CULTEC CONTACTOR® & RECHARGER®

STORMWATER MANAGEMENT SYSTEMS

DESIGN MANUAL - COMMERCIAL

RETENTION • DETENTION • INFILTRATION • WATER QUALITY

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Visit www.cultec.com/downloads.html for Product Downloads and CAD details

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1.0 Introduction

1.1 ABOUT CULTEC

Since 1986, CULTEC has revolutionized the stormwater and wastewater management industries with our Contactor and Recharger septic and stormwater chambers. Our innovative underground storage solutions, commitment to industry innovation, exceptional client service, and value-engineered solutions have solidified CULTEC as the leader of underground stormwater management solutions.

1.2 OUR MISSION

CULTEC is committed to protecting one of Earth's most valuable resources, water. Our knowledgeable and courteous team of professionals provides creative solutions while forming long-lasting, loyal relationships. Understanding and caring for our client's needs motivates us to offer superior products and services, empowering our customers with the tools they need to succeed.

1.3 CULTEC ADVANTAGES

The CULTEC Contactor and Recharger chambers replace conventional stormwater management systems such as ponds, swales, pipe and stone beds, and concrete vaults. The chambers may also be used for residential drywells. The system's modular design allows endless configurations to suit the shape of any site, and the variety of chamber heights can meet the depth constraint of nearly any project. The chambers may be installed beneath parking areas, greenspaces, athletic fields, and other finished surfaces to capitalize on the use of space and maximize land values.

CULTEC offers the largest variety of chamber sizes on the market and therefore can accommodate almost any site constraint. Chamber sizes range from 12" to 48" (305mm-1219mm) tall.

System benefits include:

- Maximum use of land area
- Detention, retention, and water quality
- Lightweight
- Modular design
- Less heavy equipment required
- Overlapping corrugation connection is fast and easy to install
- Chemically resistant and UV protected with a minimum 50-year design service life
- Capable of withstanding AASHTO HS-20/HS-25 defined traffic loads
- Meets ASTM criteria for plastic chambers
- Efficient shipping and stockpiling
- Economical hydraulic distribution manifold

1.4 TECHNICAL SUPPORT

CULTEC's Technical Services Department provides top-notch engineering and technical support for your stormwater management project. From conceptual design calculations, selection of the optimal chamber model and detailed submittal drawings, our Technical Services Department is here to help. The CULTEC Technical Services Department is the most experienced in the industry and can assist with solutions for even the most challenging sites.

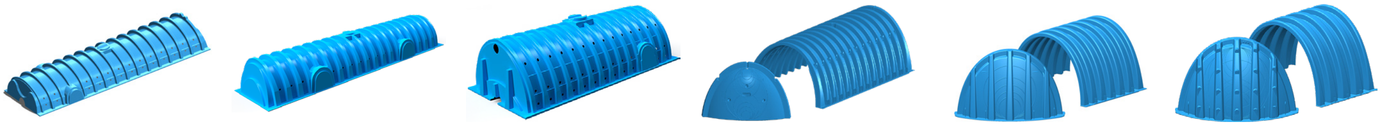
In addition to our Technical Services Department, we have Professional Engineers throughout the United States available to assist with design challenges.

Email CT-Tech@cultec.com

2.0 Product Information

2.1 PRODUCT OVERVIEW

CULTEC offers the largest selection of chamber sizes in the industry. From the low-profile Contactor (C) Series chambers to the high-profile Recharger (R) Series, our chambers can suit the storage and or infiltration needs of any site. CULTEC's unique modular design with overlapping corrugation provides the design engineer with tremendous design flexibility. Flexible chamber configurations allow avoidance of site obstacles and fit within even the most unique system shapes. The large variety of chamber heights provides vertical design flexibility to the design engineer. Additionally, CULTEC offers a full line of stormwater system accessories including geosynthetics, water-quality and maintenance devices, inspection ports, area drains and, the CULTEC HVLV internal manifold feature. The CULTEC internal manifold increases site design flexibility by eliminating the need, in most cases, for an elaborate external manifold system with storm pipe and fittings.



Shown: Contactor 100HD, Recharger 150XLHD, Recharger 280HD, Recharger 300HD, Recharger 360HD, and Recharger 902HD

Table 2.1: Chamber Model and Abbreviation Table

Full Model Name	Abbreviated Model Name
Contactor 100HD	C-100HD
Recharger 150XLHD	R-150XLHD
Recharger 280HD	R-280HD
Recharger 300HD	R-300HD
Recharger 300HD End Cap	R-300HD EC
Recharger 360HD	R-360HD
Recharger 360HD End Cap	R-360HD EC
Recharger 902HD	R-902HD
Recharger 902HD End Cap	R-902HD EC

2.2 SYSTEM ACCESSORIES

CULTEC offers a full line of accessory products to complete the system.

- Geosynthetics
- Inspection Ports and Grated Inlets
- Distribution Manifolds

Fig. 2.2: Typical CULTEC Stormwater System Components

1. CULTEC Stormwater Chamber - used for retention, detention, infiltration, reclamation
2. CULTEC HVLV™ Feed Connector - internal manifold component
3. CULTEC Separator™ Row/ ADS Isolator Row Plus- water quality filtration row
4. CULTEC No. 410™ Non-woven Geotextile - prevents soil intrusion into system
5. ADS Isolator Row Plus Geotextile- placed under CULTEC manifold components, prevents scouring of stone base
6. Stone - used for stone base, embedment stone and stone above chambers

2.3 CHAMBER MODEL SELECTION

Key considerations in selecting an appropriate chamber model for a given site typically include the depth to groundwater or other subsurface restrictive layers, the invert elevation of the downstream storm sewer or final outfall, the minimum footprint area required to achieve the target infiltration drawdown time, and the available horizontal space for system installation. The design engineer must ensure that the system provides adequate minimum cover to support anticipated service loads, while also remaining within the maximum allowable cover limits specified. In general, the largest chamber model that satisfies all applicable design constraints is preferred to optimize system performance and efficiency.

If a project falls outside the guidelines outlined in this manual, contact CULTEC Technical Services, as alternative solutions may still be available to meet site-specific requirements.

Visit www.cultec.com/downloads.html for Product Downloads and CAD details.

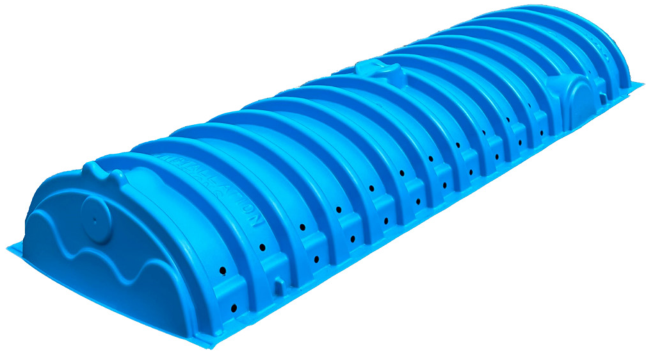
CULTEC Contactor® 100HD

Size (L x W x H)	8' x 36" x 12.5" 2.44 m x 914 mm x 318 mm
Installed Length	7.5' 2.29 m
Length Adjustment per Run	0.5' 0.15 m
Bare Chamber Storage	1.87 ft^3/ft 0.17 m^3/m 14.00 ft^3/unit 0.40 m^3/unit
Min. Installed Storage	3.84 ft^3/ft 0.36 m^3/m 28.81 ft^3/unit 0.82 m^3/unit
Min. Area Required	25 ft^2 2.32 m^2
Min. Center to Center Spacing	3.33' 1.02 m
Max. Allowable Cover	8' 2.4 m
Max. Inlet Opening in End Wall	10" 250 mm
Max. Allowable O.D. in Side Portal	6.9" 175 mm
Compatible Feed Connector	HVLV SFCx2 Feed Connector

Calculations are based on installed chamber length.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 40" (1016 mm) center-to-center spacing.

	Stone Foundation Depth		
	6" 152 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	28.81 ft^3 0.82 m^3	33.81 ft^3 0.96 m^3	38.81 ft^3 1.10 m^3
Min. Effective Depth	2.04' 0.62 m	2.54' 0.77 m	3.04' 0.93 m
Stone Required Per Chamber	1.37 yd^3 1.05 m^3	1.84 yd^3 1.40 m^3	2.30 yd^3 1.76 m^3

Calculations are based on installed chamber length.
Includes 6" (305 mm) stone above crown of chamber and typical stone surround at 40" (1016 mm) center-to-center spacing and stone foundation as listed in table.
Stone void calculated at 40%.



Contactor® 100HD Bare Chamber Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft^3/ft	m^3/m	ft^3	m^3	ft^3	m^3
12	305	0.009	0.001	0.068	0.002	13.995	0.396
11	279	0.067	0.006	0.503	0.014	13.928	0.394
10	254	0.110	0.010	0.825	0.023	13.425	0.380
9	229	0.139	0.013	1.043	0.030	12.600	0.357
8	203	0.159	0.015	1.193	0.034	11.558	0.327
7	178	0.174	0.016	1.305	0.037	10.365	0.294
6	152	0.184	0.017	1.380	0.039	9.060	0.257
5	127	0.192	0.018	1.440	0.041	7.680	0.217
4	102	0.203	0.019	1.523	0.043	6.240	0.177
3	76	0.203	0.019	1.523	0.043	4.718	0.134
2	51	0.203	0.019	1.523	0.043	3.195	0.090
1	25	0.223	0.021	1.673	0.047	1.673	0.047
Total		**1.866**	**0.173**	**13.995**	**0.396**	**13.995**	**0.396**

Calculations are based on installed chamber length.

CULTEC Recharger® 150XLHD

Size (L x W x H)	11' x 33" x 18.5" 3.35 m x 838 mm x 470 mm
Installed Length	10.25' 3.12 m
Length Adjustment per Run	0.75' 0.23 m
Bare Chamber Storage	2.65 ft^3/ft 0.25 m^3/m 27.16 ft^3/unit 0.77 m^3/unit
Min. Installed Storage	4.89 ft^3/ft 0.45 m^3/m 50.17 ft^3/unit 1.42 m^3/unit
Min. Area Required	33.31 ft^2 3.09 m^2
Min. Center-to-Center Spacing	3.25' 0.99 m
Max. Allowable Cover	8' 2.4 m
Max. Inlet Opening in End Wall	12" 300 mm
Max. Allowable O.D. in Side Portal	10.25" 260 mm
Compatible Feed Connector	HVLV FC-24 Feed Connector

Calculations are based on installed chamber length.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 39"(991 mm) center-to-center spacing.

	Stone Foundation Depth		
	6" 152 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	50.17 ft^3 1.42 m^3	56.83 ft^3 1.61 m^3	63.49 ft^3 1.80 m^3
Min. Effective Depth	2.54' 0.77 m	3.04' 0.93 m	3.54' 1.08 m
Stone Required Per Chamber	2.13 yd^3 1.63 m^3	2.75 yd^3 2.10 m^3	3.36 yd^3 2.57 m^3

Calculations are based on installed chamber length.
Includes 6" (305 mm) stone above crown of chamber and typical stone surround at 39"(991 mm) center-to-center spacing and stone foundation as listed in table.
Stone void calculated at 40%.

Recharger® 150XLHD Bare Chamber Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft^3/ft	m^3/m	ft^3	m^3	ft^3	m^3
18.5	470	0.006	0.001	0.062	0.002	27.193	0.770
18	457	0.010	0.001	0.103	0.003	27.132	0.768
17	432	0.032	0.003	0.328	0.009	27.029	0.765
16	406	0.077	0.007	0.789	0.022	26.701	0.756
15	381	0.102	0.009	1.046	0.030	25.912	0.734
14	356	0.119	0.009	1.220	0.035	24.867	0.704
13	330	0.134	0.011	1.374	0.039	23.647	0.670
12	305	0.146	0.012	1.497	0.042	22.273	0.631
11	279	0.156	0.014	1.599	0.045	20.777	0.588
10	254	0.165	0.015	1.691	0.048	19.178	0.543
9	229	0.172	0.016	1.763	0.050	17.487	0.495
8	203	0.179	0.017	1.835	0.052	15.724	0.445
7	178	0.184	0.017	1.886	0.053	13.889	0.393
6	152	0.188	0.017	1.927	0.055	12.003	0.340
5	127	0.191	0.018	1.958	0.055	10.076	0.285
4	102	0.193	0.018	1.978	0.056	8.118	0.230
3	76	0.195	0.018	1.999	0.057	6.140	0.174
2	51	0.197	0.018	2.019	0.057	4.141	0.117
1	25	0.207	0.019	2.122	0.060	2.122	0.060
Total		**2.650**	**0.246**	**27.193**	**0.770**	**27.193**	**0.770**

Calculations are based on installed chamber length.

CULTEC Recharger® 280HD

Size (L x W x H)	8' x 47" x 26.5" 2.44 m x 1194 mm x 673 mm
Installed Length	7' 2.13 m
Length Adjustment per Run	1' 0.30 m
Bare Chamber Storage	6.08 ft^3/ft 0.56 m^3/m 42.55 ft^3/unit 1.21 m^3/unit
Min. Installed Storage	9.21 ft^3/ft 0.86 m^3/m 64.46 ft^3/unit 1.83 m^3/unit
Min. Area Required	30.33 ft^2 2.82 m^2
Min. Center-to-Center Spacing	4.33' 1.32 m
Max. Allowable Cover	8' 2.4 m
Max. Inlet Opening in End Wall	18" 450 mm
Max. Allowable O.D. in Side Portal	12.25" 311 mm
Compatible Feed Connector	HVLV FC-24 Feed Connector

Calculations are based on installed chamber length.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 52"(1321 mm) center-to-center spacing.

	Stone Foundation Depth		
	6" 152 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	64.46 ft^3 1.83 m^3	70.53 ft^3 2.00 m^3	76.59 ft^3 2.17 m^3
Min. Effective Depth	3.21' 0.98 m	3.71' 1.13 m	4.21' 1.28 m
Stone Required Per Chamber	2.03 yd^3 1.55 m^3	2.59 yd^3 1.98 m^3	3.15 yd^3 2.41 m^3

Calculations are based on installed chamber length.
Includes 6" (305 mm) stone above crown of chamber and typical stone surround at 52"(1321 mm) center-to-center spacing and stone foundation as listed in table.
Stone void calculated at 40%.

Recharger® 280HD Bare Chamber Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft^3/ft	m^3/m	ft^3	m^3	ft^3	m^3
26.5	686	0.000	0.000	0.000	0.000	42.553	1.205
26	660	0.018	0.002	0.126	0.004	42.553	1.205
25	635	0.047	0.004	0.329	0.009	42.427	1.202
24	609	0.100	0.009	0.700	0.020	42.098	1.192
23	584	0.134	0.012	0.938	0.027	41.398	1.172
22	559	0.159	0.015	1.113	0.032	40.460	1.146
21	533	0.179	0.017	1.253	0.035	39.347	1.114
20	508	0.195	0.018	1.365	0.039	38.094	1.079
19	483	0.209	0.019	1.463	0.041	36.729	1.040
18	457	0.221	0.021	1.547	0.044	35.266	0.999
17	432	0.232	0.022	1.624	0.046	33.719	0.955
16	406	0.241	0.022	1.687	0.048	32.095	0.909
15	381	0.249	0.023	1.743	0.049	30.408	0.861
14	356	0.263	0.024	1.841	0.052	28.665	0.812
13	330	0.267	0.025	1.869	0.053	26.824	0.760
12	305	0.271	0.025	1.897	0.054	24.955	0.707
11	279	0.275	0.026	1.925	0.055	23.058	0.653
10	254	0.279	0.026	1.953	0.055	21.133	0.598
9	229	0.287	0.027	2.009	0.057	19.180	0.543
8	203	0.292	0.027	2.044	0.058	17.171	0.486
7	178	0.294	0.027	2.058	0.058	15.127	0.428
6	152	0.305	0.028	2.135	0.060	13.069	0.370
5	127	0.306	0.028	2.142	0.061	10.934	0.310
4	102	0.308	0.029	2.156	0.061	8.792	0.249
3	76	0.310	0.029	2.170	0.061	6.636	0.188
2	51	0.312	0.029	2.184	0.062	4.466	0.126
1	25	0.326	0.030	2.282	0.065	2.282	0.065
Total		**6.079**	**0.565**	**42.553**	**1.205**	**42.553**	**1.205**

Calculations are based on installed chamber length.

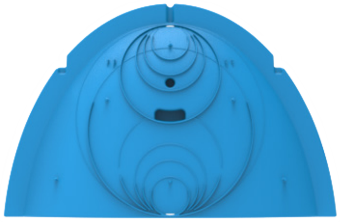
CULTEC Recharger® 300HD

Recharger 300HD Chamber	
Size (L x W x H)	7.54' x 51" x 30" 2.29 m x 1295 mm x 762 mm
Installed Length	7.08' 2.16 m
Length Adjustment per Row - with two end caps installed	0.89' 0.27 m
Length Adjustment per Row - when not using end caps	0.46' 0.14 m
Chamber Storage	6.53 ft³/ft 0.61 m³/m 46.27 ft³/unit 1.31 m³/unit
Min. Installed Storage	10.57 ft³/ft 0.98 m³/m 74.44 ft³/unit 2.12 m³/unit
Min. Area Required	33.65 ft² 3.13 m²
Chamber Weight	80.4 lbs 36.47 kg
Shipping	25 chambers/skid 12 skids/48' flatbed
Min. Center-to-Center Spacing	4.75' 1.45 m
Max. Allowable Cover	12' 3.66 m
Max. Allowable O.D. in Side Portal	10" HDPE, 12" PVC 250 mm HDPE, 300 mm PVC
Compatible Feed Connector	HVLV FC-24 Feed Connector

Calculations are based on installed chamber length.
All above values are nominal.
Includes 6" (152 mm) stone above crown of chamber and typical stone surround at 4.75' (1.45 m) center-to-center spacing and stone foundation depth as listed in table.
Stone void calculated at 40%.

	Stone Foundation Depth		
	6" 152 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	74.84 ft³ 2.12 m³	101.94 ft³ 2.89 m³	107.26 ft³ 3.04 m³
Min. Effective Depth	3.5' 1.07 m	6.00' 1.83 m	6.5' 1.98 m
Stone Required Per Chamber	71.44 ft³ 2.12 m³	88.25 ft³ 2.50 m³	105.07 ft³ 2.98 m³

Recharger 300HD Chamber



Recharger 300HD End Cap

Recharger 300HD End Cap	
Size (L x W x H)	12.2" x 45.9" x 29.3" 310 mm x 1166 mm x 744 mm
Installed Length	9.6" 244 mm
End Cap Storage	3.32 ft³/ft 0.31 m³/m 2.565 ft³/unit 0.08 m³/unit
Min. Installed Storage	16.95 ft³/ft 1.57 m³/m 13.56 ft³/unit 0.38 m³/unit
End Cap Weight	13.7 lbs 6.21 kg
Shipping	60 end caps/skid 922 lbs/skid 11 skids/48' flatbed
Max. Inlet Opening in End Cap	24" HDPE, 24" PVC 600 mm HDPE, 600 mm PVC

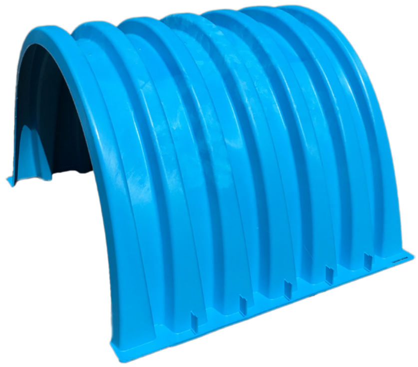
Calculations are based on installed chamber length.
All above values are nominal.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 4.75' (1.25 m) center-to-center spacing.

CULTEC Recharger® 360HD

Recharger 360HD Chamber	
Size (L x W x H)	4.17' x 60" x 36" 1.27 m x 1525 mm x 914 mm
Installed Length	3.67' 1.12 m
Length Adjustment per Row - with two end caps installed	2.5' 0.76 m
Length Adjustment per Row - when not using end caps	0.5' 0.15 m
Chamber Storage	10.00 ft^3/ft 0.929 m^3/m 36.66 ft^3/unit 1.038 m^3/unit
Min. Installed Storage	15.199 ft^3/ft 1.412 m^3/m 55.73 ft^3/unit 1.58 m^3/unit
Min. Area Required	21.08 ft^2 1.96 m^2
Chamber Weight	57.0 lbs 25.85 kg
Shipping	20 chambers/skid 1,265 lbs/skid 11 skids/48' flatbed
Min. Center-to-Center Spacing	5.75' 1.75 m
Max. Allowable Cover	12' 3.66 m
Max. Allowable O.D. in Side Portal	10" HDPE, 12" PVC 250 mm HDPE, 300 mm PVC
Compatible Feed Connector	HVLV FC-48 Feed Connector

Calculations are based on installed chamber length.
All above values are nominal.
Min. installed storage includes 6" (152 mm) stone base, 6" (152 mm) stone above crown of chamber and typical stone surround at 5.75 (1.75 m) center-to-center spacing.

	Stone Foundation Depth		
	6" 152 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	55.73 ft^3 1.58 m^3	59.95 ft^3 1.70 m^3	64.17 ft^3 1.82 m^3
Min. Effective Depth	4.00' 1.22 m	4.50' 1.37 m	5.0' 1.52 m
Stone Required Per Chamber	1.77 yd^3 1.35 m^3	2.16 yd^3 1.65 m^3	2.55 yd^3 1.95 m^3



Recharger 360HD Chamber

Recharger 360HD End Cap

Recharger 360HD End Cap	
Size (L x W x H)	18" x 60" x 36.5" 458 mm x 1525 mm x 927 mm
Installed Length	15" 381 mm
End Cap Storage	5.17 ft^3/ft 0.48 m^3/m 6.46 ft^3/unit (interlocked) 0.183 m^3/unit (interlocked)
Min. Installed Storage	12.40 ft^3/ft 1.15 m^3/m 15.50 ft^3/unit 0.44 m^3/unit
End Cap Weight	22.0 lbs 9.98 kg
Shipping	20 end caps/skid 565 lbs/skid 11 skids/48' flatbed
Max. Inlet Opening in End Cap	24" HDPE, 30" PVC 600 mm HDPE, 750 mm PVC

Calculations are based on installed chamber length.
Includes 6" (305 mm) stone above crown of chamber and typical stone surround at. 5.75' (1.75 m) center-to-center spacing and stone foundation as listed in table.
Stone void calculated at 40%.

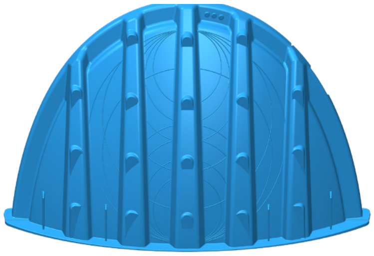
CULTEC Recharger® 902HD

Recharger 902HD Chamber	
Size (L x W x H)	4.25' x 78" x 48" 1.30 m x 1981 mm x 1219 mm
Installed Length	3.67' 1.12 m
Length Adjustment per Row - with two end caps installed	1.03' 0.31 m
Length Adjustment per Row - when not using end caps	0.58' 0.18 m
Chamber Storage	17.31 ft^3/ft 1.61 m^3/m 63.47 ft^3/unit 1.80 m^3/unit
Min. Installed Storage	27.06 ft^3/ft 2.53 m^3/m 99.28 ft^3/unit 2.81 m^3/unit
Min. Area Required	26.58 ft^2 2.47 m^2
Chamber Weight	83.0 lbs 37.65 kg
Shipping	15 chambers/skid 1,370 lbs/skid 14 skids/48' flatbed
Min. Center-to-Center Spacing	7.25' 2.21 m
Max. Allowable Cover	8.3' 2.53 m
Max. Allowable O.D. in Side Portal	10" HDPE, 12" PVC 250 mm HDPE, 300 mm PVC
Compatible Feed Connector	HVLV FC-48 Feed Connector

Calculations are based on installed chamber length.
All above values are nominal.
Includes 12" (305 mm) stone above crown of chamber and typical stone surround at 7.25' (2.21 m) center-to-center spacing and stone foundation depth as listed in table.
Stone void calculated at 40%.

	Stone Foundation Depth		
	9" 229 mm	12" 305 mm	18" 457 mm
Chamber and Stone Storage Per Chamber	99.28 ft^3 2.81 m^3	101.94 ft^3 2.89 m^3	107.26 ft^3 3.04 m^3
Min. Effective Depth	5.75' 1.75 m	6.00' 1.83 m	6.5' 1.98 m
Stone Required Per Chamber	3.32 yd^3 2.54 m^3	3.56 yd^3 2.72 m^3	4.05 yd^3 3.06 m^3

Recharger 902HD Chamber



Recharger 902HD End Cap

Recharger 902HD End Cap	
Size (L x W x H)	28.0" x 78.0" x 48.5" 711 mm x 1982 mm x 1231 mm
Installed Length	24.0" 610 mm
End Cap Storage	9.01 ft^3/ft 0.83 m^3/m 18.02 ft^3/unit 0.51 m^3/unit
Min. Installed Storage	22.08 ft^3/ft 2.05 m^3/m 44.16 ft^3/unit 1.25 m^3/unit
End Cap Weight	46.0 lbs 20.86 kg
Shipping	10 end caps/skid 540 lbs/skid 14 skids/48' flatbed
Max. Inlet Opening in End Cap	30" HDPE, 36" PVC 750 mm HDPE, 900 mm PVC

Calculations are based on installed chamber length.
All above values are nominal.
Min. installed storage includes 9" (229 mm) stone base, 12" (305 mm) stone above crown of chamber and typical stone surround at 7.25' (2.21 m) center-to-center
spacing.

2.4 CHAMBER INFORMATION TABLE

Table 2.4

	UOM	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 300HD	Recharger 360HD	Recharger 902HD
Material		PE	PE	PE	PP	PP	PP
Weight	lbs.	35	54	63	80	58	94
	kg	16	24	29	36	26	43
Installed Length	ft	7.5	10.25	7.00	7.08	3.67	3.67
	m	2.29	3.12	2.13	2.16	1.12	1.12
Width	in	36	33	47	51	60	78
	mm	914	838	1194	1295	1524	1981
Height	in	12.5	18.5	26.5	30	36	48
	mm	318	470	673	762	914	1219
Row Spacing	in	4	6	5	6	9	9
	mm	102	152	127	152	229	229
Center-to-Center Spacing	in	40	39	52	57	69	87
	mm	1016	991	1321	1448	1753	2210
Bare Chamber Storage	ft^3/ft	1.87	2.65	6.08	6.53	10.00	17.31
	m^3/m	0.17	0.25	0.56	0.61	0.93	1.61
Bare Chamber Storage	ft^3/unit	14.00	27.16	42.55	46.27	36.66	63.47
	m^3/unit	0.40	0.77	1.20	1.31	1.04	1.80
Min. Installed Storage	ft^3/ft	3.84	4.89	9.21	10.57	15.20	27.08
	m^3/m	0.36	0.45	0.86	0.98	1.41	2.52
Min. Installed Storage	ft^3/unit	28.81	50.17	64.46	74.44	55.73	99.28
	m^3/unit	0.82	1.42	1.83	2.11	1.58	2.81
Min. Storage per unit of area	ft^3/ft^2	1.15	1.51	2.13	2.32	2.64	3.73
	m^3/m^2	0.35	0.46	0.65	0.71	0.81	1.14
Min. Installation Depth	in	36.5	42.5	50.5	54	60	81
	mm	925	1078	1181	1371	1524	2058
Min. Stone Below Chambers	in	6	6	6	6	6	9
	mm	152	152	152	152	152	229
Min. Stone Above Chambers	in	6	6	6	6	6	12
	mm	152	152	152	152	152	305
Min. Fill Above Stone and Below Pavement	in	12	12	12	12	12	12
	mm	300	300	300	305	305	305
Min. Cover Below Pavement	in	18	18	18	18	18	24
	mm	450	450	450	450	450	610
Min. Fill Above Stone (Unpaved Surface)	in	14	14	14	18	18	18
	mm	350	350	350	457	457	457
Min. Cover (Unpaved Surface)	in	20	20	20	24	24	30
	mm	500	500	500	610	610	762
Max. Cover	ft	8	8	8	12	12	8.3
	m	2.4	2.4	2.4	3.66	3.66	2.53
Max. PVC Pipe Connection	in	10	15	21	24	30	42
	mm	250	375	525	600	750	900
Max. HDPE Pipe Connection	in	10	12	21	24	30	36
	mm	250	300	525	600	750	750
End Cap		Integral	Integral	Integral	Separate	Separate	Separate

2.5 MINIMUM AND MAXIMUM COVER SPECIFICATIONS

CULTEC chambers require a sufficient minimum depth of cover to carry the intended service loads, and the design engineer must ensure the depth of cover above the chambers does not exceed the maximum allowed. Table 2.5 summarizes the minimum required and maximum allowable cover for each chamber model below:

Table 2.5

Chamber Model	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 300HD	Recharger 360HD	Recharger 902HD
Chamber Height	12.5″ 318mm	18.5″ 470mm	26.5″ 673mm	30" 762mm	36.0″ 914mm	48.0″ 1219mm
*Minimum Cover Required (Paved Traffic)	18″ 450mm	18″ 450mm	18″ 450mm	18″ 450mm	18″ 450mm	24″ 600mm
**Minimum Total Depth Required (Paved Traffic)	36.5″ 925mm	42.5″ 1078mm	50.5″ 1181mm	54″ 1371mm	60″ 1524mm	81″ 2058mm
Minimum Cover Required (Unpaved Traffic)	20″ 500mm	20″ 500mm	20″ 500mm	24″ 600mm	24″ 600mm	30″ 750mm
**Minimum Total Depth Required (Unpaved Traffic)	38.5″ 976mm	44.5″ 1128mm	52.5″ 1332mm	60″ 1524mm	66″ 1676mm	87″ 2210mm
***Minimum Cover Required (Non-Traffic)	12″ 300mm	12″ 300mm	12″ 300mm	12″ 300mm	12″ 300mm	12" 300mm
Minimum Total Depth Required (Non-Traffic)	30.5″ 775mm	36.5″ 927mm	44.5″ 1130mm	48″ 1219mm	54″ 1372mm	69″ 1753mm
****Maximum Cover (All Traffic and Non-Traffic)	8′ 2.4m	8′ 2.4m	8′ 2.4m	12′ 3.66m	12′ 3.66m	8.3′ 2.53m

*Minimum cover dimension to underside of flexible pavement or to top of reinforced rigid concrete pavement. Pavement base layers may be included in minimum cover dimension.
**Minimum depth required dimension assumes typical minimum thickness of bedding and embedment stone.
***All CULTEC chambers installed in a non-traffic greenspace application require 12-inch minimum cover from finished grade to top of chamber. The 12 inches may consist of soil, stone, or any combination of the two.
****Contact CULTEC Technical Services for deep-cover applications.

2.6 MINIMUM CHAMBER SPACING SPECIFICATIONS

CULTEC chambers require sufficient spacing between adjacent rows to carry the intended service loads. The design engineer must ensure the spacing provided between chamber rows meets the minimum required. Row spacing may exceed these minimums if additional footprint area is required. Table 2.6 summarizes the minimum required spacing between chamber rows for each chamber model:

Table 2.6

	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 300HD	Recharger 360HD	Recharger 902HD
Chamber Width	36″ 914mm	33″ 838mm	47″ 1194mm	51″ 1295mm	60″ 1525mm	78″ 1981mm
Minimum Row Spacing Required	4″ 102mm	6″ 152mm	5″ 125mm	6″ 152mm	9″ 229mm	9″ 229mm
Minimum Stone Border Required	12″ 300mm	12″ 300mm	12″ 300mm	12″ 300mm	12″ 300mm	12″ 300mm

2.7 CHAMBER LENGTH

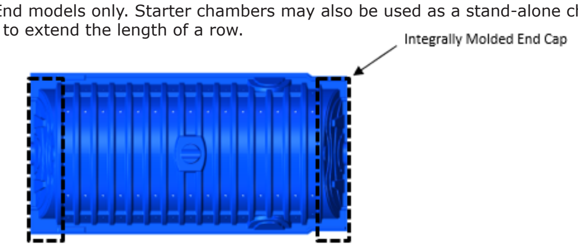
CULTEC chamber models Contactor 100HD, Recharger 150XLHD, and Recharger 280HD include integrally molded end caps. Models Recharger 300HD, Recharger 360HD, and Recharger 902HD have separate end caps. Starter and End chambers have additional installed lengths to account for these integrally molded end caps. Table 2.7 summarizes the correct installed chamber length for each model and sub-model. The design engineer and CAD designers should refer to this table when including CULTEC chambers into their drawings to ensure accurate system sizing.

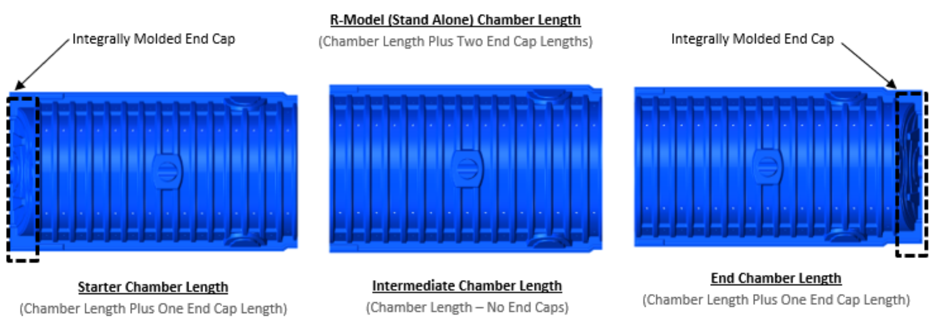
Table 2.7

	Starter	Intermediate	End	Stand-Alone R-Model	End Cap
Contactor 100HD	7.75′	7.5′	7.75′	8.0′	
	2.36m	2.296m	2.36m	2.44m	
Recharger 150XLHD	10.63′	10.25′	10.63′	11.0′	
	3.24m	3.12m	3.24m	3.35m	
Recharger 280HD	7.50′	7.0′	7.50′	8.0′	
	2.29m	2.13m	2.29m	2.44m	
Recharger 300HD		7.08'			0.8'
		2.16m			0.244m
Recharger 360HD		3.67′			1.25′
		1.12m			0.375m
Recharger 902HD		3.67′			2.00′
		1.12m			0.61m

*Contactor Series Chambers are manufactured as Starter and End models only. Starter chambers may also be used as a stand-alone chamber (R-Model). End chamber models are used to end a row as well as act as an intermediate to extend the length of a row.

Fig. 2.7: Chamber Lengths





2.8 CHAMBER END CAPS

CULTEC produces chambers with both integrally molded end caps as well as separate end caps. Storage calculations, drawing dimensions and drawing appearance are dependent upon the type of end cap used.

Fig. 2.8

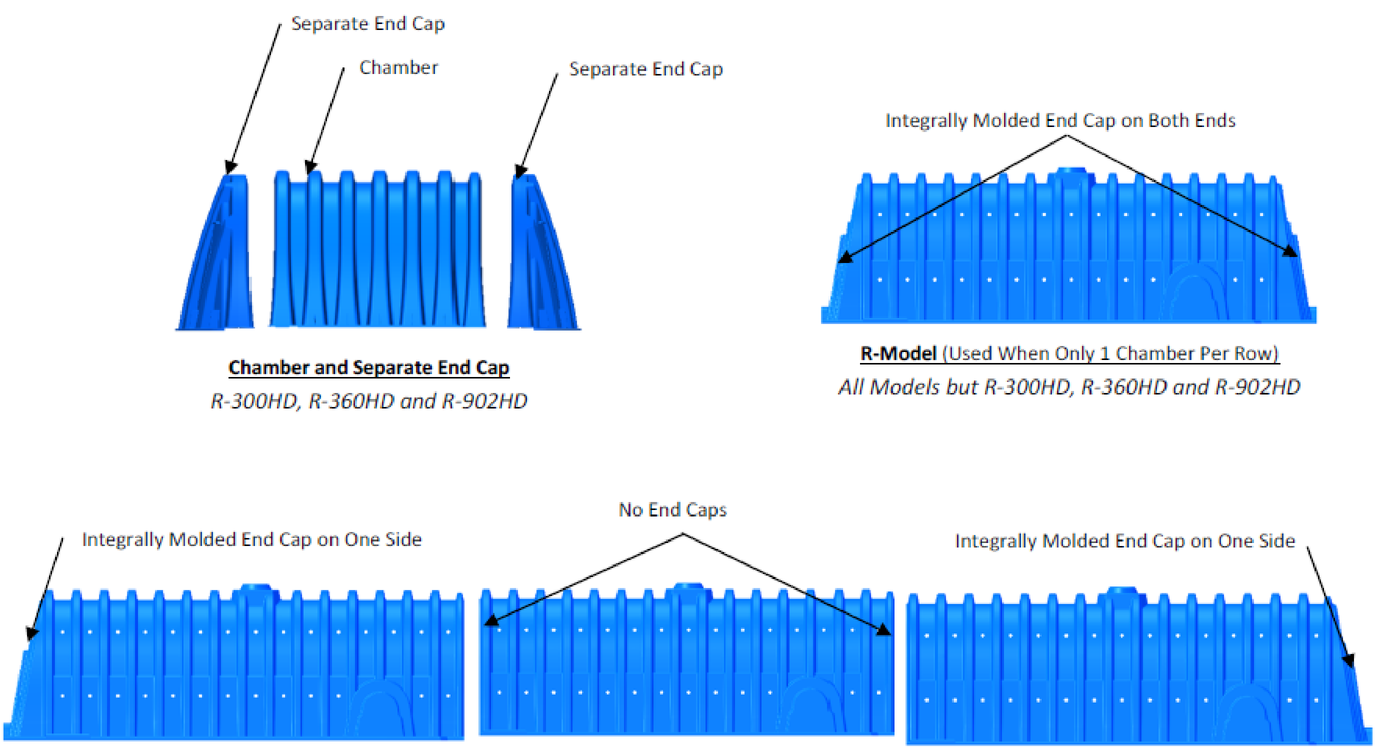
Separate End Cap Example

Integrally Molded End Cap Example

2.9 CHAMBER MODELS AND SUB-MODELS

Models R-300HD, R-360HD and R-902HD require separate end caps and do not contain sub-model types. However, models with integrally molded end caps do contain sub-models. C-100HD, R-150XLHD, and R-280HD models include sub-models with unique length dimensions and appearances when drawn. The bill of materials will also vary if the chamber model uses separate end caps or integrally molded end caps. The following images are examples of each type:

Fig. 2.9



Chamber and Separate End Cap
R-300HD, R-360HD and R-902HD

R-Model (Used When Only 1 Chamber Per Row)
All Models but R-300HD, R-360HD and R-902HD

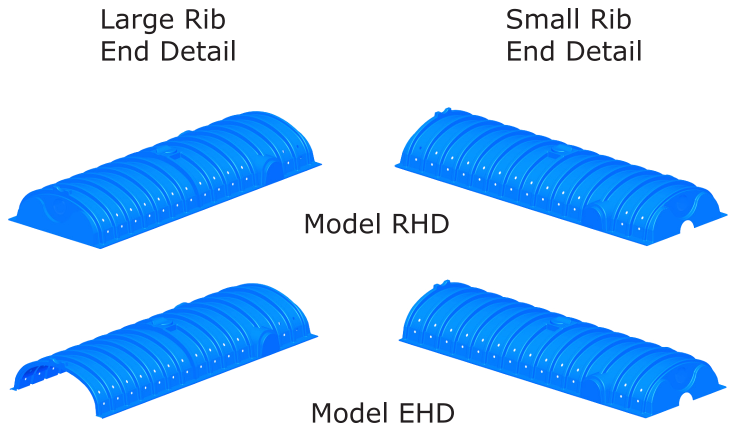
Starter Model Used to Begin Each Row
All Models but R-300HD, R-360HD and R-902HD

Intermediate-Model Used in Center of Each Row
All Models but R-300HD, R-360HD and R-902HD

End Model Used to End Each Row
All Models but R-300HD, R-360HD and R-902HD

2.9.1 Contactor® 100HD End Detail Information

Fig. 2.9.1



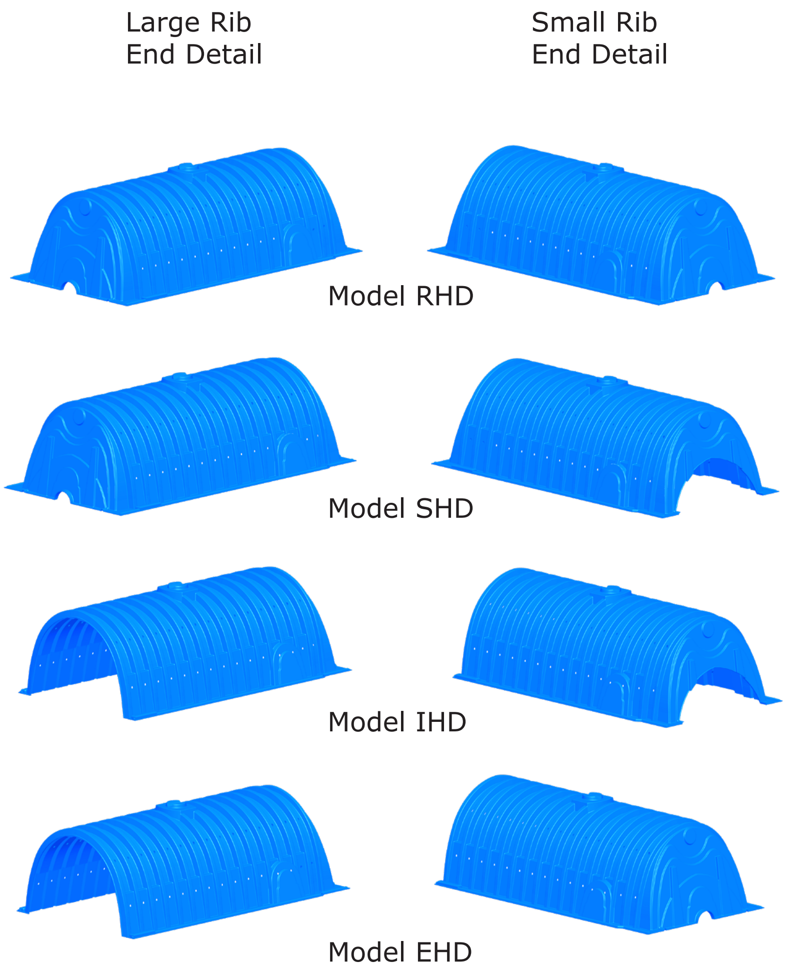
Model RHD is a **starter / stand alone** unit with two full end walls. They are used to start lines or can be used singularly. They may also be trimmed to into model type EHD.

Model EHD is a **middle / end unit** with one closed end wall and one open end. They are used to continue lines and also used to end a line.

Directional arrows located on the top of the chamber point towards the Small Rib End.

2.9.2 Recharger® Models 150XLHD and 280HD End Detail Information

Fig. 2.9.2



Model RHD is a **stand alone** unit with two fully closed end walls. They are used when a single unit is required. They may also be trimmed to into model types SHD, IHD, or EHD.

Model SHD is a **starter** unit with one closed end wall and one partially open end wall. They are used to start a chamber row.

Model IHD is an **intermediate** unit with one fully open end and one partially open end wall. They are used to continue the length of a line of chambers.

Model EHD is an **end unit** with one fully open end and one fully closed end wall. They are used to end a chamber row.

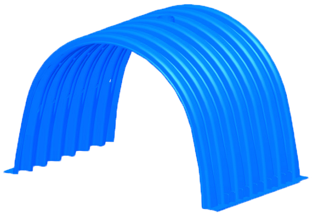
Directional arrows located on the top of the chamber point towards the Small Rib End.

2.9.3 Recharger® Models 300HD, 360HD, and 902HD End Detail Information

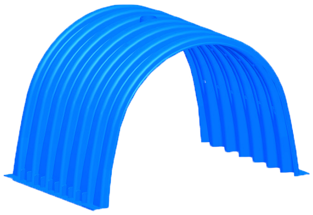
Fig. 2.9.3

The Recharger model 300HD, 360HD, and 902HD chambers only come in one model type which is fully open on both ends. The Recharger 300HD, 360HD, and 902HD chambers require the coordinating End Cap (*sold separately*) to cap rows of chambers or to create single stand alone units.

Large Rib
End Detail



Small Rib
End Detail



Directional arrows located on the top of the chamber point towards the Small Rib End.

2.10 CULTEC INTERLOCKING RIB CONNECTION

The CULTEC chambers use an overlapping rib connection to interlock together. Models C-100HD, R-150XLHD, and R-280HD use a series of model types (starters, intermediates and ends) to build a run of chambers.

The Contactor 100HD is available in Model R - Starter/Stand Alone and Model E - Middle/End models only (See Section 2.9.1).

The Recharger Models 150XLHD and 280HD come in Model R - Stand Alone, Model S - Starters, Model I - Intermediates and Model E - End units (See Section 2.9.2).

Directional arrows located on the top of the chamber point towards the Small Rib End. The open end of the next chamber overlaps the small rib end of the preceding chamber.

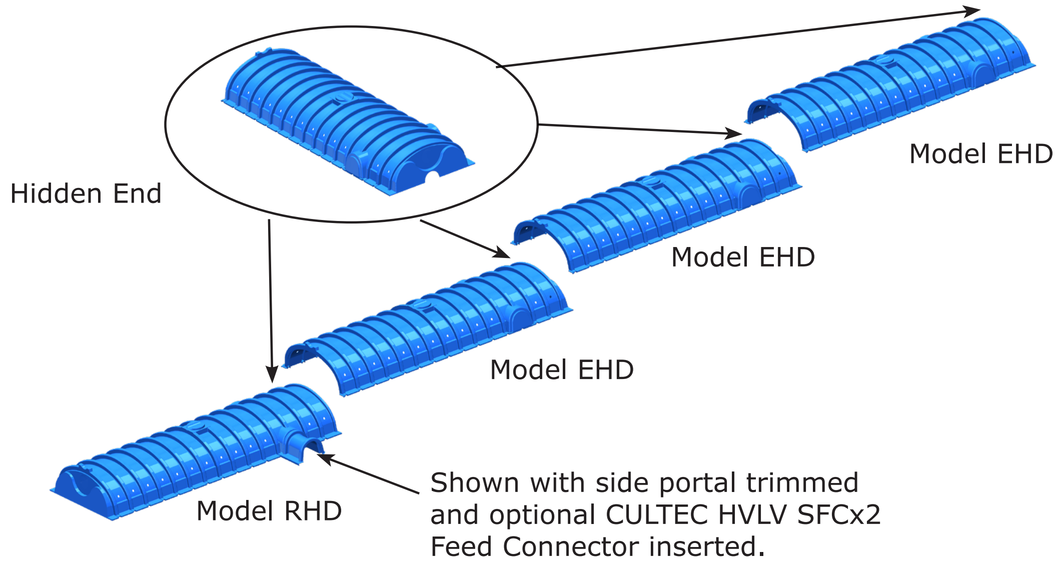
Sections 2.10.1-2.10.3 describe how the units go together for each series.

2.10.1 Typical Installation Method for Contactor® 100HD

Interlock Model RHD to EHD using the patented overlapping rib connection.

- Start each line with a Model RHD.
- Use Model EHD to continue the length of your line.
- End your line by using a Model EHD.

Fig. 2.10.1

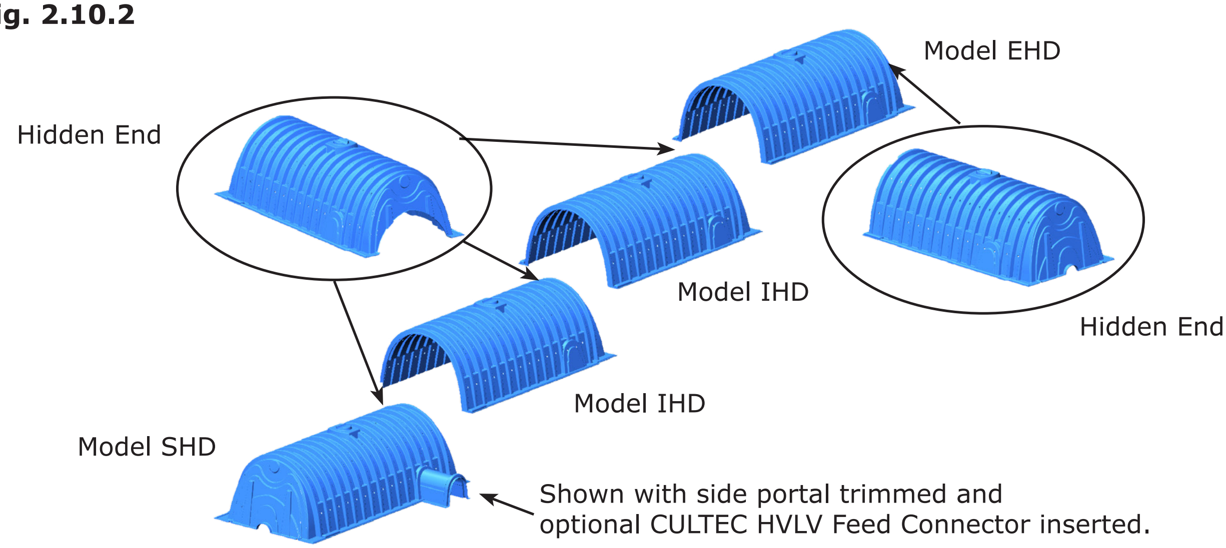


2.10.2 Typical Installation Method for Recharger® Models 150XLHD and 280HD

Interlock Model SHD to IHD using the patented overlapping rib connection. Finish the line with Model EHD.

- Start each line with a Model SHD.
- Use Model IHD to continue the length of your line.
- End your line by using a Model EHD.

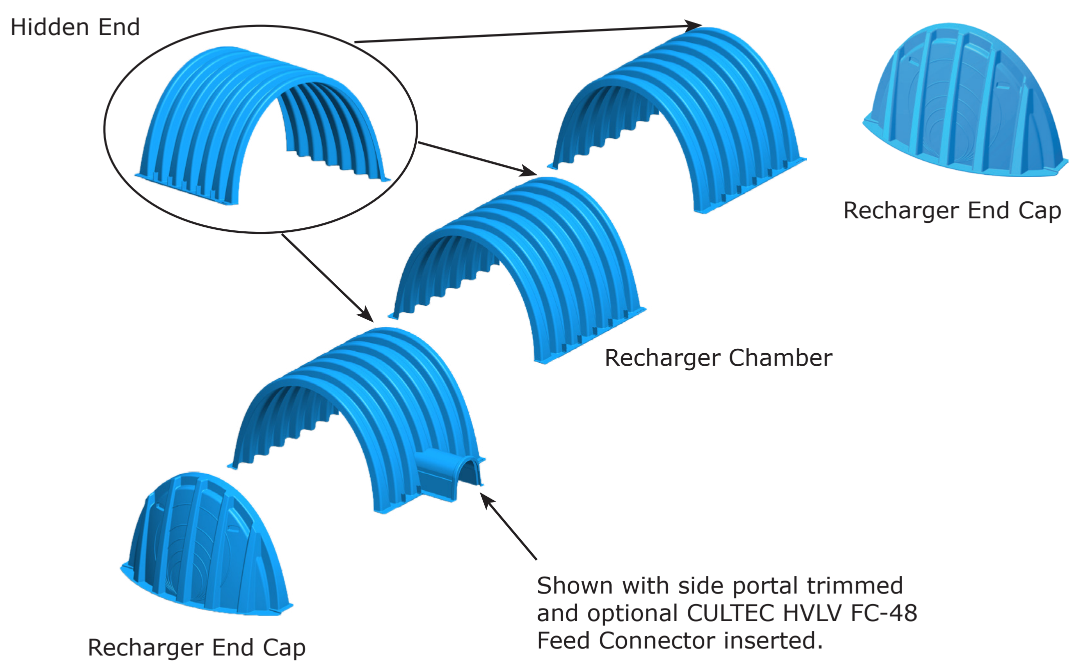
Fig. 2.10.2



2.10.3 Typical Installation Method for Recharger® Models 300HD, 360HD, and 902HD

Interlock Recharger chambers using the overlapping rib connection. Cap the ends of the lines using the Recharger End Cap.

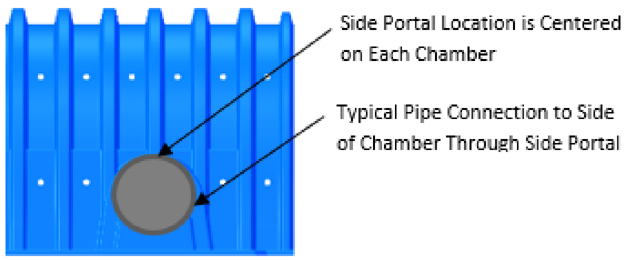
Fig. 2.10.3



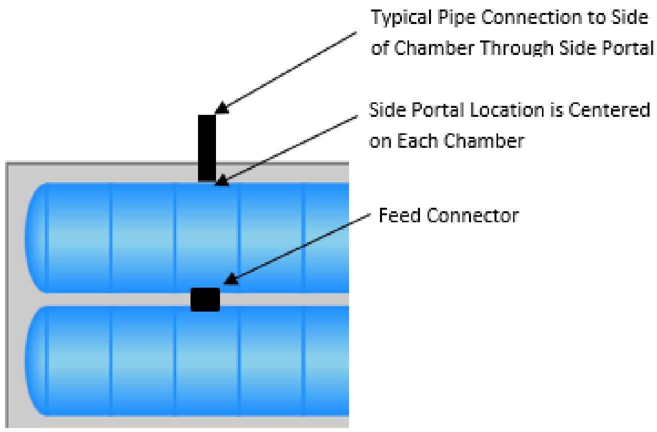
2.11 CHAMBER SIDE PORTALS

CULTEC chambers contain an integral side-portal located on each side of the part. These side portal locations are the only acceptable area where a pipe may penetrate the side of the chamber. Additionally, these side portals are the location in which the internal distribution manifold feed connectors are in installed.

Fig. 2.11



Typical Side Portal Elevation View



Typical Side Portal Plan View

2.12 CULTEC INTERNAL MANIFOLD COMPONENTS

HVLV Feed Connectors are inserted into the side portals of the CULTEC Chambers to act as an internal manifold for the CULTEC Chamber system in lieu of or in conjunction with an external pipe manifold. Table 2.12 details the various unit specifications and compatibility.

Fig. 2.12

SFCx2

FC-24

FC-48

Table 2.12

	HVLV® SFCx2 Feed Connector	HVLV® FC-24 Feed Connector	HVLV® FC-48 Feed Connector
Length	19.7" 500 mm	24.2" 614 mm	49" 1245 mm
Installed Length (exposed)	4" min. 102 mm min.	Recharger 150XLHD: 6" (152 mm) min. Recharger 280HD: 5" (127 mm) min. Recharger 300HD: 6" (152 mm) min.	Recharger 360HD: 9" (229 mm) min. Recharger 902HD: 9" (229 mm) min.
Width	12" 305 mm	16" 406 mm	16" 406 mm
Height	7.6" 194 mm	12" 305 mm	12" 305 mm
Chamber Storage Capacity	0.29 ft^3/ft 0.03 m^3/m	0.91 ft^3/ft 0.08 m^3/m	0.91 ft^3/ft 0.08 m^3/m
Compatible With	Contactor 100HD	Recharger models 150XLHD, 280HD	Recharger models 300HD, 360HD, and 902HD
Pipe Comparison	Greater flow capacity than 6" (150 mm) pipe	Greater flow capacity than 12" (300 mm) pipe	Greater flow capacity than 12" (300 mm) pipe

2.13 CULTEC STORMFILTER 330 WATER QUALITY UNIT

The CULTEC StormFilter® 330™ is designed to be a secondary in-line filter system that effectively removes many of the smaller particles not eliminated by conventional structures during the pretreatment process.

CULTEC StormFilter® 330™ is a pass-through filter system used in stormwater applications to filter rainwater run-off prior to entering the CULTEC Stormwater Management System. It has a solid bottom and sidewalls.

Table 2.13 details the StormFilter 330 specifications.

Table 2.13

	StormFilter® 330
Length	8' 2.44 m
Width	55" 1397 mm
Height	36" 914 mm
Capacity	418.5 gal. 1584 l
Filtration Capability	708.4 gpm 2682 l/min
Apparent Opening Size of Filter	70 US Std. Sieve 0.212 mm

Fig. 2.13: StormFilter 330

3.0 Applications

3.1 MARKETS

CULTEC's Contactor and Recharger chambers are available in various profiles. CULTEC stormwater chamber systems are installed sub-surface, allowing developers to maximize land use while achieving water quality and quantity objectives. Since 1986, CULTEC chambers have been used in the following markets: Private commercial developments, residential developments, single-family residential homes, athletic fields and greenspaces, institutional, municipal, and industrial sites. This design manual is intended to be used by civil design engineers to aide in the design of commercial, municipal and industrial sites. Please consult the CULTEC Residential Stormwater Management Design Guide for residential applications.

3.2 STORMWATER APPLICATIONS OVERVIEW

CULTEC chambers systems can effectively address nearly all stormwater management regulations, including both quantity and quality control. CULTEC chambers address stormwater detention (flow attenuation), retention, infiltration, water quality treatment, supplemental BMP storage and water harvesting.

3.3 DETENTION

Stormwater detention, or peak-flow attenuation, is the act of controlling the rate of stormwater flow downstream. Stormwater detention systems temporarily hold and slowly release a volume of water at a controlled rate. These systems reduce downstream flooding, offer protection against channel erosion, and provide some measure of water quality.

3.3.1 Open-bottom Detention vs. Closed-bottom (Watertight) Detention

Detention basins are typically regarded as dry ponds intended to completely drain through a controlled outlet after each storm event. Often, CULTEC systems are designed as open-bottom detention systems with a detention component and an infiltration or groundwater recharge component. Stormwater above the outlet pipe invert is considered active attenuation storage. Stormwater below the outlet pipe is intended to infiltrate into the underlying native soils. When infiltration rates are poor, no groundwater recharge is required or infiltration is prohibited, CULTEC systems may be installed with an impermeable geomembrane liner to contain the stormwater.

3.4 RETENTION

Stormwater retention ponds are basins designed to capture, temporarily hold, and slowly release a volume of stormwater in order to attenuate or control the rate of flow downstream. Unlike detention ponds, stormwater retention ponds possess a permanent pool of water below the outlet pipe, allowing the settlement of sediment as well as natural processes to remove pollutants. Retention ponds are typically regarded as wet ponds. Wet ponds provide peak flow control (attenuation) and stream channel protection plus water-quality control.

3.5 INFILTRATION

Infiltration basins are a type of stormwater detention pond designed to reduce the peak flow rate from the design storm, recharge groundwater, remove pollutants and provide some measure of channel protection. Infiltration basins exfiltrate stormwater from the basin into the surrounding native soils. Infiltration basins should only be considered when the soil is permeable and sufficient separation exists between the bottom of the basin and the groundwater elevation. Infiltration basins should contain suitable pre-treatment measures to prevent sediment from entering the system and prohibiting infiltration. The Engineer is responsible for confirming soil infiltration rates.

3.6 SUPPLEMENTAL BMP AND GREEN STORMWATER INFRASTRUCTURE STORAGE

Stormwater BMPs are either structural or non-structural practices aimed at controlling the negative effects of urban stormwater runoff. Popular structural BMPs include vegetated swales, infiltration trenches, grassed swales, linear sand filters, rain gardens and bio-swales. These BMP's generally utilize an engineered soil filtration media, sand or gravel to filter pollutants from stormwater runoff. This media offers good filtration properties but only provides marginal storage capacity. CULTEC chambers offer efficient additional storage capacity to supplement the storage of the BMP.

3.7 RAINWATER HARVESTING AND REUSE

Rainwater harvesting and reuse basins are designed to capture and permanently store a volume of stormwater runoff until it is used later. Typical harvesting and reuse applications include irrigation and washing operations. These systems are required to be water-tight and typically include a pump vault designed to pump the water to its final point of use. CULTEC systems may be designed with both stormwater detention and water harvesting and reuse components.

3.8 WATER QUALITY

Stormwater quality controls involve the removal of pollutants, including grease, oil, heavy metals, nutrients, chemicals, and sediment from stormwater runoff. Removal of these pollutants through filtration, mechanical separation or infiltration through underlying soils improves the quality of downstream runoff. CULTEC systems achieve water quality control through filtration within the CULTEC Separator Row / ADS Isolator Row Plus, retention of stormwater below the outlet pipe, and infiltration through the underlying soils.

4.0 Manufacturing and Structural Performance

4.1 MANUFACTURING STANDARDS

Quality is central to CULTEC's values. With nearly 40 years of experience in manufacturing CULTEC chambers, we have refined our processes to consistently produce high-quality products that can endure the demands of the field over the long term. CULTEC utilizes vacuum thermoforming and low-pressure injection molding as its manufacturing methods to ensure the delivery of durable and affordable products. CULTEC products are manufactured in the U.S.A.

4.2 METHODS

4.2.1 Vacuum Thermoforming

CULTEC’s vacuum thermoformed chamber line includes the Contactor 100HD and Recharger models 150XLHD and 280HD. The vacuum thermoforming process results in a product with low internal stress, minimal warping, and excellent dimensional control.

4.2.2 Low Pressure Injection Molding

CULTEC’s utilizes low-pressure injection molding to manufacture its Recharger 300HD, 360HD, and 902HD chambers. This process provides uniform wall thickness, low internal stress, and repeatable quality.

4.3 MATERIAL

CULTEC takes pride in its contribution to the resiliency and circularity of plastics. Our products are resilient to extreme weather events and variables encountered in service, in addition to offering a 50–100-year design service life. Many of CULTEC's products contain over 50% recycled material, highlighting our commitment to sustainability.

Thermoformed Chambers

CULTEC’s thermoformed chamber line is manufactured of high-density polyethylene (HDPE). This material is widely used across industries for its resistance to chemicals, high impact strength, and long-term durability. The chambers are formed with a unique blue top-coat that provides superb antioxidant, ultraviolet, and heat protection.

Structural Foam Injection Molded Chambers

CULTEC’s structural foam injection molded chambers are produced of an impact-modified copolymer polypropylene. This high-grade resin combined with antioxidant and ultraviolet protection ensures a durable product from manufacture through installation and service.

4.4 QUALITY ASSURANCE

CULTEC ensures consistent quality beginning with strict material selection and incoming inspection and continuing with the monitoring and inspection of critical characteristics of the chamber after manufacture. Part thickness, weight, arch compression, and thermal imaging are just a few of the in-house quality inspections that assure the customer receives a high-quality part every time. All CULTEC chambers include molded-in production codes, allowing traceability and full circularity throughout the lifetime of the part.

4.5 AWARDED CERTIFICATIONS AND THIRD-PARTY VERIFICATIONS

4.5.1 ASTM International (American Society for Testing and Materials)

ASTM INTERNATIONAL

ASTM F3430 and F2418 are product standards that define the material and structural requirements of stormwater chambers. ASTM F2787 is the design standard specifying the structural performance requirements for these chambers in accordance with AASHTO LRFD Section 12.12.

- Standards: ASTM F3430, F2418, and F2787
- Third-party certification: Third-party engineering reports show that CULTEC chambers meet the performance requirements of these standards. Available upon request.
- Relevant to following CULTEC Chambers: Recharger® models 300HD, 360HD, and 902HD.

4.5.2 CSA Group (Canadian Standards Association)

CSA B184 provides performance requirements for underground stormwater chambers, including those for short and long-term material properties, arch stiffness and flattening, structural live and dead loading per AASHTO LRFD Section 12.12, and manufacturing quality.

- Standard: CSA B184: Polymeric Subsurface Stormwater Management Structures
- Third-party certification: Recharger® 300HD, 360HD, and 902HD - Yes, with Intertek.
- Relevant to following CULTEC Chambers: Recharger® models 300HD, 360HD, and 902HD.

4.5.3 NJCAT Verification

"The Isolator Row … demonstrated a cumulative mass TSS removal efficiency of 81.2% and a sediment mass loading capacity of 3.58 lb./ft^2 (mass capture capacity of 2.91 lb./ft^2) of geotextile fabric filtration area when operated with a driving head < 20 inches at a hydraulic loading rate of 4.13 gpm/ft^2 of ADS PLUS fabric filtration area."

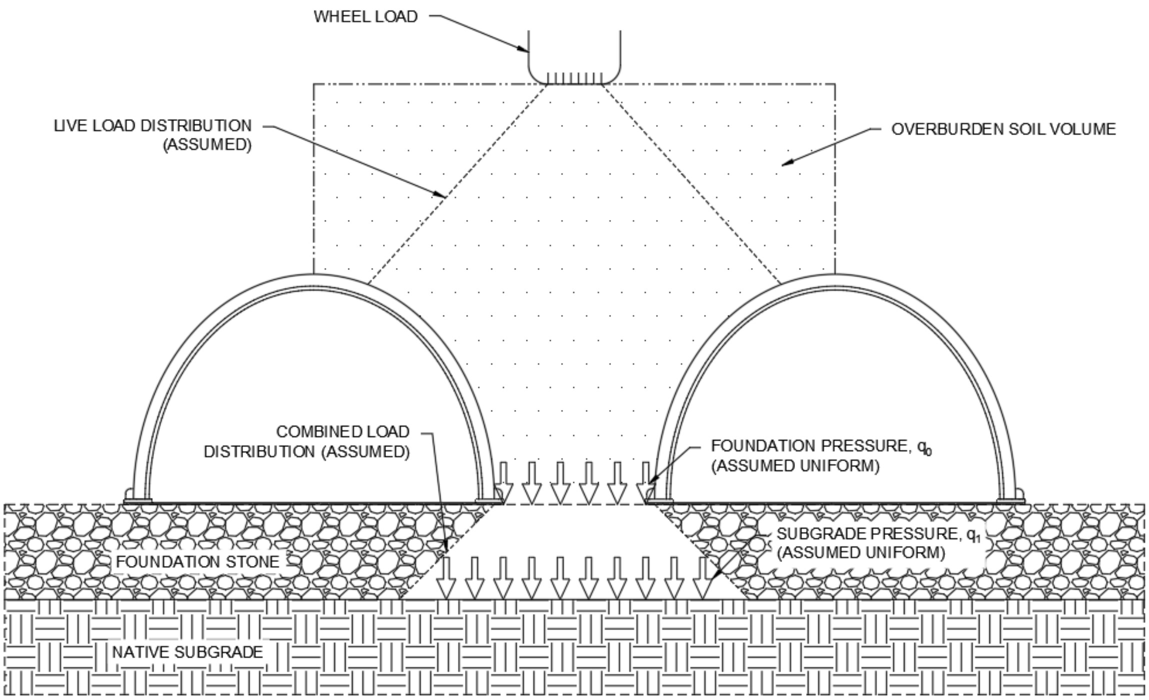
- Third-party verified by NJCAT for greater than 80% TSS removal.
- Relevant to all CULTEC Chambers installed in ADS Isolator Row Plus configuration.

5.0 Foundations for Chamber Systems

5.1 FOUNDATION REQUIREMENTS

The foundation of the CULTEC Stormwater Management System is a critical part of the system design and installation. The system subgrade must be adequate to support the system and the anticipated service loads. Flexible structures, including CULTEC chambers, are designed to transfer some of these service loads from the surface to the subgrade through columns of embedment stone. The chamber arch transfers the remainder of the loads through the chamber foot to the foundation stone layer and ultimately to the subgrade. The chamber model, depth of cover and thickness of the foundation stone layer determines the required bearing capacity of the subgrade. All CULTEC chamber systems must be installed on a bed of clean, crushed, angular foundation stone. As the depth of cover (finished grade to top of chamber) increases, the dead load placed on the chamber increases, and subsequently the pressure on the subgrade increases. Therefore, the system requires a higher subgrade bearing capacity and or greater thickness of foundation stone. CULTEC recommends that the design engineer consult with a geotechnical engineer if a concern with the CULTEC system subgrade is present.

Fig. 5.1: Load Transfer through Stone Column to Subgrade



5.2 SUBGRADE BEARING CAPACITY TABLE

CULTEC has completed subgrade bearing capacity calculations for all chamber models and cover depth scenarios from minimum cover to maximum cover. Table 5.2 summarizes the minimum required subgrade bearing capacity values:

Table 5.2

Minimum Bearing Capacity of Subgrade Required for Service Loads (ULS)

Chamber Model	Depth of Bedding Stone	Depth of Cover																					
		Inches	Min.	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126	132	138	144
		mm	Min.	610	762	914	1067	1219	1372	1524	1676	1829	1981	2134	2286	2438	2591	2743	2896	3048	3200	3353	3505	3658
C-100HD	6" (150mm)	psf	3953	3805	3509	3263	3124	3056	3038	3058	3104	3172	3257	3354	3463	3579	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	190	183	168	157	150	147	146	147	149	152	156	161	166	172	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	9" (229mm)	psf	3074	2985	2809	2621	2516	2467	2457	2475	2515	2571	2641	2720	2808	2902	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	148	143	135	126	121	118	118	119	121	123	127	131	135	139	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	12" (305mm)	psf	2507	2491	2353	2204	2121	2084	2079	2096	2132	2180	2239	2306	2381	2460	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	120	120	113	106	102	100	100	101	102	105	107	111	114	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	15" (381mm)	psf	2122	2149	2036	1914	1848	1819	1817	1834	1866	1909	1961	2019	2083	2152	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	102	103	98	92	89	87	87	88	90	92	94	97	100	103	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18" (457mm)	psf	1874	1900	1807	1705	1651	1628	1629	1645	1674	1713	1759	1811	1868	1929	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	90	91	87	82	79	78	78	79	80	82	84	87	90	93	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	21" (533mm)	psf	1689	1715	1636	1550	1504	1487	1489	1505	1532	1567	1609	1656	1707	1762	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	81	82	79	74	72	71	71	72	74	75	77	79	82	85	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	24" (610mm)	psf	1548	1573	1506	1432	1394	1380	1383	1399	1424	1457	1495	1538	1584	1634	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	74	76	72	69	67	66	66	67	68	70	72	74	76	78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
R-150XLHD	6" (150mm)	psf	3052	3029	2807	2628	2530	2485	2478	2500	2542	2600	2671	2752	2841	2936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	146	145	135	126	121	119	119	120	122	125	128	132	136	141	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	9" (229mm)	psf	2485	2514	2338	2196	2119	2086	2083	2103	2140	2190	2250	2318	2393	2473	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	119	121	112	105	102	100	100	101	103	105	108	111	115	119	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	12" (305mm)	psf	2130	2158	2015	1899	1837	1812	1812	1831	1864	1908	1960	2019	2084	2153	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	102	104	97	91	88	87	87	88	89	92	94	97	100	103	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	15" (381mm)	psf	1874	1902	1782	1686	1635	1615	1617	1636	1666	1705	1752	1804	1861	1922	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	90	91	86	81	78	78	78	79	80	82	84	87	89	92	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18" (457mm)	psf	1684	1710	1609	1527	1485	1470	1474	1491	1519	1555	1597	1644	1695	1749	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	81	82	77	73	71	71	71	72	73	75	77	79	81	84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	21" (533mm)	psf	1539	1565	1478	1408	1372	1361	1365	1382	1408	1441	1479	1522	1568	1618	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	74	75	71	68	66	65	66	66	68	69	71	73	75	78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	24" (610mm)	psf	1427	1452	1376	1316	1286	1277	1282	1299	1323	1354	1389	1428	1471	1516	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	69	70	66	63	62	61	62	62	64	65	67	69	71	73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
R-280HD	6" (150mm)	psf	2935	3021	3113	3212	3131	3091	3095	3132	3193	3273	3367	3473	3589	3712	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	141	145	149	154	150	148	149	150	153	157	162	167	172	178	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	9" (229mm)	psf	2463	2537	2618	2703	2640	2611	2618	2651	2704	2773	2853	2944	3041	3146	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	118	122	126	130	127	125	126	127	130	133	137	141	146	151	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	12" (305mm)	psf	2131	2198	2270	2345	2295	2273	2282	2313	6	2421	2491	2570	2655	2745	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	102	106	109	113	110	109	110	111	0	116	120	123	127	132	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	15" (381mm)	psf	1889	1950	2015	2083	2042	2026	2036	2065	2108	2162	2225	2295	2370	2450	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	91	94	97	100	98	97	98	99	101	104	107	110	114	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18" (457mm)	psf	1707	1763	1822	1885	1852	1840	1850	1877	1917	1966	2023	2086	2154	2225	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	82	85	87	90	89	88	89	90	92	94	97	100	103	107	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	21" (533mm)	psf	1568	1620	1675	1732	1705	1696	1707	1733	1770	1815	1867	1924	1986	2051	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	75	78	80	83	82	81	82	83	85	87	90	92	95	98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	24" (610mm)	psf	1459	1508	1559	1612	1590	1584	1595	1620	1655	1697	1745	1797	1854	1913	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	70	72	75	77	76	76	77	78	79	81	84	86	89	92	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
R-300HD	6" (150mm)	psf	2636	2726	2822	2923.7	2997	2964	2971	3008	3067	3144	3234	3334	3444	3560	3683	3810	3941	4076	4214	4355	4498	4643
		kPa	127	131	135	140	144	142	143	144	147	151	155	160	165	171	177	183	189	196	202	209	216	223
	9" (229mm)	psf	2269	2349	2434	2523	2588	2563	2573	2607	2659	2727	2805	2893	2987	3088	3194	3304	3417	3533	3652	3773	3896	4021
		kPa	109	113	117	121	124	123	123	125	128	131	135	139	143	148	153	159	164	170	175	181	187	193
	12" (305mm)	psf	2201	2285	2373	2465	2555	2534	2547	2583	2638	2707	2787	2876	2971	3073	3179	3289	3403	3520	3639	3760	3883	4008
		kPa	106	110	114	118	123	122	122	124	127	130	134	138	143	147	153	158	163	169	175	180	186	192
	15" (381mm)	psf	1801	1867	1936	2009	2063	2049	2061	2091	2135	2189	2252	2322	2397	2477	2560	2647	2736	2827	2920	3015	3111	3209
		kPa	86	90	93	96	99	98	99	100	102	105	108	111	115	119	123	127	131	136	140	145	149	154
	18" (457mm)	psf	1647	1708	1772	1838	1889	1879	1891	1919	1960	2010	2068	2131	2199	2272	2347	2425	2506	2588	2672	2758	2845	2933
		kPa	79	82	85	88	91	90	91	92	94	96	99	102	106	109	113	116	120	124	128	132	137	141
	21" (533mm)	psf	1527	1583	1643	1704	1752	1744	1757	1784	1822	1869	1922	1980	2043	2109	2178	2249	2323	2398	2475	2553	2632	2712
		kPa	73	76	79	82	84	84	84	86	87	90	92	95	98	101	105	108	111	115	119	123	126	130
	24" (610mm)	psf	1432	1485	1541	1598	1643	1638	1651	1677	1713	1756	1805	1859	1917	1978	2042	2108	2175	2245	2315	2387	2459	2533
		kPa	69	71	74	77	79	79	79	80	82	84	87	89	92	95	98	101	104	108	111	115	118	122
R-360HD	6" (150mm)	psf	2404	2516	2633	2753	2877	3004	3086	3130	3196	3279	3376	3482	3598	3721	3849	3982	4120	4261	4405	4552	4700	4851
		kPa	115	121	126	132	138	144	148	150	153	157	162	167	173	179	185	191	198	205	211	218	226	233
	9" (229mm)	psf	2118	2218	2322	2429	2539	2652	2726	2767	2826	2900	2986	3081	3183	3291	3404	3522	3643	3766	3893	4022	4152	4285
		kPa	102	106	111	117	122	127	131	133	136	139	143	148	153	158	163	169	175	181	187	193	199	206
	12" (305mm)	psf	1903	1993	2087	2184	2283	2385	2452	2490	2545	2612	2689	2774	2866	2963	3064	3169	3277	3388	3501	3615	3732	3850
		kPa	91	96	100	105	110	114	118	120	122	125	129	133	138	142	147	152	157	163	168	174	179	185
	15" (381mm)	psf	1736	1820	1906	1994	2084	2177	2238	2275	2325	2387	2457	2535	2618	2706	2798	2893	2990	3090	3192	3296	3401	3507
		kPa	83	87	91	96	100	104	107	109	112	115	118	122	126	130	134	139	144	148	153	158	163	168
	18" (457mm)	psf	1607	1683	1763	1844	1927	2012	2069	2104	2151	2208	2273	2344	2421	2501	2585	2672	2761	2852	2945	3039	3135	3232
		kPa	77	81	85	89	93	97	99	101	103	106	109	113	116	120	124	128	133	137	141	146	150	155
	21" (533mm)	psf	1504	1575	1649	1724	1801	1880	1934	1966	2011	2064	2124	2190	2261	2335	2412	2492	2574	2658	2744	2830	2919	3008
		kPa	72	76	79	83	86	90	93	94	97	99	102	105	109	112	116	120	124	128	132	136	140	144
	24" (610mm)	psf	1422	1489	1558	1628	1700	1773	1824	1855	1897	1947	2003	2065	2130	2199	2271	2345	2421	2499	2578	2658	2740	2822
		kPa	68	71	75	78	82	85	88	89	91	93	96	99	102	106	109	113	116	120	124	128	132	135
R-902HD	9" (229mm)	psf	2100	2230	2362	2496	2633	2772	2912	3055	3198	3297	3398	3508	3626	3751	3880	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	101	107	113	120	126	133	140	147	154	158	163	168	174	180	186	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	12" (305mm)	psf	1914	2032	2152	2274	2398	2524	2651	2780	2910	3000	3092	3193	3300	3412	3529	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	92	98	103	109	115	121	127	133	140	144	148	153	158	164	169	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	15" (381mm)	psf	1767	1876	1986	2098	2212	2327	2443	2561	2680	2763	2847	2939	3038	3141	3248	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	85	90	95	101	106	112	117	123	129	133	137	141	146	151	156	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18" (457mm)	psf	1650	1751	1853	1956	2061	2167	2275	2383	2492	2570	2648	2733	2824	2919	3017	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	79	84	89	94	99	104	109	114	120	123	127	131	136	140	145	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	21" (533mm)	psf	1556	1650	1745	1841	1939	2037	2137	2237	2339	2411	2484	2563	2647	2736	2827	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	75	79	84	88	93	98	103	107	112	116	119	123	127	131	136	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	24" (610mm)	psf	1480	1568	1657	1747	1838	1930	2023	2117	2211	2279	2348	2422	2500	2583	2668	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		kPa	71	75	80	84	88	93	97	102	106	109	113	116	120	124	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.3 SUBGRADE SATURATION AND SETTLEMENT

5.3.1 Settlement

Bearing capacity failure represents the ULS (ultimate limit state) of the subgrade soil. Bearing capacity failure of a CULTEC system foundation is considered unacceptable. However, minor settlement may occur, and may be considered acceptable. Acceptable levels of settlement of the subgrade would represent the SLS (service limit state) of the subgrade soil. Acceptable differential settlement of the system should be limited to 1” (25mm) measured perpendicularly across the chamber span.

5.3.2 Saturation

The design engineer should consider the effects of stormwater exfiltration to the native subgrade soils and the effect of the saturation of the bearing capacity of the sub-grade. CULTEC recommends the engineer of record consult with a geotechnical engineer if subgrade saturation is a concern.

5.4 SUBGRADE IMPROVEMENTS

If a site investigation reveals weak soils, organic or fill soils, saturated soils, karst geology, or subgrade bearing capacities less than the values listed in table 5.2, the design engineer should consult a geotechnical engineer. The geotechnical engineer should evaluate the site conditions and provide recommendations for the system installation and any possible subgrade improvement measures.
A typical solution to weak, organic, fill or moisture-sensitive subgrade conditions includes over-excavation and replacement with clean, crushed stone, sand, or other suitable material. In some circumstances, the geotechnical consultant may incorporate geotextiles, geomembranes, geogrids or other geosynthetics to remediate the poor subgrade condition.

6.0 Materials for CULTEC Chamber Systems

6.1 MATERIAL OVERVIEW

The CULTEC system includes Contactor and Recharger chambers and accessories, aggregate and backfill materials, geotextiles, storm sewers and structures. Each of these materials serves a specific purpose and contributes to the functionality of the CULTEC system.

6.2 GEOTEXTILES

The CULTEC system consists of an open-bottom corrugated plastic chamber surrounded with open-graded angular stone and high-performance geotextiles to form a sub-surface stormwater management system. These geotextiles are utilized in key locations to ensure proper system performance.

The CULTEC system utilizes two types of geotextiles.

1. A ***non-woven geotextile*** used as a separation material to prevent the migration of fines from the surrounding soil into the clean, open-graded stone.
2. A high-strength ***woven geotextile*** used in two capacities:
    a. Between the open-graded bedding stone and the chamber feet, to prevent scouring or erosion of the bedding stone.
    b. A filter system referred to as the CULTEC Separator Row / ADS Isolator Row Plus, which removes sediment, total suspended solids and debris from the stormwater runoff.

Table 6.2.a summarizes the CULTEC system geotextile location, description, and name:

Table 6.2.a

Geotextile Location	Product Name	Description	AASHTO M288 Classification
Inlet Scour Protection	ADSPLUS	6 oz. Woven Geotextile	AASHTO Class 1
CULTEC Separator Row / ADS Isolator Row Plus	ADSPLUS	6 oz. Woven Geotextile	AASHTO Class 1
CULTEC Separator Row / ADS Isolator Row Plus	CULTEC No. 410	4 oz. Non-Woven Geotextile	AASHTO Class 3
System Envelope	CULTEC No. 410	4 oz. Non-Woven Geotextile	AASHTO Class 3

Table 6.2.b summarizes the CULTEC system No. 410 non-woven geotextile critical property M.A.R.V's *(except where noted)*

Table 6.2.b

Properties	Test Method	Test Results (English)	Test Results (Metric)
Weight – Typical	ASTM D5261	4.5 oz/sy	142 g/m^2
Appearance	N/A	Black	Black
Grab Tensile Strength	ASTM D4632	120 lbs	533 N
Elongation @ Break	ASTM D4632	50%	50%
Mullen Burst	ASTM D3786	225 psi	1,551 kPa
Pin Puncture	ASTM D4833	65 lbs	289 N

CBR Puncture	ASTM D6241	340 lbs	1,513 N
Trapezoidal Tear	ASTM D4533	50 lbs	223 N
Apparent Opening Size [1,2]	D-4751	70 US Sieve	0.21 mm
Water Flow Rate [1]	D-4491	135 g/m/ft²	5,500 L/min/m²
UV Resistance @ 500 Hours	D-4355	70%	70%

1. At the time of manufacturing. Handling, storage, and shipping may change these properties.
2. Maximum average roll value (MaxARV).
3. Historical reference values. These properties are no longer recognized by ASTM or AASHTO for geosynthetics.

Table 6.2.c summarizes the ADS PLUS woven geotextile critical property M.A.R.V's *(except where noted)*

Table 6.2.c

Properties[1]	Test Method	Unit	M.A.R.V. (Minimum Average Roll Value)[2]
Appearance			Black & White
Weight	ASTM D5261	oz/yd² (g/m²)	8.0 (271.25)
Grab Tensile Strength	ASTM D4632	lbs (kN)	325 (1.45)
Grab Tensile Elongation	ASTM D4632	%	15
Trapezoidal Tear Strength	ASTM D4533	lbs (kN)	125 (0.89)
CBR Puncture Resistance	ASTM D6241	lbs (kN)	1,124 (5.0)

1. The property values listed above are subject to change without notice.
2. Minimum Average Roll Values (MARV) is calculated as the average minus two standard deviations. Statistically, it yields approximately 97.5% degree of confidence that any samples taken from quality assurance testing will meet or exceed the values described above.

To assist the design engineer, contractor or peer-review engineer, CULTEC has developed a geotextile equivalency table for many common geotextile suppliers and manufacturers. These products have been reviewed and approved as equivalents to the CULTEC No. 410 non-woven geotextile and are summarized in Table 6.2.d: When approving geotextile equivalents, the engineer of record should ensure proposed geotextiles meet or exceed all of the MARV or MaxARV values listed in tables 6.3.b and 6.3.c.

Table 6.2.d: CULTEC Geotextile Equivalency Table

CULTEC	ACF	ADS	Carthage Mills	Hanes Terratex	Layfield	Nilex	Skaps	Propex	Thrace LINQ	TenCate Mirafi	Terrafix	WINfab	US Fabrics
No. 410	N045	0451T	FX-45HS	N04.5	LP 4.5	451	GT142	Geotex 451	140EX	140N	300R	450N	US 120NW

6.3 AGGREGATE

Overview: Clean, crushed, angular, open-graded stone is utilized in the bedding and embedment zones around the CULTEC chambers. The stone provides structural support for the chambers and provides additional storage capacity. The aggregate used in CULTEC systems shall meet the following specifications:

- Clean, crushed, with no more than 5% retained on the 2.5" (63mm) sieve and no more than 5% passing the No. 4 (4.75mm) sieve.
- ASTM D2488 classification as angular or sub-angular
- Maximum loss off 40% in the AASHTO T46 LA Abrasion test (ASTM C 131)
- AASHTO M43 #3, #4, #57, or #457 for models C-100HD, R-150XLHD, R-280HD, R-300HD, and R-360HD.
- AASHTO M43 #3 or #4 for model R-902HD

CULTEC does not recommend or endorse the use of recycled concrete aggregate as bedding or embedment material. Recycled concrete is generally too soft and contains too many fines to for use in the bedding or embedment zones of a CULTEC system.

Porosity: Standard industry practice assumes a 40% porosity within the clean, crushed, angular, open-graded aggregate used in the bedding and embedment zones of a CULTEC system. Independent laboratory testing has verified aggregate porosity used in CULTEC systems with the following results:

AASHTO No. 3: 42.7%
AASHTO No. 4: 39.9%
AASHTO No. 457: N/A
AASHTO No. 57: 41.6%

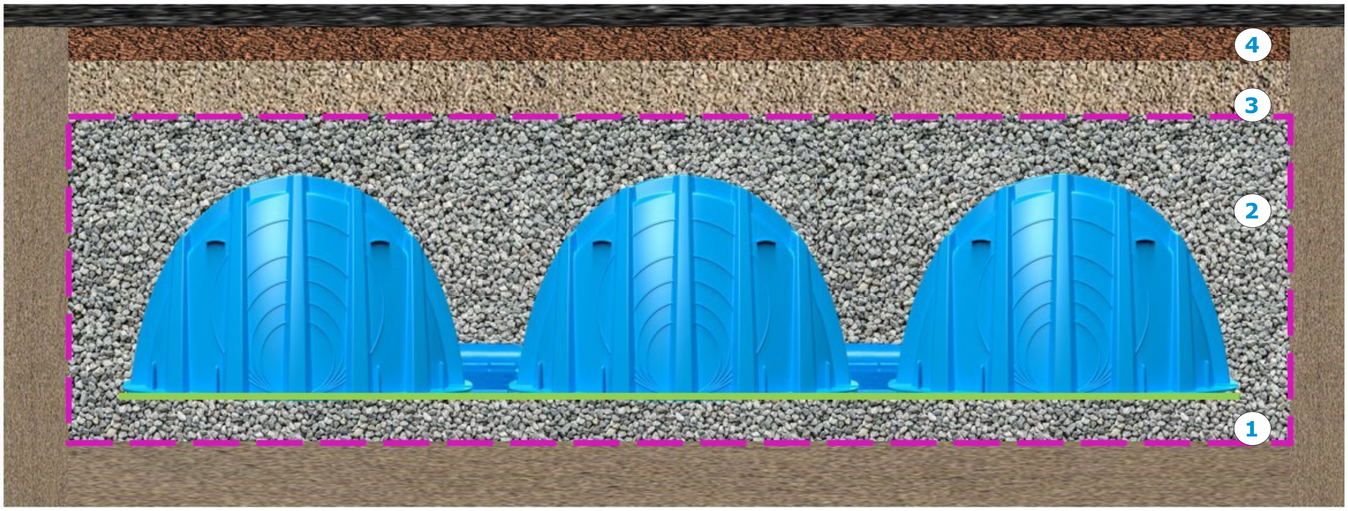
Aggregate porosity is protected from the migration of soil by the No. 410 non-woven geotextile that envelopes the system. CULTEC recommends the use of pre-treatment systems and/or the CULTEC Separator Row / ADS Isolator Row Plus to protect the aggregate porosity from sediment and debris that may reduce the porosity over time.

6.4 FILL MATERIALS

Table 6.4: Acceptable Materials Table

	Material Location	Description	AASHTO M43 Classification	Compaction/Density Requirement
4	**Final Fill Material** Fill Material for Layer 4 starts from the top of Layer 3 to the bottom of pavement or unpaved finished grade above. Refer to cross section, Ch.6-p.4 for proper minimum fill requirements.	Any soil/rock materials, native soils per engineer's plans. Check plans for pavement subgrade requirements.	Per engineer's drawings	Prepare per engineer's drawing. Paved installations may have strict material and preparation requirements.
3	**Initial Fill Material** Fill Material for Layer 3 starts from top of embedment stone (Layer 2) to minimum required depth above top of chamber. Refer to cross section, , Ch.6-p.4 for proper minimum fill requirements.	Granular well-graded soil/ aggregate mixtures, <35% fines	3, 4, 5, 6, 7, 8, 9, 10, 56, 57, 67, 68, 78, 89, 467	Compact in 6" (152mm) lifts to a minimum 95% Standard Proctor density. Contactor 100HD, Recharger 150XLHD, and Recharger 280HD: Refer to Table 6.5.1 for acceptable gross vehicle weights. Recharger 300HD, Recharger 360HD, and Recharger 902HD: Refer to Table 6.5.2 for acceptable gross vehicle weights.
2	**Embedment Stone** surrounding chambers and to a minimum elevation above chamber crown. Contactor 100HD, Recharger 150XLHD, Recharger 280HD, Recharger 300HD, Recharger 360HD: 6" min. required Recharger 902HD: 12" min. required.	Washed, crushed stone with the majority of particles between 1" - 2"	Contactor 100HD, Recharger 150XLHD, Recharger 280HD, Recharger 300HD, and Recharger 360HD: 3, 4, 57, 467 Recharger 902HD: 3,4	No compaction required
1	**Foundation Stone** below chambers per engineer's drawing Contactor 100HD, Recharger 150XLHD, Recharger 280HD, Recharger 300HD, Recharger 360HD: 6" min. required Recharger 902HD: 9" min. required	Washed, crushed stone with the majority of particles between Contactor 100HD, Recharger 150XLHD, Recharger 280HD: 3/4" - 2" (19 - 51 mm) Recharger 300HD, Recharger 360HD, and Recharger 902HD: 1" - 2"	Contactor 100HD, Recharger 150XLHD, Recharger 280HD, Recharger 300HD, and Recharger 360HD: 3, 4, 57, 467 Recharger 902HD: 3,4	Plate compact or roll to achieve a flat, unyielding surface.

Fig. 6.4: Fill Material Locations



6.5 MAXIMUM ALLOWABLE CONSTRUCTION LOADS

Table 6.5.1: Maximum Allowable Construction Loads for Models C-100HD, R-150XLHD, R-280HD

Material Location See Fig. 6.4		Maximum Allowable Wheel Loads		Maximum Allowable Track Loads		Maximum Allowable Compaction Loads	
	Cumulative Depth (in)	Max. Axle Truck(lbs)	Max. Axle Loaders (lbs)	Track Shoe Width (in)	Max Ground Pressure (psi)	Max. Centrifugal Force (lbs)	Max. Gross Vehicle Weight (lbs)
4 Final Fill Material	36 Compacted	32,000	16,000	12	17.85	38,000	16,000
				18	12.23		
				24	9.60		
				20	7.95		
				36	6.83		
	30 Compacted	32,000	16,000	12	15.38	38,000	16,000
				18	10.73		
				24	8.55		
				20	7.13		
				36	6.23		
3 Initial Fill Material	24 Compacted	32,000	16,000	12	12.90	20,000	12,000
				18	9.23		
				24	7.43		
				20	6.30		
				36	5.55		
	24 Loose/Dumped	32,000	16,000	12	11.70	20,000	12,000
				18	8.48		
				24	6.90		
				20	5.93		
				36	5.25		
	16 Compacted	32,000	16,000	12	10.50	20,000	12,000
				18	7.73		
				24	6.38		
				20	5.55		
				36	4.95		
	16 Loose/Dumped	16,000	NOT ALLOWED	12	9.45	NOT ALLOWED	12,000
				18	6.98		
				24	5.78		
				20	5.03		
				36	4.50		
2 Embedment Stone	12	8,000	NOT ALLOWED	12	8.03	NOT ALLOWED	NOT ALLOWED
				18	6.23		
				24	5.25		
				20	4.73		
				36	4.35		
	6	NOT ALLOWED	NOT ALLOWED	12	5.55	NOT ALLOWED	NOT ALLOWED
				18	4.73		
				24	4.20		
				20	3.98		
				36	3.75		

The use of wheeled equipment without proper cover is strictly prohibited.
For Tracked Vehicles: Ground pressure is vehicle operating weight divided by total truck contact area for both tracks. Turning should be kept to a minimum.
No wheeled vehicles are allowed prior to compacted fill placement.

Table 6.5.2: Maximum Allowable Construction Loads for Models R-300HD, R-360HD, R-902HD

Material Location See Fig. 6.4	Cumulative Cover Depth over Chambers (in)	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads		Maximum Allowable Compaction Loads	
		Max Axle Load for Trucks (lbs)	Max Axle Load for Loaders (lbs)	Track Shoe Width (in)	Max Ground Pressure (psi)	Maximum Centrifugal Force (lbs)	Max Gross Vehicle Weight (lbs)
4 Final Fill Material	36 Compacted	32,000	16,000	12	23.8	38,000	16,000
				18	16.3		
				24	12.8		
				30	10.6		
				36	9.1		
	30 Compacted	32,000	16,000	12	20.5	24,000	12,000
				18	14.3		
				24	11.4		
				30	9.5		
				36	8.3		
3 Initial Fill Material	24 Compacted	32,000	16,000	12	17.2	20,000	12,000
				18	12.3		
				24	9.9		
				30	8.4		
				36	7.4		
	24 Loose/Dumped	300HD: 32,000 360HD: 32,000 902HD: 24,000	300HD: 16,000 360HD: 16,000 902HD: 12,000	12	15.6	20,000	12,000
				18	11.3		
				24	9.2		
				30	7.9		
				36	7.0		
	18 Compacted	300HD: 32,000 360HD: 32,000 902HD: 24,000	300HD: 16,000 360HD: 16,000 902HD: 12,000	12	14.0	300HD: 20,000 360HD: 20,000 902HD: NOT ALLOWED	300HD: 12,000 360HD: 12,000 902HD: 5,000
				18	10.3		
				24	8.5		
				30	7.4		
				36	6.6		
	18 Loose/Dumped	300HD: 16,000 360HD: 16,000 902HD: NOT ALLOWED	NOT ALLOWED	12	12.6	NOT ALLOWED	300HD: 12,000 360HD: 12,000 902HD: NOT ALLOWED
				18	9.3		
				24	7.7		
				30	6.7		
				36	6.0		
2 Embedment Stone	12	NOT ALLOWED	NOT ALLOWED	12	10.7	NOT ALLOWED	NOT ALLOWED
				18	8.3		
				24	7.0		
				30	6.3		
				36	5.8		
	6	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED FOR RECHARGER 902HD. 6" FILL DEPTH TRACK LOAD DATA APPLIES TO RECHARGER 360HD ONLY		NOT ALLOWED	NOT ALLOWED
				12	7.4		
				18	6.3		
				24	5.6		
				30	5.3		
				36	5.0		

The use of wheeled equipment without proper cover is strictly prohibited.
For Tracked Vehicles: Ground pressure is vehicle operating weight divided by total truck contact area for both tracks. Turning should be kept to a minimum.
No wheeled vehicles are allowed prior to compacted fill placement

7.0 CULTEC System Connections

7.1 SYSTEM CONNECTIONS OVERVIEW

Stormwater runoff must be collected and conveyed to the CULTEC chamber system through a network of storm structures and storm pipes. These storm pipes that convey stormwater to the system may connect to the chambers in three standard locations. Pipe connections outside of these locations may compromise the structural integrity of the product. The three standard pipe connection locations are:

- The Chamber end cap
- The Chamber side portal knock-out
- The Chamber inspection port knock-out

The size, material and elevations of these pipes will be project specific, and therefore, should be specified by the engineer of record. The CULTEC chamber system can accept pipe connections with many pipe materials including concrete, corrugated HDPE, PP, PVC, DI, and CMP. However, CULTEC recommends the use of PVC and corrugated HDPE pipe materials whenever possible. Regardless of pipe size, material, invert or application, all storm pipe connections to the chamber system shall include a field-cut hole in the chamber or end cap that is within a ¼” (6mm) tolerance of the pipe outside diameter. All pipes shall extend a minimum of 8” (200mm) into the chamber or end cap. No special fittings, fasteners or gaskets are required for these pipe connections, and these pipe connections are not intended to be watertight.

7.2 END CAP CONNECTION - PIPE INVERT TABLE

The chamber end caps are the preferred location for storm pipe connections. The end cap provides the most flexibility for pipe sizes, materials, and inverts. To assist the engineer of record, CULTEC has developed the following table to aide in the sizing of storm pipe connections to the chamber end caps based on chamber model. Standard corrugated HDPE pipe sizes were used to develop the following pipe invert data. Custom inverts may be trimmed in chamber end caps to allow for project-specific requirements and pipe materials other than corrugated HDPE. However, pipe inverts shall not exceed the values listed in the “A” column of this table. Failure to follow these maximum pipe invert allowances may result in a poor pipe connection, compromised structural integrity of the end cap and/or chamber and poor hydraulics. Additionally, the following pipe inverts assume zero degrees of pipe skew. See sections 7.6 for allowable pipe inverts with skew.

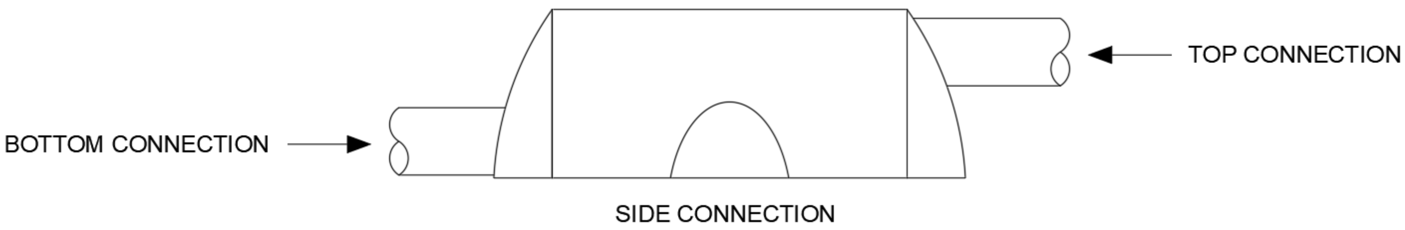


Table 7.2

Pipe Invert Elevation at End Cap

Pipe Diameter (HDPE)	Chamber Model											
	C-100HD		R-150XLHD		R-280HD		R-300HD		R-360HD		R-902HD	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6 in.	4.50	0.50	9.50	0.50	17.50	0.50	20.75	1.00	26.50	1.00	38.0	1.50
150 mm	115	13	242	13	445	13	527	26	674	26	966	39
8 in.	2.50	0.50	7.50	0.50	15.50	0.50	18.75	1.00	24.50	0.50	36.0	1.50
200 mm	64	13	191	13	394	13	476	26	623	13	915	39
10 in.		0.75	5.00	0.75	13.25	0.75	16.50	1.25	22.25	0.75	33.8	1.75
250 mm		20	127	20	337	20	419	32	566	20	858	45
12 in.			2.00	1.25	10.75	1.25	14.00	1.75	19.75	1.25	31.3	2.25
300 mm			51	32	274	32	356	45	502	32	794	58
15 in.					6.00	1.50	10.75	2.00	16.50	1.50	28.0	2.50
375 mm					153	39	273	51	420	39	712	64
18 in.					4.00	2.00	7.25	2.50	13.00	2.00	24.5	3.00
450 mm					102	51	184	64	331	51	623	77
21 in.						2.00	4.52	2.50	10.00	2.00	21.5	2.00
525 mm						51	115	64	254	51	547	51
24 in.								2.50	7.00	2.00	18.5	2.00
600 mm								64	178	51	470	51
30 in.										3.00	11.5	3.00
750 mm										77	293	77
36 in.												3.00
900 mm												77

7.3 SIDE OF CHAMBER CONNECTIONS

Storm sewer networks can be complex, and systems may require multiple inlets coming from different directions. Due to this complex nature, each CULTEC chamber is equipped with a side-portal feature. The side-portal feature is a reinforced area of the chamber that may be trimmed without compromising the structural integrity of the product. The side portal feature not only integrates with the CULTEC internal manifold but also allows for additional pipe connection points to the system. To assist the design engineer, CULTEC has developed the following table to aide in the sizing of storm pipe connections to the chamber side-portals based on chamber model. The following pipe invert data was developed using standard corrugated HDPE pipe sizes and wall thicknesses. Failure to follow these maximum pipe invert allowances and pipe sizes may result in a poor pipe connection, compromised structural integrity of the end cap and/or chamber and poor hydraulics. Additionally, the following pipe inverts assume zero degrees of pipe skew. See sections 7.6 for allowable pipe inverts with skew.

Fig. 7.3

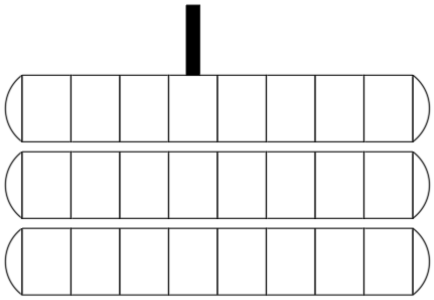


Table 7.3

Allowable Pipe Elevation at Side Portal Table

(invert above chamber invert)

Pipe Diameter	C-100HD		R-150XLHD		R-280HD		R-300HD		R-360HD		R-902HD	
	HDPE	PVC	HDPE	PVC	HDPE	PVC	HDPE	PVC	HDPE	PVC	HDPE	PVC
6 in.	0.5	0.5	4.0	4.5	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5
150 mm	15	15	100	115	150	165	150	165	150	165	150	165
8 in.		0.5	2.0	2.5	4.0	4.5	4.0	4.5	4.0	4.5	4.0	4.5
200 mm		15	50	65	100	115	100	115	100	115	100	115
10 in.			0.5	0.5	2.0	2.5	2.0	2.5	2.0	2.5	2.0	2.5
250 mm			15	15	50	65	50	65	50	65	50	65
12 in.						0.5		0.5		0.5		0.5
300 mm						15		15		15		15

7.4 CHAMBER TOP CONNECTIONS

Some top connections to the CULTEC chambers do occur. There are generally three scenarios in which a top connection would be required

- Direct inlet from the surface above
- Infiltration system overflow
- Upstream pipe invert too high to slope into end cap or side portal

Table 7.4a

Maximum Allowable Pipe Connections to Top of Chamber

Pipe Material	C-100HD		R-150XLHD		R-280HD		R-300HD		R-360HD		R-902HD	
HDPE	6"	150mm	8"	200mm	8"	200mm	10"	250mm	10"	250mm	10"	250mm
PVC	6"	150mm	8"	200mm	8"	200mm	10"	250mm	10"	250mm	10"	250mm

Direct Inlet From Surface Above:

Some surfaces generating relatively small flows may be connected directly to the top of the CULTEC chambers when needed. Typically, these would be patios, courtyards and lawn areas. The CULTEC system may be equipped with an Inspection Port Kit with a grated cover. Available inflow capacities of the grated inspection port covers have been estimated using the weir equation $Q=3.33L(H)^{3/2}$, where,

Q = Flow (cfs)
L = Perimeter of grate where flow is present
H = Depth of water (ft)
Coefficient = 3.33

Table 7.4b

Grated Inspection Port Kit Flow Capacity

cfs (L/s)

Head	Estimated Available Flow Capacity
1" (25mm)	0.20 (5.67)
2 (50mm)	0.70 (19.82)
3 (75mm)	1.30 (36.81)
4 (100mm)	2.00 (56.63)

7.5 DEALING WITH CONNECTIONS OUTSIDE OF THE GUIDELINES ABOVE

Some systems will simply require storm sewer pipes that do not meet the standards above. The pipe size, invert and/or location may require an alternative solution. This section is intended to provide guidance to the engineer of record if these scenarios may occur.

- Pipe too large for End Cap
- Perpendicular Connections too large or too high for Side Portal
- If the issue is simply that the pipe is too large for the side portal connection often the best solution is to switch pipe material from corrugated HDPE to PVC. Smooth wall PVC outside diameters are generally smaller than corrugated HDPE and may allow for a larger pipe.
- Inlet or overflow pipe too large for top connection

7.5.1 Side Inlet Options

If the required side connection is larger than the maximum allowable sizes listed in Table 7.3, or the required side connection invert is higher than the maximum allowable specification, the engineer of record may choose the following alternative methods to make the pipe connection. One of the following methods for facilitating the pipe connection may be used.

Fig. 7.5.1a: Tee Fitting – The engineer of record may choose to transition to a tee fitting to facilitate a large or elevated pipe connection. The tee fitting will shift the connection point from the chamber side to the chamber end cap where there is greater flexibility for pipe size and elevation.

Fig. 7.5.1b: Junction Manhole Structure - The engineer of record may choose to transition to a manhole structure to facilitate a large or elevated pipe connection. The structure will shift the connection point from the chamber side to the chamber end cap where there is greater flexibility for pipe size and elevation. Additionally, if an inlet, the manhole structure will allow the designer to include a CULTEC Separator Row / ADS Isolator Row Plus. If an outlet, this configuration will allow for the junction manhole to double as an outlet control structure, if desired.

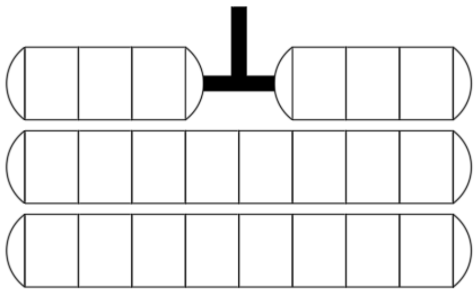


Fig. 7.5.1a

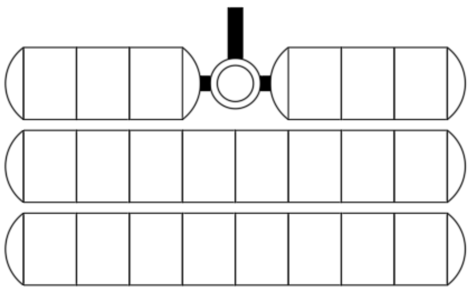


Fig. 7.5.1b

7.5.2 Inlets Inside of System Footprint

Some drainage network configurations will require an inlet within the footprint of the CULTEC system. This is a common application and can be easily accomplished with one of the following methods:

Fig. 7.5.2a: Remove Chambers - The engineer of record may choose to break the row of chambers to create space for the inlet structure. A 12” (300mm) clearance between the structure and the chambers and end caps should be maintained. CULTEC recommends connecting the inlet structure to a CULTEC Separator Row / ADS Isolator Row Plus.

Fig. 7.5.2b: Grated Inspection Port - The engineer of record may choose to transition to a manhole structure to facilitate a large or elevated pipe connection. The structure will shift the connection point from the chamber side to the chamber end cap where there is greater flexibility for pipe size and elevation. Additionally, if an inlet, the manhole structure will allow the designer to include a CULTEC Separator Row / ADS Isolator Row Plus. If an outlet, this configuration will allow for the junction manhole to double as an outlet control structure, if desired.

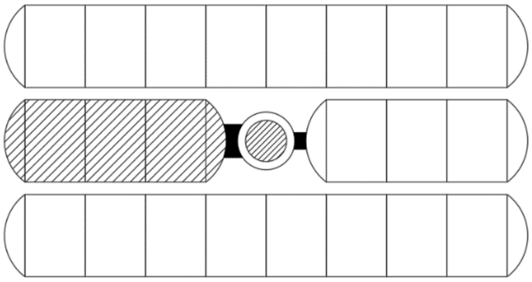


Fig. 7.5.2a

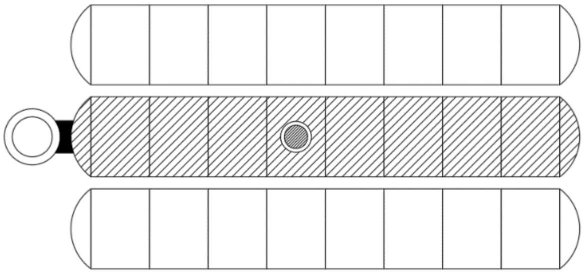


Fig. 7.5.2b

7.5.3 Large Pipe Connections

Some systems will require storm pipes that exceed the maximum allowable sizes listed in Table 7.2. To accommodate these large pipes, the engineer of record may need to incorporate a junction structure, pipe manifold, or a combination of the two into their design. The objective is to replace a single large-diameter pipe with multiple smaller-diameter pipes that can effectively connect to the chamber end cap. Additionally, multiple pipe inlets will reduce the flow rate of each inlet and subsequently reduce the possibility of bedding stone scour. For system outlets, multiple pipe outlets will increase the maximum possible discharge rates, if required. The engineer of record should contact the CULTEC Technical Services Department for project-specific guidance. Some general guidelines for these applications are as follows:

Inlets

Fig. 7.5.3a: Insert a junction structure with crown-match or concentric manifold. The primary inlet pipe will connect to the CULTEC Separator Row / ADS Isolator Row Plus. Adjacent rows connect via a large diameter pipe header with smaller pipe stubs connecting to end caps. Pipe stubs are elevated to create a CULTEC Separator Row / ADS Isolator Row Plus high-flow bypass.

Fig. 7.5.3b: Insert a junction structure with a diversion weir and size-on-size manifold. The primary inlet pipe will connect to the CULTEC Separator Row / ADS Isolator Row Plus. Adjacent rows are connected via a size-on-size pipe manifold. The diversion weir directs the first-flush into the CULTEC Separator Row / ADS Isolator Row Plus. Larger flows bypass over the weir into the pipe header.

Fig. 7.5.3c: Insert a junction structure with a single or multiple elevated bypass pipes. The primary inlet pipe will connect to the CULTEC Separator Row / ADS Isolator Row Plus. Adjacent rows connect via the elevated bypass pipes.

Fig. 7.5.3d: Insert a junction structure with a diversion weir crown-match or concentric manifold. The primary inlet pipe will connect to the CULTEC Separator Row / ADS Isolator Row Plus. Adjacent rows connect via a large diameter pipe header with smaller pipe stubs connecting to end caps. Pipe stubs are elevated to create a CULTEC Separator Row / ADS Isolator Row Plus high-flow bypass.

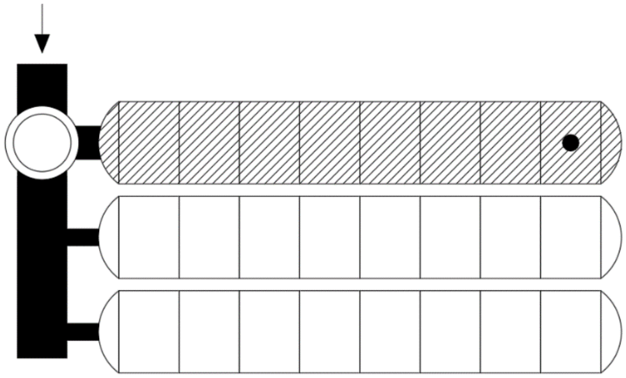


Fig. 7.5.3a

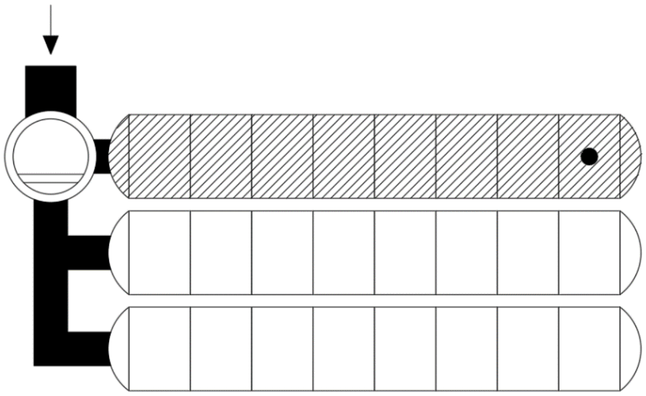


Fig. 7.5.3b

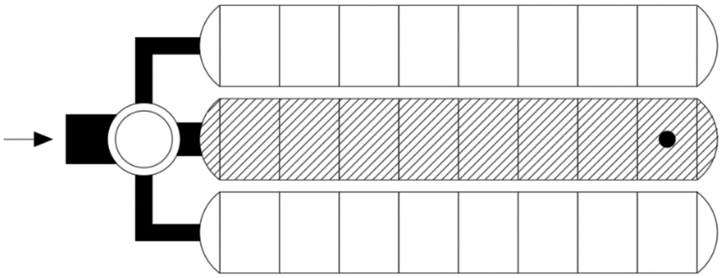


Fig. 7.5.3c

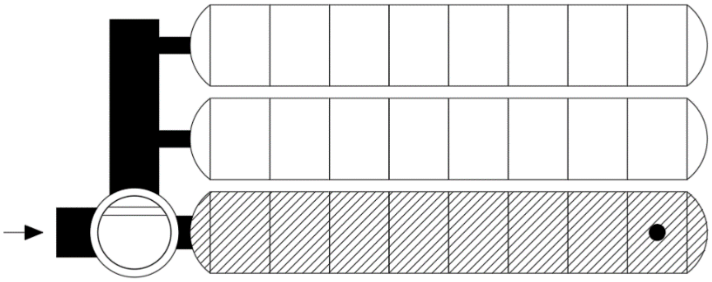


Fig. 7.5.3d

Outlets

The engineer of record may choose to transition to a manhole structure to facilitate a large or elevated pipe connection. The structure will shift the connection point from the chamber side to the chamber end cap where there is greater flexibility for pipe size and elevation. Additionally, if an inlet, the manhole structure will allow the designer to include a CULTEC Separator Row / ADS Isolator Row Plus. If an outlet, this configuration will allow for the junction manhole to double as an outlet control structure, if desired.

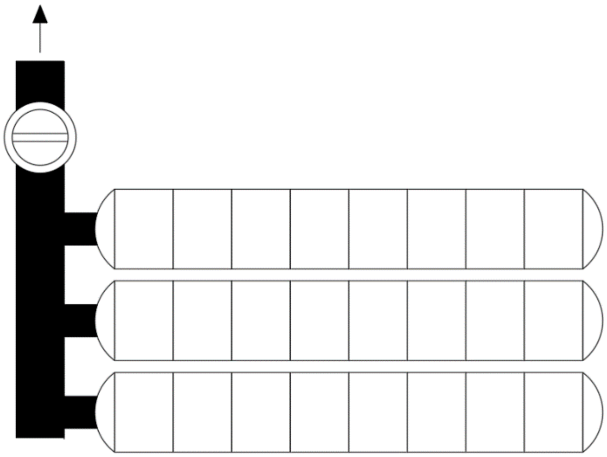


Fig. 7.5.3e

Fig. 7.5.3f

7.6 ALLOWABLE PIPE SKEW

CULTEC suggests that all pipe connections be made as square to the chamber as possible. However, site conditions may require pipe connections to the chambers at angles. Pipes may be connected to the chambers with skew, provided the maximum pipe skew is within the maximum values outlined in Table 7.6 below:

Table 7.6 Allowable Pipe Skew (degrees)

Connection Type	HDPE Pipe Size	C-100HD	R-150XLHD	R-280HD	R-300HD	R-360HD	R-902HD
Top	6" (150mm)	15	22.5	45	45	45	45
	8" (200mm)	10	15	45	45	45	45
	10" (250mm)	N/A	10	45	45	45	45
	12" (300mm)	N/A	0	30	30	45	45
	15" (375mm)	N/A	N/A	30	30	30	45
	18" (450mm)	N/A	N/A	22.5	22.5	22.5	30
	21" (525mm)	N/A	N/A	10	10	15	22.5
	24" (600mm)	N/A	N/A	N/A	N/A	15	22.5
	30" (750mm)	N/A	N/A	N/A	N/A	N/A	10
	36" (900mm)	N/A	N/A	N/A	N/A	N/A	0
Bottom	6" (150mm)	45	45	45	45	45	45
	8" (200mm)	30	30	45	45	45	45
	10" (250mm)	15	15	45	45	45	45
	12" (300mm)	N/A	10	45	45	45	45
	15" (375mm)	N/A	N/A	30	30	45	45
	18" (450mm)	N/A	N/A	22.5	22.5	30	45
	21" (525mm)	N/A	N/A	0	0	30	45
	24" (600mm)	N/A	N/A	N/A	0	22.5	30
	30" (750mm)	N/A	N/A	N/A	N/A	0	10
	36" (900mm)	N/A	N/A	N/A	N/A	N/A	0

8.0 System Sizing

8.1 SYSTEM SIZING BASICS

The design and sizing of the Cultec retention/detention system is the responsibility of the site engineer of record. Sizing requirements are site-specific based on the local stormwater regulatory requirements. CULTEC has several tools available to the design engineer of record to assist in the sizing and configuration of the system.

8.2 CULTEC STORMGENIE DESIGN TOOL

The CULTEC StormGenie® Design Tool is a web-based application developed by CULTEC to assist engineers, designers, and site planners in quickly and accurately laying out subsurface stormwater chamber systems. Users can import site plans directly into the application and automatically size systems based on the required storage capacity and desired footprint dimensions. The tool generates project-specific AutoCAD drawings, reports, and submittals for CULTEC's Contactor and Recharger Stormwater Systems in seconds!The user may request an emailed design package of the generated design. The supplied CAD drawing file is fully usable and may be modified and incorporated into existing plans.

Visit link: https://cultec.com/stormwater-design-assistance/stormgenie-design-tool/

8.3 HYDROCAD

HydroCAD is a widely used, hydrologic and hydraulic modeling software designed specifically for stormwater management system design. Engineers use it to simulate how rainfall moves across a site, how much runoff is generated, and how that runoff is controlled or detained using stormwater infrastructure like ponds, pipes, infiltration systems, and underground chamber systems, such as CULTEC chambers. HydroCAD provides direct support for the full range of CULTEC products. This partnership allows CULTEC chambers to be easily used within any HydroCAD model for stormwater storage, detention, or infiltration. HydroCAD includes complete CULTEC chamber definitions, plus an interactive chamber wizard for easy layout, pricing, and modeling of underground storage systems.

For HydroCAD questions, contact HydroCAD Software Solutions LLC at 800-927-7246 or e-mail them at support@hydrocad.net.

Visit link: https://www.hydrocad.net/cultec.htm

9.0 Hydraulics

9.1 OVERVIEW

The CULTEC chamber system includes an open bottom chamber surrounded by clean, crushed, open graded stone. The open graded stone permitted in CULTEC systems ranges in size from AASHTO M43 #3 through #57 gradation. This open graded stone provides significant hydraulic conductivity and is the primary method for the distribution of stormwater throughout the system. Additional flow capacity is provided within the proprietary CULTEC Internal Manifold System. CULTEC Feed Connectors are inserted into the chamber side portals to create an internal manifold. This manifold creates a lateral connection between each chamber row. When required, CULTEC chambers are compatible with external pipe manifolds when excessive inflow and outflows are expected and/or when the upstream or downstream pipe sizes are larger than the chamber model can physically accept.

9.2 FLOW RATES THROUGH OPEN GRADED STONE

Table 9.2 summarizes the flow capacity through the bedding stone below the chambers. Flow rates through the open graded stone are based on Darcy's "k" value for AASHTO #57 aggregate, as this is the smallest aggregate permitted in Cultec installations, and offers the most conservative flow rate values. The following flow rates represent estimated flow of a single chamber in one direction.

Table 9.2

Chamber Model	Depth of Bedding Stone		Chamber Flow Length		Max. Flow Through Bedding Stone Per Chamber cfs (m^3/s)		
	in.	mm	ft	m	AASHTO #3	AASHTO #4	AASHTO #57
Contactor 100HD	6	150	7.50	2.34	3.00 (0.0849)	1.13 (0.0319)	0.19 (0.0053)
Recharger 150XLHD	6	150	10.25	3.19	4.10 (0.1160)	1.54 (0.0436)	0.26 (0.0073)
Recharger 280HD	6	150	7.00	2.18	2.80 (0.0792)	1.05 (0.0297)	0.18 (0.0050)
Recharger 300HD	6	150	7.08	2.21	2.83 (0.0801)	1.06 (0.0300)	0.18 (0.0050)
Recharger 360HD	6	150	3.67	1.14	1.40 (0.0396)	0.55 (0.0155)	0.10 (0.0028)
Recharger 902HD	9	150	3.67	1.14	3.30 (0.0934)	1.24 (0.0351)	0.21 (0.0059)

9.3 INTERNAL MANIFOLD

CULTEC's unique, proprietary internal manifold system affords the CULTEC system additional flow capacity for peak inflow and outflow conditions. The modular feed connectors can be inserted through the side of any chamber providing a direct hydraulic connection between adjacent chamber rows. When properly sized, this internal manifold system will prevent surcharging at the upstream inlets and will provide a free-flooding condition at the outlet control structure at the downstream end of the system.

The flow capacity through the internal manifold feed connectors is summarized in Table 9.3. The feed connector flow rates calculations have been simplified using the equation for a submerged small rectangular orifice, $Q = C_d \times A \times \sqrt{2gh^1\text{-}h^2}$, where,

Q = Maximum flow rate through the orifice (cfs)
C_d = 0.60 (Unitless coefficient of discharge)
A = cross-sectional area of feed connector
g = 32.2 ft/s^2 (gravitational acceleration)
h^1 = upstream head (ft)
h^2 = downstream head (ft)

The design engineer should consider their peak flow condition, maximum flow through the bedding stone and hydraulic head when selecting the number of internal manifolds required for their project. Feed connector flow capacities listed below assume a maximum driving head of 6” (150mm) for the SFCx2 model and 12” (300mm) for the FC-24 and FC-48 models and represent the maximum flow capacity of the chamber inlet row.

Table 9.3

Internal Manifold Feed Connector Flow Capacities

Chamber Model	Compatible Feed Connector	Maximum Flow Per Feed Connector cfs (L/s)
Contactor 100HD	HVLV SCFx2	0.48 (13.59)
Recharger 150XLHD	HVLV FC-24	2.07 (58.62)
Recharger 280HD	HVLV FC-24	2.07 (58.62)
Recharger 300HD	HVLV FC-24	2.07 (58.62)
Recharger 360HD	HVLV FC-48	2.07 (58.62)
Recharger 902HD	HVLV FC-48	2.07 (58.62)

9.4 EXTERNAL PIPE MANIFOLDS

CULTEC chambers are compatible with external pipe manifolds. Pipe materials typically used in CULTEC systems include corrugated PE, PP, and SDR PVC. Although external pipe manifolds are typically not required, the design engineer may face challenges that require the use of an external pipe manifold. Examples of when the design engineer may include an external pipe manifold are:

- Extremely high inflow rates
- Extremely high outflow rates
- When the diameter of pipe required to carry design flows is greater than the allowable pipe connection for the specified chamber
- When a single inlet pipe would cause scouring of the bedding stone layer

9.4.1 Steps for Sizing an External Pipe Manifold

1. Identify Maximum Peak Inflow Rate
2. Calculate Minimum Manifold Trunk (Header) Diameter
   The flow through the inlet manifold is calculated using the equation of a short tube orifice, $Q = Ca\sqrt{2gh}$ where,

   Q = Maximum flow rate through the orifice (cfs)
   C = 0.75 (Unitless coefficient of discharge)
   A = cross-sectional area of manifold trunk pipe
   g = 32.2 ft/s^2 (gravitational acceleration)
   h = head over centroid of orifice (ft)

3. Identify Maximum Inlet Pipe Stub Size based on the selected chamber model
   The maximum allowable inlet stub sizes for each chamber model are summarized in Table 10.4.
4. Calculate the minimum number of inlet stubs required to convey peak flows
   Divide peak inflow rate by peak inflow rate per pipe stub
5. Check design against scour. Each inlet stub inflow rate should be less than the maximum allowable inflow rate per chamber model, summarized in section 9.4.2.

9.4.2 Inlet Velocity Scour Threshold

In addition to evaluating the hydraulic capacity of the inlet pipes, internal manifold, and inlet manifold stub, it is essential to assess the velocity of flow through the chamber system to ensure it does not exceed the allowable scour velocity of the aggregate bedding. Scour velocity is determined based on the critical shear stress of the uncompacted stone material beneath the chambers. To assist with system design, CULTEC has developed a simplified approach to define the maximum permissible velocities and corresponding inflow rates for a rectangular, aggregate-lined flow channel. These values can be used to guide pipe size selection and manifold layout. Table 9.4.2 provides the maximum allowable flow rates for each chamber model, based on inlet pipe sizes ranging from 6 inches (150 mm) to 30 inches (750 mm).

Table 9.4.2

Maximum Allowable Inlet Flow Rate by Chamber Model
cfs (L/s)

Inlet Pipe Diameter	C-100HD	R-150XLHD	R-280HD	R-300HD	R-360HD	R-902HD
6" (150mm)	0.57 (16.1)	0.57 (16.1)	0.62 (17.6)	0.65 (17.6)	0.65 (18.4)	0.95 (26.9)
8" (200mm)	1.01 (28.6)	1.01 (28.6)	1.11 (31.4)	1.16 (32.8)	1.16 (32.8)	1.69 (47.9)
10" (250mm)	1.58 (44.7)	1.57 (44.5)	1.73 (48.9)	1.81 (51.3)	1.81 (51.3)	2.65 (75.0)
12" (300mm)		2.26 (64.0)	2.5 (70.8)	2.61 (73.9)	2.61 (73.9)	3.81 (107.9)
15" (375mm)		3.39 (96.0)	3.9 (110.4)	3.93 (111.3)	4.07 (115.2)	5.95 (168.5)
18" (450mm)			5.5 (155.7)	5.88 (166.5)	5.87 (166.2)	8.57 (242.7)
21" (525mm)			5.5 (155.7)	7.07 (200.2)	6.99 (197.9)	11.67 (330.5)
24" (450mm)				5.63 (159.4)	6.99 (197.9)	15.24 (431.5)
30" (750mm)						20.16 (570.9)

9.5 SYSTEM VENTING

Ensuring adequate ventilation for air to escape the CULTEC system is important to ensure the system fills correctly. The CULTEC chamber and end cap joints are not air or watertight. Therefore, the chamber rows do not need to be vented. However, the entire CULTEC system should include a ventilation practice to ensure peak system performance. Most CULTEC systems can be vented using one of the following practices:

9.5.1 Ventilation through the inlet and or outlet pipes

Most ventilation occurs through the inlet and/or outlet pipes. When the anticipated HGL (hydraulic grade line) is lower than the springline of the highest inlet or outlet pipe, that pipe will allow air to escape the system as the system fills with stormwater. When the HGL is anticipated to rise above the springline of this pipe, it is recommended to utilize an alternative ventilation method.

9.5.2 Alternative Ventilation Methods

Ventilation through the CULTEC Inspection Port Kit: Ventilation through the inspection ports is an acceptable method of ventilation when the inspection port kit is within a parking lot or other hardscape surface. The CULTEC Inspection Port Kit cover is not airtight and will allow air to escape. This ventilation method should not be used in landscaped areas where the cover may become clogged with grass, leaves or other debris. This ventilation method should not be used when ponding on the finished surface above the system is expected.

Ventilation through a dedicated vent riser: The CULTEC system can be vented using a 4” (100mm) or 6” (150mm) PVC pipe connected to the top of any chamber. This pipe runs to finished grade, usually in a landscaped area, and is terminated with a candy-cane style fitting.

Ventilation through a perforated pipe connected to a storm structure: When no landscaped areas are proximal to the CULTEC system the system can be vented using a perforated 4” (100mm) or 6” (150mm) pipe connected to a nearby storm structure. This perforated pipe is installed horizontally above the system with the pipe crown matching the top of stone elevation. The pipe is transitioned to solid pipe outside of the limit of the system and connected to a nearby catch basin or manhole.

10.0 CULTEC Separator Row / ADS Isolator Row Plus

10.1 CULTEC SEPARATOR ROW / ADS ISOLATOR ROW PLUS OVERVIEW

CULTEC Separator Row / ADS Isolator Row Plus is an inexpensive means of removing sediment and Total Suspended Solids from the CULTEC chamber system, as well as providing easier access for inspection and maintenance. The CULTEC Separator Row / ADS Isolator Row Plus is designed to capture the First Flush of a rain event and is typically included as part of the “Treatment Train” for water quality. The CULTEC Separator Row / ADS Isolator Row Plus is a row of CULTEC Contactor or Recharger Chambers surrounded by high-performance geotextile. A single layer of ADS Isolator Row Plus Woven Geotextile is placed between the clean foundation stone and the chamber feet. The chambers are covered with CULTEC No. 410 non-woven geotextile. This configuration is designed to trap any sediment and/or debris that may be carried into the chamber system. The CULTEC Separator Row / ADS Isolator Row Plus has been third-party verified for up to 80% TSS removal efficiency.

10.2 CULTEC SEPARATOR ROW / ADS ISOLATOR ROW PLUS LOCATIONS

CULTEC strongly recommends a CULTEC Separator Row / ADS Isolator Row Plus be included in every system that collects parking lot runoff. These surfaces generally contain high concentrations of sediment and other pollutants. Even when a pre-treatment device such as a Hydrodynamic Separator is installed upstream, it is good practice to include a CULTEC Separator Row / ADS Isolator Row Plus as part of the treatment-train approach to water quality control. Likewise, when practical, CULTEC recommends connecting roof leaders into the CULTEC Separator Row / ADS Isolator Row Plus. CULTEC Separator Row / ADS Isolator Row Plus should be installed in-line with an upstream structure that provides access for maintenance and inspection and acts as a high-flow bypass diversion structure. The CULTEC Separator Row / ADS Isolator Row Plus is intended to be an offline filtration device. The system outlet should not connect to the CULTEC Separator Row / ADS Isolator Row Plus whenever possible.

10.3 CULTEC SEPARATOR ROW / ADS ISOLATOR ROW PLUS SIZING

Water quality control objectives are complex and are heavily dependent upon local regulations and stormwater quality objectives. The engineer of record should be familiar with local water quality regulations, individual site topography, hydrology and stormwater management objectives when designing a CULTEC Separator Row / ADS Isolator Row Plus.

Table 10.3: CULTEC Separator Row / ADS Isolator Row Plus Sizing Table

Chamber Model	Surface Loading Rate gpm/ft² (lpm/m²)	Effective Filtration Treatment Area ft² (m²)	MTFR per Chamber cfs (m³/s)
Contactor 100HD	4.13 (168.28)	20.89 (1.94)	0.192 (0.005)
Recharger 150XLHD	4.13 (168.28)	26.16 (2.43)	0.241 (0.007)
Recharger 280HD	4.13 (168.28)	24.20 (2.25)	0.223 (0.006)
Recharger 300HD	4.13 (168.28)	27.80 (2.58)	0.256 (0.007)
Recharger 360HD	4.13 (168.28)	16.33 (1.52)	0.150 (0.004)
Recharger 902HD	4.13 (168.28)	21.66 (2.01)	0.199 (0.006)

10.4 CULTEC SEPARATOR ROW / ADS ISOLATOR ROW PLUS ACCESS PIPE SIZING

All CULTEC Separator Row / ADS Isolator Row Plus require access pipes for the conveyance of stormwater into the row and for future maintenance. The access pipe requires no minimum slope and should be sloped no greater than 10%. Table 10.4 lists the minimum recommended pipe size in order to provide adequate access for the water jet maintenance process and to provide sufficient cross-sectional area to effectively flush the row.

Table 10.4

Chamber Model	Access Pipe Size (Corrugated HDPE)
Contactor 100HD	10″ (250mm)
Recharger 150XLHD	12″ (300mm)
Recharger 280HD	18″ (450mm)
Recharger 300HD	24″ (600mm)
Recharger 360HD	24″ (600mm)
Recharger 902HD	30″ (750mm)

10.5 CULTEC SEPARATOR ROW / ADS ISOLATOR ROW PLUS BYPASS

The CULTEC Separator Row / ADS Isolator Row Plus design should include an upstream diversion structure with a means of bypassing flows greater than the CULTEC Separator Row / ADS Isolator Row Plus's conveyance capacity to adjacent chamber rows. Upstream diversion structures may be precast concrete, PVC or HDPE. Structure size may vary based on local stormwater regulations, the size, material, and angle of upstream inlet pipes. In any scenario, CULTEC recommends the upstream diversion structure have a minimum 24″ (600mm) deep sump. There are three common methodologies used to incorporate the high-flow bypass.

1. Elevated Bypass Pipe
2. Diversion Weir
3. Crown-Match Tee Fitting

Elevated bypass pipes are the recommended method for providing CULTEC Separator Row / ADS Isolator Row Plus bypass. The engineer of record should size the bypass pipe to carry the maximum anticipated flows. The following table represents the suggested bypass pipe size by chamber model. Please contact CULTEC Technical Services department for assistance.

Table 10.5

Chamber Model	Maximum Bypass Pipe Size (Corrugated HDPE)
Contactor 100HD	6″ (150mm)
Recharger 150XLHD	8″ (200mm)
Recharger 280HD	12″ (300mm)
Recharger 300HD	18" (450mm)
Recharger 360HD	18″ (450mm)
Recharger 902HD	24″ (600mm)

11.0 Additional Considerations

11.1 OVERVIEW

The CULTEC chamber system provides engineers and developers with exceptional design flexibility for a wide range of stormwater management applications. The chambers are suitable for infiltration, wet and dry detention, as well as rainwater harvesting and reuse. Their modular configuration enables integration around building footprints, parking islands, and other underground utilities. Surface treatments above the system may include vehicular pavements, roadways, landscaped areas, courtyards, recreational fields, and playgrounds. The following design guidelines have been developed by CULTEC to assist design engineers with regard to placement of the CULTEC system and required horizontal clearances.

11.2 GENERAL CONSIDERATIONS

The engineer of record is responsible for evaluating and addressing the proximity of the CULTEC system to critical site infrastructure. Adequate separation must be maintained to safeguard the structural integrity and long-term functionality of all adjacent systems. Clearance considerations include, but are not limited to:

- Building foundations
- Structural retaining walls
- Existing and proposed vegetation
- Underground utilities

11.3 PROXIMITY TO BUILDING FOUNDATIONS AND STRUCTURAL RETAINING WALLS

CULTEC systems shall not be installed within the zone of influence of building foundations. The engineer of record is responsible for ensuring compliance with all applicable local, state, and national building codes regarding horizontal and vertical separation between the chamber system and any adjacent structures. Refer to Chapter 14 for considerations when designing CULTEC systems under structures.

11.4 VEGETATION

CULTEC systems shall be installed outside the critical root zone (CRZ) of existing and proposed trees to prevent root intrusion and ensure the viability of mature vegetation. The CRZ radius varies by tree species and trunk diameter; however, a general guideline is to provide a minimum horizontal offset of 1 foot for every inch of trunk diameter measured at breast height (DBH). For example, a 6-inch DBH tree, when mature, would require a 6-foot minimum horizontal separation from the CULTEC system.

Whenever possible, the system should remain entirely outside the tree's dripline. However, in cases where this is impractical due to site constraints, additional root protection measures can be implemented. If sufficient separation from the CRZ or dripline cannot be maintained, a root intrusion barrier is recommended to protectboth the CULTEC system and nearby vegetation. Acceptable root intrusion barrier materials are typically HDPE geomembrane liners with a minimum thickness of 40 mils. The liner shall be installed on the top and sides of the chamber system that are adjacent to the tree root zone.

11.5 UNDERGROUND UTILITY SEPARATION

Proper separation between underground detention systems and existing or proposed utilities is critical for ensuring long-term system performance, structural stability, and utility accessibility. This section outlines the general guidelines and best practices for horizontal and vertical separation requirements based on industry standards, manufacturer recommendations, and regulatory practices. The design engineer should always follow local building codes and regulations when locating the detention system. The following table represents the suggested minimum horizontal clearance between the CULTEC system and underground utilities. The Engineer of Record must follow all local laws and regulations with regard to underground utility clearances.

Table 11.5

Utility Type	Minimum Horizontal Clearance
Water Lines	10' (3.058m)
Sanitary Sewer Lines	10' (3.058m)
Storm Drains	10' (3.058m)
Gas Lines	10' (3.058m)
Electric/Telecommunications	5' (1.524m)
Adjacent Detention Systems	10' (3.058m)
Residential Onsite Wastewater Systems	25-50' (7.62m-15.24m)
Commercial Onsite Wastewater Systems	50-75' (15.24m-22.86m)

12.0 Impermeable Thermoplastic Geomembrane Liners

12.1 THERMOPLASTIC GEOMEMBRANE LINER OVERVIEW

Thermoplastic geomembrane liners are engineered synthetic barriers designed to limit the migration of fluids in containment applications. Commonly utilized in stormwater management basins, chemical containment areas, and landfill installations, these liners provide a durable and flexible solution for fluid control. The most frequently specified materials in geomembrane applications with CULTEC systems include polyvinyl chloride (PVC), linear low-density polyethylene (LLDPE), and either ethylene propylene diene monomer (EPDM) or reinforced polypropylene (RPP), depending on project requirements. For any application requiring a geomembrane liner, CULTEC recommends consultation with a qualified and experienced geomembrane liner supplier to ensure proper material selection, system compatibility, and installation methodology.

12.2 GEOMEMBRANE LINER APPLICATIONS

CULTEC chambers provide flexible design options for use as stormwater retention, detention, or infiltration systems. The majority of CULTEC installations function as open-bottom detention systems, offering the additional benefits of stormwater treatment through infiltration, volume reduction, and groundwater recharge. Geomembrane liners are incorporated into CULTEC systems primarily for two key applications:

1. Complete containment of the stormwater runoff. These applications would include sites with one or more of the following conditions:
   - Highly contaminated runoff
   - Constructed in contaminated in-situ soils
   - Constructed in fill
   - Constructed on weak subgrade soils
   - Insufficient separation to bedrock
   - Constructed on Karst geology
   - Close proximity to structural site elements like building foundations and retaining walls
   - Rainwater Harvesting and Reuse

2. Applications where groundwater intrusion must be prevented when the installation occurs below the groundwater elevation.

12.3 GEOMEMBRANE LINER MATERIALS

The most common thermoplastic geomembrane liner material used in CULTEC systems is polyvinyl chloride (PVC). PVC liners are chemically resistant, flexible, puncture resistant, and offer the added advantage of being solvent-welded or taped in the field. This allows PVC liners to be installed by the underground utilities contractor. Typical PVC thicknesses range from 20mil to 40mil depending on the application. CULTEC recommends 30mil PVC geomembranes for most applications.
Contact CULTEC for more information regarding thermoplastic geomembrane liners.

Liner Protection Material: Protecting the liner from puncture is critical. Two layers of a heavy, reinforcing non-woven geotextile on either side of the liner provides puncture resistance. CULTEC recommends 30 mil PVC geomembranes be protected on both sides with a minimum 8 oz. non-woven geotextile. Thicker non-woven geotextile should be used in applications that contain an increased possibility of puncture.

Fabrication and Accessories: Most liner manufacturers are capable of prefabricating geomembrane panels and supplying detailed unfolding and installation instructions to facilitate efficient, watertight deployment. Prefabricated panels can typically be fabricated in sizes up to 20,000 square feet, reducing field seaming requirements and installation time. Where site constraints or layout complexity preclude full prefabrication, field seaming is performed using either thermal fusion or solvent welding techniques, depending on the liner material.

Penetrations for piping are sealed using prefabricated pipe boots supplied by the manufacturer or, alternatively, fabricated in the field using additional liner material and secured with stainless steel pipe clamps. Storm sewer structures located within the liner footprint must be accounted for during system layout. Installers may either haunch the subgrade to allow placement of the liner beneath the structure prior to installation, or bond the liner directly to the structure using stainless steel clamps, compatible adhesives, or heat welding methods, as appropriate for the material type and site conditions.

12.4 GEOMEMBRANE LINER PLACEMENT

It is essential to evaluate whether geomembrane liner installation is required along the sides and bottom of the CULTEC system excavation, or along the top, sides, and bottom. This determination is inherently site-specific and should be based on project-specific hydrologic and geotechnical conditions. One key consideration is the elevation of the high water level (HWL). If the outlet control structure is designed with an emergency overflow to regulate the maximum surface water elevation, it may not be necessary to install a geomembrane over the top of the chamber system.

However, for off-line configurations or any design in which the CULTEC system is intended to operate at full storage capacity, it is recommended to seal the top of the system with a geomembrane liner. Similarly, when the chamber system is located directly beneath a pavement section, top-sealing with geomembrane is advised to prevent moisture infiltration into the pavement structure, which could compromise its structural integrity and reduce its service life.

Additionally, CULTEC advises sealing the top of the system with an impermeable liner in scenarios where the seasonal high water table is anticipated to approach or exceed the elevation of the system top. In all cases where groundwater interaction is a design consideration, CULTEC strongly recommends that the engineer of record consult with a qualified geotechnical engineer to assess the suitability and configuration of the impermeable liner system.

12.5 DEWATERING CONSIDERATIONS FOR GEOMEMBRANE-WRAPPED DETENTION SYSTEMS

When designing a CULTEC detention system encapsulated with an impermeable geomembrane, provisions for full dewatering of the system must be incorporated. Typically, the outlet pipe from the chamber system is set at the same invert elevation as the chamber base. For the stone bedding layer to be considered part of the system's active storage volume, water stored within this layer must be capable of draining to a downstream structure.

To facilitate this drainage, a perforated underdrain (sub-drain) pipe is installed at the bottom of the stone bedding layer. This underdrain is connected to the downstream storm sewer system or a flow control structure, allowing trapped water to be effectively removed.

However, if site constraints prevent the use of a sub-drain—such as when the invert elevation of the control structure matches that of the chamber base—drainage from the bedding stone is not feasible. In such cases, water retained within the stone envelope becomes a permanent pool and must be excluded from active detention volume calculations.

12.6 BUOYANCY AND HYDROSTATIC UPLIFT

CULTEC recommends against installing lined chamber systems below groundwater whenever possible. Although the total weight of a chamber system generally exceeds the buoyant force of the groundwater, a limiting stability condition may result when the buoyant pressure exceeds the resistance pressure directly under the chamber. This could result in a heave of the bedding under the chamber leading to instability. Alternative solutions include selecting a shallower chamber model, relocating the system to alternative parts of site, or reconfiguring the system to reduce contributing pipe lengths and slopes to keep the system closer to the surface. Alternatively, when gravity discharge is possible, a series of perforated underdrains can be installed beneath the CULTEC system to eliminate adverse affects of the groundwater. When no alternative options are feasible, CULTEC systems may be designed and installed below the seasonal high groundwater table with special design considerations.

The four alternative design options include:

1. Overexcavation and replacement with select fill
2. Overexcavation and replacement with aggregate
3. Concrete slab
4. Geogrid reinforcement

For design assistance with systems located within the groundwater table, please contact CULTEC Technical Services.

13.0 Inspection and Maintenance

13.1 INSPECTION AND MAINTENANCE OVERVIEW

Regular inspection and maintenance of the CULTEC system is critical to ensure the system is functioning correctly and as designed. All maintenance of the CULTEC system occurs through an upstream structure and/or CULTEC Separator Row / ADS Isolator Row Plus. No maintenance is required outside of the upstream storm structures and/or CULTEC Separator Row / ADS Isolator Row Plus.

13.2 CULTEC INSPECTION PORT KIT OVERVIEW

The CULTEC Universal Inspection Port Kit is a versatile and lightweight solution designed to accommodate connections to standard HDPE, SDR, and Schedule 40 PVC piping in diameters ranging from 6 inches (150 mm) to 10 inches (250 mm). The kit is compatible with both solid and slotted ductile iron frames and covers, offering flexibility for various site requirements including low-flow inlets. It facilitates direct access to the chamber system, enabling routine inspection and maintenance activities.

Properties	Test Results
Fitting Appearance	Green
Fitting Dimensions	12.5" dia. x 11" H 317 mm x 279 mm
Fitting Material	SDR-35 PVC
Frame & Cover Appearance	Black
Frame & Cover Material	Ductile Iron
Frame Dimensions	13.6" x 13.6" 346 mm x 346 mm

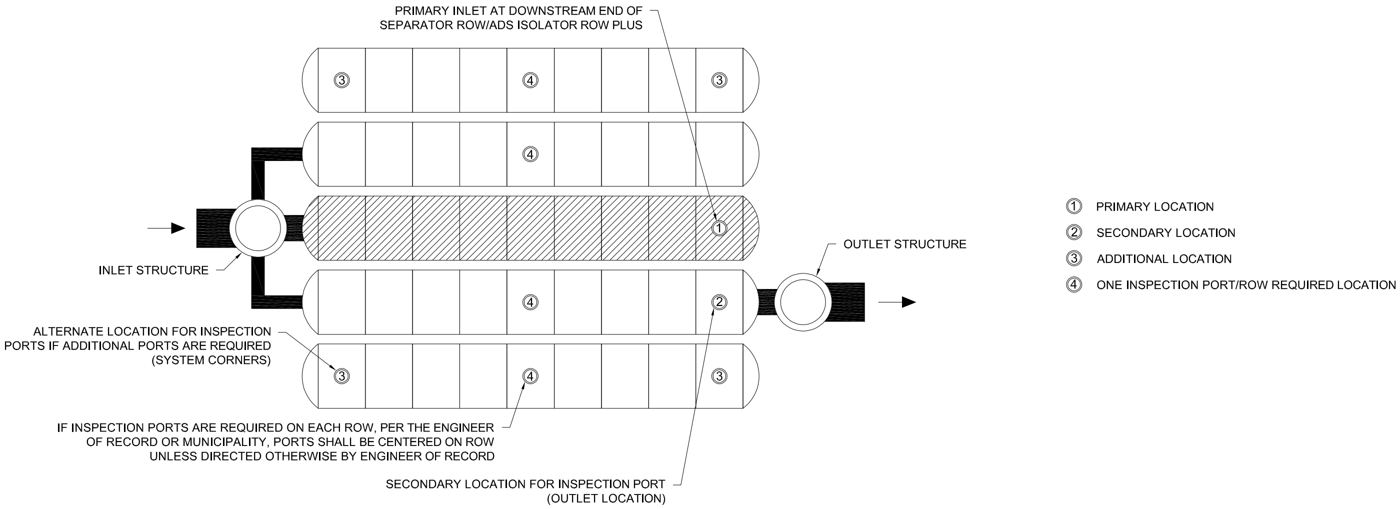
13.3 INSPECTION PORT KIT LOCATIONS

CULTEC recommends that each system be designed with a minimum of one inspection port. Local codes and stormwater regulations may require additional inspection port kits. The engineer of record should be familiar with these codes and regulations and add additional inspection port locations as needed.

Each CULTEC Separator Row / ADS Isolator Row Plus should include a minimum of one inspection port. This inspection port may count as the recommended inspection port per system. CULTEC Separator Row / ADS Isolator Row Plus inspection ports should be located at the downstream end of the row, unless the row is fed from both ends, in which case the inspection port should be located in the center of the row. CULTEC Separator Row / ADS Isolator Row Plus greater than 150’ should have multiple inspection ports and inspection port kits shall be spaced a maximum of 250’ on center.
Inspection port kits may be located outside of CULTEC Separator Row / ADS Isolator Row Plus.

Additional inspection ports are recommended at critical system locations such as inlets and outlets. The engineer of record should not only consider how the inspection port location relative to the CULTEC system but should also consider the finished surfaces above. Inspection ports are HS-20 load rated and can be located within parking lots, drive aisles and landscaped areas. Designers should ensure the inspection ports are not located on parking curbs or gutters, bollards, light pole foundations, turf playing fields or other surface features where the cover location may be hazardous.

Fig. 13.3



14.0 Best Practices for Under-Structure Detention Systems

14.1 INTRODUCTION

Developing sites in urban environments remains challenging due to growing populations and stricter water containment regulations. When space limitations prevent retention or detention systems from being installed outside the building footprint, designers are increasingly exploring the option of integrating these systems within the structure's foundation. This approach introduces several concerns, including installation methods, potential impacts of water on the foundation, and the accessibility of the system for inspection and maintenance. This document aims to guide designers by outlining the best practices for incorporating a CULTEC detention system beneath a building structure.

14.2 STRUCTURE TYPES

CULTEC detention systems can be installed under building structures, provided the level directly above the system is dedicated to parking. Multi-use structures, where the bottom level(s) are for parking and the upper levels are for office/retail/residential space are acceptable. Maintaining parking directly above the system allows for access directly to the system for critical inspection and maintenance activities to help achieve the maximum service life of the system.

14.3 PRODUCT SPECIFICATIONS

The 2024 editions of the International Plumbing Code (IPC) and International Building Code (IBC) do not explicitly define standard specifications for installing stormwater detention systems beneath buildings. However, the IBC does state that any such system must not negatively impact the structural integrity of the building. Accordingly, when using CULTEC products beneath structures, it is essential to ensure that no structural loading is transferred onto the system.

It is important to note that local codes and specifications may provide more detailed requirements and, in many cases, will take precedence. CULTEC has not conducted local investigations to determine compliance with regional codes; such evaluations are the responsibility of the project's designer of record.

While the IPC does not specifically reference stormwater detention systems, it does recognize polypropylene pipe meeting ASTM F2881 as a suitable material for building storm sewer applications.

CULTEC Stormwater Chambers

CULTEC recommends its current chamber offerings for use beneath parking structures. For detailed product performance and application guidance, refer to the relevant product specifications. CULTEC chamber systems are designed to meet applicable standards including ASTM F2787. To ensure proper system performance, all installations must follow the CULTEC installation guidelines. For effective access, inspection, and maintenance, it is recommended that pipe manifolds and connections meet the minimum diameters specified in Table 14.4. Additionally, access structures should be designed in compliance with OSHA confined space entry requirements.

14.4 PIPE MANIFOLDS

CULTEC recommends the use of pipe manifolds to facilitate inspection and maintenance. Pipe diameters should be selected in accordance with Table 14.4. Acceptable pipe options include ADS HP Storm or SaniTite HP, which meet ASTM F2881 and AASHTO M330 standards.

Although ADS HP pipes provide watertight joints as verified by ASTM D3212 laboratory testing, allowable leakage rates still apply within industry standards. Currently, there is no defined maximum leakage limit for fittings in the stormwater industry. If leakage or soil saturation is a concern, CULTEC recommends installing a thermoplastic liner around the system.

Table 14.4: Minimum Manifold Diameter by Chamber Model

	Chamber Model		
	R-300HD	R-360HD	R-902HD
Minimum Manifold Diameter	24" (600mm)	24" (600mm)	24" (600mm)

14.5 ACCESS STRUCTURES AND MAINTENANCE

CULTEC recommends the inclusion of a CULTEC Separator Row/ADS Isolator Row Plus at each inlet point to the stormwater detention system to enhance pretreatment and facilitate sediment capture. For ongoing maintenance accessibility, it is further recommended that access structures—such as manholes—be positioned outside of the building footprint or in locations where adequate vertical clearance exists to accommodate vacuum truck access and operation. This approach ensures efficient long-term maintenance while minimizing disruption to adjacent structures or site features.

14.6 THERMOPLASTIC LINER (NOT SOLD BY CULTEC)

A thermoplastic geomembrane liner may be required to create a fully contained detention system with zero infiltration or exfiltration. The use of a liner is recommended to prevent water infiltration into the underlying soils or to contact the surrounding foundation system. CULTEC does not recommend detention systems under a parking structure be installed below the seasonal high groundwater table (see Groundwater Elevation section in this document), even if buoyant conditions can be managed. Thermoplastic liners are typically polyvinyl chloride (PVC), linear low-density polyethylene (LLDPE), or high-density polyethylene (HDPE). CULTEC recommends a minimum thickness of 30 mil. CULTEC recommends a liner material that can be heat welded for under-structure applications. Geomembrane liners must always be sandwiched between two layers of non-woven geotextile padding for puncture resistance.

If a thermoplastic liner is not desired, then the project's geotechnical and structural engineers shall review the impact water will have on the soils and foundation system. The project geotechnical engineer shall review the soil conditions to determine whether moisture-sensitive native soils are at or below the system elevation. The project structural engineer shall evaluate the foundation system specified to determine whether water will adversely affect the system and determine if waterproofing is required. If it's determined a thermoplastic liner is not required by these parties, a non-woven geotextile is required to minimize soil migration into the detention system's structural backfill. When geomembrane liners are required, CULTEC strongly recommends a liner installer/supplier be contracted by the project design engineer of record to specify the liner system configuration.

14.7 SYSTEM INSTALLATION INSPECTION

A pre-construction meeting is required prior to the installation of the CULTEC system. CULTEC recommends inspecting the detention system during placement of embedment stone and backfilling, as well as 30 days after installation. The geometry of the chamber arch should be observed when placing embedment stone and placing backfill layers. When installing a detention system beneath a parking structure, space is often limited, making it essential to maintain adequate clearance between the detention system and the building's foundation.

Foundation preparation and building construction activities can increase the risk of excessive loading on the buried system. Therefore, construction phasing and proximity restrictions for equipment such as construction vehicles, cranes, tower cranes, and temporary shoring must be carefully planned to prevent overloading the system.

A post-installation inspection, conducted after all adjacent construction activities are complete, allows the design team and owner to verify that the detention system remains in proper condition and is ready for operational use.

14.8 PROJECT CONDITIONS

Foundation System
Under no circumstances should the foundation system—such as piers, columns, footings, grade beams or structural walls—impose any loads on the CULTEC detention system. CULTEC products are designed to be flexible and may undergo slight deformation to transfer loads to the surrounding or underlying soil. This behavior is incompatible with structural foundation systems and can negatively impact the support and stability of any overlying structure.

CULTEC detention systems must not be installed beneath mat or raft foundations, as these continuous slabs transfer structural loads directly to the soil below, which can compromise both the foundation and the detention system.

As a general design guideline, to avoid unintended load transfer to the chamber system, the invert elevation of the chambers should be maintained at or above the bottom elevation of adjacent structural footings.

Groundwater Elevation
CULTEC detention systems are recommended to be installed entirely above the seasonal high groundwater table. This requirement is especially critical for under-structure applications, where groundwater intrusion can result in elevated hydrostatic pressures that may compromise the integrity of the stormwater system, and potentially impact the structural foundation of the building above.

Coordination with a qualified geotechnical engineer is essential to evaluate site-specific groundwater conditions and to design appropriate mitigation measures.

Soil Conditions
The installation of a detention system beneath a parking structure presents a distinct advantage, as subsurface soils have typically undergone geotechnical evaluation to verify their adequacy for supporting the structural foundation, including assessment of minimum allowable bearing capacity. This verified bearing capacity should be referenced against the Foundation Depth tables provided in the CULTEC Design Manual to determine the required depth of stone bedding under the anticipated loading and installation conditions. Should the engineer of record request CULTEC's input on the specification of base stone for a particular application, the allowable soil bearing capacity at the proposed installation depth must be supplied by the engineer of record to facilitate an accurate recommendation.

Construction Loading
Refer to the chamber-specific CULTEC Installation Guide for detailed information regarding minimum cover requirements under various loading conditions. Construction practices such as proof rolling, temporary shoring, or other activities may impose loads that exceed the structural capacity of the chambers. Prior to initiating any operations or applying loads not explicitly addressed in the Installation Guide, the contractor must consult with a CULTEC representative to evaluate the proposed loading conditions and their proximity to the stormwater detention system. For construction loading scenarios that exceed the standard AASHTO design vehicle, a project-specific loading analysis must be coordinated with a CULTEC representative to ensure structural integrity and system performance.

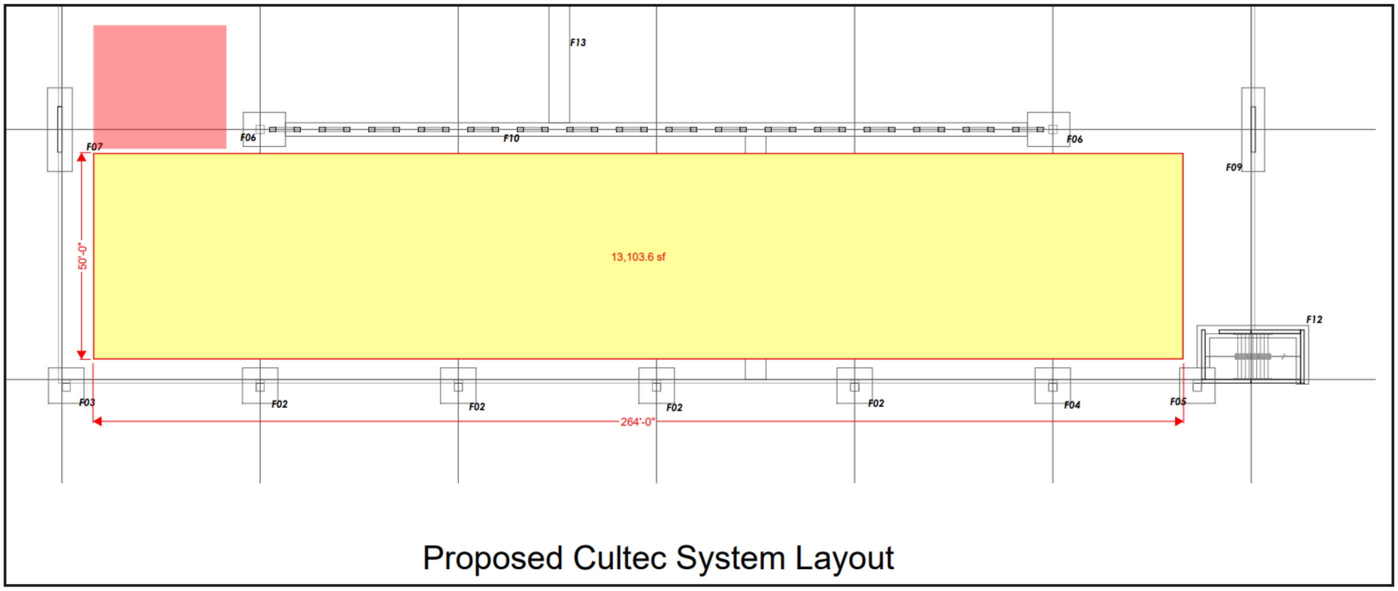
Other Loading
Local building codes may prescribe specific loading criteria that subsurface systems are required to withstand. CULTEC has not conducted an evaluation of local code requirements to verify the appropriateness of its products in relation to site-specific design loads, service conditions, or regulatory compliance. If any anticipated project-specific loads exceed those addressed in CULTEC's published design documentation, it is the responsibility of the design professional to consult with a CULTEC representative to assess the applicability of the system to the intended use. Furthermore, CULTEC has not performed a seismic analysis to evaluate the performance or suitability of its chamber systems installed beneath parking structures, nor the potential impacts such systems may have on adjacent structures or foundation elements under seismic loading conditions.

14.9 DESIGN LAYOUT

Upon confirmation by the engineer of record that the site conditions and required system performance parameters are compatible with the use of a CULTEC stormwater detention system, CULTEC can assist in the design phase by providing CAD-based layout services to support the development of an optimized chamber configuration tailored to project-specific requirements. These services may include recommendations for base stone depth, contingent upon the submission of the allowable bearing capacity at the proposed installation elevation. Before proceeding with any chamber system layout, CULTEC requires a detailed drawing from the engineer of record depicting all critical foundation elements, including footings, structural walls, columns, piers, and grade beams. These drawings must clearly indicate the required horizontal separation between the chamber system and structural components to ensure that the proposed chamber configuration remains outside the foundation's zone of influence.

For additional information regarding available design support services, please contact a CULTEC representative.

Fig. 14.9 Example Structural Plan Supplied to CULTEC



Disclaimer: *CULTEC provides the following considerations for reference only and recommends review by the project-specific civil engineer, geotechnical engineer, and structural engineer. CULTEC has not performed any site-specific analysis to determine the suitability of its systems for installation beneath a parking structure. Design layout services offered by CULTEC are intended as a supplementary resource and are provided under the direction and approval of the engineer of record.*

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