

6/7/2019 - Updated with complete resin and pipe sample identifications
6/5/2019 - Updated with Pipe Stiffness & Flattening/RSC at 60 °C and Resistance to Internal Pressure 165 and 1,000 hours results
4/1/2019 - Revised with correct information on Pass/Fail criteria on the results of CB content.
3/29/2019 - Updated with Resin Melt Flow Index results and Pipe Carbon Black Content
3/20/2019

Mail To:

César Vantini
Kanaflex S/A Indústria de Plásticos
Rod. Waldomiro Correa de Camargo, 16300, Km 60,5 - Vila Martins, Itu-SP 13308-200
Tel.: +55-11-4785-2144 | Cel.: +55-11-971-410-757

E-mail: cesar.vantini@kanaflex.com.br

Dear César Vantini:

Thank you for using TRI for your pipe testing needs.
TRI is pleased to present this final report for HDPE pipe testing as follows:

TRI Job Number:	44327
Material Tested:	Dow HDPE40055L Resin Pellets and One 250-mm diameter Pipe Sample with Perforations – KNTS SUPER DN/DI 250 SN8 PE NBR ISO 21138-3 C01-25882-10-18 HDPE-40055L
Tests Requested:	<u>Resin</u> Melt Flow Index (ISO 1133-1) Oxidative Induction Time -OIT (ISO 11357-6) Density/Specific Gravity (ISO 1183-1) <u>Pipe</u> Dimensions and Workmanship (ISO 3126) Ring Stiffness (ISO 9969) Compression Molding (ASTM D4703, Proc. C) Environmental Stress Crack (ESCR) -24 h (ASTM D1693, Cond. B) Pipe Stiffness & Flattening/RSC ≤18" at 23 °C (at 5, 10 and 20% strain) (ASTM D2412) Pipe Stiffness & Flattening/RSC ≤18" at 60 °C (at 5, 10 and 20% strain) (ASTM D2412) Resistance to Internal Pressure (resin evaluation) -Short Term -165 h (ISO 1167-1 &-2) Resistance to Internal Pressure (resin evaluation) -Long Term -1,000 h (ISO 1167-1 &-2) Carbon Black Content (ISO 6964) Oxidative Induction Time -OIT (ISO 11357-6) Density/Specific Gravity (ISO 1183-1)

If you have any questions or require any additional information, please call us at +55 11 976-552-056

Sincerely,



Analysis & Quality Review
Julio A. Z. Ferreira, Ph.D., Pr.Eng.
Director of S. American Operations
Geosynthetic Services Division
www.tri-ambiental.com

*signature is on file
Mario Paredes
Senior Engineer - Pipe Division

ISO 21138-3				
Corrugated Polyethylene Pipe Test Report for				
Company:		TRI Brazil		
Log #:		44327		
Month/Year Sampled:		October 2018		
Month/Year Tested:		2/12/2019		
Nominal Inside Diameter:		250 mm		
RESIN TESTING				
Test Method - Description	Specification Limits	Result		Pass / Fail
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.949	g/cm ³	Pass
ISO 1133-1 – Melt Index @ 5kg	≤ 1.6 g	0.43	g	Pass
ISO 11357 – Oxidative-Induction Time	Not Required by ISO 21138-3. Additional test required by client	16	minutes	NA
PIPE TESTING				
Test Method - Description	Specification Limits	Result (SI)		Pass / Fail
ISO 6964 – Carbon Black Content	Not Required by ISO 21138-3. Additional test required by client	1.90	%	NA
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.954	g/cm ³	Pass
ASTM D1693, Condition B - ESCR	Not Required by ISO 21138-3. Additional test required by client. AASHTO: ≤ 20% Failure after 24 hours	0.0	% failure after 24 hours	Pass
ISO 11357 – Oxidative-Induction Time	≥ 20 minutes (this requirement is only valid for pipes and fittings intended to be joined in field by fusing or welding)	42	minutes	Pass
ISO 3126 – Workmanship	No visible defects (3 samples)	OK		Pass
ISO 21138 – Markings	ISO 21138-3, DN/OD or DN/ID, Manufacturer's Name/Trademark, Stiffness Class, Material, Close Tolerance Class	OK		Pass
ISO 21138 – Delamination	No Delamination	OK		Pass
ISO 3126 – Inside Diameter	≥ 245 mm	252.63	mm	Pass
ISO 3126 – Wall Thickness, e5	≥ 1.5 mm	2.02	mm	Pass
ISO 3126 – Perforations Area	NA	81.13	cm ² /m	NA
ISO 9969 – Pipe Ring Stiffness @ 3% Deflection	≥ 8,000 kN/m ²	8603	kN/m ²	Pass
ASTM D2412 – Pipe Stiffness at 23 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	396	kPa	NA
	10% Deflection	288	kPa	NA
	20% Deflection	211	kPa	NA
ASTM D2412 – Pipe Stiffness at 60 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	145	kPa	NA
	10% Deflection	119	kPa	NA
	20% Deflection	90	kPa	NA

Test Method - Description	Specification Limits	Result (SI)	Pass / Fail
ASTM D2412 – Pipe Flattening at 23 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ASTM D2412 – Pipe Flattening at 60 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure, Short Term	165 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 4.0 MPa and 80°C	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure - Long Term	1000 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 2.8 MPa and 80°C	OK	Pass
n/t – samples not available for testing; n/a – not applicable			

6/7/2019 - Updated with complete resin and pipe sample identifications
6/5/2019 - Updated with Pipe Stiffness & Flattening/RSC at 60 °C and Resistance to Internal Pressure 165 and 1,000 hours results
4/1/2019 - Revised with correct information on Pass/Fail criteria on the results of CB content.
3/29/2019 - Updated with Resin Melt Flow Index results and Pipe Carbon Black Content
3/20/2019

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Bill To:

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E-mail: cesar.vantini@kanaflex.com.br

Dear César Vantini:

Thank you for using TRI for your pipe testing needs.
TRI is pleased to present this final report for HDPE pipe testing as follows:

TRI Job Number: 44327


Material Tested: Dow HDPE40055L Resin Pellets and One 300-mm diameter Pipe Sample with Perforations – KNTS SUPER DN/DI 300 SN8 PE NBR ISO 21138-3 C0125765-10-18 HDPE-40055L

Resin
Melt Flow Index (ISO 1133-1)
Oxidative Induction Time -OIT (ISO 11357-6)
Density/Specific Gravity (ISO 1183-1)

Pipe
Dimensions and Workmanship (ISO 3126)
Ring Stiffness (ISO 9969)
Compression Molding (ASTM D4703, Proc. C)
Environmental Stress Crack (ESCR) -24 h (ASTM D1693, Cond. B)
Pipe Stiffness & Flattening/RSC ≤18" at 23 °C (at 5, 10 and 20% strain) (ASTM D2412)
Pipe Stiffness & Flattening/RSC ≤18" at 60 °C (at 5, 10 and 20% strain) (ASTM D2412)
Resistance to Internal Pressure (resin evaluation) -Short Term -165 h (ISO 1167-1 &-2)
Resistance to Internal Pressure (resin evaluation) -Long Term -1,000 h (ISO 1167-1 &-2)
Carbon Black Content (ISO 6964)
Oxidative Induction Time -OIT (ISO 11357-6)
Density/Specific Gravity (ISO 1183-1)

If you have any questions or require any additional information, please call us at +55 11 976-552-056

Sincerely,



Analysis & Quality Review
Julio A. Z. Ferreira, Ph.D., Pr.Eng.
Director of S. American Operations
Geosynthetic Services Division
www.tri-ambiental.com

*signature is on file
Mario Paredes
Senior Engineer - Pipe Division

ISO 21138-3

Corrugated Polyethylene Pipe Test Report for

Company: TRI Brazil
 Log #: 44327
 Month/Year Sampled: October 2018
 Month/Year Tested: 2/12/2019
 Nominal Inside Diameter: 300 mm

RESIN TESTING

Test Method - Description	Specification Limits	Result	Pass / Fail
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.949 g/cm ³	Pass
ISO 1133-1 – Melt Index @ 5kg	≤ 1.6 g	0.43 g	Pass
ISO 11357 – Oxidative-Induction Time	Not Required by ISO 21138-3. Additional test required by client	16 minutes	NA

PIPE TESTING

Test Method - Description	Specification Limits	Result (SI)	Pass / Fail
ISO 6964 – Carbon Black Content	Not Required by ISO 21138-3. Additional test required by client	2.08 %	NA
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.954 g/cm ³	Pass
ASTM D1693, Condition B - ESCR	Not Required by ISO 21138-3. Additional test required by client. AASHTO: ≤ 20% Failure after 24 hours	0.0 % failure after 24 hours	Pass
ISO 11357 – Oxidative-Induction Time	≥ 20 minutes (this requirement is only valid for pipes and fittings intended to be jointed in field by fusing or welding)	60 minutes	Pass
ISO 3126 – Workmanship	No visible defects (3 samples)	OK	Pass
ISO 21138 – Markings	ISO 21138-3, DN/OD or DN/ID, Manufacturer's Name/Trademark, Stiffness Class, Material, Close Tolerance Class	OK	Pass
ISO 21138 – Delamination	No Delamination	OK	Pass
ISO 3126 – Inside Diameter	≥ 294 mm	316.99 mm	Pass
ISO 3126 – Wall Thickness, e5	≥ 1.70 mm	1.98 mm	Pass
ISO 3126 – Perforations Area	NA	69.54 cm ² /m	NA
ISO 9969 – Pipe Ring Stiffness @ 3% Deflection	≥ 8,000 kN/m ²	8576 kN/m ²	Pass
ASTM D2412 – Pipe Stiffness at 23 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	389 kPa	NA
	10% Deflection	298 kPa	NA
	20% Deflection	203 kPa	NA
ASTM D2412 – Pipe Stiffness at 60 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	141 kPa	NA
	10% Deflection	116 kPa	NA
	20% Deflection	88 kPa	NA

Test Method - Description	Specification Limits	Result (SI)	Pass / Fail
ASTM D2412 – Pipe Flattening at 23 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ASTM D2412 – Pipe Flattening at 60 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure, Short Term	165 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 4.0 MPa and 80°C	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure - Long Term	1000 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 2.8 MPa and 80°C	OK	Pass
n/t – samples not available for testing; n/a – not applicable			

6/7/2019 - Correction of ISO 2138-3 specification limit for ISO 3126 – Inside Diameter and Updated with complete resin and pipe sample identifications

6/5/2019 - Updated with Pipe Stiffness & Flattening/RSC at 60 °C and Resistance to Internal Pressure 165 and 1,000 hours results

4/1/2019 - Revised with correct information on Pass/Fail criteria on the results of CB content.

3/29/2019 - Updated with Resin Melt Flow Index results and Pipe Carbon Black Content

3/20/2019

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Dear César Vantini:

Thank you for using TRI for your pipe testing needs.

TRI is pleased to present this final report for HDPE pipe testing as follows:

TRI Job Number: 44327

Material Tested: Dow HDPE40055L Resin Pellets and One 400-mm diameter Pipe Sample with Perforations – KNTS SUPER DN/DI 400 SN8 PE NBR ISO 21138-3 C0125822-10-18 HDPE-40055L

Tests Requested:

Resin
Melt Flow Index (ISO 1133-1)
Oxidative Induction Time -OIT (ISO 11357-6)
Density/Specific Gravity (ISO 1183-1)

Pipe
Dimensions and Workmanship (ISO 3126)
Ring Stiffness (ISO 9969)
Compression Molding (ASTM D4703, Proc. C)
Environmental Stress Crack (ESCR) -24 h (ASTM D1693, Cond. B)
Pipe Stiffness & Flattening/RSC $\leq 18''$ at 23 °C (at 5, 10 and 20% strain) (ASTM D2412)
Pipe Stiffness & Flattening/RSC $\leq 18''$ at 60 °C (at 5, 10 and 20% strain) (ASTM D2412)
Resistance to Internal Pressure (resin evaluation) -Short Term -165 h (ISO 1167-1 &-2)
Resistance to Internal Pressure (resin evaluation) -Long Term -1,000 h (ISO 1167-1 &-2)
Carbon Black Content (ISO 6964)
Oxidative Induction Time -OIT (ISO 11357-6)
Density/Specific Gravity (ISO 1183-1)

If you have any questions or require any additional information, please call us at +55 11 976-552-056

Sincerely,



Analysis & Quality Review
Julio A. Z. Ferreira, Ph.D., Pr.Eng.
Director of S. American Operations
Geosynthetic Services Division

www.tri-ambiental.com

*signature is on file
Mario Paredes
Senior Engineer - Pipe Division

ISO 21138-3

Corrugated Polyethylene Pipe Test Report for

Company: TRI Brazil
 Log #: 44327
 Month/Year Sampled: October 2018
 Month/Year Tested: 2/12/2019
 Nominal Inside Diameter: 400 mm

RESIN TESTING

Test Method - Description	Specification Limits	Result	Pass / Fail
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.949 g/cm ³	Pass
ISO 1133-1 – Melt Index @ 5kg	≤ 1.6 g	0.43 g	Pass
ISO 11357 – Oxidative-Induction Time	Not Required by ISO 21138-3. Additional test required by client	16 minutes	NA

PIPE TESTING

Test Method - Description	Specification Limits	Result (SI)	Pass / Fail
ISO 6964 – Carbon Black Content	Not Required by ISO 21138-3. Additional test required by client	1.84 %	NA
ISO 1183-1 – Density	≥ 0.930 g/cm ³	0.954 g/cm ³	Pass
ASTM D1693, Condition B - ESCR	Not Required by ISO 21138-3. Additional test required by client. AASHTO: ≤ 20% Failure after 24 hours	0.0 % failure after 24 hours	Pass
ISO 11357 – Oxidative-Induction Time	≥ 20 minutes (this requirement is only valid for pipes and fittings intended to be jointed in field by fusing or welding)	53 minutes	Pass
ISO 3126 – Workmanship	No visible defects (3 samples)	OK	Pass
ISO 21138 – Markings	ISO 21138-3, DN/OD or DN/ID, Manufacturer's Name/Trademark, Stiffness Class, Material, Close Tolerance Class	OK	Pass
ISO 21138 – Delamination	No Delamination	OK	Pass
ISO 3126 – Inside Diameter	≥ 392 mm	396.72 mm	Pass
ISO 3126 – Wall Thickness, e5	≥ 2.30 mm	2.64 mm	Pass
ISO 3126 – Perforations Area	NA	57.95 cm ² /m	NA
ISO 9969 – Pipe Ring Stiffness @ 3% Deflection	≥ 8,000 kN/m ²	8734 kN/m ²	Pass
ASTM D2412 – Pipe Stiffness at 23 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	396 kPa	NA
	10% Deflection	304 kPa	NA
	20% Deflection	208 kPa	NA
ASTM D2412 – Pipe Stiffness at 60 °C @ 5, 10, 20% Deflection (not required by ISO 21138-3. Additional test required by client)	5% Deflection	137 kPa	NA
	10% Deflection	113 kPa	NA
	20% Deflection	85 kPa	NA

ASTM D2412 – Pipe Flattening at 23 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ASTM D2412 – Pipe Flattening at 60 °C @ 20%	Not Required by ISO 21138-3. Additional test required by client. AASHTO: no wall cracking, splitting, or delimitation prior to 20% deflection	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure, Short Term	165 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 4.0 MPa and 80°C	OK	Pass
ISO 1167-1 &-2 - Resistance to Internal Pressure - Long Term	1000 Hours Minimum, per ISO 21138, Table 3 for PE pipes. Testing at 2.8 MPa and 80°C	OK	Pass
n/t – samples not available for testing; n/a – not applicable			