5 psi.

ATTACHMENT A

Sample Identification, Handling, Storage and Disposal

Laboratory Test Standards

Application of Test Results

SAMPLE IDENTIFICATION, HANDLING, STORAGE AND DISPOSAL

Test materials were sent to GeoSyntec Consultants (GeoSyntec) Geomechanics and Environmental Laboratory in Atlanta, Georgia by the client or its representative(s). Samples delivered to the laboratory were identified by client sample identification (ID) numbers which had been assigned by representative(s) of the client. Upon being received at the laboratory, each sample was assigned a laboratory sample number to facilitate tracking and documentation.

Based on the information provided to GeoSyntec by the client or its representative(s) and, when applicable, procedural guidelines recommended by an industrial hygiene consultant, the following Occupational Safety and Health Administration (OSHA) level of personal protection was adopted for handling and testing of the test materials:

[X] test materials were not contaminated, no special protection measures were taken;
[ ] level D
[ ] level C
[ ] level B

In accordance with the health and safety guidelines of GeoSyntec, contaminated materials are stored in a designated containment area in the laboratory. Non-contaminated materials are stored in a general storage area in the laboratory.

GeoSyntec Geomechanics and Environmental Laboratory will return contaminated materials to the client or designated representative(s), at the clients' cost, 30 days following the completion of the testing program, unless special arrangements for proper disposal have been made with the laboratory. Materials which are not contaminated will be discarded 90 days after they were received at the laboratory, unless long-term storage arrangements are specifically made with GeoSyntec Geomechanics and Environmental Laboratory.

LABORATORY TEST STANDARDS

At the request of the client, the laboratory testing program was performed utilizing the guidelines provided in the following test standards:

[X] **moisture content** - American Society for Testing and Materials (ASTM) D 2216 "*Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures*";

[ ] **moisture content** - ASTM D 4643 "*Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Method*";

[ ] **particle-size analysis** - ASTM C 136, "*Standard Method for Sieve Analysis of Fine and Coarse Aggregates*";

[ ] **particle-size analysis** - ASTM D 422, "*Standard Method for Particle-Size Analysis of Soils*";

[ ] **percent passing No. 200 sieve** - ASTM D 1140, "*Standard Test Method for Amount of Material in Soil Finer Than No. 200 (75 microns) sieve*";

[ ] **Atterberg limits** - ASTM D 4318, "*Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*";

[ ] **soil classification** - ASTM D 2487, "*Standard Test Method for Classification of Soils for Engineering Purposes*";

[ ] **soil pH** - ASTM D 4972, "*Standard Test Method for pH of Soils*";

[ ] **soil pH** - United States Environmental Protection Agency (USEPA) SW-846 Method 9045, Revision 1, 1987, Standard Test Method for Measurement of "*Soil pH*";

[ ] **specific gravity** - ASTM D 854, "*Standard Test Method for Specific Gravity of Soils*";

[ ] **carbonate content** - ASTM D 3042, "*Standard Test Method for Insoluble Residue in Carbonate Aggregates*";

[ ] **carbonate content** - ASTM D 4373, *"Standard Test Method for Calcium Carbonate Content of Soils"*;

[ ] **acid reactivity** - ASTM D 2488, *"Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)"*;

[ ] **soundness** - ASTM C 88, *"Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate"*;

[ ] **loss-on-ignition (LOI)** - ASTM D 2974, *"Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils"*;

[ ] **standard Proctor compaction** - ASTM D 698, *"Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop"*;

[ ] **modified Proctor compaction** - ASTM D 1557, *"Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop"*;

[ ] **maximum relative density** - ASTM D 4253, *"Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table"*;

[ ] **minimum relative density** - ASTM D 4254, *"Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density"*;

[ ] **unit weight** - ASTM D 2937, *"Standard Test Method for Density of Soil In Place by the Drive-Cylinder Method"*;

[ ] **unit weight, void ratio, porosity, and degree of saturation** - U. S. Army Corp of Engineers (USCOE); EM-1110-2-1906, *"Unit Weight, Void Ratio, Porosity, and Degree of Saturation, Appendix II"*;

[ ] **mass per unit area** - ASTM D 3776, *"Standard Test Method for Mass Per Unit Area (weight) of Woven Fabric"*;

[ ] **thickness measurement** - ASTM D 1777, *"Standard Test Method for Measuring Thickness of Textile Materials"*;

[ ] **free swell** - United States Pharmacopeia National Formulary (USP-NF) XVII, *"Swell Index of Clay"*;

[ ] **swell of clay in GCL's** - Geosynthetic Research Institute (GRI) GCL-1, *"Standard Test Method for Swell Measurement of the Clay Component of GCL's"*;

[ ] **fluid loss** - American Petroleum Institute (API) RP 13B, *"Section 4, Bentonite"*;

[ ] **marsh funnel** - API RP 13B, *"Section 4, Field Testing of Oil Mud Viscosity and Gel Strength"*;

[ ] **double hydrometer** - ASTM D 4221, *"Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer"*;

[ ] **pinhole dispersion** - ASTM D 4647, *"Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test"*;

[ ] **gradient ratio** - ASTM D 5101, *"Standard Test Method for Measuring the Soil-Geotextile System Clogging Potential by the Gradient Ratio"*;

[ ] **hydraulic conductivity ratio (HCR)** - ASTM D 5567, *"Standard Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems"*;

[ ] **hydraulic transmissivity** - ASTM D 4716, *"Standard Test Method for Constant Head Hydraulic Transmissivity (In-plane flow) of Geotextiles and Geotextile Related Products"*;

[ ] **one-dimensional consolidation** - ASTM D 2435, *"Standard Test Method for One-Dimensional Consolidation Properties of Soil"*;

[ ] **one-dimensional swell/collapse** - ASTM D 4546, *"Standard Test Method for One-Dimensional Swell or Settlement Potential of Cohesive Soils"*;

[ ] **unconfined compressive strength (UCS)** - ASTM D 2166, *" Standard Test Method for Unconfined Compressive Strength of Cohesive Soil"*;

[ ] **triaxial compressive strength ($\overline{ICU}$)** - ASTM D 4767, *"Standard Test Method for Triaxial Compression Test on Cohesive Soils"*;

[ ] **triaxial compressive strength (UU)** - ASTM D 2850, *"Standard Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression"*;

[ ] **rigid wall constant head hydraulic conductivity** - ASTM D 2434, *"Standard Test Method for Permeability of Granular Soils (Constant Head)"*;

[ ] **rigid wall constant head hydraulic conductivity** - USCOE; EM-1110-2-1906, *"Standard Test Method for Permeability Tests, Appendix VII"*;

[ ] **flexible wall falling head hydraulic conductivity** - ASTM D 5084, *"Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"*;

[ ] **flexible wall falling head hydraulic conductivity** - USCOE; EM-1110-2-1906, *"Standard Test Method for Permeability Tests, Appendix VII"*;

[ ] **index flux of GCL** - proposed ASTM method rough draft # 1, 6/18/94, *"Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter"*;

[X] **flexible wall falling head hydraulic conductivity** - GRI GCL-2, *"Standard Test Method for Permeability of Geosynthetic Clay Liners (GCLs)"*;

[ ] **permeability/compatibility** - USEPA Method 9100 SW-846, Revision 1, 1987, Standard Test Method for Measurement of *"Saturated Hydraulic Conductivity, Saturated Leachate Conductivity and Intrinsic Permeability"*;

[ ] **permeability** - API RP 27, *"Recommended Practice for Determining Permeability of Porous Media"*;

[ ] **capillary-moisture** - ASTM D 2325, *"Standard Test Method for Capillary-Moisture Relationships for Coarse- and Medium-Textured Soils by Porous-Plate Apparatus"*;

[ ] **capillary-moisture** - ASTM D 3152, *"Standard Test Method for Capillary-Moisture Relationships for Fine-Textured Soils by Pressure-Membrane Apparatus"*;

[ ] **paint filter liquids** - USEPA Method 9095, SW-846, Revision 1, 1987, *"Paint Filter Liquids Test"*; and

[ ] **bulk unit weight** - ASTM C 138, *"Standard Test Method for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete"*.

APPLICATION OF TEST RESULTS

The reported test results apply to the field materials inasmuch as the samples sent to the laboratory for testing are representative of these materials. This report applies only to the materials tested and does not necessarily indicate the quality or condition of apparently identical or similar materials. The testing was performed in accordance with the general engineering standards and conditions reported. The test results are related to the testing conditions used during the testing program. As a mutual protection to the client, the public, and GeoSyntec, this report is submitted and accepted for the exclusive use of the client and upon the condition that this report is not used, in whole or in part, in any advertising, promotional or publicity matter without prior written authorization from GeoSyntec.

- **Direct Shear Test Results**

SUMMARY OF LABORATORY RESULTS FROM DIRECT SHEAR TESTING ON THE OSDF GCL SAMPLES.

INTRODUCTION

This document contains the laboratory results for the direct shear tests on GCL samples conducted by GeoSyntec Consultants at its Soil-Geosynthetic Interaction Testing Laboratory (SGI). Two types of tests were performed on each sample: internal direct shear on the GCL and interface direct shear on the GCL-Geomembrane interface. Tests were conducted following the procedures and methods stated on the specifications.

SCOPE OF TESTING

Internal and interface direct shear testing was required to evaluate whether a GCL lot to be used at the OSDF was in compliance with the specifications. A total of 24 GCL samples representing a number of GCL lots were tested to find their internal and interface shear strengths.

TEST PROCEDURES

The laboratory test procedures followed are described in Attachment 1. Also included in Attachment 1 are the initial moisture content and the final range of moisture content of the samples tested.

TEST RESULTS

The internal and interface shear strength results are included in Attachment 2 and summarized in the tables below. All GCL samples were tested for normal stresses of 20 and 45 psi, with most of them being tested also for a normal stress of 5 psi.

INTERNAL SHEAR STRENGTH

Test Series No.	QA Sample No.	Lot No.	Measured Peak Shear Strength for Conformance Shear Tests (psi)			Measured Large-Displacement Shear Strength for Conformance Shear Tests (psi)		
			5psi	20psi	45psi	5psi	20psi	45psi
01I	GCL-01	97081402	4.4	9.1	12.4	1.3	2.4	6.4
02I	GCL-02	97081502	3.8	5.9	12.9	1.1	3.0	6.1
03I	GCL-03	97062902	6.3	9.1	13.7	1.3	2.8	4.8
04I	GCL-04	97082002	5.9	11.1	18.9	2.7	3.4	4.1
05I	GCL-05	97082102		11.8	15.3		5.2	6.1
06I	GCL-06	97082502	3.8	7.7	9.8	1.3	3.4	4.2
07I	GCL-07	97082302		9.7	11.6		3.2	5.6
08I	GCL-08	97082602		10.3	17.2		3.0	7.6
09I	GCL-09	97082702	6.5	10.1	13.7	2.6	2.9	5.2
10I	GCL-10	97082812	3.3	7.8	9.8/13.3	2.1	2.7	3.5/6.8
11I	GCL-11	97090102	4.6	7.0	13.4	1.7	3.4	5.4
12I	GCL-12	97082802		7.9	16.6		2.6	5.4
13I	GCL-13	97090302	6.1	10.8	17.2	3.3	3.0	5.4
14I	GCL-14	97090402	6.0	12.9	15.3	3.9	3.8	6.0
15I	GCL-15	97090202						
16I	GCL-16	97090502						
17I	GCL-17	97090512		9.1	14.6		3.1	6.7
18I	GCL-18	97090612		11.2	14.3		2.5	5.5
19I	GCL-19	97090702		9.9	12.0		3.2	5.7
20I	GCL-20	97081302						
21I	GCL-21	97080802		9.4	17.4		2.6	5.3
22I	GCL-22	97101002	4.6	13.5	20.8	4.0	2.9	5.9
23I	GCL-23	97101002	5.2	9.7	19.7	2.5	5.4	7.1
24I	GCL-24	97102302	5.3	8.0	17.2	5.3	3.5	6.1
25I	GCL-25	97102302	4.2	9.1	17.6	3.9	5.6	7.4
26I	GCL-26	97102402	4.7	9.5	17.9	4.3	4.0	5.6
27I	GCL-27	97102402	4.8	8.3	17.4	4.7	4.2	7.6

INTERFACE SHEAR STRENGTH

Test Series No.	QA Sample No.	Lot No.	Measured Peak Shear Strength for Conformance Shear Tests (psi)			Measured Large-Displacement Shear Strength for Conformance Shear Tests (psi)		
			5psi	20psi	45psi	5psi	20psi	45psi
01G	GCL-01	97081402	2.6	6.7	12.7	2.0	4.2	8.6
02G	GCL-02	97081502		5.7	11.1		4.0	6.3
03G	GCL-03	97062902		10.6	15.8		4.4	6.6
04G	GCL-04	97082002	2.3	7.7	15.0	1.7	5.1	10.0
05G	GCL-05	97082102		6.4	14.2		3.9	8.0
06G	GCL-06	97082502		7.0	14.9		3.3	6.4
07G	GCL-07	97082302		8.3	12.6		5.6	6.2
08G	GCL-08	97082602		6.3	10.5		3.1	5.6
09G	GCL-09	97082702	3.0	9.7	14.9	1.7	6.1	6.4
10G	GCL-10	97082812	2.3	7.4	9.6/8.9	1.8	5.1	8.0/7.2
11G	GCL-11	97090102	2.1	7.0	10.5/9.9	1.5	5.7	8.9/7.9
12G	GCL-12	97082802		7.1	12.9		4.5	5.7
13G	GCL-13	97090302	2.4	9.7	13.2	1.6	2.6	6.2
14G	GCL-14	97090402	2.7	9.5	11.0	1.7	4.9	6.8
15G	GCL-15	97090202						
16G	GCL-16	97090502						
17G	GCL-17	97090512		6.7	14.8		4.0	7.9
18G	GCL-18	97090612	2.0	7.2	11.1	1.6	4.6	5.6
19G	GCL-19	97090702		7.0	15.5		4.1	7.7
20G	GCL-20	97081302						
21G	GCL-21	97080802		8.9	14.5		4.0	6.5
22G	GCL-22	97101002	2.6	9.8	16.4	2.2	6.1	11.0
23G	GCL-23	97101002	2.5	8.4	18.7	1.7	4.5	8.3
24G	GCL-24	97102302	2.5	8.4	16.8	2.0	6.2	6.3
25G	GCL-25	97102302	2.6	8.7	16.0	1.8	5.6	6.0
26G	GCL-26	97102402	2.5	8.6	17.7	2.0	5.5	6.2
27G	GCL-27	97102402	2.7	8.4	17.4	1.6	5.0	6.1

ATTACHMENT 1

INTERNAL

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Change for general Procedure

TEST PROCEDURES AND CONDITIONS
~~TEST SERIES NUMBER~~: 11

Test Specimen Configuration (from top to bottom) and Placement Conditions:

- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-01). ~~GCL's initial moisture content was 9.4%. GCL's final moisture content ranged from 86% to 133% for the test series; and~~
- lower shear box: rigid substrate with textured steel gripping surface.

Designated Shear Plane: Within GCL

Test Procedures for Each Normal Stress Condition:

- A fresh GCL specimen was trimmed from the bulk sample of the GCL and placed between two rigid wooden substrates with textured steel gripping surfaces. The ends of each geotextile were then sandwiched between a second rigid wooden substrate prior to testing. The entire test specimen was then placed in the shear box to provide confinement for the exposed bentonite component. The textured steel gripping surfaces were employed to minimize slippage between each geotextile component of the GCL and rigid wood substrate, therefore providing a relatively uniform transfer of shear load onto the GCL specimen.
- Soaking conditions: The GCL specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the GCL specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the Bentofix NS GCL sample.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

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change for general Procedure

INTERFACE

TEST PROCEDURES AND CONDITIONS

~~TEST SERIES NUMBER: 1G~~

Test Specimen Configuration (from top to bottom) and Placement Conditions:

- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-01) with woven geotextile against geomembrane. ~~GCL's initial moisture content was 9.0%. GCL's final moisture content ranged from 74 to 85% for the test series.~~
- 80-mil NSC textured HDPE geomembrane (GM-7); and
- lower shear box: bedding layer of compacted concrete sand.

Test Interface: GCL against geomembrane

Test Procedures for Each Normal Stress Condition:

- A fresh specimen of concrete sand was compacted into the lower shear box by hand tamping to a relatively dense state under dry conditions forming a 3 in. thick bedding layer.
- A fresh specimen of geomembrane was trimmed from the bulk sample and attached to the lower shear box with mechanical compression clamps.
- A fresh specimen of GCL was trimmed from the bulk sample and attached to the upper shear box with mechanical compression clamps. The GCL was oriented so that the woven geotextile component of the GCL was in contact with the geomembrane.
- A rigid substrate with a textured steel gripping surface was placed on top of the GCL. The textured steel gripping surface was used to minimize slippage between the upper geotextile component of the GCL and rigid wooden substrate, therefore providing a relatively uniform transfer of shear load onto the test interface.
- Soaking conditions: The entire test specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the entire test specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the geosynthetic samples.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

MOISTURE CONTENT FOR SAMPLES TESTED FOR INTERNAL SHEAR STRENGTH

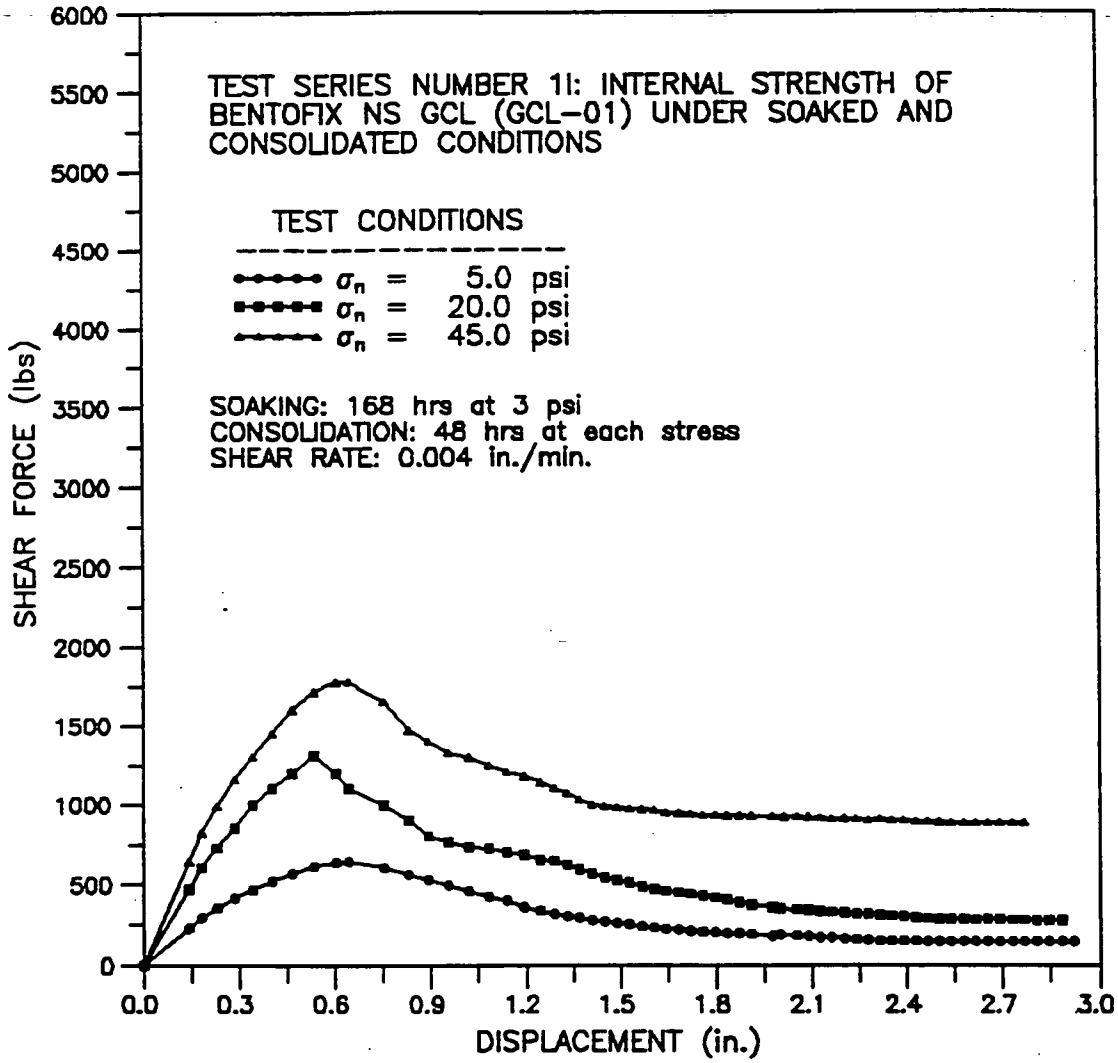
Test Series No.	Normal Stress Range (psi)	Moisture Content (%)	
		Initial	Final Range
01I	5 to 45	9.4	86 to 133
02I	5 to 45	9.4	63 to 79
03I	5 to 45	8.6	64 to 101
04I	5 to 45	9.3	75 to 87
05I	20 to 45	9.7	77 to 80
06I	5 to 45	9.4	87 to 108
07I	20 to 45	9.0	60 to 90
08I	20 to 45	9.2	50 to 76
09I	5 to 45	8.7	57 to 105
10I	5 to 45	8.0	51 to 95
11I	5 to 45	9.4	48 to 76
12I	20 to 45	8.7	70 to 78
13I	5 to 45	8.3	65 to 90
14I	5 to 45	9.7	62 to 84
15I			
16I			
17I	20 to 45	10.4	57 to 65
18I	20 to 45	9.4	67 to 78
19I	20 to 45	9.2	57 to 59
20I			
21I	20 to 45	9.4	67 to 80
22I	5 to 45	10.0	55 to 75
23I	5 to 45	9.4	56 to 88
24I	5 to 45	8.3	56 to 90
25I	5 to 45	9.0	62 to 76
26I	5 to 45	10.0	49 to 70
27I	5 to 45	10.0	55 to 71

MOISTURE CONTENT FOR SAMPLES TESTED FOR INTERFACE SHEAR STRENGTH

Test Series No.	Normal Stress Range (psi)	Moisture Content (%)	
		Initial	Final Range
01G	5 to 45	9.0	74 to 85
02G	20 to 45	9.6	70 to 119
03G	20 to 45	9.0	75 to 77
04G	5 to 45	9.0	70 to 112
05G	20 to 45	9.9	65 to 69
06G	20 to 45	9.6	60 to 91
07G	20 to 45	8.5	52 to 75
08G	20 to 45	8.8	63 to 93
09G	5 to 45	8.9	62 to 107
10G	5 to 45	8.2	60 to 101
11G	5 to 45	9.0	73 to 110
12G	20 to 45	9.0	54 to 95
13G	5 to 45	8.6	79 to 97
14G	5 to 45	8.5	64 to 107
15G			
16G			
17G	20 to 45	10.2	53 to 74
18G	5 to 45	9.3	87 to 108
19G	20 to 45	9.2	54 to 76
20G			
21G	20 to 45	9.1	78 to 110
22G	5 to 45	9.1	54 to 82
23G	5 to 45	9.4	57 to 84
24G	5 to 45	8.4	61 to 100
25G	5 to 45	9.4	55 to 84
26G	5 to 45	9.1	49 to 91
27G	5 to 45	8.1	53 to 80

ATTACHMENT 2

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

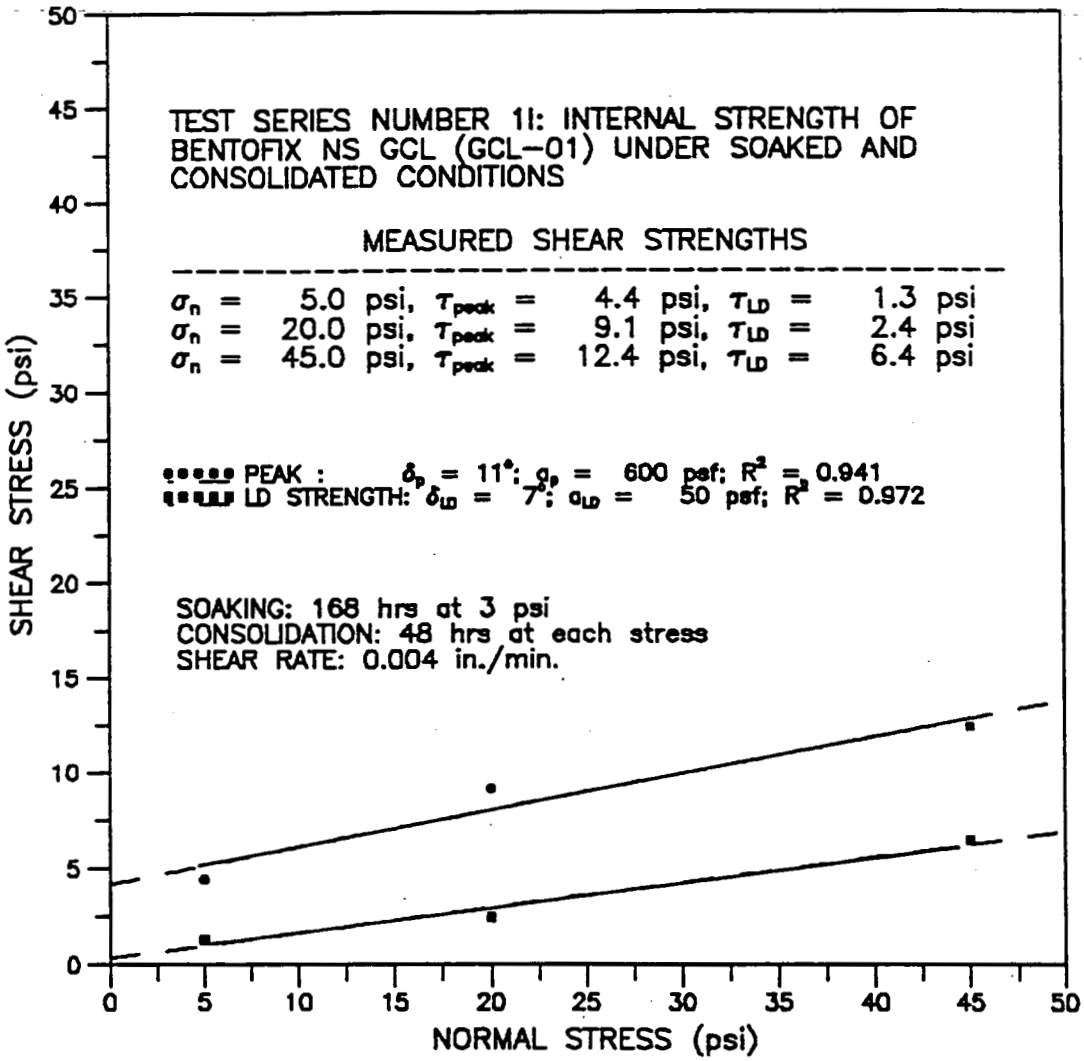
DATE TESTED: 24 AUGUST TO 2 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



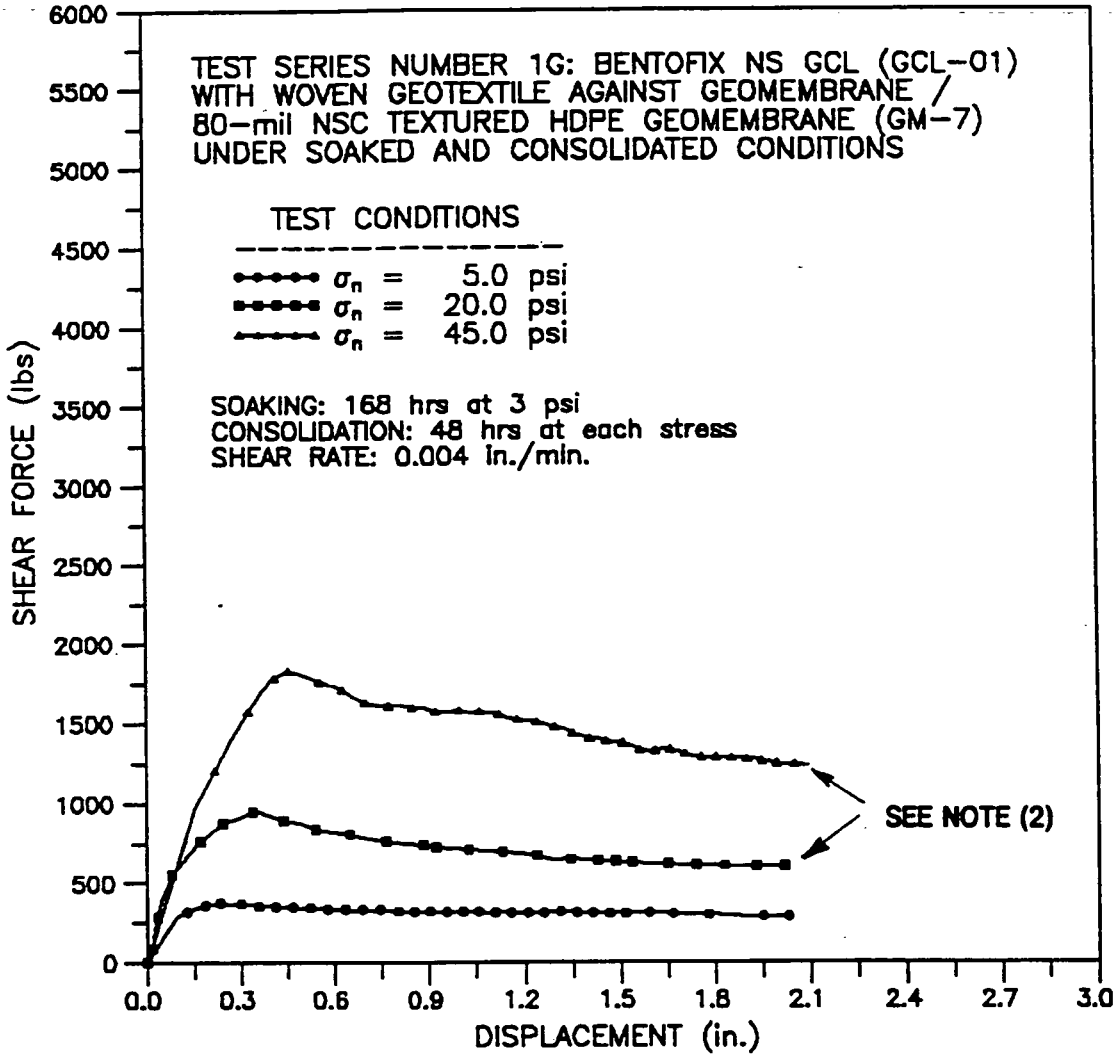
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 24 AUGUST TO 2 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

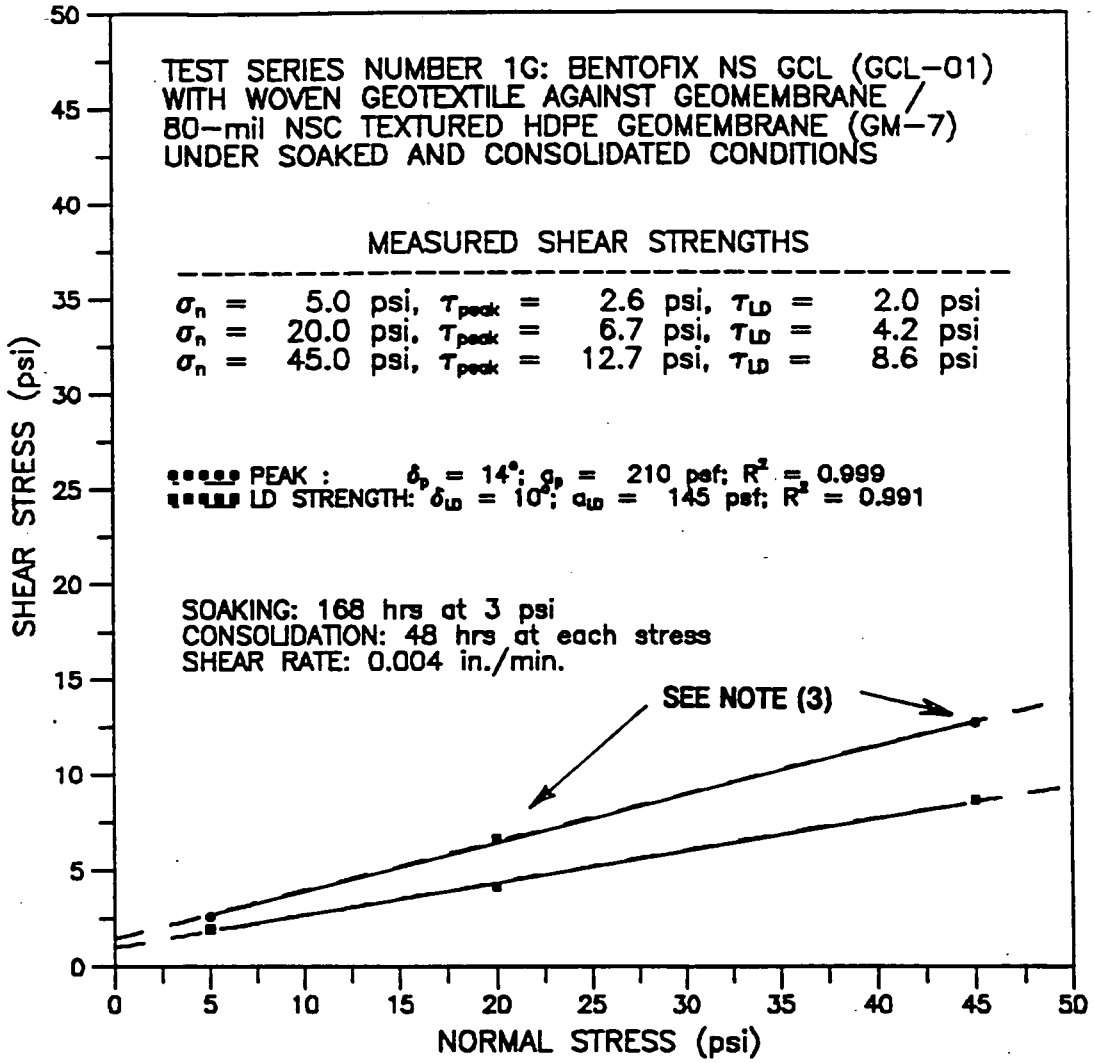
DATE TESTED: 5 TO 14 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



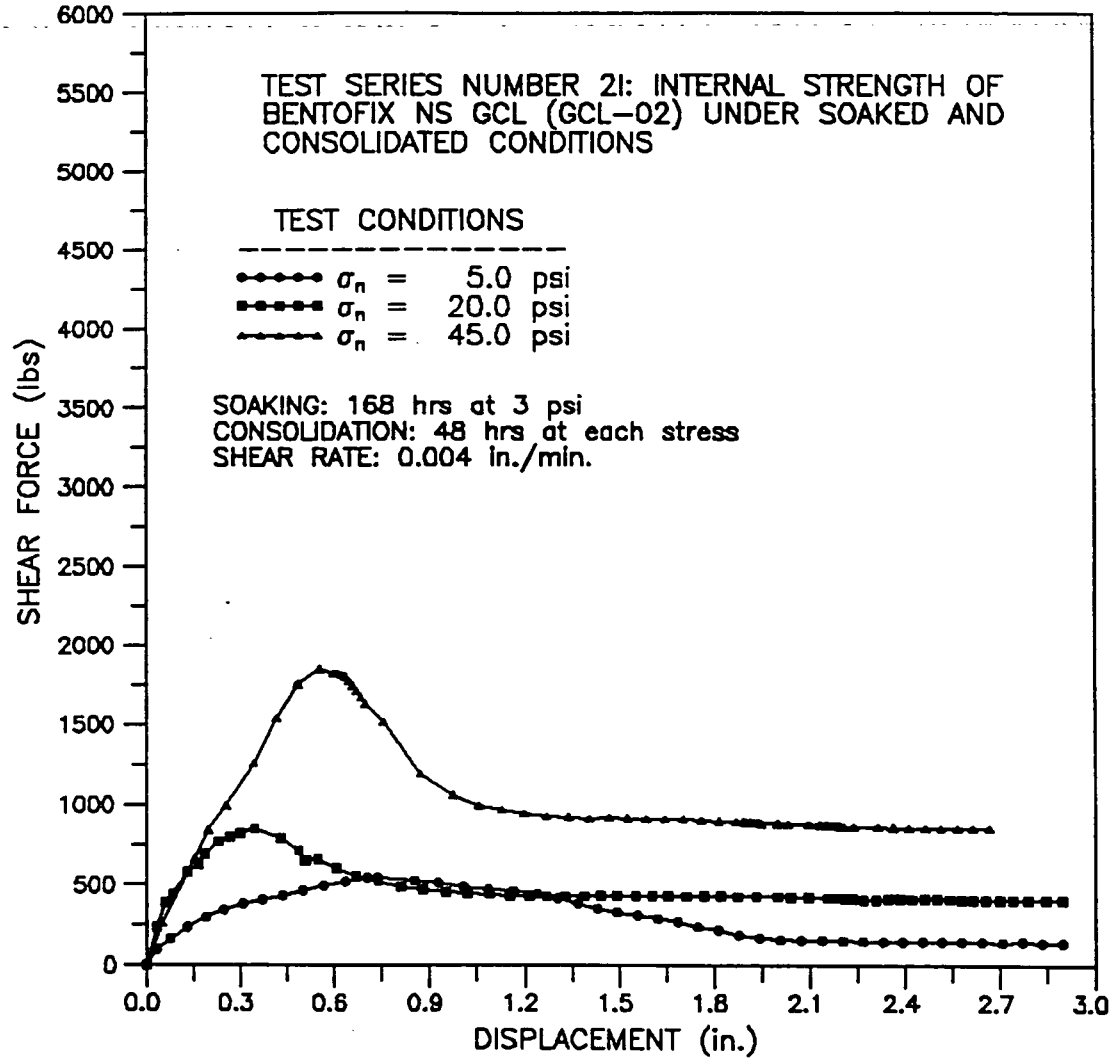
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 5 TO 14 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	000501

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

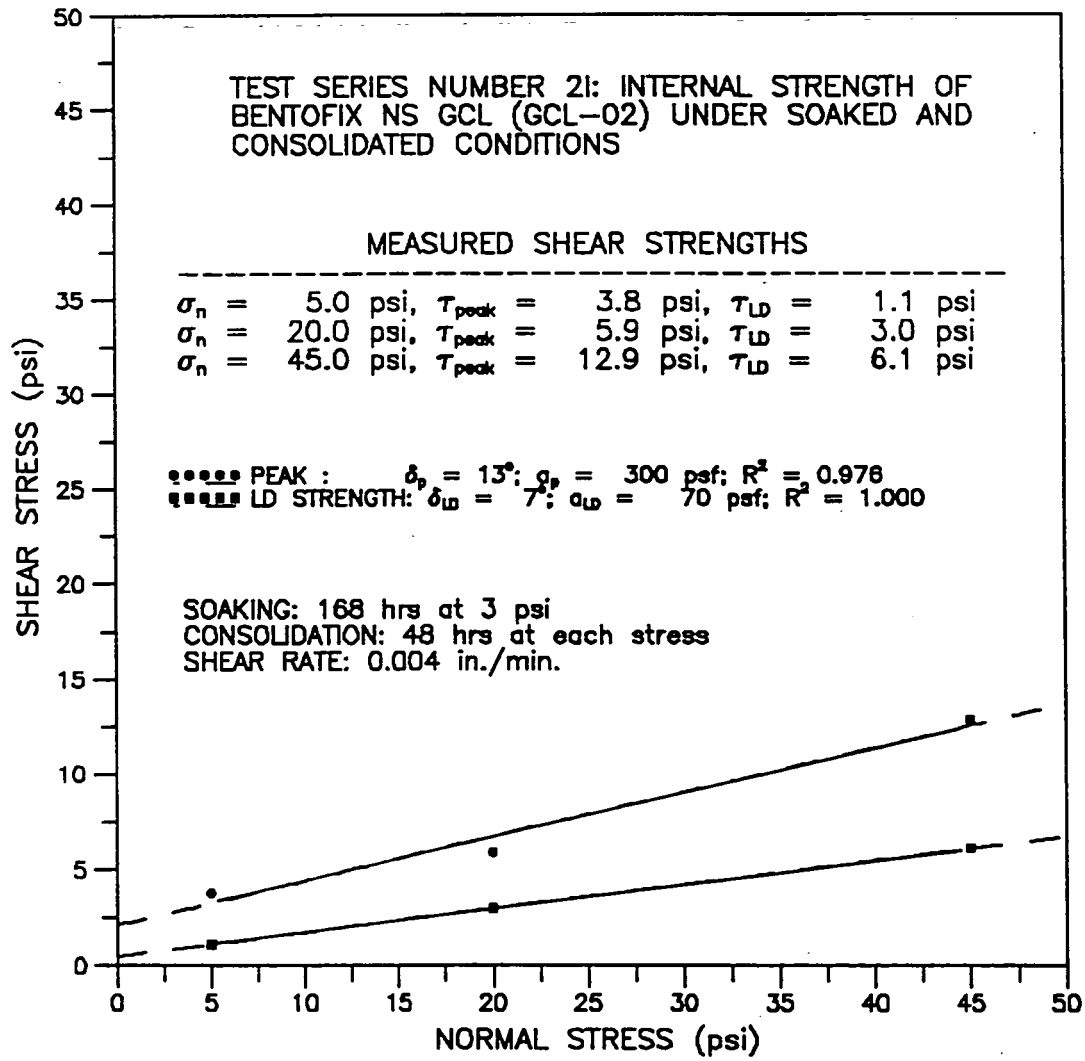
DATE TESTED: 26 AUGUST TO 4 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GO0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	000502

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



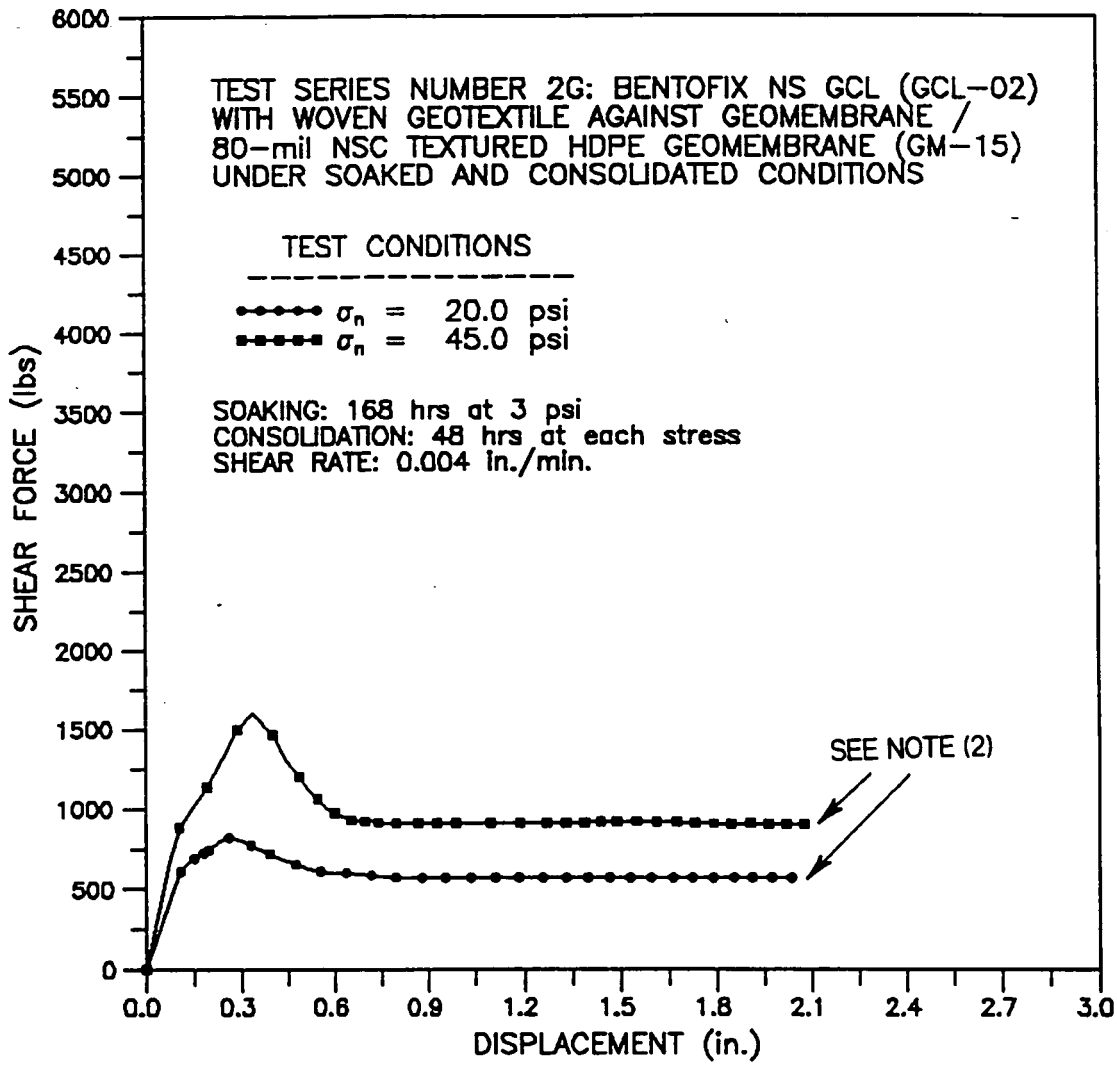
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 26 AUGUST TO 4 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

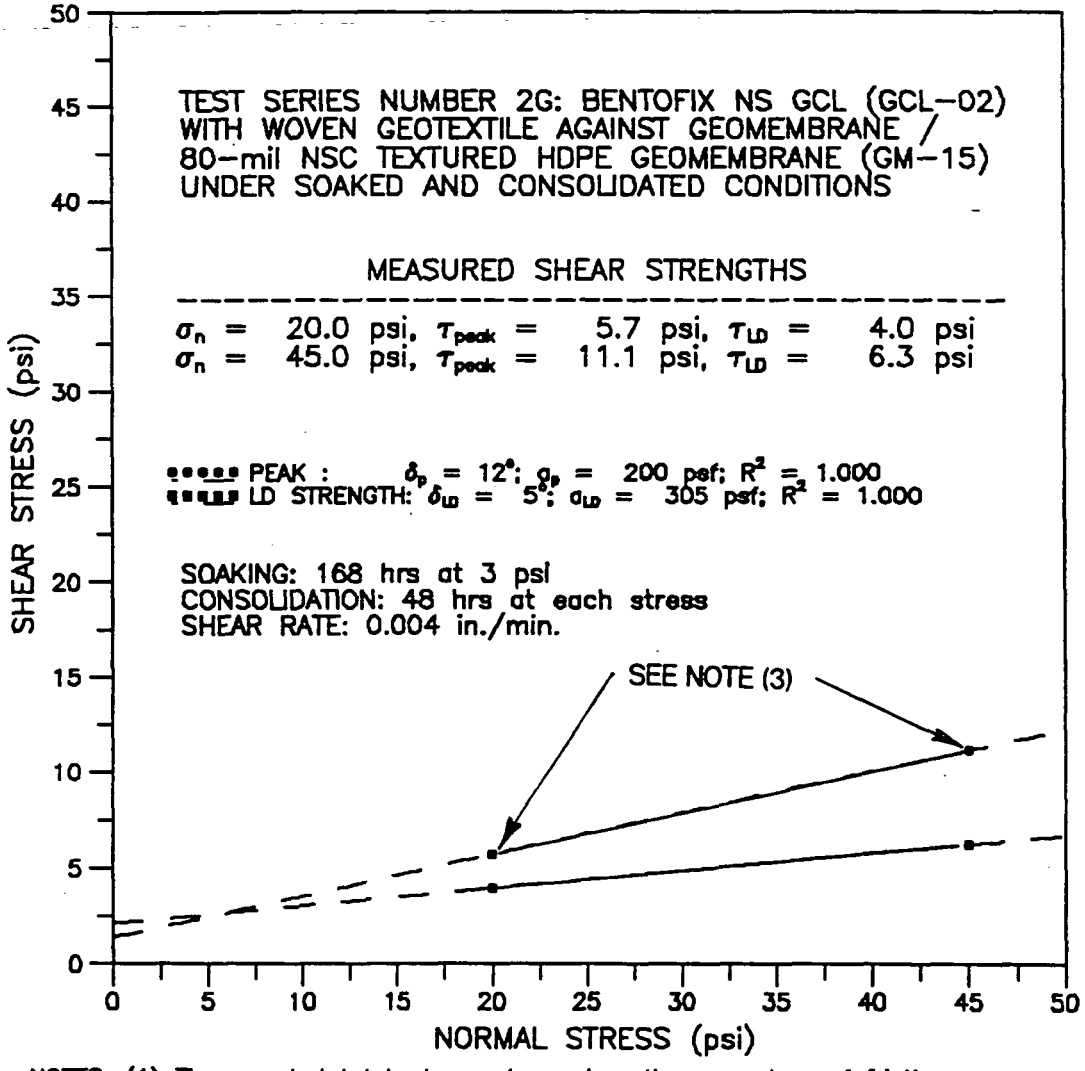
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	000504

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

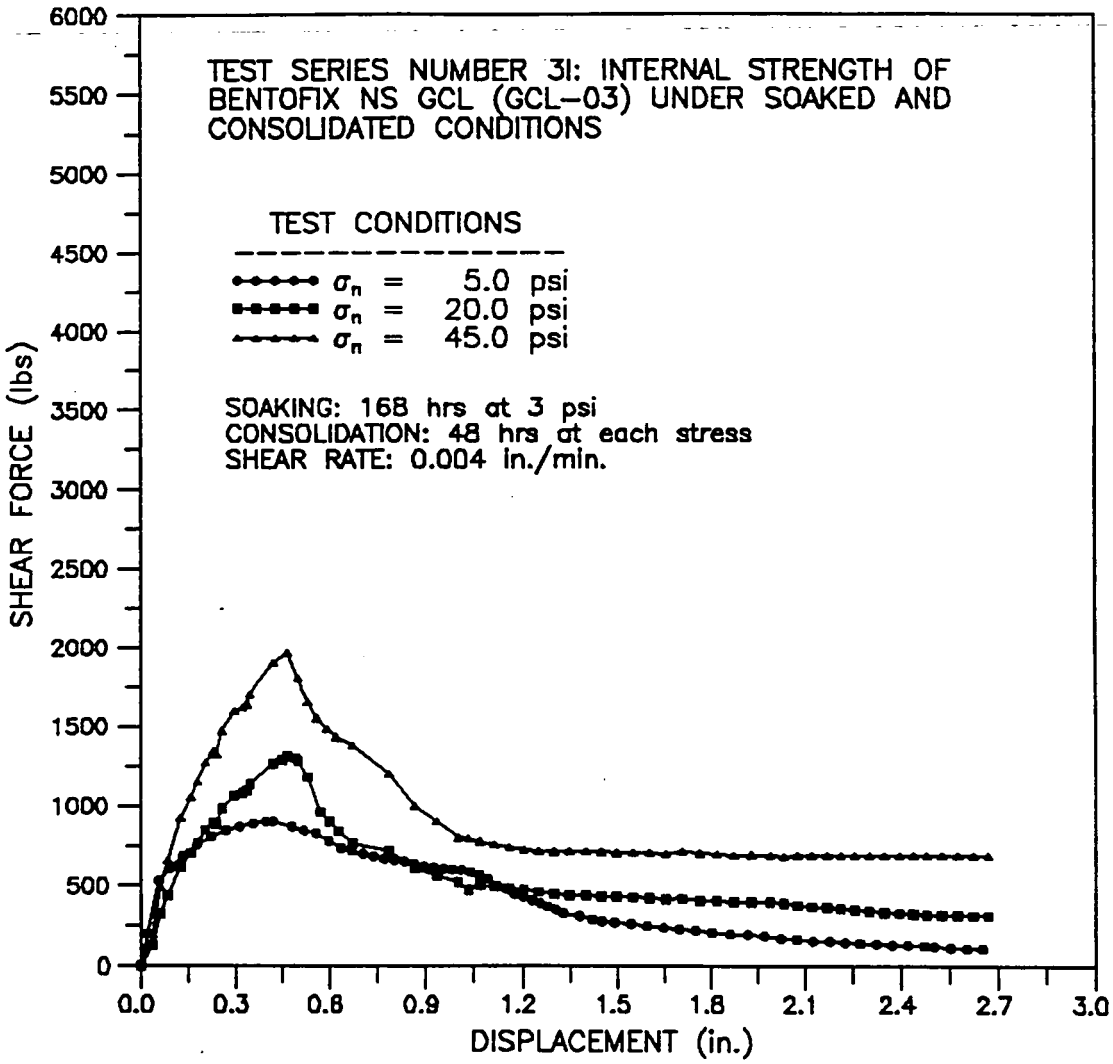
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

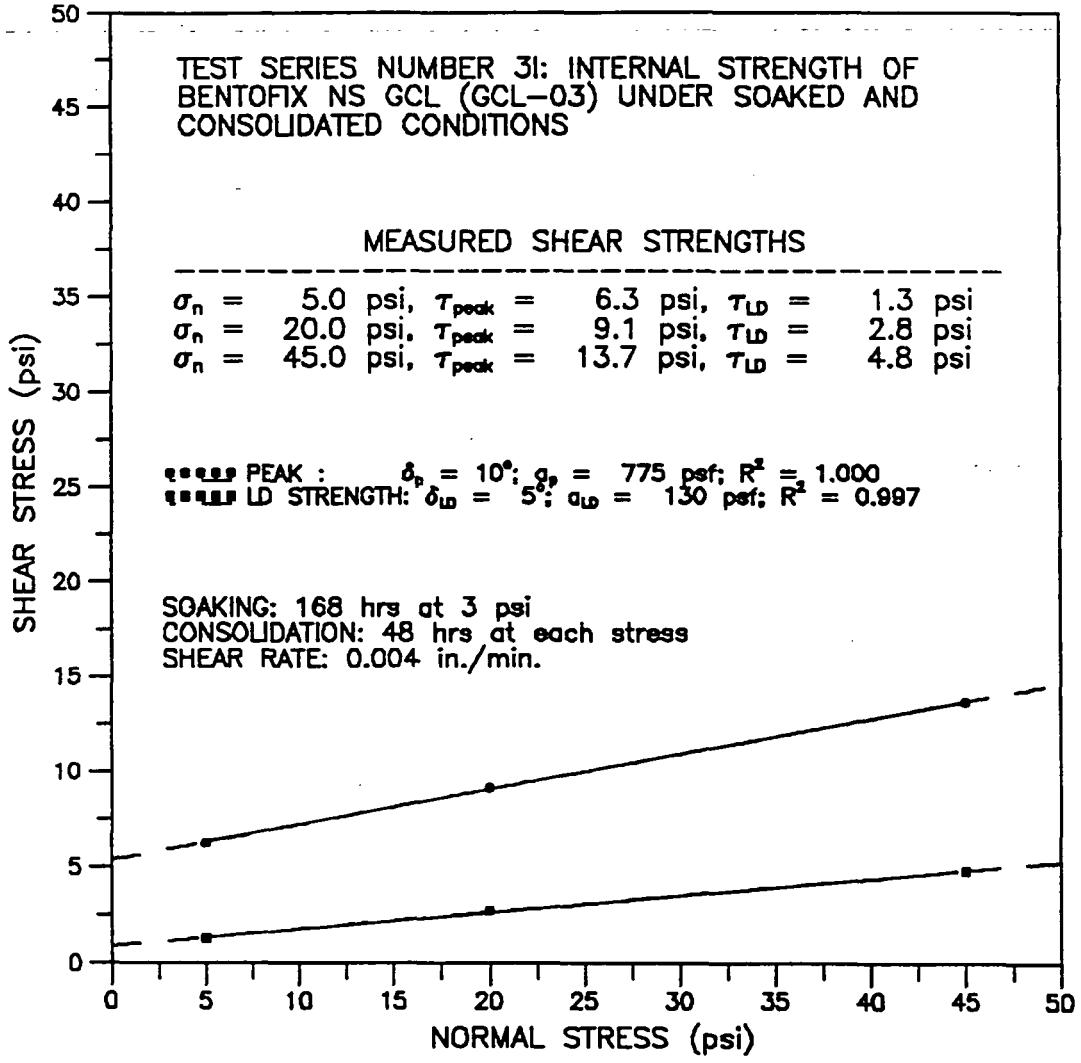
DATE TESTED: 27 AUGUST TO 5 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730088
FILE NO.	000506

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



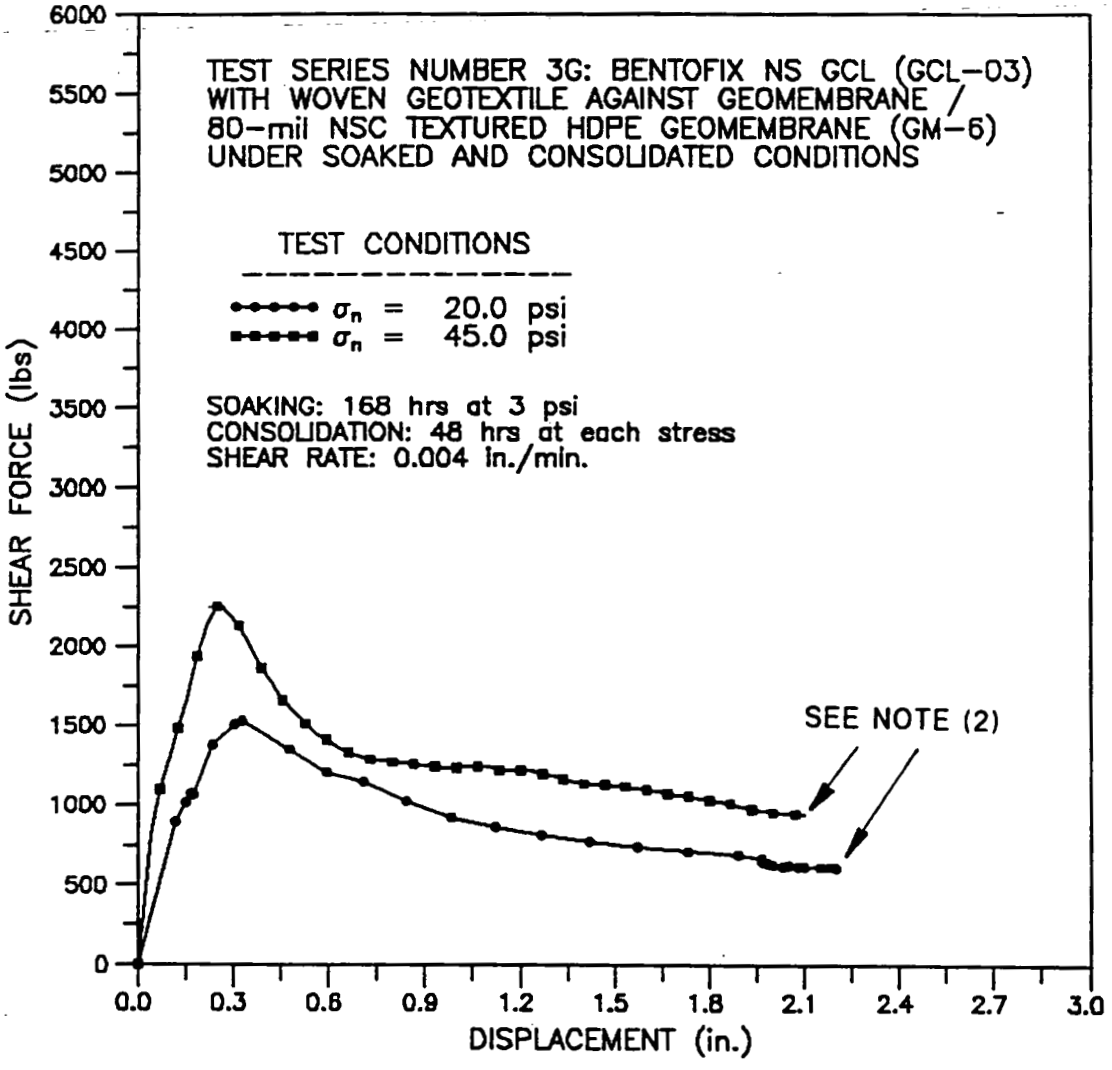
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 27 AUGUST TO 5 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	000507

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

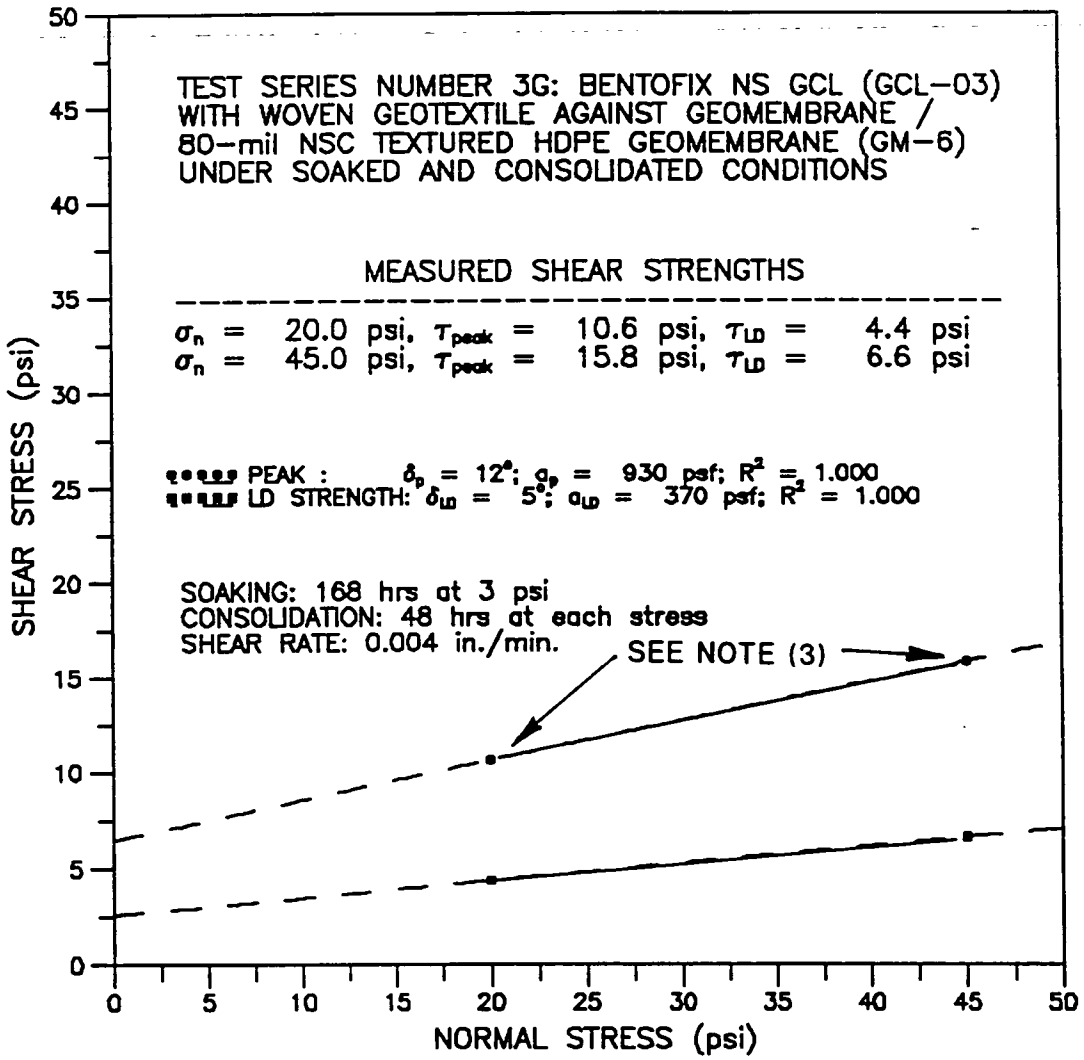
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	000508

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

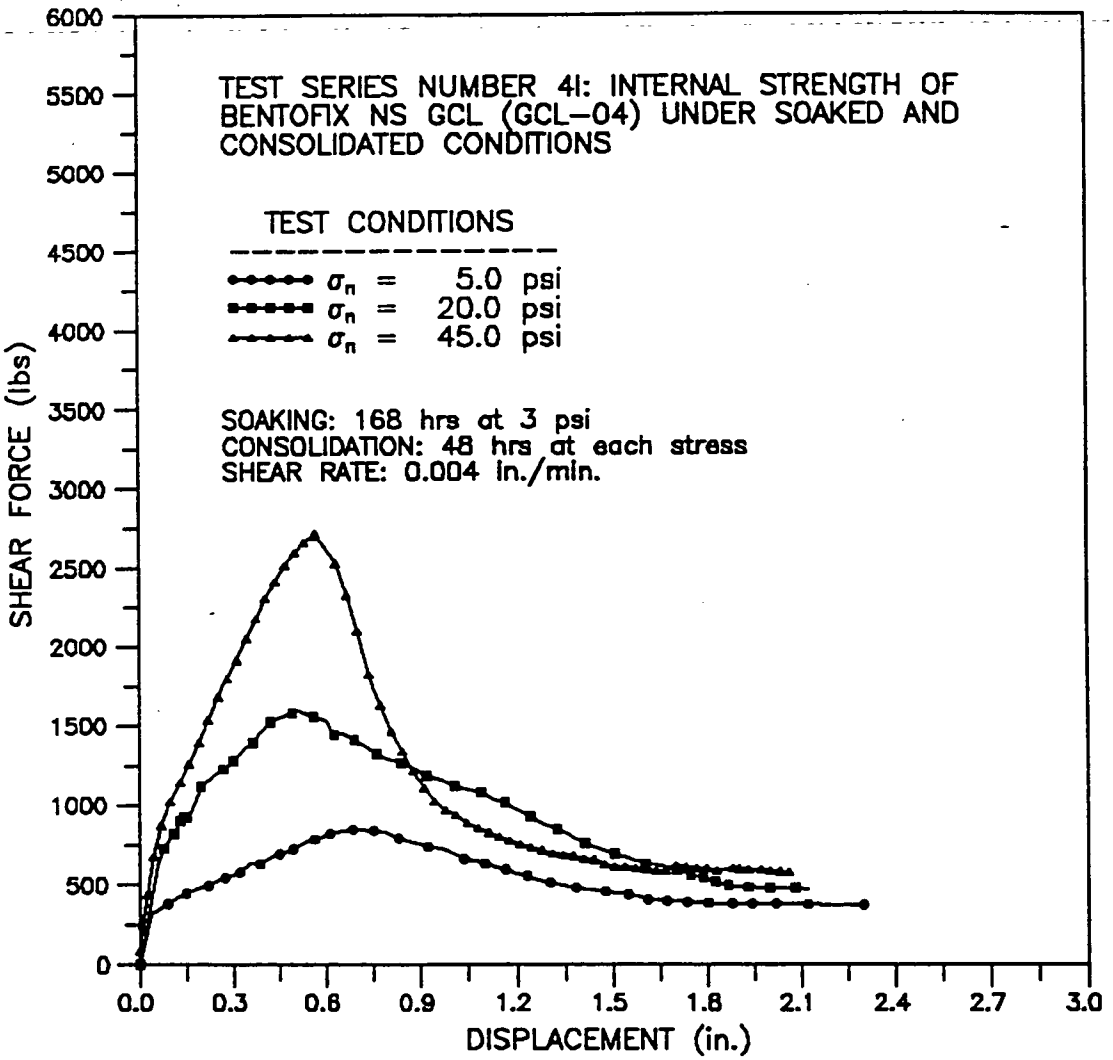
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	000509

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

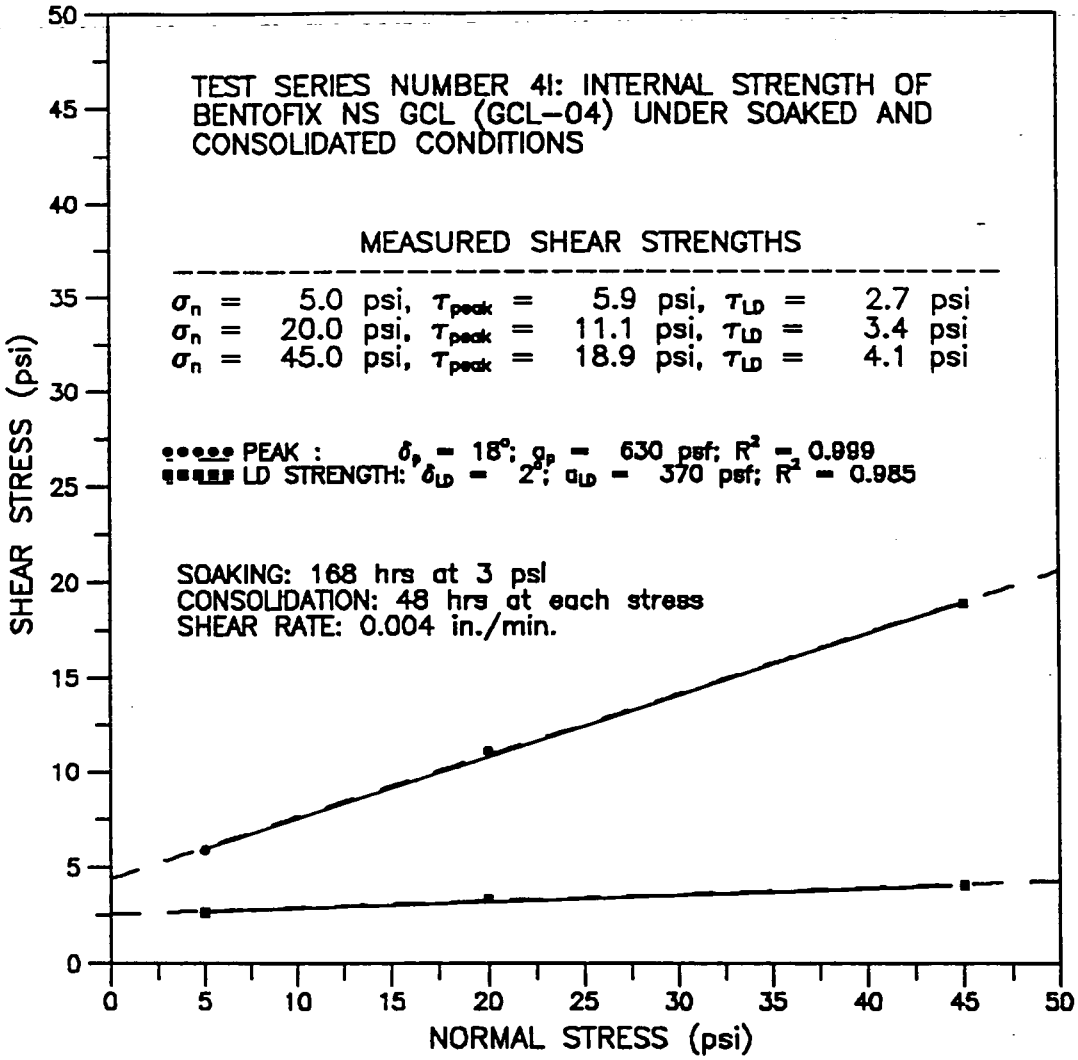
DATE TESTED: 3 TO 12 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730107
FILE NO.	000510

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



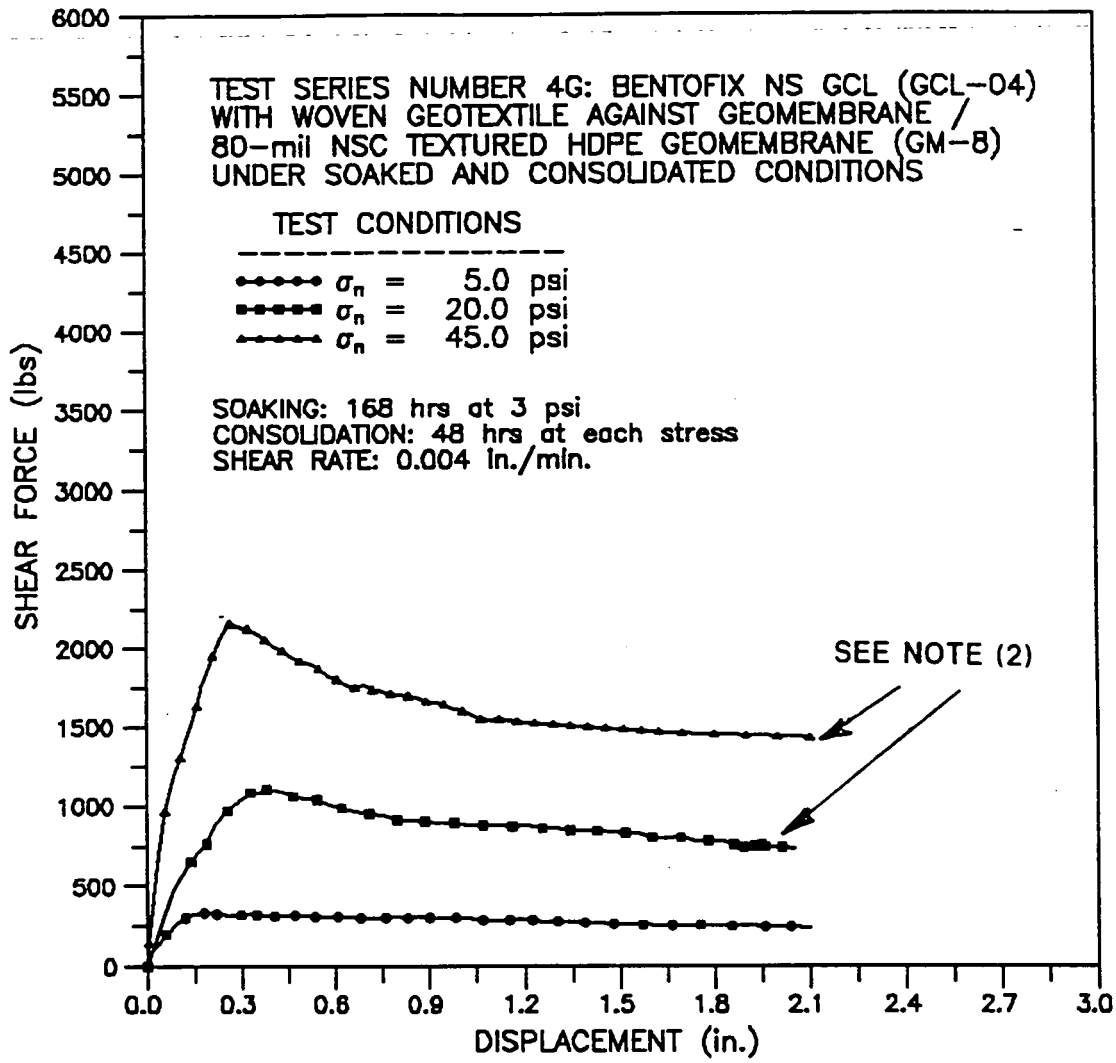
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 3 TO 12 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730107
FILE NO.	000511

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

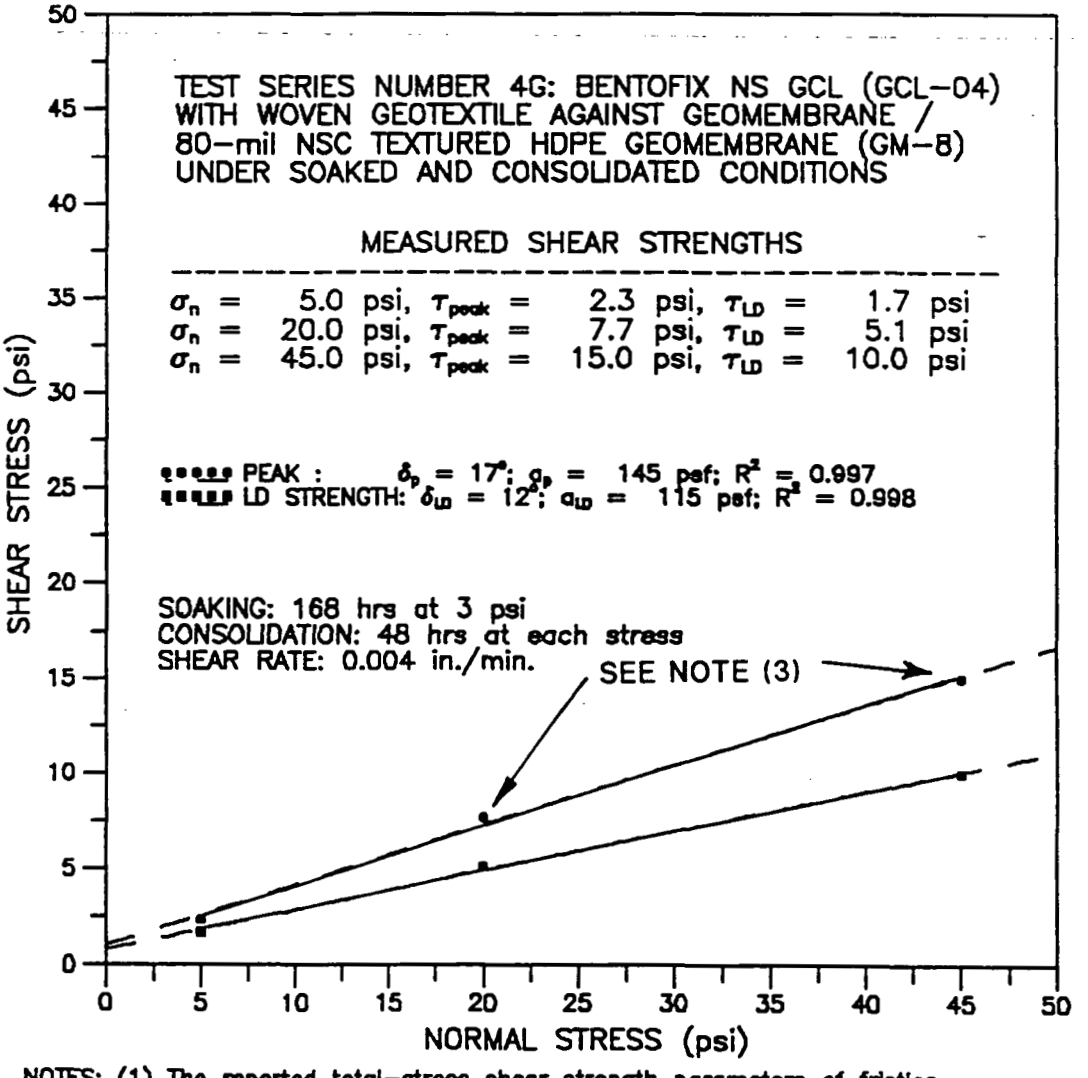
DATE TESTED: 6 TO 15 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730107
FILE NO.	000512

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



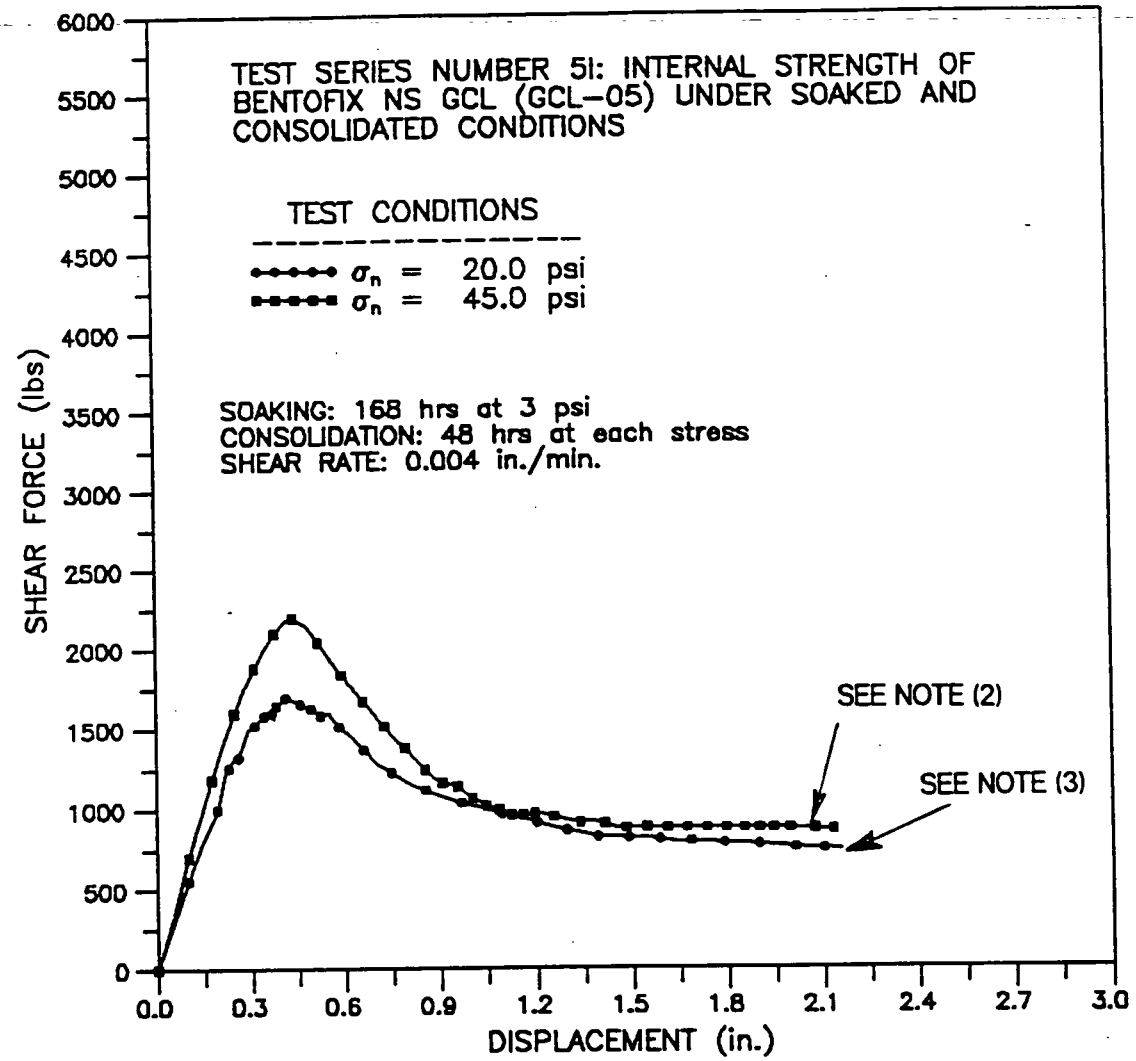
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 6 TO 15 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730107
FILE NO.	000513

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



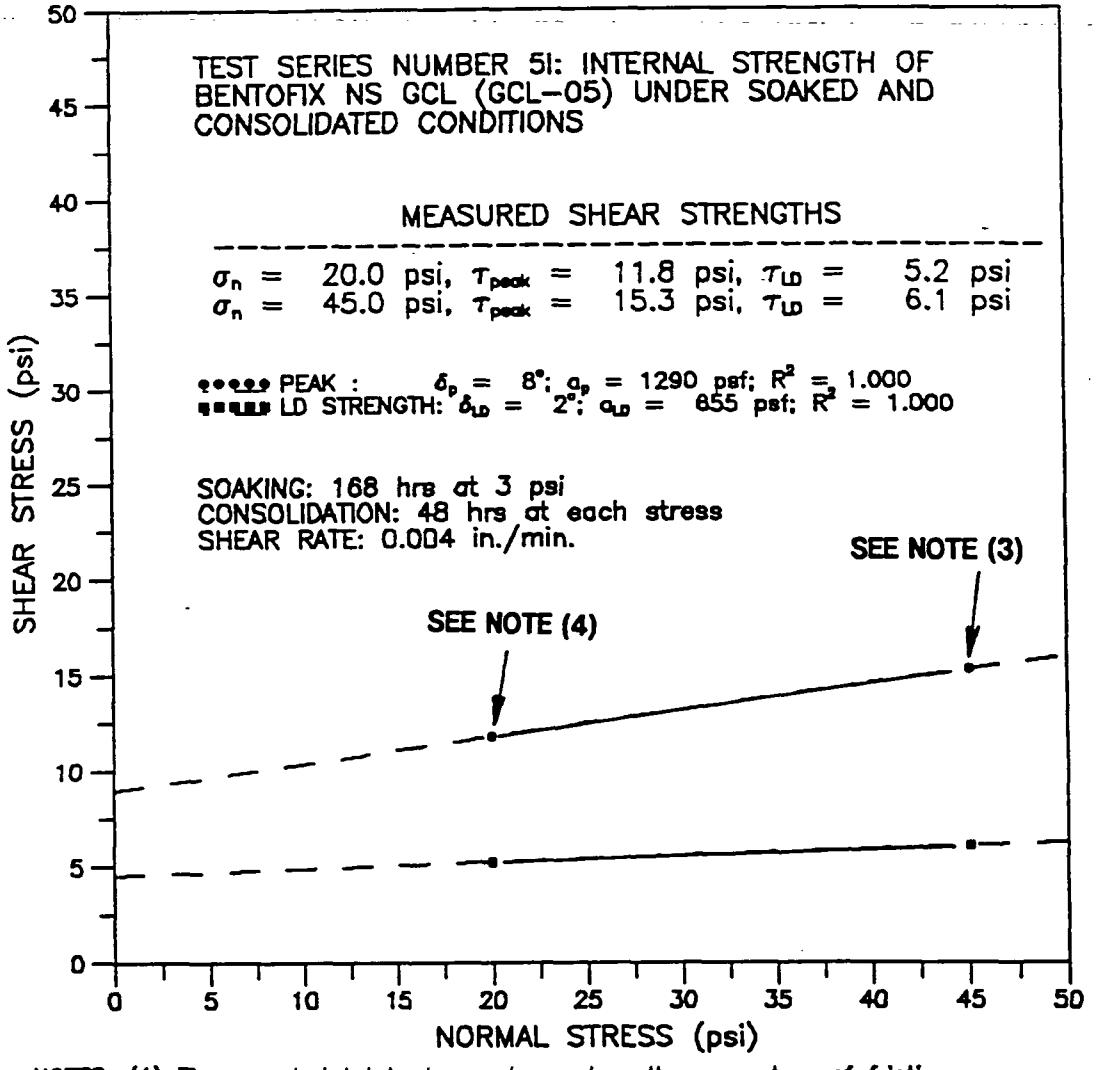
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) Internal shear failure within GCL was observed.
(3) Partial internal shear failure within GCL was observed.

DATE TESTED: 18 TO 27 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730116
FILE NO.	000514

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



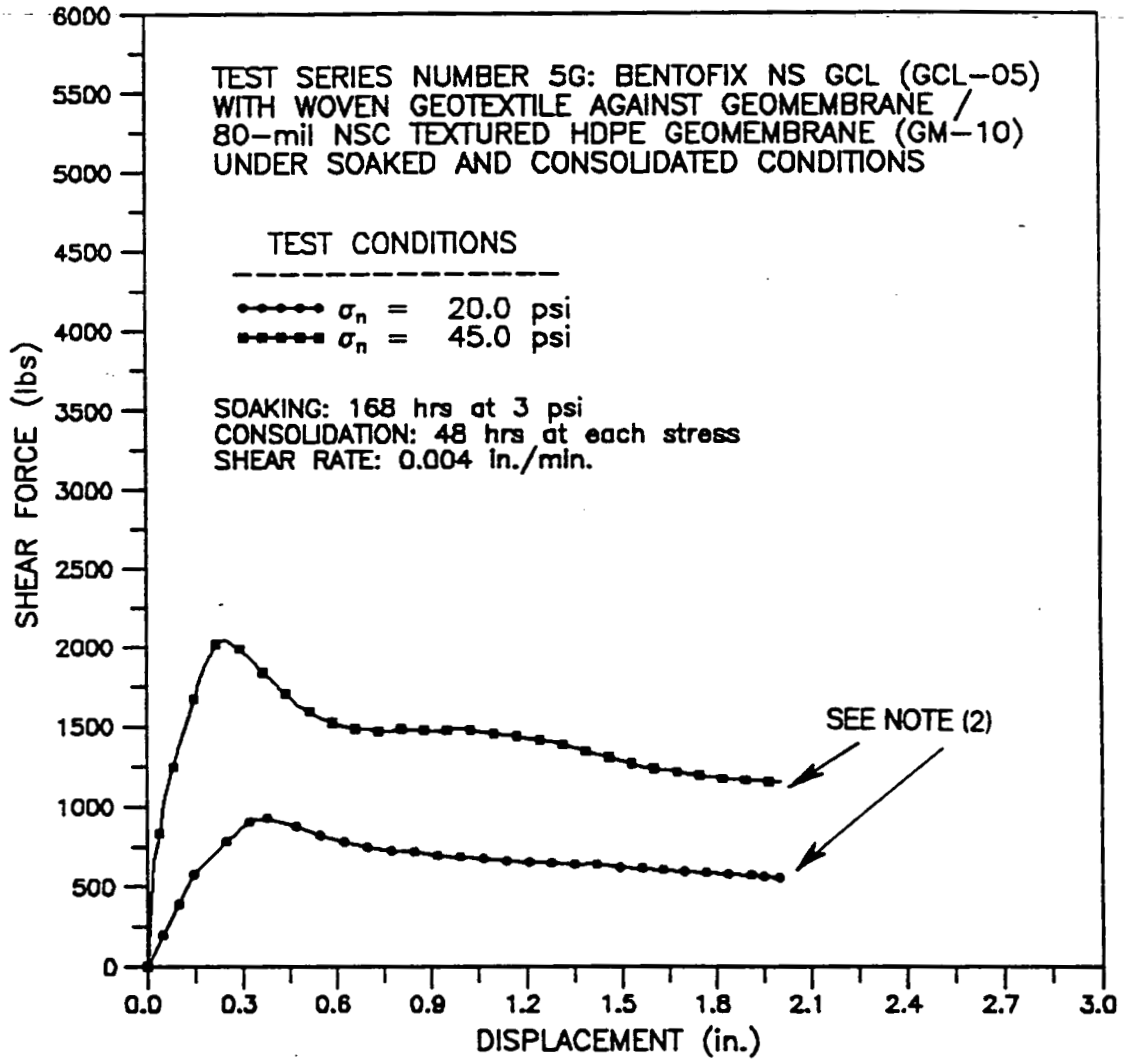
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Internal shear failure within GCL was observed.
(4) Partial internal failure within GCL was observed.

DATE TESTED: 18 TO 27 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730116
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

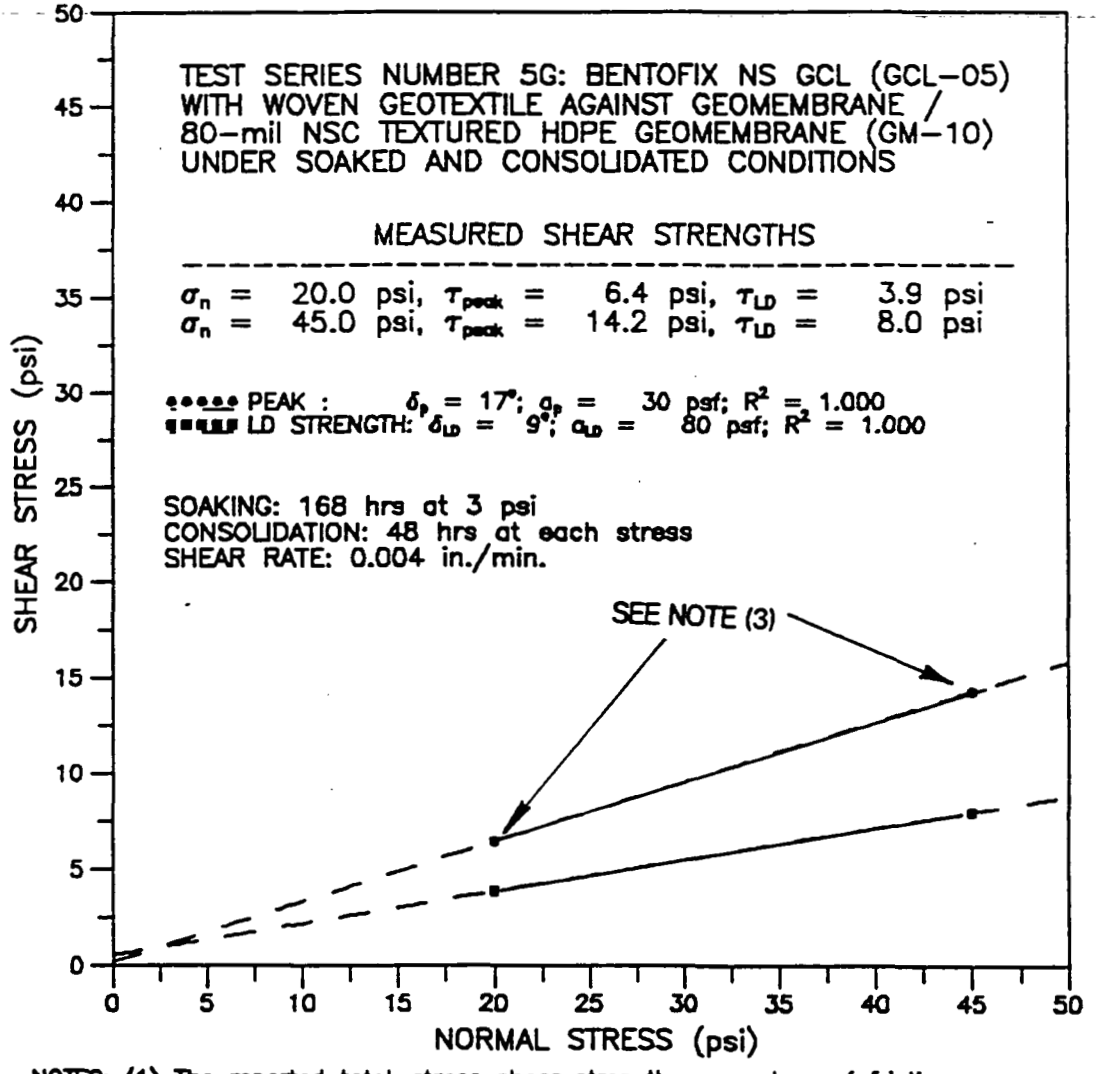
(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 18 TO 28 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730116
FILE NO.	000516

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



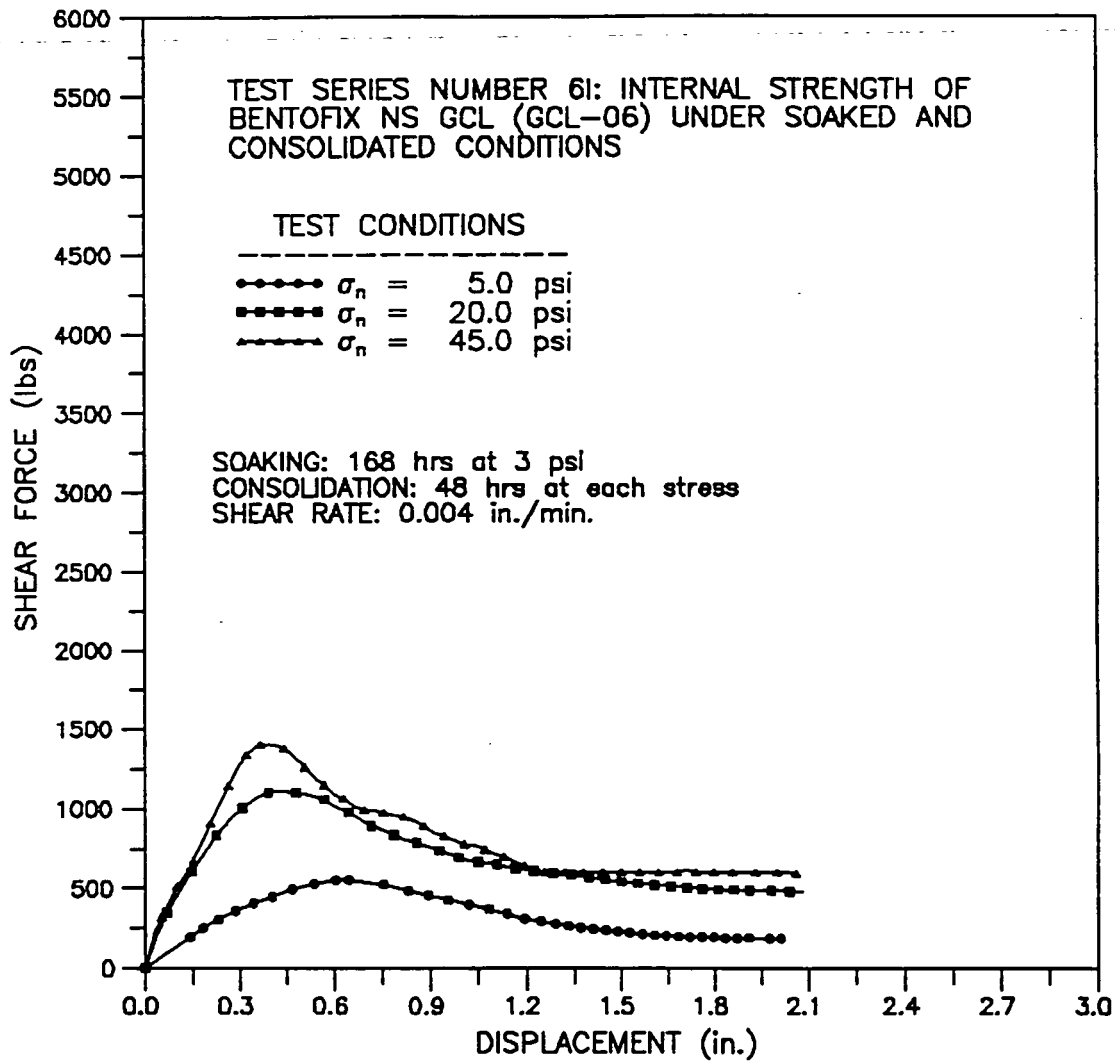
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 18 TO 28 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	G00166-04.1
DOCUMENT NO.	59730167
FILE NO.	000517

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

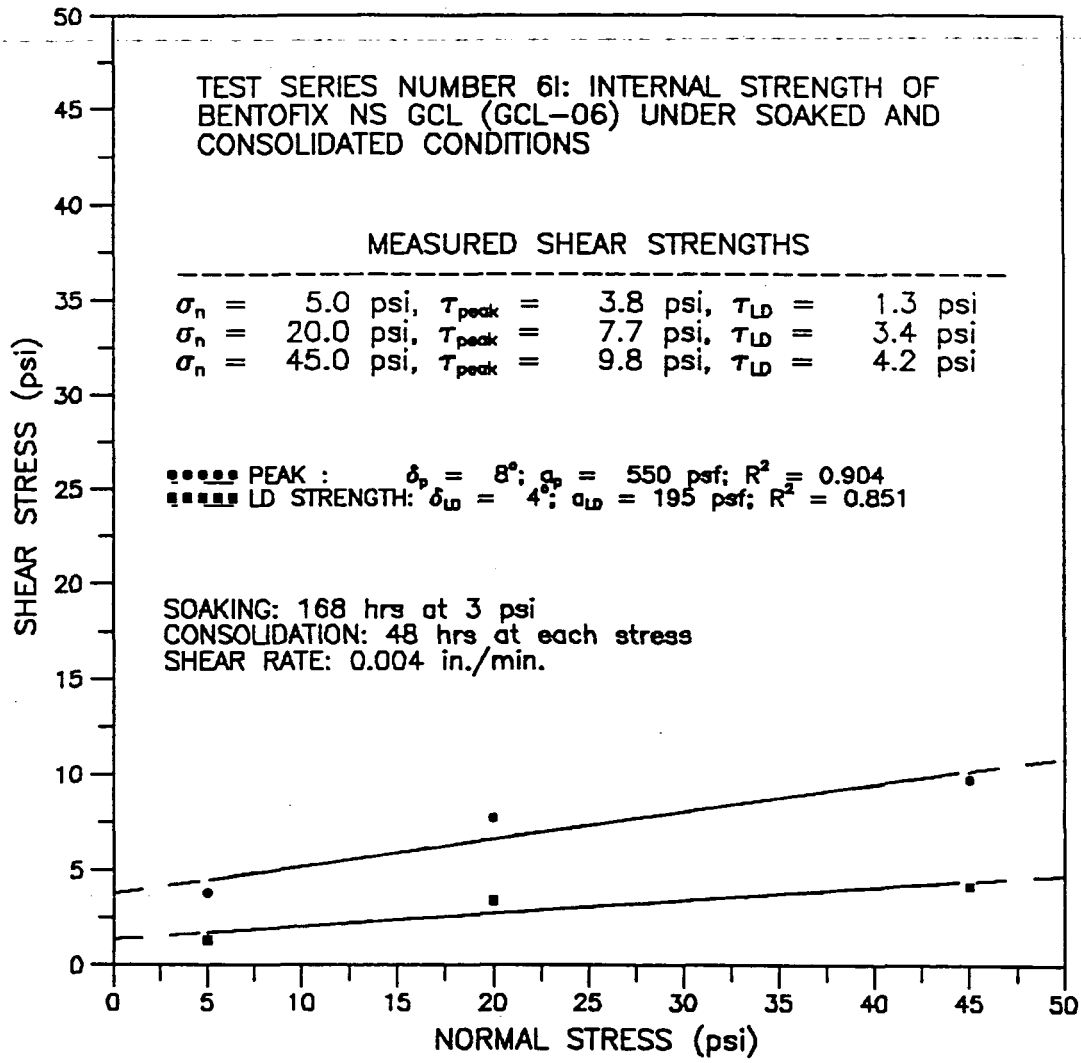
DATE TESTED: 29 SEPTEMBER TO 12 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730109
FILE NO.	000518

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



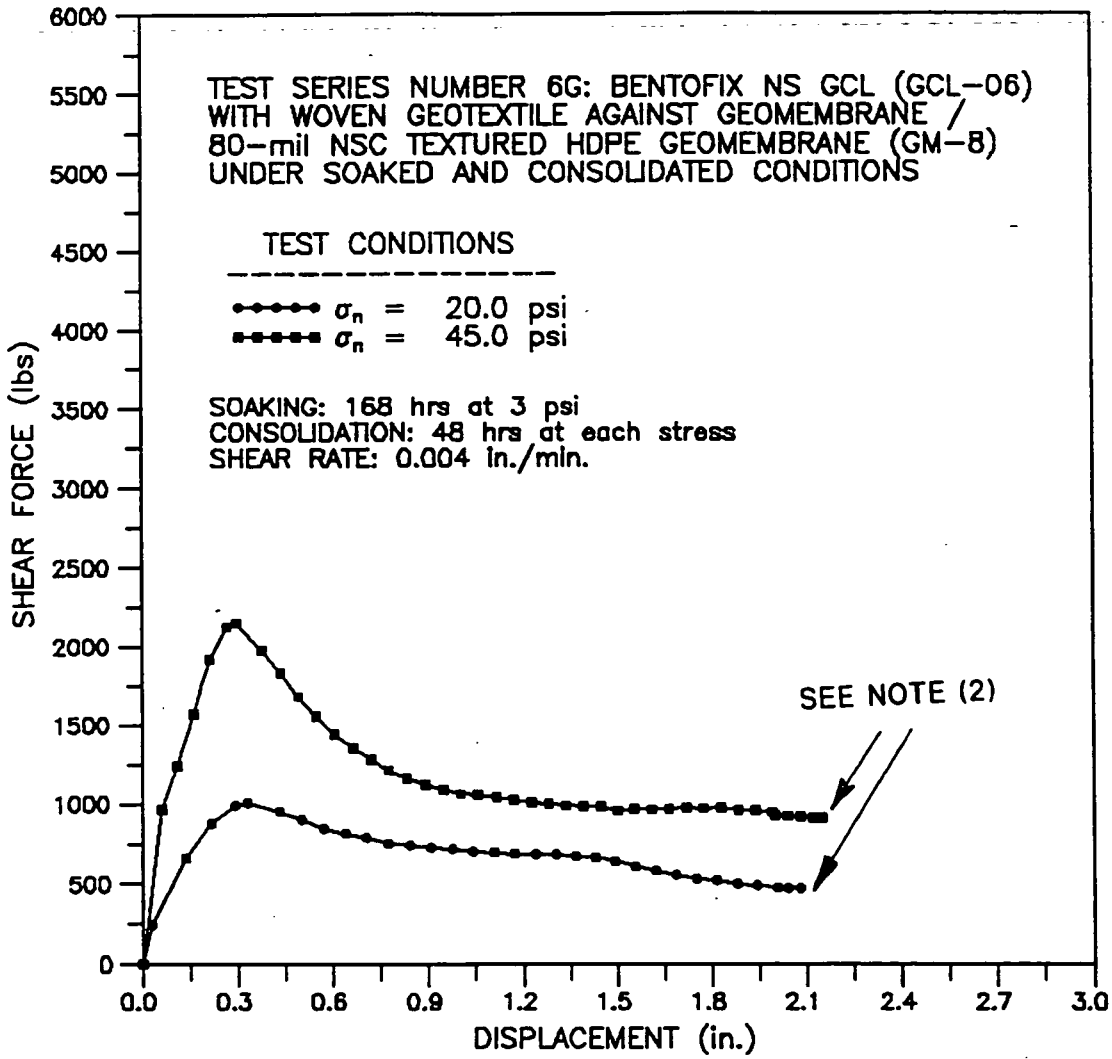
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 29 SEPTEMBER TO 12 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730109
FILE NO.	000519

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

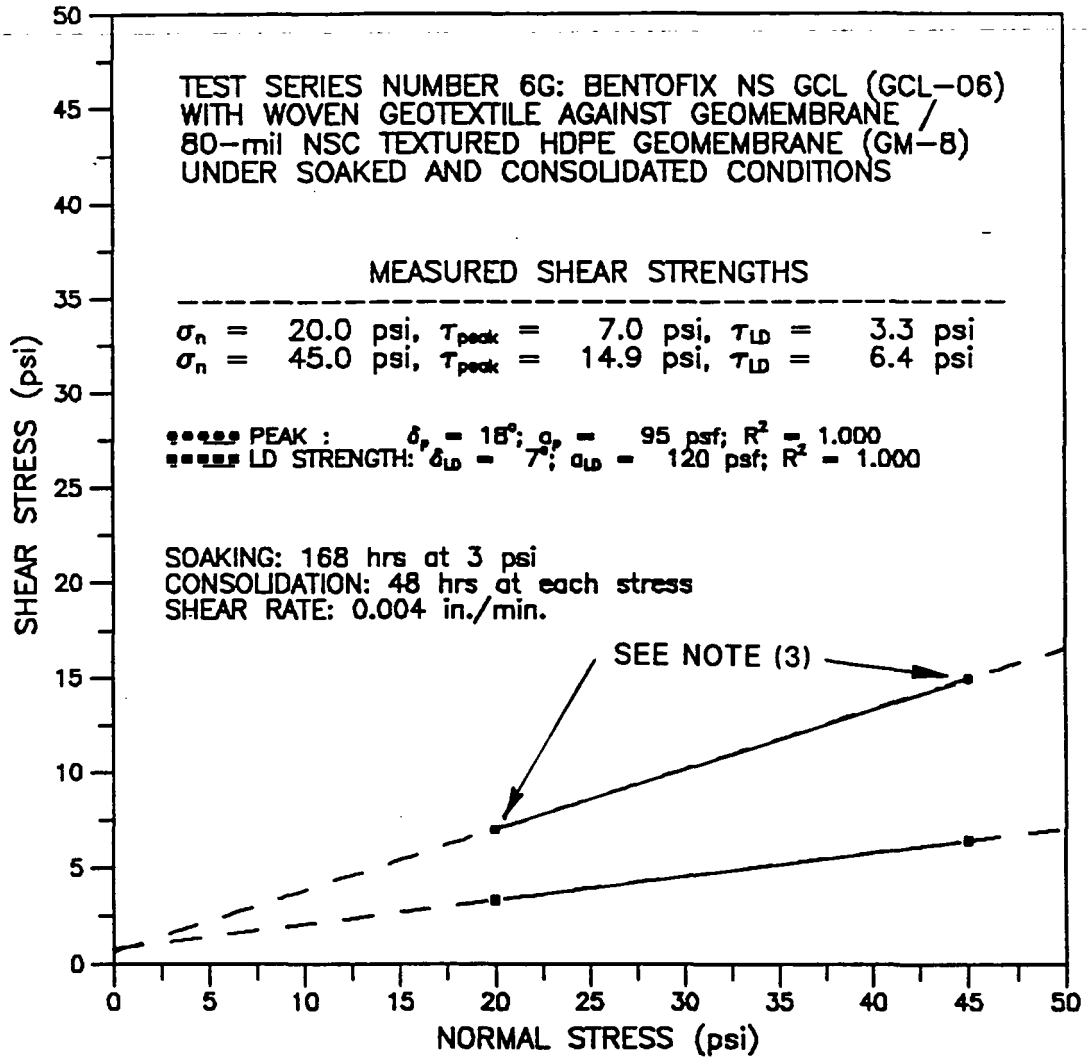
DATE TESTED: 29 SEPTEMBER TO 8 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730109
FILE NO.	000520

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



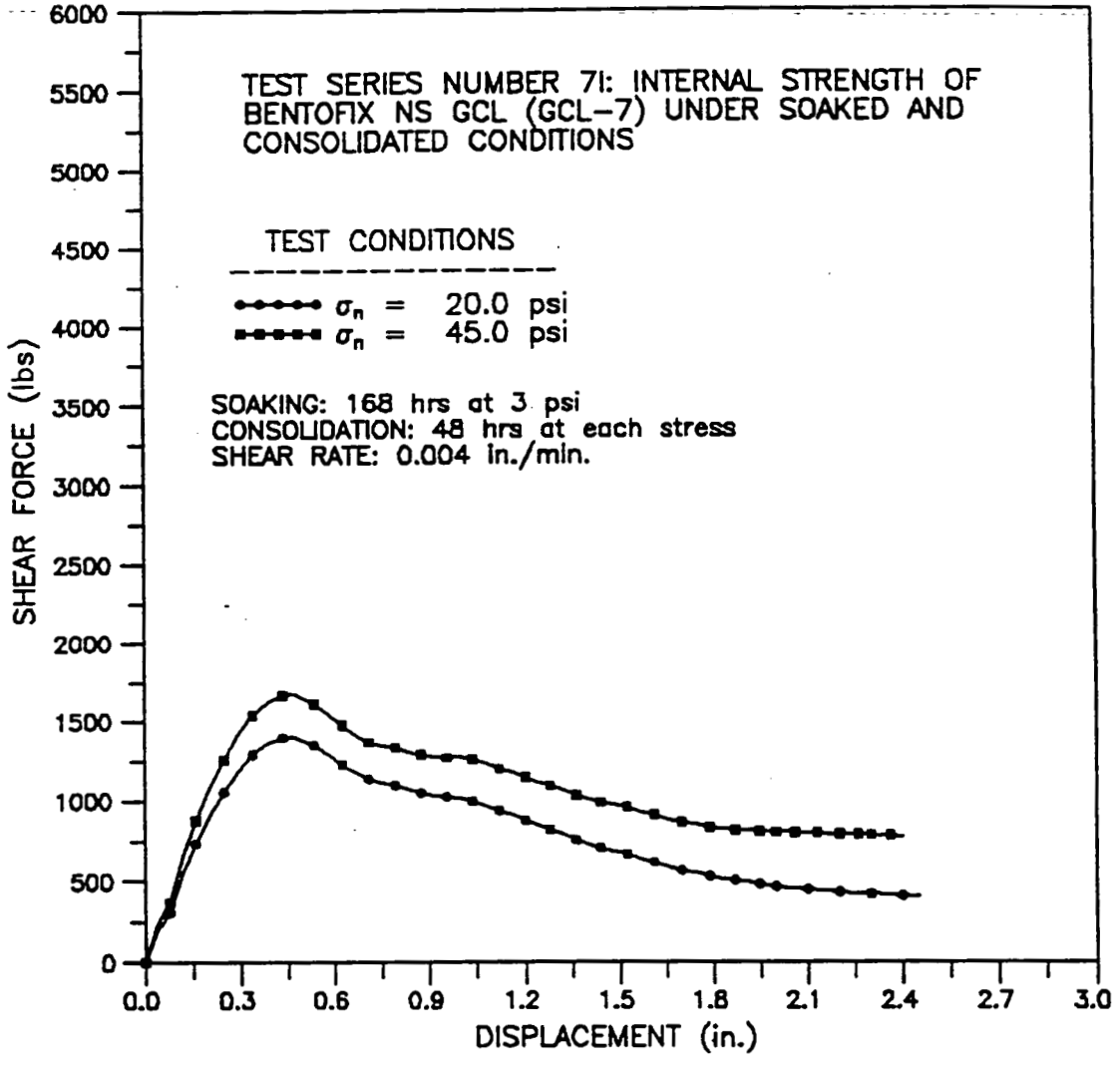
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 29 SEPTEMBER TO 8 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730109
FILE NO.	000521

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

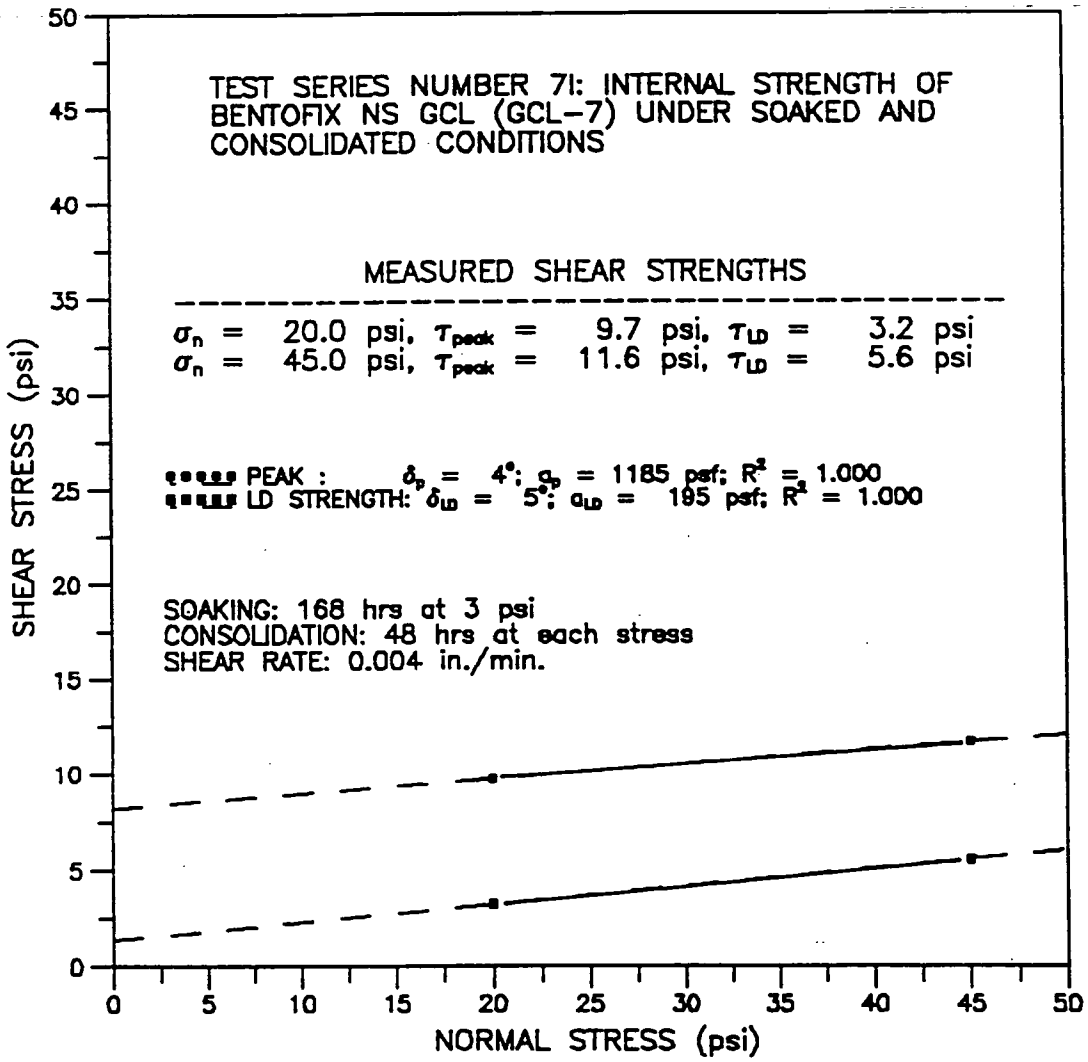
DATE TESTED: 27 SEPTEMBER TO 6 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730089
FILE NO.	000522

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL

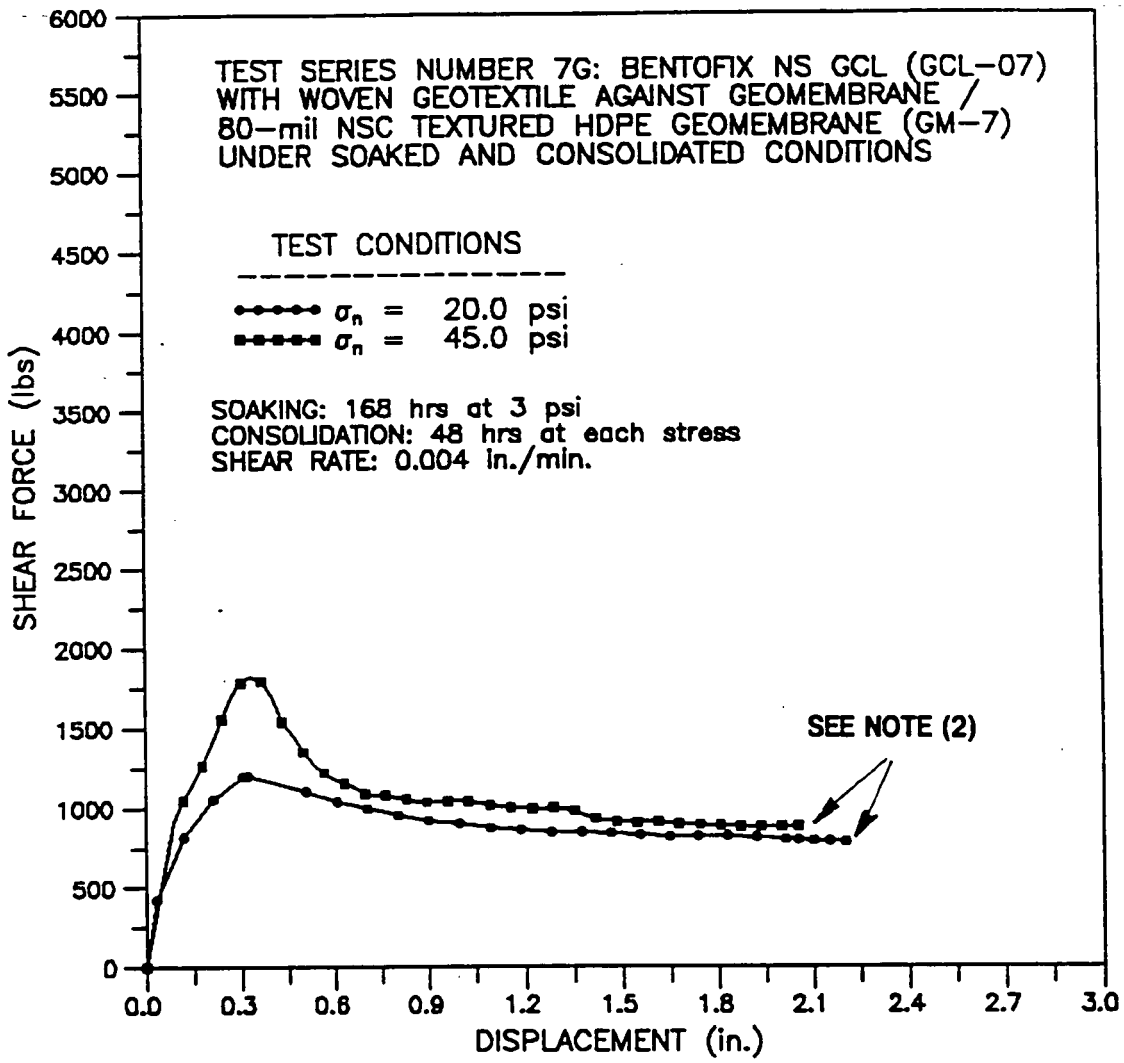
DATE TESTED: 27 SEPTEMBER TO 6 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730089
FILE NO.	000523

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

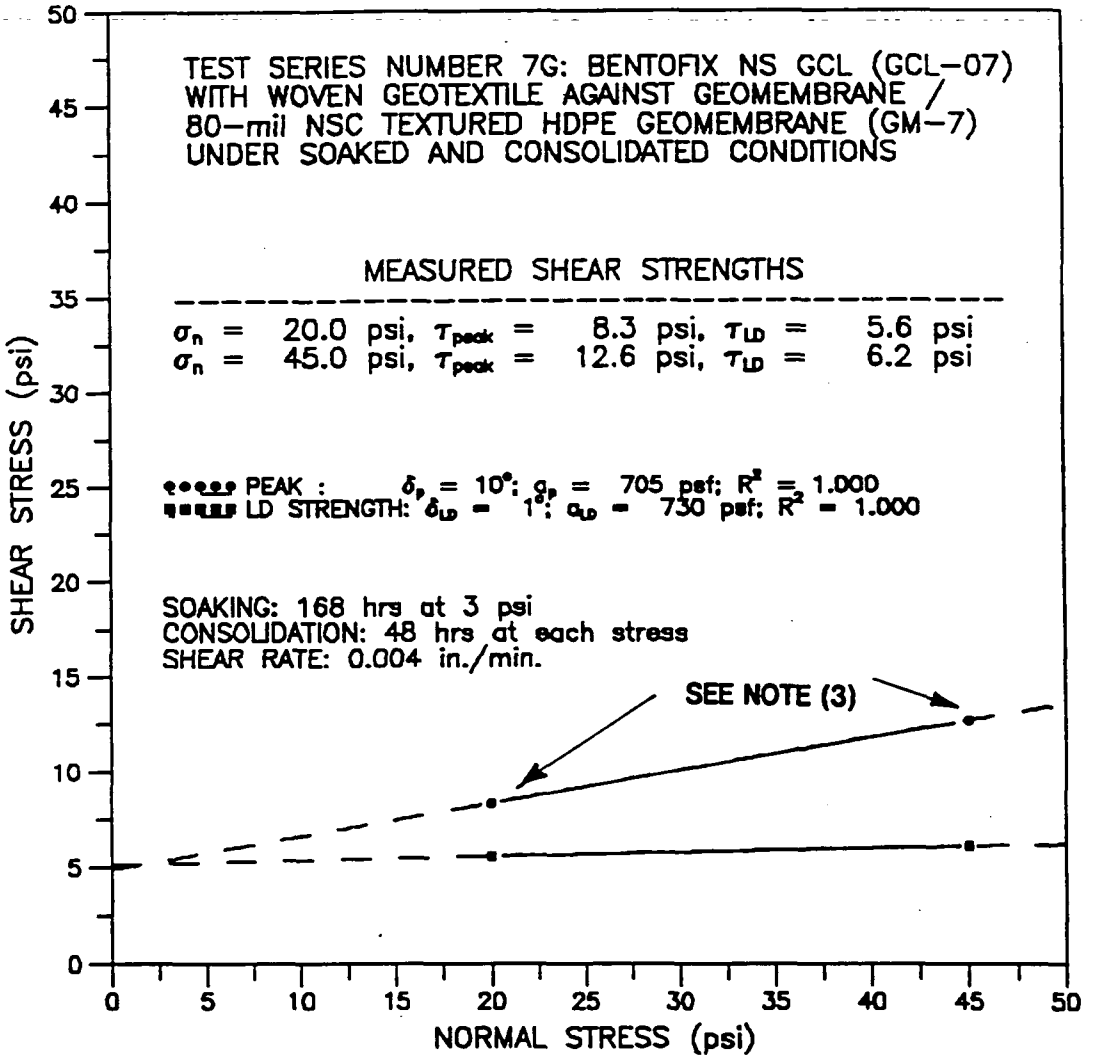
DATE TESTED: 27 SEPTEMBER TO 6 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730089
FILE NO.	000524

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



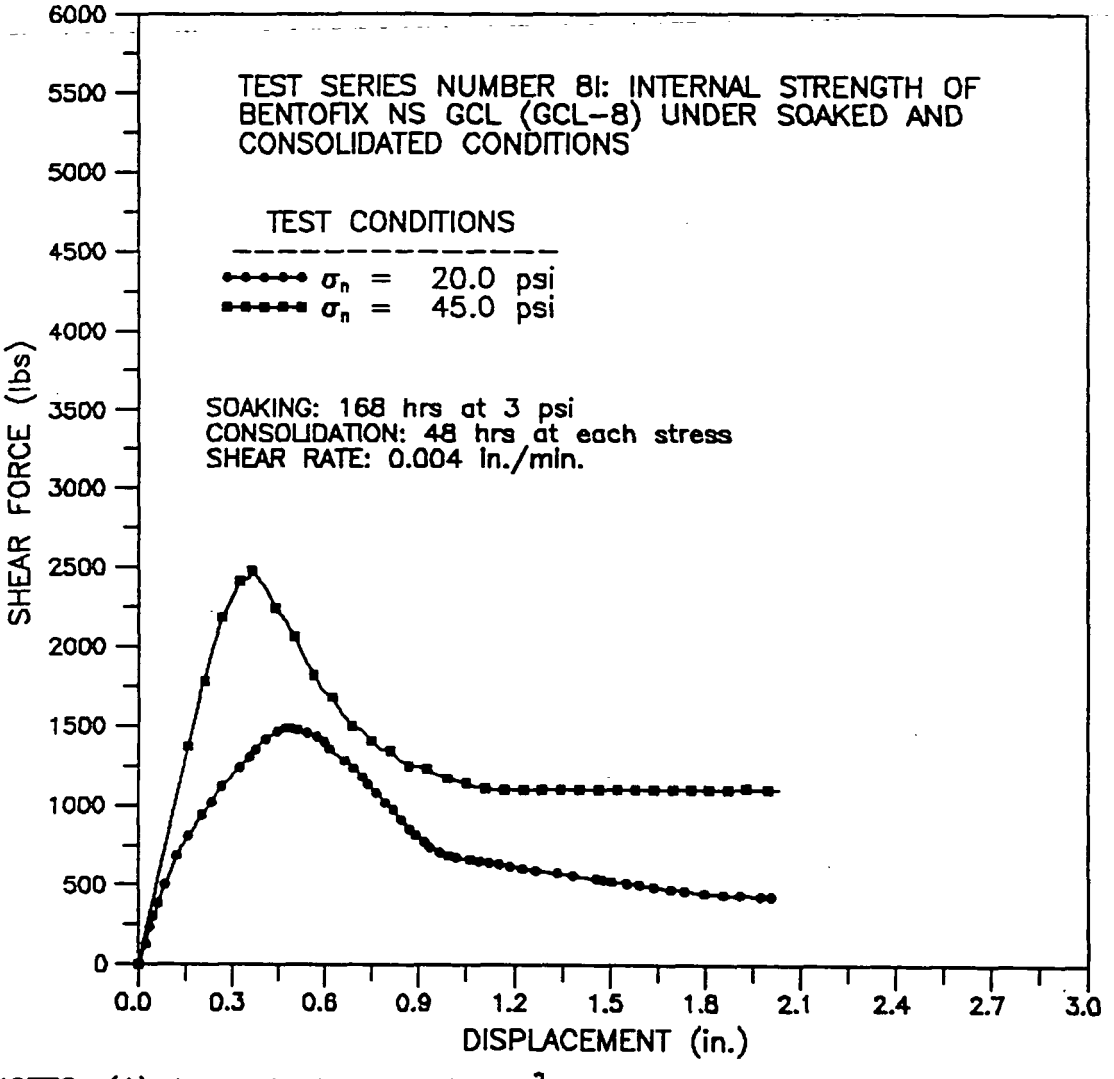
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 27 SEPTEMBER TO 6 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730089
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

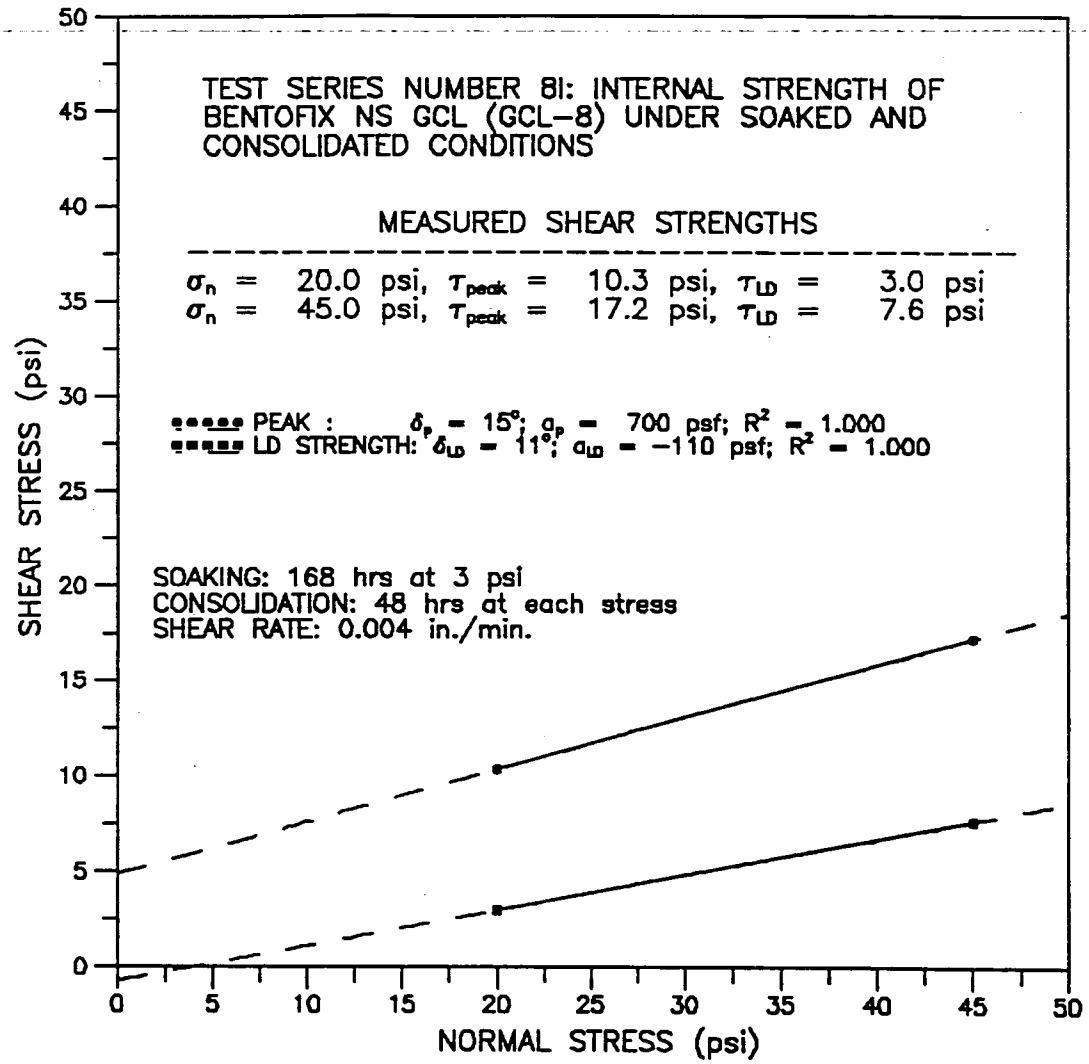
DATE TESTED: 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730106
FILE NO.	000526

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



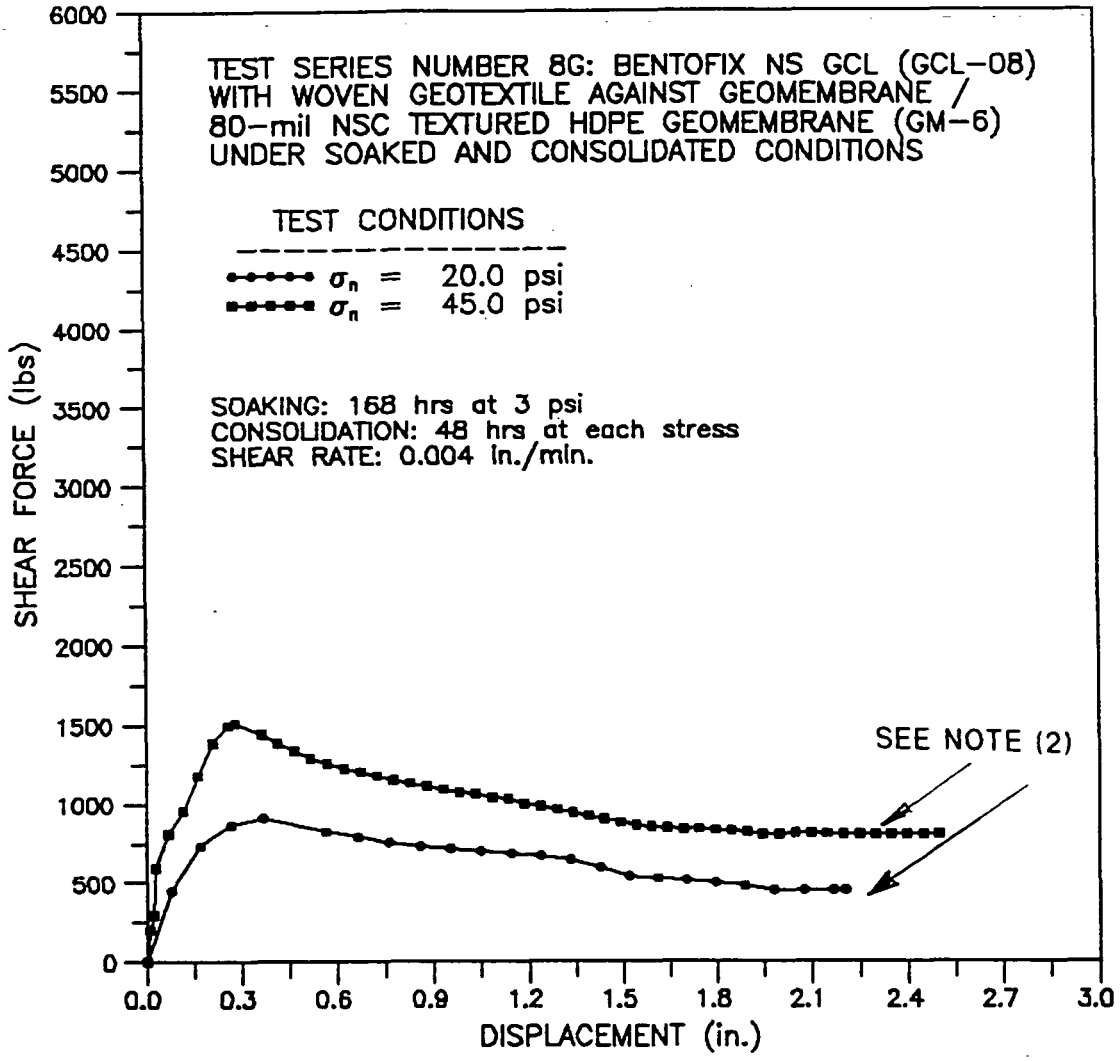
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730106
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

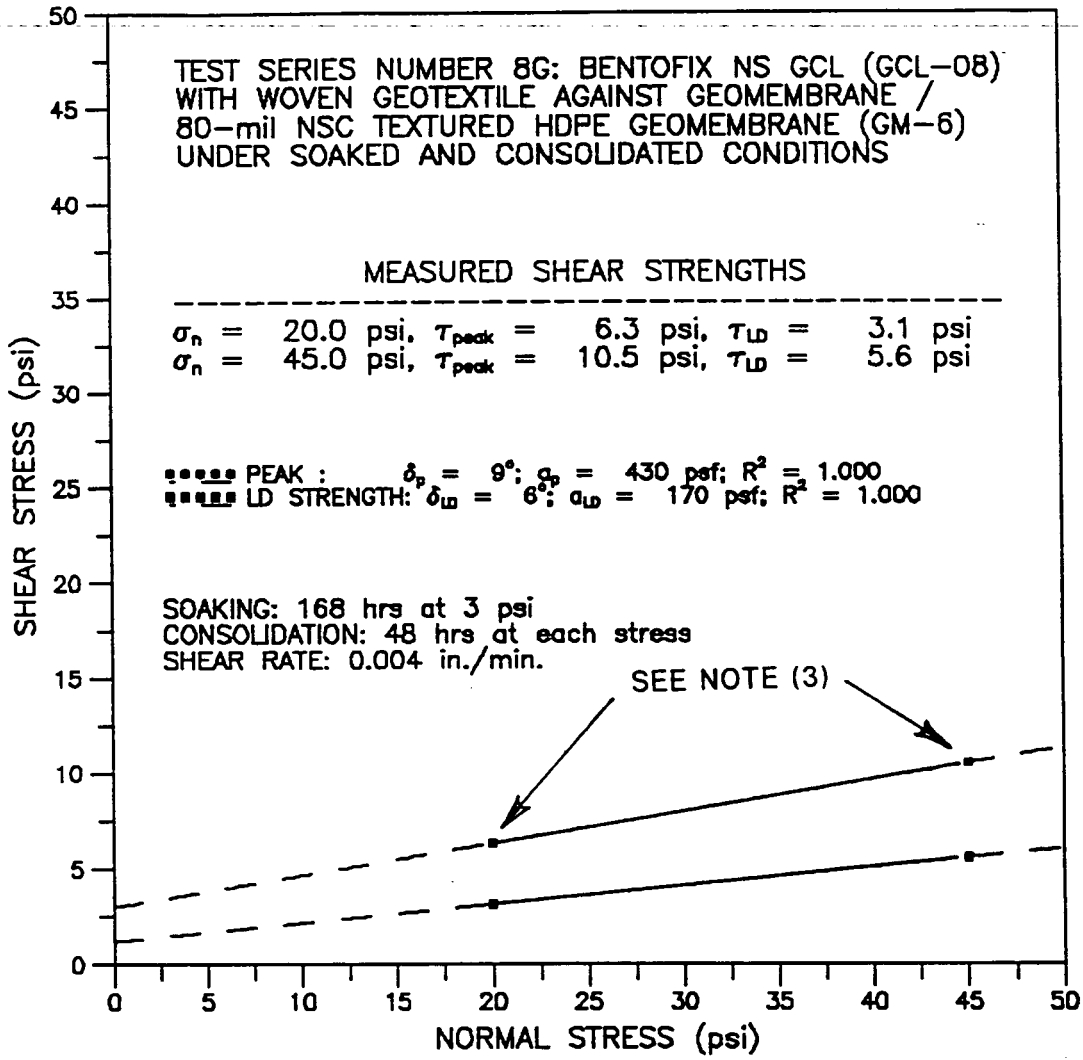
DATE TESTED: 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730106
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



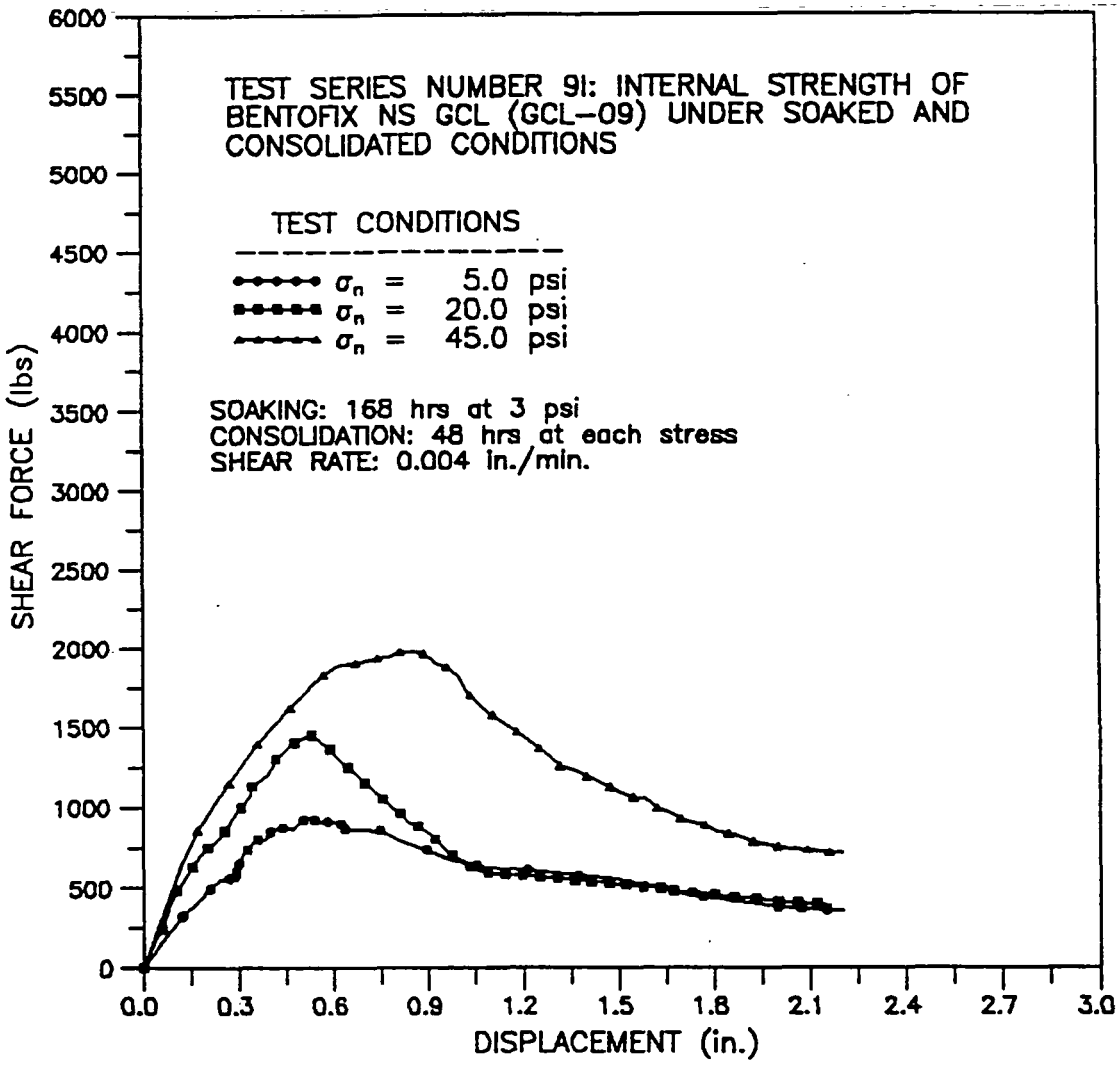
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730106
FILE NO.	000529

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

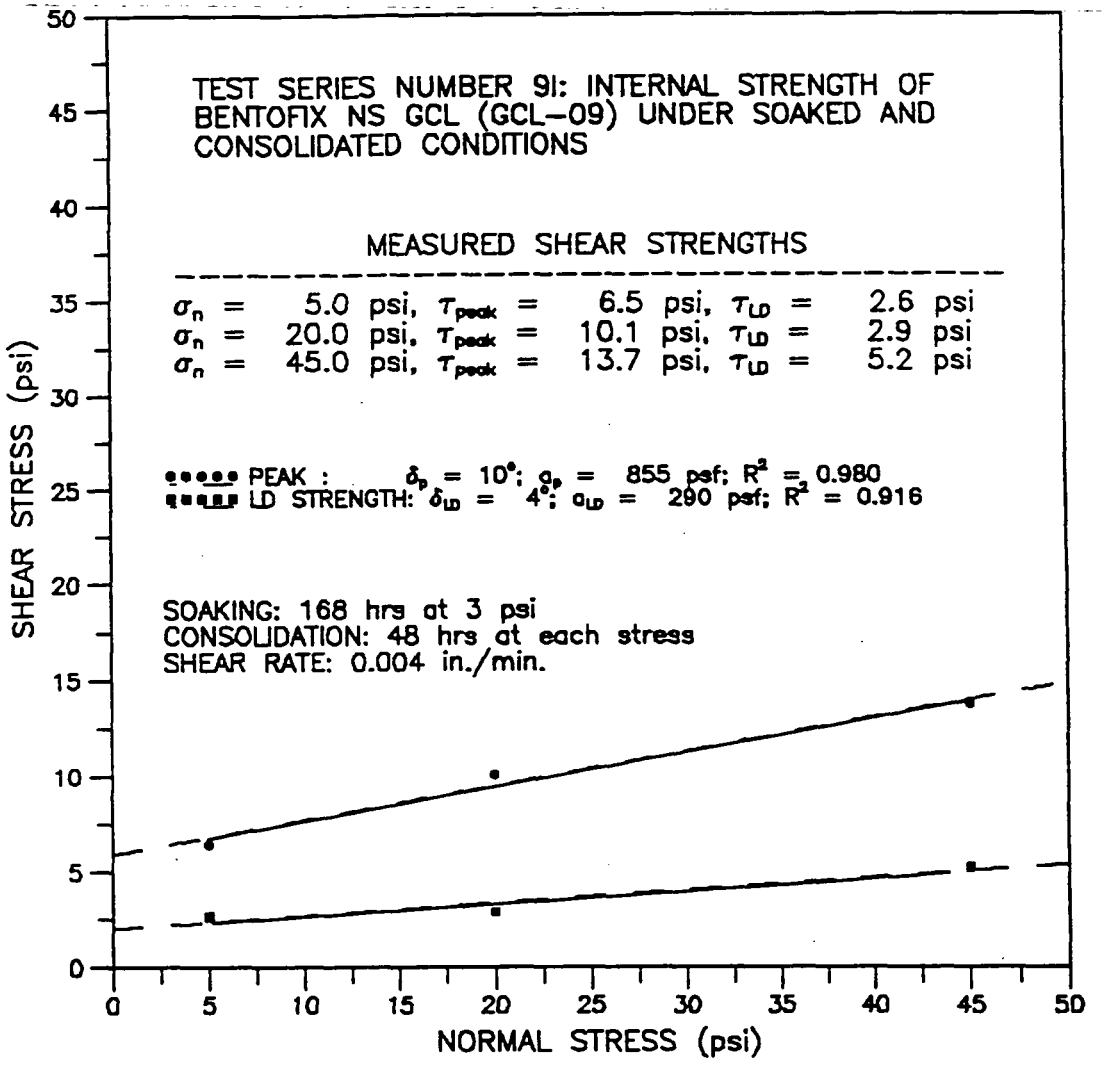
DATE TESTED: 8 TO 17 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730099
FILE NO.	000530

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



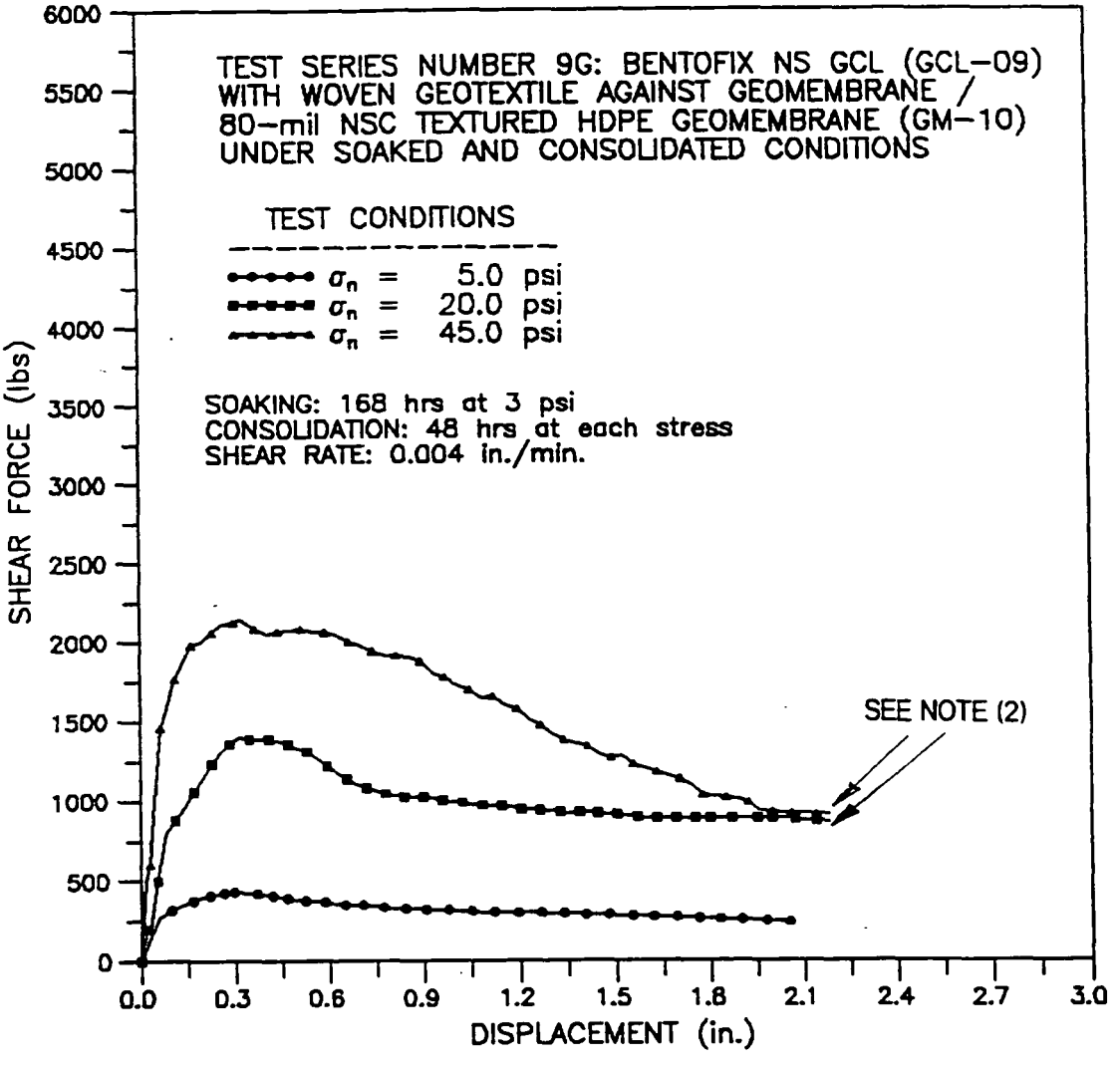
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL

DATE TESTED: 8 TO 17 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730099
FILE NO.	000531

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

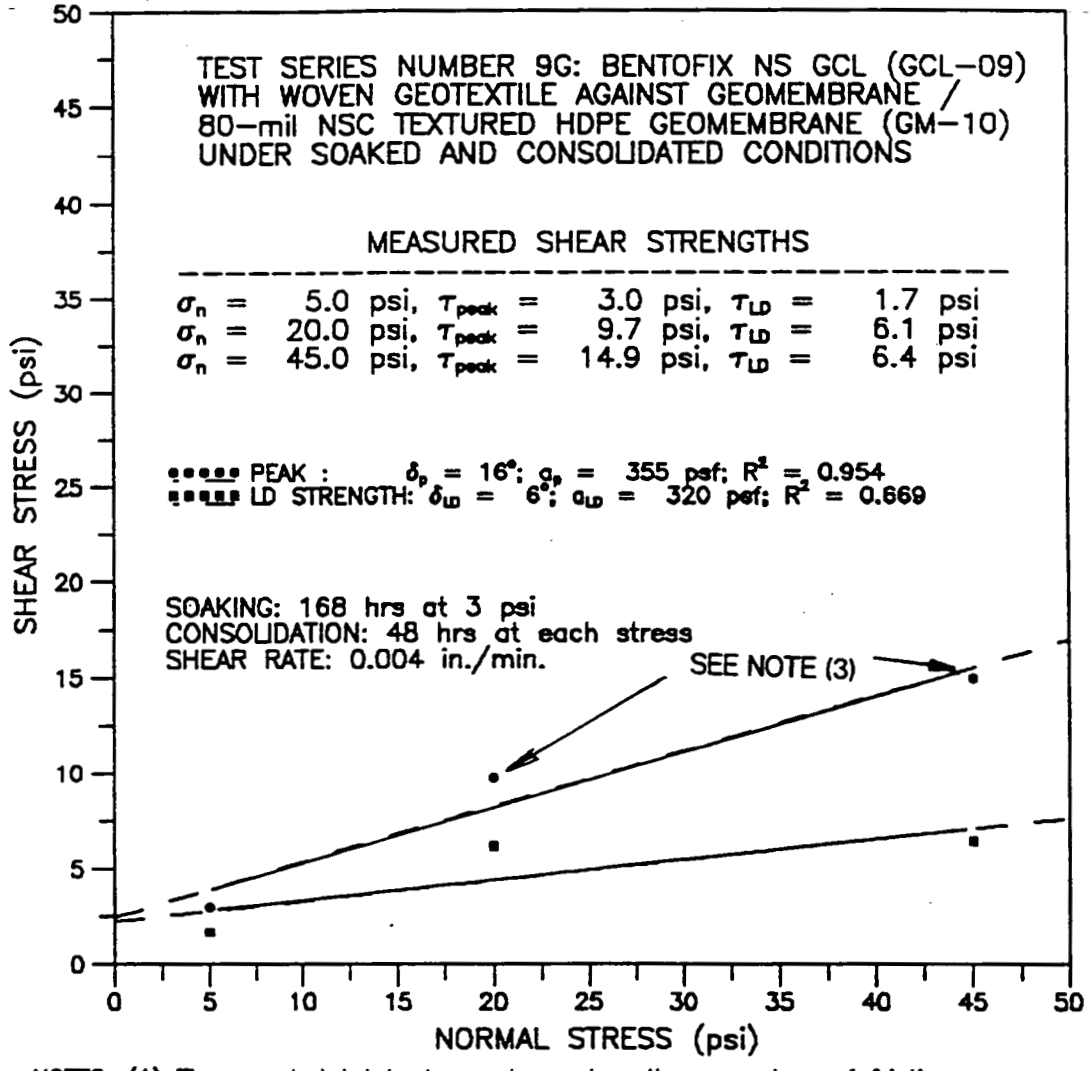
DATE TESTED: 12 TO 21 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730099
FILE NO.	000532

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



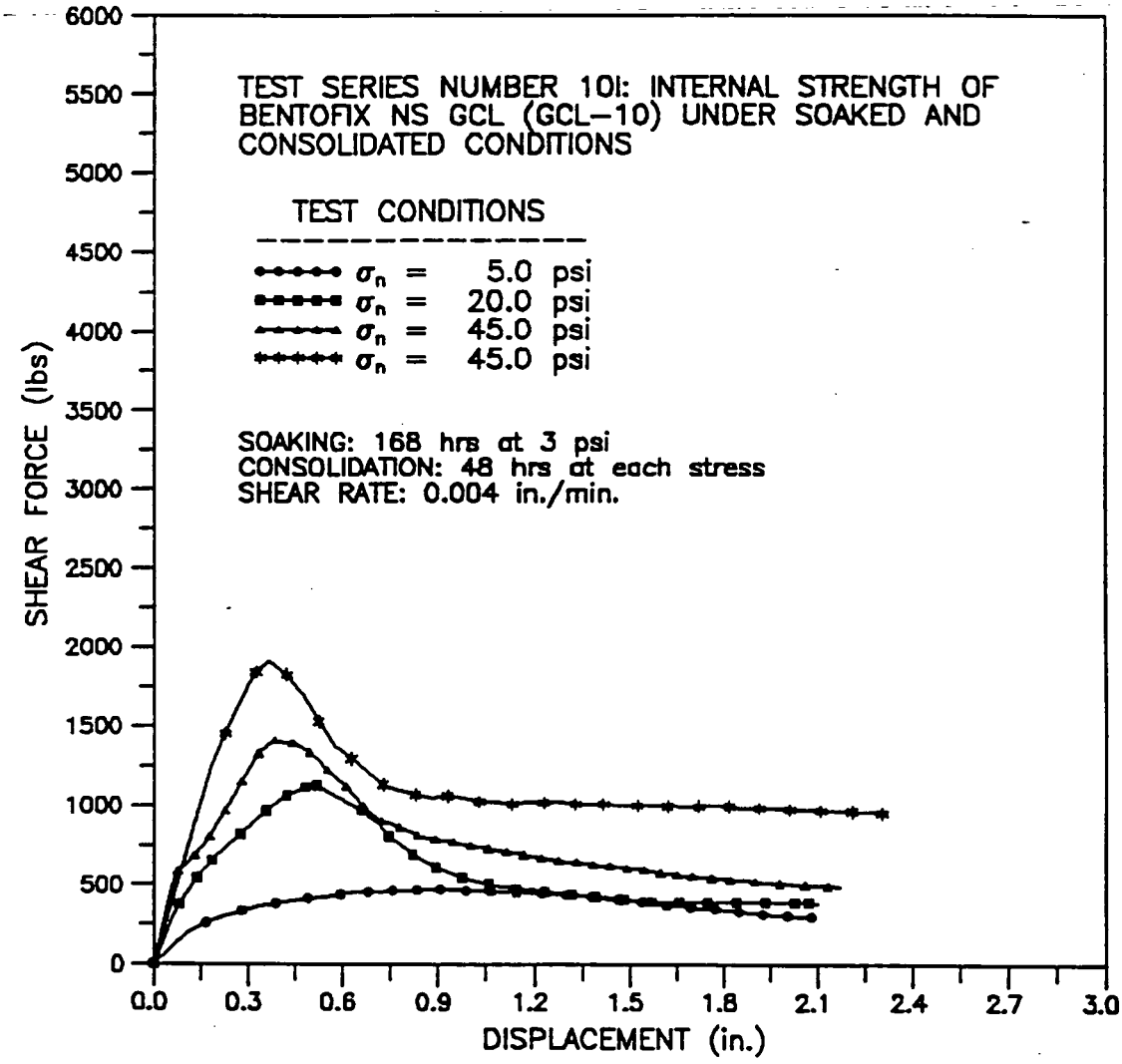
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 12 TO 21 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730099
FILE NO.	000533

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

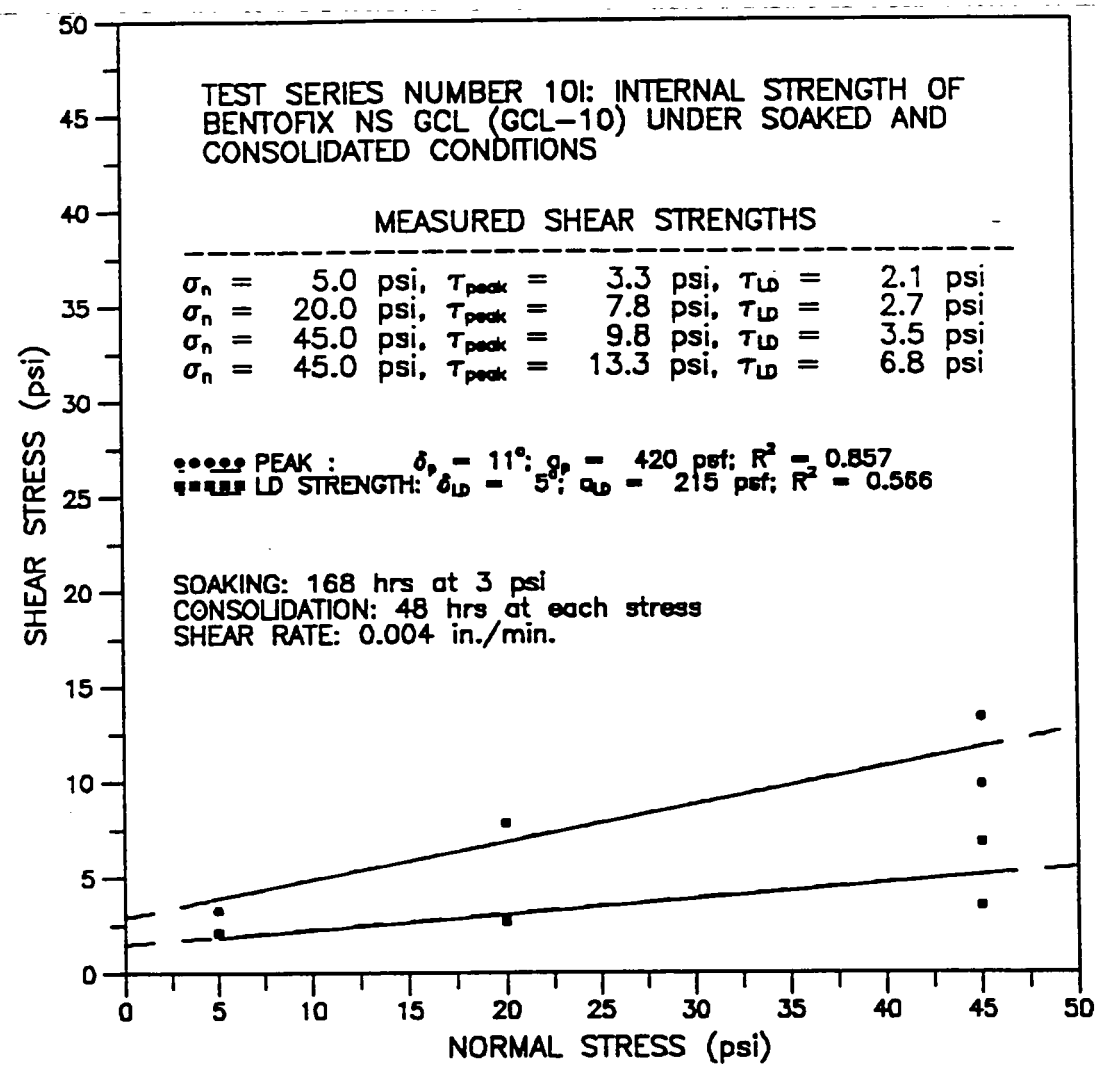
DATE TESTED: 11 SEPTEMBER TO 1 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730108
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



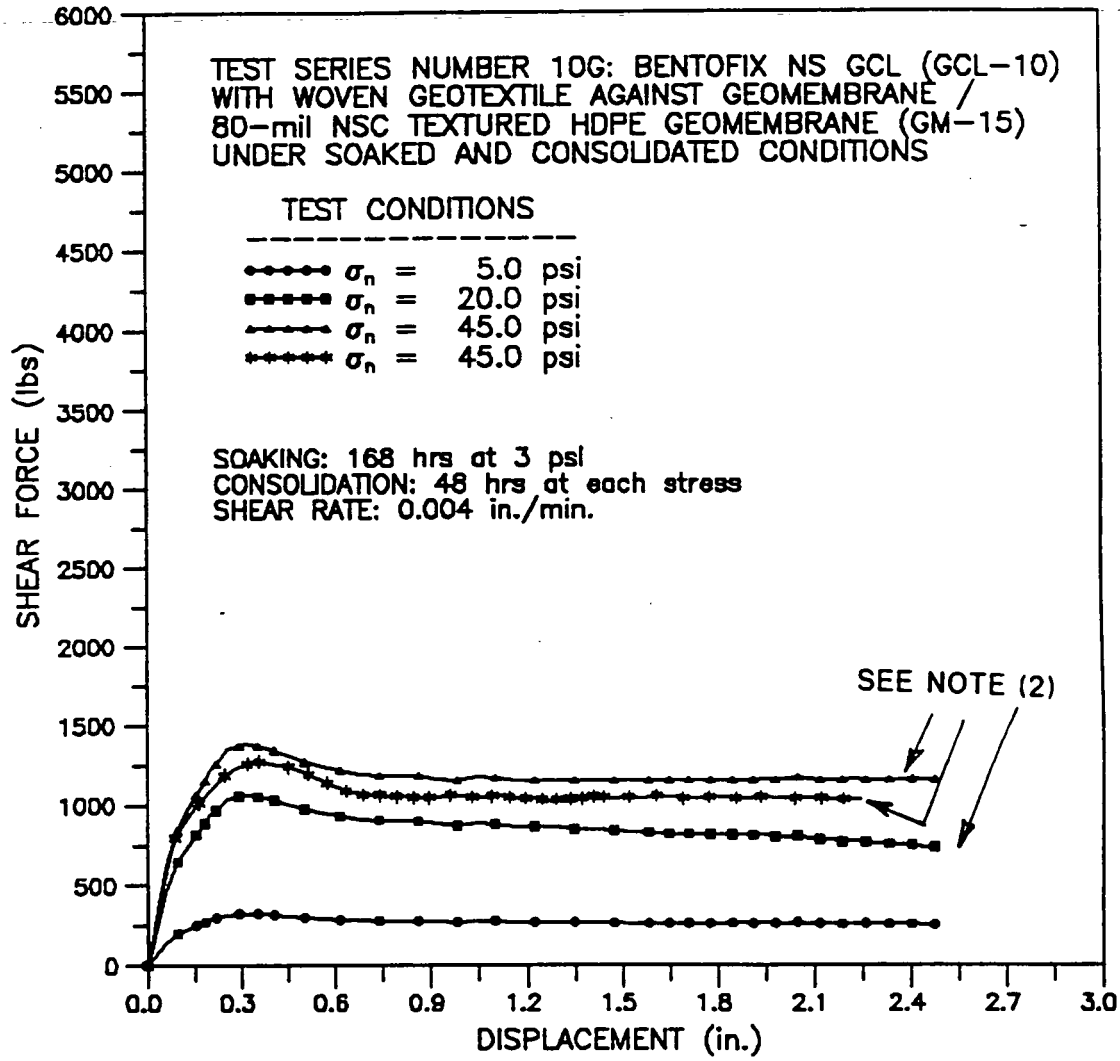
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 11 SEPTEMBER TO 1 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730108
FILE NO.	000535

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

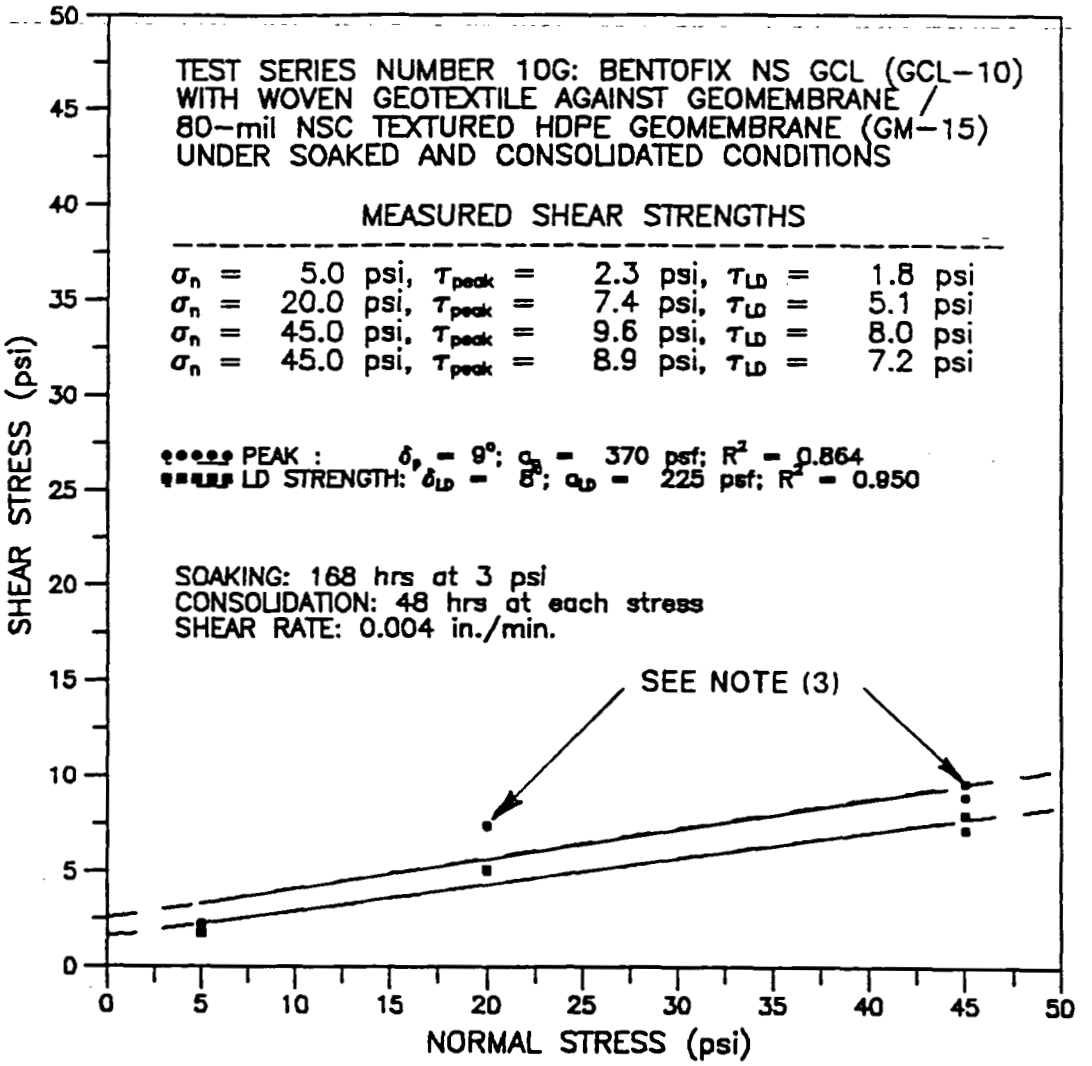
DATE TESTED: 13 TO 24 SEPTEMBER AND 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730108
FILE NO.	000536

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



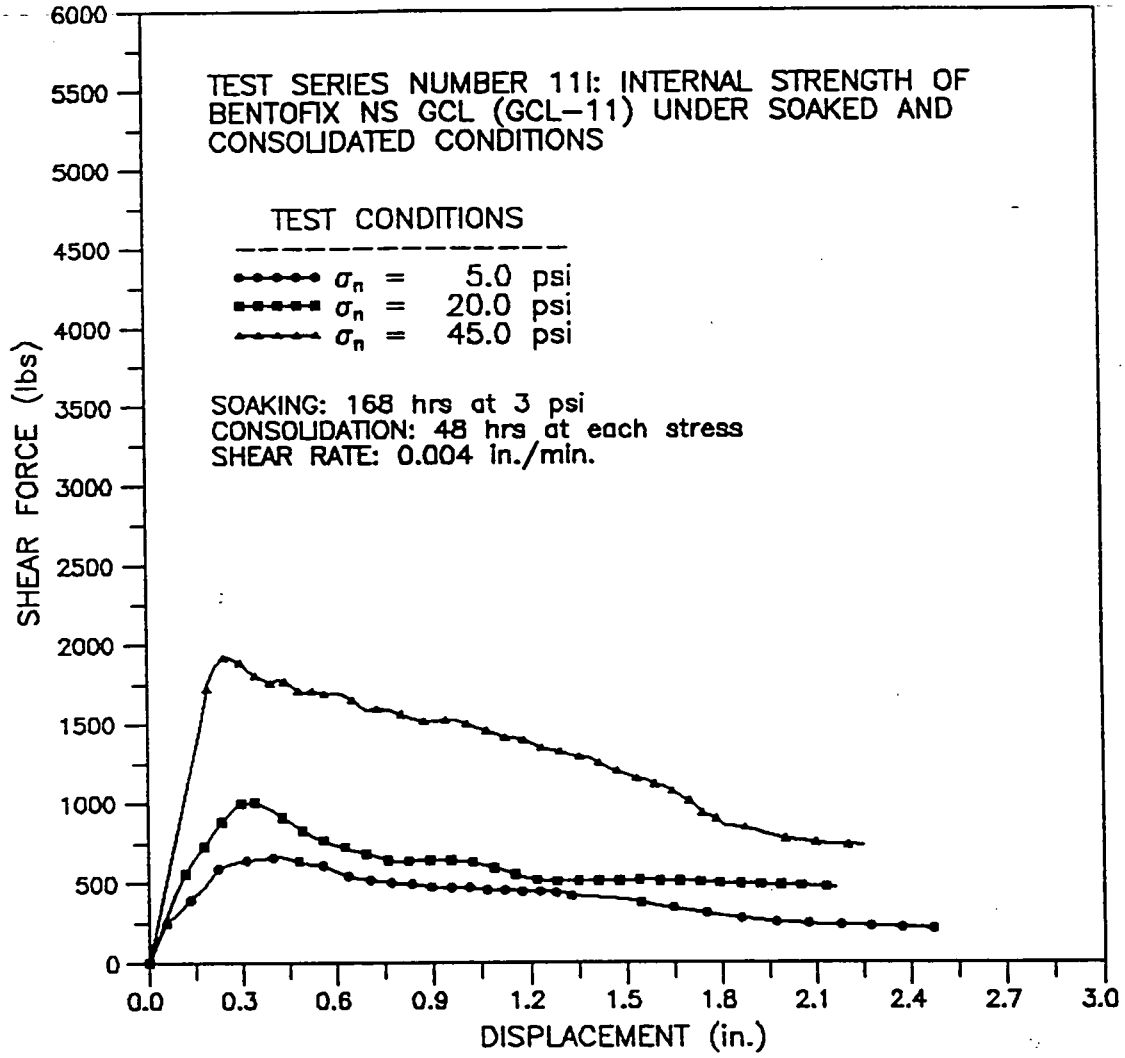
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 13 TO 24 SEPTEMBER AND 6 TO 15 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730108
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

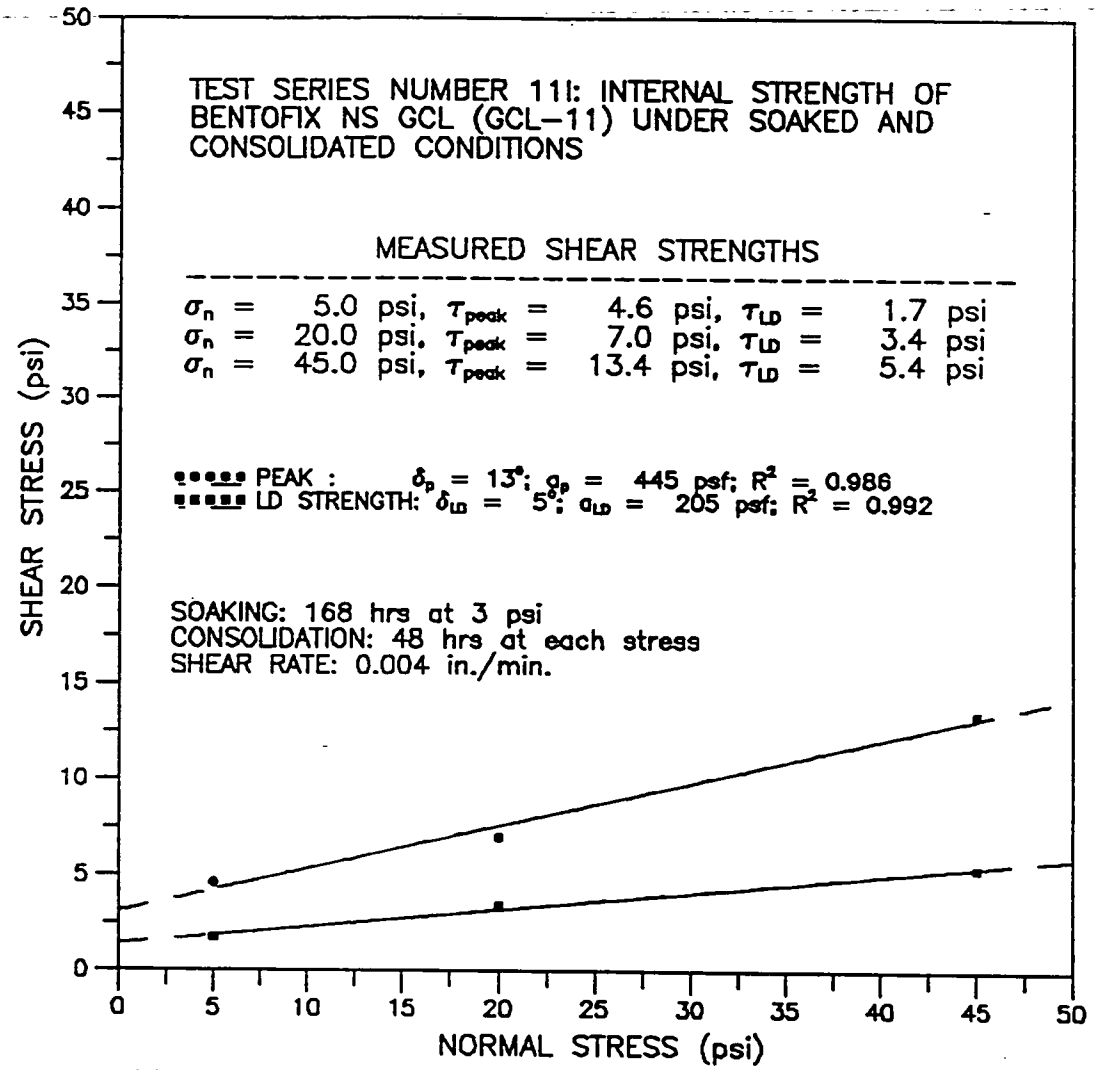
DATE TESTED: 15 TO 24 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730101
FILE NO.	000538

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



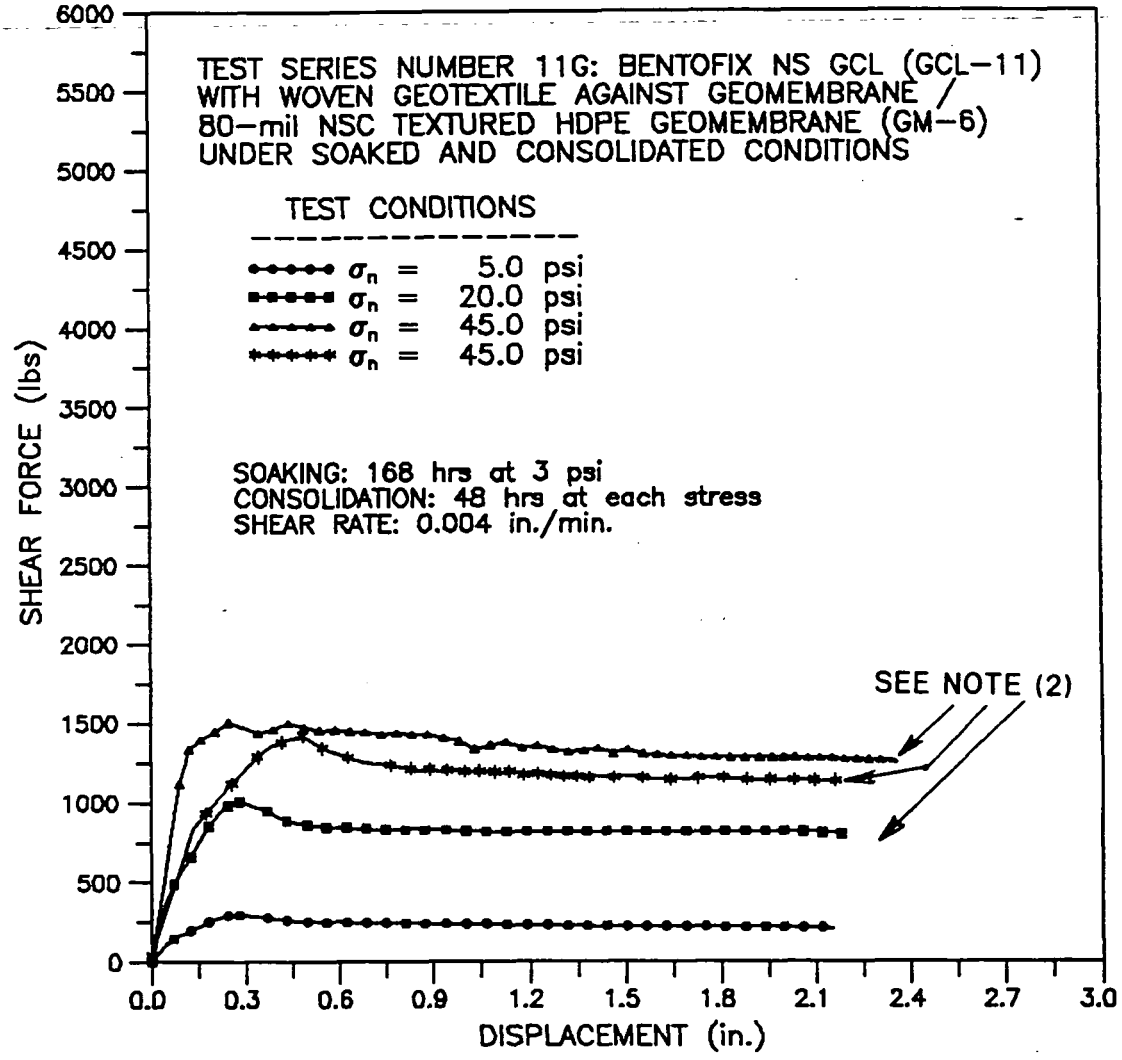
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 15 TO 24 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730101
FILE NO.	000539

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

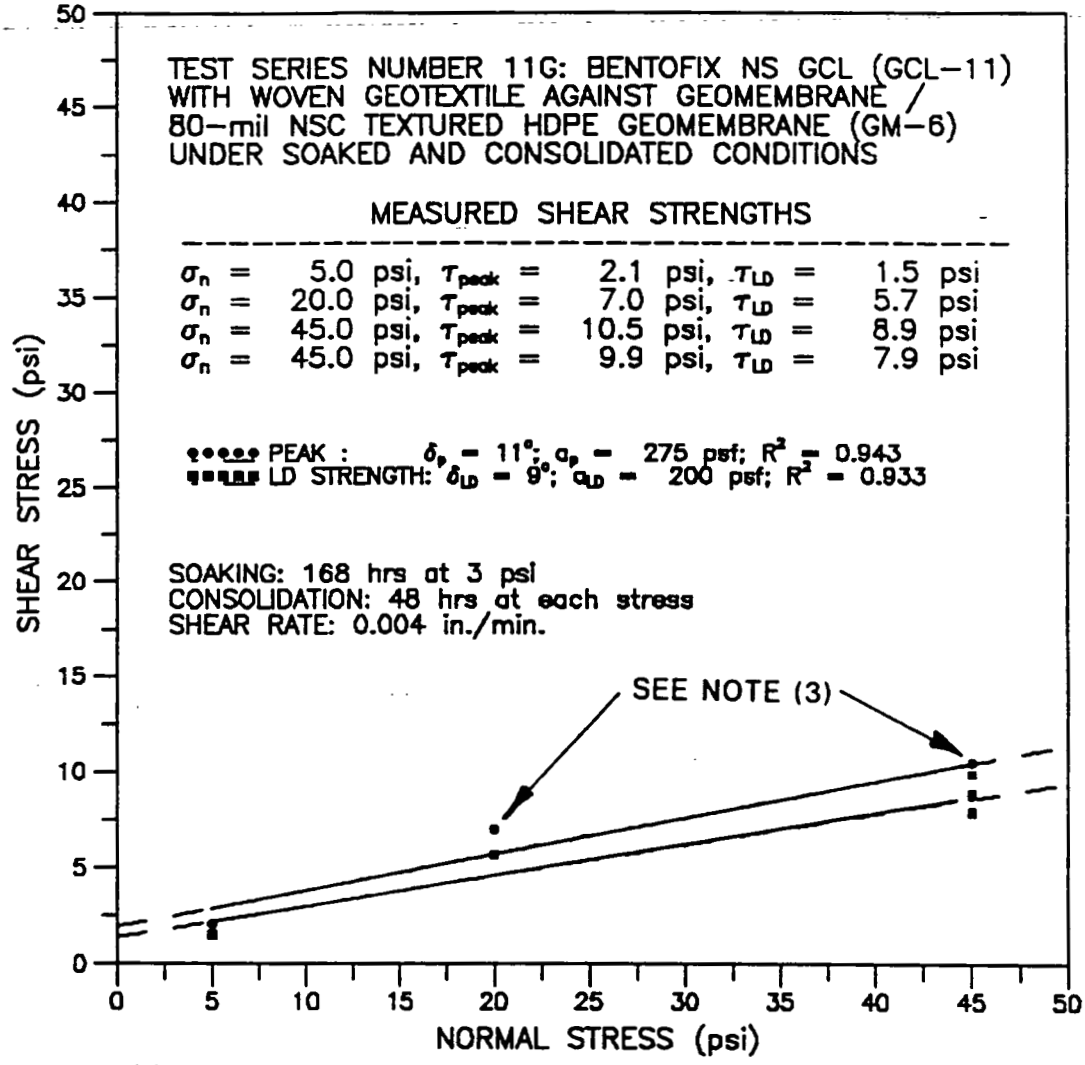
DATE TESTED: 17 TO 26 SEPTEMBER AND 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730101
FILE NO.	000540

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



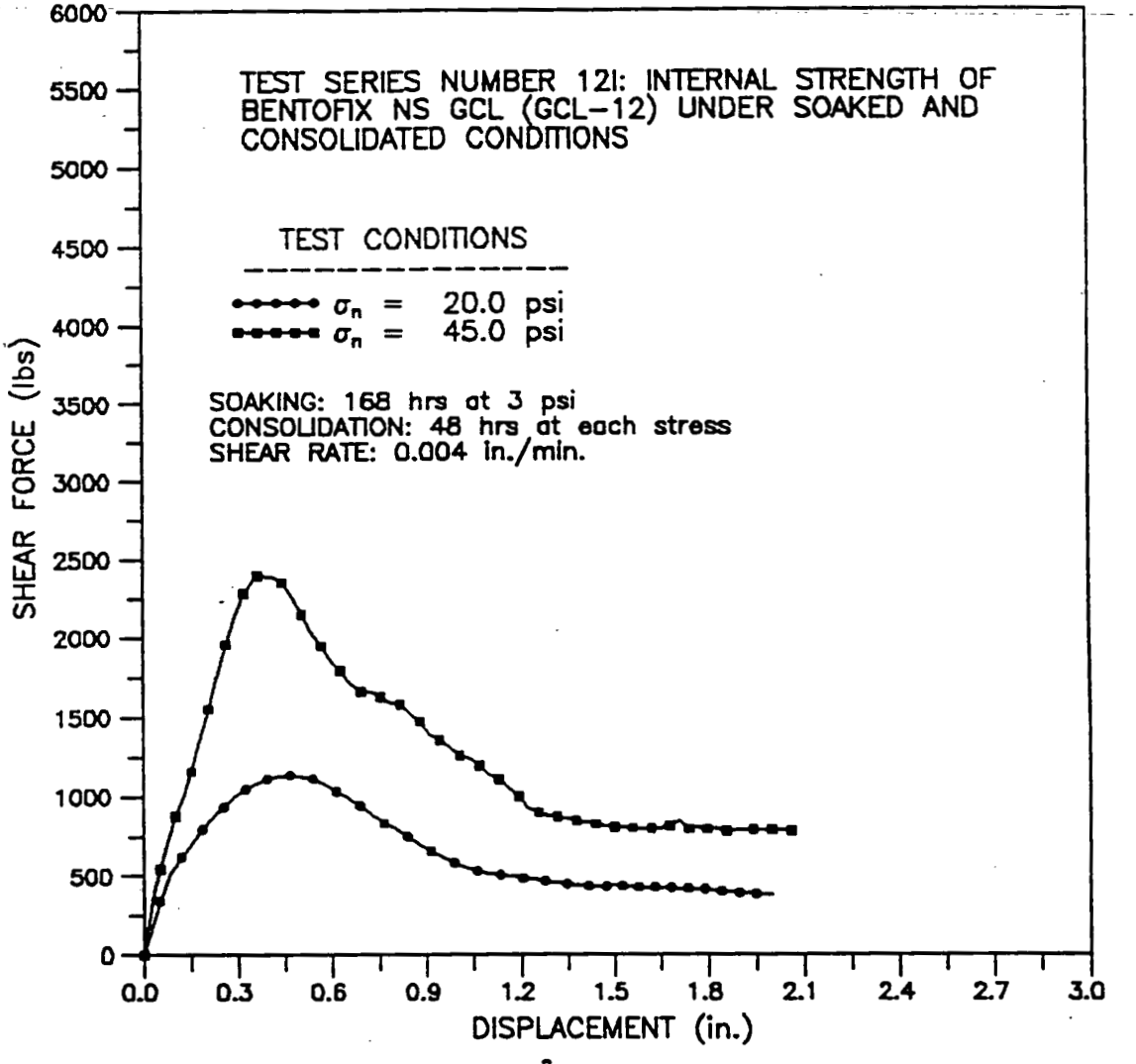
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 17 TO 26 SEPTEMBER AND 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730101
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

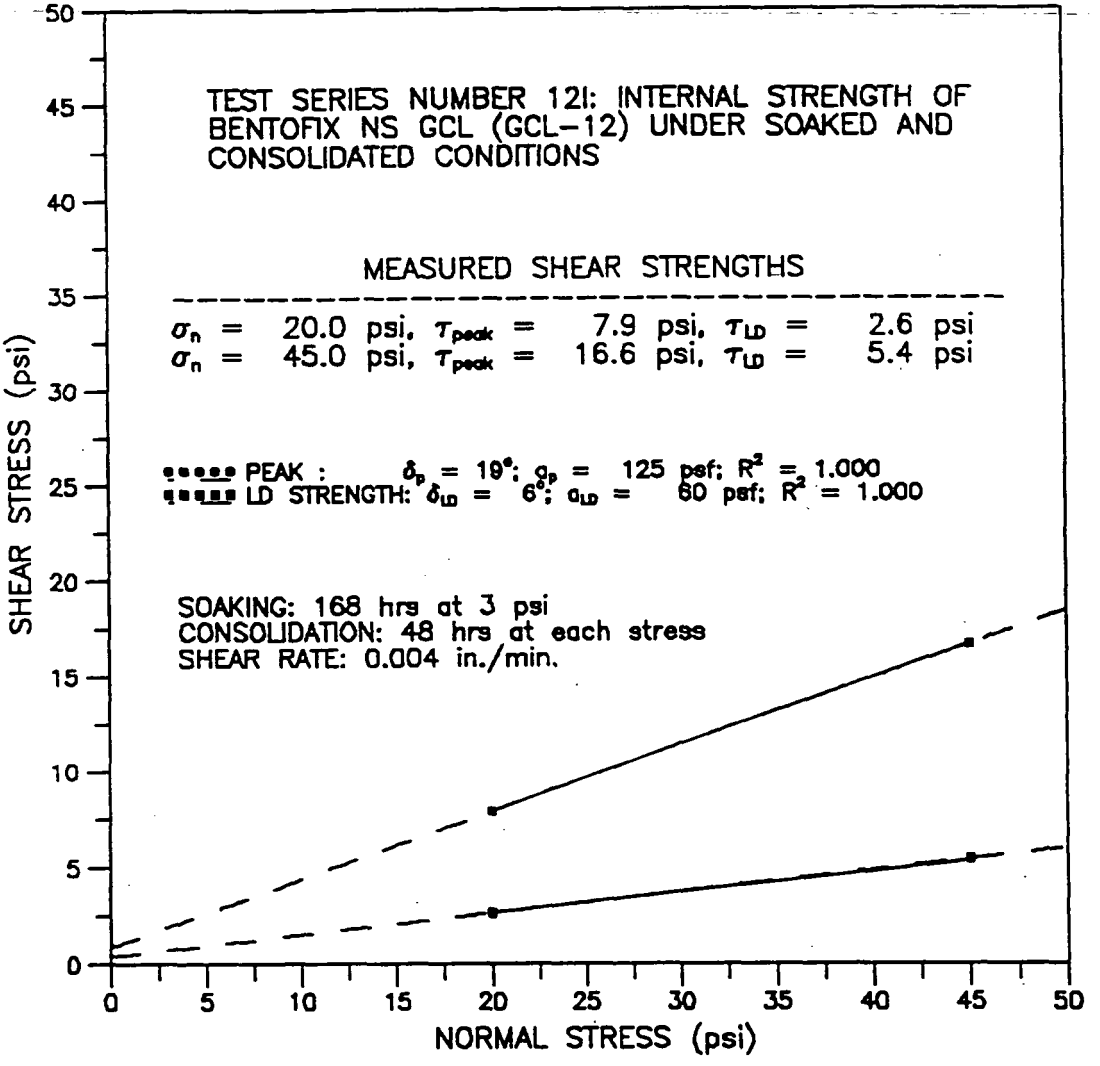
DATE TESTED: 1 TO 10 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730095
FILE NO.	000542

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



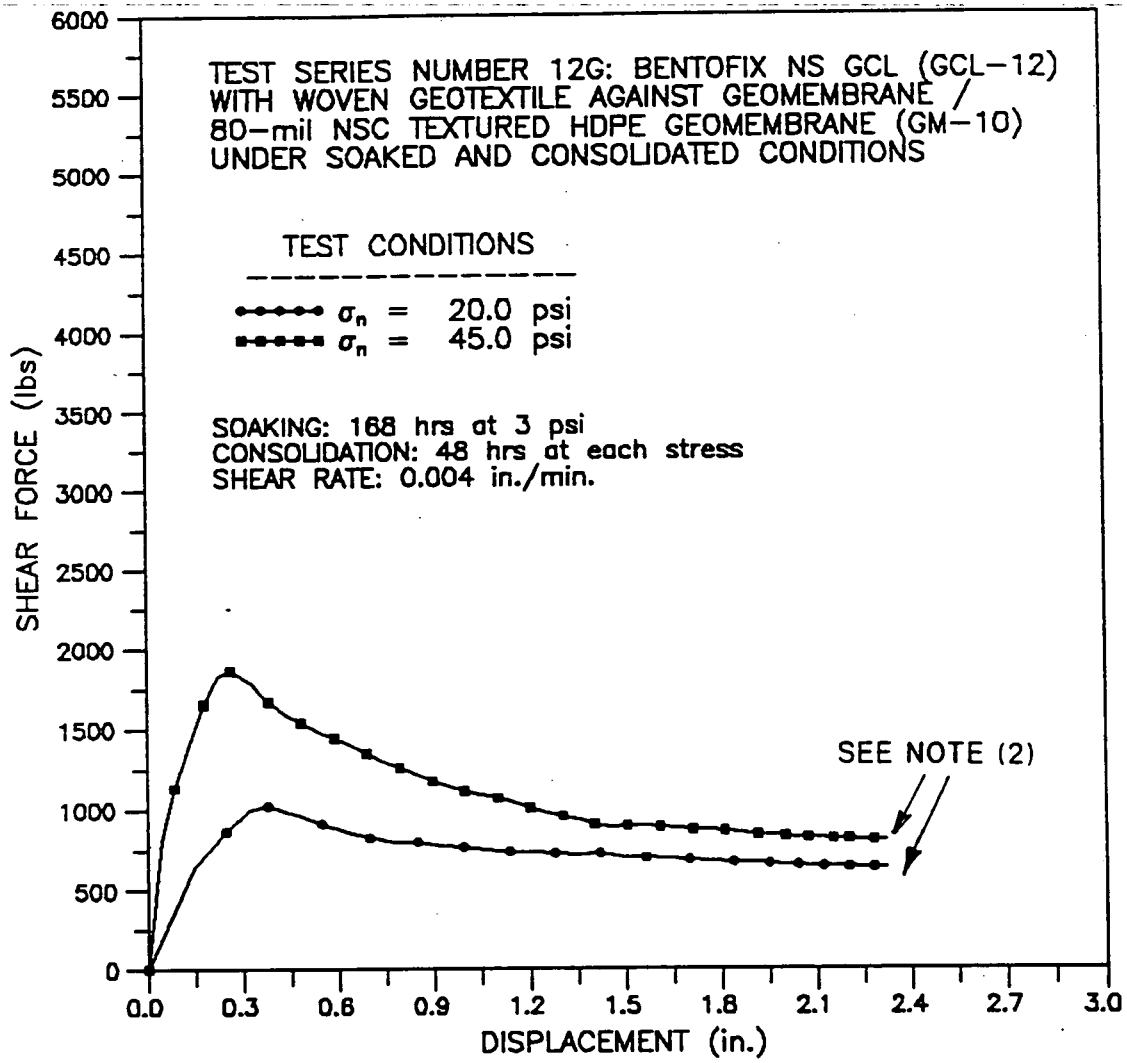
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e. internal shear failure) was observed to occur within the GCL.

DATE TESTED: 1 TO 10 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730095
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

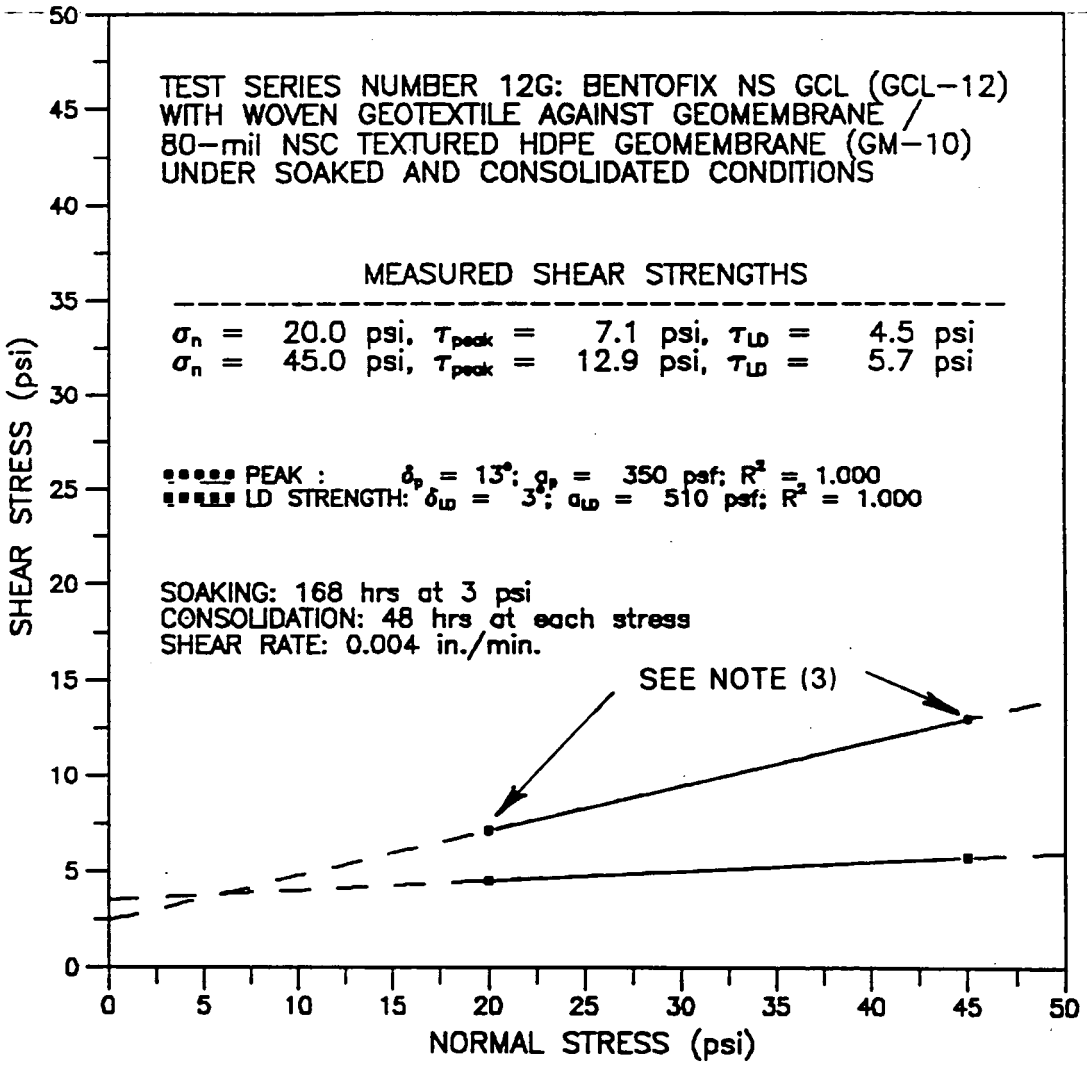
(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 1 TO 10 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730095
FILE NO.	000544

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



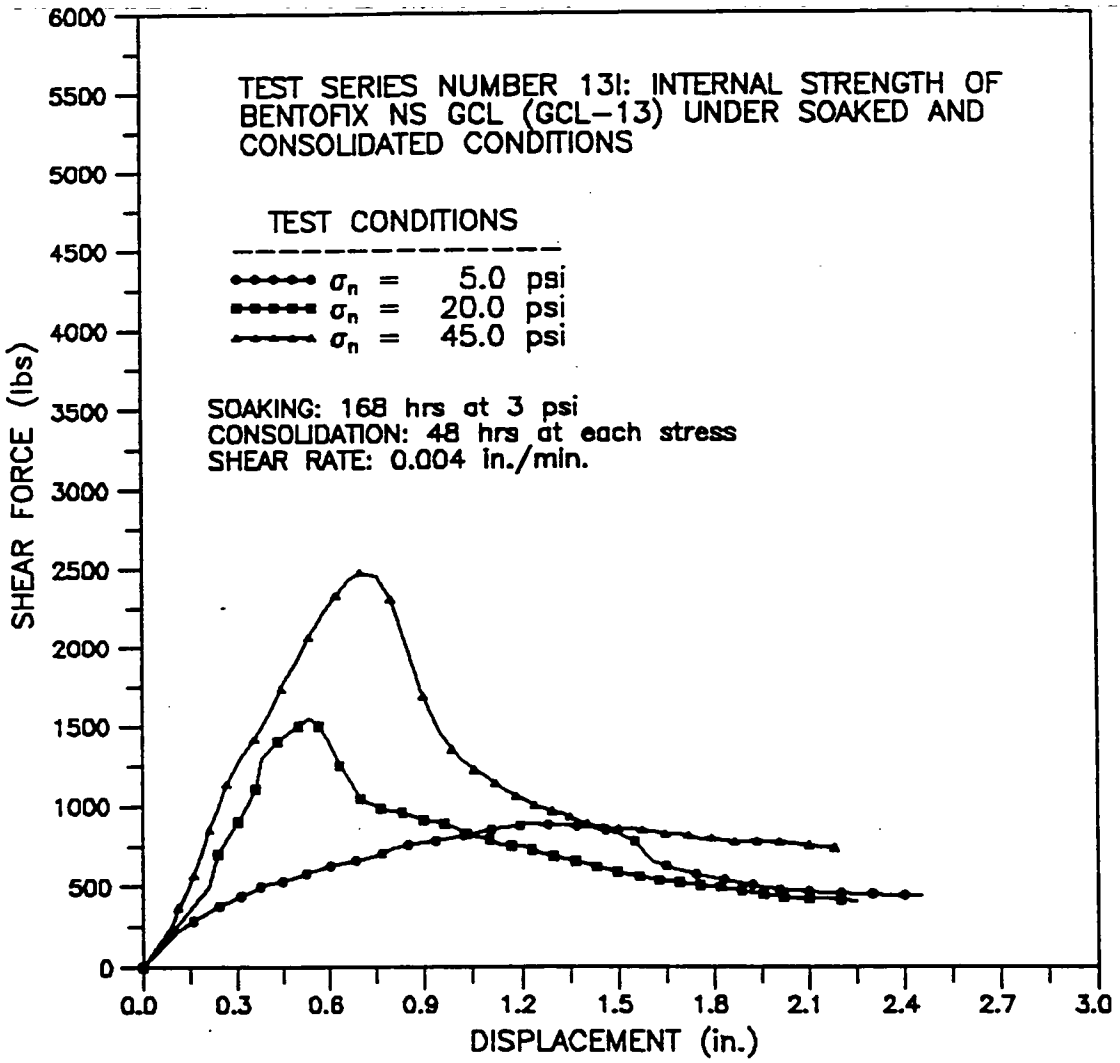
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 1 TO 10 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730095
FILE NO.	000545

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

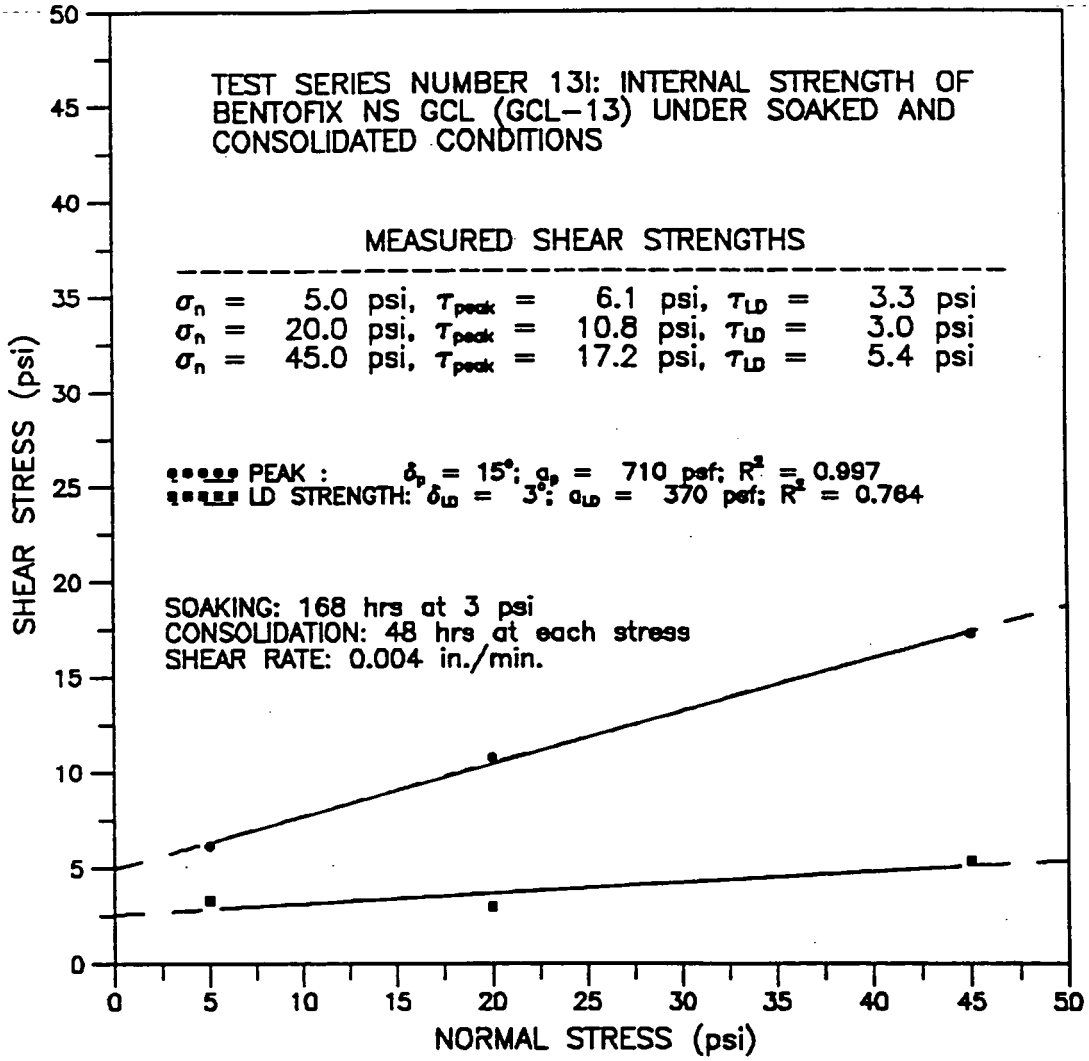
DATE TESTED: 20 TO 29 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730090
FILE NO.	000546

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



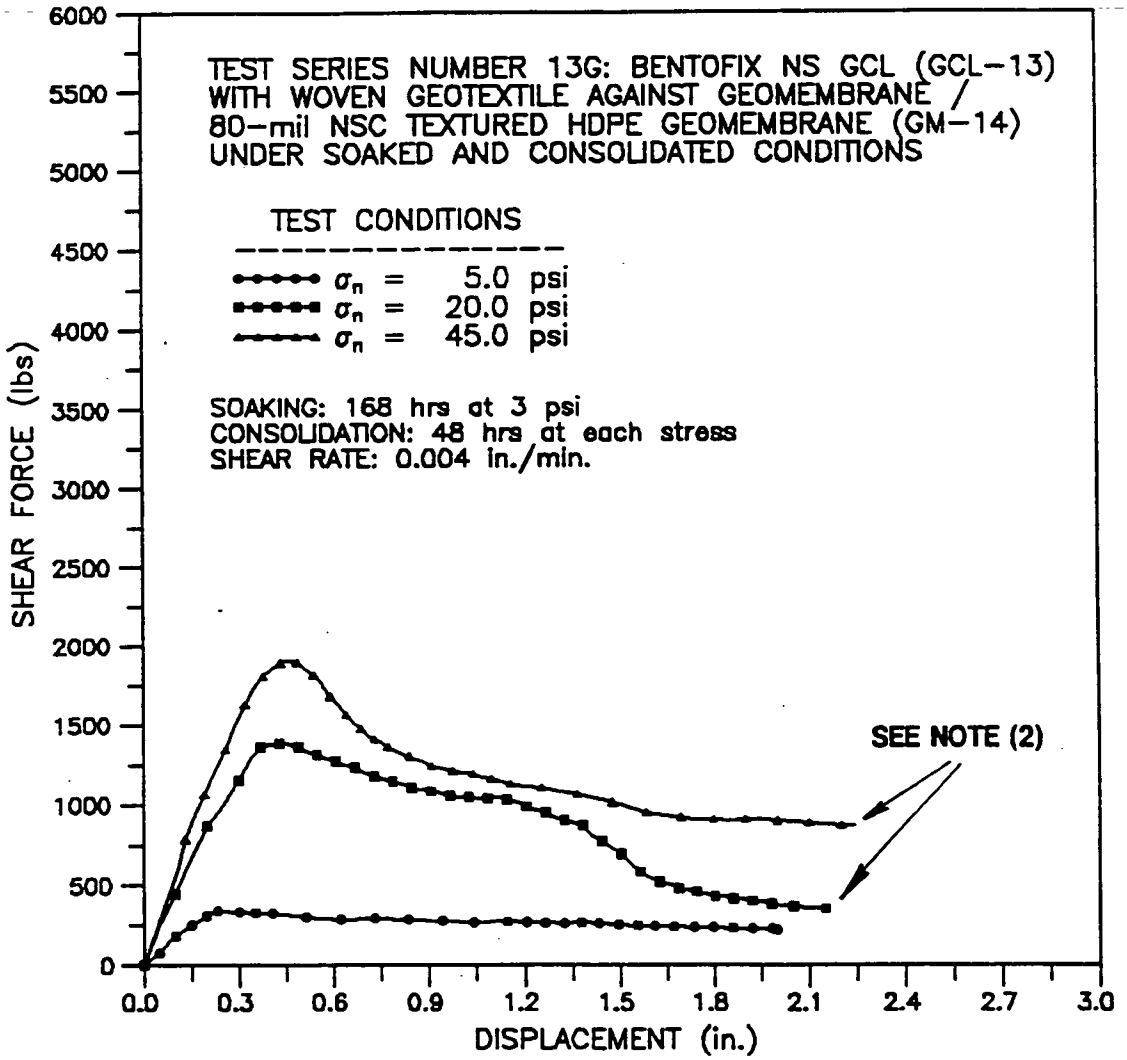
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 27 AUGUST TO 5 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730090
FILE NO.	000547

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

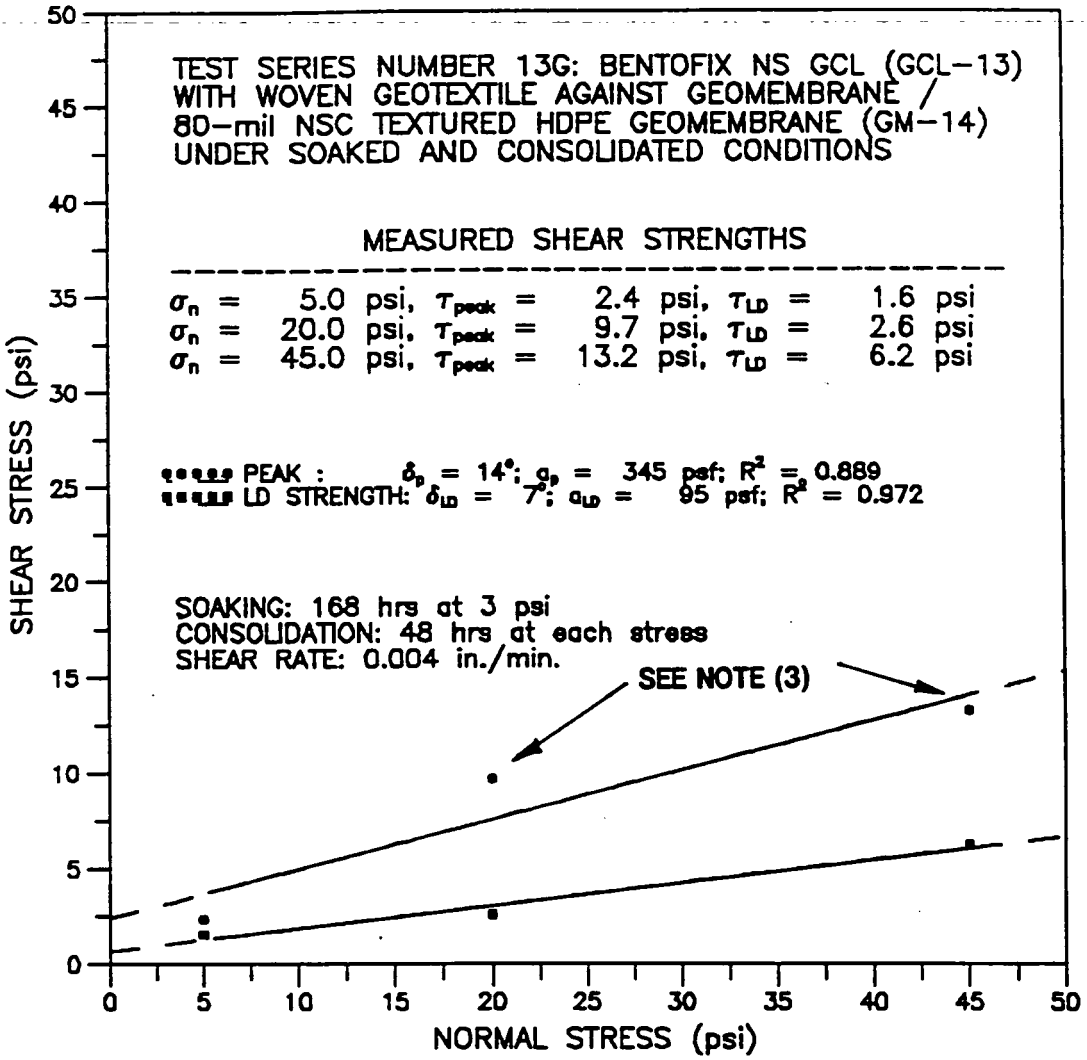
DATE TESTED: 22 SEPTEMBER TO 1 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730090
FILE NO.	000548

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



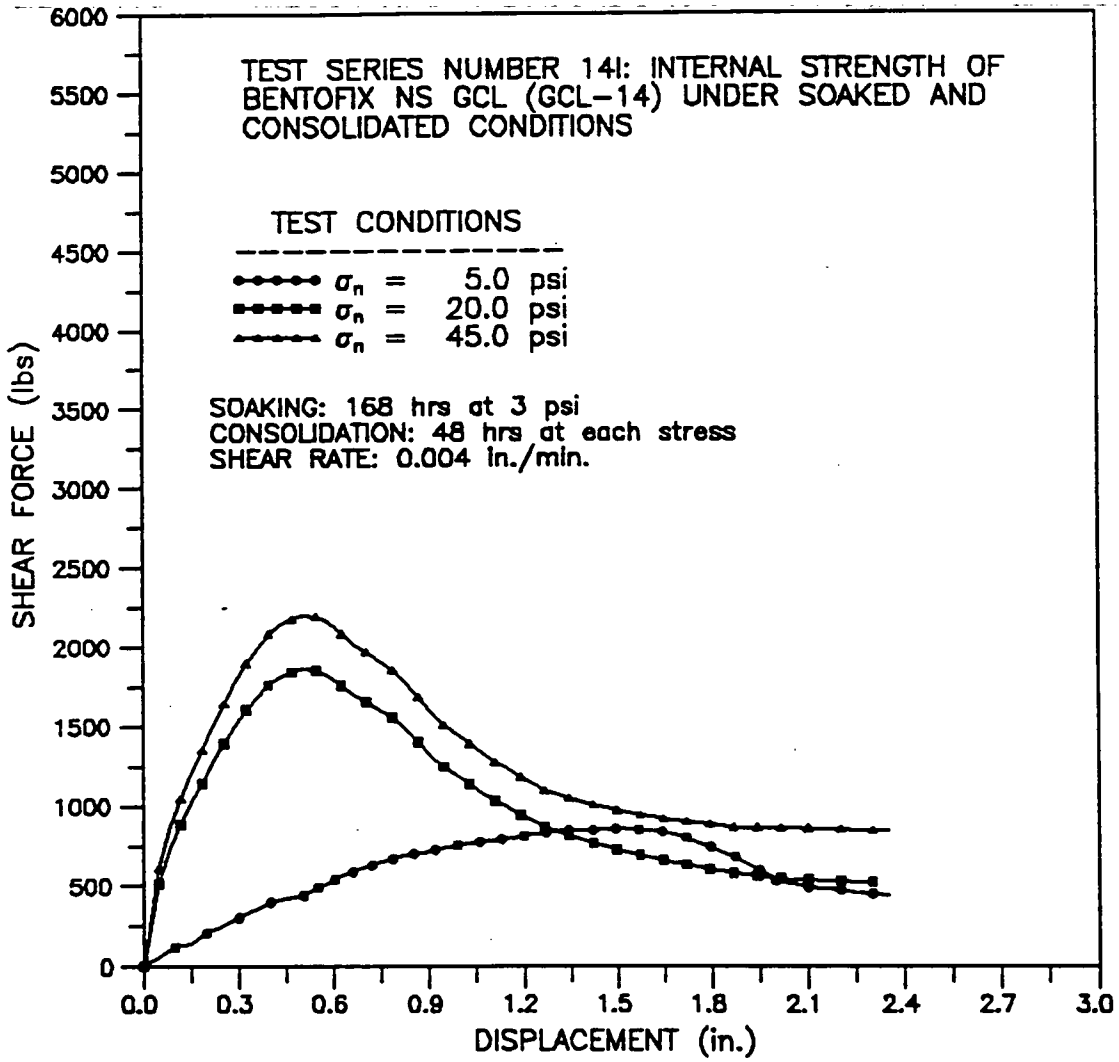
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 22 SEPTEMBER TO 1 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730090
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

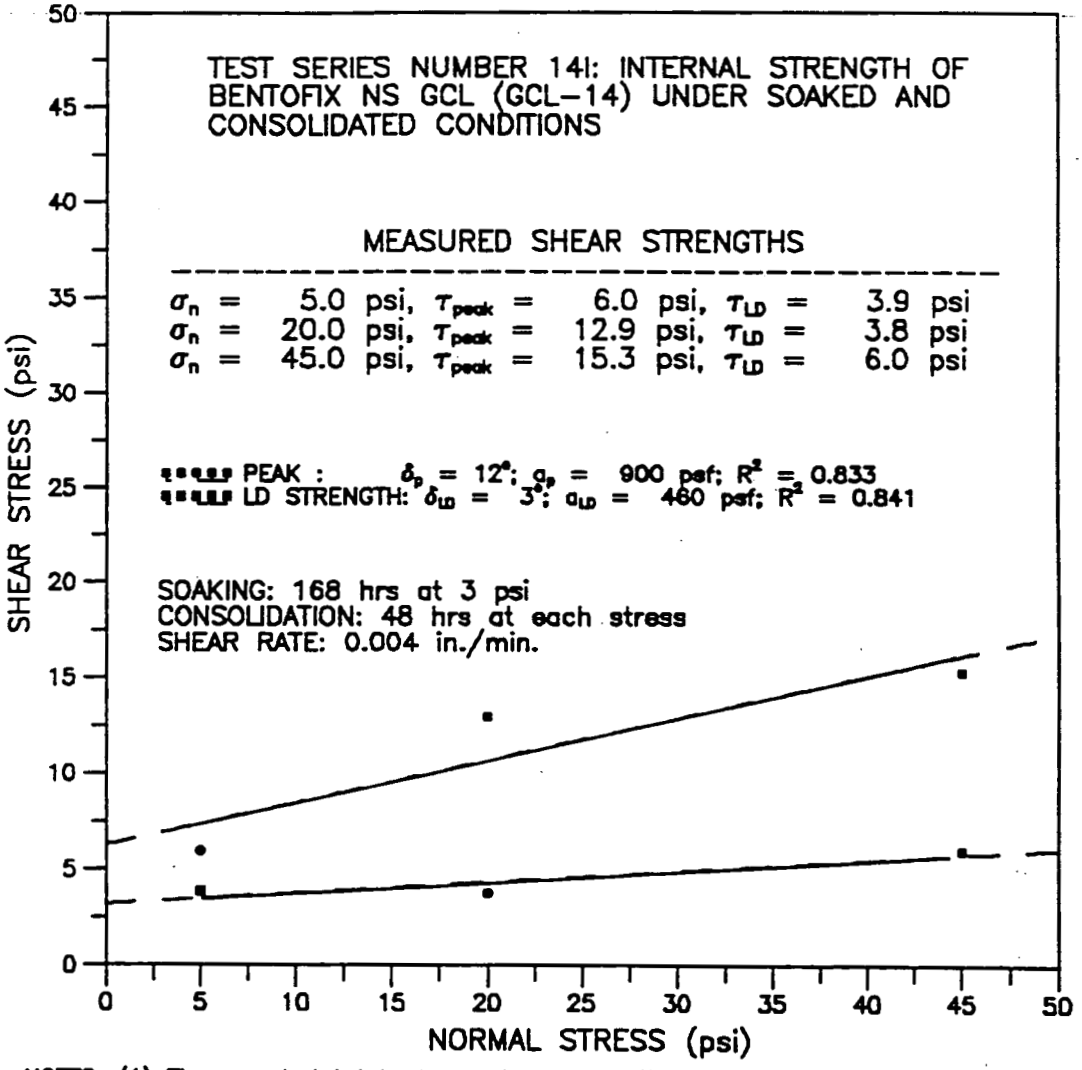
DATE TESTED: 22 SEPTEMBER TO 3 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730091
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



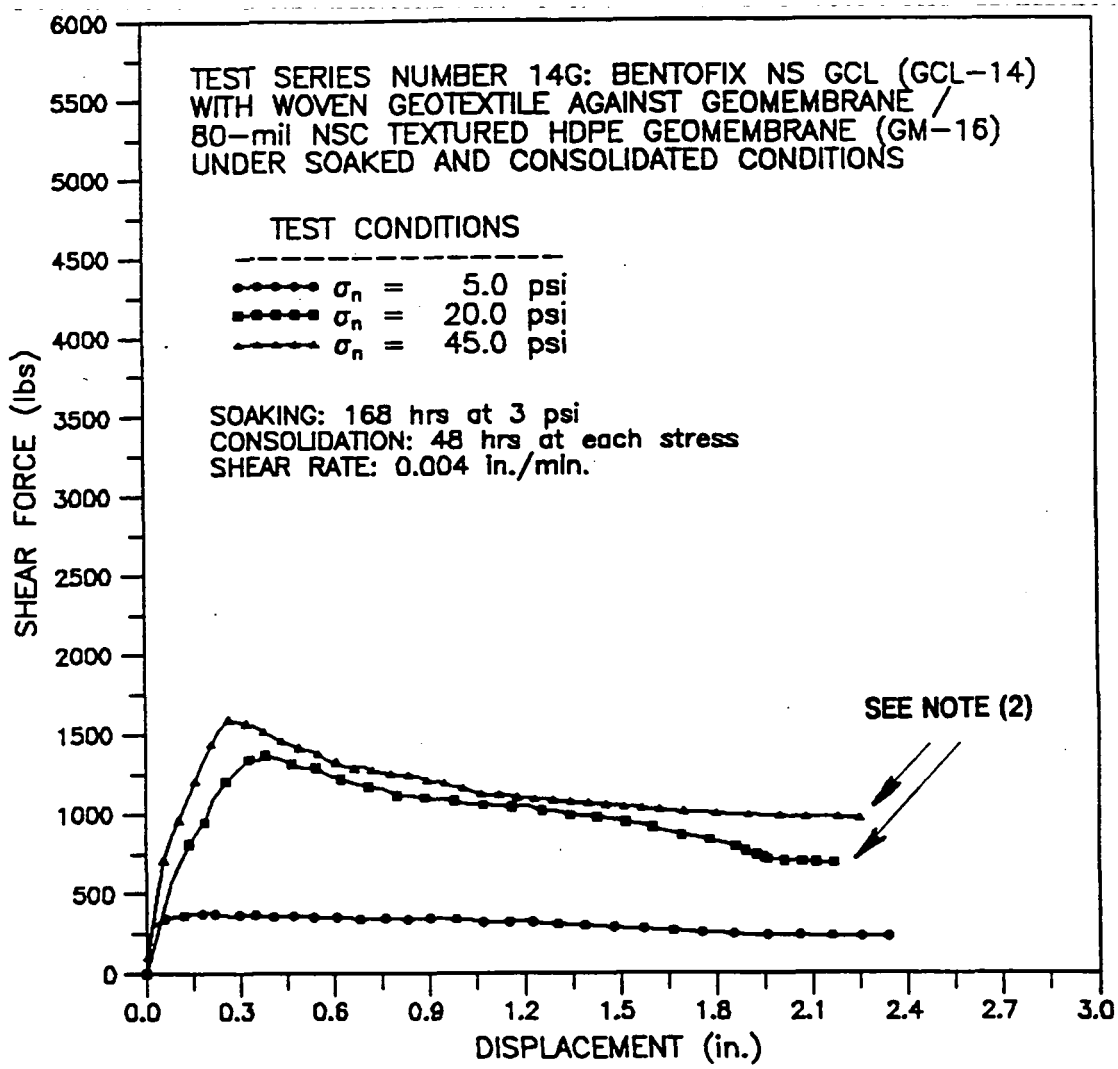
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 22 SEPTEMBER TO 3 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730091
FILE NO.	000551

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

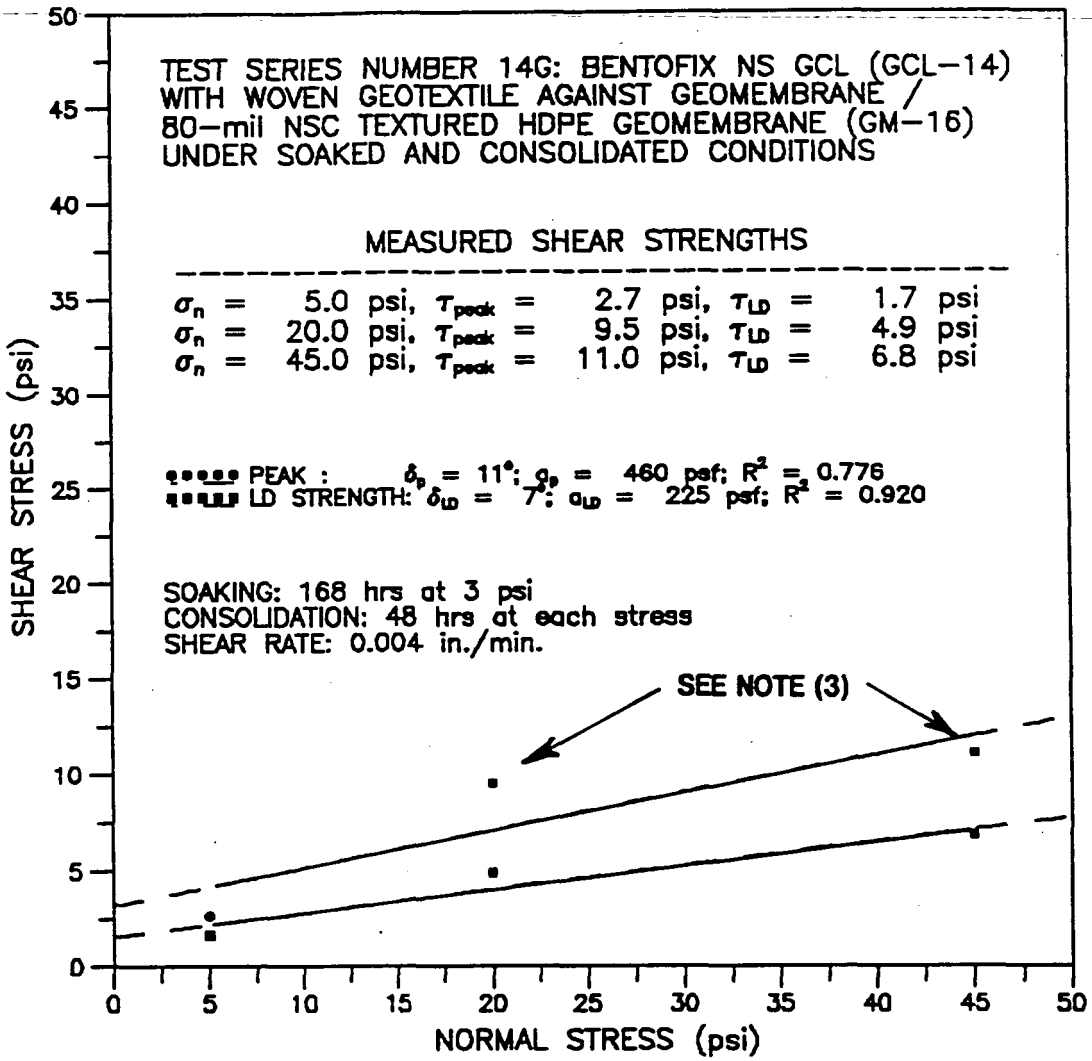
(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 24 SEPTEMBER TO 3 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730091
FILE NO.	000552

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



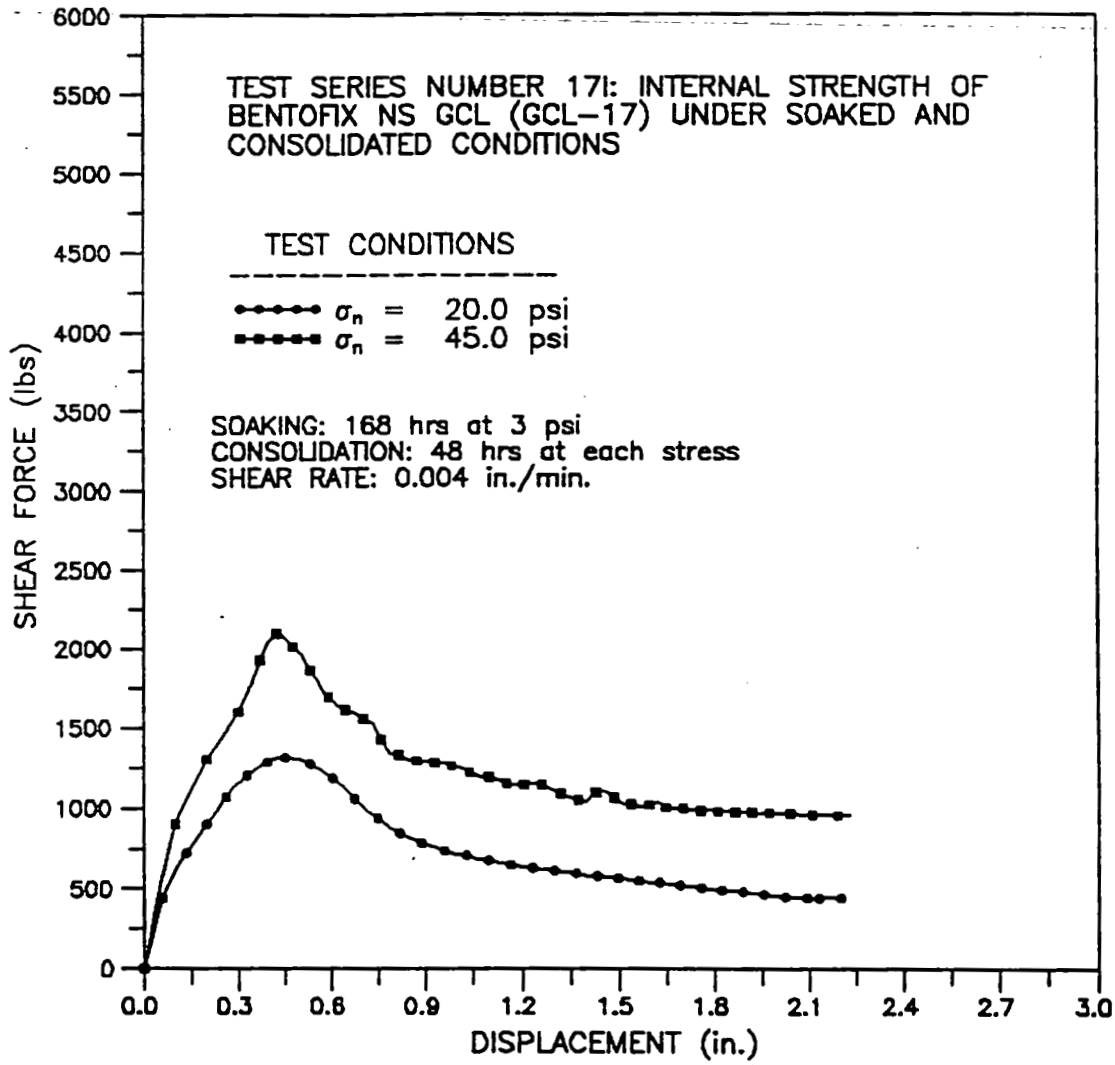
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 24 SEPTEMBER TO 3 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730091
FILE NO.	000553

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

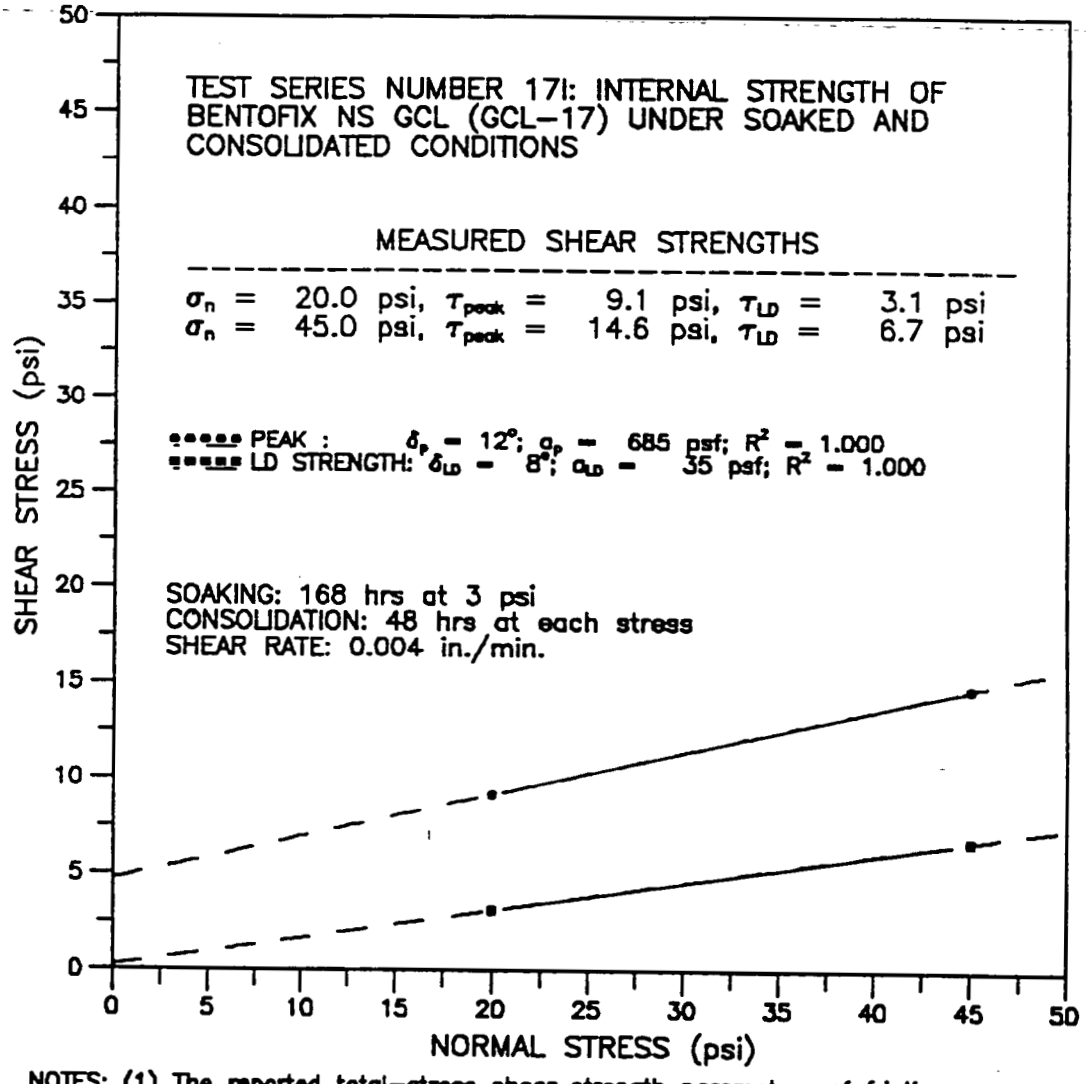
DATE TESTED: 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730096
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



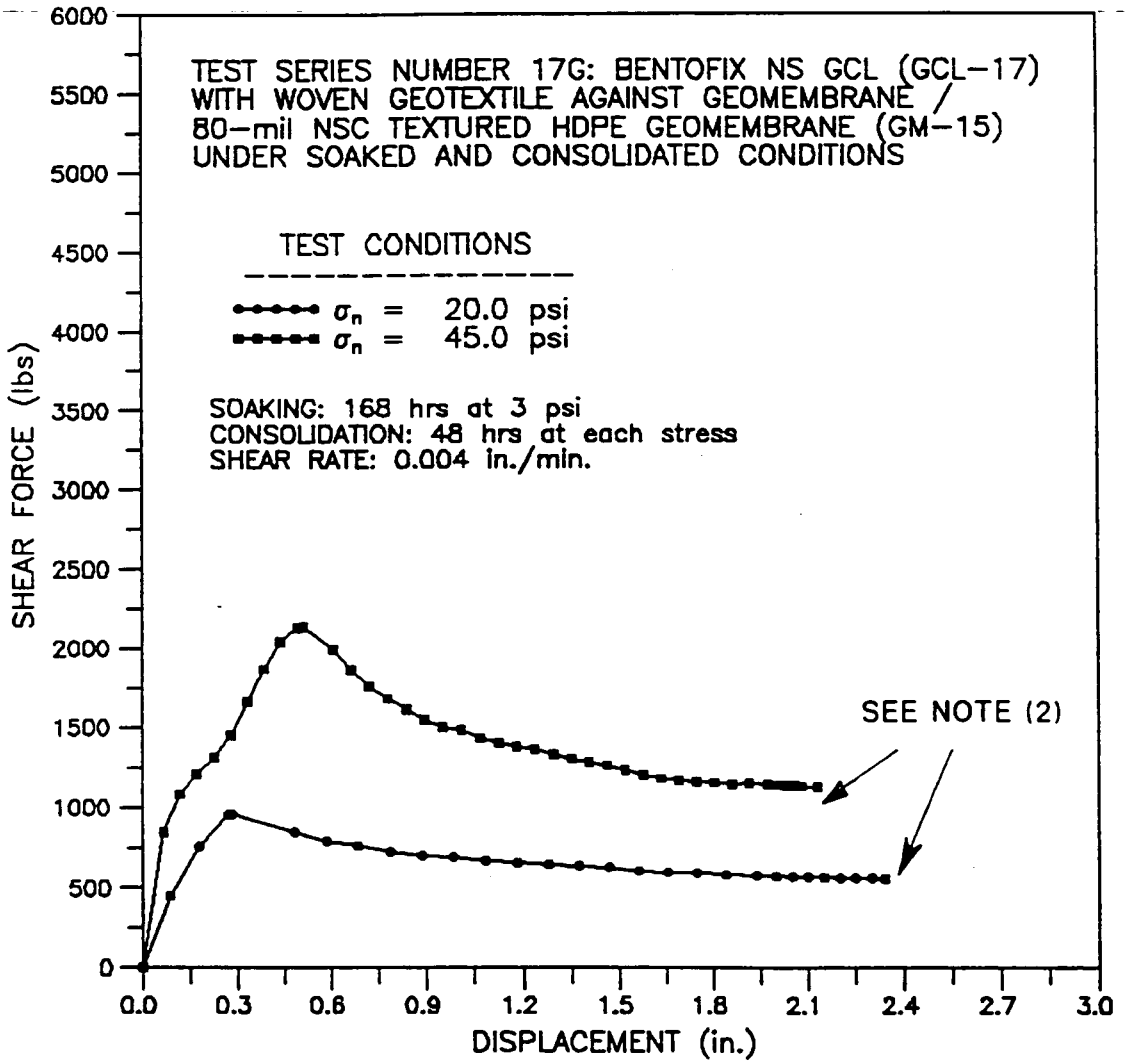
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730096
FILE NO.	000555

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

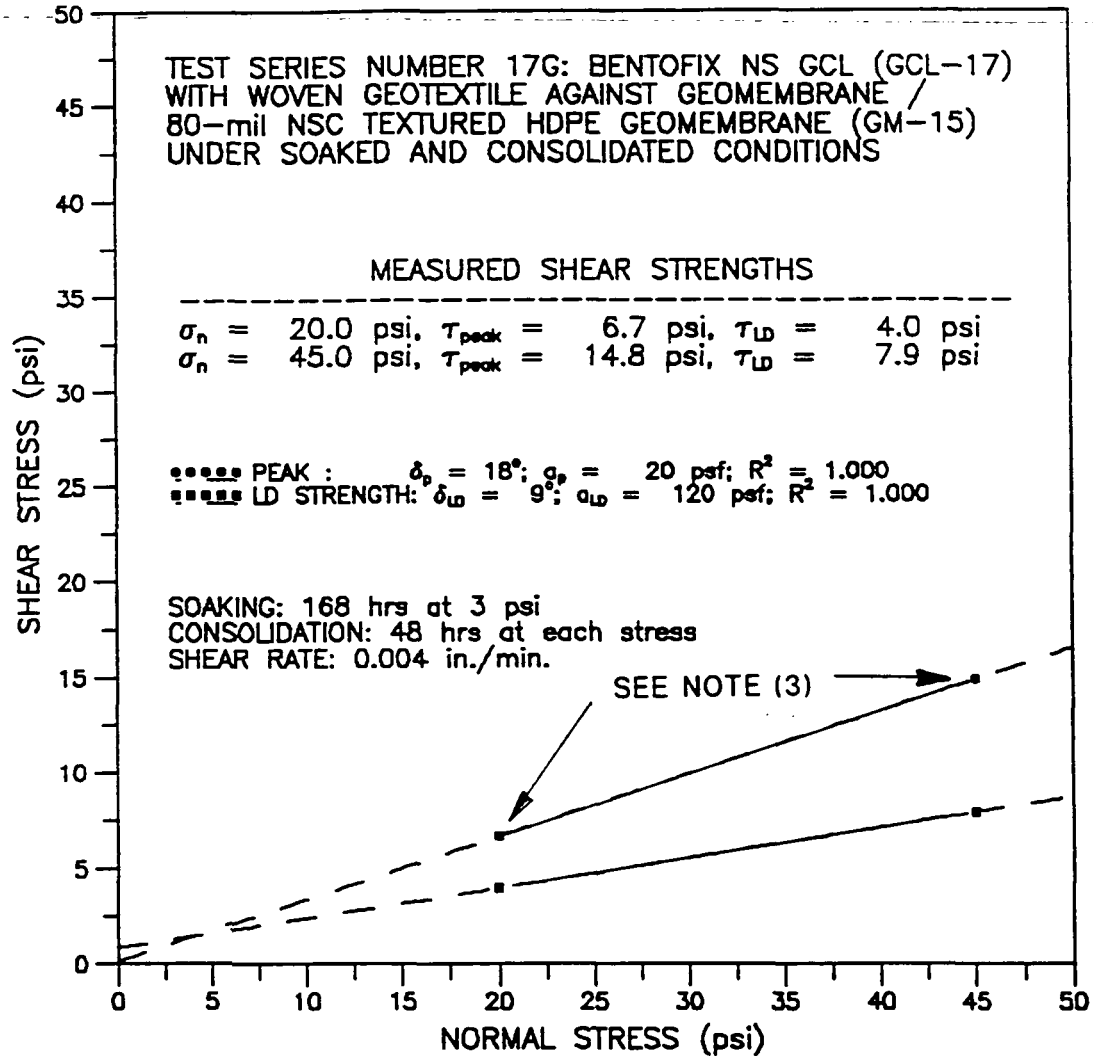
DATE TESTED: 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730096
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



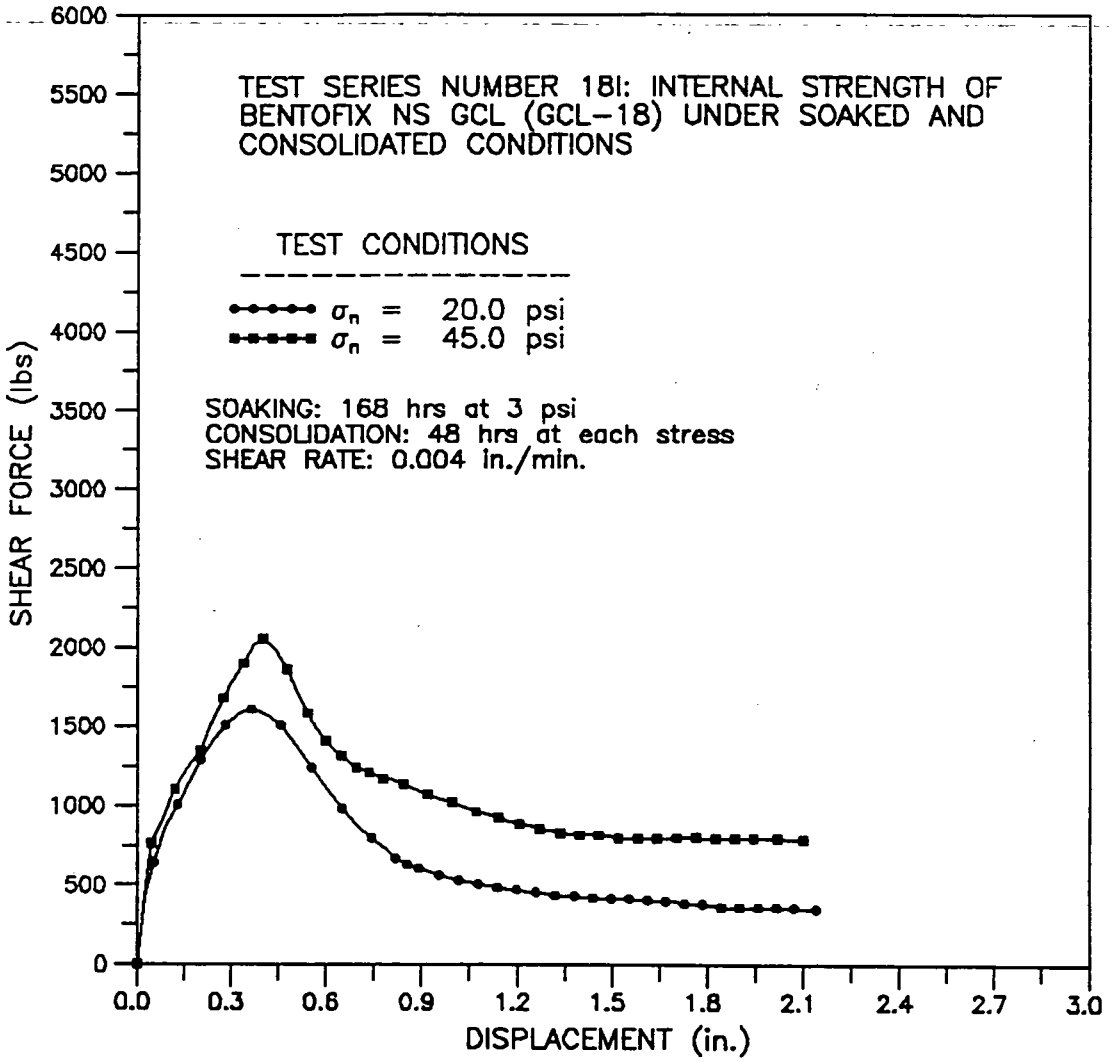
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 4 TO 13 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730096
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL

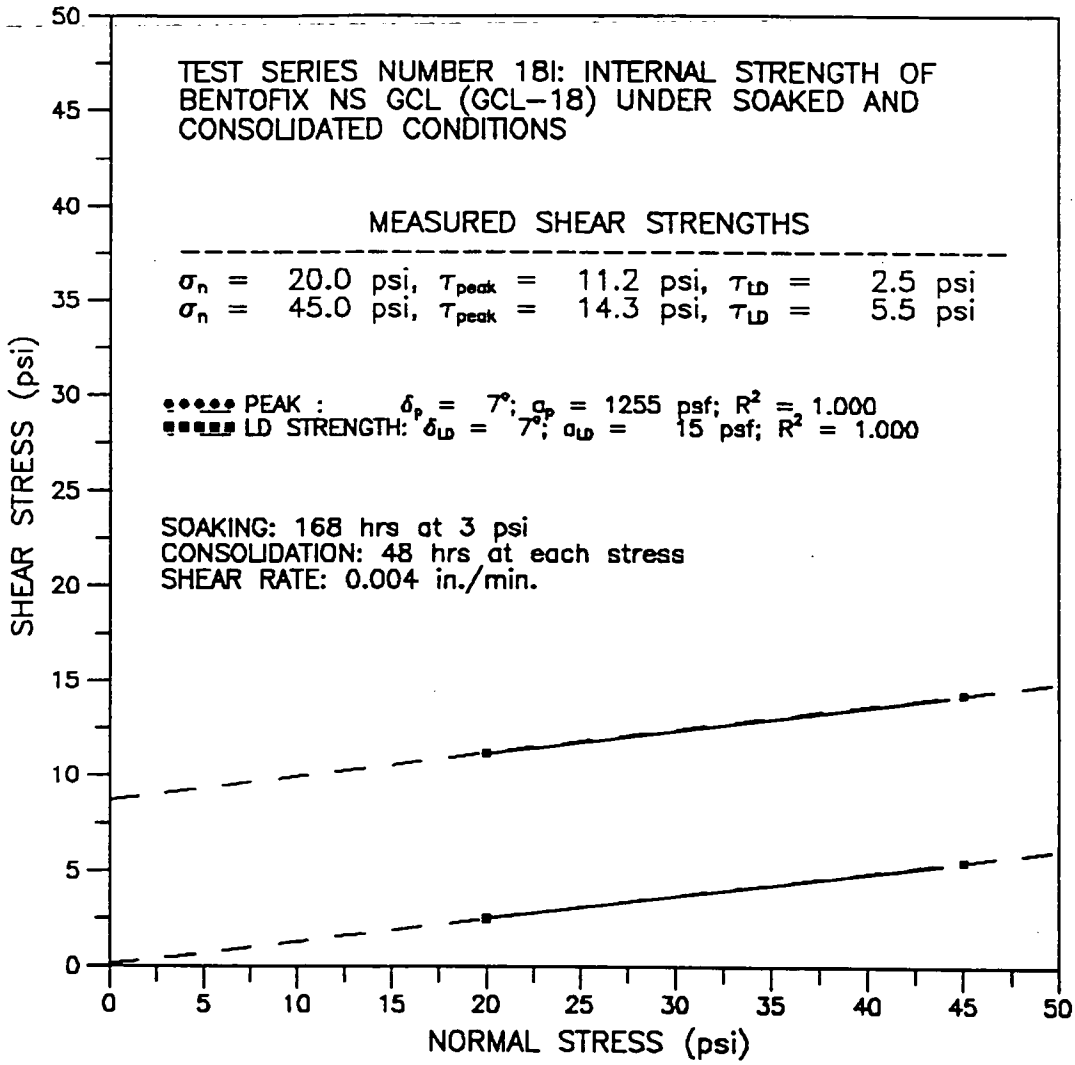
DATE TESTED: 22 TO 31 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730137
FILE NO.	000558

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



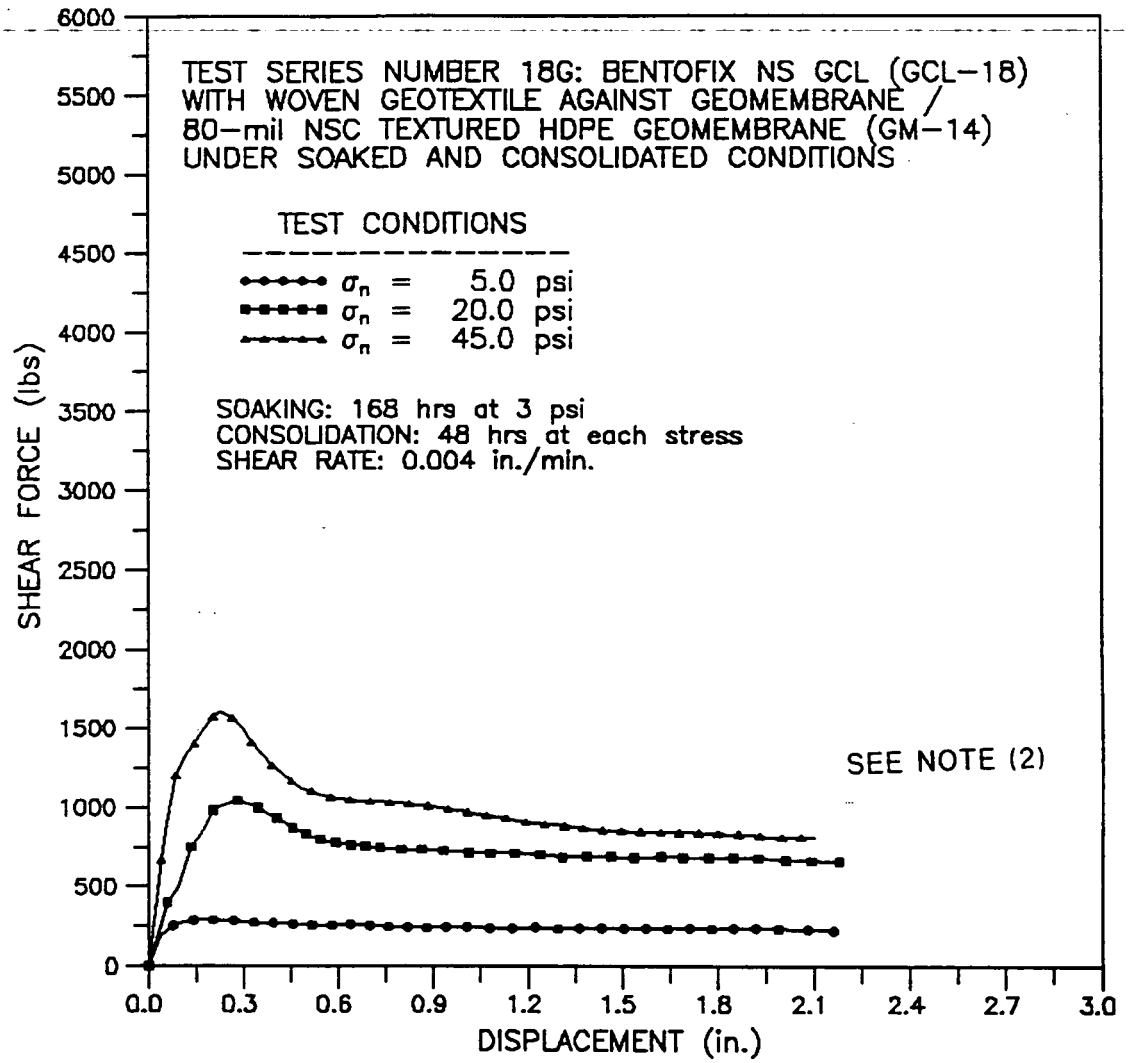
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 22 TO 31 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730137
FILE NO.	000559

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

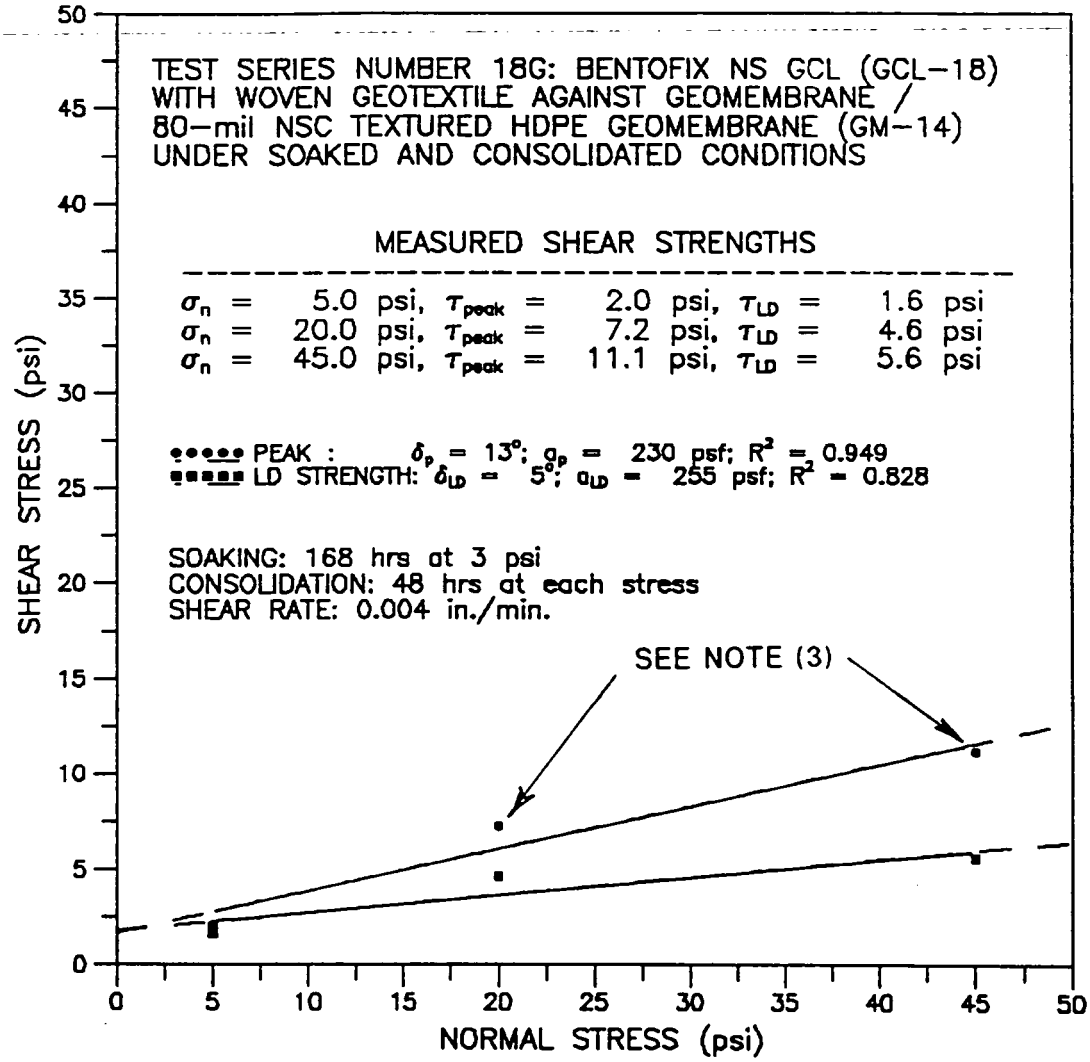
DATE TESTED: 22 OCTOBER TO 14 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730137
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

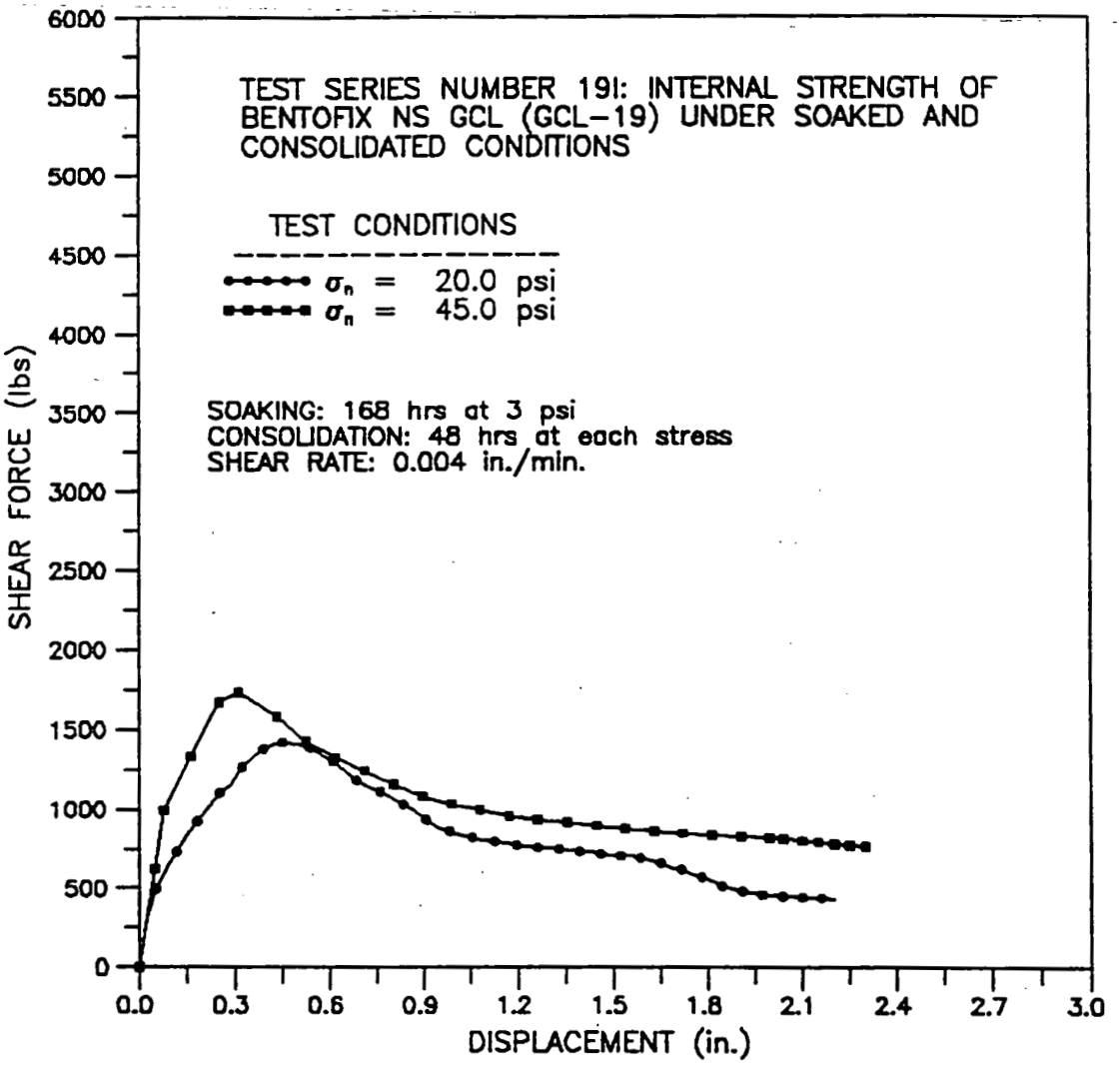
DATE TESTED: 22 OCTOBER TO 14 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730137
FILE NO.	000561

5/3

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

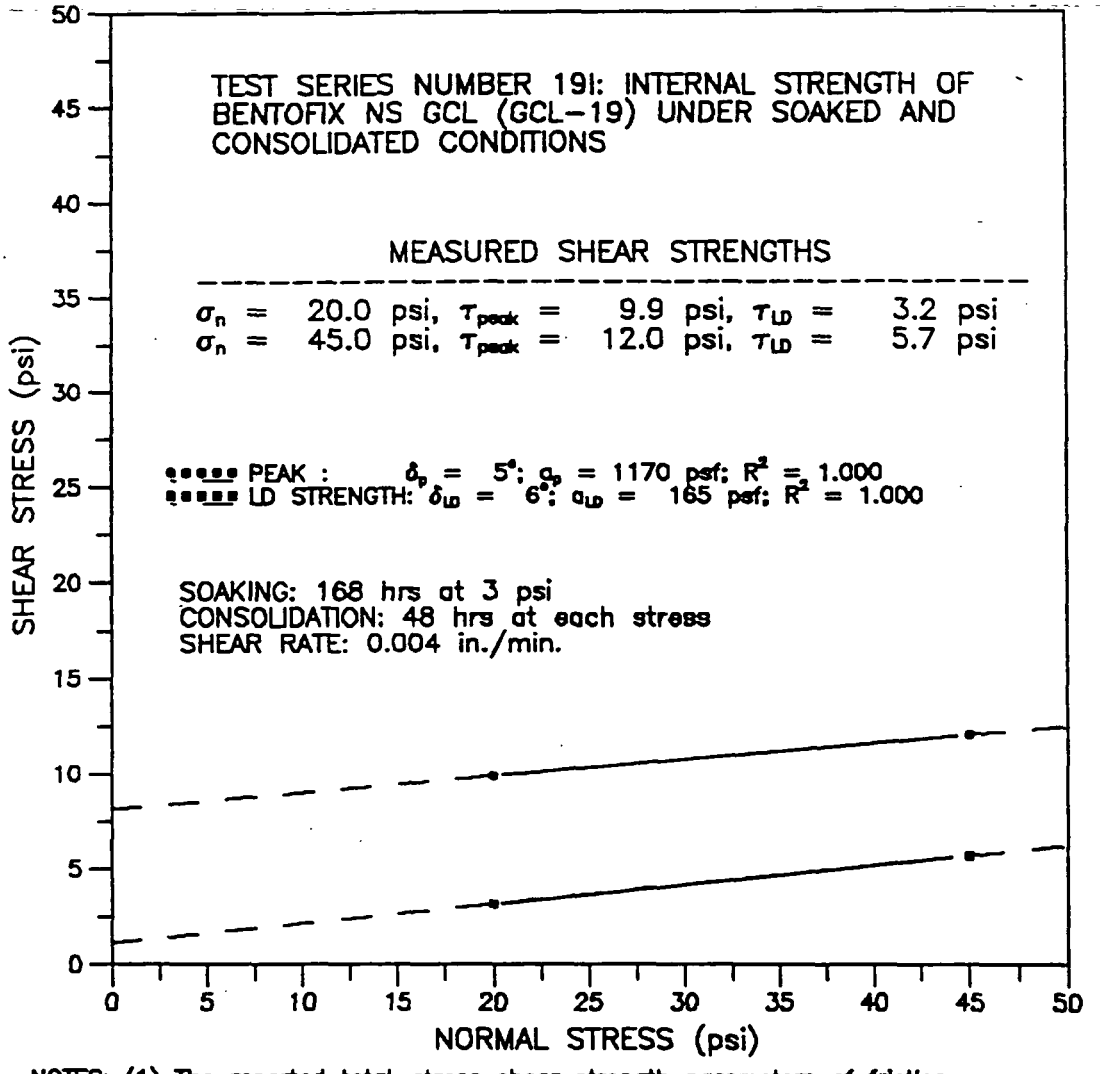
DATE TESTED: 8 TO 17 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730105
FILE NO.	000562

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



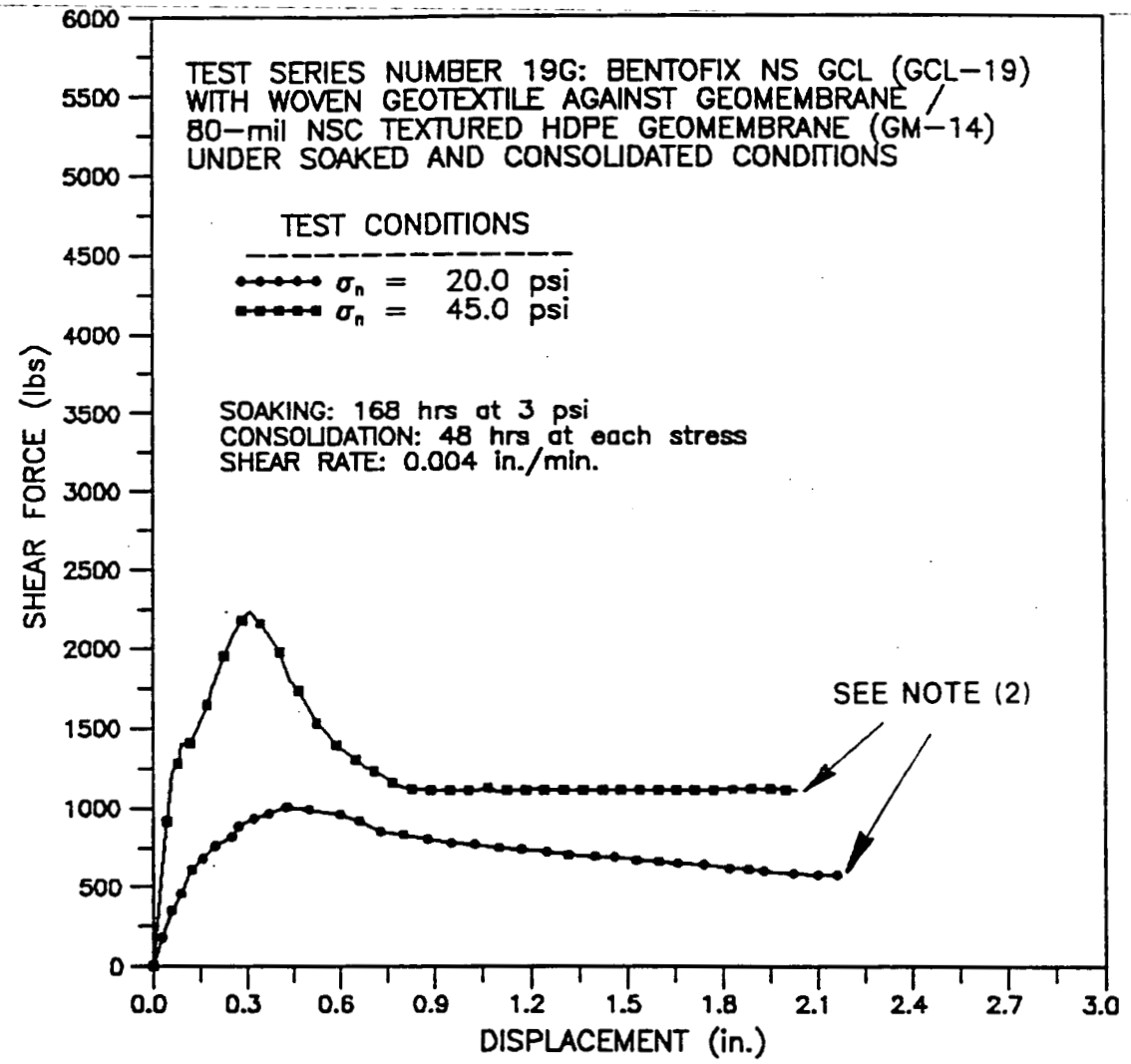
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 8 TO 17 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730105
FILE NO.	000563

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

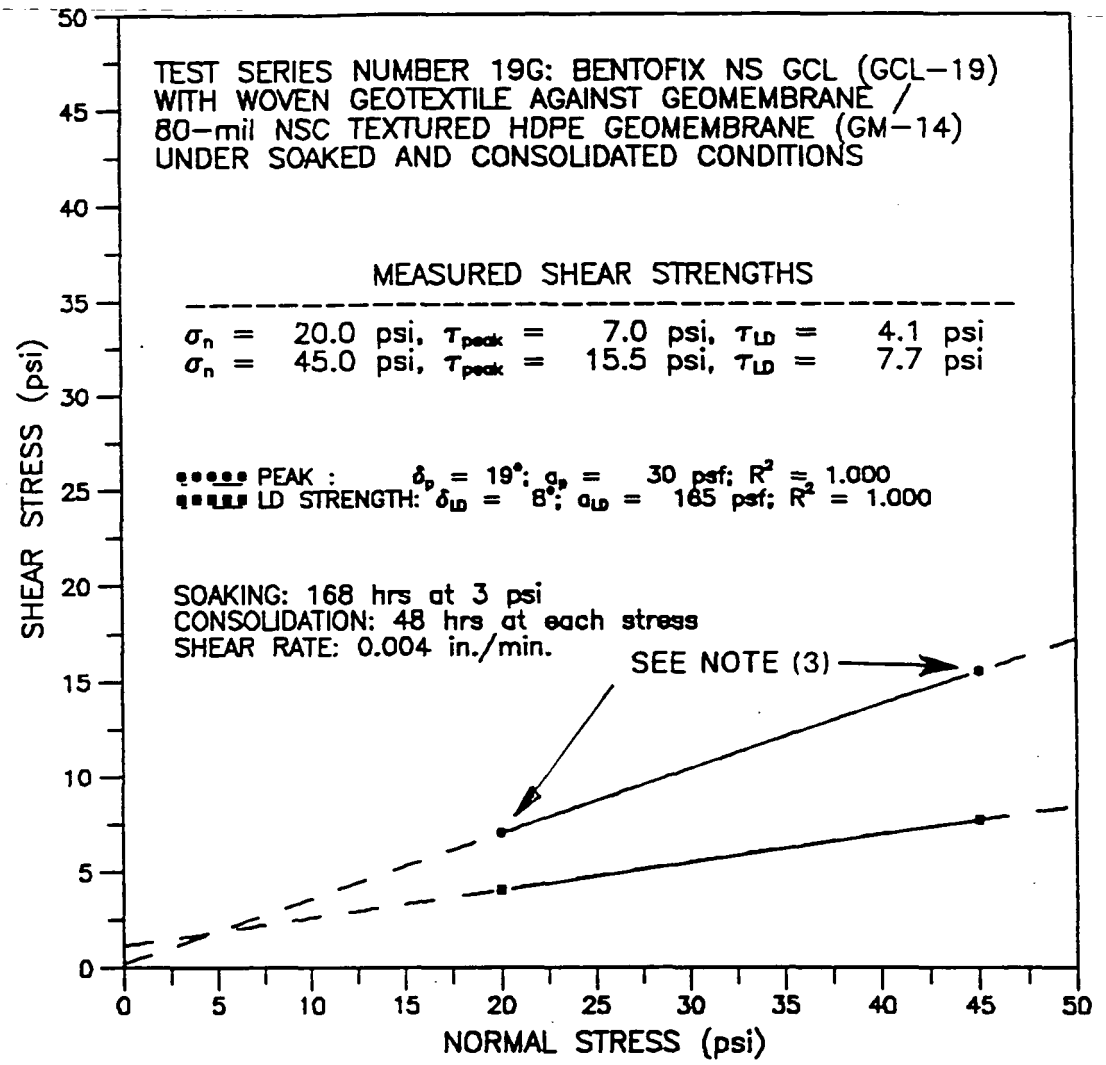
(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 8 TO 17 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730105
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



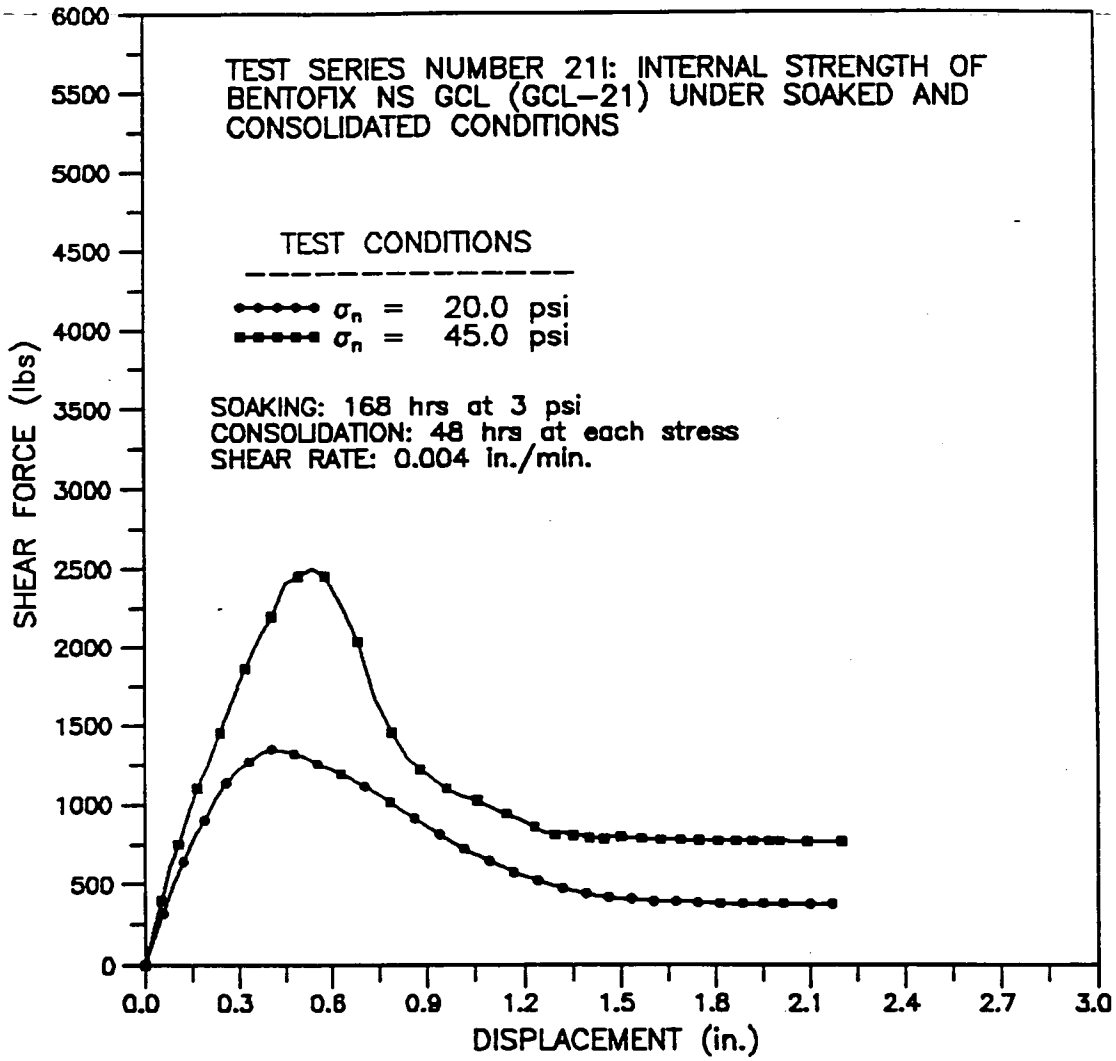
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 8 TO 17 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	1-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730105
FILE NO.	000565

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

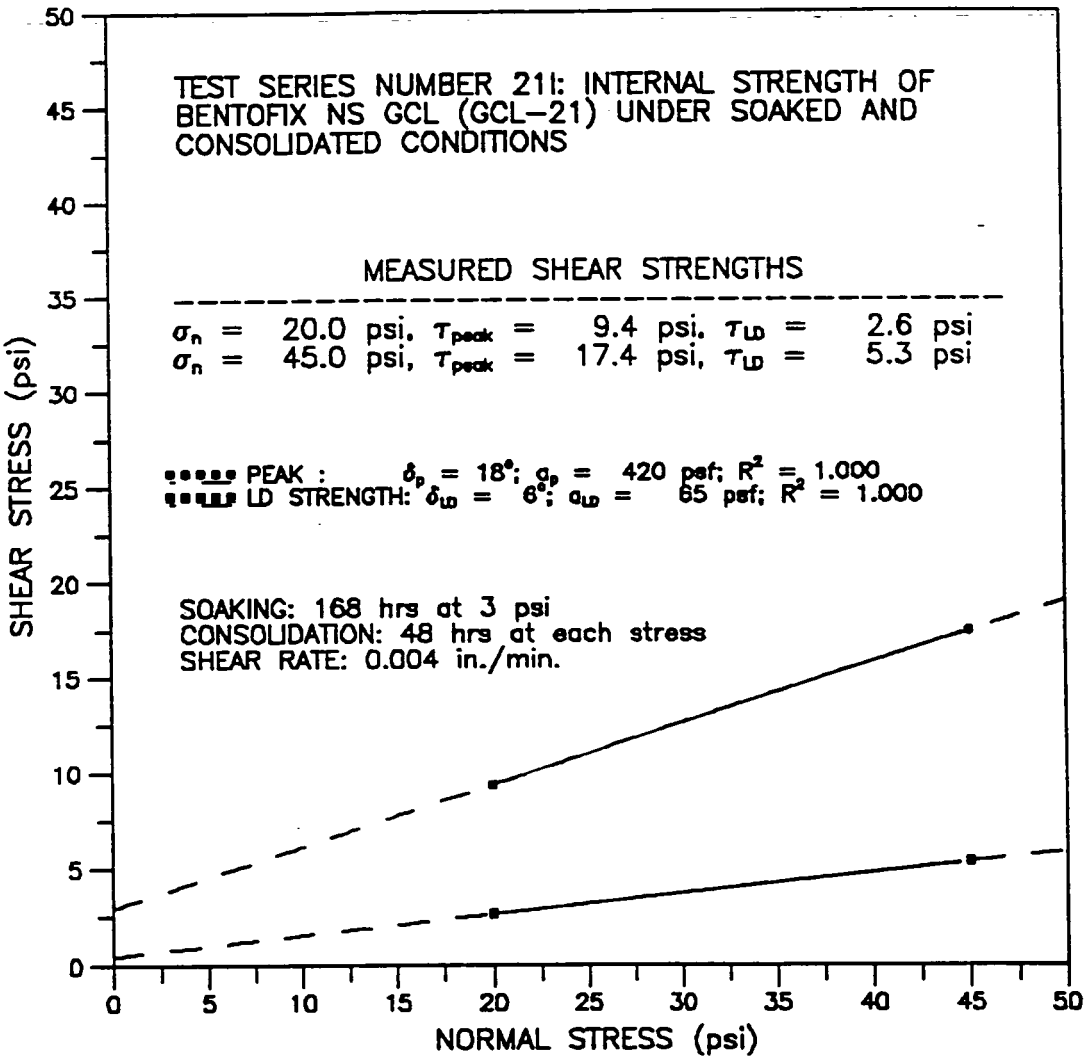
DATE TESTED: 15 TO 24 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730113
FILE NO.	000566

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



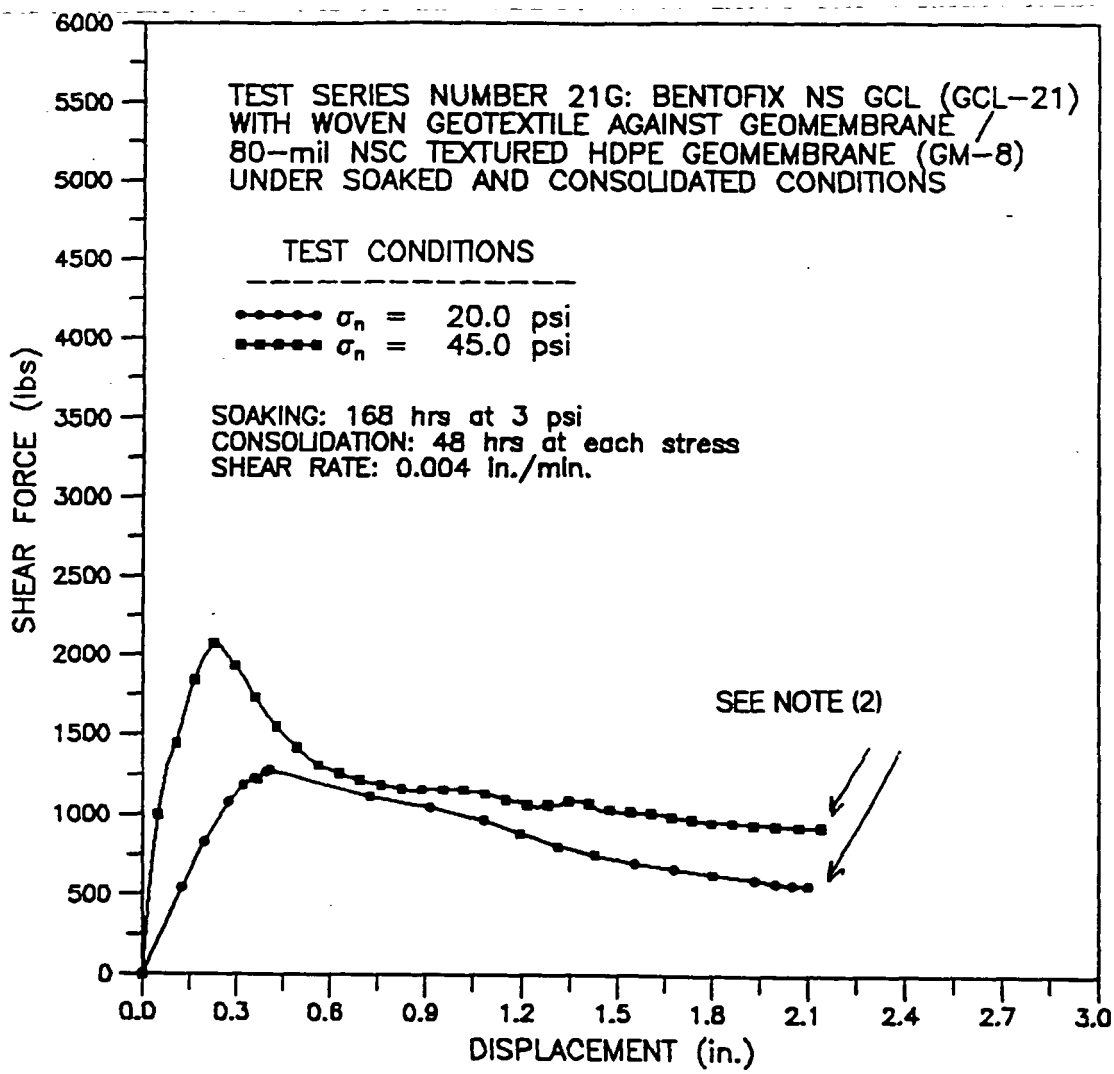
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL

DATE TESTED: 15 TO 24 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730113
FILE NO.	000567

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



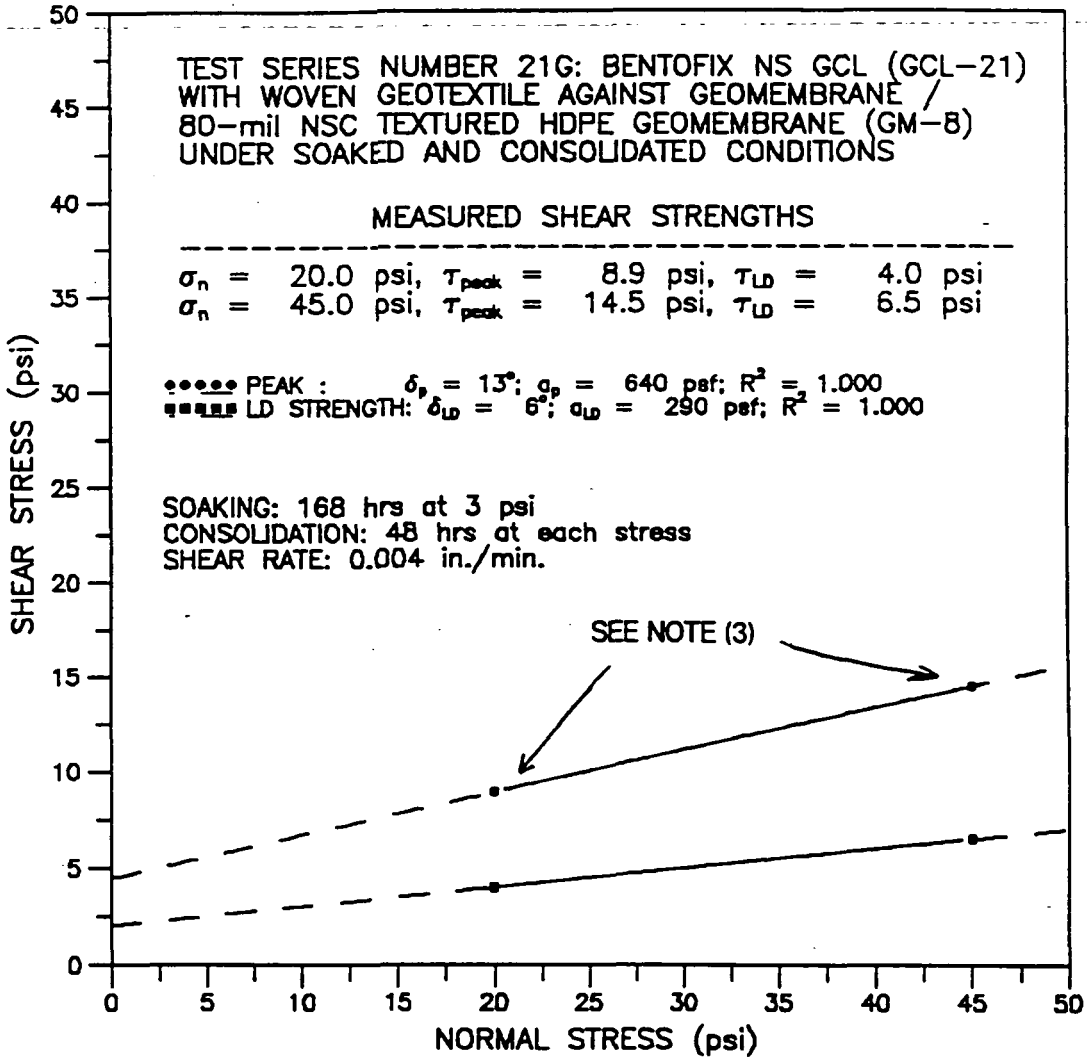
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 15 TO 24 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730113
FILE NO.	000568

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



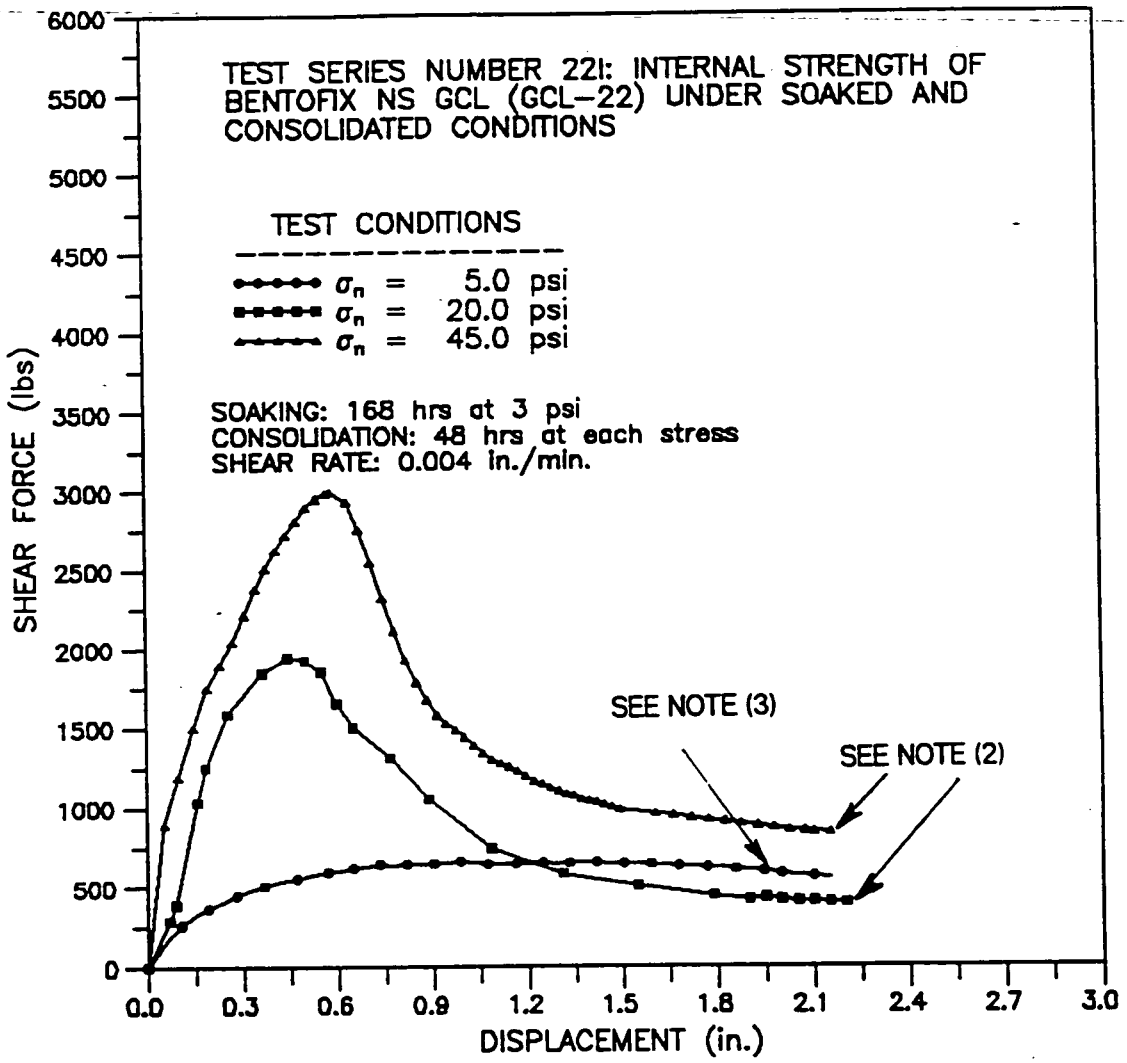
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 15 TO 24 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GO0166-04.1
DOCUMENT NO.	F9730113
FILE NO.	000569

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



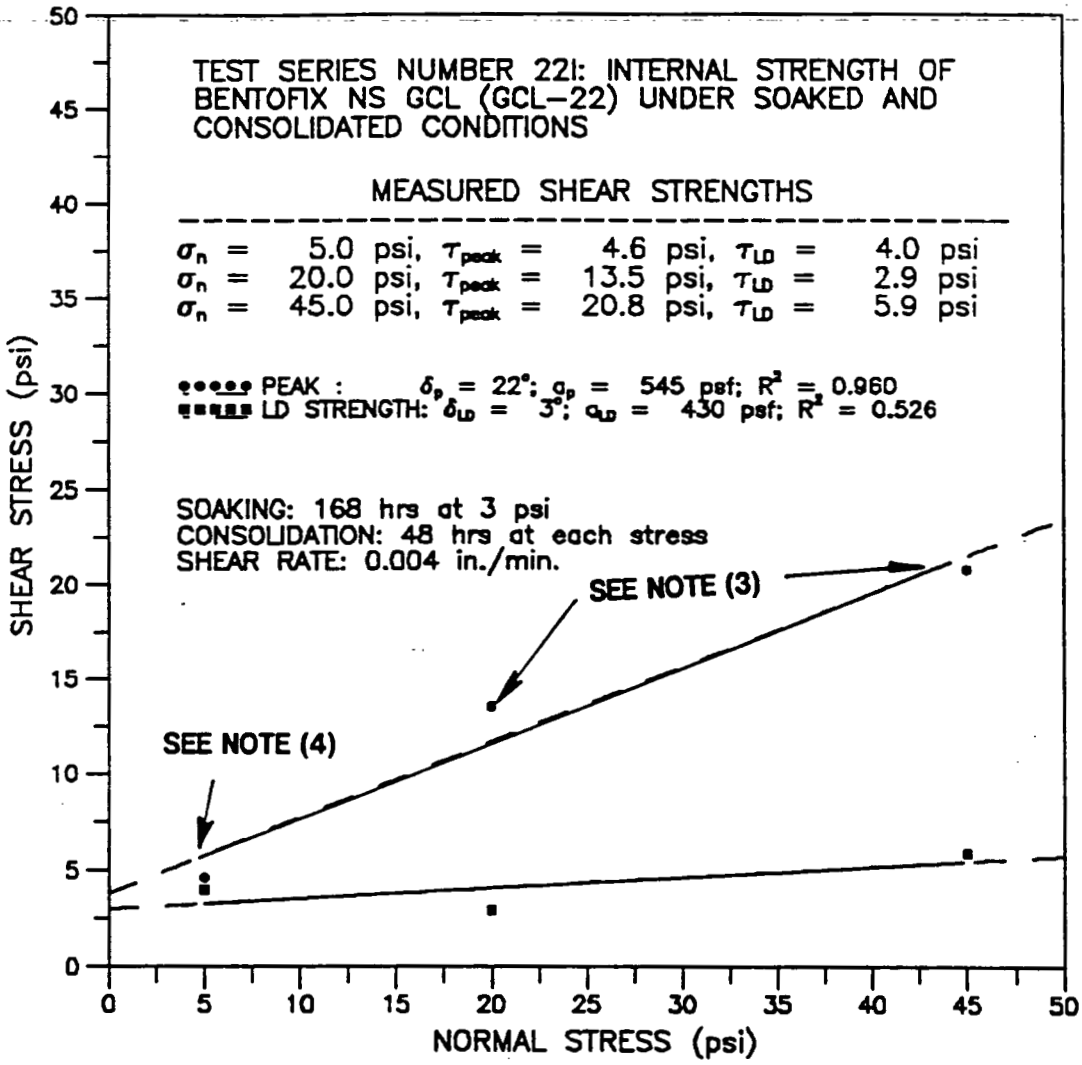
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) Internal shear failure within GCL was observed.
(3) Partial internal shear failure within GCL was observed.

DATE TESTED: 23 OCTOBER TO 1 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730117
FILE NO.	000570

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



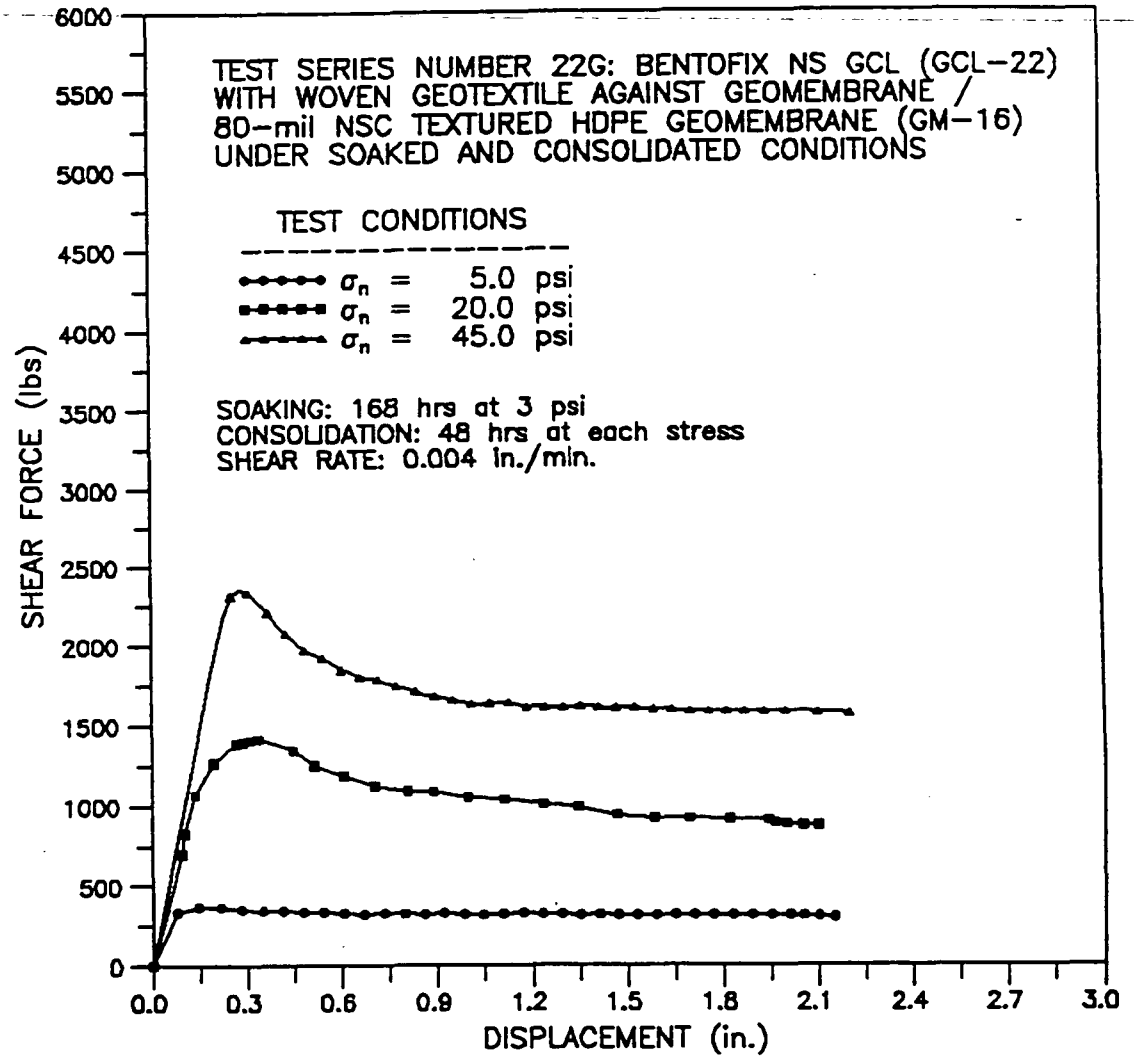
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Internal shear failure within GCL was observed.
(4) Partial internal failure within GCL was observed.

DATE TESTED: 23 OCTOBER TO 1 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730117
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) For each test, sliding (i.e., shear failure) was observed to occur at the intended interface.

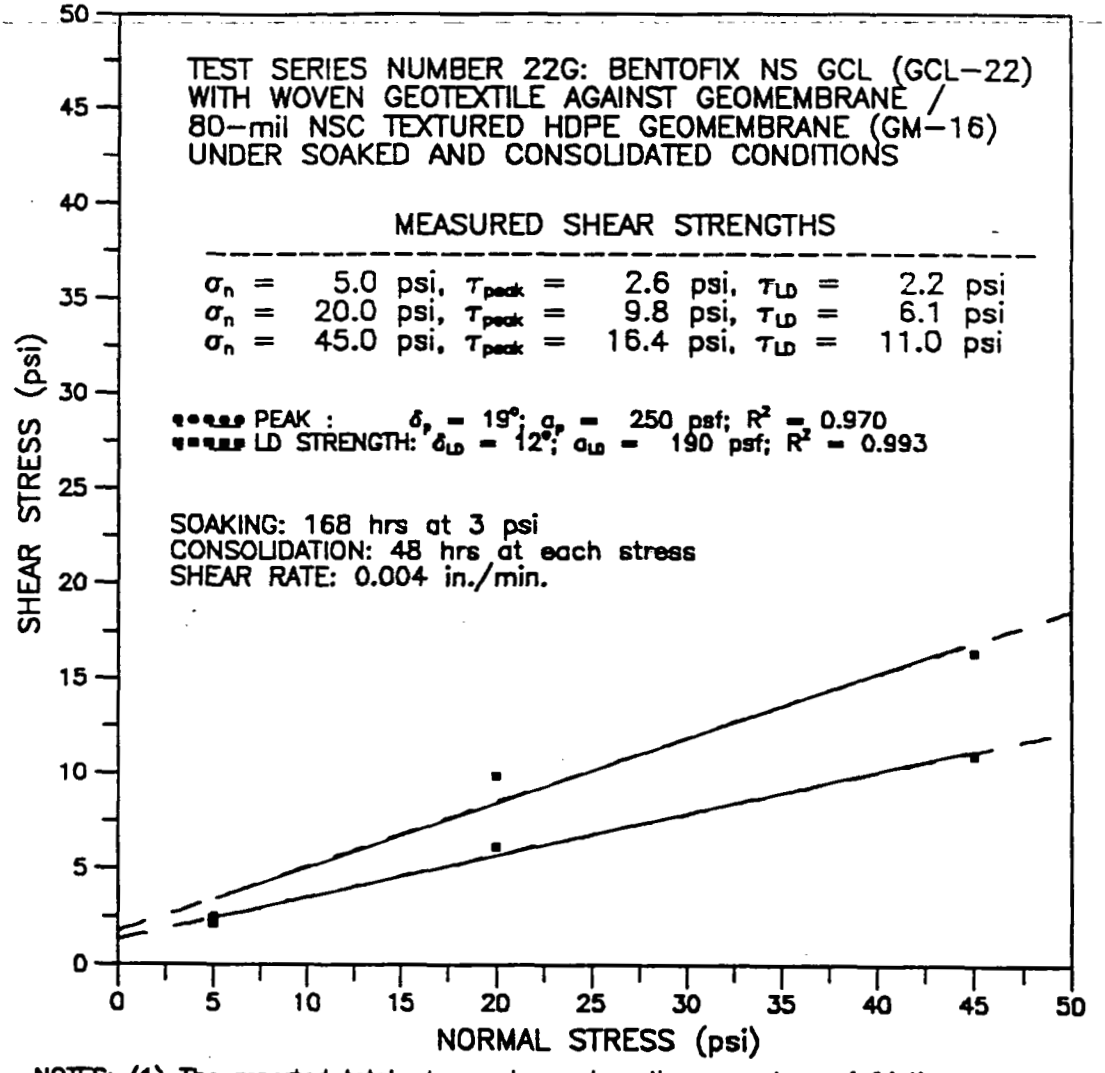
DATE TESTED: 11 TO 21 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730117
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



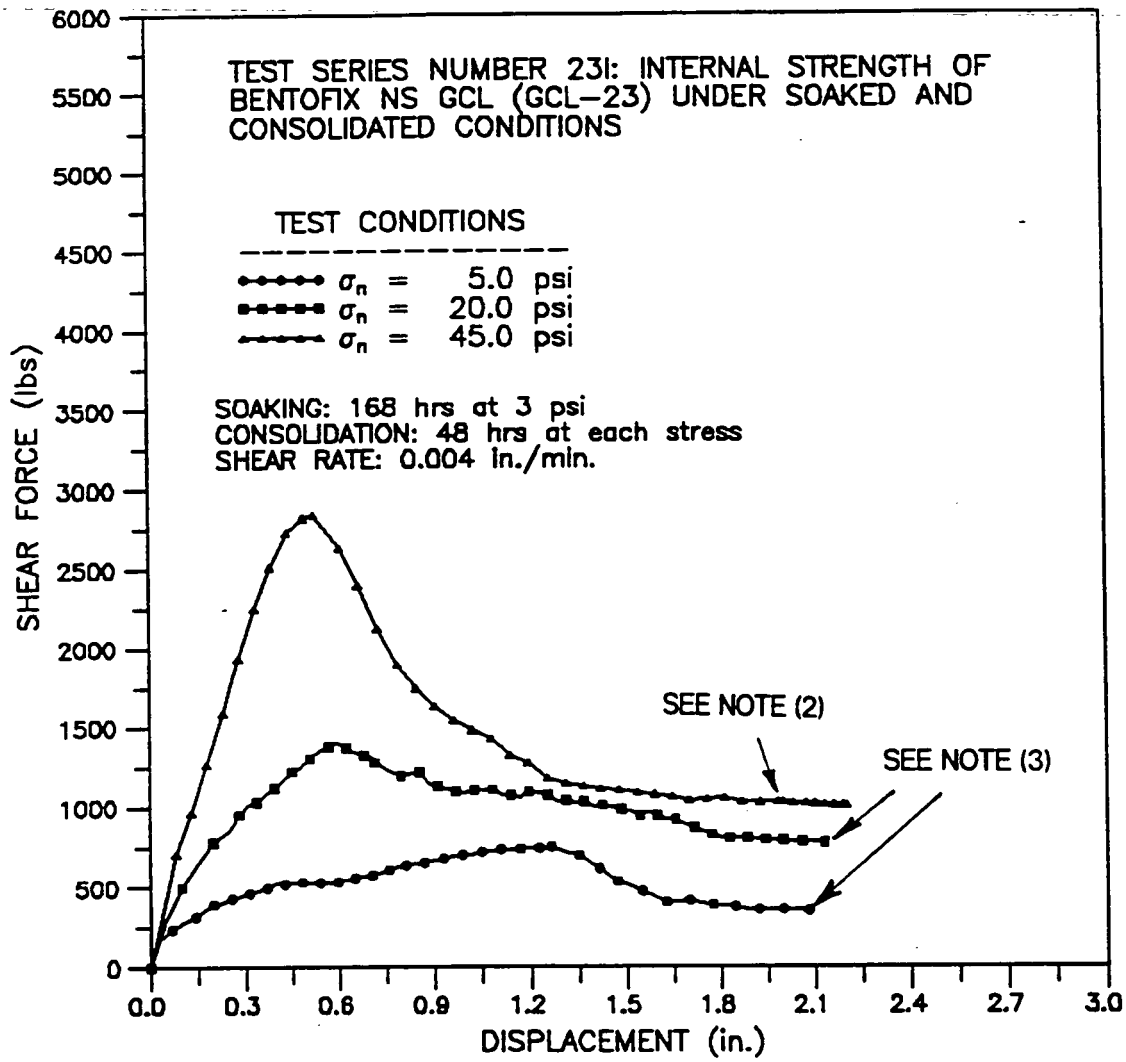
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e., shear failure) was observed to occur at the intended interface.

DATE TESTED: 11 TO 21 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730117
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



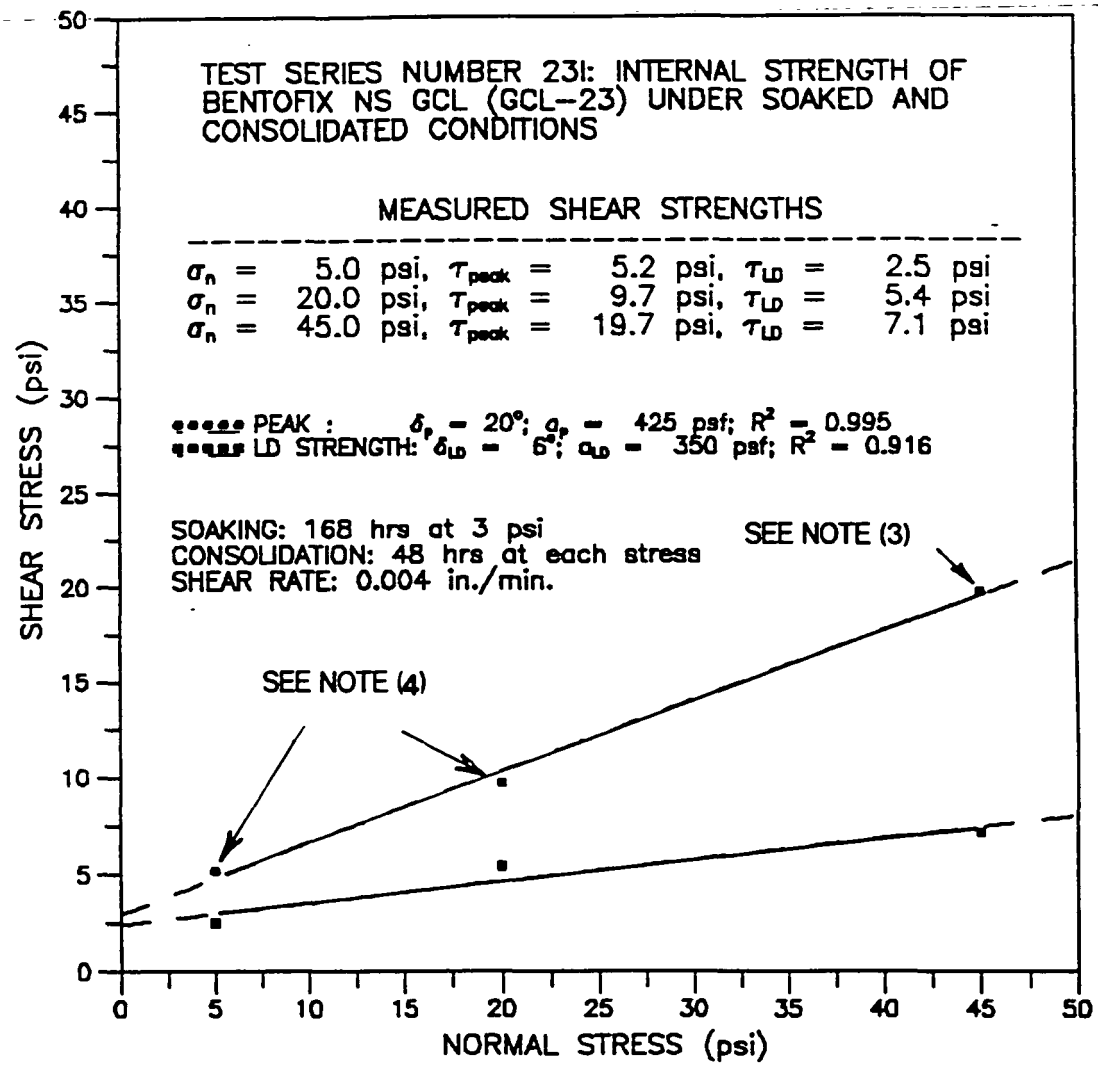
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) Internal shear failure within GCL was observed.
(3) Partial internal shear failure within GCL was observed.

DATE TESTED: 13 TO 22 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730114
FILE NO.	000574

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



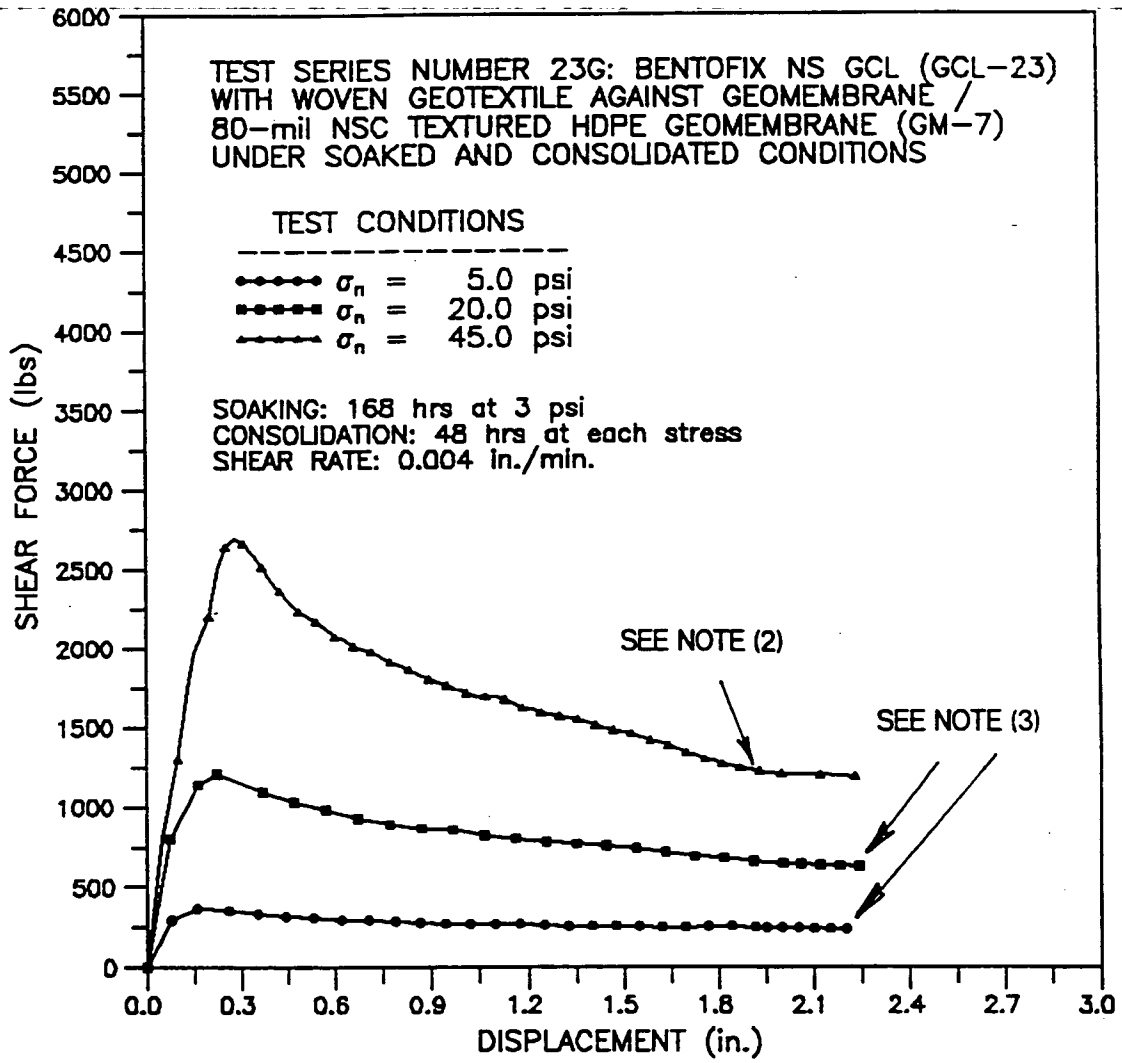
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Internal shear failure within GCL was observed.
(4) Partial internal failure within GCL was observed.

DATE TESTED: 13 TO 22 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730114
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Partial internal shear failure was observed to occur within the GCL.

(3) Shear failure was observed to occur at the intended interface.

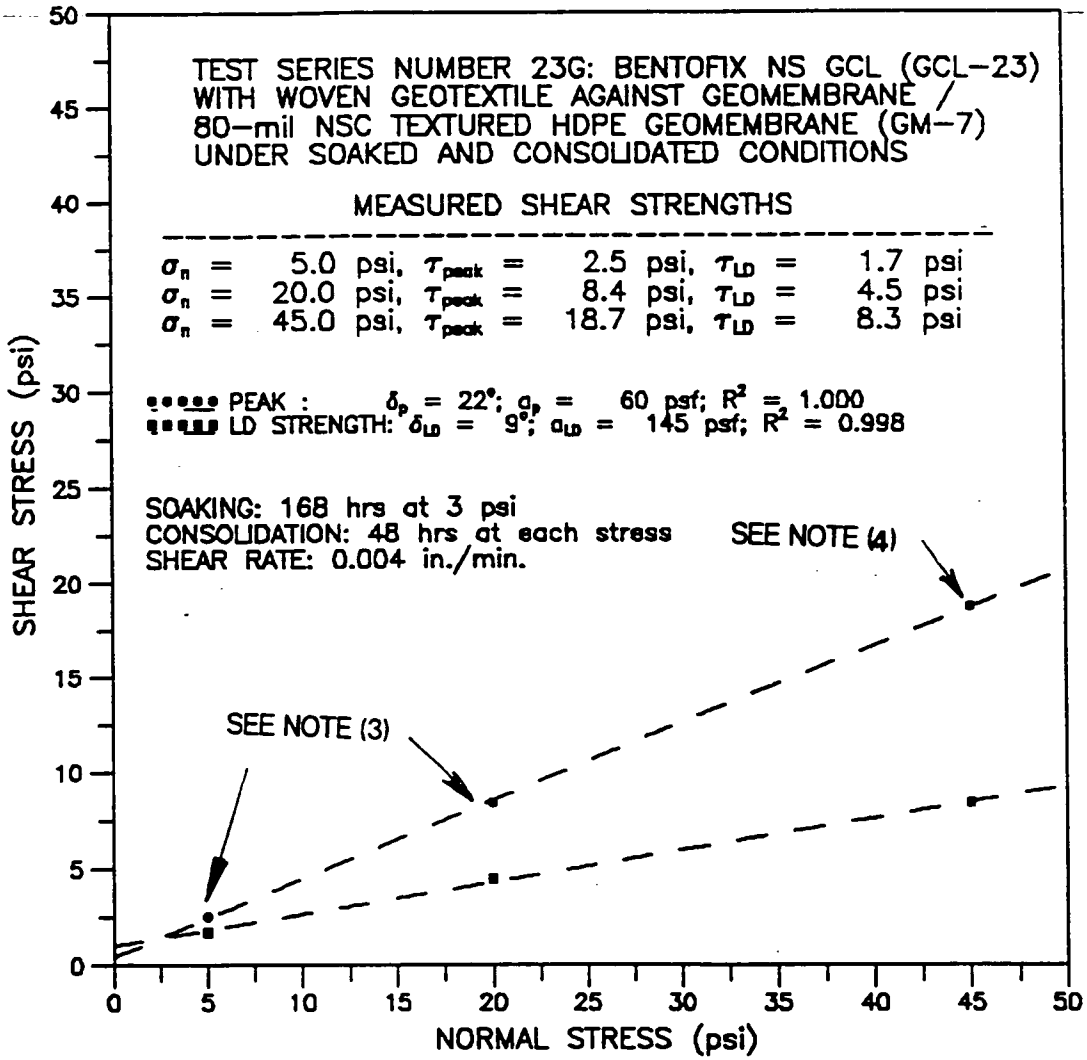
DATE TESTED: 13 TO 23 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730114
FILE NO.	000576

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



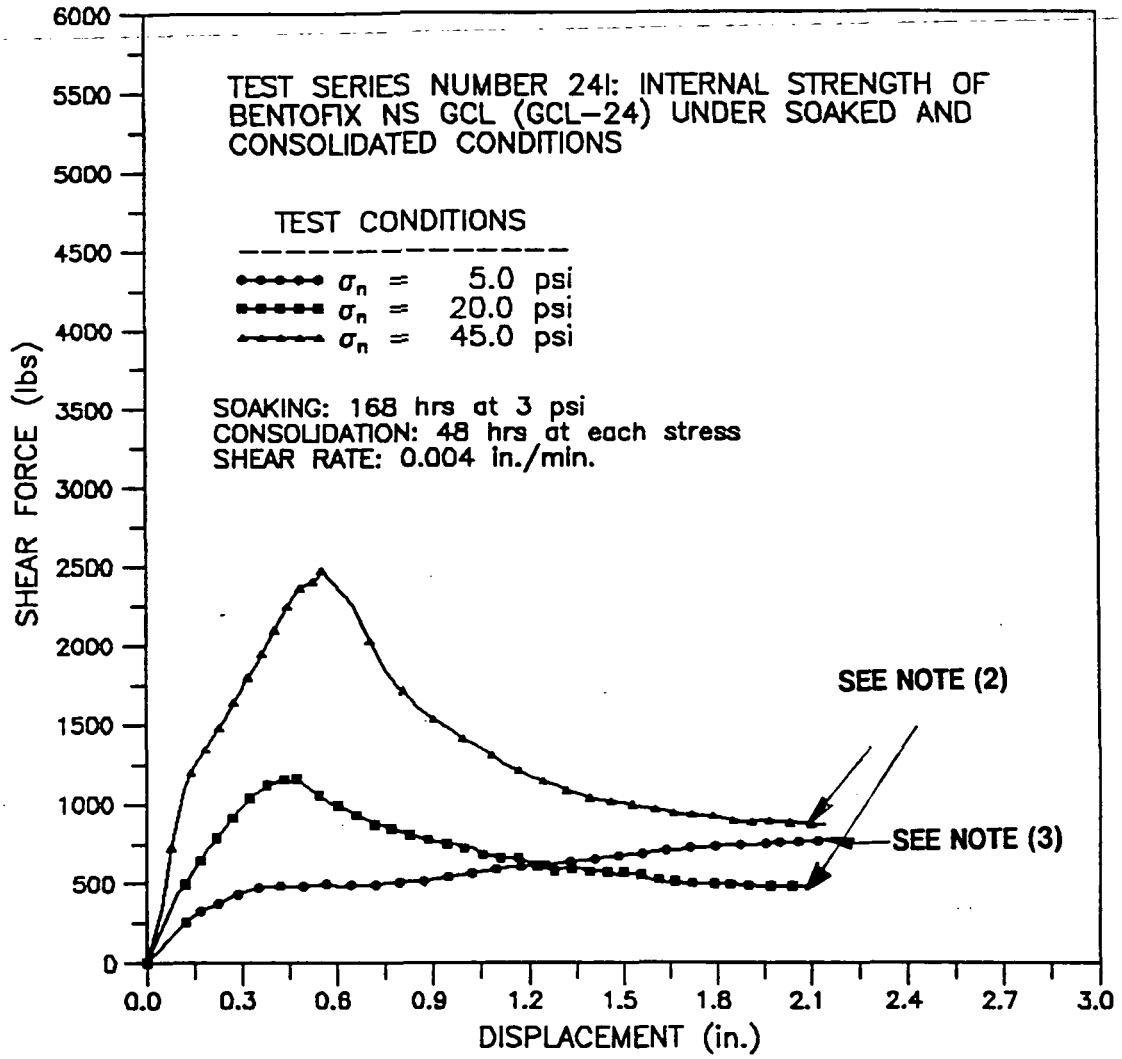
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Shear failure was observed to occur at the intended interface.
(4) Partial internal shear failure was observed to occur within GCL.

DATE TESTED: 13 TO 23 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730114
FILE NO.	000577

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



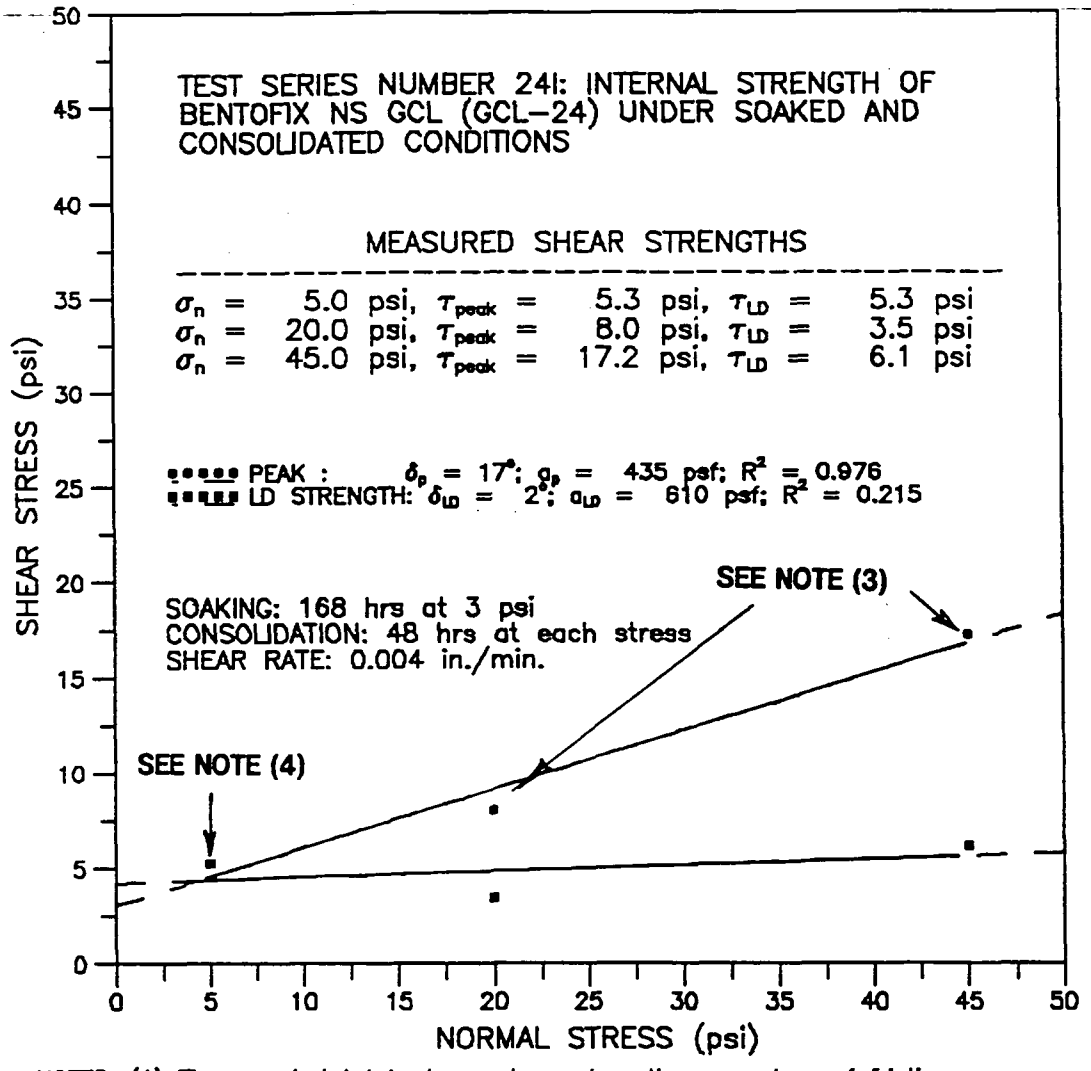
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) Internal shear failure within GCL was observed.
(3) No internal shear failure within GCL was observed.

DATE TESTED: 25 OCTOBER TO 3 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730124
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



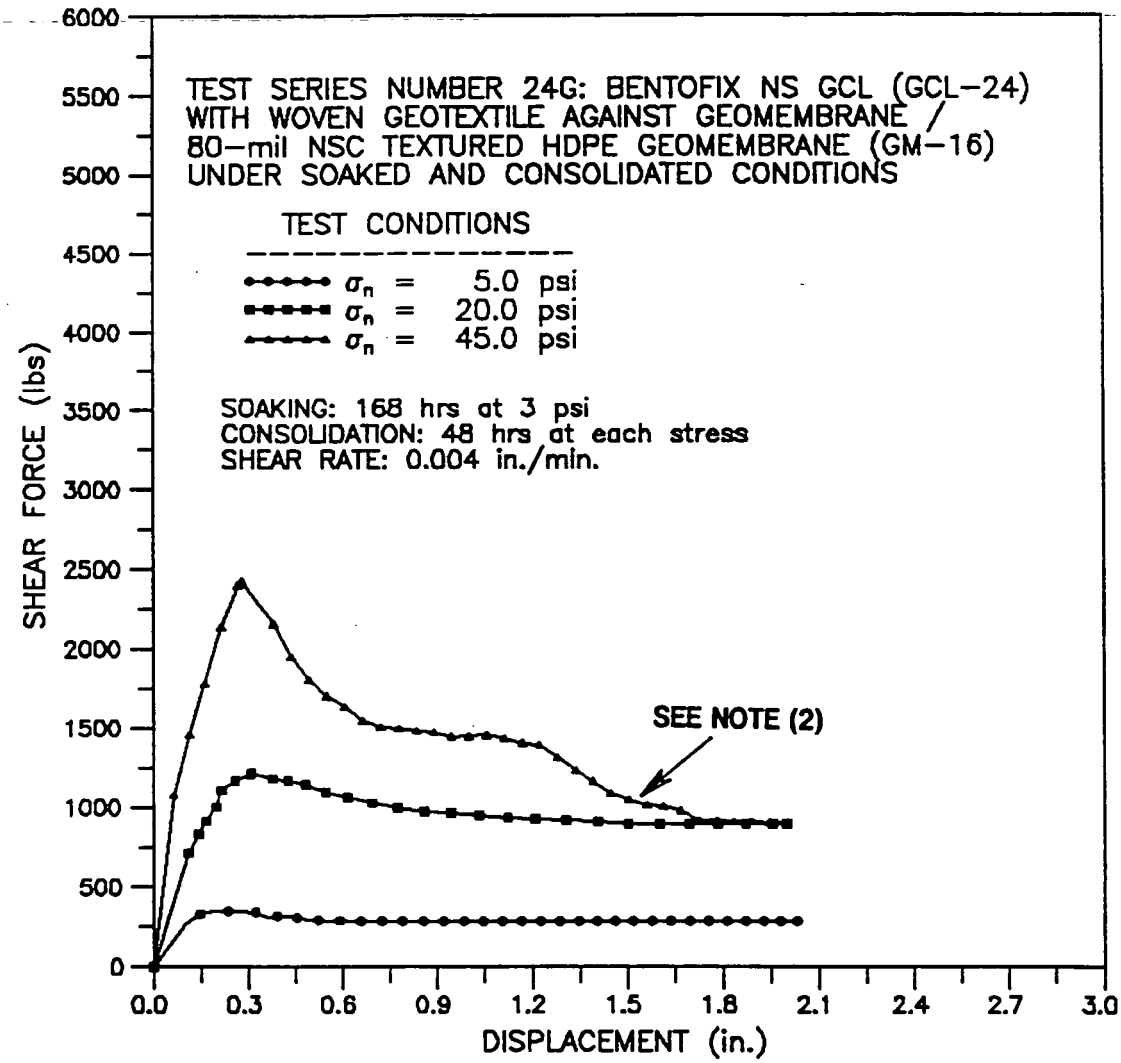
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Internal shear failure within GCL was observed.
(4) No internal failure within GCL was observed.

DATE TESTED: 25 OCTOBER TO 3 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730124
FILE NO.	000579

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

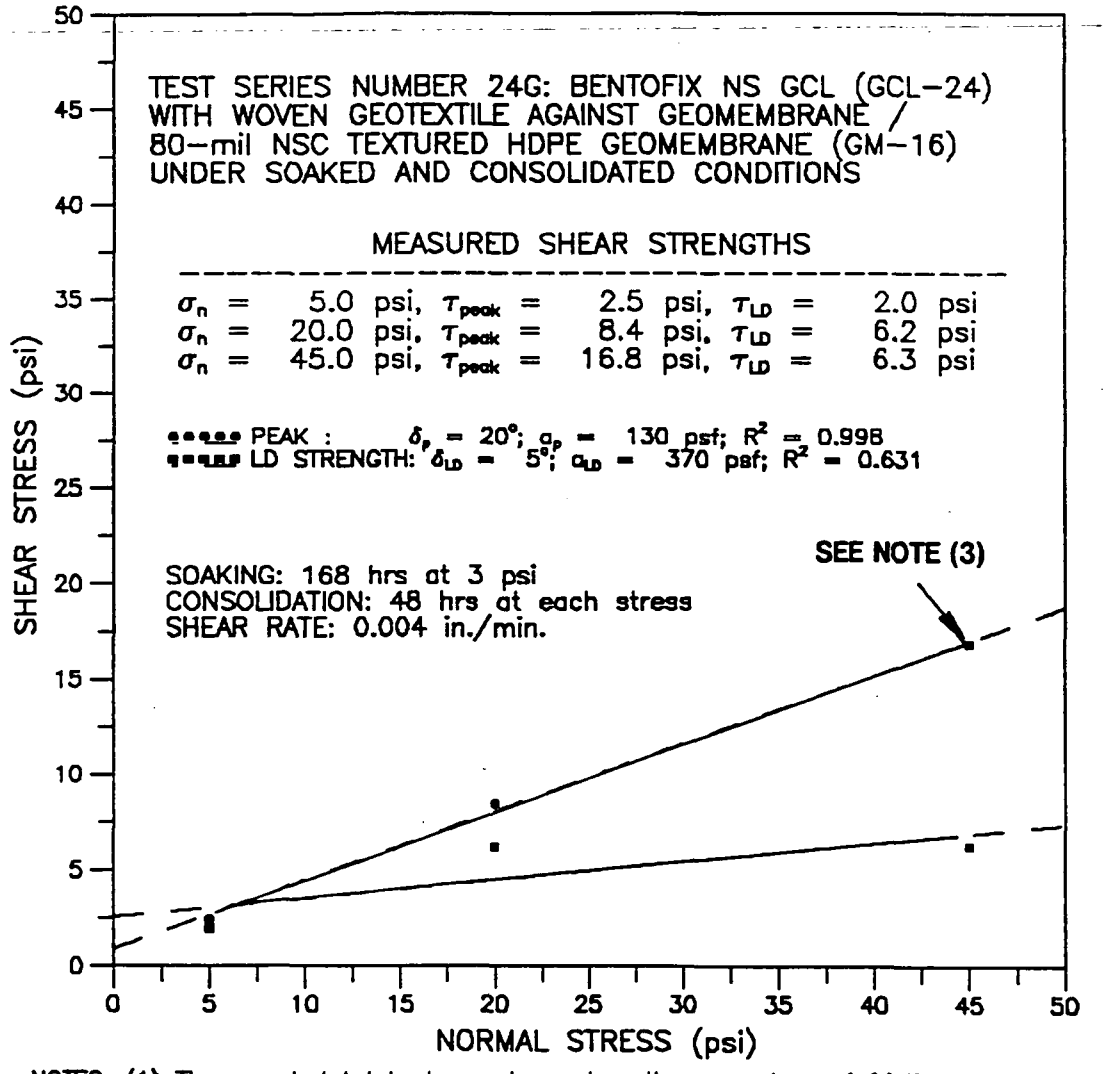
DATE TESTED: 25 OCTOBER TO 3 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730124
FILE NO.	000580

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



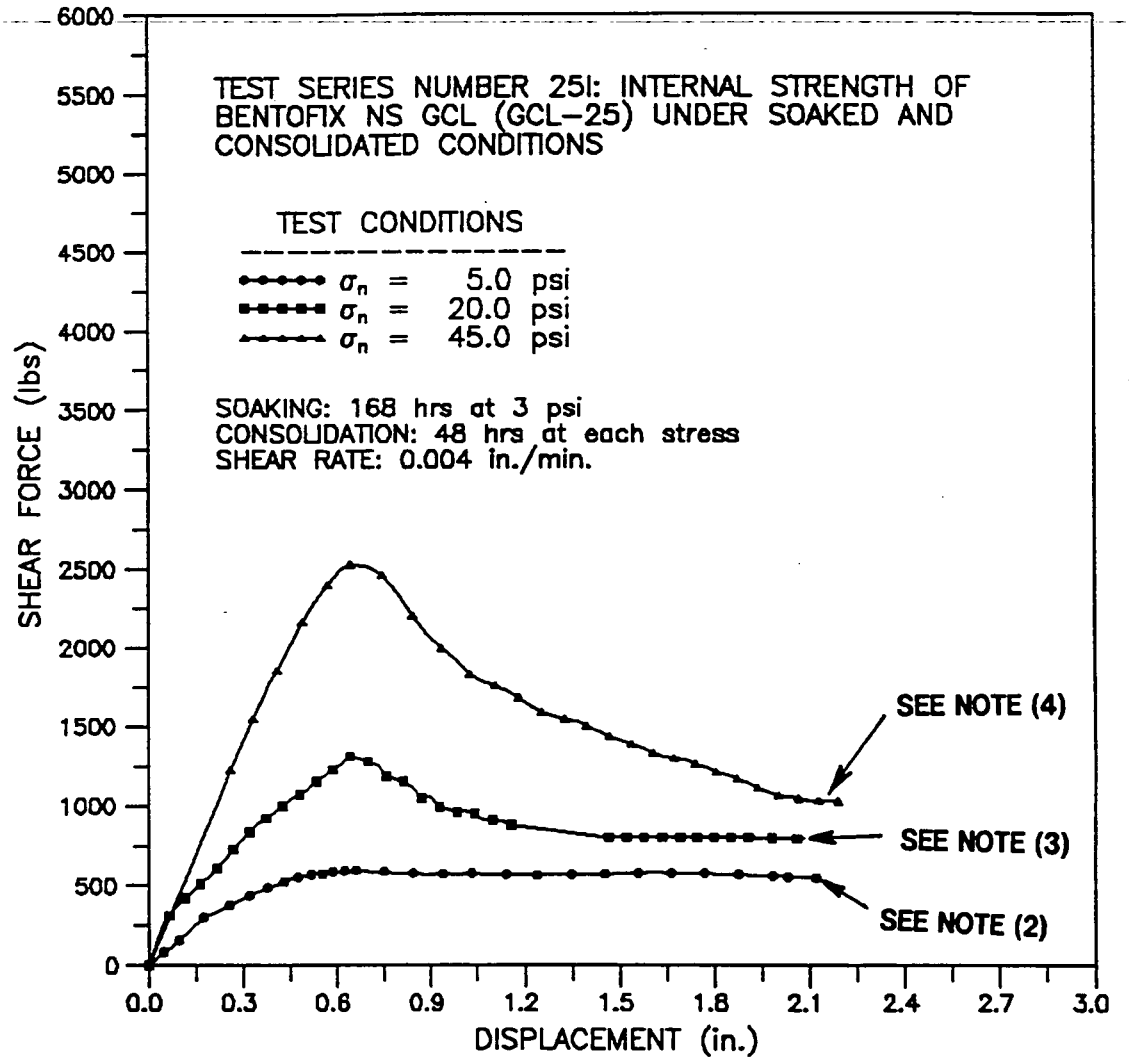
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 25 OCTOBER TO 3 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730124
FILE NO.	000581

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



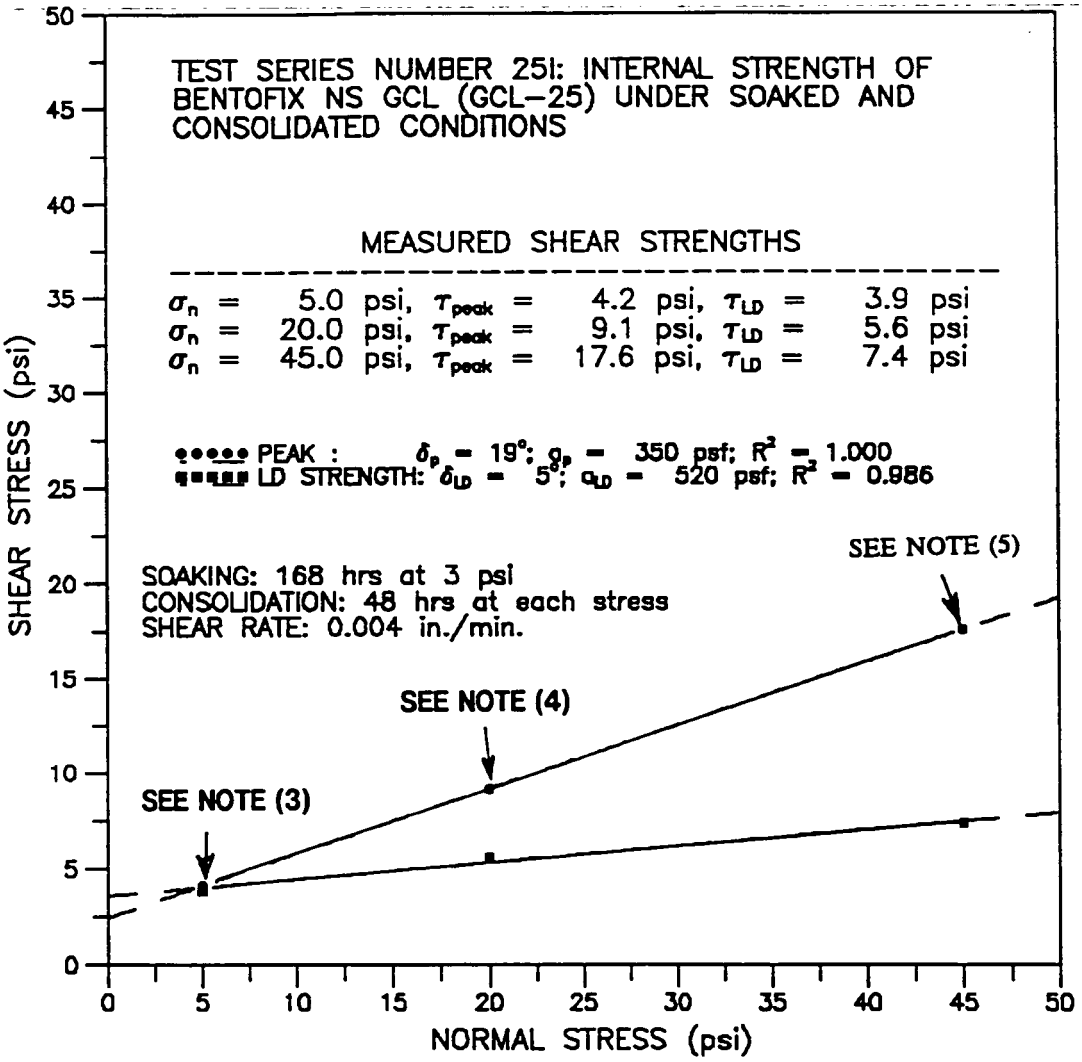
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) No internal shear failure within GCL was observed.
(3) Partial internal shear failure within GCL was observed.
(4) Internal shear failure within GCL was observed.

DATE TESTED: 27 OCTOBER TO 5 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730125
FILE NO.	000582

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



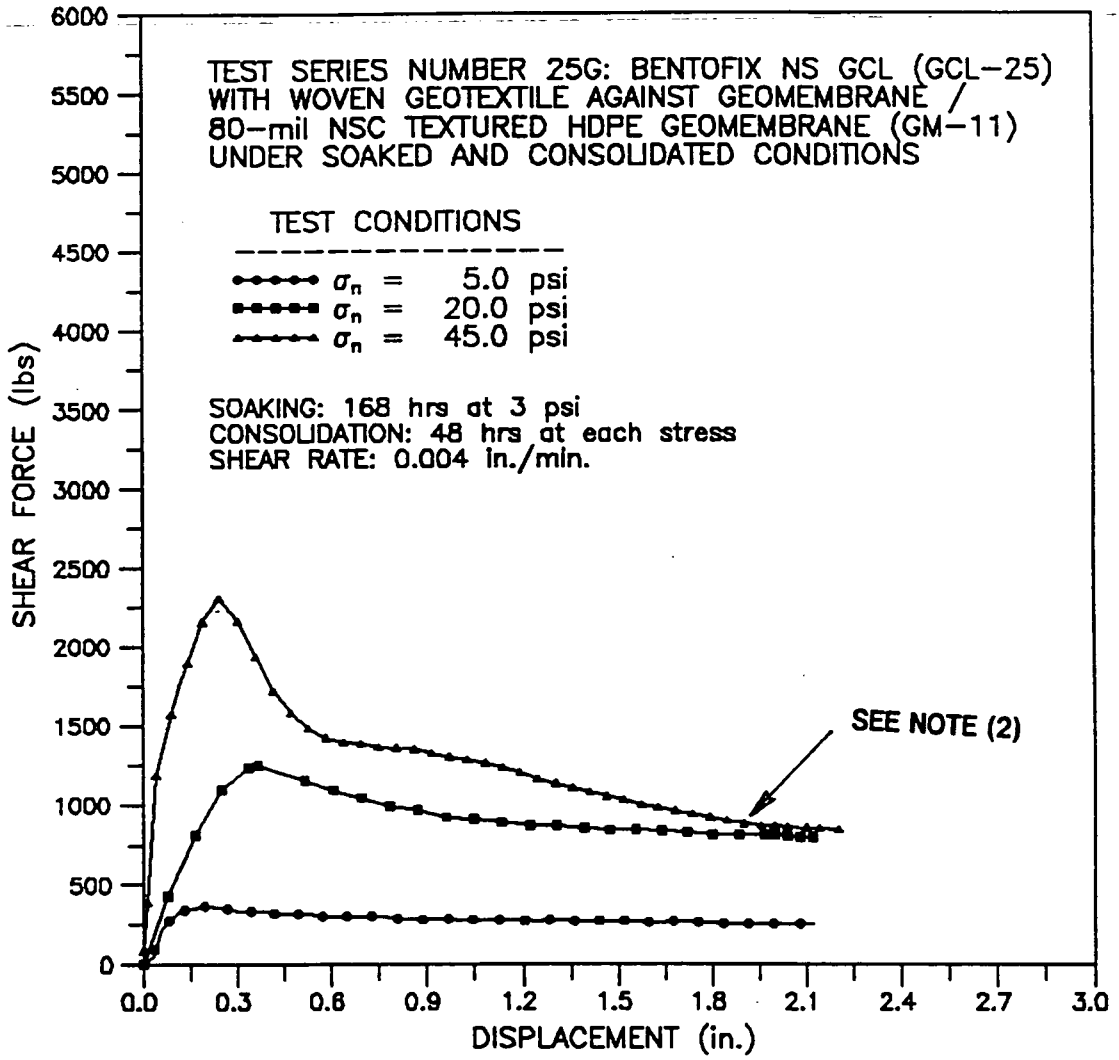
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) No internal shear failure within GCL was observed.
(4) Partial internal failure within GCL was observed.
(5) Internal shear failure within GCL was observed.

DATE TESTED: 27 OCTOBER TO 5 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730125
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

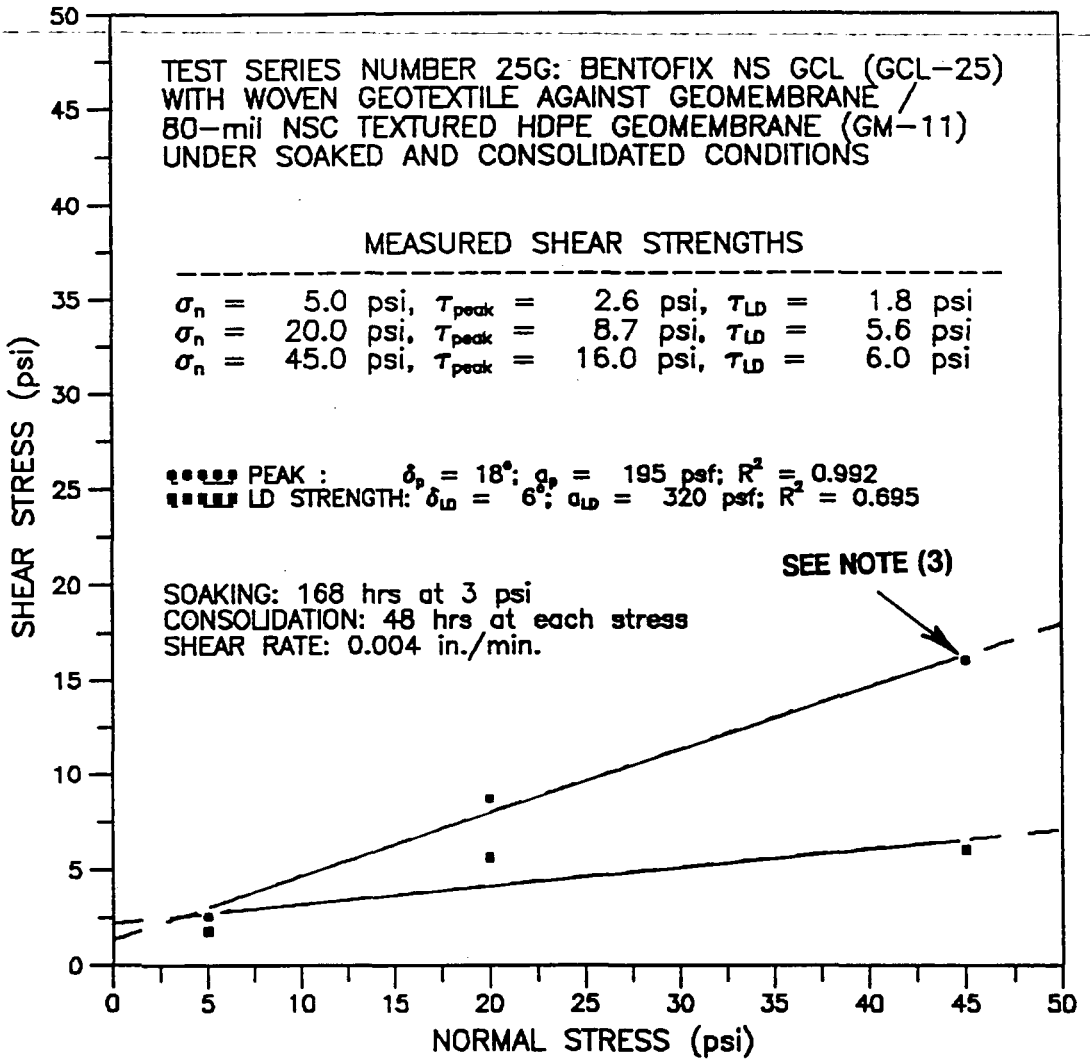
DATE TESTED: 27 OCTOBER TO 5 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730125
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



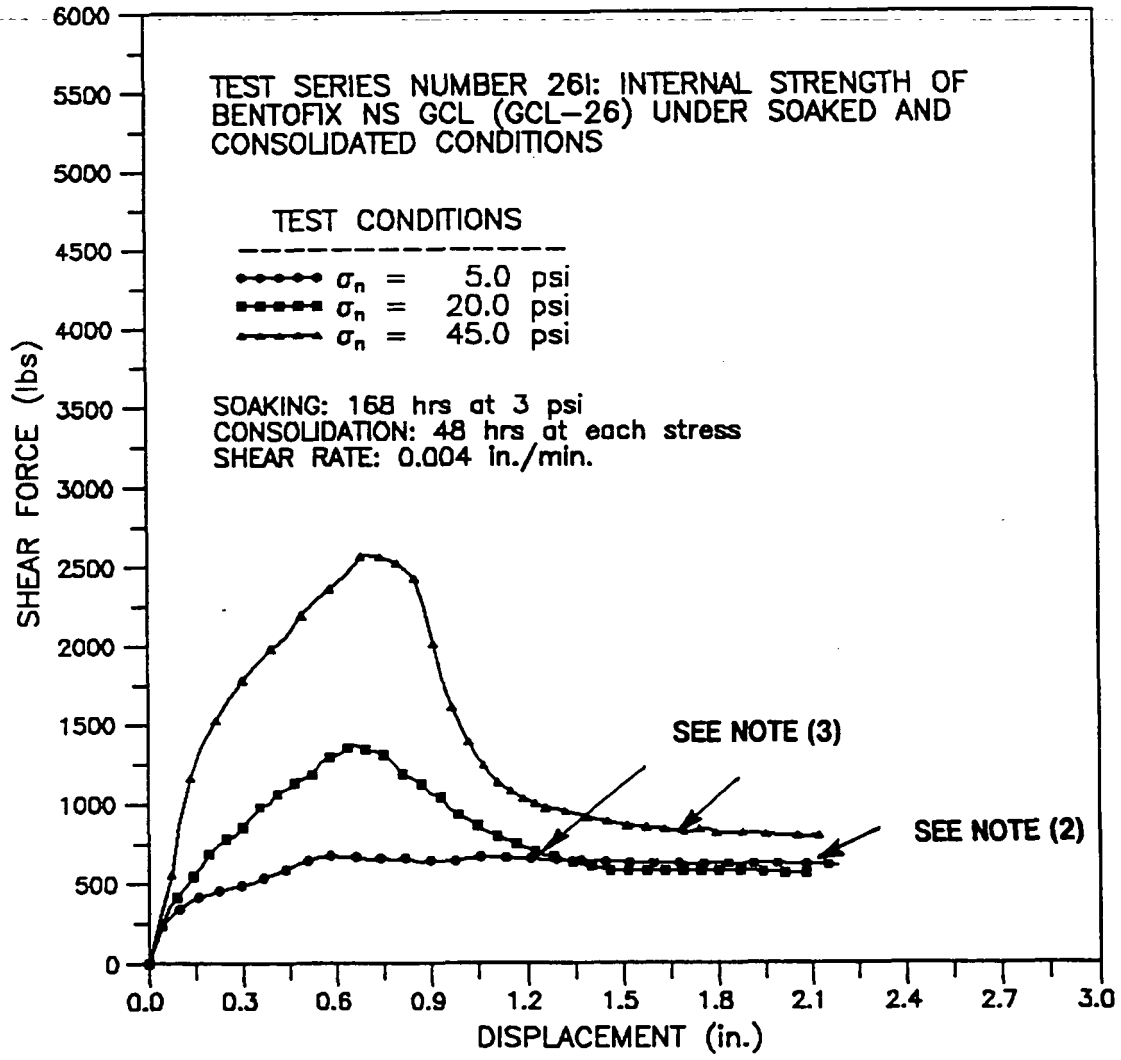
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 27 OCTOBER TO 5 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730125
FILE NO.	000585

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



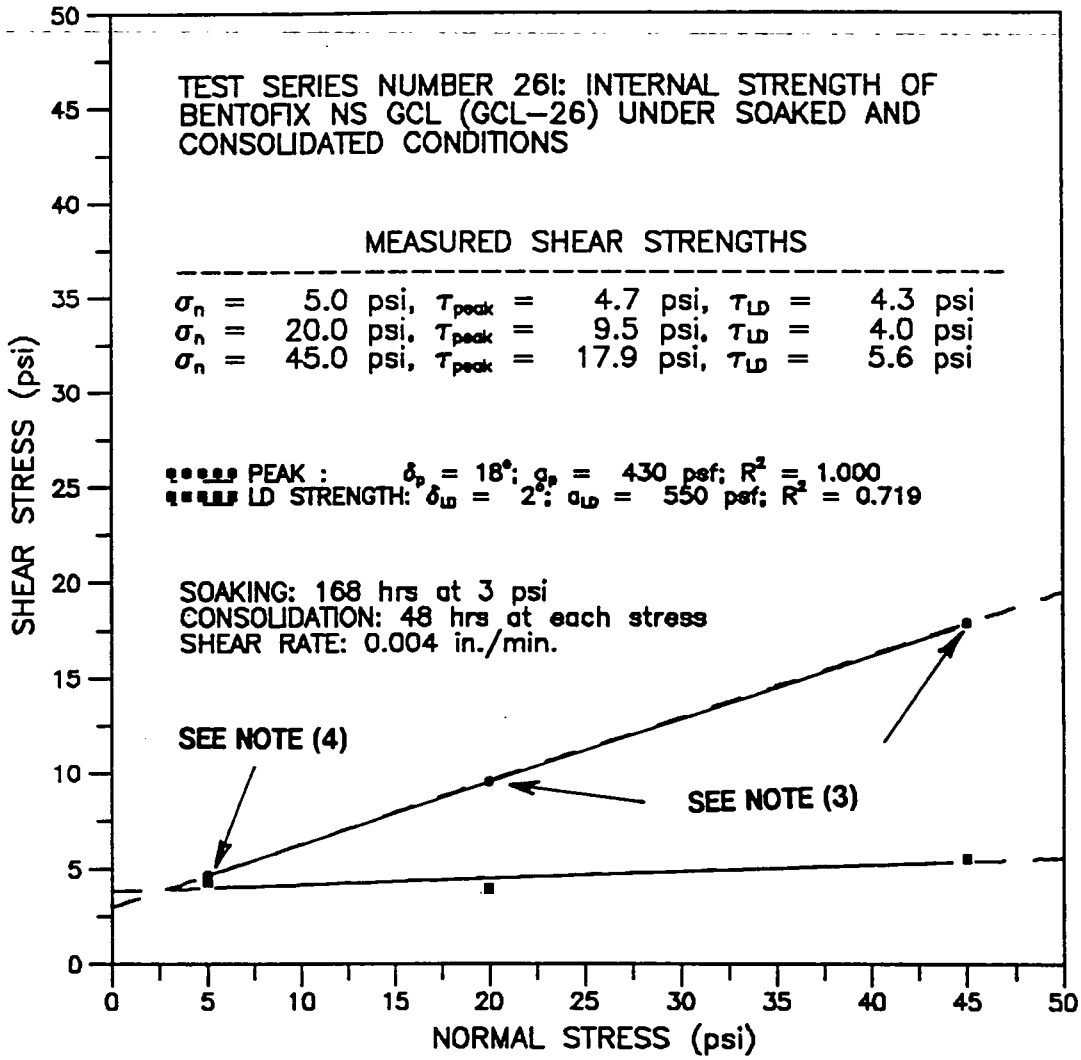
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) No internal shear failure within GCL was observed.
(3) Internal shear failure within GCL was observed.

DATE TESTED: 29 OCTOBER TO 7 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730128
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



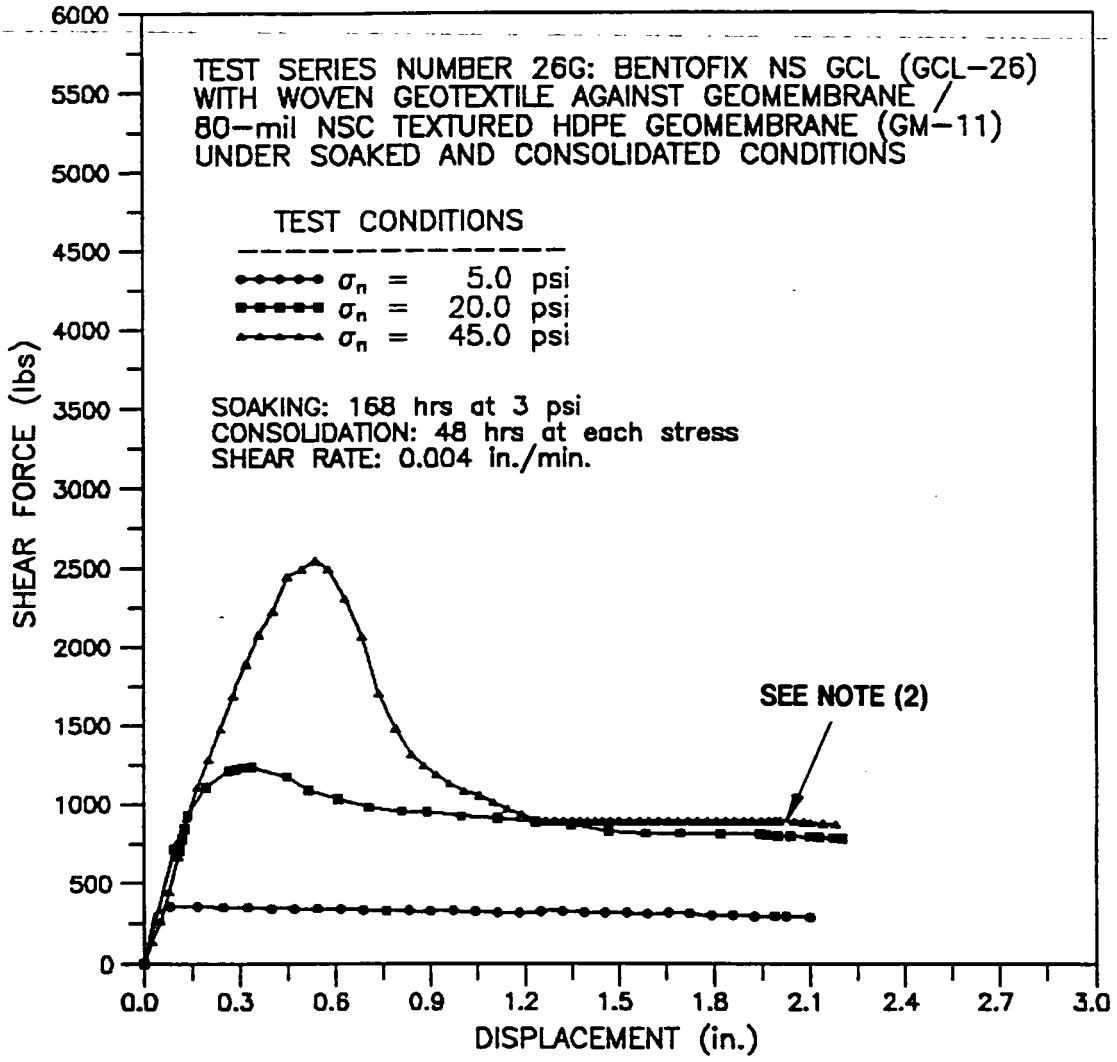
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Internal shear failure within GCL was observed.
(4) No internal failure within GCL was observed.

DATE TESTED: 29 OCTOBER TO 7 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730128
FILE NO.	000587

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

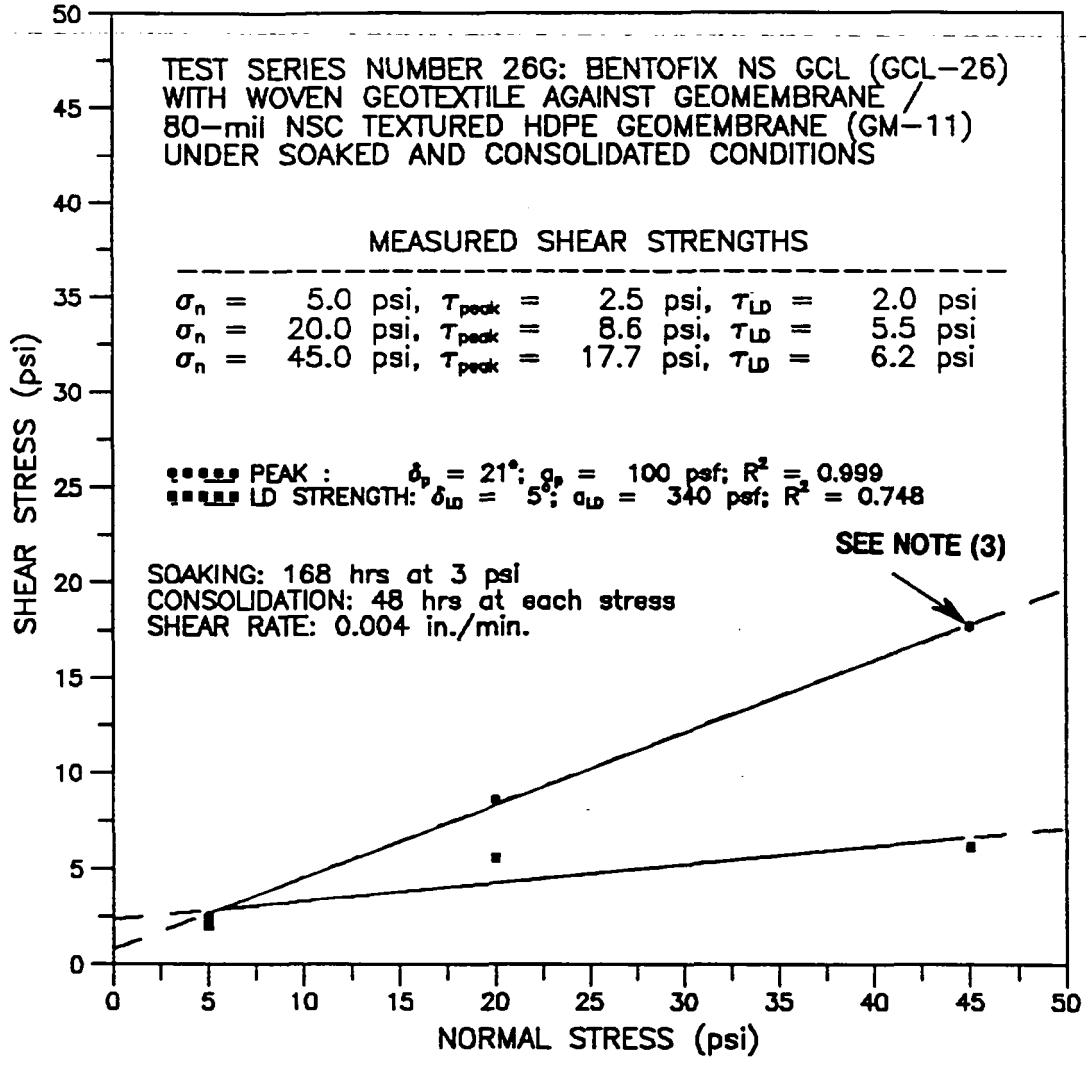
DATE TESTED: 29 OCTOBER TO 7 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730128
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



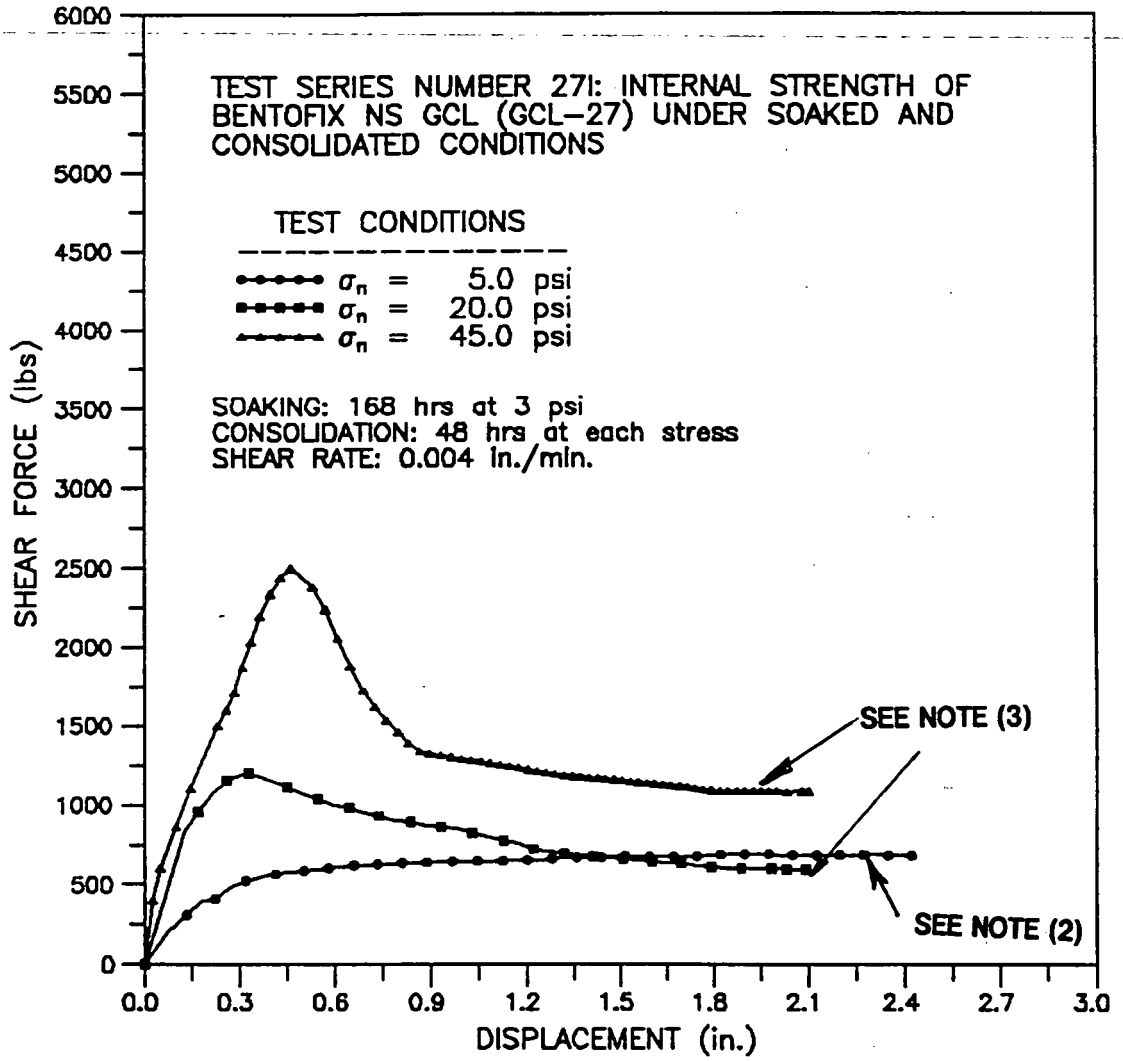
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 29 OCTOBER TO 7 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730128
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



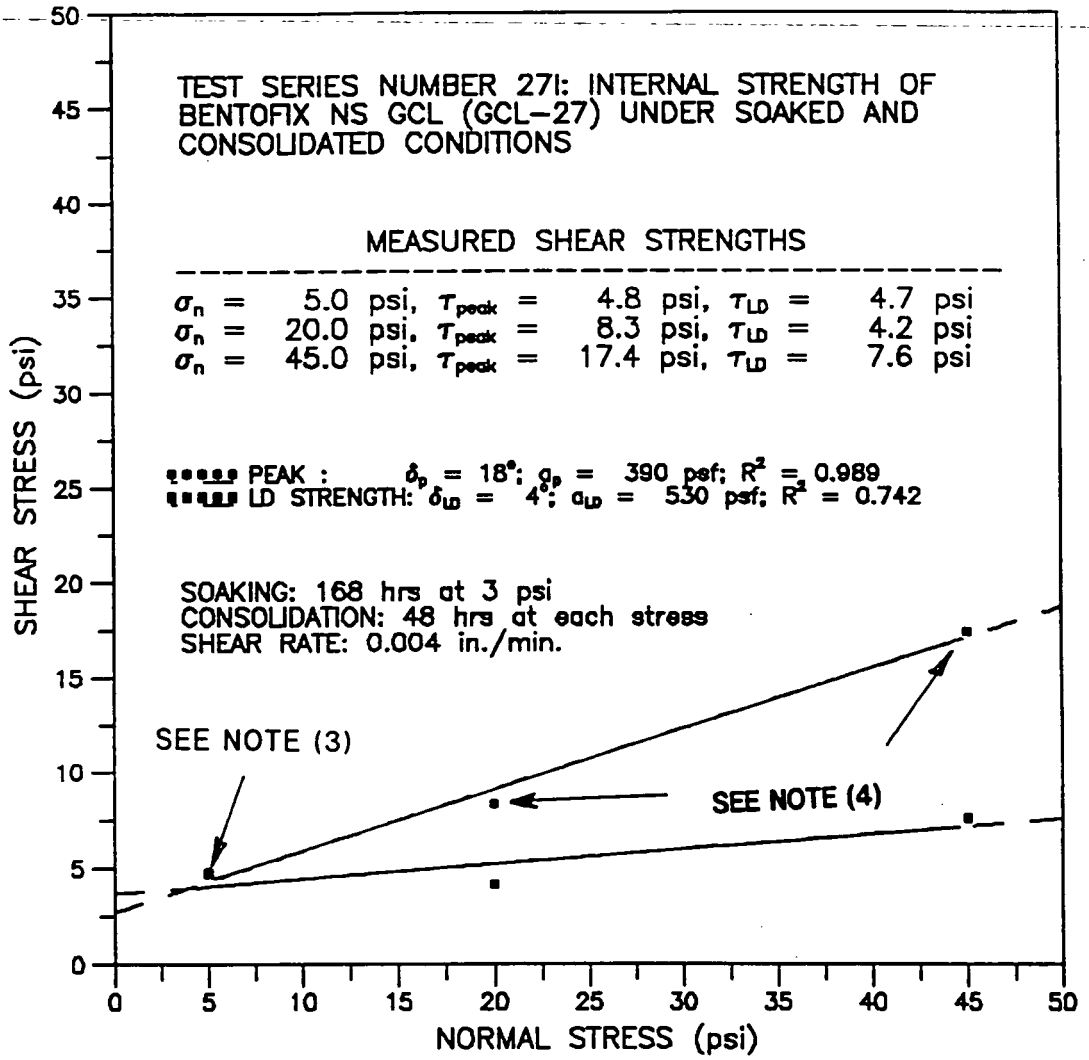
NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.
(2) No internal shear failure within GCL was observed.
(3) Internal shear failure within GCL was observed.

DATE TESTED: 1 TO 10 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730130
FILE NO.	000590

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



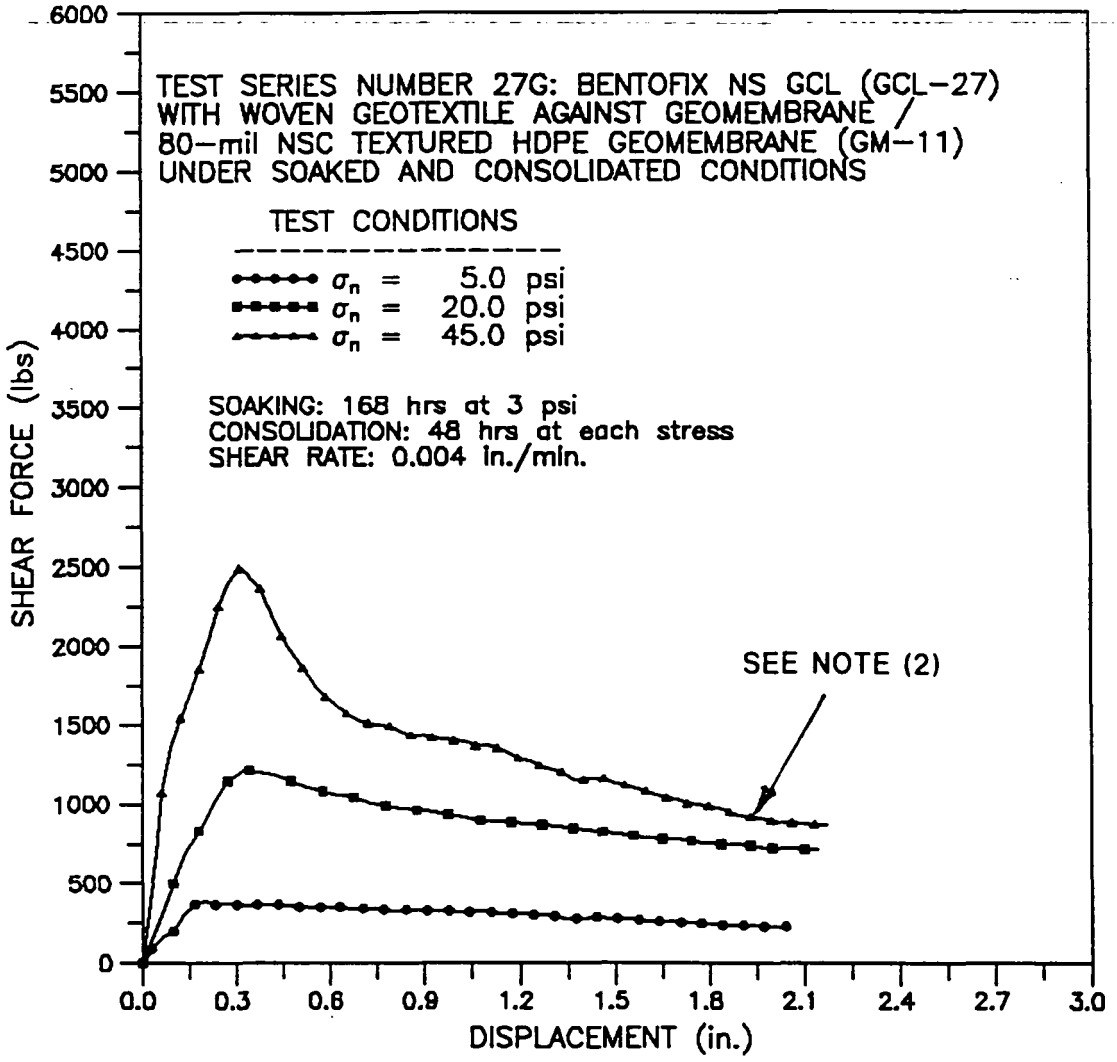
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) No internal shear failure within GCL was observed.
(4) Internal failure within GCL was observed.

DATE TESTED: 1 TO 10 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730130
FILE NO.	000591

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

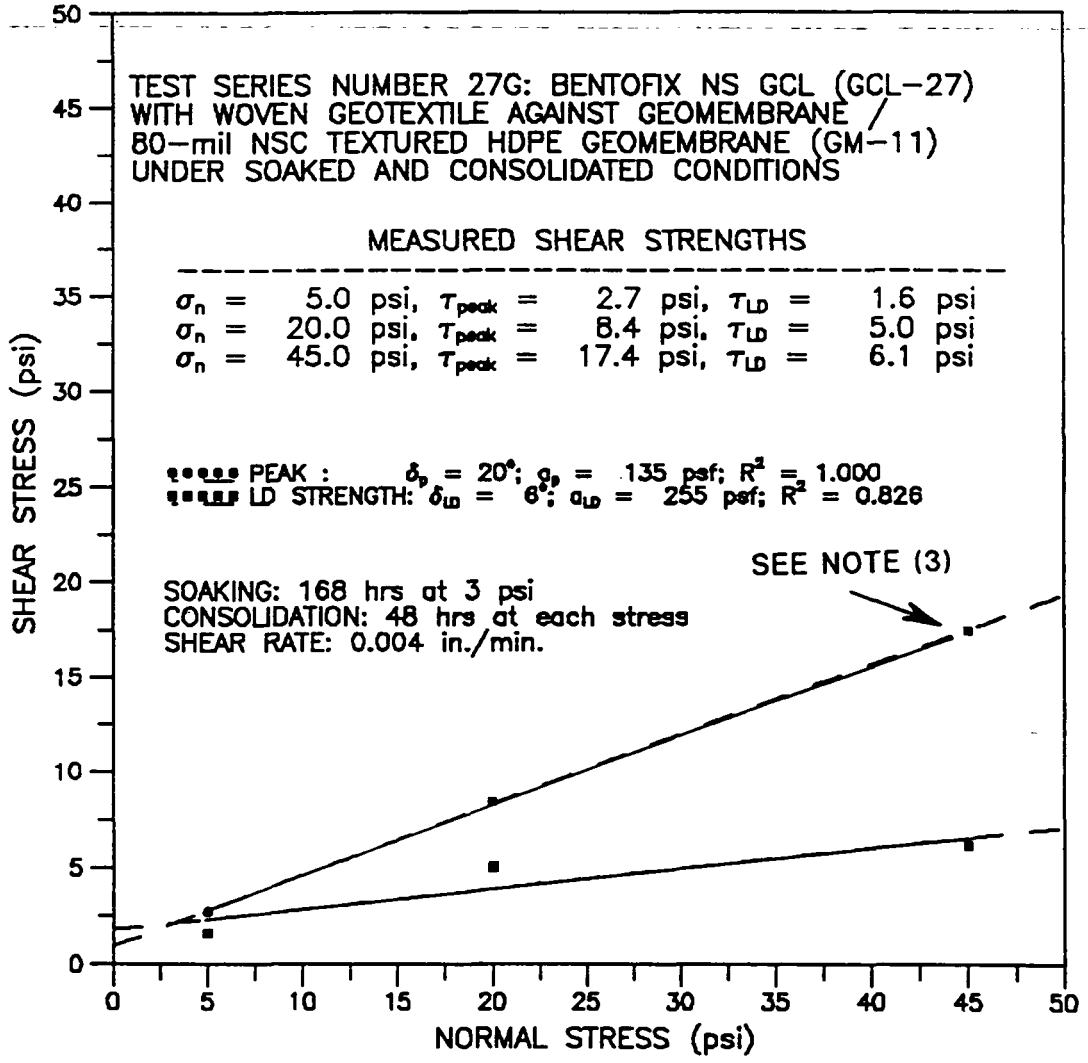
DATE TESTED: 1 TO 10 NOVEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730130
FILE NO.	000592

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 1 TO 10 NOVEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730130
FILE NO.	000593

- **Direct Shear Compliance Packages**

DIRECT SHEAR
COMPLIANCE PACKAGES

QA I.D. No GCL -	Lot Number	Package Included Yes/No	Approval Status
01	97081402	Yes	Approved 10 Oct 97
02	97081502	Yes	Rejected
03	97062902	Yes	Approved 10 Nov 97
04	97082012	Yes	Approved 7 Nov 97
05	97082102	Yes	Approved 30 Oct 97
06	97082502	Yes	Rejected
07	97082302	Yes	Approved 10 Oct 97
08	97082602	No	Pending Approval for Phase II
09	97082702	Yes	Approved 17 Oct 97
10	97082812	Yes	Rejected
11	97090102	No	Pending Approval for Phase II
12	97082802	Yes	Approved 15 Oct 97
13	97090302	Yes	Approved 10 Oct 97
14	97090402	Yes	Approved 10 Oct 97
15	97090202	No	Rejected Based on QC Test Results
16	97090502	No	Rejected, Small Lot Size (3 rolls)
17	97090512	Yes	Approved 15 Oct 97
18	97090612	Yes	Approved 18 Oct 97
19	97090702	Yes	Approved 21 Oct 97
20	97081302	No	Rejected, Small Lot Size (1 roll)
21	97080802	Yes	Approved 30 Oct 97
22	97101002	Yes	Approved 10 Nov 97
23	97101002	Yes	Approved 10 Nov 97
24	97102302	Yes	Approved 14 Nov 97
25	97102302	Yes	Approved 14 Nov 97
26	97102402	Yes	Approved 14 Nov 97
27	97102402	Yes	Approved 14 Nov 97
28	97101002	No	Hydraulic Conductivity Retest (GCL 23)
29	97101002	No	Hydraulic Conductivity Retest (GCL 23)

Baseline

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS Baseline Factors of Safety for RCI on GCL Shear Strength

Computations By:
(Cognizant Engineer)

Signature Robert A. Morgan III — Date 14 OCT 1997

Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Assumptions and Procedures Checked By:
(Checker)

Signature [illegible] — Date 14 Oct 97

Printed Name and Title Gary R. Schmertmann, Sr. Project Engineer

Computations Checked by:

Signature [illegible] — Date 14 Oct 97

Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Computations Backchecked by:
(Cognizant Engineer)

Signature Robert A. Morgan III — Date 14 OCT 1997

Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Approved by:
(PDP)

Signature [illegible] — Date 14 Oct 97

Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Approved by:
(DTL and TETL)

Signature [illegible] — Date 15 Oct 97

Printed Name and Title Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval

Written By: RAM Date: 10/14/97 Reviewed by: GRS Date: 10/14/97

Client: FDF Project: OSDF Project/Proposal No.: GR0166 Task No.: 04

Calculation of Baseline Factors of Safety for RCI on GCL Shear Strength
(RCI no. 1702-006R dated 7 October 1997)

Introduction

A request for clarification of information (RCI) regarding the shear strength requirements in the GCL specification was issued on 7 October 1997 (RCI no. 1702-006R). The RCI presents two *baseline* slope stability factors of safety (FS), one for peak GCL shear strength and the other for large-displacement GCL shear strength. The RCI indicates that the baseline FS values were obtained by reanalyzing two slope stability analysis cases from the OSDF design and changing the GCL shear strength envelopes to those defined in the GCL specification.

Purpose

The purpose of this calculation is to present the slope stability analyses performed to obtain the baseline FS values.

Slope Stability Analysis Cases

The two slope stability analysis cases to be reanalyzed were identified in the RCI as indicated below.

- The first case, referred to as the *interim* case, consists of the most critical interim slope (3H:1V) of impacted material that can potentially exist in the OSDF. The detailed analysis for this case is presented on pages 23 to 26 of section 3.3 of the design calculations, and is there identified by the title "OSDF Interim Conditions – Peak Short Term" and the file name "CASE5B". This case is relevant to the peak GCL shear strength envelope.

- The second case, referred to as the *final* case, consists of the most critical final slope of impacted material that will exist in the OSDF. The detailed analysis for this case is presented on pages 31 to 34 of section 3.3 of the design calculations, and is there identified by the title "OSDF Final Long Term – Large Disp." and the file name "CASE7B". This case is relevant to the large-displacement GCL shear strength envelope.

Method

The baseline FS values were calculated using the steps described below.

1. Obtain the computer analysis program (XSTABL) and input files used to perform the two analyses identified above for the OSDF design calculations. Confirm that the correct analysis program and input files have been obtained by repeating the two analyses and checking that the calculated FS values match those presented in the design calculations.

2. Modify the input files for the two analysis cases as follows:

   - Define the GCL as one material with a single non-linear shear strength envelope. Use the peak shear strength envelope defined in the GCL specification for the interim case (Figure 1) and the large-displacement shear strength envelope defined in the GCL spec. for the final case (Figure 2). This modification will allow shear strengths used in the analysis to represent the shear strength envelopes defined in the GCL specification.

   - Subdivide the geometry line defining the impacted material slope face into several segments, without changing the slope inclination or height. This modification will cause the analysis solution to use more columns in the area where the potential slip surface passes along the GCL. As each analysis column will have a different level of normal stress on the GCL, this modification will allow the shear strengths used in the analysis to more closely simulate the intended shear strength envelope.

   - For the interim case, truncate the input geometry at a point approximately 50 ft outside the toe of the impacted material slope. The geometry outside this point has no influence on the analysis results and is truncated to simplify the search process for locating the critical potential slip surface.

3. Analyze the interim and final slope stability cases using the XSTABL computer program and the input files created in Step 2 that include the shear strength envelopes defined in the GCL specification. For each case, locate the critical potential slip surface that passes along the GCL and calculate the corresponding slope stability factor of safety (FS) using Spencer's analysis method. The calculated FS values are the *baseline* values.

Results

The repeat analyses from the OSDF design calculations produced the following FS values: FS=1.919 for the interim case and FS=1.543 for the final case. These are the same FS values presented in the design calculations, indicating that the correct computer analysis program (XSTABL) and input files were obtained. The computer output files for the repeat analyses are attached as Appendix A.

The reanalyses using the shear strength envelopes given in the GCL specification resulted in the following FS values: FS=1.944 for the interim case and FS=1.574 for the final case. Therefore, after rounding to the nearest 0.1 value, the baseline FS values are as follows:

Interim Case:	baseline FS=	1.9	for peak GCL strength.
Final Case:	baseline FS=	1.6	for large-displacement GCL strength.

The computer output files for the baseline analyses are attached as Appendix B.

Written By: RAM Date: 10/14/97 Reviewed by: GRS Date: 10/14/97

Client: FDF Project: OSDF Project/Proposal No.: GA 0166 Task No.: 04

Figure 1 - Peak Shear Strength Envelope Defined in Specification

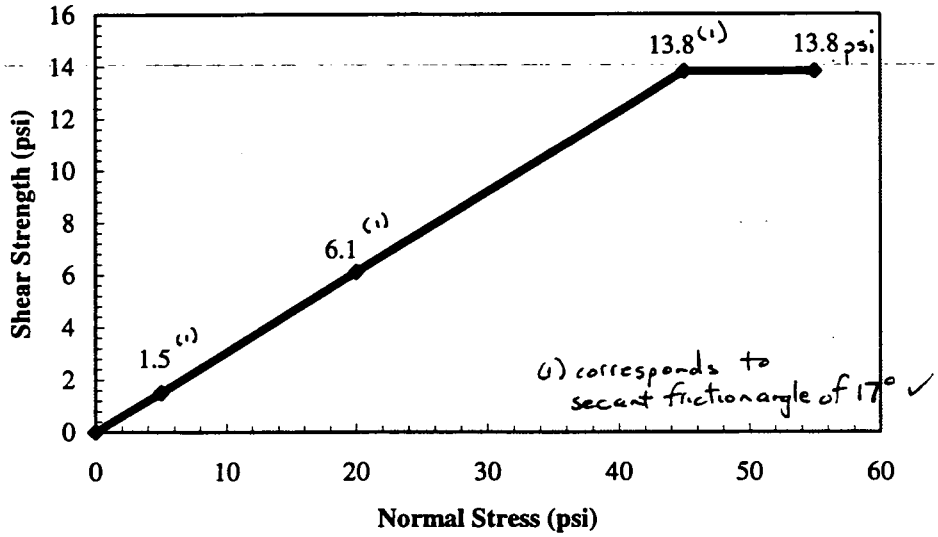
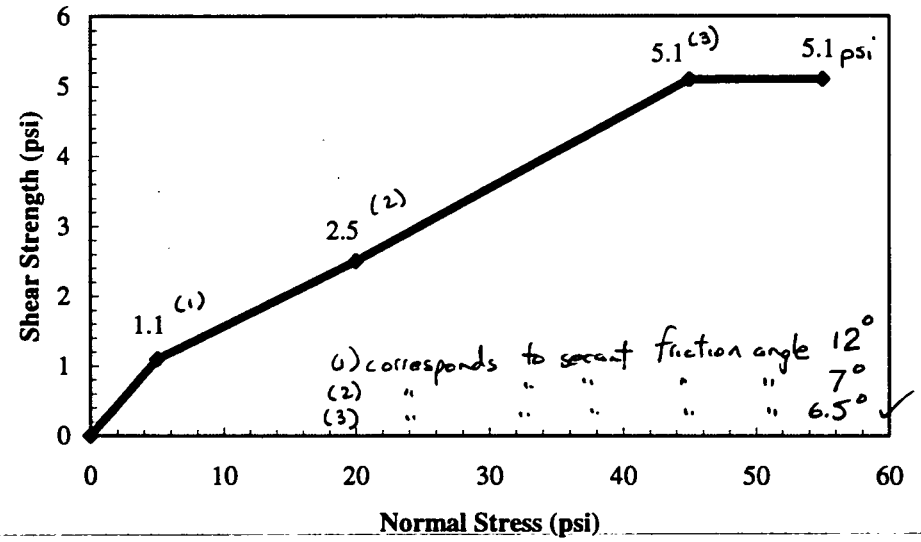


Figure 2- Large-Displacement Shear Strength Envelope Defined in Specification



Note: It is conservative to model envelopes as flat above 45psi

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GRS 10/14/97

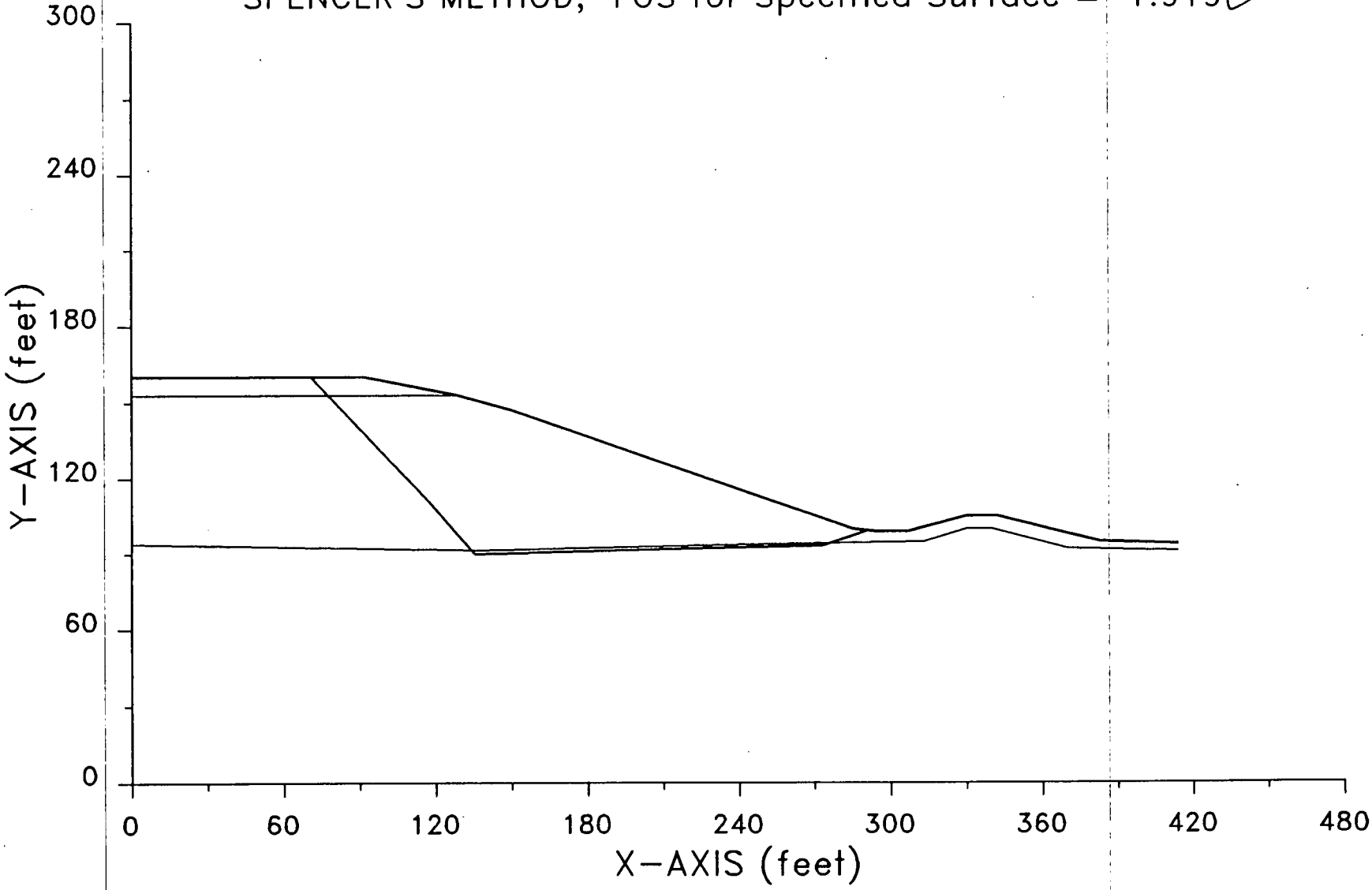
RAM 10/14/97

APPENDIX A

CASE5B 10-13-97 14:59

OSDF Interim Conditions—Peak Short T

SPENCER'S METHOD, FOS for Specified Surface = 1.919



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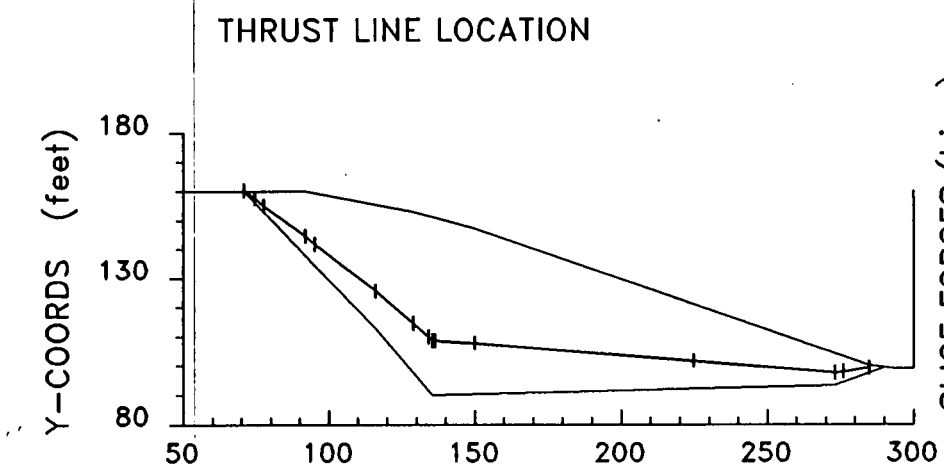

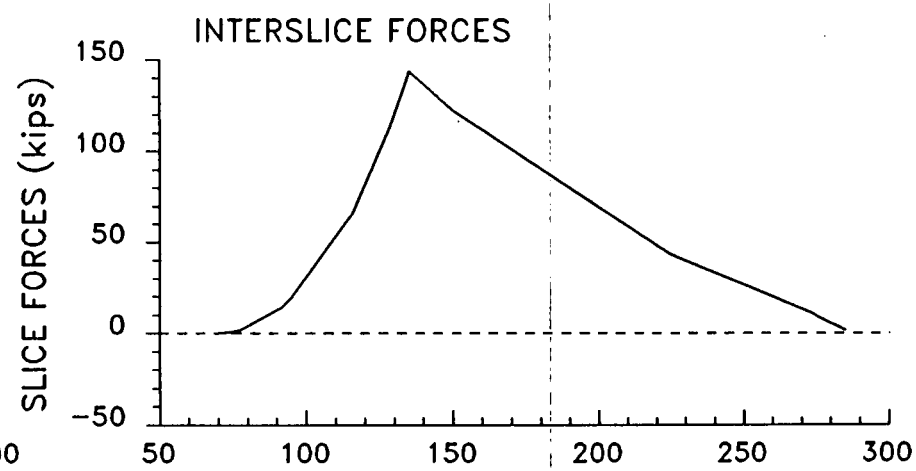

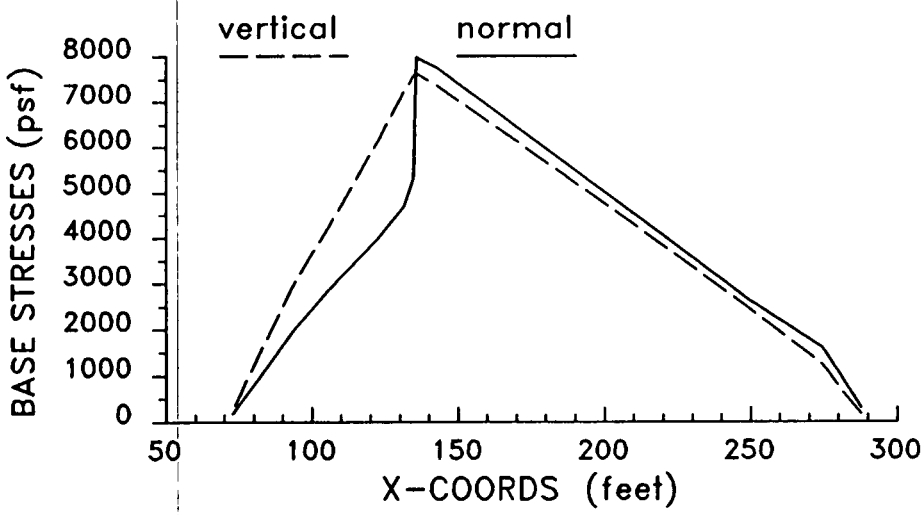

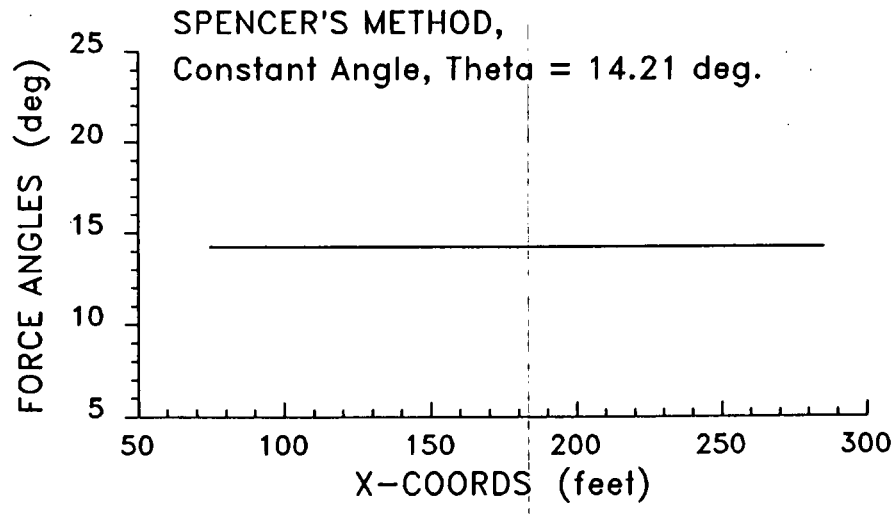

OSDF Interim Conditions—Peak Short T
SPENCER'S METHOD, FOS for Specified Surface = 1.919 ✓

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000603

XSTABL File: CASE5B 10-13-97 14:59

```
*****************************************
*              X S T A B L              *
*                                       *
*       Slope Stability Analysis        *
*              using the                *
*           Method of Slices            *
*                                       *
*        Copyright (C) 1992 á 96        *
*   Interactive Software Designs, Inc.  *
*       Moscow, ID 83843, U.S.A.        *
*                                       *
*         All Rights Reserved           *
*                                       *
*  Ver. 5.201                96 á 1202  *
*****************************************
```

Problem Description : OSDF Interim Conditions-Peak Short T

SEGMENT BOUNDARY COORDINATES
---

10 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	285.0	100.0	1
5	285.0	100.0	294.0	99.0	1
6	294.0	99.0	307.0	99.0	2
7	307.0	99.0	330.0	105.0	2
8	330.0	105.0	342.0	105.0	2
9	342.0	105.0	383.0	95.0	2
10	383.0	95.0	414.0	94.0	2

9 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	4
4	224.8	93.2	285.0	94.4	5
5	285.0	94.4	313.0	95.0	6
6	313.0	95.0	330.0	100.0	6
7	330.0	100.0	340.0	100.0	6
8	340.0	100.0	370.0	92.0	6
9	370.0	92.0	414.0	91.0	6

ISOTROPIC Soil Parameters
---

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	15.00	.000	.0	0
4	125.0	125.0	.0	17.00	.000	.0	0
5	125.0	125.0	.0	23.00	.000	.0	0
6	125.0	125.0	.0	30.00	.000	.0	0

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 7 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	290.52	99.39
2	273.30	93.21
3	135.57	90.01
4	116.06	112.79
5	95.26	134.42
6	74.61	156.18
7	70.89	160.00

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	287.76	98.40	1.30	5.52	-19.73	6.34	895.
2	280.56	95.81	5.73	8.88	-19.73	19.20	6357.
3	274.71	93.72	9.87	2.82	-19.73	19.20	3483.
4	249.05	92.65	19.87	48.50	-1.33	19.20	120458.
5	187.40	91.21	42.77	74.80	-1.33	19.20	399853.
6	143.25	90.19	58.74	13.50	-1.33	15.95	99124.

7	136.04	90.02	60.97	.93	-1.33	15.95	7088.
8	134.96	90.73	60.57	1.23	49.42	15.95	9290.
9	131.67	94.56	57.67	5.34	49.42	15.95	38519.
10	122.53	105.24	48.99	12.94	49.42	10.71	79239.
11	105.66	123.60	33.81	20.80	46.12	10.71	87908.
12	93.63	136.14	23.55	3.26	46.50	10.71	9598.
13	84.81	145.43	14.57	14.37	46.50	.00	26180.
14	76.12	154.59	5.41	3.02	46.50	.00	2041.
15	72.75	158.09	1.91	3.72	45.76	.00	888.

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	14.2040	1.9192	1.9455
3	14.2106	1.9193	1.9192

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	297.0	200.0	25.00	0.	0.	0.	.00
2	1025.7	200.0	25.00	0.	0.	0.	.00
3	1593.5	.0	23.00	0.	0.	0.	.00
4	2662.1	.0	23.00	0.	0.	0.	.00
5	5626.5	.0	17.00	0.	0.	0.	.00
6	7728.3	.0	17.00	0.	0.	0.	.00
7	7975.9	.0	15.00	0.	0.	0.	.00
8	5319.5	.0	15.00	0.	0.	0.	.00
9	4687.0	200.0	25.00	0.	0.	0.	.00
10	3971.6	200.0	25.00	0.	0.	0.	.00
11	2849.4	200.0	25.00	0.	0.	0.	.00
12	1957.7	200.0	25.00	0.	0.	0.	.00
13	1189.4	200.0	25.00	0.	0.	0.	.00
14	448.5	.0	30.00	0.	0.	0.	.00
15	160.0	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	287.76	297.0	162.1	.0	176.4
2	280.56	1025.7	716.3	.0	353.4
3	274.71	1593.5	1233.1	.0	352.4
4	249.05	2662.1	2483.7	.0	588.7
5	187.40	5626.5	5345.6	.0	896.2
6	143.25	7728.3	7342.5	.0	1231.0
7	136.04	7975.9	7621.1	.0	1113.5
8	134.96	5319.5	7571.5	.0	742.6
9	131.67	4687.0	7209.3	.0	1242.9
10	122.53	3971.6	6123.6	.0	1069.1
11	105.66	2849.4	4226.3	.0	796.5

12	93.63	1957.7	2944.3	.0	579.8
13	84.81	1189.4	1821.6	.0	393.2
14	76.12	448.5	676.3	.0	134.9
15	72.75	160.0	238.8	.0	48.1

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	14.21	1611.	1.69	2.59	.651
2	276.12	14.21	8215.	3.58	8.87	.404
3	273.30	14.21	10907.	4.21	10.86	.388
4	224.80	14.21	43457.	9.44	28.88	.327
5	150.00	14.21	122699.	17.35	56.65	.306
6	136.50	14.21	142343.	18.43	60.83	.303
7	135.57	14.21	143589.	18.52	61.11	.303
8	134.34	14.21	136668.	18.31	60.03	.305
9	129.00	14.21	113355.	16.69	55.32	.302
10	116.06	14.21	65725.	12.66	42.66	.297
11	95.26	14.21	19237.	7.14	24.96	.286
12	92.00	14.21	14249.	6.57	22.14	.297
13	77.63	14.21	1496.	2.00	7.00	.286
14	74.61	14.21	445.	1.45	3.82	.378
15	70.89	.00	-1.	.14	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3691.70 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 744.98 (psf)

Total Length of failure surface = 251.39 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.919

Total shear strength available along specified failure surface = 359.46E+03 lb

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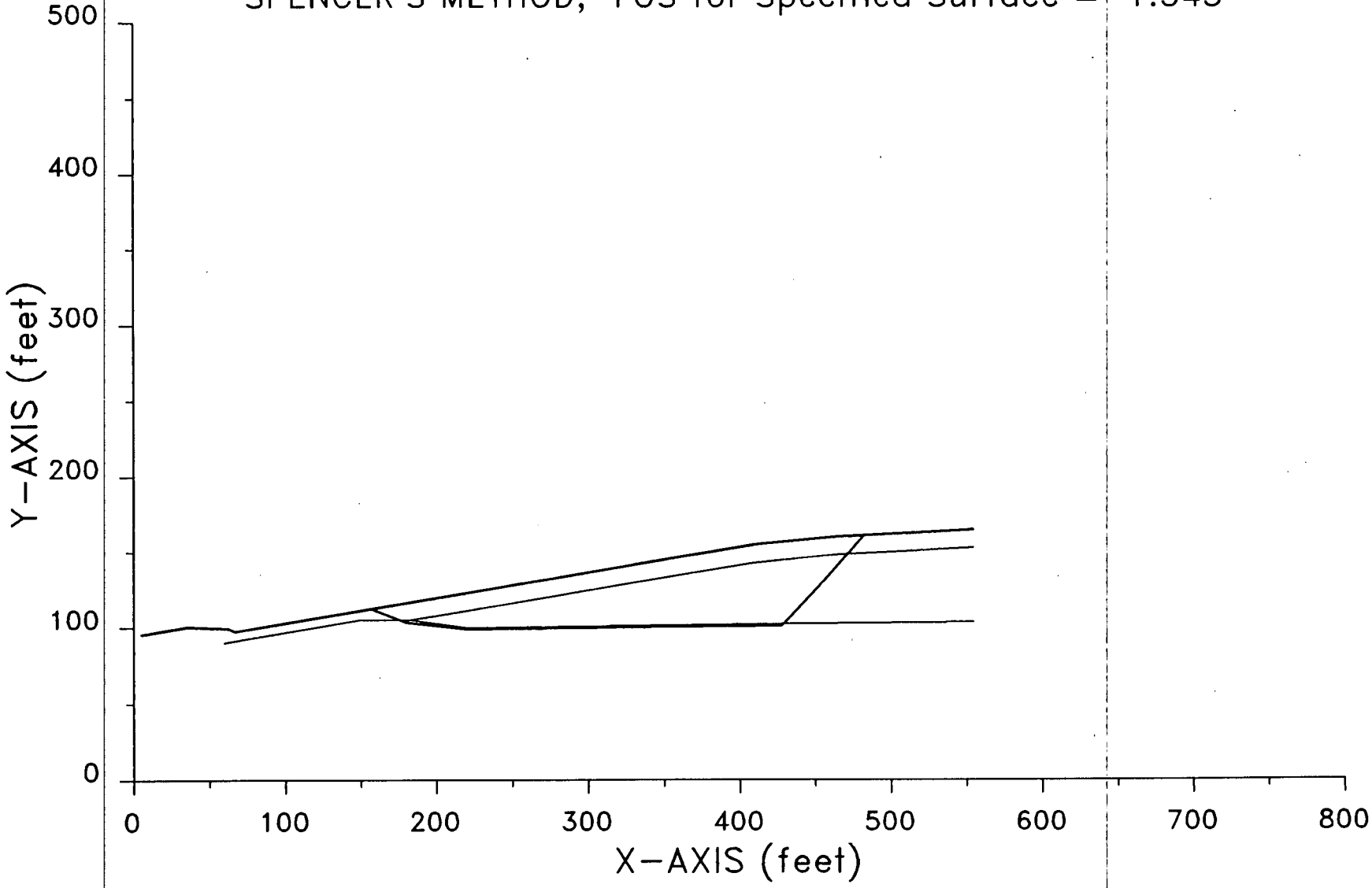
OSDF Final Long Term – Large Disp.
SPENCER'S METHOD, FOS for Specified Surface = 1.543



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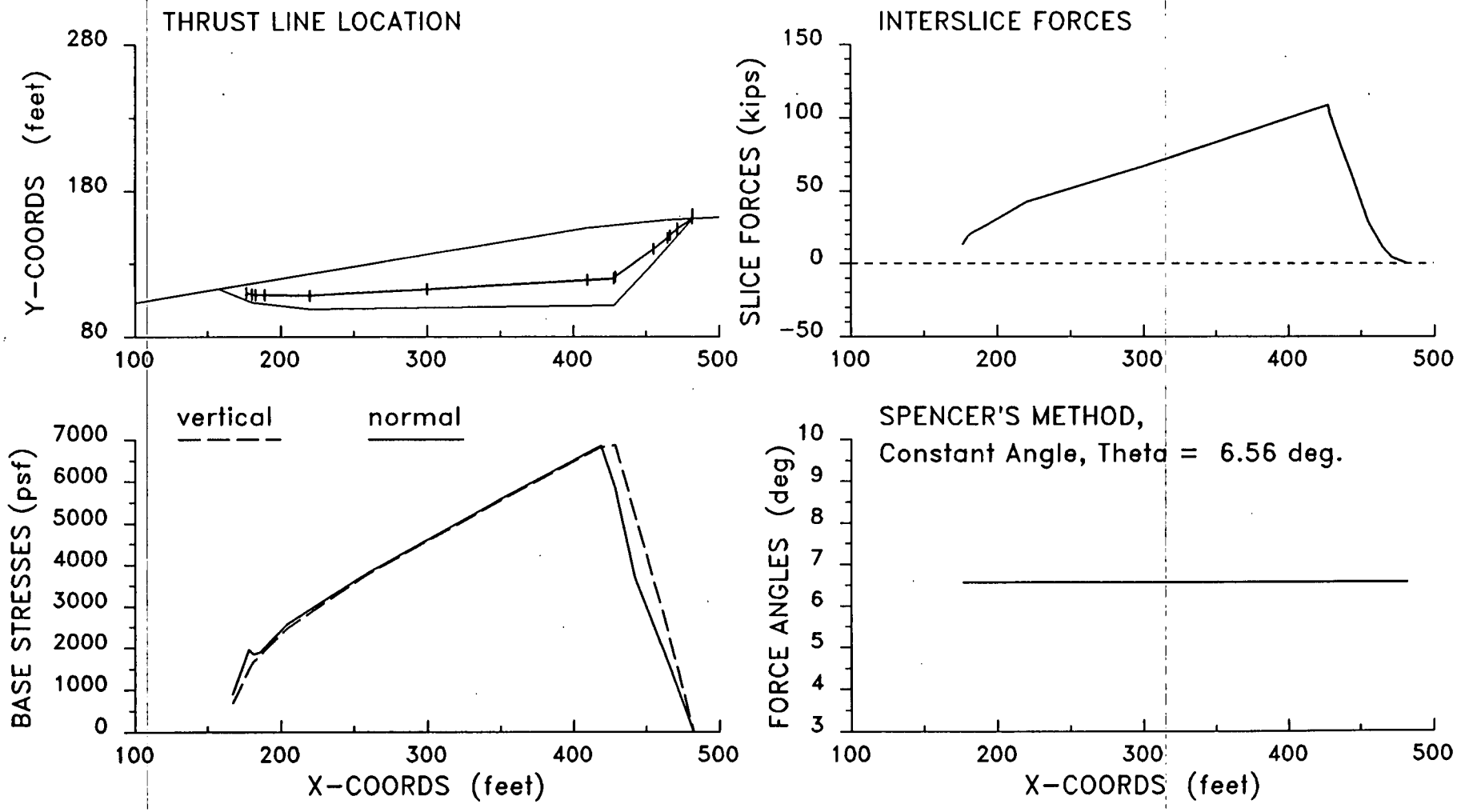

OSDF Final Long Term - Large Disp.
SPENCER'S METHOD, FOS for Specified Surface = 1.543

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XSTABL File: CASE7B 10-13-97 15:00

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 á 96       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.201                 96 á 1202 *
*****************************************
```

Problem Description : OSDF Final Long Term - Large Disp.

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.3	2
3	62.5	99.3	67.0	97.5	2
4	67.0	97.5	410.0	154.7	2
5	410.0	154.7	465.0	160.2	2
6	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1
5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	6
9	220.0	100.0	300.0	100.8	5
10	300.0	100.8	410.0	102.0	4
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	5.00	.000	.0	0
4	125.0	125.0	.0	6.00	.000	.0	0
5	125.0	125.0	.0	8.00	.000	.0	0
6	125.0	125.0	.0	10.00	.000	.0	0

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 7 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	157.53	112.60
2	180.25	103.47
3	220.00	99.00
4	428.25	101.18
5	455.60	130.37
6	481.96	160.45
7	482.22	161.06

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	166.99	108.80	5.38	18.91	-21.89	9.47	12707.
2	178.35	104.24	11.83	3.81	-21.89	9.47	5634.
3	181.63	103.32	13.30	2.75	-6.42	9.47	4572.
4	186.00	102.82	14.52	6.00	-6.42	9.47	10891.
5	204.50	100.74	19.69	31.00	-6.42	9.47	76287.
6	260.00	99.42	30.27	80.00	.60	9.47	302667.
7	355.00	100.41	45.11	110.00	.60	9.47	620328.
8	419.13	101.08	54.53	18.25	.60	5.71	124392.

9	428.73	101.69	54.88	.95	46.86	5.71	6548.
10	442.40	116.28	41.66	26.40	46.86	5.71	137441.
11	460.30	135.73	24.00	9.40	48.77	5.71	28196.
12	466.00	142.24	18.01	2.00	48.77	2.86	4503.
13	469.35	146.06	14.36	4.69	48.77	2.86	8425.
14	476.83	154.59	6.20	10.27	48.77	2.86	7955.
15	482.09	160.76	.30	.26	66.95	2.86	10.

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	6.5387	1.5423	1.5719
3	6.5620	1.5427	1.5423

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	883.7	.0	30.00	0.	0.	0.	.00
2	1945.3	.0	30.00	0.	0.	0.	.00
3	1843.3	.0	30.00	0.	0.	0.	.00
4	1888.7	.0	10.00	0.	0.	0.	.00
5	2560.6	.0	10.00	0.	0.	0.	.00
6	3815.1	.0	8.00	0.	0.	0.	.00
7	5672.9	.0	6.00	0.	0.	0.	.00
8	6848.4	.0	5.00	0.	0.	0.	.00
9	5829.9	.0	5.00	0.	0.	0.	.00
10	3691.3	.0	25.00	0.	0.	0.	.00
11	2081.0	.0	25.00	0.	0.	0.	.00
12	1562.0	.0	25.00	0.	0.	0.	.00
13	1245.3	.0	25.00	0.	0.	0.	.00
14	511.4	.0	30.00	0.	0.	0.	.00
15	18.2	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	166.99	883.7	671.9	.0	330.7
2	178.35	1945.3	1479.2	.0	728.0
3	181.63	1843.3	1662.5	.0	689.9
4	186.00	1888.7	1815.2	.0	215.9
5	204.50	2560.6	2460.9	.0	292.7
6	260.00	3815.1	3783.3	.0	347.6
7	355.00	5672.9	5639.3	.0	386.5
8	419.13	6848.4	6816.0	.0	388.4
9	428.73	5829.9	6860.4	.0	330.6
10	442.40	3691.3	5207.0	.0	1115.8
11	460.30	2081.0	2999.6	.0	629.0
12	466.00	1562.0	2251.5	.0	472.2
13	469.35	1245.3	1795.1	.0	376.4

14	476.83	511.4	774.9	.0	191.4
15	482.09	18.2	37.4	.0	6.8

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	176.44	6.56	13053.	4.89	10.75	.455
2	180.25	6.56	18840.	5.06	12.92	.391
3	183.00	6.56	21324.	5.06	13.68	.370
4	189.00	6.56	23910.	5.80	15.36	.378
5	220.00	6.56	42028.	8.84	24.01	.368
6	300.00	6.56	66801.	12.40	36.52	.340
7	410.00	6.56	103021.	17.56	53.71	.327
8	428.25	6.56	108839.	18.49	55.35	.334
9	429.20	6.56	103179.	18.57	54.42	.341
10	455.60	6.56	28150.	9.44	28.89	.327
11	465.00	6.56	11633.	6.36	19.10	.333
12	467.00	6.56	8995.	5.88	16.92	.347
13	471.69	6.56	4060.	5.28	11.80	.447
14	481.96	6.56	7.	.29	.60	.481
15	482.22	.00	-2.	2.84	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3900.75 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 450.16 (psf)

Total Length of failure surface = 353.41 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.543

Total shear strength available along specified failure surface = 245.42E+03 lb

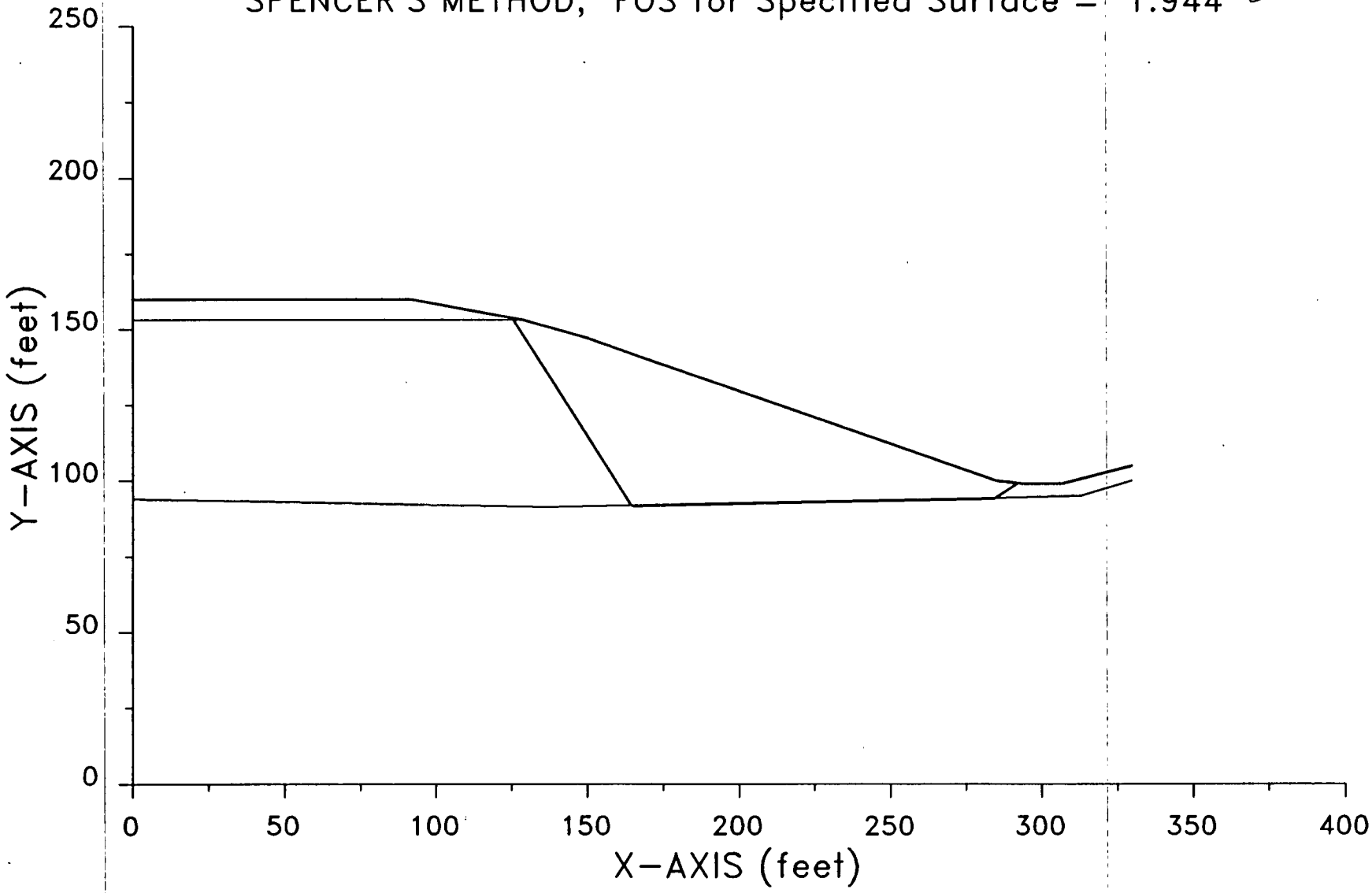
GES 10/14/97

RAM 10/14/97

APPENDIX B

CASE5ES 10-14-97 17:39

OSDF Interim Closure Short Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.944



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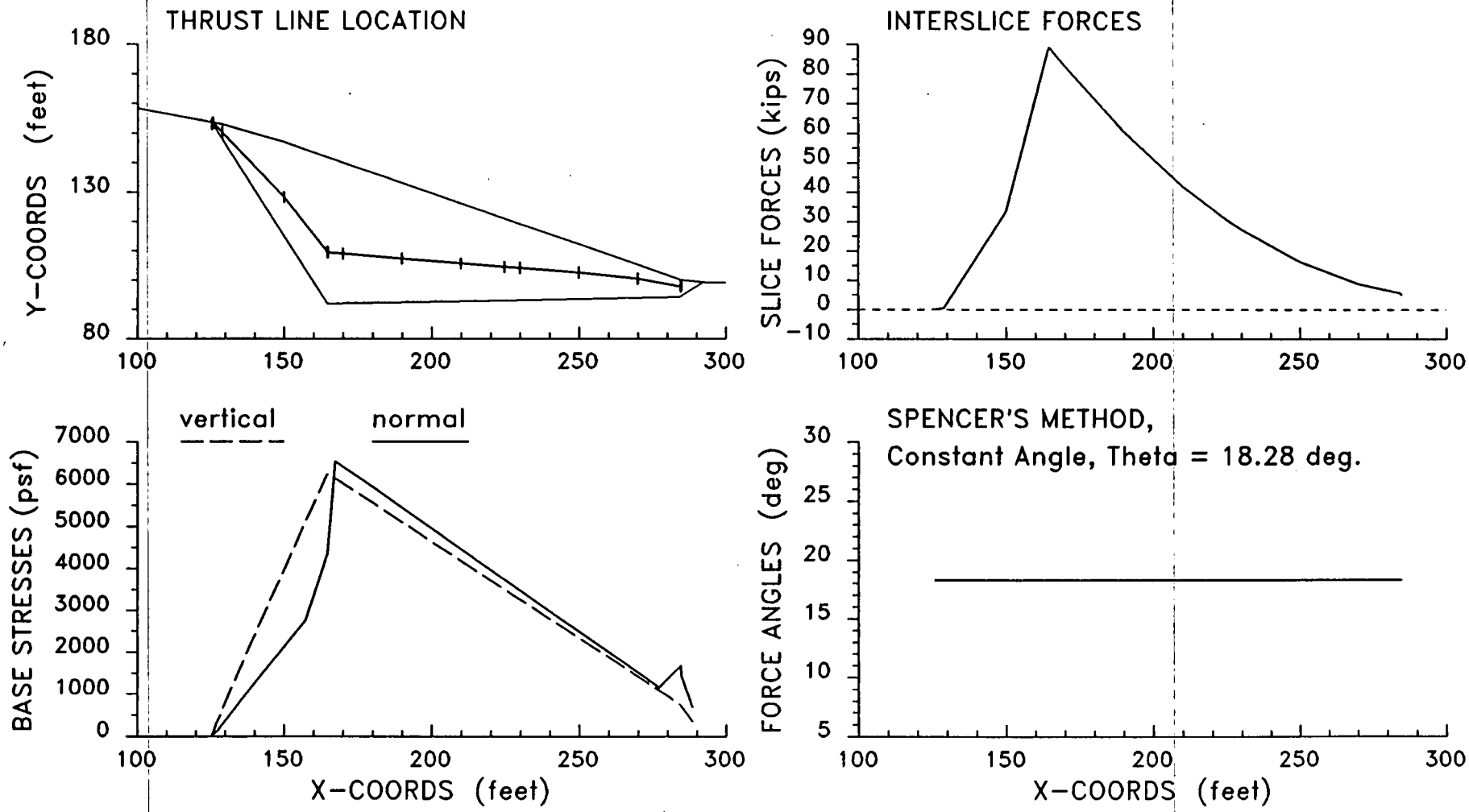

OSDF Interim Closure Short Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.944

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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```

Problem Description : OSDF Interim Closure Short Term,Peak

SEGMENT BOUNDARY COORDINATES
---

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	220.1
4	2880.0	880.5
5	6480.0	1981.1
6	10080.0	1981.1

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	292.31	99.19
2	284.78	94.40
3	284.58	94.19
4	224.80	93.00
5	164.88	91.78
6	164.69	91.97
7	125.81	153.00
8	125.42	153.68

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	288.65	96.86	2.73	7.31	-32.45	6.34	2495.
2	284.89	94.47	5.57	.22	-32.45	19.12	156.
3	284.68	94.29	5.82	.20	-46.40	19.12	142.
4	277.29	94.04	8.63	14.58	-1.14	19.12	15724.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37498.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55869.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.17	19.29	56722.
9	200.00	92.50	37.10	20.00	-1.17	19.29	92762.
10	180.00	92.09	44.46	20.00	-1.17	19.03	111155.
11	167.44	91.83	49.06	5.12	-1.17	19.29	31401.
12	164.78	91.88	49.95	.19	45.00	19.29	1205.
13	157.34	103.50	40.93	14.69	57.50	19.29	75139.
14	139.50	131.51	18.49	21.00	57.50	15.95	48534.
15	127.40	150.50	2.81	3.19	57.50	10.71	1119.
16	125.61	153.34	.30	.39	60.07	10.71	15.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	18.2890	1.9450	1.9392
3	18.2848	1.9449	1.9450

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	18.2848	1.9441	1.9450

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	18.2848	1.9441	1.9450

SLICE INFORMATION ... continued :

Slice	Sigma	c-value	phi	U-base	U-top	P-top	Delta

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	(psf)	(psf)		(lb)	(lb)	(lb)	
1	678.5	.0	30.00	0.	0.	0.	.00
2	1425.6	200.0	25.00	0.	0.	0.	.00
3	1668.2	.0	17.00	0.	0.	0.	.00
4	1149.4	.0	17.00	0.	0.	0.	.00
5	1998.1	.0	17.00	0.	0.	0.	.00
6	2977.0	.0	17.00	0.	0.	0.	.00
7	3591.2	.0	17.00	0.	0.	0.	.00
8	4085.4	.0	17.00	0.	0.	0.	.00
9	4944.1	.0	17.00	0.	0.	0.	.00
10	5924.4	.0	17.00	0.	0.	0.	.00
11	6534.4	1981.1	.00	0.	0.	0.	.00
12	4348.8	.0	17.00	0.	0.	0.	.00
13	2747.1	200.0	25.00	0.	0.	0.	.00
14	1202.5	200.0	25.00	0.	0.	0.	.00
15	122.9	200.0	25.00	0.	0.	0.	.00
16	20.3	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	288.65	678.5	341.3	.0	201.5
2	284.89	1425.6	696.3	.0	444.8
3	284.68	1668.2	727.4	.0	262.3
4	277.29	1149.4	1078.5	.0	180.7
5	260.00	1998.1	1874.9	.0	314.2
6	240.00	2977.0	2793.4	.0	468.2
7	227.40	3591.2	3369.8	.0	564.7
8	217.40	4085.4	3832.6	.0	642.5
9	200.00	4944.1	4638.1	.0	777.5
10	180.00	5924.4	5557.8	.0	931.6
11	167.44	6534.4	6133.0	.0	1019.0
12	164.78	4348.8	6243.7	.0	683.9
13	157.34	2747.1	5116.0	.0	761.8
14	139.50	1202.5	2311.2	.0	391.3
15	127.40	122.9	350.7	.0	132.4
16	125.61	20.3	37.7	.0	6.0

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	18.28	4872.	3.53	5.46	.647
2	284.78	18.28	5192.	3.52	5.68	.620
3	284.58	18.28	5607.	3.52	5.96	.592
4	270.00	18.28	8733.	6.45	11.30	.571
5	250.00	18.28	16190.	8.87	18.70	.475
6	230.00	18.28	27299.	10.84	26.00	.417

7	224.80	18.28	30783.	11.33	27.92	.406
8	210.00	18.28	42094.	12.78	33.40	.383
9	190.00	18.28	60591.	14.82	40.81	.363
10	170.00	18.28	82755.	16.93	48.12	.352
11	164.88	18.28	88967.	17.47	50.01	.349
12	164.69	18.28	88223.	17.49	49.89	.351
13	150.00	18.28	33305.	13.11	31.97	.410
14	129.00	18.28	212.	2.09	5.01	.418
15	125.81	18.28	9.	.28	.60	.460
16	125.42	.00	-3.	-.82	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2851.89 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 539.54 (psf)

Total Length of failure surface = 202.35 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.944

Total shear strength available along specified failure surface = 212.25E+03 lb

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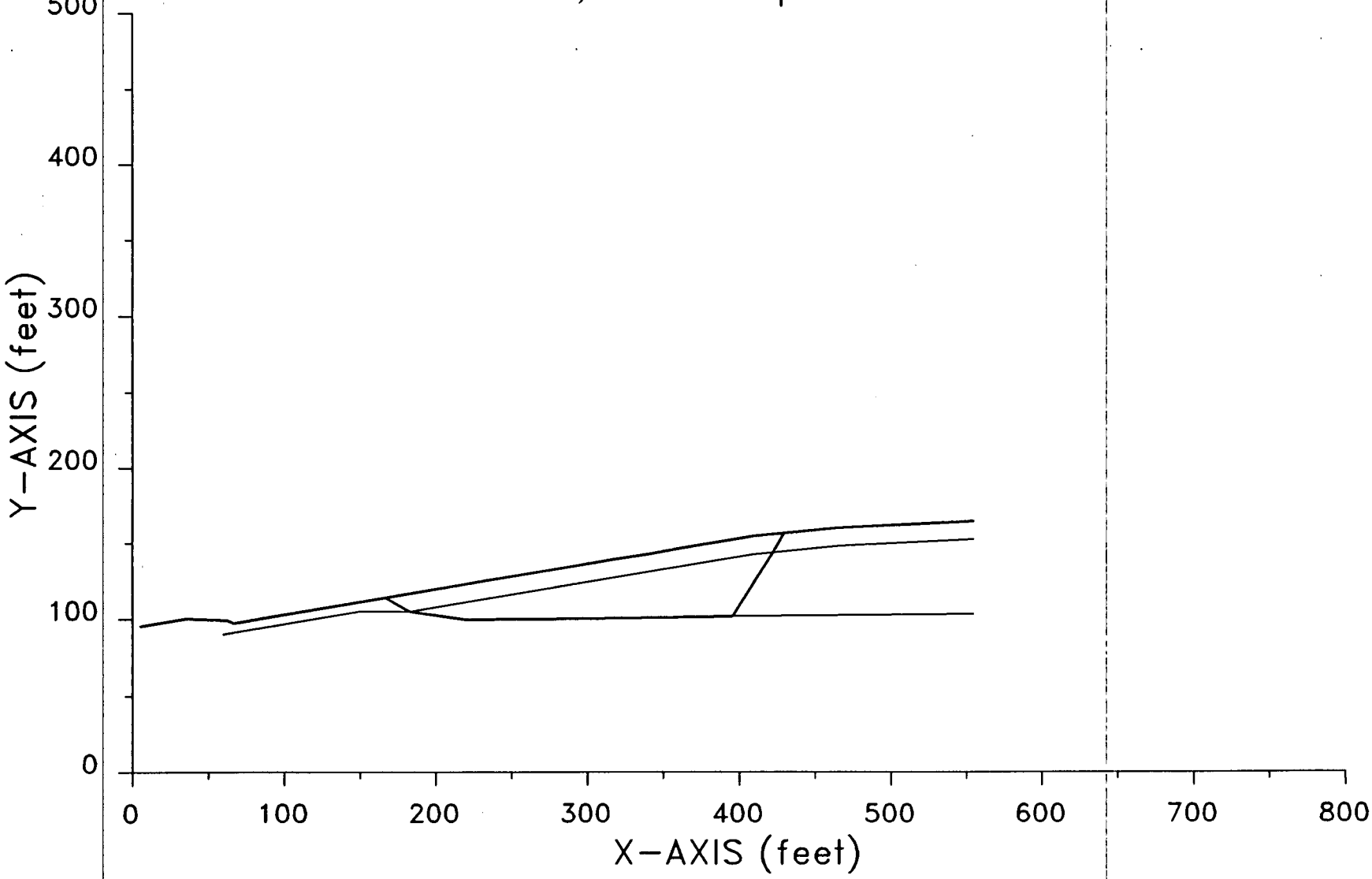
OSDF Final Long Term – Large Displ.

SPENCER'S METHOD, FOS for Specified Surface = 1.574



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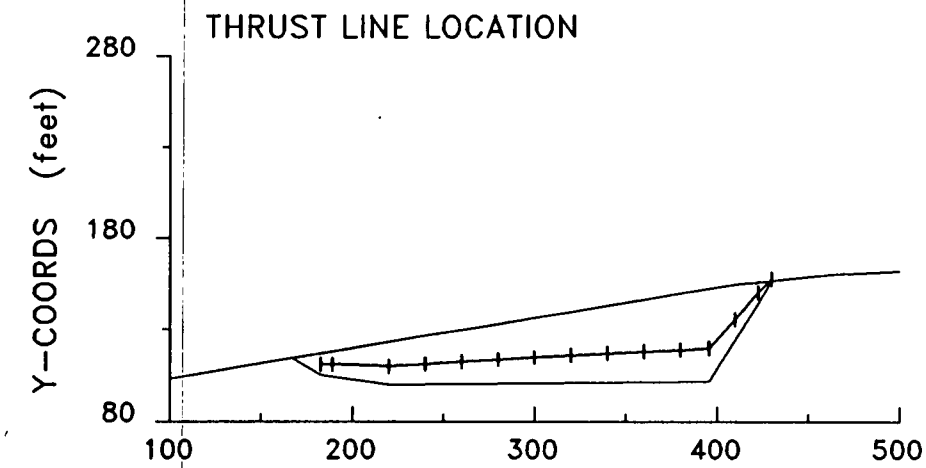

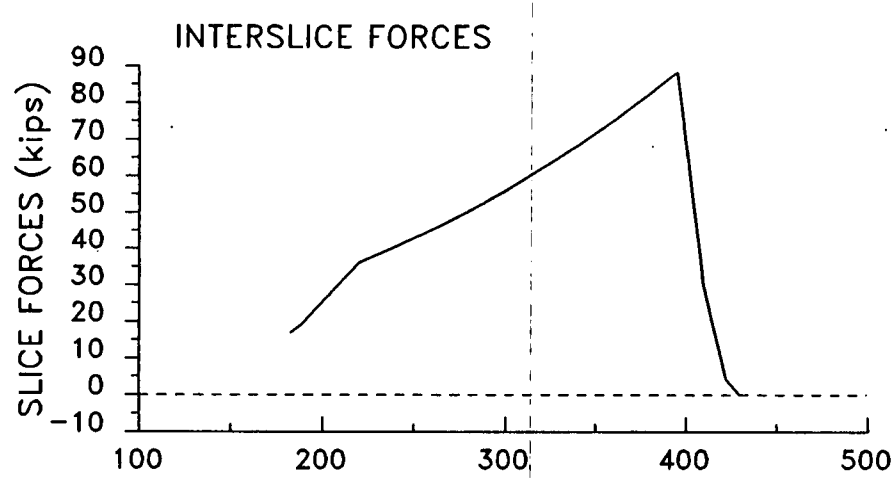

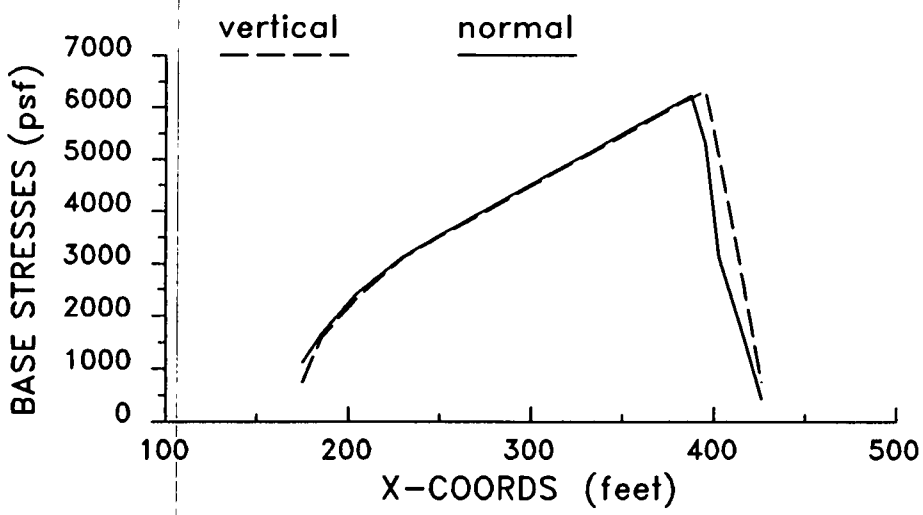

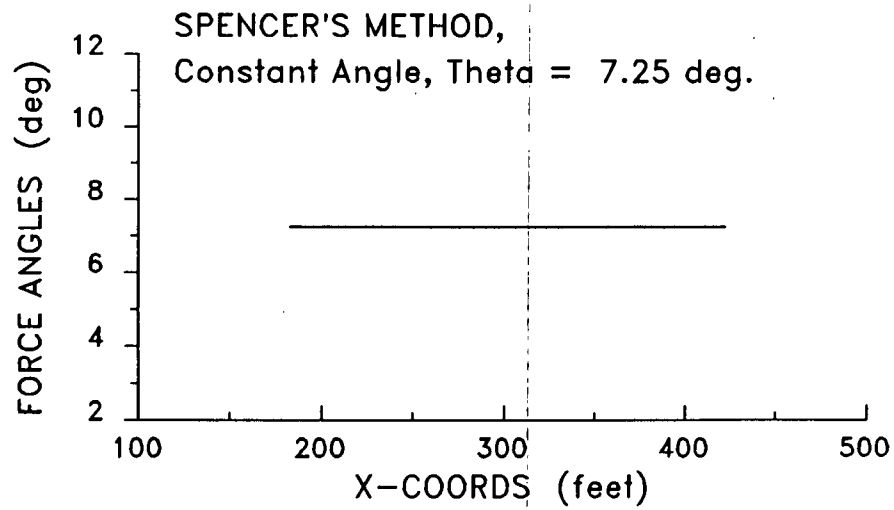

OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.574

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*                                       *
*  Ver. 5.201                 96 á 1202 *
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```

Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

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5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	158.4
4	2880.0	360.0
5	6480.0	734.4
6	10080.0	734.4

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	395.59	101.66
6	395.77	101.84
7	422.67	144.07
8	429.96	156.70

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.71	37.34	20.00	.64	9.37	93348.
9	330.00	100.93	40.42	20.00	.64	9.37	101043.
10	350.00	101.15	43.55	20.00	.64	9.65	108864.
11	370.00	101.38	46.67	20.00	.64	9.37	116684.
12	387.79	101.57	49.43	15.59	.64	9.46	96318.
13	395.68	101.75	50.56	.18	45.00	9.46	1157.
14	402.89	113.01	40.50	14.23	57.50	9.46	72028.
15	416.34	134.12	21.21	12.67	57.50	5.71	33589.
16	426.32	150.38	5.95	7.29	60.00	5.71	5421.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	7.1536	1.5717	1.6178
3	7.2533	1.5739	1.5717
4	7.2509	1.5738	1.5739

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	7.2509	1.5738	1.5739

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	1107.2	.0	30.00	0.	0.	0.	.00

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2	1666.1	91.2	5.33	0.	0.	0.	.00
3	2401.4	91.2	5.33	0.	0.	0.	.00
4	3124.7	60.5	5.94	0.	0.	0.	.00
5	3521.1	60.5	5.94	0.	0.	0.	.00
6	3911.1	60.5	5.94	0.	0.	0.	.00
7	4307.4	60.5	5.94	0.	0.	0.	.00
8	4701.3	60.5	5.94	0.	0.	0.	.00
9	5088.5	60.5	5.94	0.	0.	0.	.00
10	5482.0	60.5	5.94	0.	0.	0.	.00
11	5875.5	60.5	5.94	0.	0.	0.	.00
12	6221.6	60.5	5.94	0.	0.	0.	.00
13	5305.7	60.5	5.94	0.	0.	0.	.00
14	3111.4	.0	25.00	0.	0.	0.	.00
15	1629.3	.0	25.00	0.	0.	0.	.00
16	411.0	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1107.2	739.6	.0	406.2
2	186.00	1666.1	1594.4	.0	156.8
3	204.50	2401.4	2304.8	.0	200.4
4	230.00	3124.7	3100.0	.0	244.9
5	250.00	3521.1	3493.8	.0	271.1
6	270.00	3911.1	3881.3	.0	296.9
7	290.00	4307.4	4275.0	.0	323.1
8	310.00	4701.3	4667.4	.0	349.1
9	330.00	5088.5	5052.2	.0	374.7
10	350.00	5482.0	5443.2	.0	400.7
11	370.00	5875.5	5834.2	.0	426.7
12	387.79	6221.6	6178.2	.0	449.6
13	395.68	5305.7	6320.3	.0	389.0
14	402.89	3111.4	5062.8	.0	921.9
15	416.34	1629.3	2651.1	.0	482.7
16	426.32	411.0	743.6	.0	150.8

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	7.25	16760.	5.60	11.83	.473
2	189.00	7.25	19125.	6.42	13.68	.469
3	220.00	7.25	35932.	9.77	23.20	.421
4	240.00	7.25	40240.	10.95	26.40	.415
5	260.00	7.25	44996.	12.01	29.50	.407
6	280.00	7.25	50193.	12.99	32.60	.398
7	300.00	7.25	55838.	13.90	35.80	.388
8	320.00	7.25	61825.	14.76	38.88	.380
9	340.00	7.25	68241.	15.59	41.96	.372

10	360.00	7.25	75094.	16.38	45.13	.363
11	380.00	7.25	82383.	17.15	48.21	.356
12	395.59	7.25	88364.	17.74	50.64	.350
13	395.77	7.25	87456.	17.76	50.49	.352
14	410.00	7.25	30626.	11.16	30.52	.366
15	422.67	7.25	4123.	5.85	11.90	.492
16	429.96	.00	0.	.66	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3548.13 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 383.25 (psf)

Total Length of failure surface = 296.23 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.574

Total shear strength available along specified failure surface = 178.68E+03 lb

GCL 01

COMPUTATION COVER SHEET

1268

SUBJECT OF COMPUTATIONS Geosynthetic Clay Liner (GCL) 01 - Compliance Package

Computations By:
(Cognizant Engineer)

Signature Robert A. Morgan III — Date 13 OCT 1997

Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Assumptions and Procedures Checked By:
(Checker)

Signature [illegible] — Date 14 Oct 97

Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Computations Checked by:

Signature [illegible] — Date 14 Oct 97

Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Computations Backchecked by:
(Cognizant Engineer)

Signature Robert A. Morgan III — Date 15 OCT 1997

Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Approved by:
(PDP)

Signature [illegible] — Date 15 Oct 1997

Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Approved by:
(DTL and TETL)

Signature [illegible] — Date 15 Oct 97

Printed Name and Title Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval

000630

Written By: RAM Date: 10/13/97 Reviewed by: GRS Date: 10/14/97

Client: FDF Project: OSDF Project/Proposal No.: GQ0166 Task No.: 04

PURPOSE

Evaluate whether GCL QA sample no. 01 complies with the shear strength requirements given in the GCL specification (Section 02772, Paragraph 2.01.E.3).

METHOD

The method for evaluating the GCL sample is outlined in RCI number 1702-006R. The method involves the following basic steps.

1. Use shear test results from the GCL sample to establish the envelopes of measured peak and large-displacement internal and interface shear strength.
2. Reanalyze two slope stability cases that were included in the OSDF design calculations using the measured peak and large-displacement strength envelopes established in Step 1. Obtain the slope stability factors of safety for the critical potential slip surface for each analysis case.
3. Compare the slope stability factors of safety computed in Step 2 to the baseline factors of safety.

SHEAR TEST RESULTS

The results of the GCL internal shear and GCL/geomembrane interface shear tests performed on QA sample no. 01 are shown in the following table. The laboratory test results are presented in Appendix A.

QA Sample No.	Case	Test Type	Measured Shear Strengths		
			5 psi	20 psi	45 psi
01	Peak	GCL Internal	4.4 psi	9.1 psi	12.4 psi
		GCL/GMB Interface	2.6	6.7	12.7
01	Large-displacement	GCL Internal	1.3	2.4	6.4
		GCL/GMB Interface	2.0	4.2	8.6

STABILITY ANALYSES RESULTS

The results of the slope stability analyses performed using the computer program XSTABL are shown in the table below. The analyses output files and figures showing critical slip surfaces are presented in Appendix B.

QA Sample No.	Test Type	Filename	Factor of Safety	Comply ?
Baseline	Peak	NA	1.9	NA
01	GCL Internal	NPK01AS	2.1	YES
	GCL/GMB Interface	NPK01BS	1.9	YES
Baseline	Large-displacement	NA	1.6	NA
01	GCL Internal	NLD01AS	1.7	YES
	GCL/GMB Interface	NLD01BS	2.2	YES

RAM 10/13/97
GRS. 10/14/97

APPENDIX A

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 1I

Test Specimen Configuration (from top to bottom) and Placement Conditions:

- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-01). GCL's initial moisture content was 9.4%. GCL's final moisture content ranged from 86% to 133% for the test series; and
- lower shear box: rigid substrate with textured steel gripping surface.

Designated Shear Plane: Within GCL

Test Procedures for Each Normal Stress Condition:

- A fresh GCL specimen was trimmed from the bulk sample of the GCL and placed between two rigid wooden substrates with textured steel gripping surfaces. The ends of each geotextile were then sandwiched between a second rigid wooden substrate prior to testing. The entire test specimen was then placed in the shear box to provide confinement for the exposed bentonite component. The textured steel gripping surfaces were employed to minimize slippage between each geotextile component of the GCL and rigid wood substrate, therefore providing a relatively uniform transfer of shear load onto the GCL specimen.
- Soaking conditions: The GCL specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the GCL specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the Bentofix NS GCL sample.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 1G

Test Specimen Configuration (from top to bottom) and Placement Conditions:

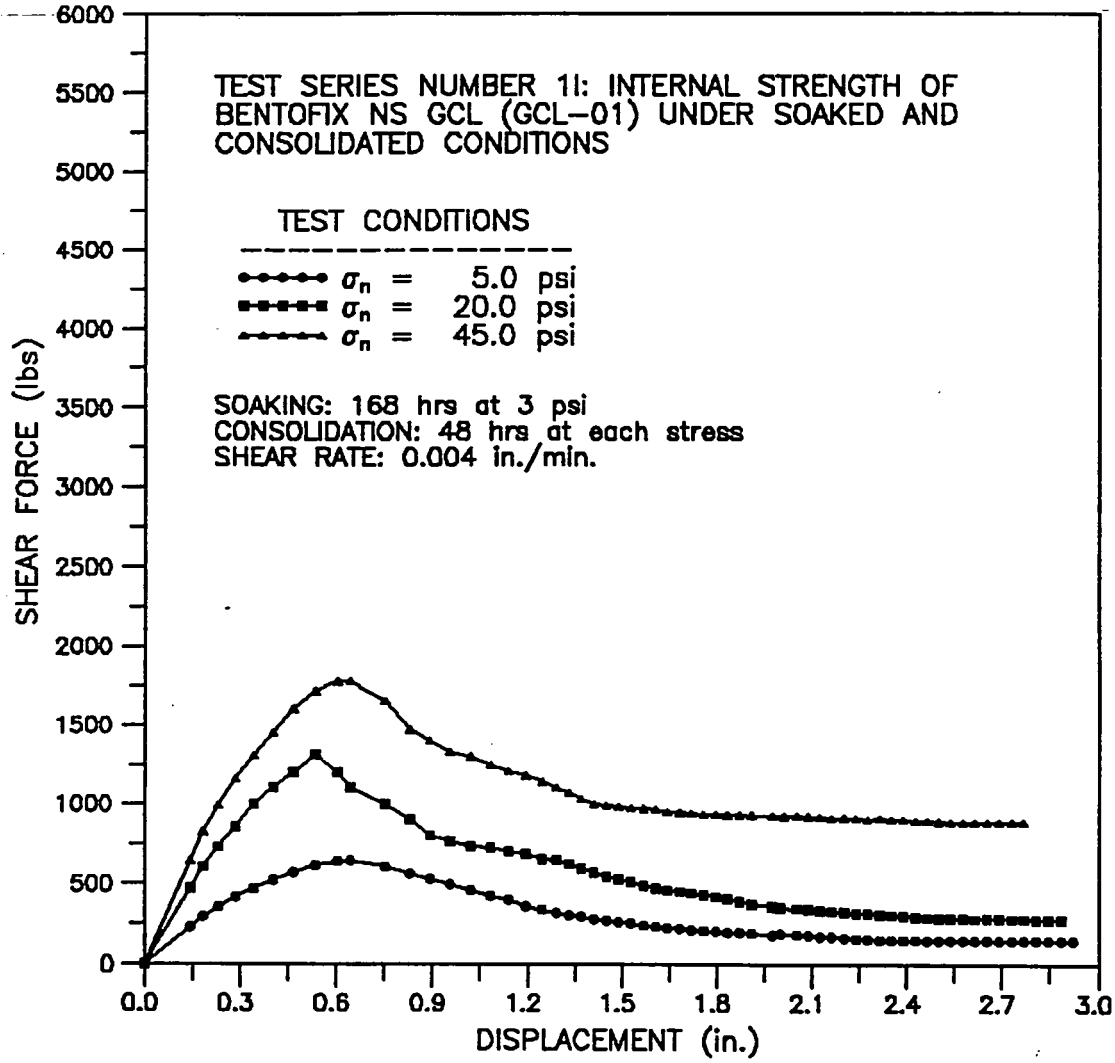
- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-01) with woven geotextile against geomembrane. GCL's initial moisture content was 9.0%. GCL's final moisture content ranged from 74 to 85% for the test series;
- 80-mil NSC textured HDPE geomembrane (GM-7); and
- lower shear box: bedding layer of compacted concrete sand.

Test Interface: GCL against geomembrane

Test Procedures for Each Normal Stress Condition:

- A fresh specimen of concrete sand was compacted into the lower shear box by hand tamping to a relatively dense state under dry conditions forming a 3 in. thick bedding layer.
- A fresh specimen of geomembrane was trimmed from the bulk sample and attached to the lower shear box with mechanical compression clamps.
- A fresh specimen of GCL was trimmed from the bulk sample and attached to the upper shear box with mechanical compression clamps. The GCL was oriented so that the woven geotextile component of the GCL was in contact with the geomembrane.
- A rigid substrate with a textured steel gripping surface was placed on top of the GCL. The textured steel gripping surface was used to minimize slippage between the upper geotextile component of the GCL and rigid wooden substrate, therefore providing a relatively uniform transfer of shear load onto the test interface.
- Soaking conditions: The entire test specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the entire test specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the geosynthetic samples.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

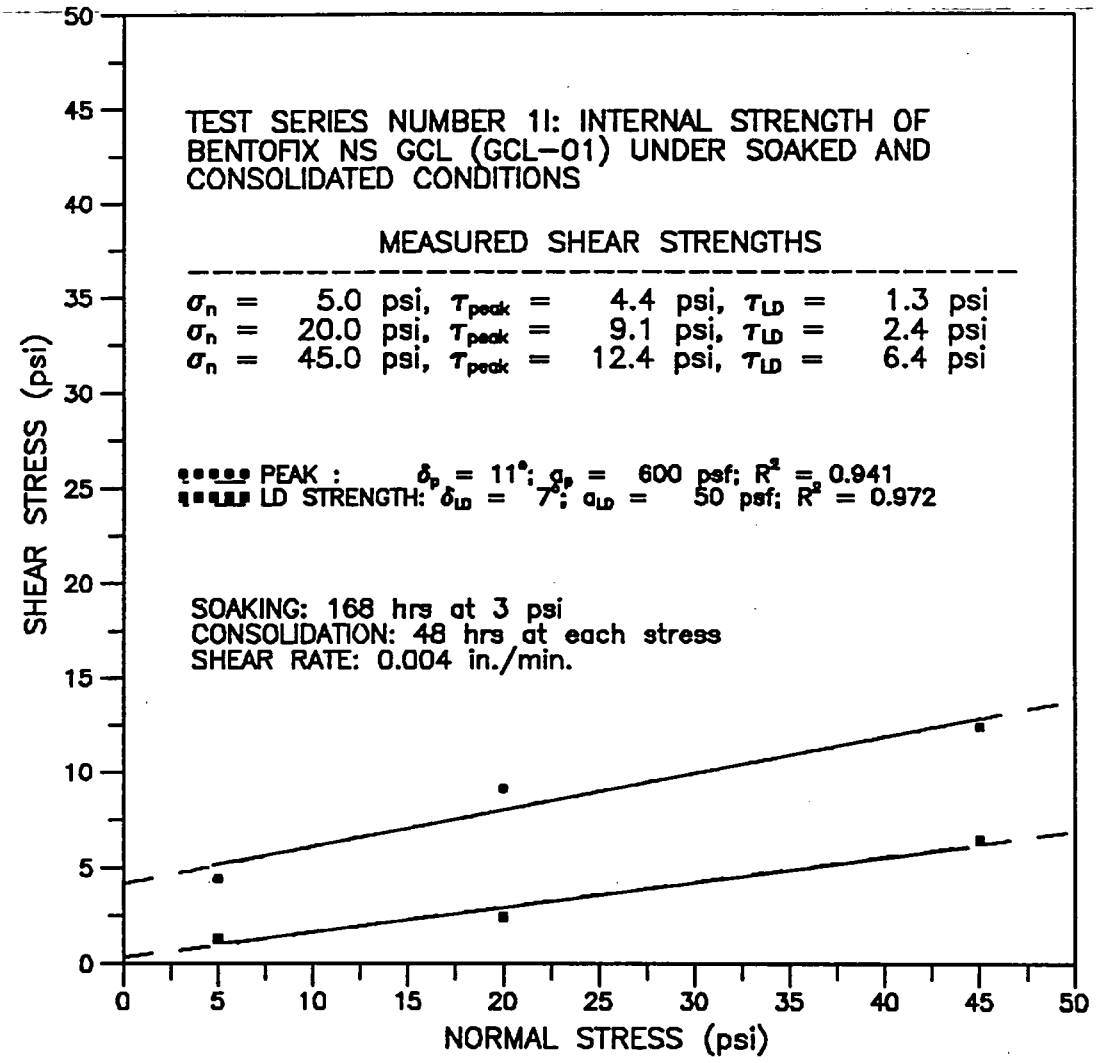
DATE TESTED: 24 AUGUST TO 2 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



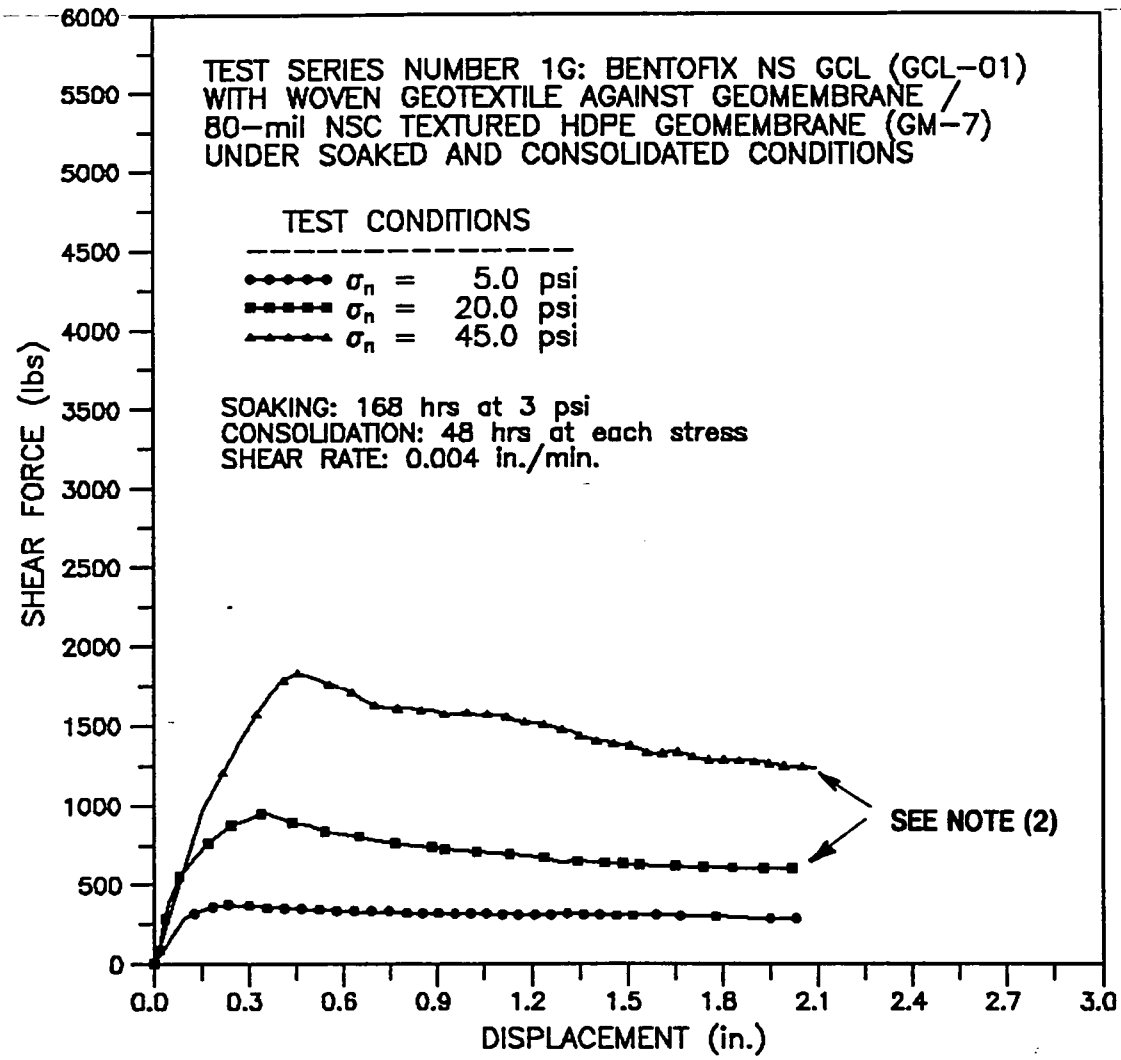
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 24 AUGUST TO 2 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	000636

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

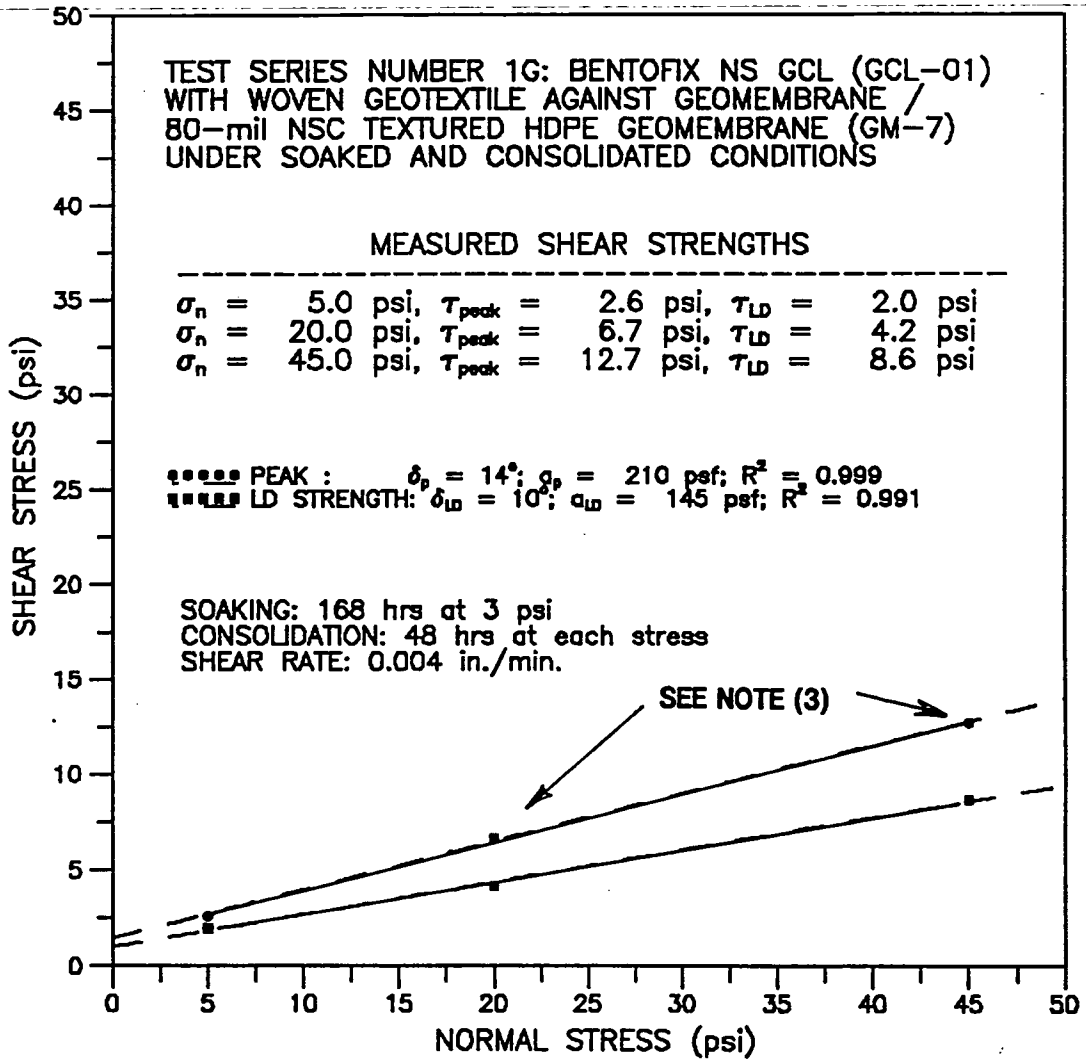
DATE TESTED: 5 TO 14 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	000637

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 5 TO 14 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730086
FILE NO.	000638

RAM 10/13/97
GRS 10/14/97

APPENDIX B

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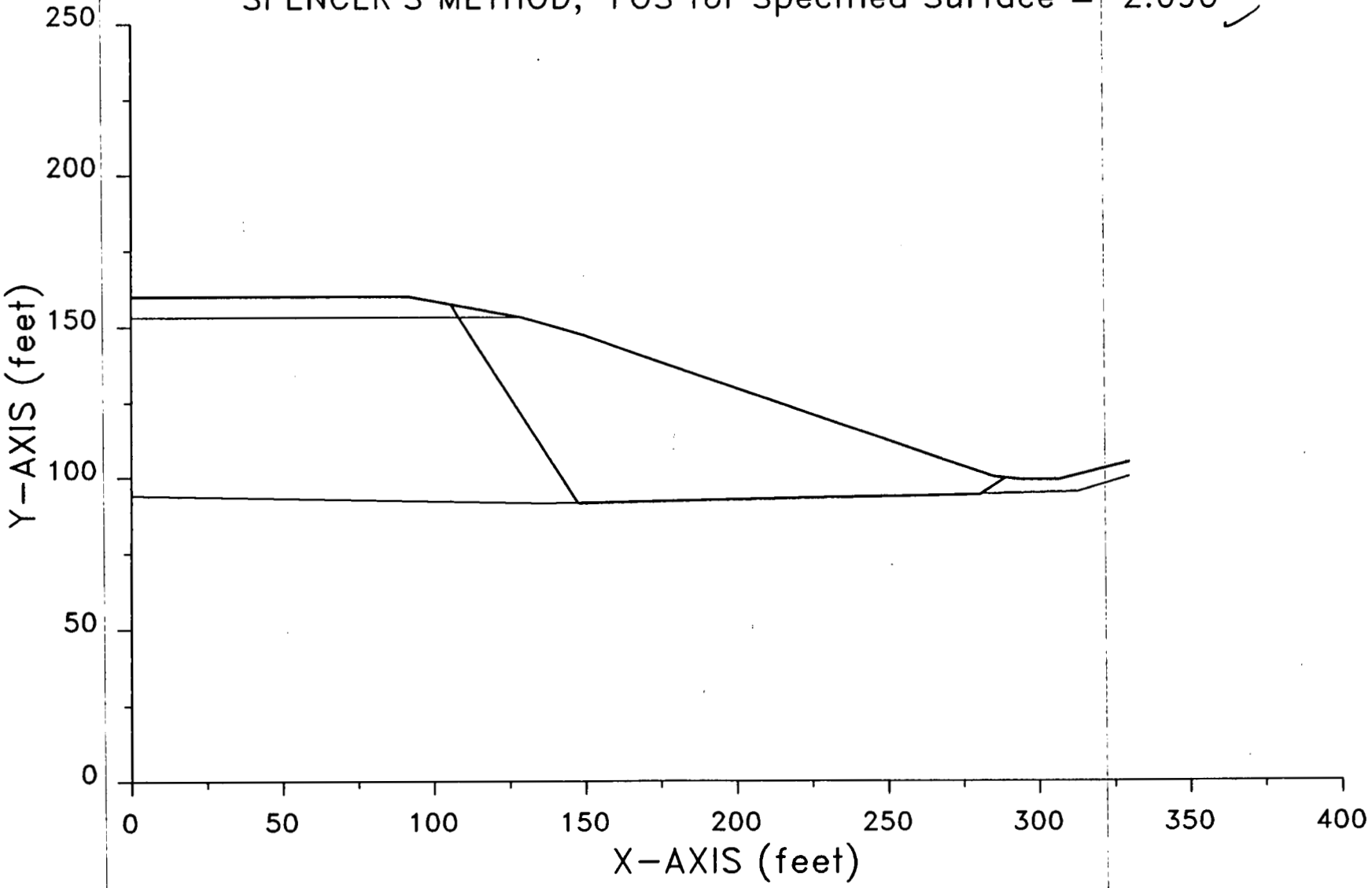
OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 2.090



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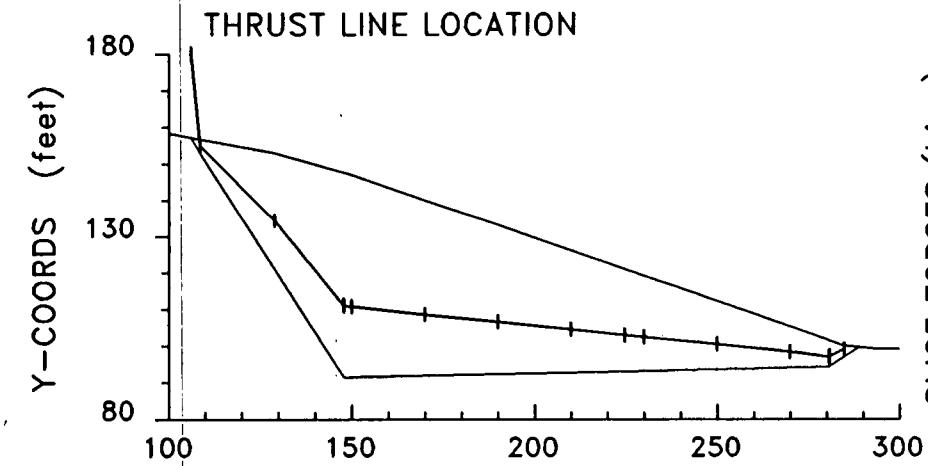

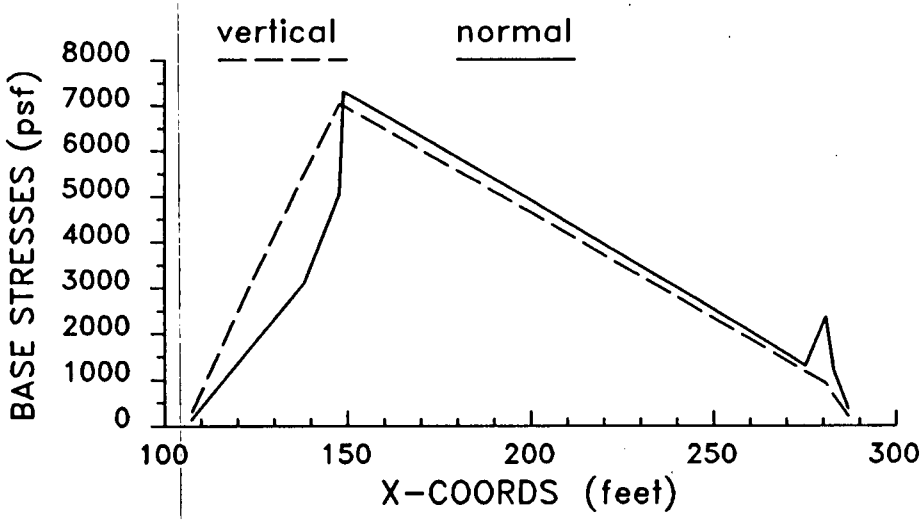

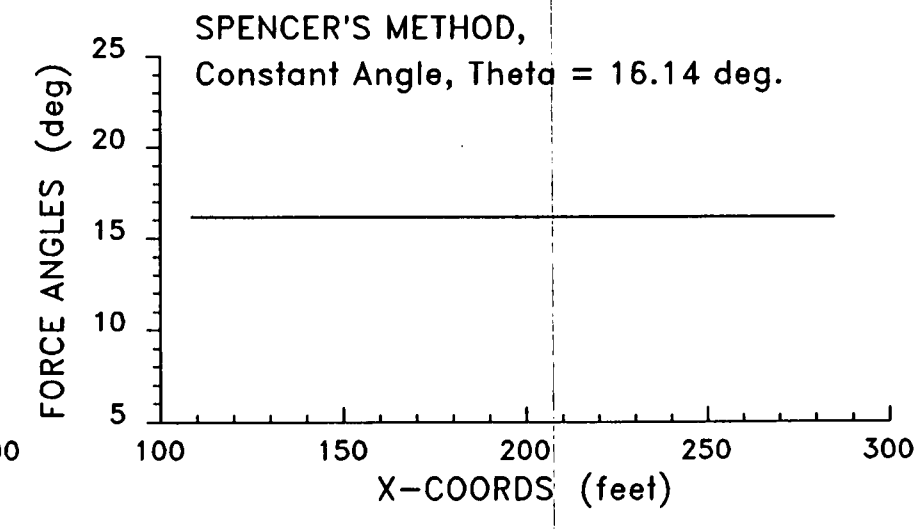

OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 2.090

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XSTABL File: NPK01AS 10-09-97 13:33

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*        Moscow, ID 83843, U.S.A.       *
*                                       *
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*                                       *
*  Ver. 5.201                 96 á 1202 *
*****************************************
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Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES
---

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

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ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	633.6
4	2880.0	1310.4
5	6480.0	1785.6
6	10080.0	1785.6

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	289.15	99.54
2	280.95	94.32
3	280.75	94.11
4	224.80	93.00
5	147.93	91.39
6	147.69	91.63
7	108.59	153.00
8	106.09	157.33

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	287.08	98.22	1.55	4.15	-32.47	6.34	805.
2	282.97	95.61	5.09	4.05	-32.47	19.12	2579.
3	280.85	94.21	7.22	.20	-46.40	19.12	180.
4	275.38	94.00	9.33	10.75	-1.14	19.12	12542.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37504.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55871.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.20	19.29	56730.
9	200.00	92.48	37.12	20.00	-1.20	19.29	92799.
10	180.00	92.06	44.49	20.00	-1.20	19.03	111221.
11	160.00	91.64	51.86	20.00	-1.20	19.29	129643.
12	148.96	91.41	55.88	2.07	-1.20	15.95	14460.
13	147.81	91.51	56.12	.24	45.00	15.95	1683.
14	138.35	106.30	44.03	18.69	57.50	15.95	102871.
15	118.79	136.98	17.95	20.41	57.50	10.71	45790.
16	107.34	155.17	1.93	2.50	60.02	10.71	603.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	15.9144	2.1106	2.1662
3	16.0156	2.1140	2.1106
4	16.0129	2.1139	2.1140

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	16.1460	2.0905	2.0867
3	16.1442	2.0904	2.0905

Nonlinear M-C Iteration Number - 3

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment

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1	16.1442	2.0900	2.0905

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	16.1442	2.0900	2.0905

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	346.3	.0	30.00	0.	0.	0.	.00
2	1190.6	200.0	25.00	0.	0.	0.	.00
3	2351.2	408.0	17.40	0.	0.	0.	.00
4	1294.5	408.0	17.40	0.	0.	0.	.00
5	2042.0	408.0	17.40	0.	0.	0.	.00
6	3007.2	930.2	7.52	0.	0.	0.	.00
7	3598.4	930.2	7.52	0.	0.	0.	.00
8	4075.9	930.2	7.52	0.	0.	0.	.00
9	4904.0	930.2	7.52	0.	0.	0.	.00
10	5849.3	930.2	7.52	0.	0.	0.	.00
11	6788.5	1785.6	.00	0.	0.	0.	.00
12	7294.9	1785.6	.00	0.	0.	0.	.00
13	5019.8	930.2	7.52	0.	0.	0.	.00
14	3092.9	200.0	25.00	0.	0.	0.	.00
15	1219.0	200.0	25.00	0.	0.	0.	.00
16	127.1	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	287.08	346.3	193.9	.0	95.7
2	282.97	1190.6	636.7	.0	361.3
3	280.85	2351.2	903.0	.0	547.7
4	275.38	1294.5	1166.7	.0	389.3
5	260.00	2042.0	1875.2	.0	501.4
6	240.00	3007.2	2793.6	.0	635.0
7	227.40	3598.4	3369.8	.0	672.4
8	217.40	4075.9	3833.1	.0	702.5
9	200.00	4904.0	4639.9	.0	754.8
10	180.00	5849.3	5561.0	.0	814.5
11	160.00	6788.5	6482.1	.0	854.4
12	148.96	7294.9	6985.5	.0	854.4
13	147.81	5019.8	7014.5	.0	762.1
14	138.35	3092.9	5504.1	.0	785.8
15	118.79	1219.0	2243.5	.0	367.7
16	107.34	127.1	241.3	.0	35.1

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SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	16.14	1365.	1.92	3.10	.619
2	280.95	16.14	6085.	2.73	7.08	.385
3	280.75	16.14	6711.	2.71	7.36	.369
4	270.00	16.14	11355.	4.25	11.30	.376
5	250.00	16.14	22637.	6.78	18.70	.363
6	230.00	16.14	37101.	9.12	26.00	.351
7	224.80	16.14	41128.	9.76	27.92	.350
8	210.00	16.14	53267.	11.61	33.41	.347
9	190.00	16.14	71122.	14.12	40.83	.346
10	170.00	16.14	90633.	16.62	48.15	.345
11	150.00	16.14	111382.	19.16	55.57	.345
12	147.93	16.14	113552.	19.43	56.20	.346
13	147.69	16.14	112489.	19.44	56.03	.347
14	129.00	16.14	33321.	13.28	32.03	.415
15	108.59	16.14	480.	1.81	3.86	.468
16	106.09	.00	-2.	55.95	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3277.93 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 611.70 (psf)

Total Length of failure surface = 220.97 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 2.090

Total shear strength available along specified failure surface = 282.49E+03 lb

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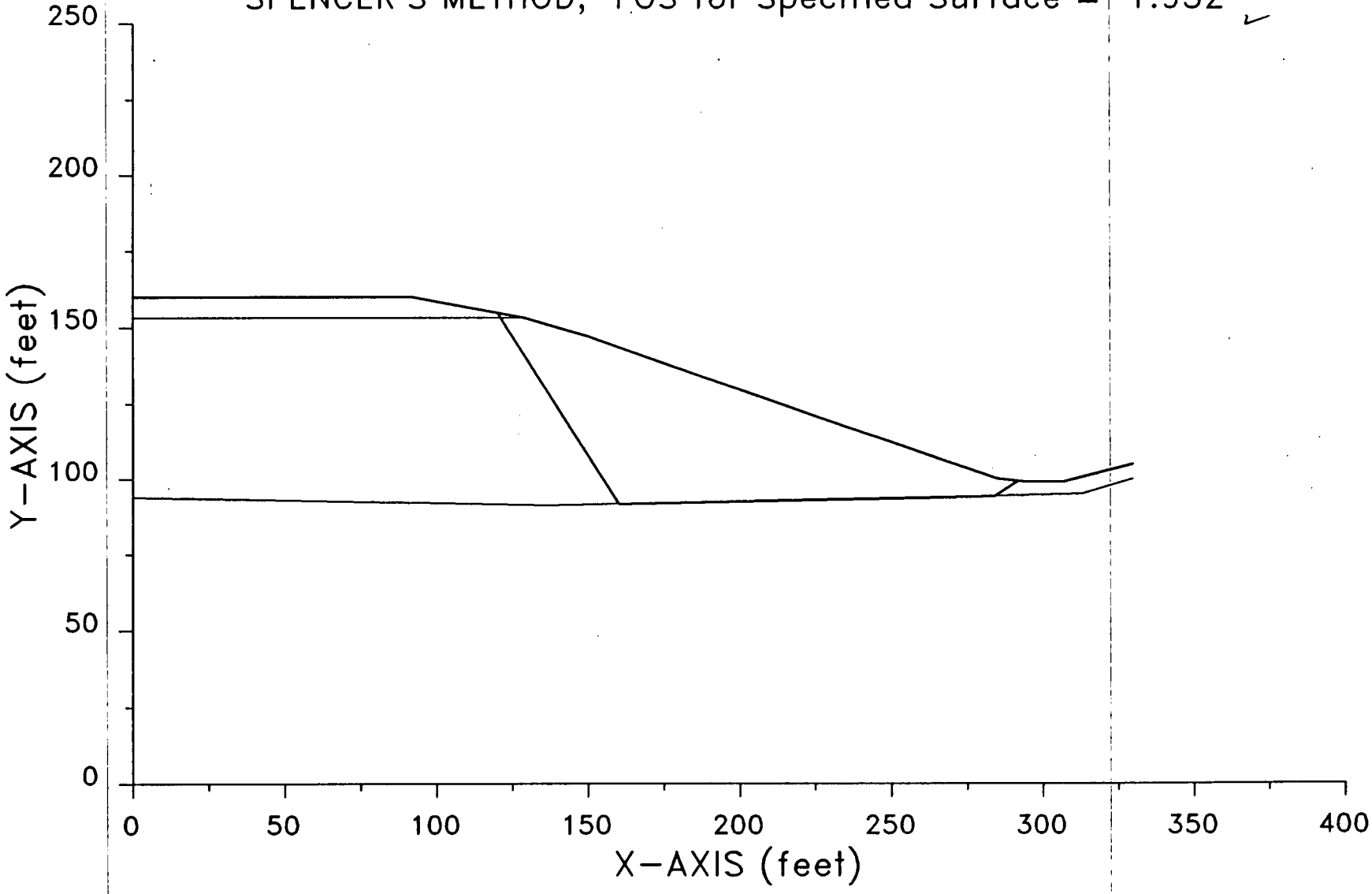
OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.932



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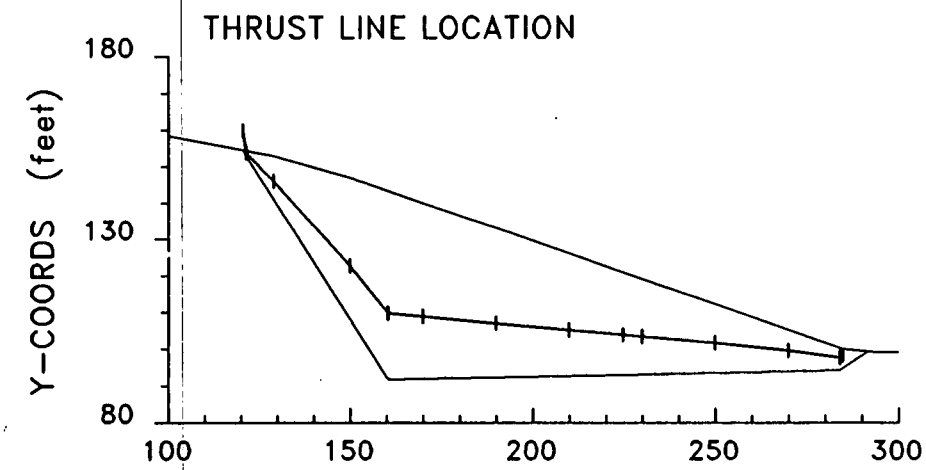

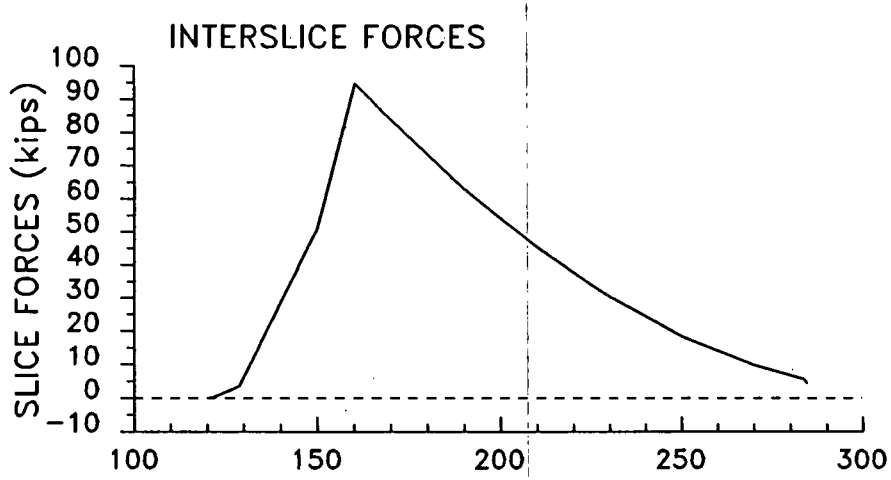

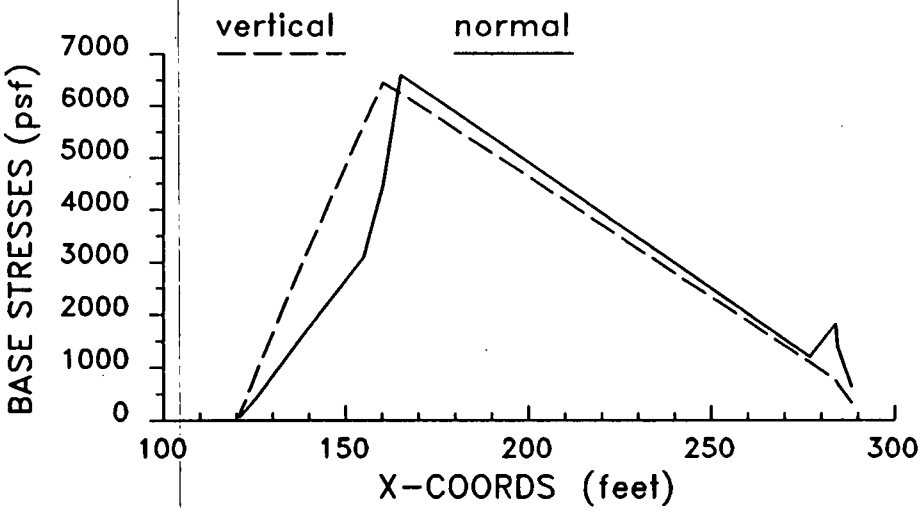

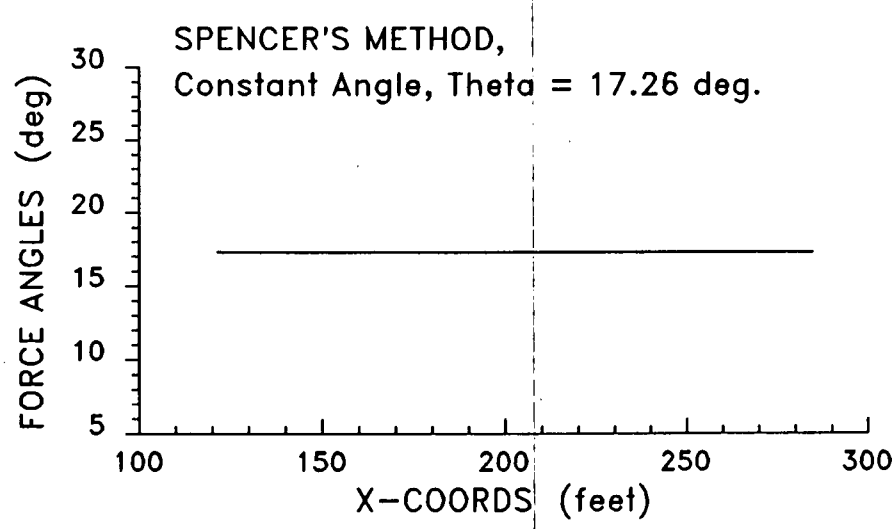

OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.932

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*              X S T A B L              *
*                                       *
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*               using the               *
*            Method of Slices           *
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Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	374.4
4	2880.0	964.8
5	6480.0	1828.8
6	10080.0	1828.8

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	291.87	99.24
2	284.25	94.39
3	284.05	94.18
4	224.80	93.00
5	160.54	91.72
6	160.38	91.89
7	121.44	153.00
8	120.52	154.60

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	288.43	97.05	2.57	6.87	-32.46	6.34	2204.
2	284.62	94.63	5.50	.75	-32.46	19.12	519.
3	284.15	94.28	6.01	.20	-46.40	19.12	147.
4	277.02	94.04	8.72	14.05	-1.14	19.12	15323.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37497.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55868.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.14	19.29	56716.
9	200.00	92.51	37.09	20.00	-1.14	19.29	92735.
10	180.00	92.11	44.44	20.00	-1.14	19.03	111106.
11	165.27	91.81	49.84	9.46	-1.14	19.29	58937.
12	160.46	91.81	51.53	.16	46.74	19.29	1031.
13	155.19	100.03	45.15	10.38	57.49	19.29	58580.
14	139.50	124.66	25.34	21.00	57.49	15.95	66523.
15	125.22	147.07	6.65	7.56	57.49	10.71	6282.
16	120.98	153.80	.72	.92	60.17	10.71	82.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.2181	1.9364	1.9552
3	17.2440	1.9371	1.9364

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.2631	1.9322	1.9316

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	17.2631	1.9322	1.9316

SLICE INFORMATION ... continued :

Slice	Sigma	c-value	phi	U-base	U-top	P-top	Delta

	(psf)	(psf)		(lb)	(lb)	(lb)	
1	617.6	.0	30.00	0.	0.	0.	.00
2	1369.7	200.0	25.00	0.	0.	0.	.00
3	1821.8	177.6	15.29	0.	0.	0.	.00
4	1183.7	177.6	15.29	0.	0.	0.	.00
5	2011.8	177.6	15.29	0.	0.	0.	.00
6	2981.1	273.6	13.50	0.	0.	0.	.00
7	3586.1	273.6	13.50	0.	0.	0.	.00
8	4071.4	273.6	13.50	0.	0.	0.	.00
9	4915.9	273.6	13.50	0.	0.	0.	.00
10	5880.0	273.6	13.50	0.	0.	0.	.00
11	6583.9	1828.8	.00	0.	0.	0.	.00
12	4450.2	273.6	13.50	0.	0.	0.	.00
13	3077.6	200.0	25.00	0.	0.	0.	.00
14	1695.6	200.0	25.00	0.	0.	0.	.00
15	391.1	200.0	25.00	0.	0.	0.	.00
16	45.7	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	288.43	617.6	320.8	.0	184.6
2	284.62	1369.7	688.0	.0	434.1
3	284.15	1821.8	751.6	.0	349.6
4	277.02	1183.7	1090.6	.0	259.4
5	260.00	2011.8	1874.9	.0	376.5
6	240.00	2981.1	2793.4	.0	511.9
7	227.40	3586.1	3369.8	.0	587.0
8	217.40	4071.4	3832.2	.0	647.3
9	200.00	4915.9	4636.8	.0	752.2
10	180.00	5880.0	5555.3	.0	872.0
11	165.27	6583.9	6230.2	.0	946.5
12	160.46	4450.2	6441.8	.0	694.4
13	155.19	3077.6	5643.6	.0	846.3
14	139.50	1695.6	3167.8	.0	512.7
15	125.22	391.1	830.9	.0	197.9
16	120.98	45.7	89.4	.0	13.7

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	17.26	4154.	3.25	5.13	.634
2	284.25	17.26	5185.	3.25	5.87	.553
3	284.05	17.26	5648.	3.24	6.15	.526
4	270.00	17.26	9811.	5.52	11.30	.489
5	250.00	17.26	18535.	7.98	18.70	.427
6	230.00	17.26	30500.	10.17	26.00	.391

7	224.80	17.26	34085.	10.72	27.92	.384
8	210.00	17.26	45374.	12.34	33.39	.370
9	190.00	17.26	63179.	14.54	40.79	.357
10	170.00	17.26	83895.	16.75	48.09	.348
11	160.54	17.26	94570.	17.81	51.59	.345
12	160.38	17.26	93894.	17.82	51.48	.346
13	150.00	17.26	50594.	14.41	38.82	.371
14	129.00	17.26	3354.	4.86	11.86	.410
15	121.44	17.26	62.	.66	1.43	.462
16	120.52	.00	-2.	5.11	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2954.66 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 563.37 (psf)

Total Length of failure surface = 207.40 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.932 ✓

Total shear strength available along specified failure surface = 225.76E+03 lb

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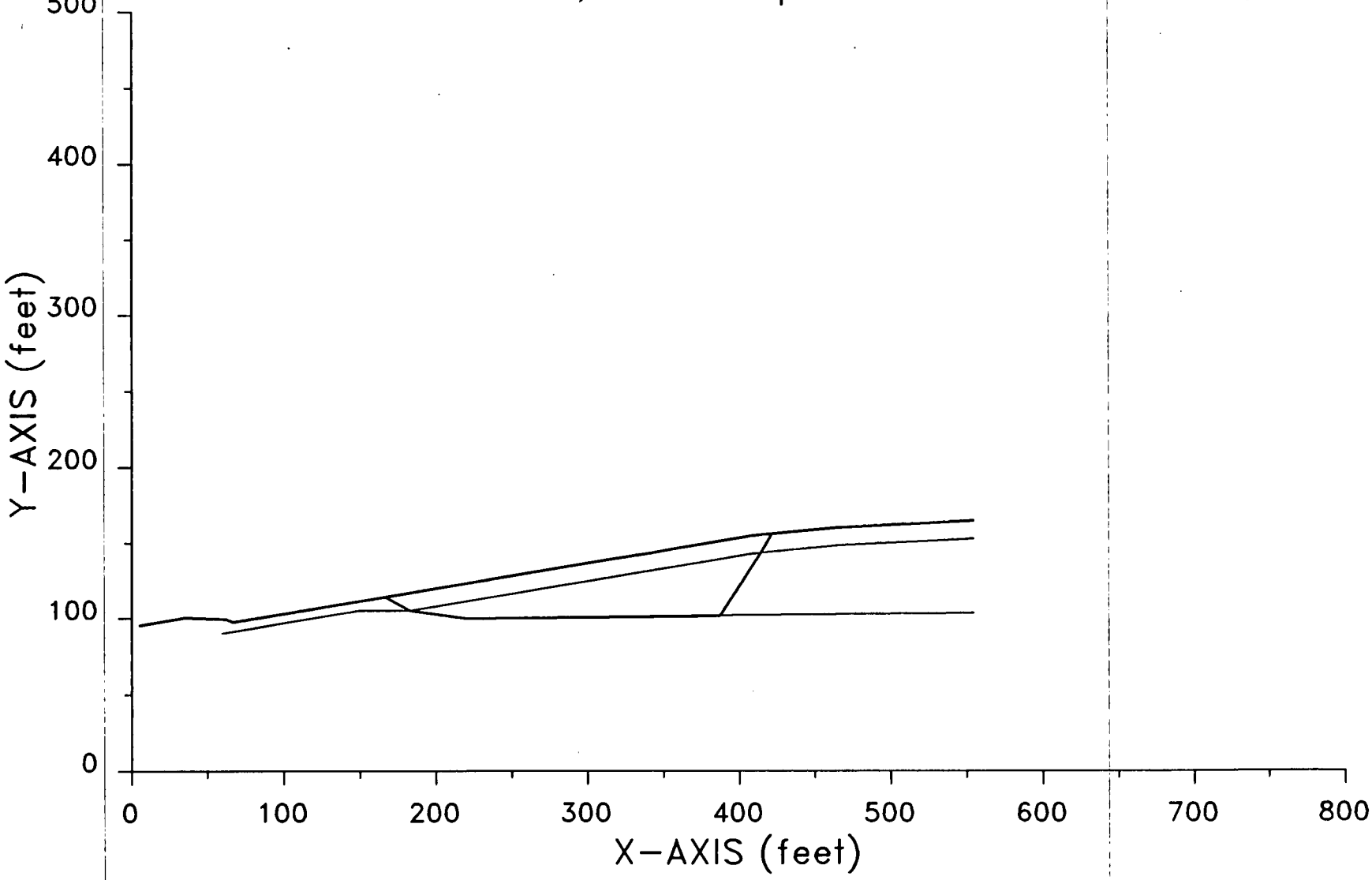
OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.711



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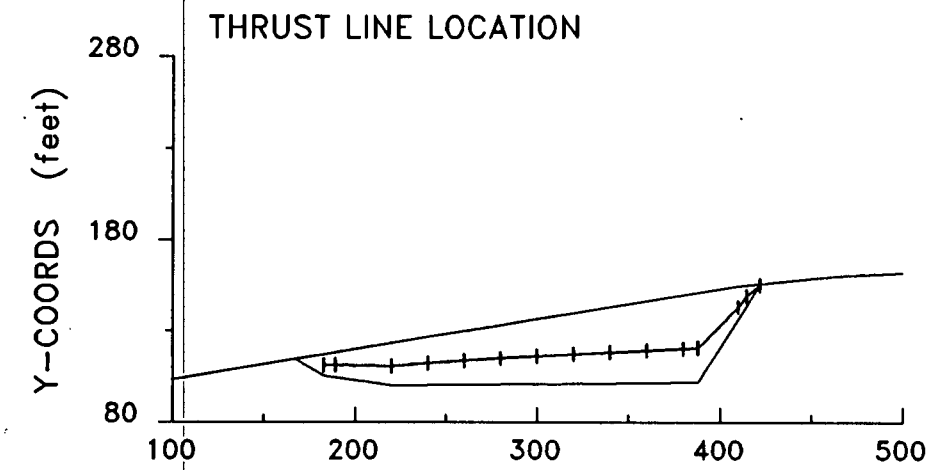

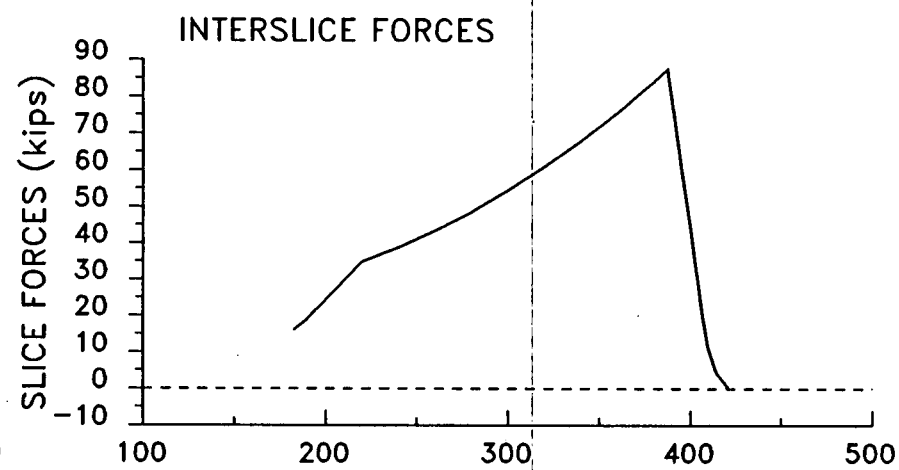

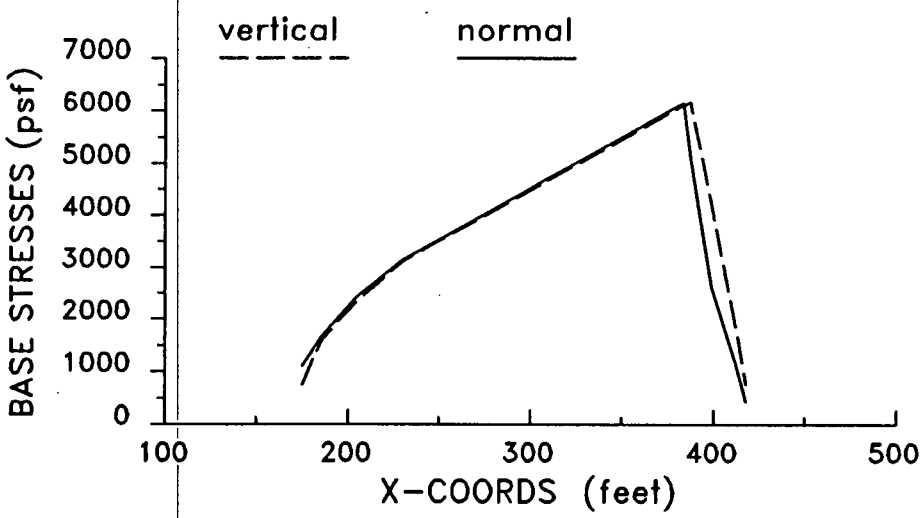

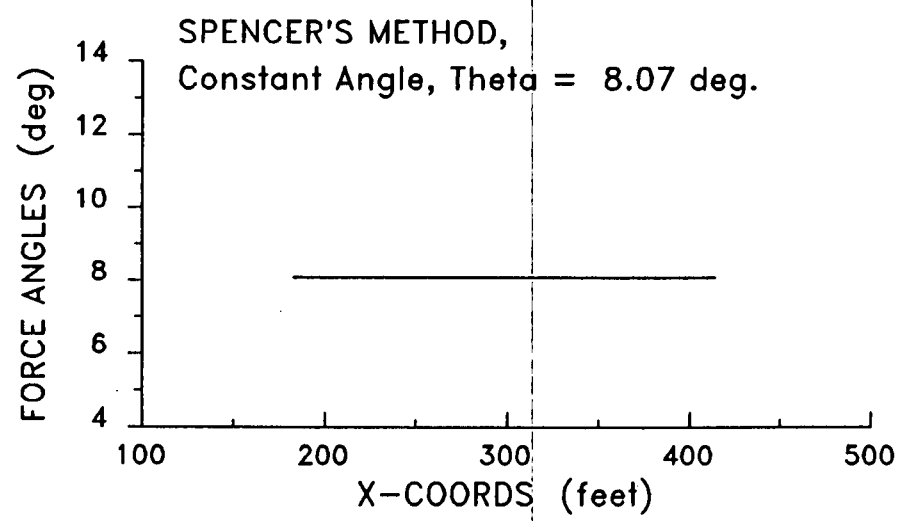

OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.711 ✓

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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```

Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

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5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	187.2
4	2880.0	345.6
5	6480.0	921.6
6	10080.0	921.6

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	387.83	101.59
6	388.00	101.76
7	414.43	143.24
8	421.72	155.87

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.71	37.34	20.00	.65	9.37	93343.
9	330.00	100.94	40.41	20.00	.65	9.37	101030.
10	350.00	101.16	43.54	20.00	.65	9.65	108841.
11	370.00	101.39	46.66	20.00	.65	9.37	116652.
12	383.91	101.55	48.81	7.83	.65	9.46	47769.
13	387.91	101.67	49.34	.17	45.00	9.46	1049.
14	399.00	119.02	33.84	22.00	57.50	9.46	93068.
15	412.22	139.77	15.16	4.43	57.50	5.71	8397.
16	418.08	149.56	5.95	7.29	60.01	5.71	5420.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	8.0375	1.7103	1.7428
3	8.0715	1.7112	1.7103

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	8.0715	1.7112	1.7103

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	1095.1	.0	30.00	0.	0.	0.	.00
2	1670.0	134.4	4.19	0.	0.	0.	.00

3	2404.0	134.4	4.19	0.	0.	0.	.00
4	3125.2	-115.2	9.09	0.	0.	0.	.00
5	3523.3	-115.2	9.09	0.	0.	0.	.00
6	3915.1	-115.2	9.09	0.	0.	0.	.00
7	4313.2	-115.2	9.09	0.	0.	0.	.00
8	4708.3	-115.2	9.09	0.	0.	0.	.00
9	5096.8	-115.2	9.09	0.	0.	0.	.00
10	5491.5	-115.2	9.09	0.	0.	0.	.00
11	5886.3	-115.2	9.09	0.	0.	0.	.00
12	6157.4	-115.2	9.09	0.	0.	0.	.00
13	5094.6	-115.2	9.09	0.	0.	0.	.00
14	2625.0	.0	25.00	0.	0.	0.	.00
15	1175.6	.0	25.00	0.	0.	0.	.00
16	417.3	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1095.1	739.6	.0	369.5
2	186.00	1670.0	1594.4	.0	150.1
3	204.50	2404.0	2304.8	.0	181.6
4	230.00	3125.2	3100.0	.0	224.9
5	250.00	3523.3	3493.8	.0	262.1
6	270.00	3915.1	3881.3	.0	298.7
7	290.00	4313.2	4275.0	.0	336.0
8	310.00	4708.3	4667.2	.0	372.9
9	330.00	5096.8	5051.5	.0	409.2
10	350.00	5491.5	5442.1	.0	446.1
11	370.00	5886.3	5832.6	.0	483.1
12	383.91	6157.4	6100.8	.0	508.4
13	387.91	5094.6	6168.0	.0	409.0
14	399.00	2625.0	4230.4	.0	715.3
15	412.22	1175.6	1894.5	.0	320.3
16	418.08	417.3	743.7	.0	140.8

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	8.07	16090.	5.72	11.83	.484
2	189.00	8.07	18422.	6.59	13.68	.482
3	220.00	8.07	34685.	10.21	23.20	.440
4	240.00	8.07	38597.	11.69	26.40	.443
5	260.00	8.07	43180.	12.96	29.50	.439
6	280.00	8.07	48424.	14.06	32.60	.431
7	300.00	8.07	54339.	15.03	35.80	.420
8	320.00	8.07	60800.	15.92	38.87	.409
9	340.00	8.07	67906.	16.74	41.95	.399
10	360.00	8.07	75668.	17.51	45.12	.388

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11	380.00	8.07	84085.	18.25	48.20	.379
12	387.83	8.07	87557.	18.53	49.41	.375
13	388.00	8.07	86753.	18.55	49.27	.377
14	410.00	8.07	11107.	6.62	18.41	.359
15	414.43	8.07	4282.	5.80	11.90	.487
16	421.72	.00	-3.	-1.02	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3475.29 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 375.91 (psf)

Total Length of failure surface = 287.57 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

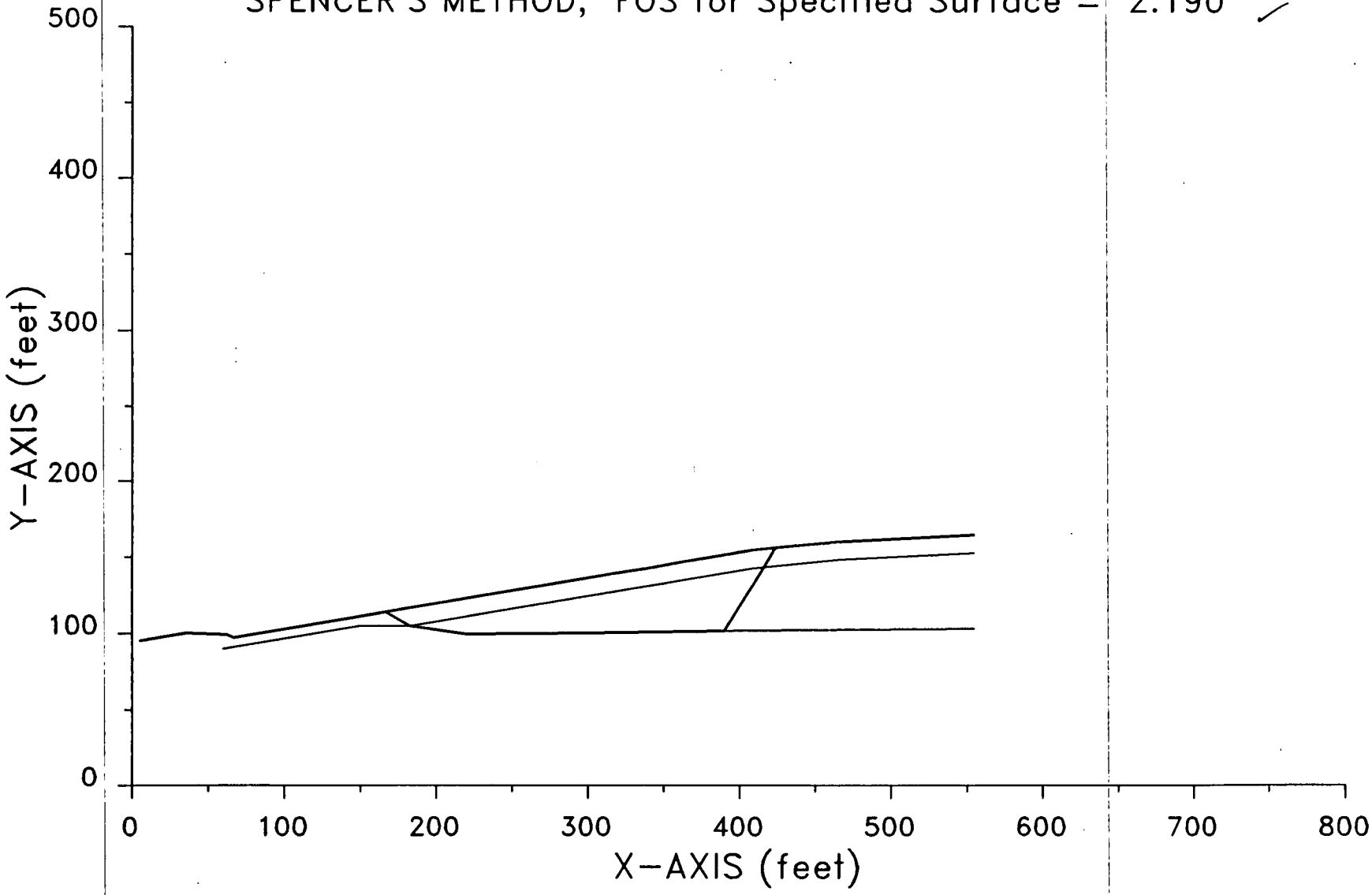
FACTOR OF SAFETY = 1.711

Total shear strength available along specified failure surface = 184.98E+03 lb

NLD01BS 10-10-97 9:29

OSDF Final Long Term – Large Displ.

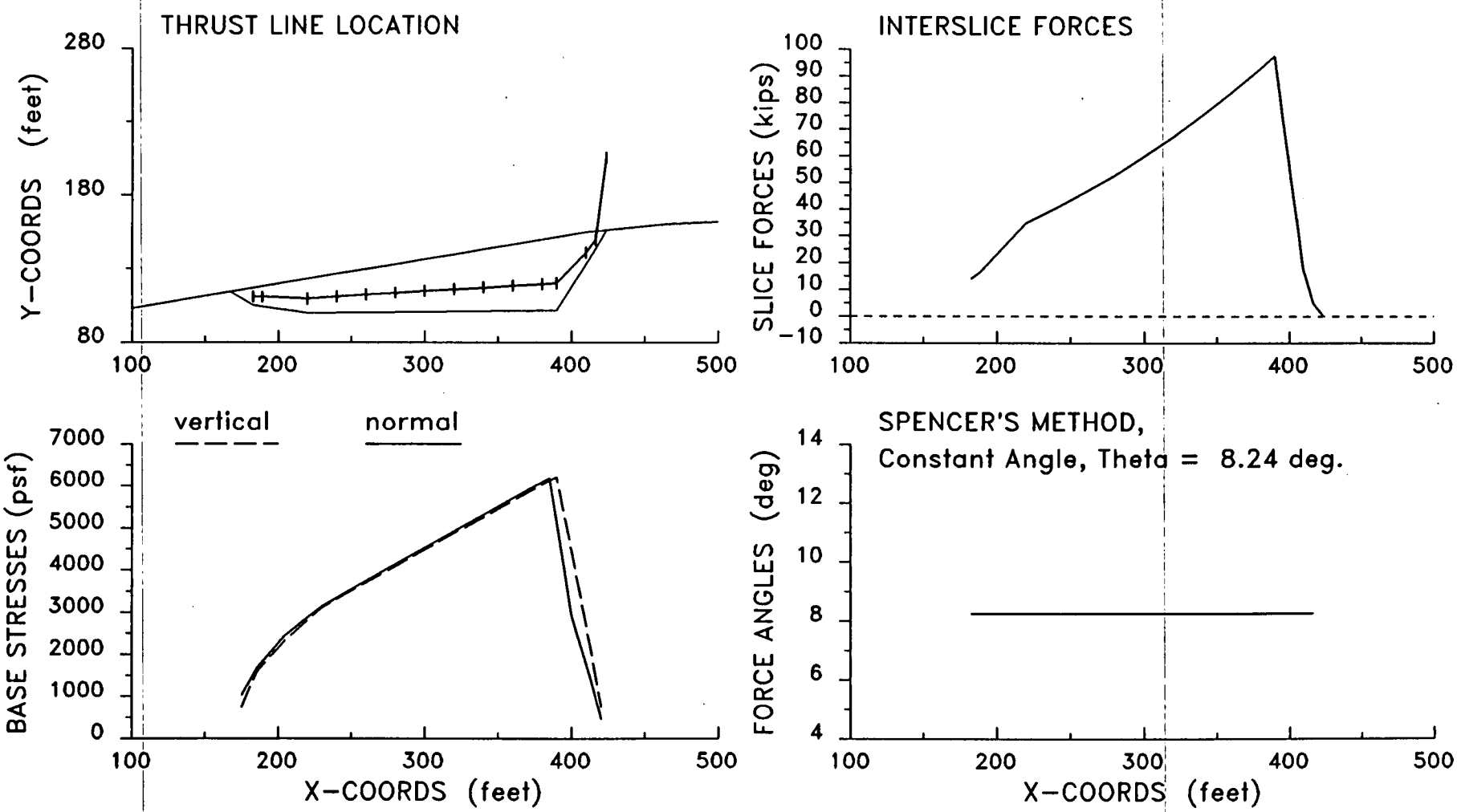
SPENCER'S METHOD, FOS for Specified Surface = 2.190



000661

12668

3/31



OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 2.190

1268

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000662

XSTABL File: NLD01BS 10-10-97 9:29

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 á 96       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.201                 96 á 1202 *
*****************************************
```

Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	288.0
4	2880.0	604.8
5	6480.0	1238.4
6	10080.0	1238.4

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	389.94	101.63
6	390.10	101.78
7	416.65	143.47
8	423.95	156.10

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.71	37.34	20.00	.66	9.37	93339.
9	330.00	100.94	40.41	20.00	.66	9.37	101016.
10	350.00	101.17	43.53	20.00	.66	9.65	108818.
11	370.00	101.40	46.65	20.00	.66	9.37	116621.
12	384.97	101.57	48.96	9.94	.66	9.46	60827.
13	390.02	101.71	49.66	.16	43.15	9.46	1005.
14	400.05	117.41	35.64	19.90	57.51	9.46	88637.
15	413.33	138.25	16.78	6.65	57.51	5.71	13951.
16	420.30	149.78	5.95	7.30	59.96	5.71	5427.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	8.1872	2.1885	2.2267
3	8.2391	2.1903	2.1885
4	8.2378	2.1902	2.1903

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	8.2378	2.1902	2.1903

SLICE INFORMATION .... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	1018.8	.0	30.00	0.	0.	0.	.00

2	1684.6	182.4	8.34	0.	0.	0.	.00
3	2424.2	182.4	8.34	0.	0.	0.	.00
4	3135.4	97.9	9.98	0.	0.	0.	.00
5	3532.9	97.9	9.98	0.	0.	0.	.00
6	3924.1	97.9	9.98	0.	0.	0.	.00
7	4321.6	97.9	9.98	0.	0.	0.	.00
8	4715.6	97.9	9.98	0.	0.	0.	.00
9	5103.0	97.9	9.98	0.	0.	0.	.00
10	5496.7	97.9	9.98	0.	0.	0.	.00
11	5890.3	97.9	9.98	0.	0.	0.	.00
12	6181.3	97.9	9.98	0.	0.	0.	.00
13	5146.3	97.9	9.98	0.	0.	0.	.00
14	2909.9	.0	25.00	0.	0.	0.	.00
15	1370.5	.0	25.00	0.	0.	0.	.00
16	445.7	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1018.8	739.6	.0	268.5
2	186.00	1684.6	1594.4	.0	196.1
3	204.50	2424.2	2304.8	.0	245.6
4	230.00	3135.4	3100.0	.0	296.7
5	250.00	3532.9	3493.8	.0	328.6
6	270.00	3924.1	3881.3	.0	360.0
7	290.00	4321.6	4275.0	.0	392.0
8	310.00	4715.6	4666.9	.0	423.6
9	330.00	5103.0	5050.8	.0	454.8
10	350.00	5496.7	5440.9	.0	486.4
11	370.00	5890.3	5831.0	.0	518.0
12	384.97	6181.3	6119.4	.0	541.4
13	390.02	5146.3	6208.0	.0	458.2
14	400.05	2909.9	4454.6	.0	619.5
15	413.33	1370.5	2097.9	.0	291.8
16	420.30	445.7	743.4	.0	117.5

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	8.24	13767.	5.74	11.83	.485
2	189.00	8.24	16392.	6.40	13.68	.468
3	220.00	8.24	34757.	9.52	23.20	.411
4	240.00	8.24	40118.	10.77	26.40	.408
5	260.00	8.24	46045.	11.90	29.50	.403
6	280.00	8.24	52527.	12.96	32.60	.398
7	300.00	8.24	59575.	13.96	35.80	.390
8	320.00	8.24	67045.	14.93	38.87	.384
9	340.00	8.24	75054.	15.86	41.94	.378

10	360.00	8.24	83612.	16.76	45.11	.372
11	380.00	8.24	92717.	17.65	48.18	.366
12	389.94	8.24	97444.	18.09	49.73	.364
13	390.10	8.24	96730.	18.09	49.60	.365
14	410.00	8.24	17318.	7.67	21.67	.354
15	416.65	8.24	4819.	5.78	11.89	.486
16	423.95	.00	0.	49.29	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3522.15 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 389.00 (psf)

Total Length of failure surface = 289.90 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 2.190

Total shear strength available along specified failure surface = 247.00E+03 lb

GCL 02

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS Geosynthetic Clay Liner (GCL) 02 - Compliance Package

Computations By: (Cognizant Engineer)
Signature [signature] Date 14 OCT 1997
Printed Name ROBERT A. MORGAN III
and Title SR. STAFF ENGINEER

Assumptions and Procedures Checked By: (Checker)
Signature [signature] Date 14 Oct 97
Printed Name Gary R. Schmertmann
and Title Sr. Project Engr.

Computations Checked by:
Signature [signature] Date 14 Oct 97
Printed Name Gary R. Schmertmann
and Title Sr. Project Engr.

Computations Backchecked by: (Cognizant Engineer)
Signature [signature] Date 15 OCT 1997
Printed Name ROBERT A. MORGAN III
and Title SR. STAFF ENGINEER

Approved by: (PDP)
Signature [signature] Date 15 Oct 97
Printed Name Gary R. Schmertmann
and Title Senior Project Engineer

Approved by: (DTL and TETL)
Signature [signature] Date 15 Oct 97
Printed Name Kenneth W. Cargill
and Title Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1	Add interface analysis	6 Nov 1997	MCO	GRS	[signature]

GEOSYNTEC CONSULTANTS

Written By: RAM Date: 10/14/97 Reviewed by: GPS Date: 10/15/97

Client: FDF Project: OSDF Project/Proposal No.: GQ0166 Task No.: 04

PURPOSE

Evaluate whether GCL QA sample no. 02 complies with the shear strength requirements given in the GCL specification (Section 02772, Paragraph 2.01.E.3).

METHOD

The method for evaluating the GCL sample is outlined in RCI number 1702-006R. The method involves the following basic steps.

1. Use shear test results from the GCL sample to establish the envelopes of measured peak and large-displacement internal and interface shear strength.
2. Reanalyze two slope stability cases that were included in the OSDF design calculations using the measured peak and large-displacement strength envelopes established in Step 1. Obtain the slope stability factors of safety for the critical potential slip surface for each analysis case.
3. Compare the slope stability factors of safety computed in Step 2 to the baseline factors of safety.

SHEAR TEST RESULTS

The results of the GCL internal shear tests performed on QA sample no. 02 are shown in the following table. The results of the GCL/geomembrane interface shear test were ~~not available for this calculation.~~ added (Revision No. 1) The laboratory test results are presented in Appendix A.

QA Sample No.	Case	Test Type	Measured Shear Strengths		
			5 psi	20 psi	45 psi
02	Peak	GCL Internal	3.8 psi	5.9 psi	12.9 psi
		GCL/GMB Interface	0[1]	5.7	11.1
02	Large-displacement	GCL Internal	1.1	3.0	6.1
		GCL/GMB Interface	0[1]	4.0	6.3

STABILITY ANALYSES RESULTS

The results of the slope stability analyses performed using the computer program XSTABL are shown in the table below. The analyses output files and figures showing critical slip surfaces are presented in Appendix B.

QA Sample No.	Test Type	Filename	Factor of Safety	Comply ?
Baseline	Peak	NA	1.9	NA
02	GCL Internal	NPK02AS	1.9	YES
	GCL/GMB Interface	NPK02BS	1.7	NO
Baseline	Large-displacement	NA	1.6	NA
02	GCL Internal	NLD02AS	1.8	YES
	GCL/GMB Interface	NLD02BS	1.9	YES

Revision No. 1

[1] Interface shear strength values for QA sample 02 at 5 psi normal stress were not available at the time that this calculation package was prepared. These values were assumed to equal zero. This assumption is conservative in the context of RCI 1702-006R.

RAM 10/14/97
GRS 10/14/97
Revision No. 1: MCO 11/06/97

APPENDIX A

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 2I

Test Specimen Configuration (from top to bottom) and Placement Conditions:

- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-02). GCL's initial moisture content was 9.4%. GCL's final moisture content ranged from 63% to 79% for the test series; and
- lower shear box: rigid substrate with textured steel gripping surface.

Designated Shear Plane: Within GCL

Test Procedures for Each Normal Stress Condition:

- A fresh GCL specimen was trimmed from the bulk sample of the GCL and placed between two rigid wooden substrates with textured steel gripping surfaces. The ends of each geotextile were then sandwiched between a second rigid wooden substrate prior to testing. The entire test specimen was then placed in the shear box to provide confinement for the exposed bentonite component. The textured steel gripping surfaces were employed to minimize slippage between each geotextile component of the GCL and rigid wood substrate, therefore providing a relatively uniform transfer of shear load onto the GCL specimen.
- Soaking conditions: The GCL specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the GCL specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the Bentofix NS GCL sample.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 2G

Test Specimen Configuration (from top to bottom) and Placement Conditions:

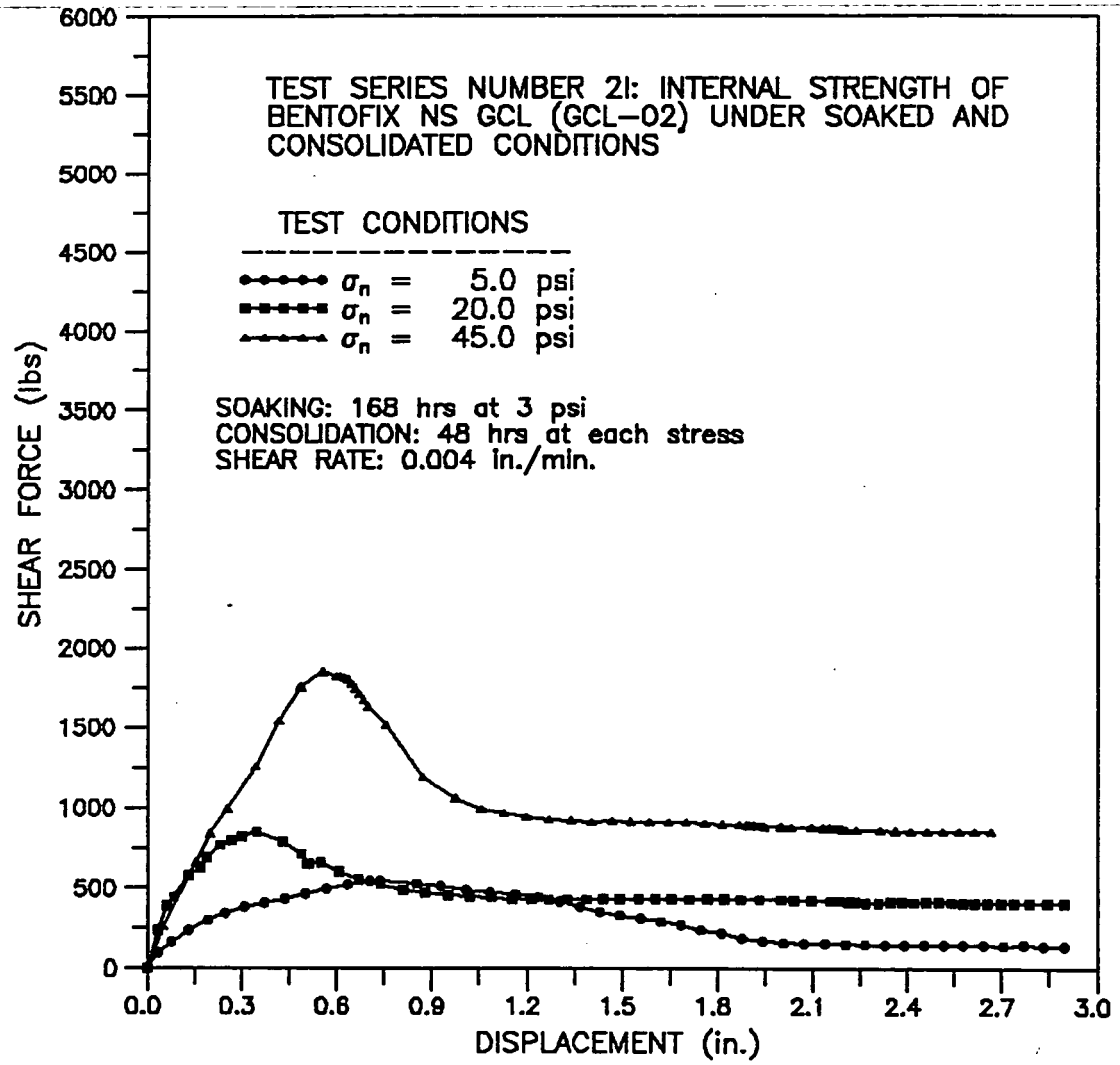
- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-02) with woven geotextile against geomembrane. GCL's initial moisture content was 9.6%. GCL's final moisture content ranged from 70 to 119% for the test series;
- 80-mil NSC textured HDPE geomembrane (GM-15); and
- lower shear box: bedding layer of compacted concrete sand.

Test Interface: GCL against geomembrane

Test Procedures for Each Normal Stress Condition:

- A fresh specimen of concrete sand was compacted into the lower shear box by hand tamping to a relatively dense state under dry conditions forming a 3 in. thick bedding layer.
- A fresh specimen of geomembrane was trimmed from the bulk sample and attached to the lower shear box with mechanical compression clamps.
- A fresh specimen of GCL was trimmed from the bulk sample and attached to the upper shear box with mechanical compression clamps. The GCL was oriented so that the woven geotextile component of the GCL was in contact with the geomembrane.
- A rigid substrate with a textured steel gripping surface was placed on top of the GCL. The textured steel gripping surface was used to minimize slippage between the upper geotextile component of the GCL and rigid wooden substrate, therefore providing a relatively uniform transfer of shear load onto the test interface.
- Soaking conditions: The entire test specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the entire test specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 20 and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the geosynthetic samples.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

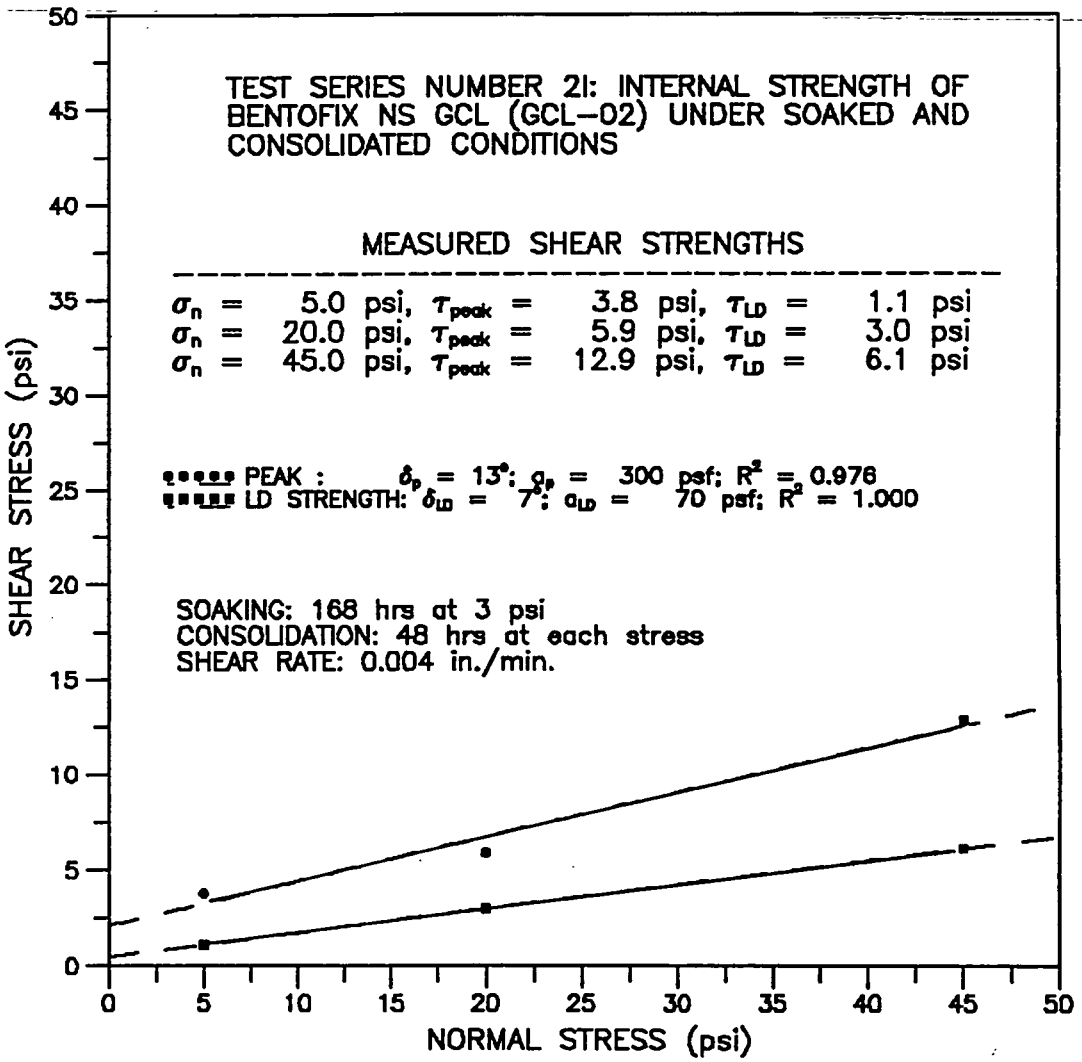
(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

DATE TESTED: 26 AUGUST TO 4 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



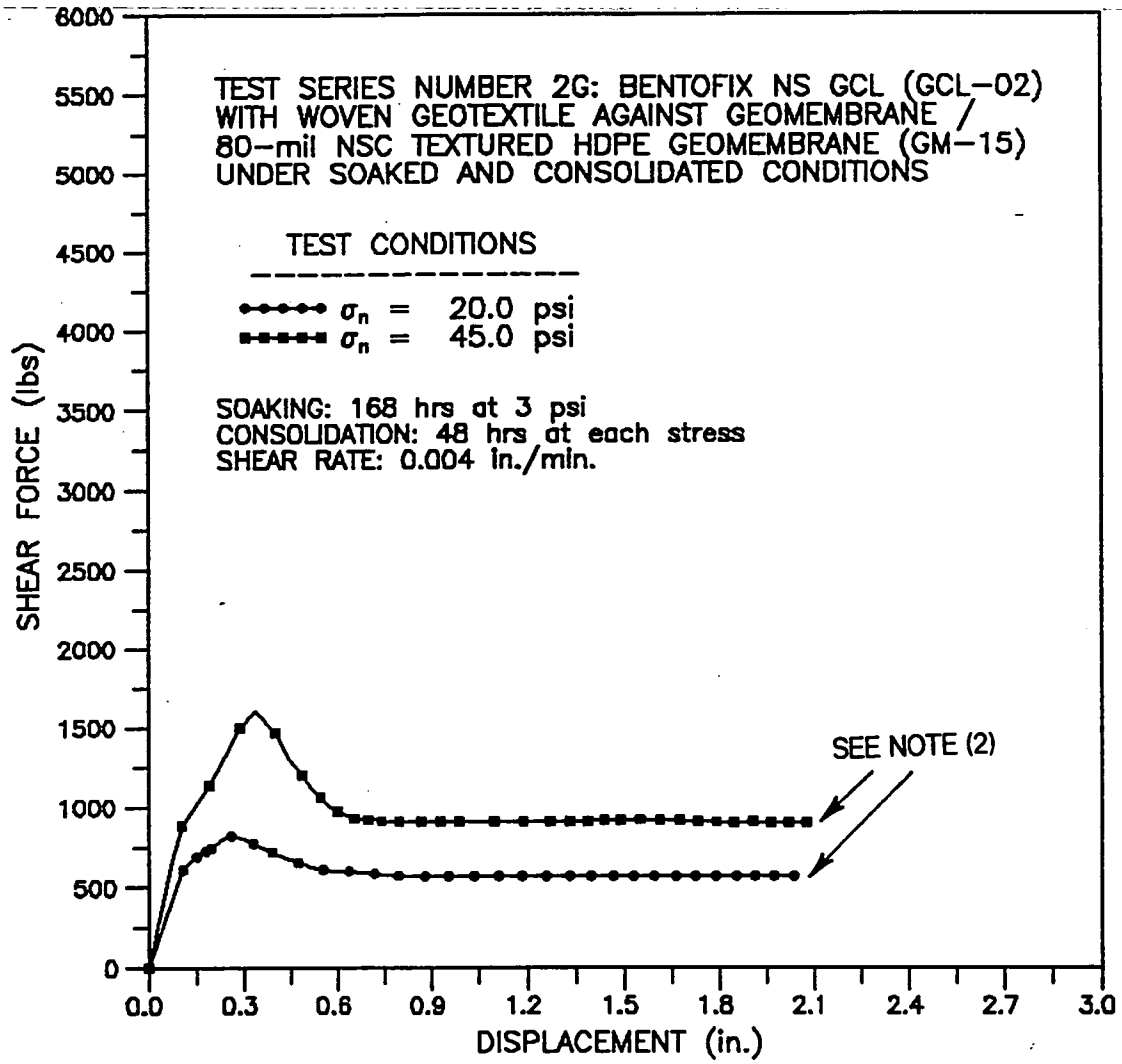
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 26 AUGUST TO 4 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

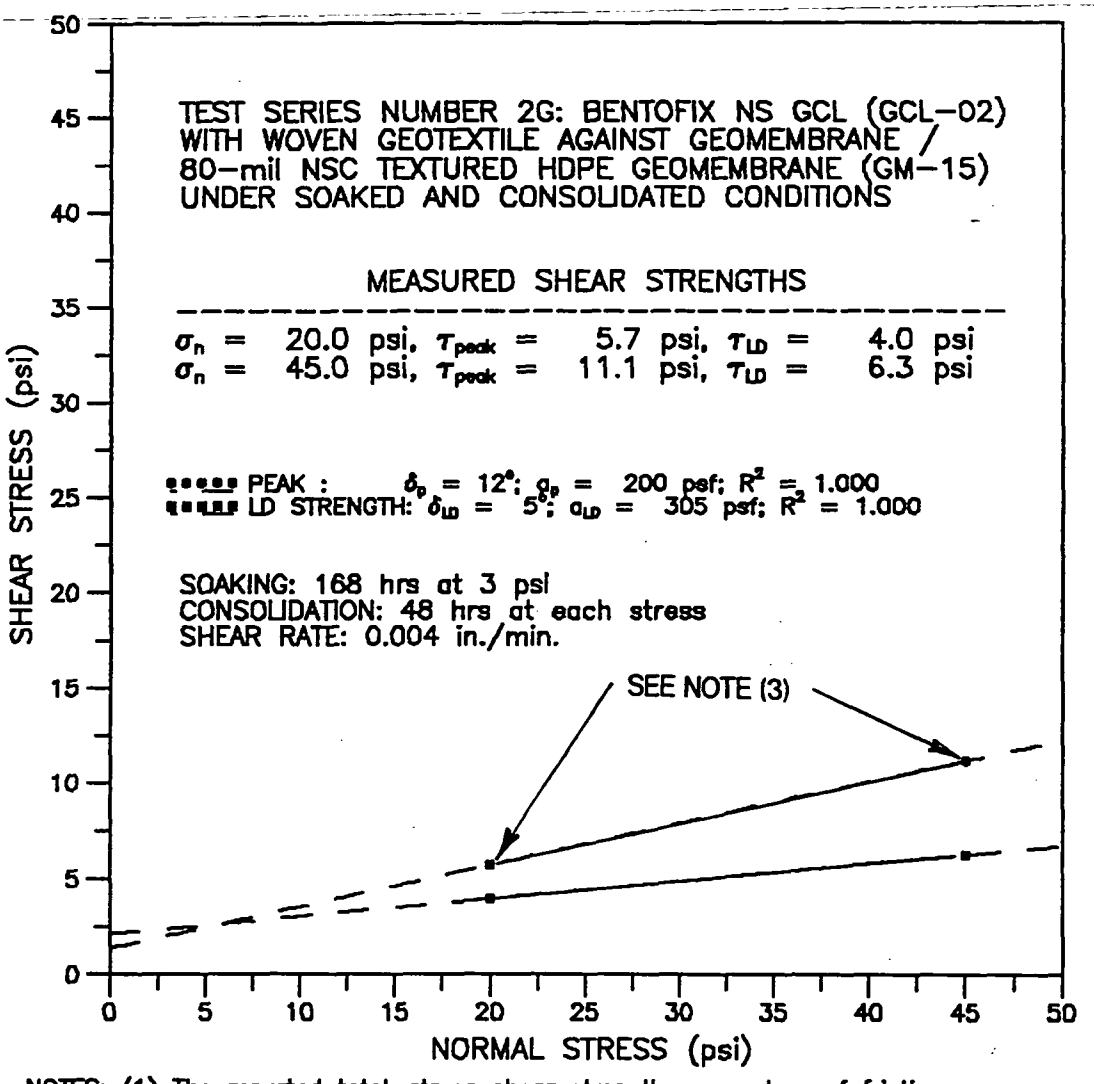
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	G00166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087
FILE NO.	

RAM 10/14/97

GRS 10/14/97

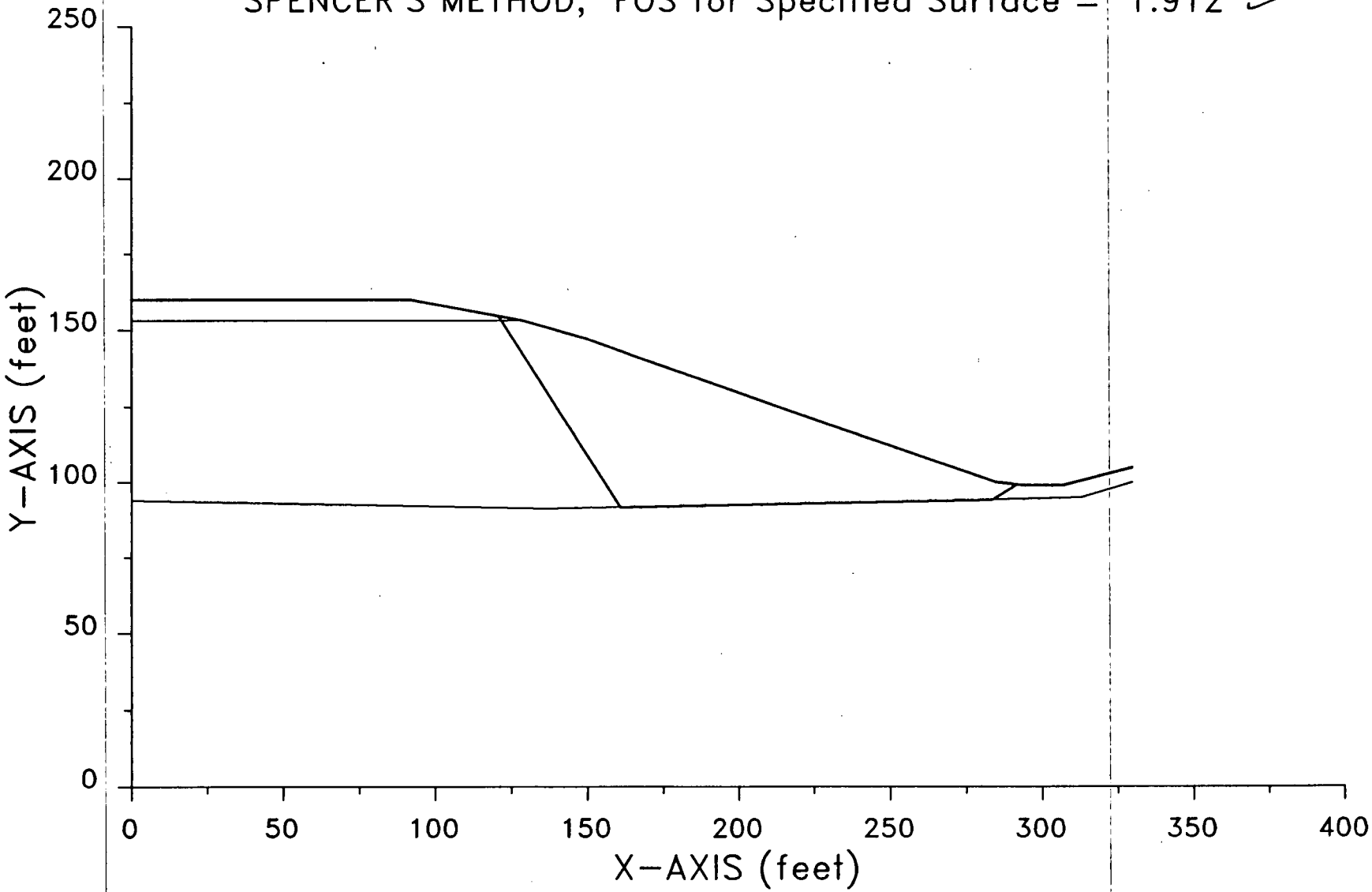
Revision No.: MCO 11/06/97

APPENDIX B

NPR02AS 10-09-97 14:00

OSDF Interim Closure/Short-Term,Peak

SPENCER'S METHOD, FOS for Specified Surface = 1.912



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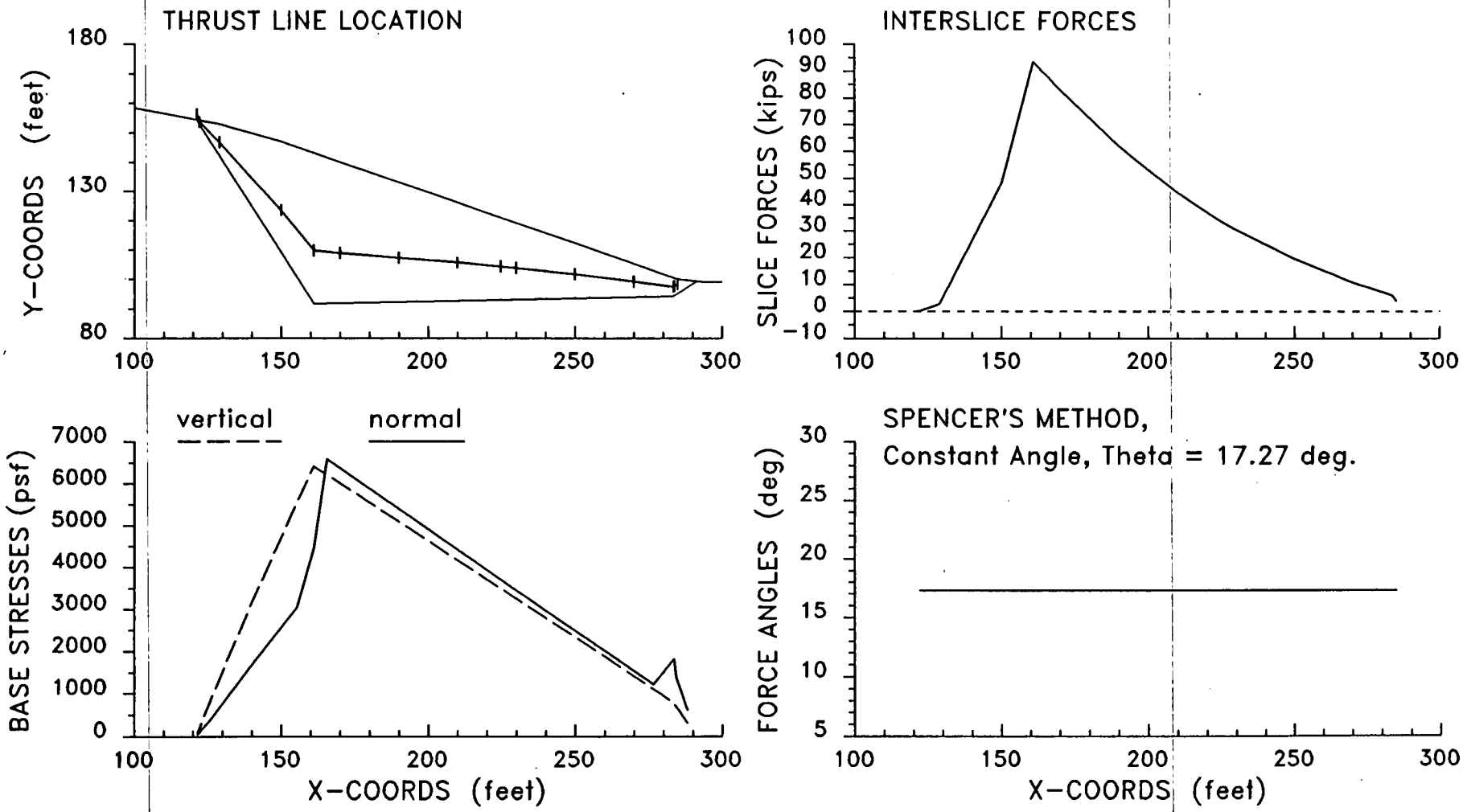
7/20 10/37

000679



OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.912

1268

11/93

000680

XSTABL File: NPK02AS 10-09-97 14:00

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.201                 96 á 1202 *
*****************************************
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Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES
---

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	547.2
4	2880.0	849.6
5	6480.0	1857.6
6	10080.0	1857.6

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	291.55	99.27
2	283.87	94.38
3	283.66	94.17
4	224.80	93.00
5	161.14	91.74
6	160.99	91.90
7	122.06	153.00
8	121.21	154.47

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	288.27	97.19	2.45	6.55	-32.50	6.34	2006.
2	284.43	94.74	5.46	1.13	-32.50	19.12	773.
3	283.76	94.27	6.15	.21	-45.00	19.12	160.
4	276.83	94.03	8.80	13.66	-1.14	19.12	15023.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37501.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55870.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.13	19.29	56714.
9	200.00	92.51	37.09	20.00	-1.13	19.29	92727.
10	180.00	92.11	44.44	20.00	-1.13	19.03	111092.
11	165.57	91.83	49.72	8.86	-1.13	19.29	55068.
12	161.07	91.82	51.31	.15	46.85	19.29	962.
13	155.49	100.52	44.55	10.99	57.50	19.29	61204.
14	139.50	125.63	24.37	21.00	57.50	15.95	63976.
15	125.53	147.55	6.10	6.94	57.50	10.71	5294.
16	121.64	153.74	.66	.85	60.03	10.71	70.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.0828	1.9196	1.9448
3	17.1066	1.9203	1.9196

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.2743	1.9107	1.9063
3	17.2716	1.9106	1.9107

Nonlinear M-C Iteration Number - 3

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	17.2716	1.9117	1.9107

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	17.2716	1.9117	1.9107

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	593.9	.0	30.00	0.	0.	0.	.00
2	1369.0	200.0	25.00	0.	0.	0.	.00
3	1813.4	446.4	7.97	0.	0.	0.	.00
4	1213.9	446.4	7.97	0.	0.	0.	.00
5	2013.5	446.4	7.97	0.	0.	0.	.00
6	2962.8	43.2	15.64	0.	0.	0.	.00
7	3572.4	43.2	15.64	0.	0.	0.	.00
8	4061.2	43.2	15.64	0.	0.	0.	.00
9	4912.0	43.2	15.64	0.	0.	0.	.00
10	5883.2	43.2	15.64	0.	0.	0.	.00
11	6577.2	1857.6	.00	0.	0.	0.	.00
12	4434.6	43.2	15.64	0.	0.	0.	.00
13	3029.2	200.0	25.00	0.	0.	0.	.00
14	1623.9	200.0	25.00	0.	0.	0.	.00
15	351.6	200.0	25.00	0.	0.	0.	.00
16	42.3	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	288.27	593.9	306.3	.0	179.4
2	284.43	1369.0	682.2	.0	438.6
3	283.76	1813.4	769.4	.0	366.3
4	276.83	1213.9	1099.8	.0	322.4
5	260.00	2013.5	1875.0	.0	381.0
6	240.00	2962.8	2793.5	.0	456.6
7	227.40	3572.4	3369.8	.0	545.8
8	217.40	4061.2	3832.1	.0	617.4
9	200.00	4912.0	4636.4	.0	742.0
10	180.00	5883.2	5554.6	.0	884.3
11	165.57	6577.2	6215.4	.0	971.7
12	161.07	4434.6	6413.4	.0	672.1
13	155.49	3029.2	5569.1	.0	843.5
14	139.50	1623.9	3046.5	.0	500.7
15	125.53	351.6	762.8	.0	190.4
16	121.64	42.3	82.1	.0	12.8

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	17.27	3826.	3.10	4.90	.634
2	283.87	17.27	5380.	3.13	6.01	.520
3	283.66	17.27	5853.	3.17	6.29	.503
4	270.00	17.27	10811.	5.18	11.30	.459
5	250.00	17.27	19628.	7.97	18.70	.426
6	230.00	17.27	30424.	10.57	26.00	.407
7	224.80	17.27	33783.	11.16	27.92	.400
8	210.00	17.27	44599.	12.75	33.39	.382
9	190.00	17.27	62177.	14.82	40.79	.363
10	170.00	17.27	83137.	16.86	48.08	.351
11	161.14	17.27	93361.	17.78	51.36	.346
12	160.99	17.27	92723.	17.79	51.25	.347
13	150.00	17.27	47714.	14.21	37.85	.375
14	129.00	17.27	2677.	4.47	10.89	.410
15	122.06	17.27	50.	.60	1.31	.459
16	121.21	.00	-3.	1.65	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2942.33 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 561.38 (psf)

Total Length of failure surface = 206.32 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.912

Total shear strength available along specified failure surface = 221.41E+03 lb

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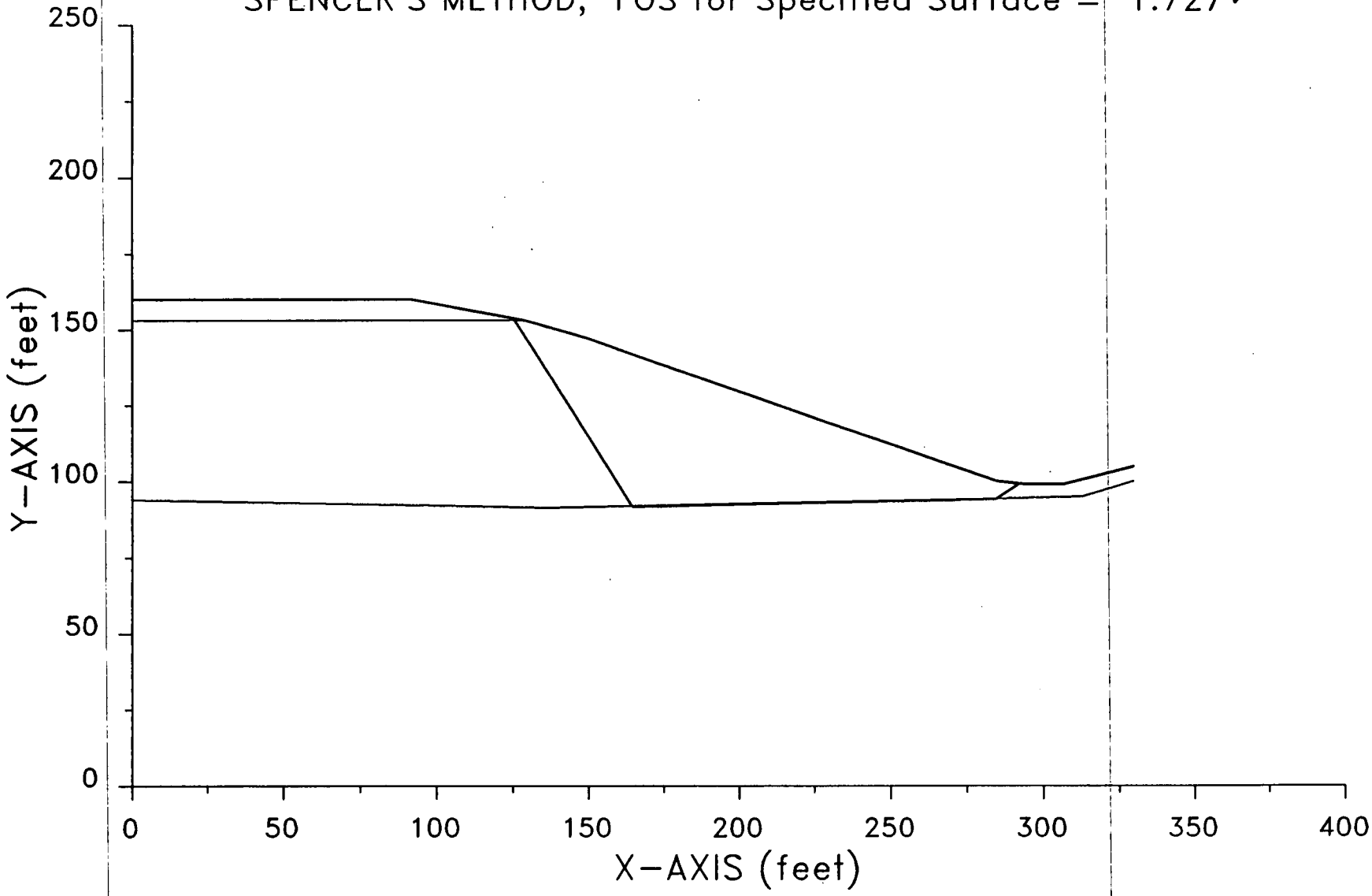
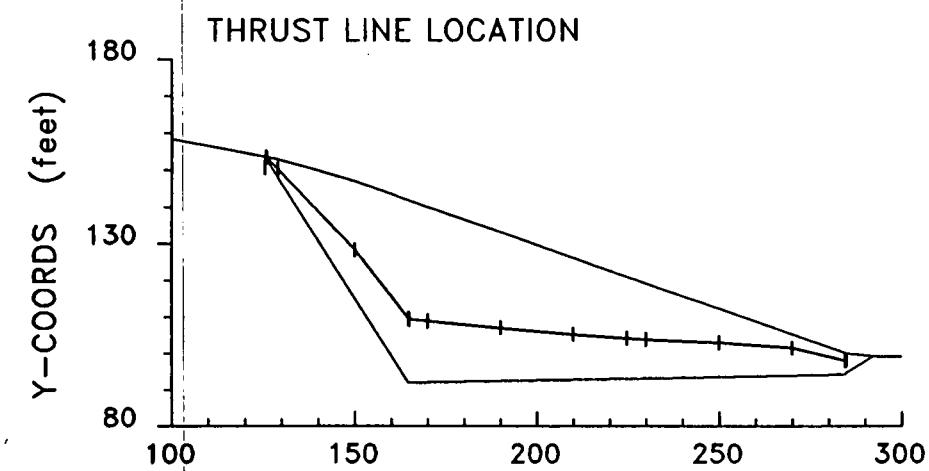
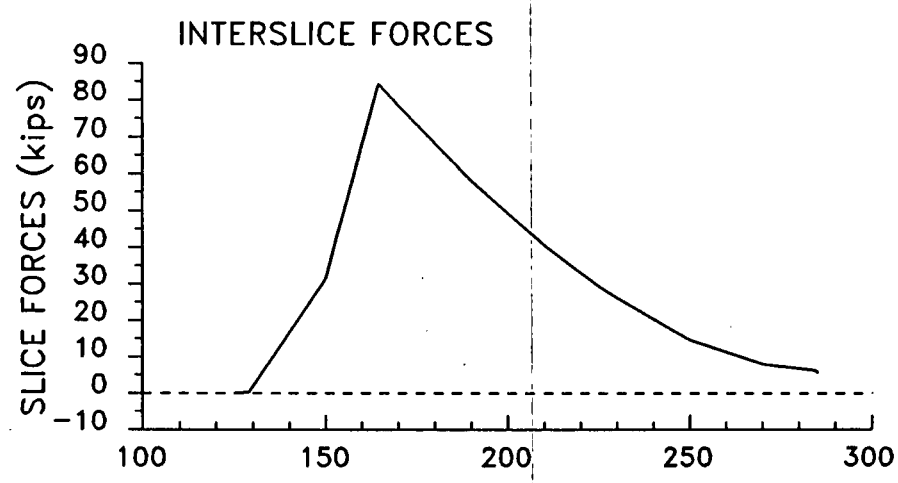
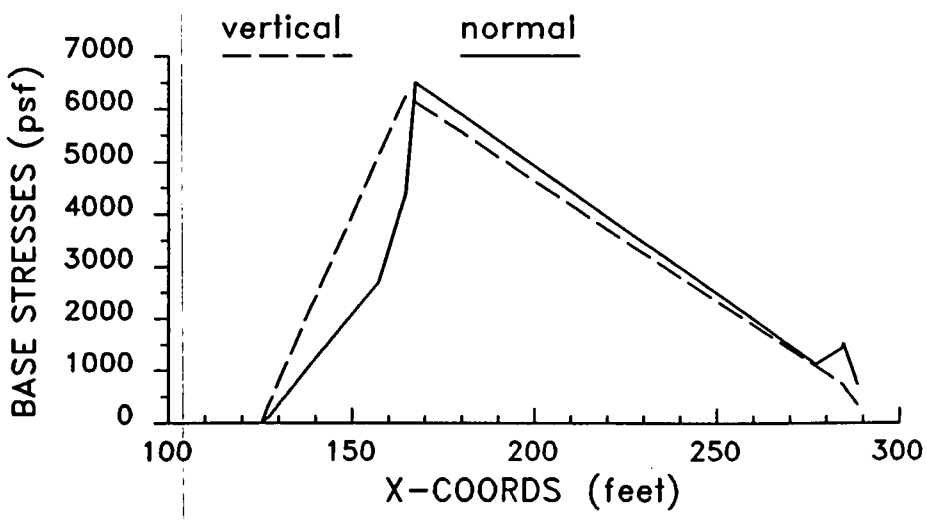
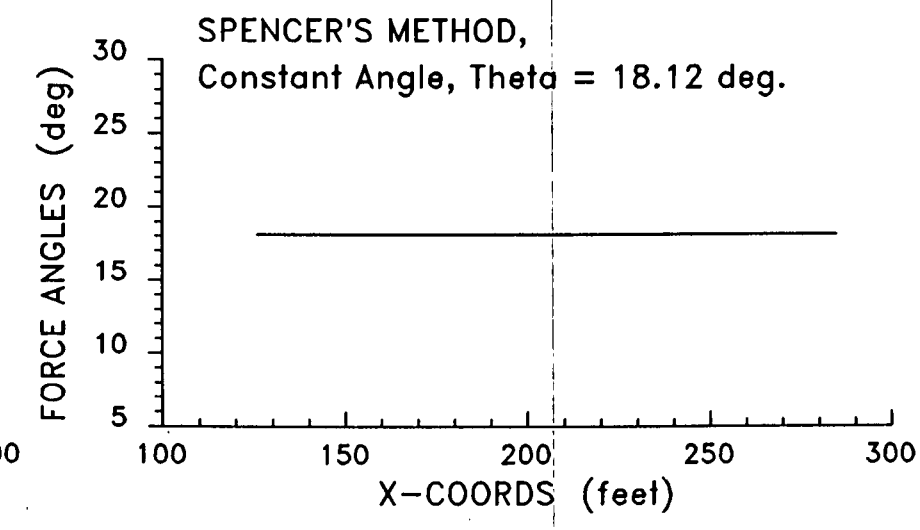
OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.727











OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 1.727 ✓

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Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	.0
4	2880.0	820.8
5	6480.0	1598.4
6	10080.0	1598.4

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	292.31	99.19
2	284.78	94.40
3	284.58	94.19
4	224.80	93.00
5	164.88	91.78
6	164.69	91.97
7	125.81	153.00
8	125.42	153.68

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	288.65	96.86	2.73	7.31	-32.45	6.34	2495.
2	284.89	94.47	5.57	.22	-32.45	19.12	156.
3	284.68	94.29	5.82	.20	-46.40	19.12	142.
4	277.29	94.04	8.63	14.58	-1.14	19.12	15724.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37498.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55869.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.17	19.29	56722.
9	200.00	92.50	37.10	20.00	-1.17	19.29	92762.
10	180.00	92.09	44.46	20.00	-1.17	19.03	111155.
11	167.44	91.83	49.06	5.12	-1.17	19.29	31401.
12	164.78	91.88	49.95	.19	45.00	19.29	1205.
13	157.34	103.50	40.93	14.69	57.50	19.29	75139.
14	139.50	131.51	18.49	21.00	57.50	15.95	48534.
15	127.40	150.50	2.81	3.19	57.50	10.71	1119.
16	125.61	153.34	.30	.39	60.07	10.71	15.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	18.1197	1.7285	1.7276

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	18.1197	1.7266	1.7276

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	18.1197	1.7266	1.7276

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta

1	726.2	.0	30.00	0.	0.	0.	.00
2	1518.9	200.0	25.00	0.	0.	0.	.00
3	1440.9	-273.6	20.81	0.	0.	0.	.00
4	1116.0	-273.6	20.81	0.	0.	0.	.00
5	1984.4	-273.6	20.81	0.	0.	0.	.00
6	2982.3	198.7	12.19	0.	0.	0.	.00
7	3589.0	198.7	12.19	0.	0.	0.	.00
8	4077.0	198.7	12.19	0.	0.	0.	.00
9	4925.1	198.7	12.19	0.	0.	0.	.00
10	5893.3	198.7	12.19	0.	0.	0.	.00
11	6498.1	1598.4	.00	0.	0.	0.	.00
12	4368.9	198.7	12.19	0.	0.	0.	.00
13	2688.8	200.0	25.00	0.	0.	0.	.00
14	1172.0	200.0	25.00	0.	0.	0.	.00
15	111.8	200.0	25.00	0.	0.	0.	.00
16	20.3	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	288.65	726.2	341.3	.0	242.8
2	284.89	1518.9	696.3	.0	526.0
3	284.68	1440.9	727.4	.0	158.7
4	277.29	1116.0	1078.5	.0	87.2
5	260.00	1984.4	1874.9	.0	278.3
6	240.00	2982.3	2793.4	.0	488.2
7	227.40	3589.0	3369.8	.0	564.1
8	217.40	4077.0	3832.6	.0	625.1
9	200.00	4925.1	4638.1	.0	731.2
10	180.00	5893.3	5557.8	.0	852.3
11	167.44	6498.1	6133.0	.0	925.7
12	164.78	4368.9	6243.7	.0	661.6
13	157.34	2688.8	5116.0	.0	842.0
14	139.50	1172.0	2311.2	.0	432.3
15	127.40	111.8	350.7	.0	146.0
16	125.61	20.3	37.7	.0	6.8

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	18.12	5419.	3.52	5.46	.645
2	284.78	18.12	5771.	3.51	5.68	.619
3	284.58	18.12	6115.	3.64	5.96	.611
4	270.00	18.12	7793.	7.35	11.30	.651
5	250.00	18.12	14481.	9.26	18.70	.495
6	230.00	18.12	26003.	10.48	26.00	.403
7	224.80	18.12	29480.	10.94	27.92	.392

8	210.00	18.12	40507.	12.42	33.40	.372
9	190.00	18.12	58004.	14.58	40.81	.357
10	170.00	18.12	78465.	16.83	48.12	.350
11	164.88	18.12	84165.	17.41	50.01	.348
12	164.69	18.12	83413.	17.44	49.89	.350
13	150.00	18.12	31202.	13.10	31.97	.410
14	129.00	18.12	106.	2.20	5.01	.439
15	125.81	18.12	7.	.28	.60	.471
16	125.42	.00	-4.	-3.04	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2829.87 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 536.02 (psf)

Total Length of failure surface = 202.35 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.727 ✓

Total shear strength available along specified failure surface = 187.28E+03 lb

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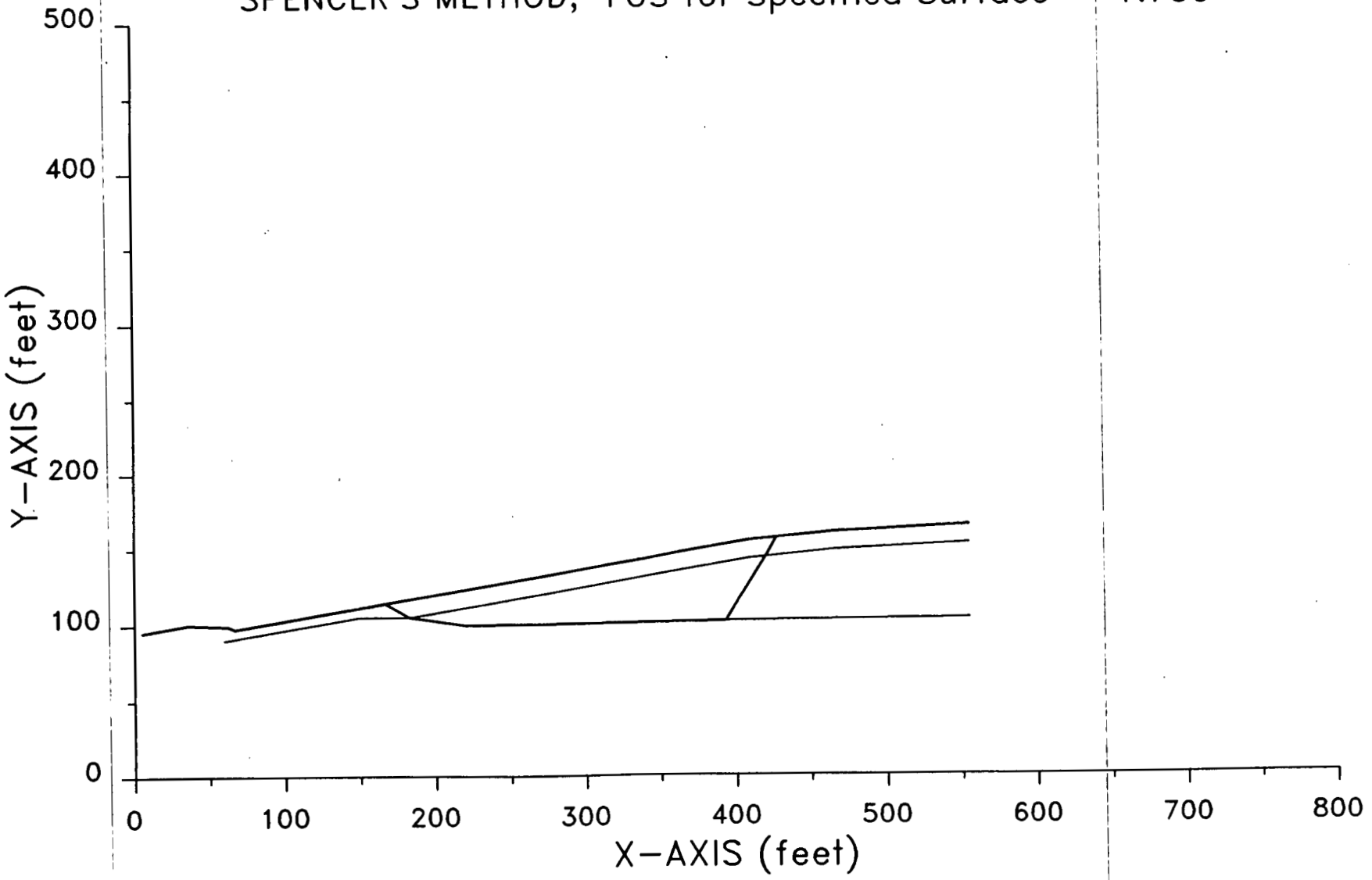
OSDF Final Long Term – Large Displ.

SPENCER'S METHOD, FOS for Specified Surface = 1.750



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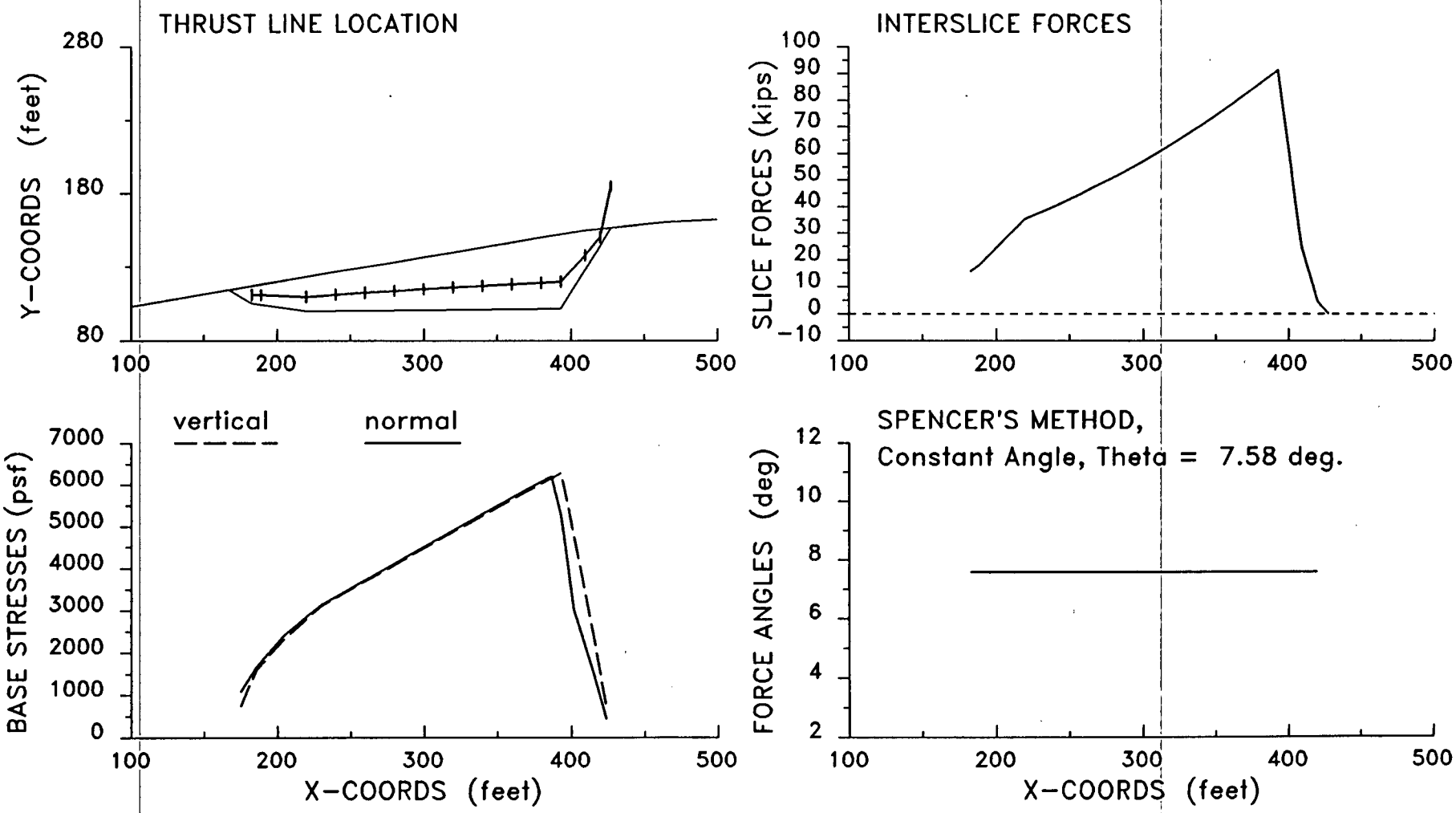

OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.750

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*            Method of Slices           *
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Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	158.4
4	2880.0	432.0
5	6480.0	878.4
6	10080.0	878.4

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	393.30	101.66
6	393.46	101.82
7	420.21	143.82
8	427.51	156.45

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.71	37.34	20.00	.65	9.37	93341.
9	330.00	100.94	40.41	20.00	.65	9.37	101023.
10	350.00	101.17	43.53	20.00	.65	9.65	108830.
11	370.00	101.40	46.65	20.00	.65	9.37	116637.
12	386.65	101.58	49.22	13.30	.65	9.46	81835.
13	393.38	101.74	50.19	.16	45.00	9.46	1004.
14	401.73	114.80	38.52	16.54	57.51	9.46	79634.
15	415.11	135.81	19.41	10.21	57.51	5.71	24768.
16	423.86	150.14	5.95	7.30	59.97	5.71	5429.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	7.5034	1.7476	1.7924
3	7.5871	-----	1.7476
3	7.5452	1.7486	-----
4	7.5850	1.7496	1.7486
5	7.5841	1.7496	1.7496

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	7.5841	1.7496	1.7496

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta

19/20 29/37

1	1074.1	.0	30.00	0.	0.	0.	.00
2	1669.2	67.2	7.22	0.	0.	0.	.00
3	2408.1	67.2	7.22	0.	0.	0.	.00
4	3128.4	74.9	7.07	0.	0.	0.	.00
5	3525.1	74.9	7.07	0.	0.	0.	.00
6	3915.5	74.9	7.07	0.	0.	0.	.00
7	4312.2	74.9	7.07	0.	0.	0.	.00
8	4705.8	74.9	7.07	0.	0.	0.	.00
9	5092.6	74.9	7.07	0.	0.	0.	.00
10	5485.8	74.9	7.07	0.	0.	0.	.00
11	5878.9	74.9	7.07	0.	0.	0.	.00
12	6202.3	74.9	7.07	0.	0.	0.	.00
13	5220.8	74.9	7.07	0.	0.	0.	.00
14	3024.2	.0	25.00	0.	0.	0.	.00
15	1523.6	.0	25.00	0.	0.	0.	.00
16	423.2	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1074.1	739.6	.0	354.4
2	186.00	1669.2	1594.4	.0	159.3
3	204.50	2408.1	2304.8	.0	212.7
4	230.00	3128.4	3100.0	.0	264.5
5	250.00	3525.1	3493.8	.0	292.6
6	270.00	3915.5	3881.3	.0	320.3
7	290.00	4312.2	4275.0	.0	348.4
8	310.00	4705.8	4667.0	.0	376.3
9	330.00	5092.6	5051.1	.0	403.7
10	350.00	5485.8	5441.5	.0	431.6
11	370.00	5878.9	5831.8	.0	459.4
12	386.65	6202.3	6153.0	.0	482.4
13	393.38	5220.8	6273.7	.0	412.8
14	401.73	3024.2	4814.6	.0	806.0
15	415.11	1523.6	2425.7	.0	406.1
16	423.86	423.2	743.7	.0	139.7

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	7.58	15636.	5.65	11.83	.477
2	189.00	7.58	18020.	6.44	13.68	.471
3	220.00	7.58	35257.	9.70	23.20	.418
4	240.00	7.58	39963.	10.87	26.40	.412
5	260.00	7.58	45156.	11.95	29.50	.405
6	280.00	7.58	50828.	12.94	32.60	.397
7	300.00	7.58	56988.	13.87	35.80	.387

8	320.00	7.58	63502.	14.76	38.87	.380
9	340.00	7.58	70480.	15.61	41.95	.372
10	360.00	7.58	77931.	16.44	45.12	.364
11	380.00	7.58	85853.	17.24	48.19	.358
12	393.30	7.58	91380.	17.77	50.26	.354
13	393.46	7.58	90604.	17.78	50.12	.355
14	410.00	7.58	24823.	9.65	26.91	.359
15	420.21	7.58	4364.	5.83	11.90	.490
16	427.51	.00	0.	27.88	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3535.11 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 385.35 (psf)

Total Length of failure surface = 293.65 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.750

Total shear strength available along specified failure surface = 197.98E+03 lb

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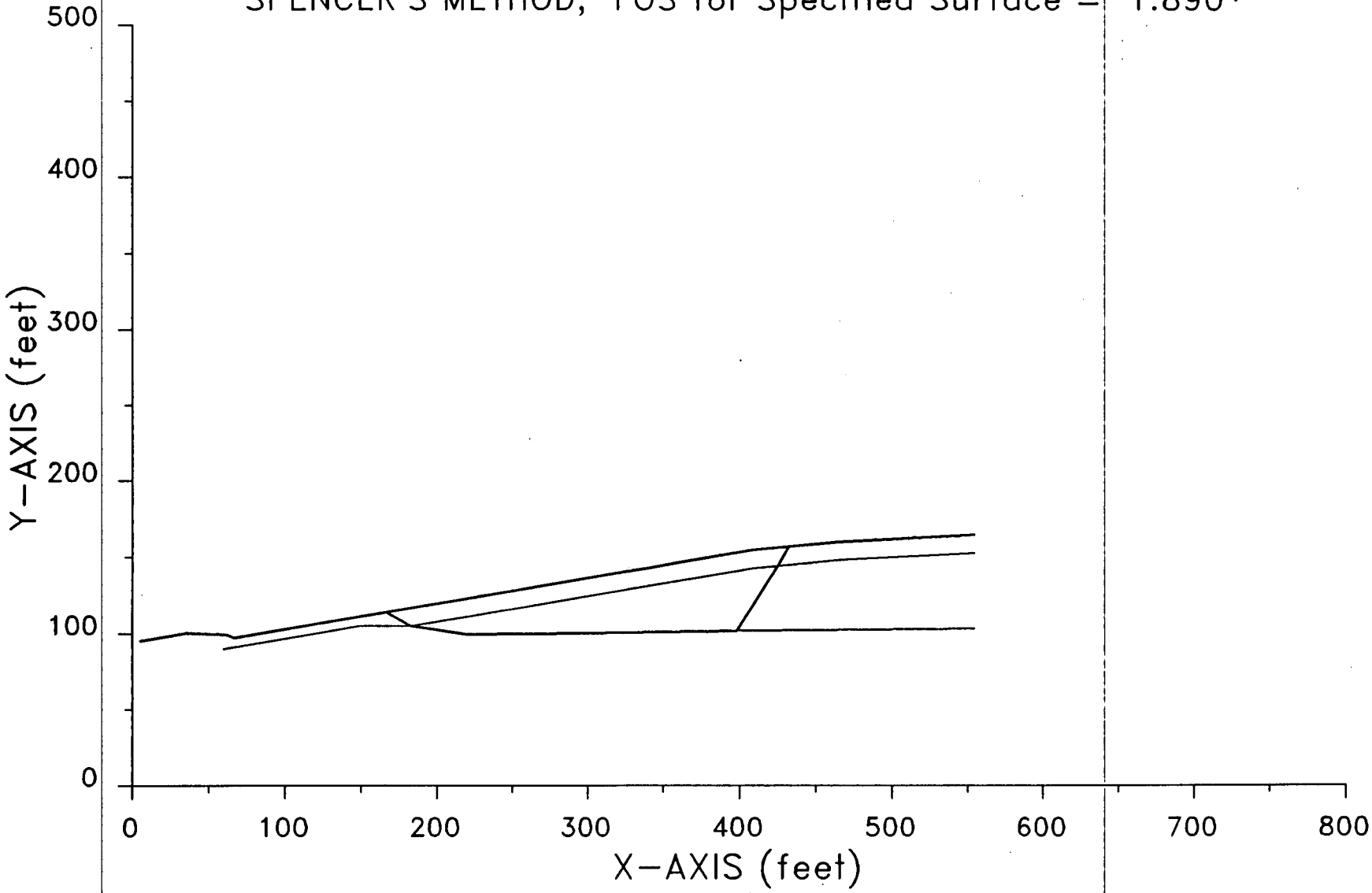
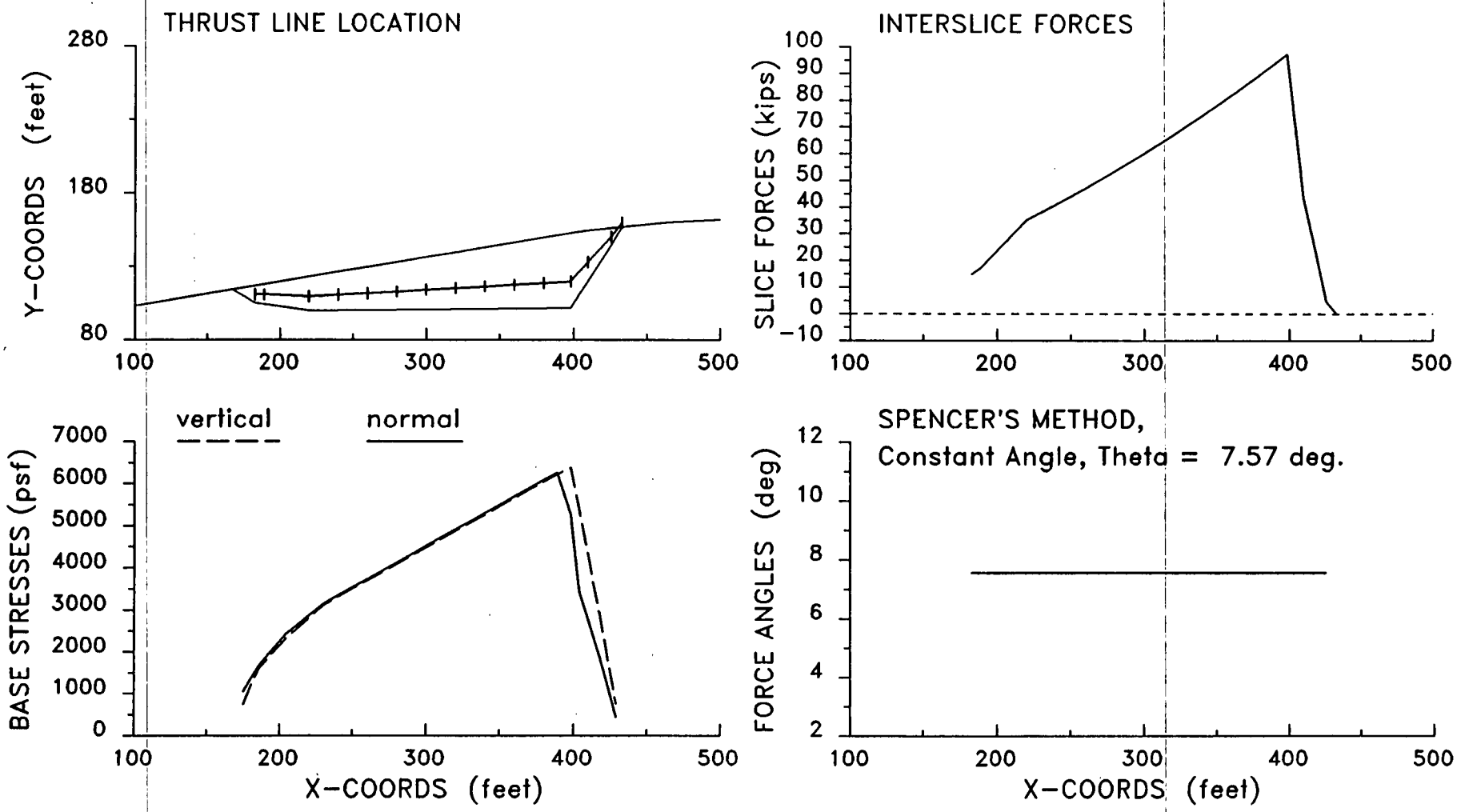
OSDF Final Long Term – Large Displ.

SPENCER'S METHOD, FOS for Specified Surface = 1.890





OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.890✓

000701

1268

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XSTABL File: NLD02BS 10-31-97 11:10

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	.0
4	2880.0	576.0
5	6480.0	907.2
6	10080.0	907.2

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	398.30	101.62
6	398.55	101.88
7	425.62	144.36
8	432.91	156.99

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.70	37.35	20.00	.59	9.37	93366.
9	330.00	100.91	40.44	20.00	.59	9.37	101097.
10	350.00	101.12	43.58	20.00	.59	9.65	108953.
11	370.00	101.33	46.72	20.00	.59	9.37	116809.
12	389.15	101.53	49.70	18.30	.59	9.46	113689.
13	398.42	101.75	51.02	.25	46.12	9.46	1594.
14	404.27	110.86	42.88	11.45	57.49	9.46	61375.
15	417.81	132.11	23.38	15.62	57.49	5.71	45646.
16	429.27	150.68	5.95	7.29	60.01	5.71	5421.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	7.4919	1.8879	1.9356
3	7.5679	-----	1.8879
3	7.5299	1.8889	-----
4	7.5662	1.8900	1.8889
5	7.5653	1.8899	1.8900

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	7.5653	1.8899	1.8900

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta

1	1047.2	.0	30.00	0.	0.	0.	.00
2	1661.7	-192.0	14.93	0.	0.	0.	.00
3	2415.3	-192.0	14.93	0.	0.	0.	.00
4	3134.8	311.0	5.26	0.	0.	0.	.00
5	3530.4	311.0	5.26	0.	0.	0.	.00
6	3919.7	311.0	5.26	0.	0.	0.	.00
7	4315.3	311.0	5.26	0.	0.	0.	.00
8	4710.0	311.0	5.26	0.	0.	0.	.00
9	5098.3	311.0	5.26	0.	0.	0.	.00
10	5493.0	311.0	5.26	0.	0.	0.	.00
11	5887.6	311.0	5.26	0.	0.	0.	.00
12	6261.3	311.0	5.26	0.	0.	0.	.00
13	5268.0	311.0	5.26	0.	0.	0.	.00
14	3429.8	.0	25.00	0.	0.	0.	.00
15	1869.7	.0	25.00	0.	0.	0.	.00
16	432.7	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1047.2	739.6	.0	319.9
2	186.00	1661.7	1594.4	.0	132.9
3	204.50	2415.3	2304.8	.0	239.2
4	230.00	3134.8	3100.0	.0	317.2
5	250.00	3530.4	3493.8	.0	336.4
6	270.00	3919.7	3881.3	.0	355.4
7	290.00	4315.3	4275.0	.0	374.6
8	310.00	4710.0	4668.3	.0	393.9
9	330.00	5098.3	5054.8	.0	412.8
10	350.00	5493.0	5447.6	.0	432.0
11	370.00	5887.6	5840.5	.0	451.2
12	389.15	6261.3	6212.5	.0	469.4
13	398.42	5268.0	6377.6	.0	421.0
14	404.27	3429.8	5360.2	.0	846.2
15	417.81	1869.7	2922.0	.0	461.3
16	429.27	432.7	743.7	.0	132.2

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	7.57	14832.	5.65	11.83	.477
2	189.00	7.57	17050.	6.45	13.68	.471
3	220.00	7.57	35145.	9.42	23.20	.406
4	240.00	7.57	40912.	10.37	26.40	.393
5	260.00	7.57	46987.	11.33	29.50	.384
6	280.00	7.57	53366.	12.29	32.60	.377
7	300.00	7.57	60054.	13.24	35.80	.370

8	320.00	7.57	67014.	14.18	38.89	.365
9	340.00	7.57	74275.	15.13	41.98	.360
10	360.00	7.57	81840.	16.06	45.18	.356
11	380.00	7.57	89710.	16.99	48.27	.352
12	398.30	7.57	97176.	17.84	51.13	.349
13	398.55	7.57	95900.	17.85	50.91	.351
14	410.00	7.57	43507.	13.00	34.85	.373
15	425.62	7.57	4540.	5.83	11.90	.490
16	432.91	.00	0.	2.54	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3597.60 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 393.34 (psf)

Total Length of failure surface = 299.35 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.890

Total shear strength available along specified failure surface = 222.53E+03 lb

GCL 03

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS Geosynthetic Clay Liner (GCL) 03 - Compliance Package

Computations By: (Cognizant Engineer)
Signature [signature] Date 14 OCT 1997
Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Assumptions and Procedures Checked By: (Checker)
Signature [signature] Date 15 Oct 97
Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Computations Checked by:
Signature [signature] Date 15 Oct 97
Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Computations Backchecked by: (Cognizant Engineer)
Signature [signature] Date 15 OCT 1997
Printed Name and Title ROBERT A. MORGAN III, SR. STAFF ENGINEER

Approved by: (PDP)
Signature [signature] Date 15 Oct 97
Printed Name and Title Gary R. Schmertmann, Sr. Project Engr.

Approved by: (DTL and TETL)
Signature [signature] Date 15 Oct 97
Printed Name and Title Kenneth W Cargill, Associate

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1	Add interface analysis	6 Nov 1997	MCO	GRS	[signature]

Written By: RAM Date: 10/14/97 Reviewed by: GRS Date: 10/15/97

Client: FDF Project: OSDF Project/Proposal No.: GQ0166 Task No.: 04

PURPOSE

Evaluate whether GCL QA sample no. 03 complies with the shear strength requirements given in the GCL specification (Section 02772, Paragraph 2.01.E.3).

METHOD

The method for evaluating the GCL sample is outlined in RCI number 1702-006R. The method involves the following basic steps.

1. Use shear test results from the GCL sample to establish the envelopes of measured peak and large-displacement internal and interface shear strength.
2. Reanalyze two slope stability cases that were included in the OSDF design calculations using the measured peak and large-displacement strength envelopes established in Step 1. Obtain the slope stability factors of safety for the critical potential slip surface for each analysis case.
3. Compare the slope stability factors of safety computed in Step 2 to the baseline factors of safety.

SHEAR TEST RESULTS

The results of the GCL internal shear tests performed on QA sample no. 03 are shown in the following table. The results of the GCL/geomembrane interface shear tests were ~~not available for this calculation~~ added (Revision No. 1). The laboratory test results are presented in Appendix A.

QA Sample No.	Case	Test Type	Measured Shear Strengths		
			5 psi	20 psi	45 psi
03	Peak	GCL Internal	6.3 psi	9.1 psi	13.7 psi
		GCL/GMB Interface	0[1]	10.6	15.8
03	Large-displacement	GCL Internal	1.3	2.8	4.8
		GCL/GMB Interface	0[1]	4.4	6.6

STABILITY ANALYSES RESULTS

The results of the slope stability analyses performed using the computer program XSTABL are shown in the table below. The analyses output files and figures showing critical slip surfaces are presented in Appendix B.

QA Sample No.	Test Type	Filename	Factor of Safety	Comply ?
Baseline	Peak	NA	1.9	NA
03	GCL Internal	NPK03AS	2.2	YES
	GCL/GMB Interface	NPK03BS	2.3	YES
Baseline	Large-displacement	NA	1.6	NA
03	GCL Internal	NLD03AS	1.6	YES
	GCL/GMB Interface	NLD03BS	2.0	YES

Revision No. 1

[1] Interface shear strength values for QA sample 03 at 5 psi normal stress were not available at the time that this calculation package was prepared. These values were assumed to equal zero. This assumption is conservative in the context of RCI 1702-006R.

RAM 10/14/97

GRS 10/14/97

Revision No. 1: MCO 11/06/97 ✓

APPENDIX A

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 3I

Test Specimen Configuration (from top to bottom) and Placement Conditions:

- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-03). GCL's initial moisture content was 8.6%. GCL's final moisture content ranged from 64% to 101% for the test series; and
- lower shear box: rigid substrate with textured steel gripping surface.

Designated Shear Plane: Within GCL

Test Procedures for Each Normal Stress Condition:

- A fresh GCL specimen was trimmed from the bulk sample of the GCL and placed between two rigid wooden substrates with textured steel gripping surfaces. The ends of each geotextile were then sandwiched between a second rigid wooden substrate prior to testing. The entire test specimen was then placed in the shear box to provide confinement for the exposed bentonite component. The textured steel gripping surfaces were employed to minimize slippage between each geotextile component of the GCL and rigid wood substrate, therefore providing a relatively uniform transfer of shear load onto the GCL specimen.
- Soaking conditions: The GCL specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the GCL specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 5, 20, and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the Bentofix NS GCL sample.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

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TEST PROCEDURES AND CONDITIONS
TEST SERIES NUMBER: 3G

Test Specimen Configuration (from top to bottom) and Placement Conditions:

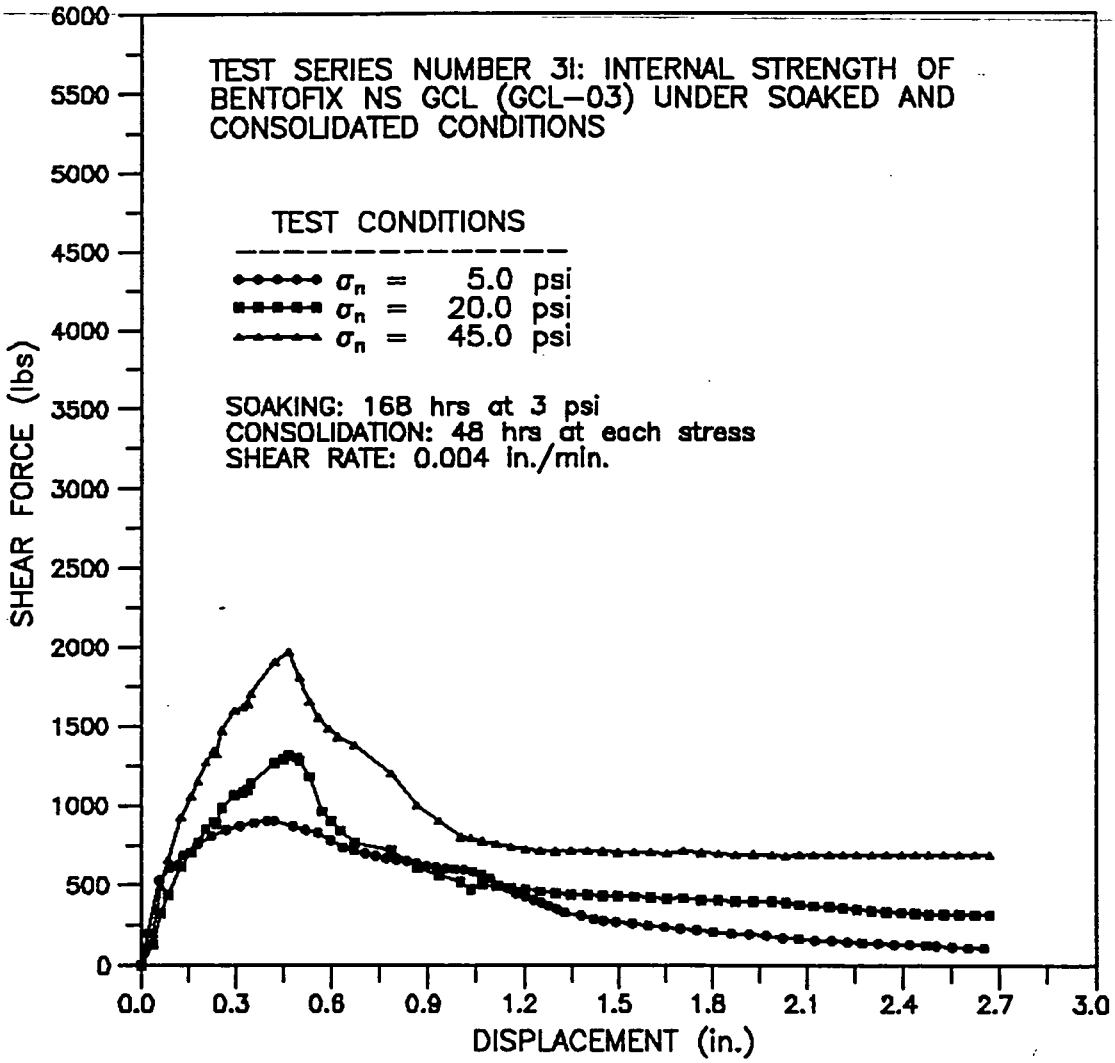
- upper shear box: rigid substrate with textured steel gripping surface;
- Bentofix NS GCL (GCL-03) with woven geotextile against geomembrane. GCL's initial moisture content was 9.0%. GCL's final moisture content ranged from 75 to 77% for the test series;
- 80-mil NSC textured HDPE geomembrane (GM-6); and
- lower shear box: bedding layer of compacted concrete sand.

Test Interface: GCL against geomembrane

Test Procedures for Each Normal Stress Condition:

- A fresh specimen of concrete sand was compacted into the lower shear box by hand tamping to a relatively dense state under dry conditions forming a 3 in. thick bedding layer.
- A fresh specimen of geomembrane was trimmed from the bulk sample and attached to the lower shear box with mechanical compression clamps.
- A fresh specimen of GCL was trimmed from the bulk sample and attached to the upper shear box with mechanical compression clamps. The GCL was oriented so that the woven geotextile component of the GCL was in contact with the geomembrane.
- A rigid substrate with a textured steel gripping surface was placed on top of the GCL. The textured steel gripping surface was used to minimize slippage between the upper geotextile component of the GCL and rigid wooden substrate, therefore providing a relatively uniform transfer of shear load onto the test interface.
- Soaking conditions: The entire test specimen was soaked in tap water for 168 hours under a normal stress of 3 psi.
- Consolidation conditions: After the 168 hour soaking period, the tap water was drained, and the entire test specimen was consolidated for 48 hours under each test normal stress.
- Test normal stresses: 20 and 45 psi.
- Constant shear displacement rate: 0.004 in/min.
- The direction of shear for each interface direct shear test was in the direction of manufacture (machine direction) of the geosynthetic samples.
- Each test was sheared until a minimum total shear displacement of 2 in. was achieved.

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



NOTES: (1) A constant area of 1 ft^2 was assumed when computing normal and shear stresses.

(2) For each test, sliding (i.e., internal shear failure) was observed to occur within the GCL.

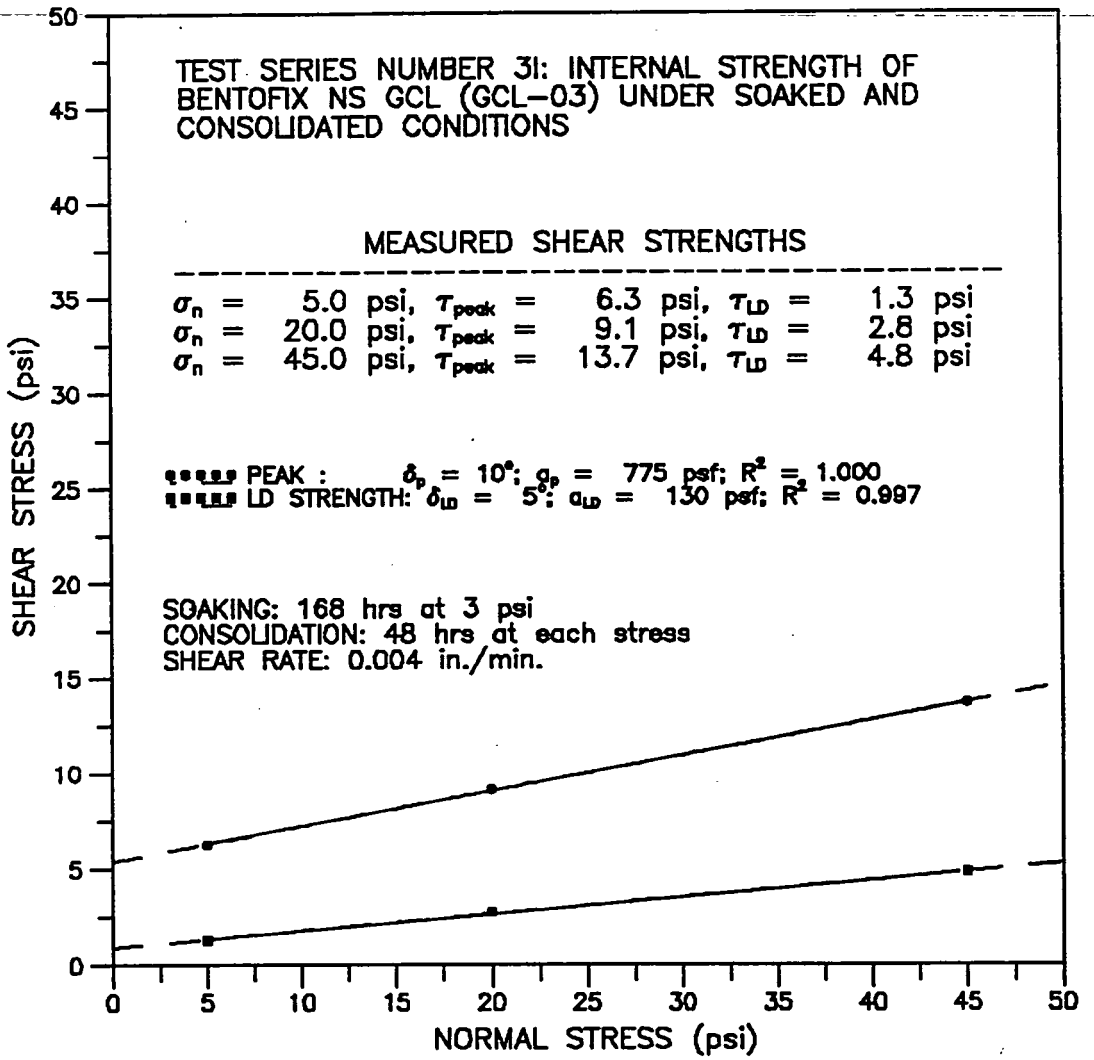
DATE TESTED: 27 AUGUST TO 5 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-1
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	

FLUOR DANIEL FERNALD
ON-SITE DISPOSAL FACILITY
PHASE 1 CONSTRUCTION
DIRECT SHEAR TESTING



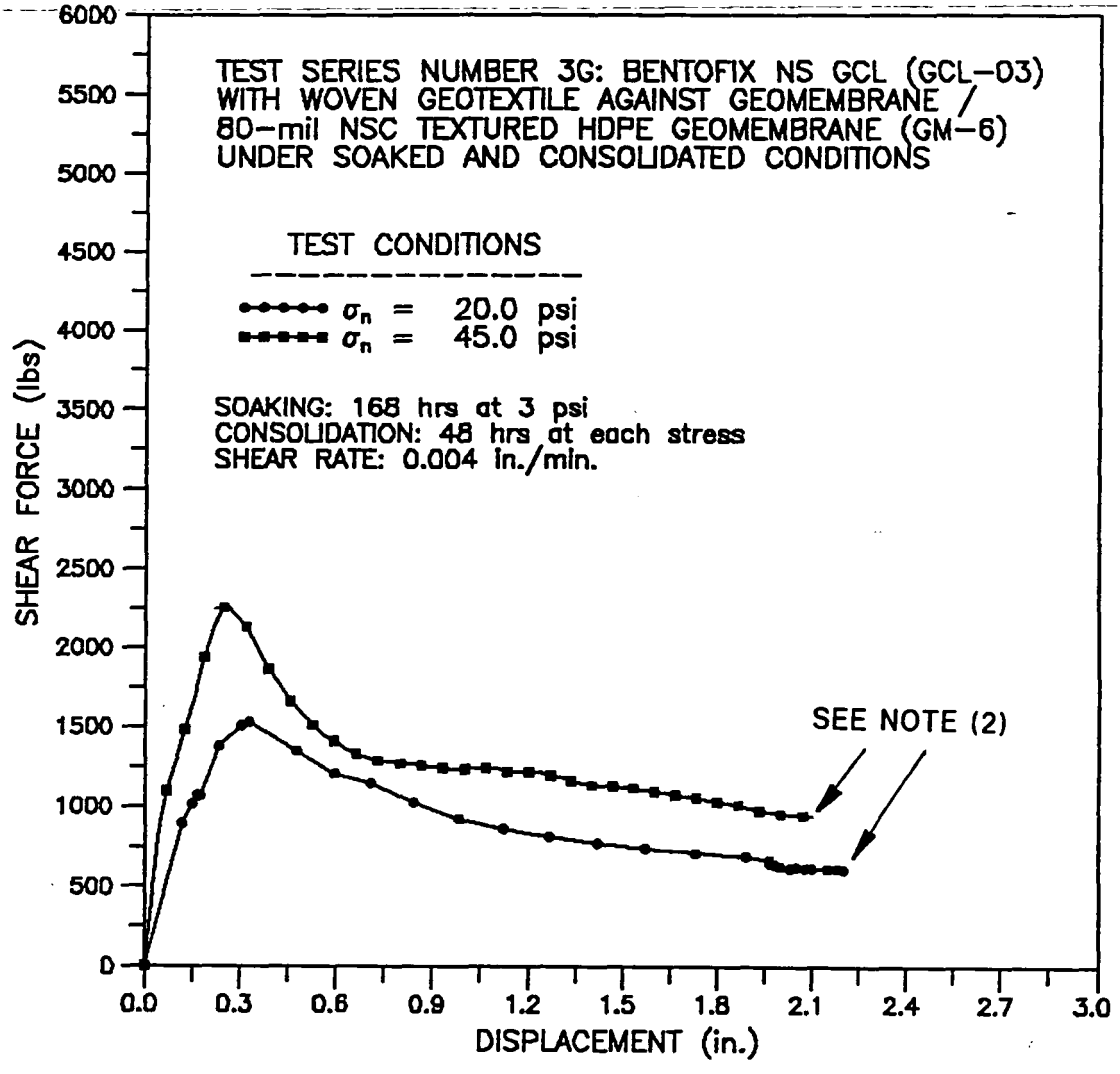
NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) For each test, sliding (i.e, internal shear failure) was observed to occur within the GCL.

DATE TESTED: 27 AUGUST TO 5 SEPTEMBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The shear box size was 12 in. by 12 in. (300 mm by 300 mm), and the contact area remained constant throughout the entire test.

(2) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

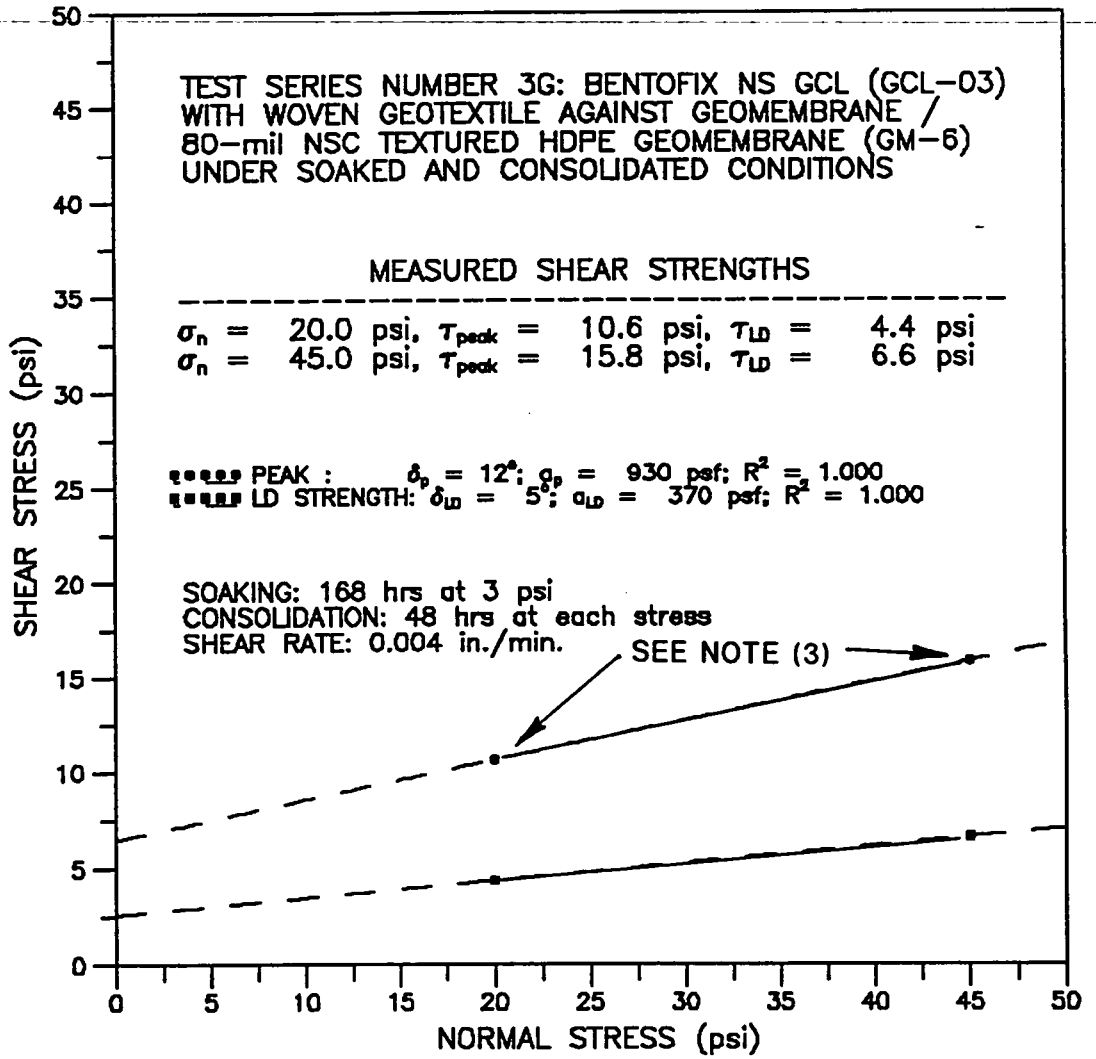
DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS

SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-3
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730087 1.5
FILE NO.	

FLUOR DANIEL FERNALD ON-SITE DISPOSAL FACILITY PHASE 1 CONSTRUCTION DIRECT SHEAR TESTING



NOTES: (1) The reported total-stress shear strength parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using the strength parameters for applications involving normal stresses outside the range of stresses covered by the test series.
(2) The large displacement shear strength (τ_{LD}) was calculated using the shear force at a shear displacement of 2 in. for each test.
(3) Sliding (i.e., shear failure) was observed to occur within the GCL rather than the intended interface.

DATE TESTED: 20 TO 29 OCTOBER 1997

GEOSYNTEC CONSULTANTS
SOIL-GEOSYNTHETIC INTERACTION TESTING LABORATORY

FIGURE NO.	A-4
PROJECT NO.	GQ0166-04.1
DOCUMENT NO.	F9730088
FILE NO.	

RAM 10/14/97

GRS 10/14/97

Revision No 1: MCO 11/06/97

APPENDIX B

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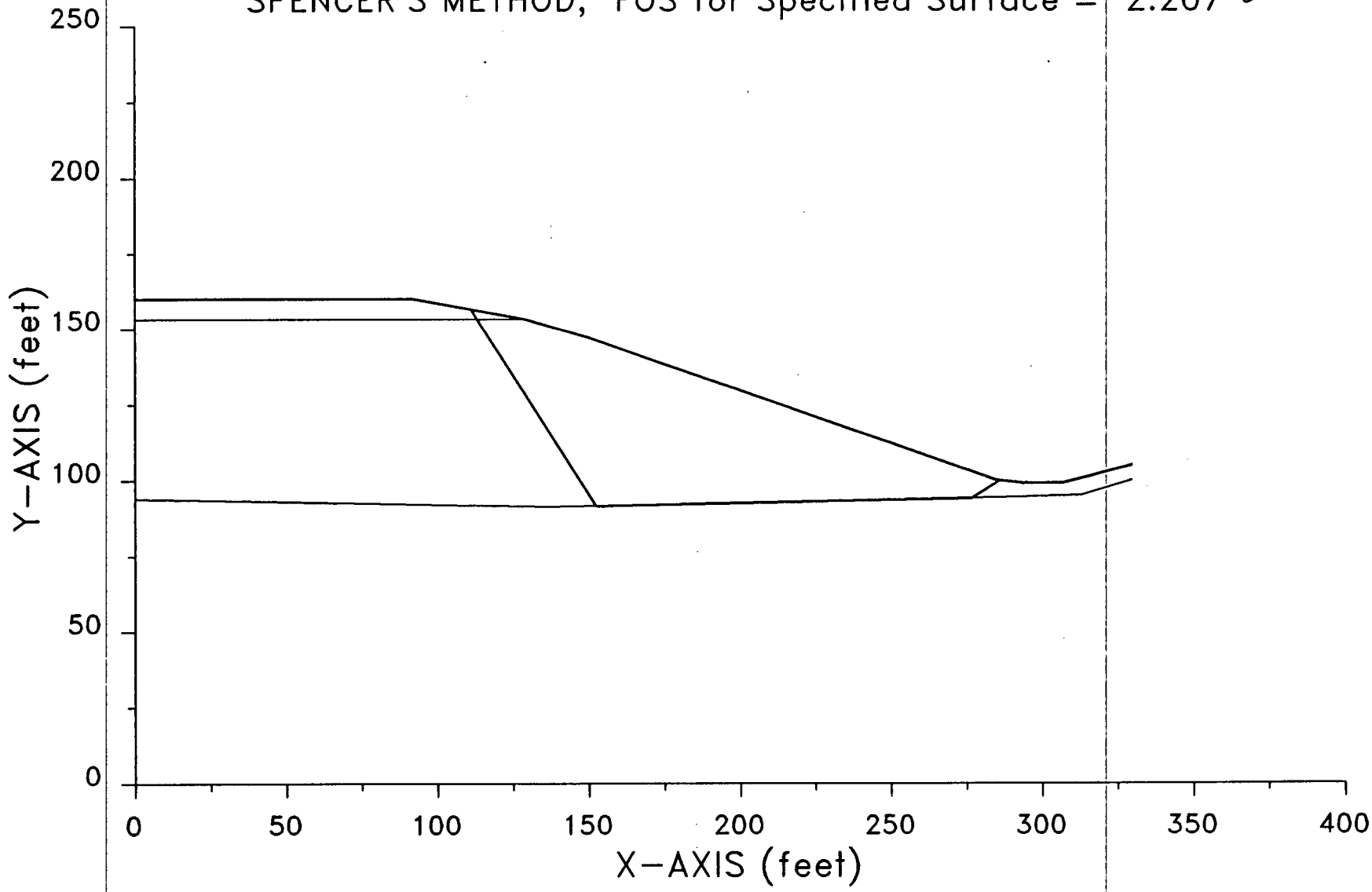
OSDF Interim Closure/Short-Term,Peak

SPENCER'S METHOD, FOS for Specified Surface = 2.207



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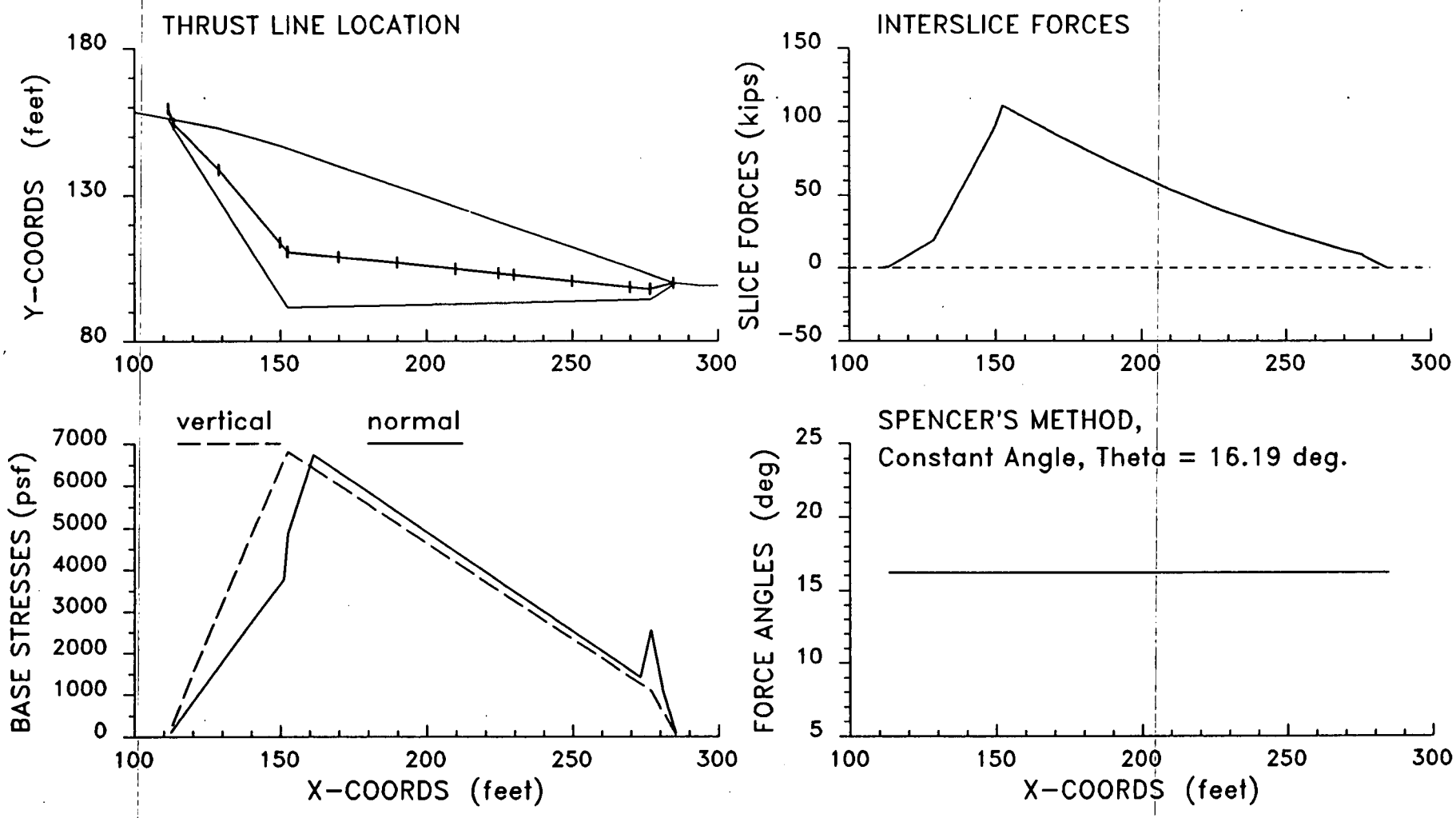

OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 2.207

XSTABL File: NPK03AS 10-09-97 14:33

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 á 96       *
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*        Moscow, ID 83843, U.S.A.       *
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*  Ver. 5.201                 96 á 1202 *
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```

Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES
---

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

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ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	907.2
4	2880.0	1310.4
5	6480.0	1972.8
6	36000.0	1972.8

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	286.02	99.89
2	277.16	94.24
3	276.96	94.04
4	224.80	93.00
5	152.69	91.52
6	152.48	91.73
7	113.45	153.00
8	111.54	156.30

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	285.51	99.56	.38	1.02	-32.51	6.34	49.
2	281.08	96.74	4.62	7.84	-32.51	19.12	4528.
3	277.06	94.14	8.61	.20	-45.00	19.12	215.
4	273.48	93.97	10.02	6.96	-1.14	19.12	8720.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37495.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55867.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.18	19.29	56724.
9	200.00	92.49	37.11	20.00	-1.18	19.29	92773.
10	180.00	92.08	44.47	20.00	-1.18	19.03	111174.
11	161.35	91.70	51.33	17.31	-1.18	19.29	111069.
12	152.58	91.63	54.47	.21	45.00	19.29	1430.
13	151.24	93.68	52.89	2.48	57.50	19.29	16396.
14	139.50	112.11	37.89	21.00	57.50	15.95	99471.
15	121.23	140.79	13.68	15.55	57.50	10.71	26583.
16	112.49	154.65	1.47	1.91	59.96	10.71	351.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	14.5270	2.2750	2.5452
3	15.4210	-----	2.2750
3	14.9740	2.3038	-----
4	15.3214	2.3276	2.3038
5	15.2392	-----	2.3276
5	15.2803	2.3270	-----
6	15.2033	2.3194	2.3270
7	15.2675	-----	2.3194
7	15.2354	2.3216	-----
8	15.2598	2.3233	2.3216
9	15.2569	2.3233	2.3233

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	16.1952	2.2105	2.1809
3	16.1807	2.2100	2.2105

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Nonlinear M-C Iteration Number - 3

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	16.1906	2.2073	2.2070

Nonlinear M-C Iteration Number - 4

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	16.1906	2.2073	2.2070

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	16.1906	2.2073	2.2070

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	83.4	.0	30.00	0.	0.	0.	.00
2	1068.9	200.0	25.00	0.	0.	0.	.00
3	2544.8	772.8	10.57	0.	0.	0.	.00
4	1406.6	772.8	10.57	0.	0.	0.	.00
5	2049.0	772.8	10.57	0.	0.	0.	.00
6	2998.0	780.5	10.43	0.	0.	0.	.00
7	3593.2	780.5	10.43	0.	0.	0.	.00
8	4072.5	780.5	10.43	0.	0.	0.	.00
9	4904.9	780.5	10.43	0.	0.	0.	.00
10	5855.2	780.5	10.43	0.	0.	0.	.00
11	6734.4	1972.8	.00	0.	0.	0.	.00
12	4859.5	780.5	10.43	0.	0.	0.	.00
13	3763.0	200.0	25.00	0.	0.	0.	.00
14	2677.0	200.0	25.00	0.	0.	0.	.00
15	923.2	200.0	25.00	0.	0.	0.	.00
16	98.0	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) --TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)

1	285.51	83.4	47.7	.0	21.8
2	281.08	1068.9	577.6	.0	316.4
3	277.06	2544.8	1076.6	.0	565.3
4	273.48	1406.6	1252.9	.0	469.1
5	260.00	2049.0	1874.8	.0	523.4
6	240.00	2998.0	2793.4	.0	603.5
7	227.40	3593.2	3369.8	.0	653.1
8	217.40	4072.5	3832.7	.0	693.1
9	200.00	4904.9	4638.6	.0	762.5
10	180.00	5855.2	5558.7	.0	841.7
11	161.35	6734.4	6416.5	.0	893.8
12	152.58	4859.5	6808.8	.0	758.7
13	151.24	3763.0	6611.2	.0	885.6
14	139.50	2677.0	4736.7	.0	656.1
15	121.23	923.2	1709.5	.0	285.6
16	112.49	98.0	183.9	.0	25.6

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	16.19	80.	.47	.76	.620
2	277.16	16.19	8224.	3.68	8.48	.434
3	276.96	16.19	8872.	3.66	8.75	.418
4	270.00	16.19	12475.	4.45	11.30	.394
5	250.00	16.19	24226.	6.99	18.70	.374
6	230.00	16.19	38039.	9.53	26.00	.367
7	224.80	16.19	41963.	10.18	27.92	.365
8	210.00	16.19	53932.	12.01	33.40	.360
9	190.00	16.19	71908.	14.45	40.81	.354
10	170.00	16.19	91939.	16.84	48.12	.350
11	152.69	16.19	110540.	18.93	54.54	.347
12	152.48	16.19	109643.	18.94	54.40	.348
13	150.00	16.19	96676.	18.09	51.38	.352
14	129.00	16.19	19127.	10.12	24.41	.414
15	113.45	16.19	285.	1.37	2.94	.467
16	111.54	.00	-1.	3.09	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3223.49 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 606.49 (psf)

Total Length of failure surface = 211.84 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

14/21 17/38

FACTOR OF SAFETY = 2.207

Total shear strength available
along specified failure surface = 283.60E+03 lb

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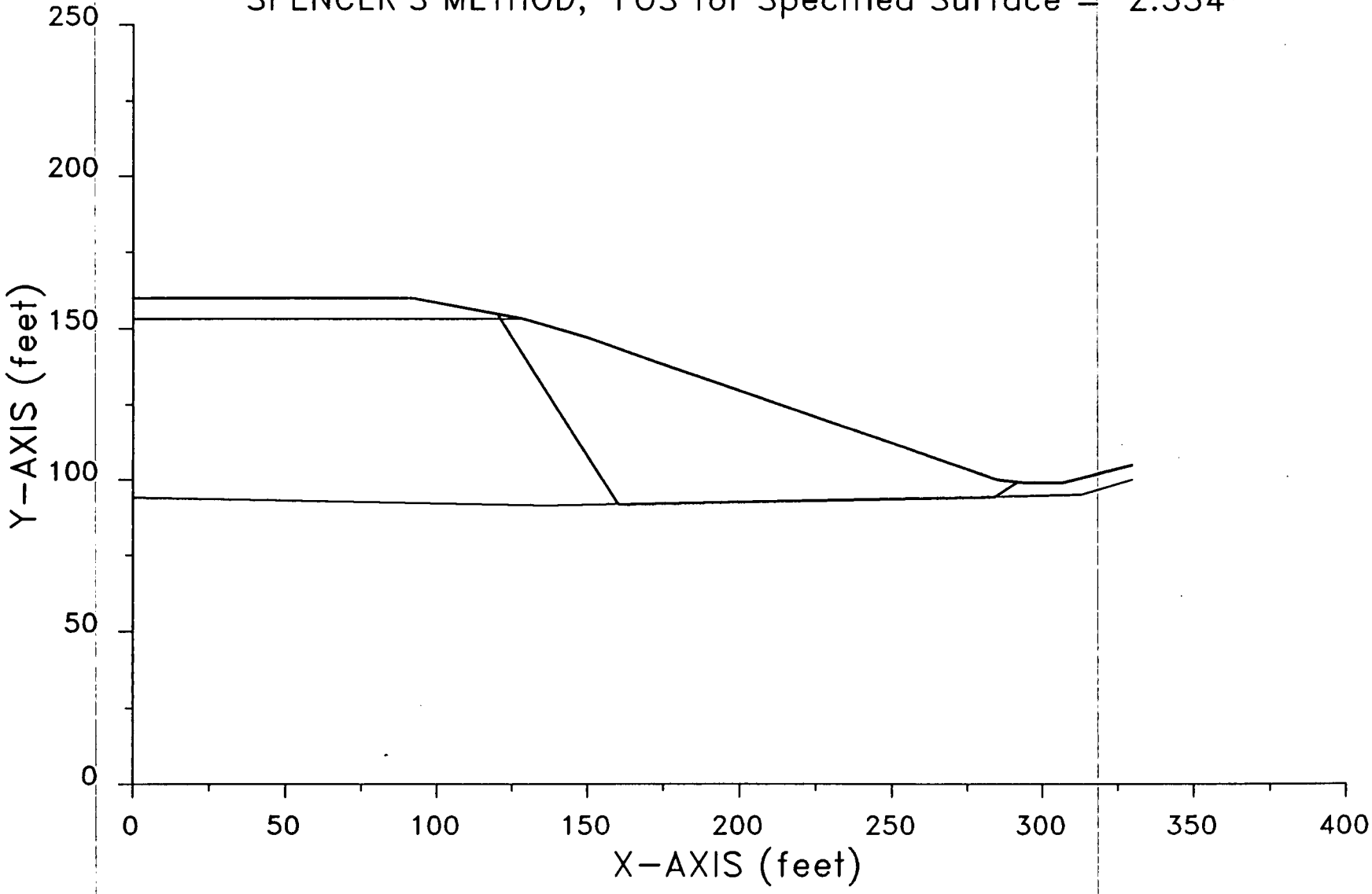
OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 2.334



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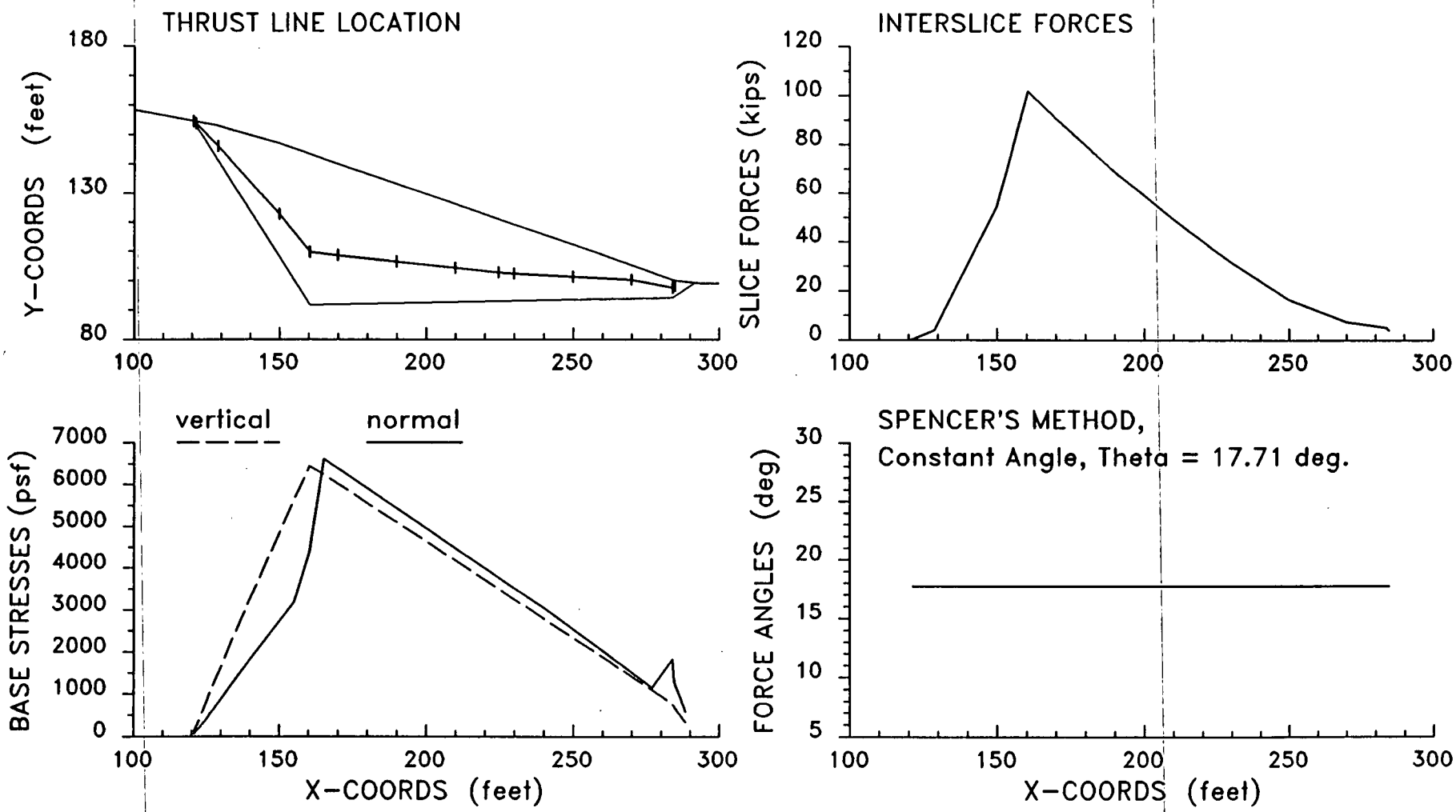

OSDF Interim Closure/Short-Term,Peak
SPENCER'S METHOD, FOS for Specified Surface = 2.334

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 á 96       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.201                 96 á 1202 *
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Problem Description : OSDF Interim Closure/Short-Term,Peak

SEGMENT BOUNDARY COORDINATES
---

13 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	160.0	92.0	160.0	2
2	92.0	160.0	129.0	153.0	2
3	129.0	153.0	150.0	147.0	1
4	150.0	147.0	170.0	140.0	1
5	170.0	140.0	190.0	133.1	1
6	190.0	133.1	210.0	126.1	1
7	210.0	126.1	230.0	119.1	1
8	230.0	119.1	250.0	112.2	1
9	250.0	112.2	270.0	105.2	1
10	270.0	105.2	285.0	100.0	1
11	285.0	100.0	294.0	99.0	2
12	294.0	99.0	307.0	99.0	2
13	307.0	99.0	330.0	105.0	2

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	153.0	129.0	153.0	1
2	.0	94.1	136.5	91.4	3
3	136.5	91.4	224.8	93.2	3
4	224.8	93.2	285.0	94.4	3
5	285.0	94.4	313.0	95.0	3
6	313.0	95.0	330.0	100.0	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	200.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	.0
4	2880.0	1526.4
5	6480.0	2275.2
6	10080.0	2275.2

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	291.87	99.24
2	284.25	94.39
3	284.05	94.18
4	224.80	93.00
5	160.54	91.72
6	160.38	91.89
7	121.44	153.00
8	120.52	154.60

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	288.43	97.05	2.57	6.87	-32.46	6.34	2204.
2	284.62	94.63	5.50	.75	-32.46	19.12	519.
3	284.15	94.28	6.01	.20	-46.40	19.12	147.
4	277.02	94.04	8.72	14.05	-1.14	19.12	15323.
5	260.00	93.70	15.00	20.00	-1.14	19.29	37497.
6	240.00	93.30	22.35	20.00	-1.14	19.03	55868.
7	227.40	93.05	26.96	5.20	-1.14	19.29	17523.
8	217.40	92.85	30.66	14.80	-1.14	19.29	56716.
9	200.00	92.51	37.09	20.00	-1.14	19.29	92735.
10	180.00	92.11	44.44	20.00	-1.14	19.03	111106.
11	165.27	91.81	49.84	9.46	-1.14	19.29	58937.
12	160.46	91.81	51.53	.16	46.74	19.29	1031.
13	155.19	100.03	45.15	10.38	57.49	19.29	58580.
14	139.50	124.66	25.34	21.00	57.49	15.95	66523.
15	125.22	147.07	6.65	7.56	57.49	10.71	6282.
16	120.98	153.80	.72	.92	60.17	10.71	82.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.7009	2.3457	2.3531
3	17.7080	2.3460	2.3457

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	17.7081	2.3337	2.3337

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	17.7081	2.3337	2.3337

SLICE INFORMATION ... continued :

Slice	Sigma	c-value	phi	U-base	U-top	P-top	Delta

	(psf)	(psf)		(lb)	(lb)	(lb)	
1	572.3	.0	30.00	0.	0.	0.	.00
2	1270.3	200.0	25.00	0.	0.	0.	.00
3	1811.4	-508.8	35.25	0.	0.	0.	.00
4	1141.1	-508.8	35.25	0.	0.	0.	.00
5	2021.4	-508.8	35.25	0.	0.	0.	.00
6	3039.4	927.4	11.75	0.	0.	0.	.00
7	3637.7	927.4	11.75	0.	0.	0.	.00
8	4117.7	927.4	11.75	0.	0.	0.	.00
9	4952.8	927.4	11.75	0.	0.	0.	.00
10	5906.2	927.4	11.75	0.	0.	0.	.00
11	6602.9	2275.2	.00	0.	0.	0.	.00
12	4373.0	927.4	11.75	0.	0.	0.	.00
13	3162.1	200.0	25.00	0.	0.	0.	.00
14	1748.1	200.0	25.00	0.	0.	0.	.00
15	413.4	200.0	25.00	0.	0.	0.	.00
16	46.8	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	288.43	572.3	320.8	.0	141.6
2	284.62	1270.3	688.0	.0	339.5
3	284.15	1811.4	751.6	.0	330.5
4	277.02	1141.1	1090.6	.0	127.5
5	260.00	2021.4	1874.9	.0	394.1
6	240.00	3039.4	2793.4	.0	668.3
7	227.40	3637.7	3369.8	.0	721.6
8	217.40	4117.7	3832.2	.0	764.4
9	200.00	4952.8	4636.8	.0	838.8
10	180.00	5906.2	5555.3	.0	923.8
11	165.27	6602.9	6230.2	.0	974.9
12	160.46	4373.0	6441.8	.0	787.2
13	155.19	3162.1	5643.6	.0	717.5
14	139.50	1748.1	3167.8	.0	435.0
15	125.22	413.4	830.9	.0	168.3
16	120.98	46.8	89.4	.0	11.6

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	285.00	17.71	3646.	3.28	5.13	.639
2	284.25	17.71	4555.	3.28	5.87	.558
3	284.05	17.71	5013.	3.23	6.15	.526
4	270.00	17.71	7229.	6.28	11.30	.555
5	250.00	17.71	16348.	7.67	18.70	.410
6	230.00	17.71	31649.	9.10	26.00	.350

7	224.80	17.71	35983.	9.67	27.92	.346
8	210.00	17.71	49133.	11.43	33.39	.342
9	190.00	17.71	68815.	13.97	40.79	.343
10	170.00	17.71	90680.	16.57	48.09	.345
11	160.54	17.71	101668.	17.81	51.59	.345
12	160.38	17.71	101020.	17.81	51.48	.346
13	150.00	17.71	54766.	14.40	38.82	.371
14	129.00	17.71	3880.	4.82	11.86	.406
15	121.44	17.71	68.	.66	1.43	.459
16	120.52	.00	0.	-.27	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2986.84 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 566.92 (psf)

Total Length of failure surface = 207.40 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 2.334

Total shear strength available along specified failure surface = 274.39E+03 lb

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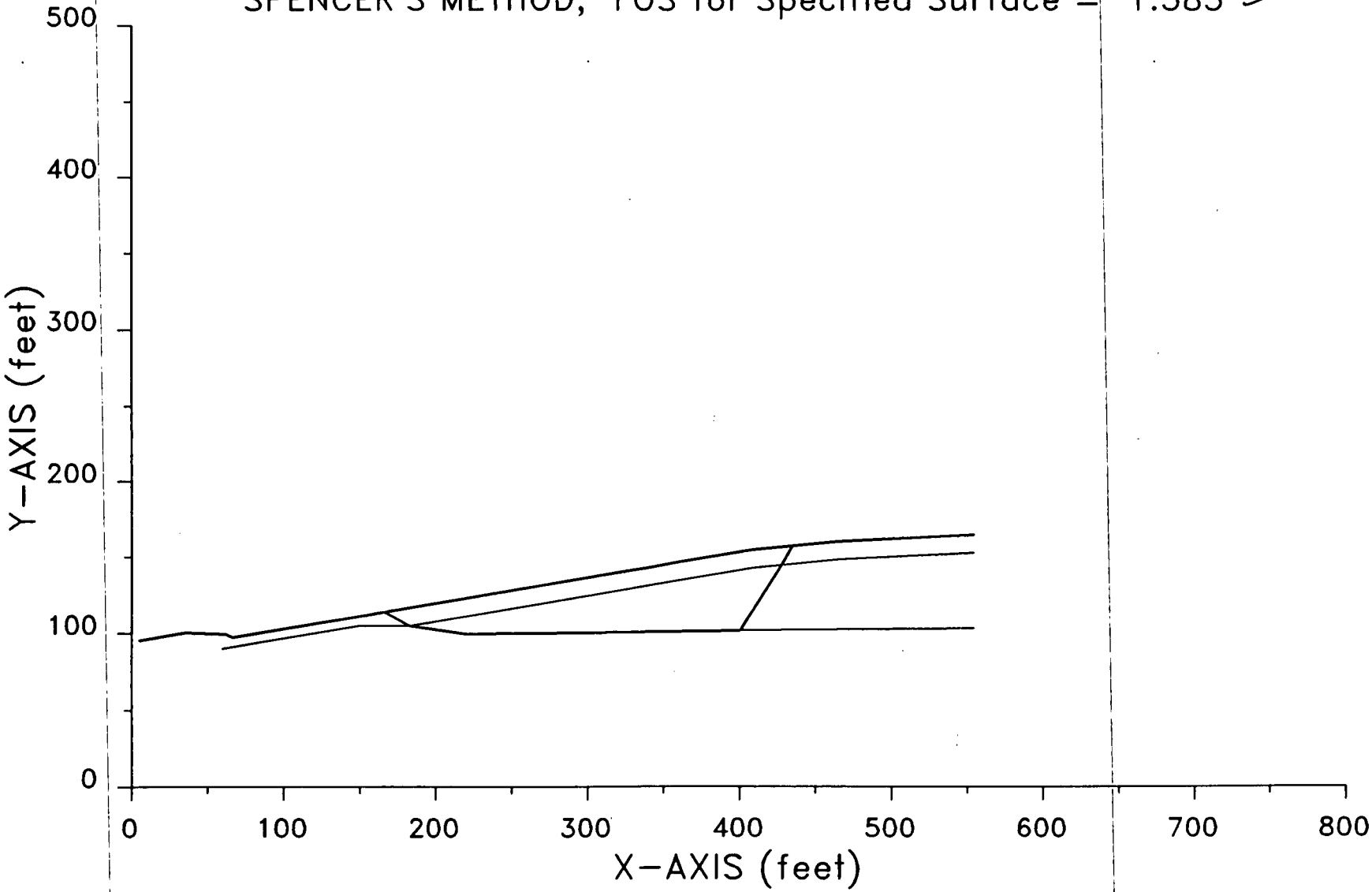
OSDF Final Long Term – Large Displ.

SPENCER'S METHOD, FOS for Specified Surface = 1.585



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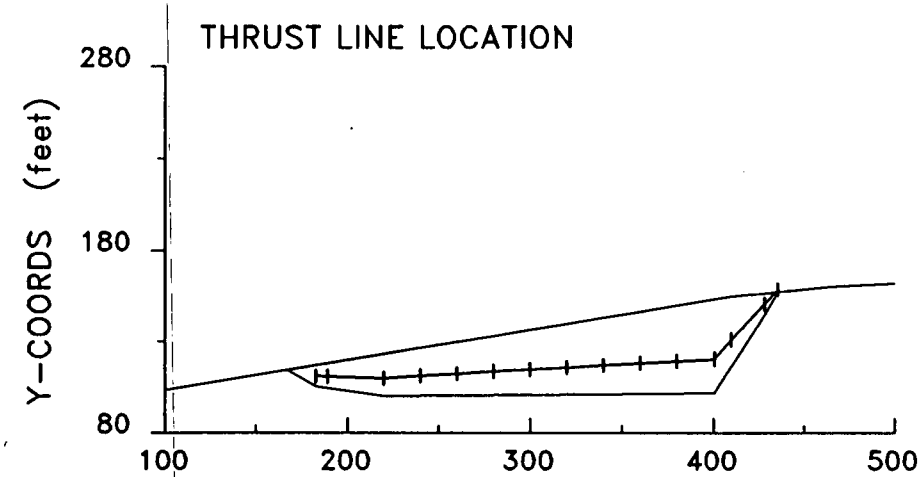

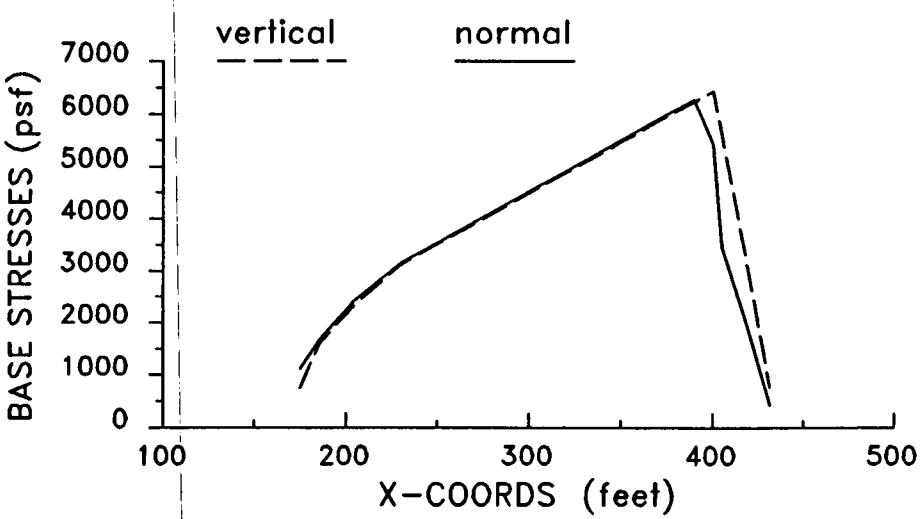

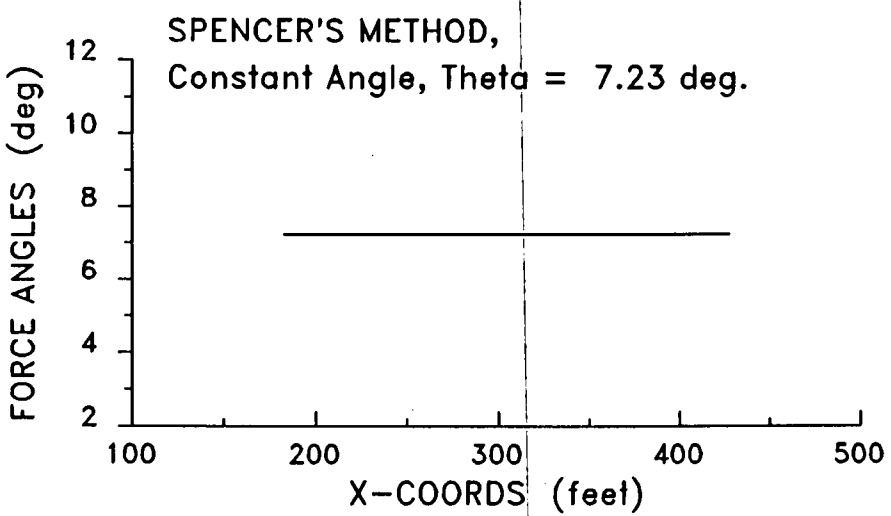

OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.585

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*****************************************
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*                                       *
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*               using the               *
*            Method of Slices           *
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Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	187.2
4	2880.0	403.2
5	6480.0	691.2
6	10080.0	691.2

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	400.64	101.66
6	400.88	101.90
7	428.09	144.61
8	435.38	157.24

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.71	37.34	20.00	.60	9.37	93362.
9	330.00	100.92	40.43	20.00	.60	9.37	101085.
10	350.00	101.13	43.57	20.00	.60	9.65	108933.
11	370.00	101.34	46.71	20.00	.60	9.37	116782.
12	390.32	101.55	49.87	20.64	.60	9.46	128661.
13	400.76	101.78	51.38	.24	45.00	9.46	1543.
14	405.44	109.06	44.88	9.12	57.50	9.46	51164.
15	419.04	130.41	25.19	18.09	57.50	5.71	56965.
16	431.73	150.92	5.95	7.29	60.00	5.71	5422.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	7.1440	1.5831	1.6277
3	7.2360	1.5851	1.5831
4	7.2339	1.5851	1.5851

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	7.2339	1.5851	1.5851

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	1103.7	.0	30.00	0.	0.	0.	.00

2	1671.8	115.2	5.71	0.	0.	0.	.00
3	2407.8	115.2	5.71	0.	0.	0.	.00
4	3127.2	172.8	4.57	0.	0.	0.	.00
5	3522.8	172.8	4.57	0.	0.	0.	.00
6	3912.1	172.8	4.57	0.	0.	0.	.00
7	4307.7	172.8	4.57	0.	0.	0.	.00
8	4702.1	172.8	4.57	0.	0.	0.	.00
9	5090.0	172.8	4.57	0.	0.	0.	.00
10	5484.2	172.8	4.57	0.	0.	0.	.00
11	5878.5	172.8	4.57	0.	0.	0.	.00
12	6274.7	172.8	4.57	0.	0.	0.	.00
13	5403.3	172.8	4.57	0.	0.	0.	.00
14	3455.3	.0	25.00	0.	0.	0.	.00
15	1939.4	.0	25.00	0.	0.	0.	.00
16	412.1	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1103.7	739.6	.0	402.0
2	186.00	1671.8	1594.4	.0	178.2
3	204.50	2407.8	2304.8	.0	224.6
4	230.00	3127.2	3100.0	.0	266.8
5	250.00	3522.8	3493.8	.0	286.8
6	270.00	3912.1	3881.3	.0	306.5
7	290.00	4307.7	4275.0	.0	326.4
8	310.00	4702.1	4668.1	.0	346.3
9	330.00	5090.0	5054.3	.0	365.9
10	350.00	5484.2	5446.7	.0	385.8
11	370.00	5878.5	5839.1	.0	405.7
12	390.32	6274.7	6233.6	.0	425.7
13	400.76	5403.3	6422.5	.0	381.7
14	405.44	3455.3	5610.3	.0	1016.5
15	419.04	1939.4	3149.0	.0	570.6
16	431.73	412.1	743.7	.0	150.1

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	7.23	16660.	5.60	11.83	.473
2	189.00	7.23	19159.	6.37	13.68	.466
3	220.00	7.23	36751.	9.63	23.20	.415
4	240.00	7.23	41501.	10.73	26.40	.406
5	260.00	7.23	46573.	11.77	29.50	.399
6	280.00	7.23	51962.	12.77	32.60	.392
7	300.00	7.23	57675.	13.72	35.80	.383
8	320.00	7.23	63659.	14.65	38.89	.377
9	340.00	7.23	69955.	15.56	41.98	.371

10	360.00	7.23	76568.	16.44	45.17	.364
11	380.00	7.23	83499.	17.31	48.26	.359
12	400.64	7.23	90981.	18.19	51.48	.353
13	400.88	7.23	89765.	18.22	51.28	.355
14	410.00	7.23	49251.	14.64	38.48	.380
15	428.09	7.23	4143.	5.85	11.90	.492
16	435.38	.00	0.	1.03	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3602.12 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 387.06 (psf)

Total Length of failure surface = 301.94 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.585 ✓

Total shear strength available along specified failure surface = 185.25E+03 lb

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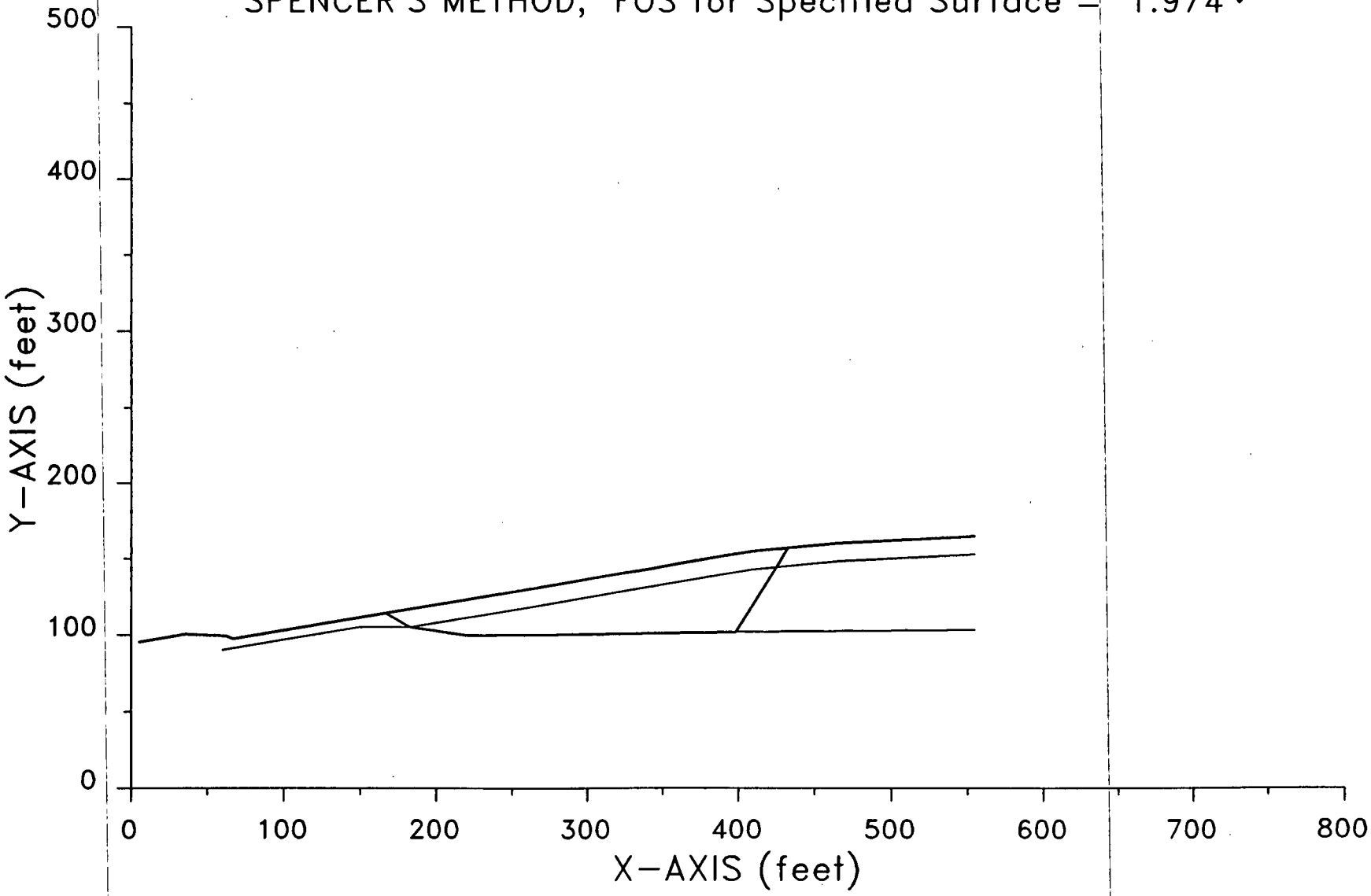
OSDF Final Long Term – Large Displ.

SPENCER'S METHOD, FOS for Specified Surface = 1.974



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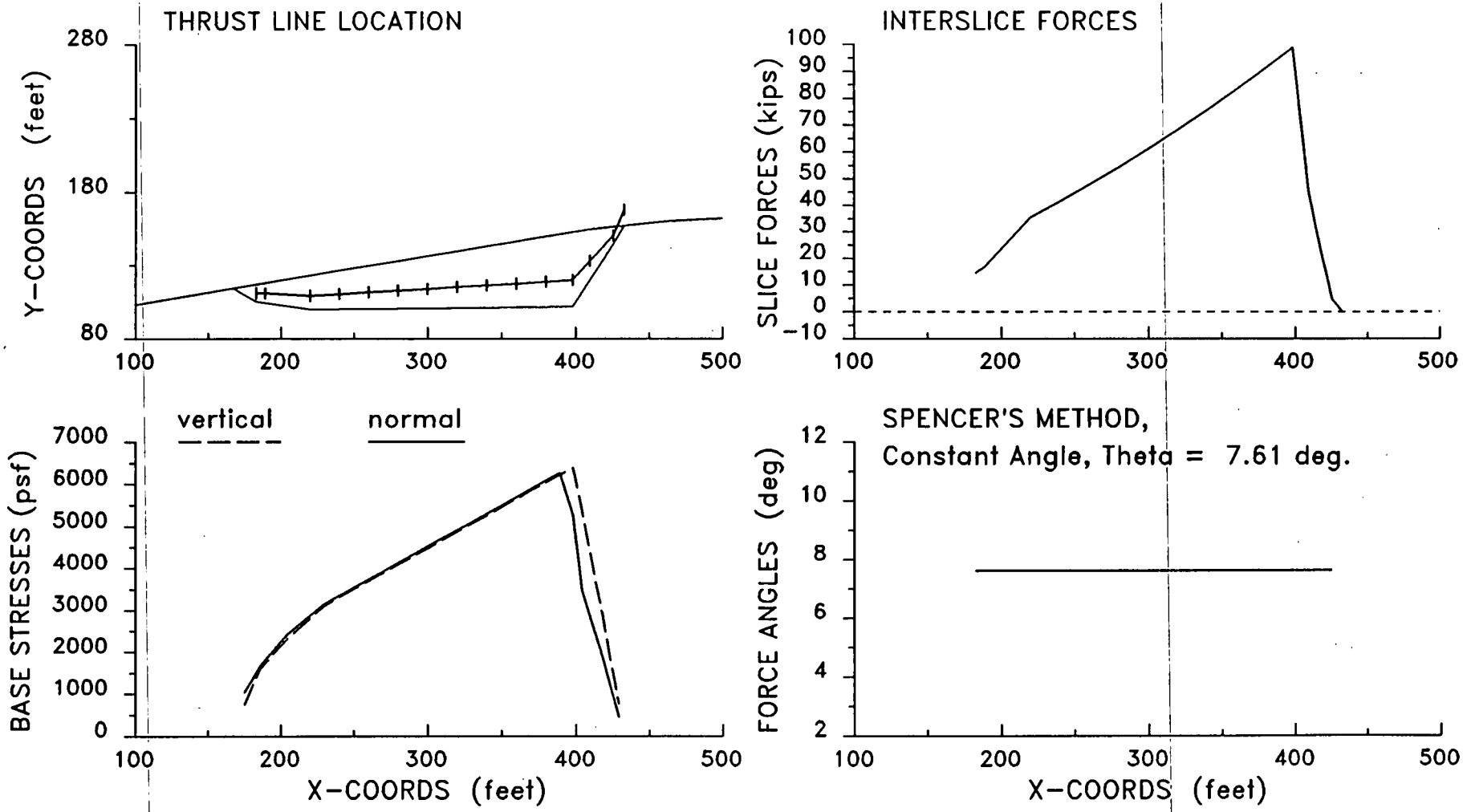

OSDF Final Long Term – Large Displ.
SPENCER'S METHOD, FOS for Specified Surface = 1.974 ✓

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*                                       *
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*               using the               *
*            Method of Slices           *
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Problem Description : OSDF Final Long Term - Large Displ.

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	5.5	95.6	35.5	100.6	2
2	35.5	100.6	62.5	99.4	2
3	62.5	99.4	67.0	97.5	2
4	67.0	97.5	220.0	123.0	2
5	220.0	123.0	240.0	126.4	2
6	240.0	126.4	260.0	129.7	2
7	260.0	129.7	280.0	133.0	2
8	280.0	133.0	300.0	136.4	2
9	300.0	136.4	320.0	139.7	2
10	320.0	139.7	340.0	143.0	2
11	340.0	143.0	360.0	146.4	2
12	360.0	146.4	380.0	149.7	2
13	380.0	149.7	410.0	154.7	2
14	410.0	154.7	465.0	160.2	2
15	465.0	160.2	555.0	164.7	2

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	90.0	120.0	100.0	2
2	120.0	100.0	150.0	105.0	2
3	150.0	105.0	183.0	105.0	2
4	183.0	105.0	189.0	106.0	1

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5	189.0	106.0	410.0	142.8	1
6	410.0	142.8	467.0	148.5	1
7	467.0	148.5	555.0	152.9	1
8	183.0	105.0	220.0	100.0	3
9	220.0	100.0	300.0	100.8	3
10	300.0	100.8	410.0	102.0	3
11	410.0	102.0	555.0	103.5	3

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	.0	25.00	.000	.0	0
2	125.0	125.0	.0	30.00	.000	.0	0
3	125.0	125.0	.0	.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 3

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	-1000.0	.0
2	.0	.0
3	720.0	.0
4	2880.0	633.6
5	6480.0	950.4
6	10080.0	950.4

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface specified by
the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.10	114.18
2	183.00	105.00
3	220.00	99.80
4	300.00	100.60
5	398.30	101.62
6	398.55	101.88
7	425.62	144.36
8	432.91	156.99

****
SELECTED METHOD OF ANALYSIS: Spencer (1973)
****

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	175.05	109.59	5.92	15.90	-30.01	9.46	11759.
2	186.00	104.58	12.75	6.00	-8.00	9.46	9566.
3	204.50	101.98	18.44	31.00	-8.00	9.46	71448.
4	230.00	99.90	24.80	20.00	.57	9.65	62000.
5	250.00	100.10	27.95	20.00	.57	9.37	69875.
6	270.00	100.30	31.05	20.00	.57	9.37	77625.
7	290.00	100.50	34.20	20.00	.57	9.65	85500.
8	310.00	100.70	37.35	20.00	.59	9.37	93366.
9	330.00	100.91	40.44	20.00	.59	9.37	101097.
10	350.00	101.12	43.58	20.00	.59	9.65	108953.
11	370.00	101.33	46.72	20.00	.59	9.37	116809.
12	389.15	101.53	49.70	18.30	.59	9.46	113689.
13	398.42	101.75	51.02	.25	46.12	9.46	1594.
14	404.27	110.86	42.88	11.45	57.49	9.46	61375.
15	417.81	132.11	23.38	15.62	57.49	5.71	45646.
16	429.27	150.68	5.95	7.29	60.01	5.71	5421.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	7.5386	1.9722	2.0214
3	7.6113	-----	1.9722
3	7.5749	1.9733	-----
4	7.6096	1.9744	1.9733
5	7.6089	1.9743	1.9744

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	7.6089	1.9743	1.9744

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta

1	1034.5	.0	30.00	0.	0.	0.	.00
2	1664.1	-211.2	16.35	0.	0.	0.	.00
3	2419.4	-211.2	16.35	0.	0.	0.	.00
4	3136.9	380.2	5.03	0.	0.	0.	.00
5	3532.3	380.2	5.03	0.	0.	0.	.00
6	3921.4	380.2	5.03	0.	0.	0.	.00
7	4316.8	380.2	5.03	0.	0.	0.	.00
8	4711.3	380.2	5.03	0.	0.	0.	.00
9	5099.5	380.2	5.03	0.	0.	0.	.00
10	5493.9	380.2	5.03	0.	0.	0.	.00
11	5888.4	380.2	5.03	0.	0.	0.	.00
12	6261.9	380.2	5.03	0.	0.	0.	.00
13	5259.9	380.2	5.03	0.	0.	0.	.00
14	3461.1	.0	25.00	0.	0.	0.	.00
15	1886.7	.0	25.00	0.	0.	0.	.00
16	437.7	.0	30.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	175.05	1034.5	739.6	.0	302.5
2	186.00	1664.1	1594.4	.0	140.3
3	204.50	2419.4	2304.8	.0	252.5
4	230.00	3136.9	3100.0	.0	332.4
5	250.00	3532.3	3493.8	.0	350.0
6	270.00	3921.4	3881.3	.0	367.3
7	290.00	4316.8	4275.0	.0	385.0
8	310.00	4711.3	4668.3	.0	402.5
9	330.00	5099.5	5054.8	.0	419.8
10	350.00	5493.9	5447.6	.0	437.4
11	370.00	5888.4	5840.5	.0	455.0
12	389.15	6261.9	6212.5	.0	471.7
13	398.42	5259.9	6377.6	.0	427.0
14	404.27	3461.1	5360.2	.0	817.4
15	417.81	1886.7	2922.0	.0	445.6
16	429.27	437.7	743.7	.0	128.0

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	183.00	7.61	14438.	5.65	11.83	.478
2	189.00	7.61	16703.	6.42	13.68	.469
3	220.00	7.61	35234.	9.31	23.20	.401
4	240.00	7.61	41307.	10.23	26.40	.387
5	260.00	7.61	47656.	11.17	29.50	.379
6	280.00	7.61	54277.	12.13	32.60	.372
7	300.00	7.61	61174.	13.09	35.80	.366

8	320.00	7.61	68309.	14.06	38.89	.362
9	340.00	7.61	75713.	15.03	41.98	.358
10	360.00	7.61	83389.	16.00	45.18	.354
11	380.00	7.61	91337.	16.96	48.27	.351
12	398.30	7.61	98845.	17.84	51.13	.349
13	398.55	7.61	97573.	17.85	50.91	.351
14	410.00	7.61	44275.	13.00	34.85	.373
15	425.62	7.61	4636.	5.83	11.90	.490
16	432.91	.00	0.	10.57	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3602.23 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 395.27 (psf)

Total Length of failure surface = 299.35 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 1.974 ✓

Total shear strength available along specified failure surface = 233.61E+03 lb