



DRISCOPEX[®] 5300 SERIES CLIMATE GUARD[®] SYSTEMS



DRISCOPEX[®] Series 5300 Climate Guard[®]
HDPE Pipe and Fitting System for
Closed-Loop Ground-Source
Heat Pump Applications

Bulletin: PP 650

DRISCOPEX® 5300 Series Climate Guard®

HDPE Pipe and Fitting System for
Closed-Loop Ground-Source Heat Pump Applications

Performance Pipe

PERFORMANCE PIPE is the functional successor to the operations of Plexco¹ and Driscopipe². On July 1, 2000, Chevron Chemical Company and Phillips Chemical Company were joined to form Chevron Phillips Chemical Company LP. Performance Pipe, a division of Chevron Phillips Chemical Company LP, succeeds Plexco and Driscopipe as North America's largest producer of polyethylene piping products for geothermal, industrial, municipal, mining, oilfield, gas and utility applications.

Performance Pipe offers more than forty years of polyethylene pipe manufacturing experience, nine manufacturing facilities ISO certified in eight states.

The unmatched quality and performance of Performance Pipe polyethylene piping products is enhanced and strengthened with over four decades of quality polyolefin plastic resin production from Chevron Phillips Chemical Company LP.

DRISCOPEX® 5300 Series Climate Guard® Pipe and Fitting System

DriscoPlex® 5300 Series Climate Guard® high-density polyethylene pipe and fittings are the quality piping system for closed-loop, earth-coupled heat pump applications. DriscoPlex® 5300 Series Climate Guard® pipe and fittings are the system of choice for residential, commercial, institutional and industrial installations. Performance Pipe offers a complete system of DriscoPlex® 5300 pressure-rated pipe and fittings that meet or exceed applicable IGSHPA and ASTM specifications and requirements.

DRISCOPEX® 5300 Climate Guard® Systems - The Key to Performance

Economical - Easy to join, lightweight and flexible to help reduce construction and installation costs.

Tough and Durable - Excellent impact and abrasion resistance. Pressure ratings based on long-term tests. Exceptional resistance to slow crack growth and environmental stress cracking.



¹ Formerly - Plexco, a Division of Chevron Chemical Company

² Formerly - Phillips Driscopipe, A Division of Phillips Petroleum Company

NOTICE - This publication is intended for use as a guide to support the designer of piping systems. It is not intended to be used as installation instructions, and should not be used in place of the advice of a professional engineer. It does not constitute a guarantee or warranty for piping installations. Performance Pipe has made every reasonable effort to ensure the accuracy of this publication, but it may not provide all necessary information, particularly with respect to special or unusual applications. This publication may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most current edition.

Ductile and Flexible - Flexible DriscoPlex® 5300 Climate Guard® Series pipe follows the "lay of the land" to ease trench and down hole installation.

Resistant to Chemicals and Corrosion - Excellent resistance to most chemical compounds and aggressive soils.

Thermally Conductive - DriscoPlex® 5300 Climate Guard® pipe offers high strength PE 3408 to minimize pipe wall thickness and maximize heat transfer.

Leak-Tight Joining - Long, continuous coils or straight lengths reduce joining requirements. Properly made heat fusion joints are as strong as the pipe itself and do not leak.

Excellent Hydraulics - DriscoPlex® 5300 Climate Guard® pipe offers high volume flows with low flow resistance. The hydraulically smooth, non-wetting surface provides excellent flow properties. A Hazen-Williams C-factor of 150-155 is typically used to estimate flow resistance. DriscoPlex® 5300 Climate Guard® pipe does not rust, rot, corrode, tuberculate or support biological growth.

Sequential Footage Markings on coils to assist with proper depth setting in borehole installations.

DRISCOPEX® 5300 Climate Guard® Pipe and Fitting Products

Pipe

- PE 3408 DR 11- 3/4" IPS, 1" IPS, 1-1/4" IPS, 1-1/2" IPS, 2" IPS, 3" IPS and 4" IPS standard.
- PE 3408 DR 15.5 - 3" IPS, 4" IPS, 6" IPS and 8" IPS standard.
- Other sizes through 54" IPS, other DR's, and Schedule 40 available upon request.
- DriscoPlex® 5300 Climate Guard® Unicoil™ proprietary twin-coil with patented Polywing™ u-bend for down hole or horizontal loop applications - 3/4" IPS, 1" IPS and 1-1/4" IPS

Fittings and Valves

DriscoPlex® 5300 Climate Guard® molded fittings for butt fusion through 8" IPS and for socket fusion through 4" IPS.

Materials and Standards

DriscoPlex® 5300 Climate Guard® pipe and molded fittings are manufactured from high-density, high molecular weight PE 3408 polyethylene compound that meets or exceeds ASTM D 3350 cell classification 345464C, and is listed by the Plastic Pipe Institute in PPI TR-4 with HDB ratings of 1600 psi (11.04 MPa) at 73°F (23°C) and 800 psi (5.52 MPa) at 140°F (60°C).

DriscoPlex® 5300 Climate Guard® pipe is manufactured in accordance with ASTM D 3035. Molded fittings are manufactured in accordance with ASTM D 3261 (butt outlet) and ASTM D 2683 (socket outlet).

Secure Joining

DriscoPlex® 5300 Climate Guard® pipe and fittings are quickly joined by socket, butt or saddle heat fusion, electrofusion, or mechanical fittings. Climate Guard® 5300 mechanical connection fittings are available for joining to other materials or to itself. Suitable electrofusion fittings may also be used. Heat fusion joining procedures are available upon request.

Unicoil™ U-Bend Coil

Pre-Fused Polyethylene U-Bend Coils for Efficient, Reliable Installation

Until now, installers have spent precious field time fabricating u-bends from elbows and making-up u-bend coils for down hole and horizontal heat pump piping loops. But no more - Now there is Unicoil™ u-bend coil from Performance Pipe.

Unicoil™ u-bend coil is the original pre-fused polyethylene u-bend coil system created by Performance Pipe. Unicoil™ u-bend coil features the patented one-piece Polywing Unibend that is pre-fused to two coils of DriscoPlex® 5300 Climate Guard® pipe, all in one convenient package.

Unibend with Polywing - It Goes Down Easy, and Stays Down

Unibend is the first tight radius one-piece u-bend designed specifically for geothermal heat pump applications. The unique Unibend is factory pre-fused to two lengths of DriscoPlex® 5300 Climate Guard® pipe (supply and return) that are coiled together and banded into a single package for easy handling and quick field installation. Unibend features a pointed end for self-guiding installation to slide through the toughest borehole conditions. The one-piece Unibend design eliminates the third fusion where two elbows are fused together, thus fewer joints are buried at extreme depths.

Unibend features the patented Polywing anti-buoyancy attachment port to minimize the possibility of a loop assembly "floating" out of the borehole. When an anti-buoyancy wing tube is fitted through the Polywing attachment port, the wing tube folds against the Unibend during down-hole insertion, but the wing tube springs out to resist buoyant forces. The Polywing anti-buoyancy port may also be used to connect weights, stiffeners, or other devices without risking damage or compromising Unibend performance.



Configurations

DriscoPlex® 5300 Climate Guard® Unicoil™ piping systems are available in three pipe sizes and two pressure ratings.

- Pipe sizes: 3/4" IPS, 1" IPS or 1-1/4" IPS
- Working pressure ratings: SDR 11 160 psi water at 73°F (standard) or SDR 9 200 psi water at 73°F (special order) for deep installations or high static pressures.
- Outside width across Unibend†:

3/4" IPS & 1" IPS	3 1/4" wide
1-1/4" IPS	4" wide

† This dimension is the approximate outside width across the Unibend at the end of the Unicoil™ u-bend coil including the fusion beads. When used in downhole applications, appropriate clearance between the borehole and the outside width of the Unibend is required to allow downhole passage.

DriscoPlex® 5300 Climate Guard® Unicoil™ geothermal piping systems sets the standard for reliability, cost-efficiency and ease of installation in the ground source heat pump industry.

General Guidelines for Closed-Loop Ground-Source Heat Pump Applications

- Verify that the total system pressure, operating plus surge, does not exceed the pressure rating of the lowest rated component in the system.
- Carefully inspect the pipe to detect any damage that may have occurred during shipping or handling.
- Conduct hydrostatic leak testing in accordance with Performance Pipe procedures. *Do not test piping with pressurized air.*
- Install DriscoPlex® 5300 Climate Guard® piping products in accordance with accepted standards for water-source heat pump applications and ASTM D 2774 *Underground Installation of Thermoplastic Pressure Piping*.
- When laid in a trench, ensure that the trench bottom is smooth and free from sharp or angular objects. Embedment soils must be free from refuse, organic material, cobbles, boulders, large rocks or stones, and frozen clods. Blocking must not be used to change pipe grade or to intermittently support pipe across excavated sections.
- When installed down-hole, such as in a vertical loop, be sure any ballast used to facilitate down-hole insertion does not impinge, gouge or cut into the pipe.

Technical Information

Heat Transfer

Heat transfer properties of various materials can be expressed by a "K-Value". A higher K-Value reflects greater heat transfer properties.

<i>Material</i>	<i>K-Value, BTU-h/ft-°F</i>
DriscoPlex ¹ ™ 5300 Climate Guard [®] PE 3408	0.225
PVC	0.087

Table 1 Approximate Water Volume for 100 Feet of Pipe†

<i>Nominal Pipe Size</i>	<i>Gallons</i>	<i>Nominal Pipe Size</i>	<i>Gallons</i>
3/4" IPS DR 11	2.93	3" IPS DR 11	32.57
1" IPS DR 11	4.60	4" IPS DR 11	53.84
1-1/4" IPS DR 11	7.33	6" IPS DR 15.5	133.47
1-1/2" IPS DR 11	9.60	8" IPS DR 15.5	226.17
2" IPS DR 11	15.00		

* Approximate volume of water in U.S. gallons at 73°F for ASTM D 3035 nominal outside diameter and average wall thickness for pipe.

Table 2 Climate Guard[®] 5300 Pressure Rating (psi) vs. Temperature (°F)‡

<i>Temp, °F</i>	<i>DR 15.5</i>	<i>SDR 11</i>	<i>SDR 9**</i>
73	110	160	200
80	104	151	189
90	95	138	173
100	87	126	157
110	78	114	142
120	70	102	128
130	63	91	114
140	55	80	100

* PE 3408 pressure ratings for water. PE 3408 HDB = 1600 psi at 73°F and 800 psi at 140°F. Intermediate temperature LTHS interpolated in accordance with PPI TN-18. ** Optional SDR 9 for Unicoil™.

Table 3 Estimated Flow Properties for 100 Feet of Pipe - GPM, Pressure Drop (psi), Velocity (fps)†

GPM	3/4" IPS DR 11		1" IPS DR 11		1-1/4" IPS DR 11		1-1/2" IPS DR 11		2" IPS DR 11		3" IPS DR 11		4" IPS DR 11		6" IPS DR 15.5		8" IPS DR 15.5	
	psi	fps	psi	fps	psi	fps	psi	fps	psi	fps	psi	fps	psi	fps	psi	fps	psi	fps
2	0.34	1.14	0.11	0.73	0.04	0.46	0.02	0.35	0.01	0.22								
3	0.73	1.71	0.24	1.09	0.08	0.68	0.04	0.52	0.01	0.33								
4	1.24	2.27	0.41	1.45	0.13	0.91	0.07	0.69	0.02	0.44								
5	1.87	2.84	0.63	1.81	0.20	1.14	0.10	0.87	0.04	0.56	0.01	0.26						
6	2.62	3.41	0.88	2.18	0.28	1.37	0.15	1.04	0.05	0.67	0.01	0.31						
7	3.48	3.98	1.17	2.54	0.38	1.59	0.19	1.22	0.07	0.78	0.01	0.36						
8	4.46	4.55	1.49	2.90	0.48	1.82	0.25	1.39	0.08	0.89	0.01	0.41						
9	5.54	5.12	1.85	3.26	0.60	2.05	0.31	1.56	0.10	1.00	0.02	0.46						
10	6.74	5.69	2.25	3.63	0.73	2.28	0.38	1.74	0.13	1.11	0.02	0.51	0.01	0.31				
12			3.16	4.35	1.02	2.73	0.53	2.08	0.18	1.33	0.03	0.61	0.01	0.37				
15			4.77	5.44	1.54	3.41	0.80	2.60	0.27	1.67	0.04	0.77	0.01	0.46				
18			6.69	6.53	2.15	4.10	1.12	3.13	0.38	2.00	0.06	0.92	0.02	0.56				
21					2.86	4.78	1.48	3.65	0.50	2.33	0.08	1.07	0.02	0.65				
24					3.66	5.46	1.90	4.17	0.64	2.67	0.10	1.23	0.03	0.74				
27					4.56	6.14	2.36	4.69	0.80	3.00	0.12	1.38	0.04	0.84				
30					5.54	6.83	2.87	5.21	0.97	3.33	0.15	1.54	0.04	0.93				
35					7.37	7.96	3.82	6.08	1.29	3.89	0.20	1.79	0.06	1.08	0.01	0.44		
40							4.89	6.95	1.65	4.45	0.25	2.05	0.07	1.24	0.01	0.50		
45							6.08	7.81	2.05	5.00	0.31	2.30	0.09	1.39	0.01	0.56		
50							7.39	8.68	2.49	5.56	0.38	2.56	0.11	1.55	0.01	0.62		
55									2.97	6.11	0.45	2.81	0.13	1.70	0.01	0.69		
60									3.49	6.67	0.53	3.07	0.16	1.86	0.02	0.75		
70									4.65	7.78	0.70	3.58	0.21	2.17	0.02	0.87	0.01	0.52
80									5.95	8.89	0.90	4.09	0.27	2.48	0.03	1.00	0.01	0.59
90									7.40	10.00	1.12	4.61	0.33	2.79	0.04	1.12	0.01	0.66
100											1.36	5.12	0.40	3.10	0.04	1.25	0.01	0.84
110											1.63	5.63	0.48	3.41	0.05	1.37	0.01	0.81
120											1.91	6.14	0.56	3.72	0.06	1.50	0.02	0.88
130											2.21	6.65	0.65	4.02	0.07	1.82	0.02	0.96

†U.S. gallons of water. ASTM D 3035 nominal outside diameter & average wall thickness. Pressure drop estimated using Hazen-Williams C = 150 for water at 60°F.

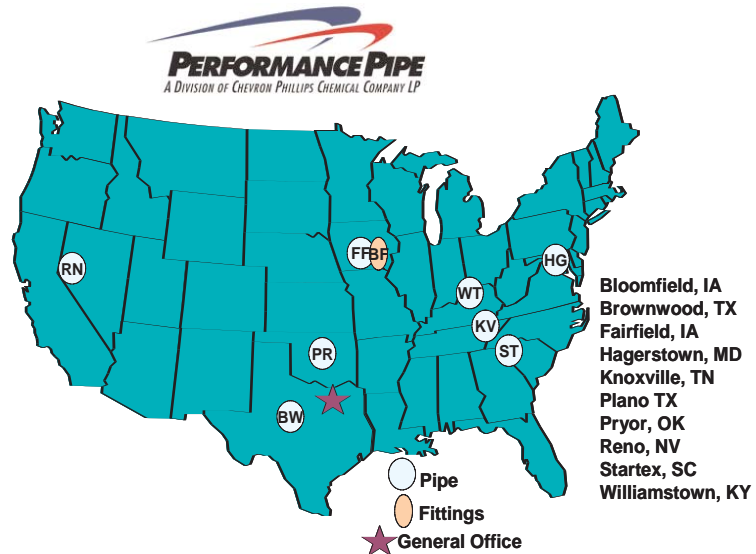
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PERFORMANCE PIPE Product Literature

Technical Notes & Bulletins*:

- PP 102-DS** DRISCOPLEX® 5300 Series Climate Guard® Geothermal Piping System Data Sheet
- PP 652** Model Specifications for DRISCOPLEX® 5300 Climate Guard® Systems

Model Specifications DRISCOPLEX[®] 5300 Series Climate Guard[®] Systems for Geothermal Applications

Scope: This specification designates requirements for geothermal (ground source heat pump) pipe and fittings.

Material: All pipe and heat fused materials shall be manufactured from high density, extra-high molecular weight PE 3408 material. The material shall maintain a 1600 psi Hydrostatic Design Basis at 73.4 degrees F per ASTM D-2837, and shall be listed in PPI TR4 as a PE3408 piping formulation. The material shall have a cell classification of 345464C as specified in ASTM D-3350.

Pipe: The extruded pipe shall conform to the specifications and requirements of ASTM D-3035. Clean rework material from the manufacturer's own production may be used provided the pipe or fittings meet all requirements of this specification. Recycled and reclaimed materials from outside the manufacturer's plant shall not be used. Pipe used for vertical bore applications shall include a factory-fused, single, piece, injection molded U-bend Polywing fitting. The approved pipe product is DRISCOPLEX[®] 5300 Series Climate Guard[®] Pipe from Performance Pipe.

Fittings: Molded fittings shall be manufactured to the specifications and requirements of ASTM D-2683 for socket fittings, ASTM D-3261 for butt fittings, ASTM F-1055 for electrofusion fittings and ASTM F-1924 Section 3.1.6.1 for Mechanical fittings. All fittings shall be rated for pressure service equivalent to SDR 11 PE 3408 pipe. The material used in fitting manufacture shall be the same approved base resin material as the connecting pipe.

The approved fittings are DRISCOPLEX[®] 5300 Series Climate Guard[®] Systems from Performance Pipe.

Joints: Approved joining methods are heat fusion, electrofusion, flanging, transition fittings and approved mechanical stab fittings. Persons performing heat fusion shall be qualified in accordance with the manufacturer's recommended fusion joining procedures. Electrofusion and mechanical joints shall be made in accordance with the fitting manufacturer's instructions.

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Manufacturer:The pipe and fittings manufacturer shall have in place a functional quality assurance program shall and be ISO (the International Organization for Standardization) Certified.

The approved manufacturer for pipe and fittings is Performance Pipe

Marking: Each pipe shall be durably marked with the manufacturer's name, nominal size, pressure rating, ASTM standard, material designation or cell classification number and date and location of manufacture. Coils shall be marked with footage marks at intervals no greater than two feet. Each fitting shall be identified with the manufacturer's name, nominal size, ASTM standard and lot number.

Installation: Construction and installation shall be in compliance with IGSHPA Standards (as amended from time to time) and all applicable local, state and federal regulations. The Contractor shall observe all appropriate safety requirements in accordance with local, state and federal codes and regulations.

Hydrotesting: The completed system shall be hydrostatically tested at a pressure not greater than 150% of the pipe pressure rating in accordance with Performance Pipe hydrostatic leak testing procedures. Testing with compressed air or a compressed gas is prohibited.

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DriscoPlex[®] 5300 Series PE3608 / (PE3408) Geothermal Systems Data Sheet

Typical Material Physical Properties of DriscoPlex[®] 5300 Series

High Density Polyethylene Materials

Property	Unit	Test Procedure	Typical Value
Material Designation	---	PPI TR-4	PE3608
Cell Classification	---	ASTM D3350	345464C
Pipe Properties			
Density	gms / cm ³	ASTM D1505	0.955 (black)
Melt Index Condition 190 / 2.16	gms / 10 minutes	ASTM D1238	0.08
Hydrostatic Design Basis 73°F (23°C)	psi	ASTM D2837	1600
Hydrostatic Design Basis 140°F (60°C)	psi	ASTM D2837	800
Color: UV Stabilizer [C] [E]	---	ASTM D3350	Min 2% carbon Black Color UV Stabilizer
Material Properties			
Flexural Modulus 2% Secant - 16:1 span: depth, 0.5 in / min.	psi	ASTM D790	>110,000
Tensile Strength at Yield	psi	ASTM D638 Type IV	3200
Elongation at Break 2 in / min., Type IV bar	%	ASTM D638	>800
Elastic Modulus	psi	ASTM D638	>150,000
Hardness	Shore D	ASTM D2240	62
PENT	hrs	ASTM F1473	>100
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	256
Brittleness Temperature	°F	ASTM D746	-103
Thermal Expansion	in / in / °F	ASTM D696	1.0 x 10 ⁻⁴

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NOTICE: This data sheet provides typical physical property information for polyethylene resins used to manufacture PERFORMANCE PIPE polyethylene piping products. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for piping products. Some of these typical physical property values were determined using compression molded plaques. Values obtained from tests of specimens taken from piping product can vary from these typical values. Performance Pipe has made every reasonable effort to ensure the accuracy of this data sheet, but this data sheet may not provide all necessary information, particularly with respect to special or unusual applications. The data sheet may be changed from time to time without notice. Contact Performance Pipe to determine if you have the most recent edition.

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Before using the piping product, the user is advised and cautioned to make its own determination and assessment of the safety and suitability of the piping product for the specific use in question and is further advised against relying on the information contained herein as it may relate to any specific use or application. It is the ultimate responsibility of the user to ensure that the piping product is suited and the information is applicable to the user's specific application. This data sheet provides typical physical property information for polyethylene resins used to manufacture the piping product. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for the piping product. These typical physical property values were determined using compression-molded plaques prepared from resin. Values obtained from tests of specimens taken from the piping product can vary from these typical values. Performance Pipe does not make, and expressly disclaims, all warranties, of merchantability or fitness for a particular purpose, regardless of whether oral or written, express or implied, allegedly arising from any usage of trade or from any course of dealing in connection with the use of information contained herein or the piping product itself. The user expressly assumes all risk and liability, whether based in contract, tort or otherwise, in connection with th