

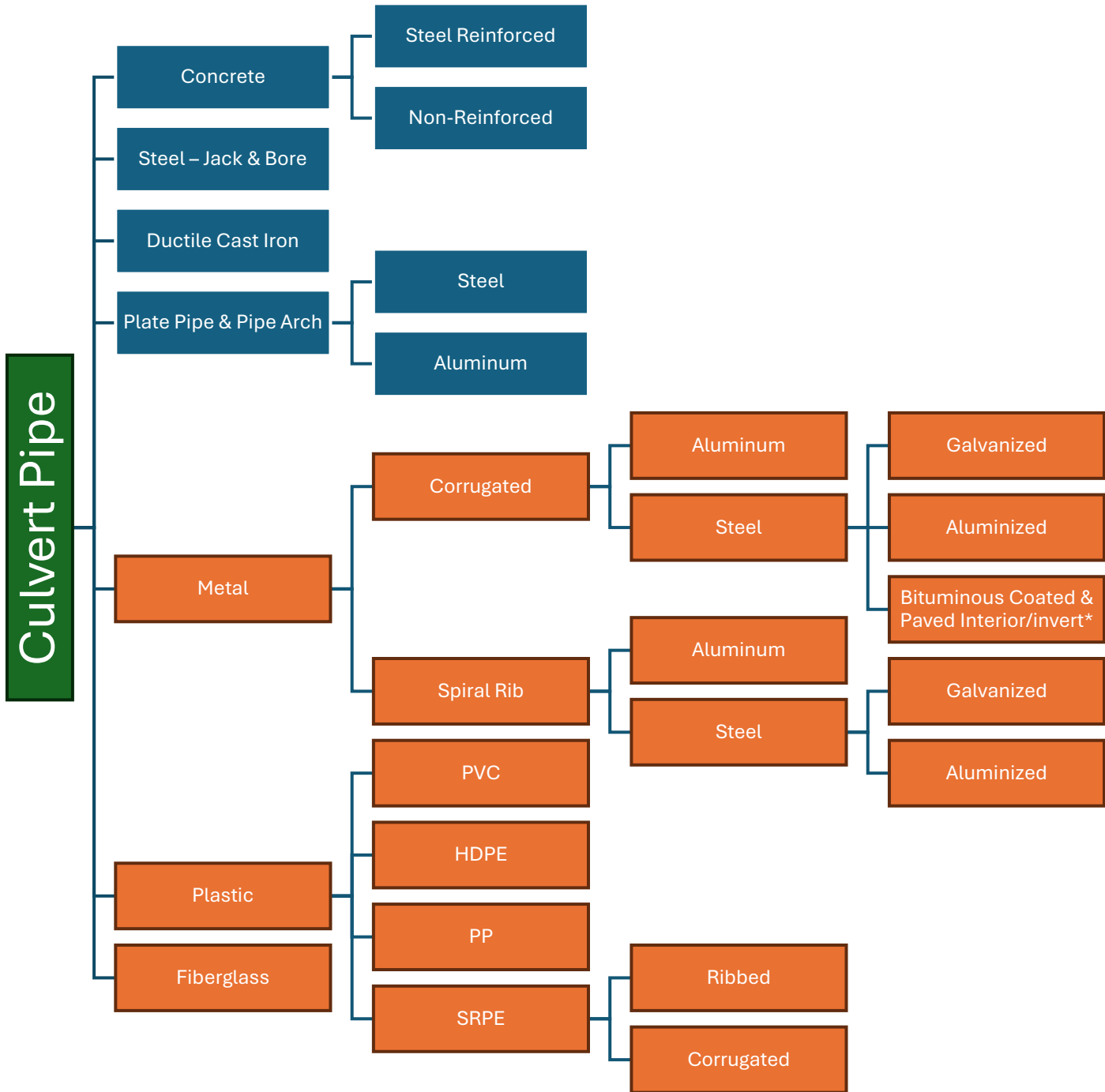


CMD: Structural Plastics & Composites

**By: Alexander Lewis, PE
Composite Materials Specialist**



Flexible Pipe Program



Flexible Metal Pipe



Corrugated →

Materials	Steel, Aluminum
Configuration	Corrugated, Ribbed
Diameters	6" and up
Industry Standards	LRFD, AASHTO M36, AASHTO M196
Applications	Storm Drain, Cross Drain, Side Drain, Gutter Drain, French Drain
Coatings (Steel only)	<ul style="list-style-type: none"> Galvanized (AASHTO M218) Aluminized (AASHTO M274) Bituminous (AASHTO M190)
Project Method of Acceptance	Sampling & Testing (the "sample" is just documentation submitted to MAC) <ul style="list-style-type: none"> Notarized Material Certificate from Pipe Manufacturer QC summary sheet Mill Certificate
What to look for	stamp
Wall Zone eligible?	No
100-yr DSL	Yes – use Culvert Service Life Estimator (CSLE)



← **Spiral Ribbed**

Project Sampling

430-9 Specific Requirements for Steel Reinforced Polyethylene Ribbed Pipe, Corrugated High-Density Polyethylene Pipe, Polypropylene Pipe, and Polyvinyl Chloride (PVC) Pipe.

430-9.1 Sampling Requirements: Submit a sample of each pipe material and diameter used on each project to the Engineer a minimum of two weeks prior to the installation, provided that the pipe meets all of the following:

1. Pipe material is PVC, HDPE, steel reinforced polyethylene
2. Pipe is corrugated or ribbed
3. Pipe diameter is 12" or larger
4. Project quantity for a pipe diameter is more than 100 linear feet, unless intended for use as cross drain
5. Pipe is not perforated, unless the material is PVC
6. Pipe is intended for applications requiring 100 year design service life as defined in the Florida Department of Transportation Drainage Manual.

The length of each sample pipe section must comprise at least seven regular corrugations (not including the first three corrugations of the pipe on the bell or spigot ends).



Class I vs Class II

Topic	Class I	Class II	Reference
Design Service Life	50 year	100 year	<ul style="list-style-type: none"> Standard Specification 948-7 Materials Manual 6.1 Vol II Drainage Manual Table 6-1
Florida Keys	No HDPE	No HDPE	<ul style="list-style-type: none"> Drainage Manual Table 6-1
Cover Height	Max fill – 10 feet	Min/max cover varies by diameter (see Appendix C)	<ul style="list-style-type: none"> Drainage Manual Appendix C Drainage Manual Table 6-1
Joint Performance	<ul style="list-style-type: none"> Watertight to 5 psi Maximum 5% vertical deflection 	<p>Non-Wall Zone Pipes: Meet Class I</p> <p>Wall Zone Pipes (Polypropylene & PVC):</p> <ul style="list-style-type: none"> Watertight to 10.8 psi Maximum 5% vertical deflection 2-inch gap from the home position 	<ul style="list-style-type: none"> Standard Specifications 430-4.1 Materials Manual 6.1 Vol II Drainage Manual Table 6-1
Project Sampling/Testing	n/a	<p>Yes, but...</p> <p>For projects let after July 1, 2024: Polypropylene will be sampled at the discretion of the State Materials Office</p>	<ul style="list-style-type: none"> Standard Specifications 430-9

“Wall Zone”

- Any pipes under permanent structures such as retaining walls, MSE walls, buildings, etc. shall use a 100 year DSL

6.5 PIPES WITHIN WALLED EMBANKMENT SECTIONS

Wall Zone Pipes are defined as pipes, existing or proposed, that are: (1) within or adjacent to embankment retaining walls, (2) connected to inlets that are within embankment retaining walls, or (3) beneath a bridge substructure element, such as an end bent or pier.

For proposed Wall Zone Pipes, increase the pipe diameter to accommodate future lining.

When incorporating existing pipes within or adjacent to proposed retained earth embankments sections, assess the condition of the pipe (both water tightness and structural adequacy under the proposed loading) and confer with the geotechnical and structural engineers. Existing pipes must meet the structural, hydraulic joint, and wall zone criteria listed within this Chapter and **Specification 430**.

Identify Wall Zone Pipes on the Optional Pipe Materials Tabulation. Refer to **Appendix D** for wall types and criteria.



Project Sampling

MAC Sample

- Physical Pipe Sample (delivered to SMO)
- Notarized Material Certificate (one per project)
- Signed Shipping Ticket (one per shipment)
- QC Summary Sheet or Test Data (if available)

Each LOT of flexible pipe, as defined in the QC Plan in accordance with **Materials Manual Section 6.1.8.1**, is accepted when all the following requirements are satisfied:

- A) Prior to the first shipment of pipe to each project, a notarized material certification is sent to the project in accordance with **Specifications Section 6**.
- B) The QC test results and inspections meet the requirements as specified herein and in the **Specifications**.
- C) The Production Facility has completed all patching and minor repair work using methods approved in the QC Plan.
- D) The QCM or the designated QC Technician has applied QC labels to the pipe.
- E) Each shipment includes a QC signed or stamped shipping ticket on the Production Facility's letterhead detailing the quantities, sizes, type, lengths, and mean inside diameter for each LOT of pipe.
- F) All required QC documentation has been completed and kept on file for QC activities.



Sample Logging

CONTECH ENGINEERED SOLUTIONS, INC.
MONTGOMERY, ALABAMA PLANT
Department of Transportation
A-2000 PIPE CERTIFICATION

DATE: 09/08/2025

SALES ORDER#26582150

BUYER: Princeton Contracting LLC

SALES BLANKET #9763526

FDOT: 436565-1-52-01

FDOT: 4232513-52-01

This is to certify that the material for the above order was manufactured and/or tested in accordance with the minimum requirements of Table 1 below and F949 and D3212. Table 3 lists the pipe numbers certified.

Material Information

Sample Category

Project

Contracts

T6539: Crs Contracts [PRINCE CONTRACTING, LLC]

Projects

423251-3-52-01: SR 25/OKEECHOBEE RD FROM EAST OF NW 87 AVE TO NW 79 AVE (CONCRETE)

Pay Items

0430175118 - PIPE CULVERT,OPTIONAL MATERIAL,ROUND, 18"S/CD

Material

MAC Spec

948 - Optional Drainage Products and Liner Repair Systems
948 - Optional Drainage Products and Liner Repair Systems, Supplemental Specification, 01/2020, v6.2

Sample Information

Method Of Acceptance

Sampling And Testing

Sample Level

VT

Category

ASTM F949 Corrugated PVC Pipe

Production Facility

FPP-09 - Contech (Montgomery AL) - PVC

Sampled By

Yoandry Cepeda Reyes

Date Sample Taken

9/11/2025

LOT

24

Laboratory Information

Lab	Reason For Routing	Status	Type	Date Sample Received	Comment
DSM001 - State Materials Office	Initial Routing	Received	Full	9/17/2025	

TABLE 1: SPECIFICATIONS AND MINIMUM TEST REQUIREMENT

DIAMETER IN. (MM)	MINIMUM PIPE STIFFNESS	MINIMUM FLATTENING	MINIMUM IMPACT
	F949 LBE/IN ² (KPA)	%	F949 FT-LBF (J)
18" (450)	46 (320)	41.1	140 (189)
21" (525)	46 (320)	40.3	140 (189)
24" (600)	46 (320)	41.6	140 (189)
30" (750)	46 (320)	41.1	140 (189)
36" (900)	46 (320)	40.7	140 (189)

TABLE 2: PIPE INSIDE DIAMETER

DIAMETER IN. (MM)	MEAN	MINIMUM	MAXIMUM
18" (450)	17.552"	17.51"	17.594"
21" (525)	20.705"	20.656"	20.754"
24" (600)	23.469"	23.412"	23.526"
30" (750)	29.469"	29.388"	29.550"
36" (900)	35.475"	35.370"	35.580"

TABLE 3: LOT TEST RESULTS

PRODUCT	EXTRUSION NUMBER	LOT NUMBER	STIFFNESS PSI	FLATTENING %	IMPACT
18" A-2000 PERF Pipe 22'	9M25244	24	PASS/FAIL P	PASS/FAIL P	PASS/FAIL P
24" A-2000 PERF Pipe 22'	8M25212	21	P	P	P

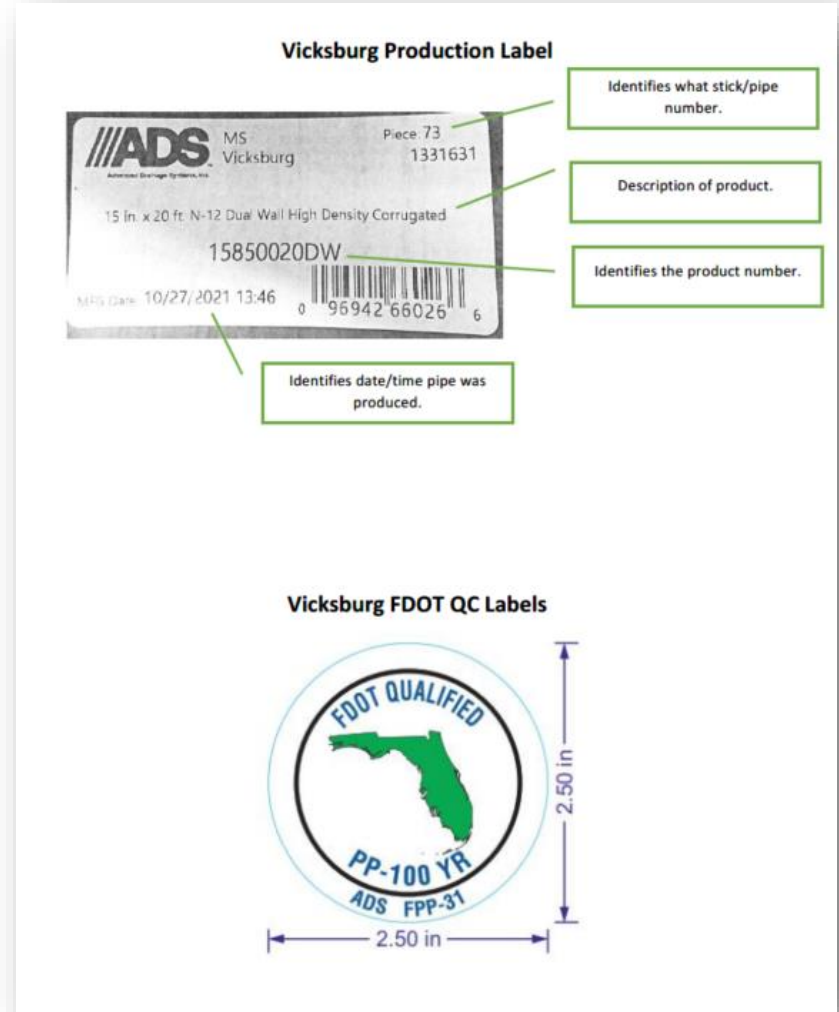
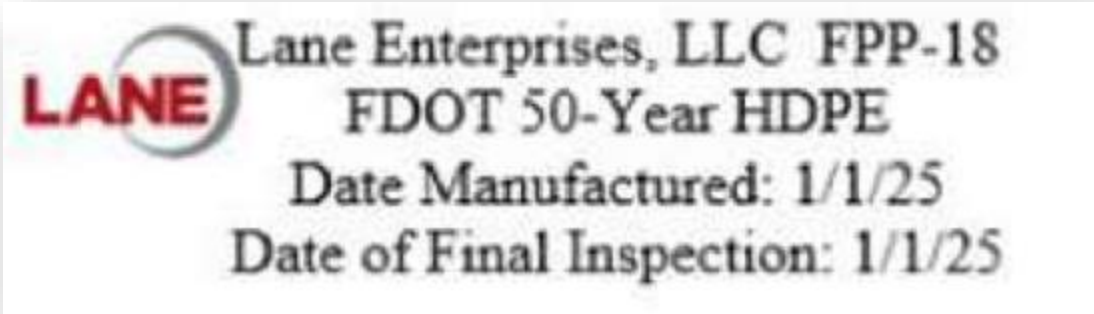
Sworn to and subscribed before me on this day the 08th day of September 2025

Bruno Will
NOTARY PUBLIC

I certify that the above test results represent samples taken from lot numbers listed.

Carl Moseley
Carl, Moseley Quality Control

QC/Production Label Examples



PVC Pipe

Configuration	Corrugated exterior, smooth interior, perforations available
Color	White
Diameters	12-42"
Industry Standards	LRFD, ASTM F949
Applications	Storm Drain, Cross Drain, Side Drain, Vertical Drain, French Drain
Current Manufacturers	Contech Engineered Solutions
Project Method of Acceptance	Sampling & Testing
What to look for	Printed Label, inkjet marking, documentation, defects
Wall Zone eligible?	Yes
100-year DSL	Yes – ASTM F949 pipe



HDPE Pipe

Configuration	Type S/SP – Dual Wall
Color	Black
Diameters	4-60"
Industry Standards	LRFD, AASHTO M252 (4-10"), AASTHO M294V (12-60")
Applications	Strom Drain, Cross Drain, Side Drain, French Drain (50 year), Edge Drain (M252), Underdrain (M252)
Current Manufacturers	<ul style="list-style-type: none"> • Advanced Drainage Systems, • Southeast Culvert • Lane Enterprises • Prinsco
Project Method of Acceptance	Sampling & Testing
What to look for	Printed Label, inkjet marking, documentation, defects, "V" – Virgin Resin ONLY
Wall Zone eligible?	No
100-year DSL	Yes



Polypropylene Pipe

Configuration	<ul style="list-style-type: none"> • Type S/SP – Dual Wall • Type D – Triple Wall
Color	Gray
Diameters	12-60"
Industry Standards	LRFD, AASHTO M330
Applications	Storm Drain, Cross Drain, Side Drain, French Drain
Current Manufacturers	<ul style="list-style-type: none"> • Advanced Drainage Systems, • Lane Enterprises • Prinsco
Project Method of Acceptance	Sampling & Testing
What to look for	Printed Label, inkjet marking, documentation, defects
Wall Zone eligible?	Yes
100-year DSL	Yes



Steel Reinforced Polyethylene Pipe

Configuration	Corrugated or ribbed exterior, smooth interior
Color	Black
Diameters	12-72" (can produce larger)
Industry Standards	LRFD, AASHTO M335 (ribbed), AASHTO MP42 (Corrugated)
Applications	Storm Drain, Cross Drain, Side Drain
Current Manufacturers	Contech Engineered Solutions (ribbed)
Project Method of Acceptance	Sampling & Testing
What to look for	Printed Label, inkjet marking, documentation, defects
Wall Zone eligible?	No
100-year DSL	Ribbed – yes Corrugated - no





Fiber Reinforced Polymer Program

FDOT Materials Acceptance and Certification System



Materials Acceptance and Certification Reports

Run your own reports at:
<https://macreporting.fdot.gov/ReportsMainView/smoLink>

Select Report to View

Production Facility

[Active Prod Fclty w/Samples](#)

[Agg FC Product Classification](#)

[Aggregate Production Facility Listing](#)

[Aggregate Sources Timeline](#)

[All Producers \(Excel\)](#)

[Approved Aggregate Products From Mines or Terminals Listing](#)

[Approved Products at Expired Mines or Terminals](#)

[Asphalt Production Facility Listing](#)

[Asphalt Recycled Products](#)

[Asphalt Targets](#)

[Cementitious Materials Production Facility Listing](#)

[Coatings Production Facility Listing](#)

[Fiber Reinforced Polymer Production Facility Listing](#)



Fiber Reinforced Polymer Production Facility Listing

FDOT State Materials Office, 5007 N.E. 39th Avenue, Gainesville, FL 32609 (352) 955-6600

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Note:

This report replaces the Approved Aggregate Products For Friction Course Report.

Lists all Aggregate Production Facilities

Lists Approval of Aggregate Production Facility in the Date Range Specified. Reports a summary per year and total summary for the date range.

Lists all non-expired Production Facilities in an Excel file

Lists Approved Aggregate Products for Mines or Terminals

A summary report to identify Approved Products at Expired Facilities, and approved Products at Terminals Expired at Mine

Lists all Asphalt Production Facilities

Approved Asphalt Recycled Products Report by Plant

A listing of the asphalt gradation and gravity (Gsb) data for Asphalt Products per mine or terminal

Lists Cementitious Materials Production Facilities

Lists all Coatings Production Facilities

Lists all Fiber Reinforced Polymer Production Facilities

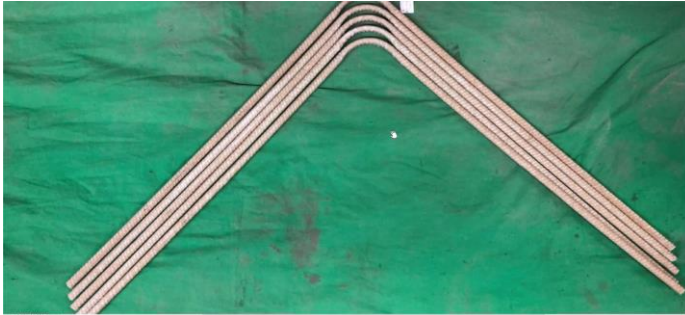
There is also a FRP lab report to find approved independent labs



Send Questions or Issues to [System Admin\(s\)](#) or [Contact a MAC Admin](#)
Report Technical Problems to the Service Desk @ 1-866-955-4357 (Help) or e-mail: [Service Desk](#)
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FRP Reinforcement Materials



Glass Fiber Reinforced Polymer (GFRP)

- Most common
- 60 GPa (8.7 Msi) modulus bars available (Type III)
- Currently only FRP rebar material specified in ACI 440 Code



Carbon Fiber Reinforced Polymer (CFRP)

- Most expensive, one producer (Tokyo Rope)
- Type II (Strands): 155 GPa (22.4 Msi) modulus
- Type I (bars): 124 GPa (18 Msi) modulus
- Virtually no thermal expansion
- Currently restricted from use with Stainless Steel, but this is being researched



Basalt Fiber Reinforced Polymer (BFRP)

- Less common due to fiber sourcing challenges
- Treated as identical to GFRP in ASTM
- Currently restricted from use in submerged conditions, but this is being researched
- 60 GPa (8.7 Msi) modulus bars available (Type III)

Effective: July 1, 2026

932-4.3 Material Acceptance: Submit to the Engineer a certificate of analysis for each production LOT from the producer of the FRP reinforcing bars, confirming compliance with the requirements of this Section.

932-4.3.1 Sampling: The Engineer will identify specimens for the test samples. Contractor will provide the testing samples if the project includes more than 15,000-feet of straight or 10,000-feet of bent or 10,000-feet of spiral or a combined length of more than 20,000-feet of FRP reinforcing bars. One sample of each size of straight, bent, and spiral FRP reinforcing bar must be selected. A straight bar sample includes six specimens of at least 7-foot length. A bent or spiral bar sample includes five specimens of at least 2-foot length. Testing will not be required for bars to be used solely as reinforcement for sheet pile bulkhead cap or pile jackets, but samples will still be selected and retained by the Engineer until final acceptance of the work.



Current

932-4.3 Material Acceptance: Submit to the Engineer a certificate of analysis for each production LOT from the producer of the FRP reinforcing bars, confirming compliance with the requirements of this Section.

932-4.3.1 Sampling: The Engineer will select a minimum of six straight bars with minimum lengths of 7 feet each and a minimum of five bent bars or spiral bends/revolutions from each shipment, representing a random production LOT, per bar size of FRP reinforcing for testing in accordance with Table 932-9. Testing shall be conducted, at the Contractor's expense, by a Department approved independent laboratory. Each test shall be replicated a minimum of three times per sample. Submit the test results to the Engineer for review and approval prior to installation. Testing will not be required for bars to be used solely as reinforcement for sheet pile bulkheads, but LOT samples will still be selected and retained by the Engineer until final acceptance of the work.

415-3 Protection of Material.

Store reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it from mechanical injury and surface deterioration. Ensure that the reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material prior to incorporation into the work. Protect FRP against UV exposure and extreme ambient storage temperatures as required by the FRP manufacturer. If the manufacturer does not provide any requirements, limit FRP sun exposure to 4 months and maximum ambient storage temperature to 120°F.



Current

415-3 Protection of Material.

415-3.1 Steel Reinforcing: Store steel reinforcement above the surface of the ground, upon platforms, skids, or other supports, and protect it from mechanical injury and surface deterioration. Ensure that the steel reinforcement is free from loose rust, scale, dirt, paint, oil, and other foreign material prior to incorporation into the work.

415-3.2 Fiber Reinforcing Polymer (FRP) Reinforcing: Store FRP reinforcement above the surface of the ground, in boxes or upon platforms, skids, or other supports, and protect it from mechanical injury and direct exposure to UV light. Ensure that the FRP reinforcement is free from dirt, paint, oil, and other foreign material prior to incorporation into the work.

Effective: July 1, 2026

415-5.3 Tying: Securely tie all reinforcement together without damage. Use ties of sufficient strength to maintain the reinforcement in its proper position. For stainless steel reinforcement, use stainless steel wire or non-metallic tying materials.

The tying materials should not damage the reinforcement during the construction.



Current

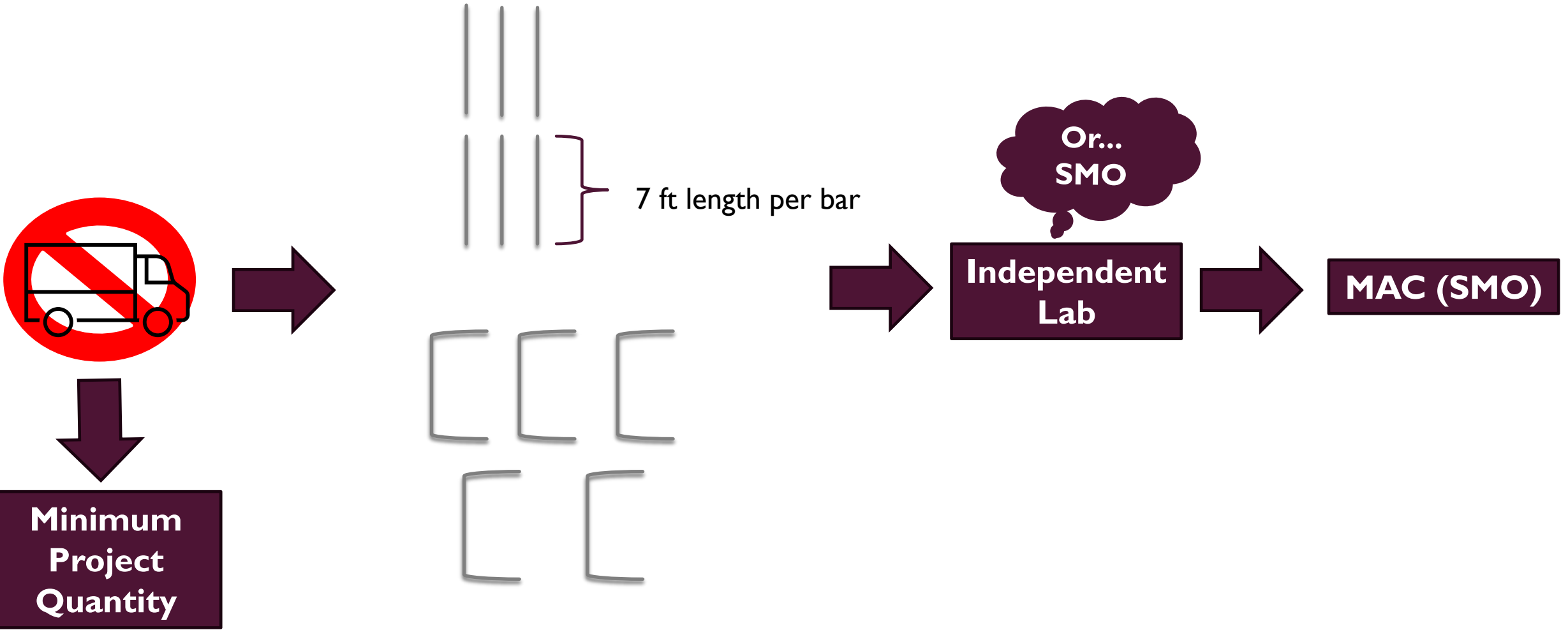
415-5.3 Tying:

415-5.3.1 Steel Reinforcing: Tie steel reinforcing using pliable steel wire that readily bends and twists without breaking and that provides a tie of sufficient strength to hold the steel reinforcing in its proper position. Tie stainless reinforcing steel using plastic coated pliable steel wire; or stainless steel wire meeting the requirements of ASTM A276, UNS S31600.

Non-metallic fasteners for steel reinforcing may be used in precast concrete products upon approval by the appropriate District Materials Office (DMO).

415-5.3.2 Fiber Reinforcing Polymer (FRP) Reinforcing: Tie FRP reinforcing using self-locking plastic straps; or plastic coated pliable steel wire that readily bends and twists without breaking and that provides a tie of sufficient strength to hold the FRP reinforcing in its proper position.

Project Sampling & Testing *(Future)*



Fiber Reinforced Polymer Product Evaluation



Certificate of Analysis (COA)



MATERIAL CERTIFICATION

MANUFACTURED GLASS FIBER REINFORCEMENT POLYMER BAR (GFRP)

FDOT Financial Identification Number (FIN): 437935-1-52-01

FDOT Contract Number: T5743

Project Location: Barracuda bvd & BR 795700

Description of Products: GFRP straight and bent reinforcement bars

Batch Number: 229001-4, 229001-5, 229001-8, 2213004-5-60, 2213004-4-60, 2213005-8-60

Certified By: X. Seynave

Test Results: see attached test reports

We certify that the described product meets or exceeds the material specifications as provided in the contract documents.

Manufacturer Officer or Designee:

Name (print): Xavier Seynave

Signature:

Date: 2022-06-27



CERTIFIED TEST REPORT

EVALUATION OF NON-METALLIC FIBER REINFORCED POLYMER (FRP) BARS FOR CONCRETE REINFORCEMENT
- Per FDOT Spec. 932-3 -

Report Number: R-5.10_06-16-21_PMM
Date: April 7, 2022

Certified Test Report

V-Rod #8
lot number: 2213005-8-60
manufacturing process: pultrusion
type of resin: vinyl ester
type of fibre: ECR glass
a production lot is defined by a change of the lot number of the resin and/or a change of machine

Test report

manufacturer's code: FRP-06

nominal cross-sectional area: 0,790 mm²

Product characterisation

		sample 1	sample 2	sample 3	sample 4	sample 5	average	std dev	required	
									min	max
fibre mass content	%	86	86	86	86	86	86	0,1	70	n/a
ASTM D2584 (temp 650°C, minus sand coating)										
glass transition temperature	°F	234	223	231	223	228	228	4,5	212	n/a
ASTM E1356 (20°C/min, half-height)										
degree of cure	%	100	100	100	100	100	100	0,1	95	n/a
CSA S807 annex A										
measured cross-sectional area	in ²	0,880	0,879	0,879	0,879	0,881	0,880	0,0008	0,738	0,913
ASTM D7205										
ultimate tensile force	kip	128,6	131,9	131,4	127,4	135,8	131,0	2,91	66,8	n/a
ASTM D7205										
tensile modulus of elasticity	ksi	8840	8715	8862	8927	8851	8839	69,0	6500	n/a
ASTM D7205										
moisture absorption (24h)	%	0,04	0,03	0,02	0,03	0,03	0,03	0,005	n/a	0,25
ASTM D570										

date: 2022-06-23

for QC department:

#8 Straight
FDOT SAMPLE #: 22CDSGFRP03A
DATE SAMPLED: 6/27/2022

Notarized Material Certificate

Instron 34TM-50kN



Specifications

- 50 kN load capacity in tension and compression
- Additional 0.2kN load cell for greater precision with weaker materials
- 0.2 kN & 5kN pneumatic plate grips, 50kN wedge grips
- Long Travel Extensometer
 - Calibrated To ASTM E83 Class B1 at 1", 2" gauge length to 30" travel

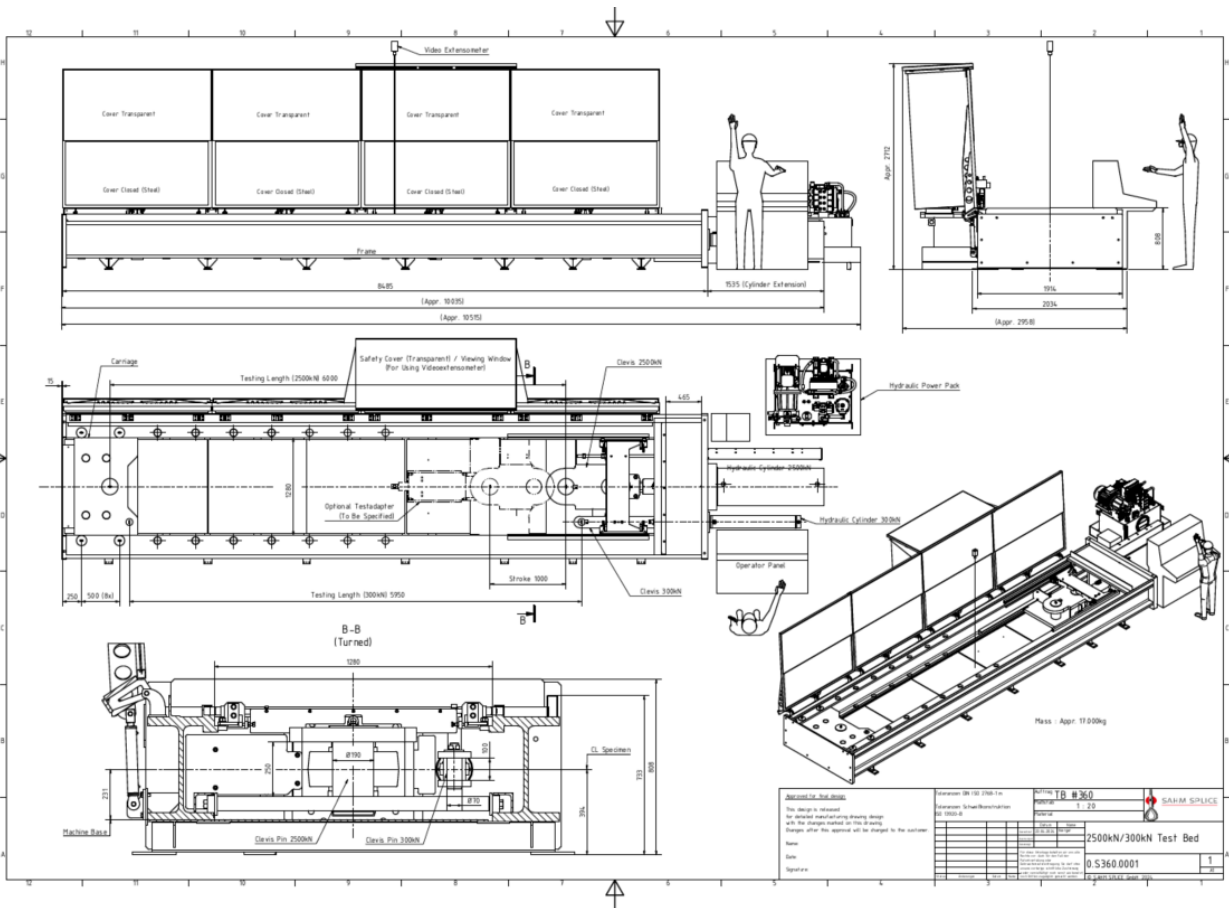
Rebar Tests

- ASTM D4475
- ASTM D7617

Structural Composites & Plastics

- ASTM D638
- ASTM D790
- ASTM D3039
- ASTM D7078
- And more...

Horizontal Tensile Test Machine



General

- Manufacturer: Sahm Splice
- Length: 32 ft
- Delivery timeline: Q2 2026
- Design based on frames produced for and currently used by Tokyo Rope USA
- Purpose: perform ASTM tensile testing on FRP bars and prestressing strands

Features & Capability

- 2500/500 kN 2-in-1 test bed
- Modular grip design developed by Tokyo Rope USA
- Ceiling mounted video extensometer
- Maximum sample length: 18 ft
- Connected to FDOT Network for easy data extraction and analysis



Questions?

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