Drainage Solutions in Steel
Hel-Cor Lock-Seam Corrugated Steel Pipe

Armtec first introduced Hel-Cor pipe to the construction industry in 1970. Since then, Hel-Cor has proven its effectiveness and durability in countless installations, under diverse conditions.

The inherent strength of these helically-corrugated, light-weight steel sections, in conjunction with the diversity of sizes, couplings, fittings, and finishes, combine to make Hel-Cor one of the most versatile, cost-effective systems for applications such as:

- Culverts
- Sewers
- Stream Enclosures
- Underpasses
- Intakes
- Outfalls
- Water transmission lines

The annular corrugated pipe ends, when fitted with Hugger bands and O-ring gaskets, provide conduits with very low rates of infiltration and exfiltration.

Hel-Cor is available in diameters ranging from 150 to 3600 mm, in two shapes (full-round and pipe-arch); two corrugations; five wall thicknesses; and three factory-applied finishes. The material and fabrication of Hel-Cor Lock Seam Pipe conforms to CSA Standard CAN/CSA G401.

Flexibility and High Compressive Strength

The helical corrugations and continuous lock-seam provide high ring compression strength in a relatively light-weight, thin-walled structure.

Vertical live and dead-loads are transferred to the surrounding soil, thus creating a composite steel/soil interaction, effectively distributing the load around the entire circumference. Unit pressure on the top and bottom of the pipe can be as little as one third of that encountered with rigid pipe under identical conditions.

Economy of Installation

Depending upon the installation, cost savings in excess of 25% over other systems are not uncommon.

The long, light-weight sections of Hel-Cor pipe lend themselves to fast, easy handling and installation with light equipment and simple tools.

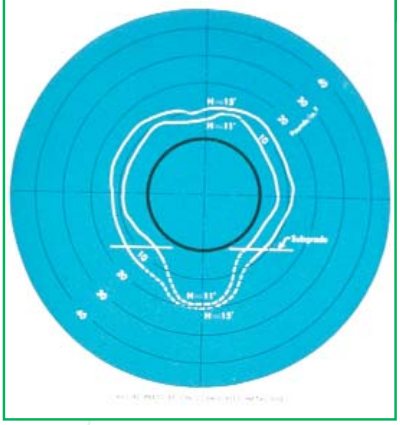
Shapes: The full-round pipe is used for most typical, general-purpose applications.

Pipe-arch is used where headroom is limited. The low, wide pipe-arch shape provides the required hydraulic capacity at lower depths of flow. For fast, unrestricted run-off at low water levels, the pipe-arch is very effective.

Selection guides for full round and pipe-arch are shown in Tables 6 to 14.

Corrugations: Hel-Cor lock-seam pipe is supplied in three corrugations: 38 x 6.5 mm, 68 x 13 mm, and 125 x 26 mm. The latter provides additional stiffness, which is especially important with larger pipes to minimize deflection during backfilling. Refer to pages 6 and 7 for the section properties of the three corrugations.

Flexible Ring Compression



Rigid Ring Compression

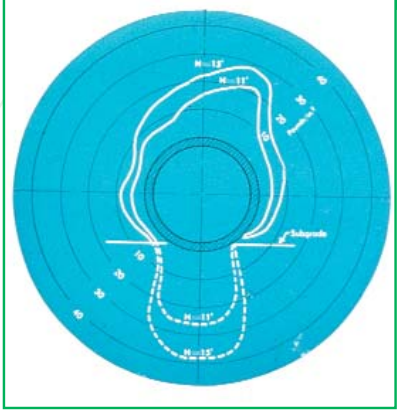


Table 1 - Corrugation Profiles (mm) & Diameters

Nominal		
Pitch	Depth	Inside Diameter (mm)
38	6.5	150, 200, 250
68	13	300 - 2000
125	26	1200 - 3600

Durability Considerations – Three Finishes

To accommodate a variety of durability and hydraulic design considerations, three factory-applied finishes are available. These are Galvanized Steel, Aluminized Steel Type 2 and Polymer Coated Steel.

Galvanized Steel: This standard general-purpose finish is a continuous galvanized coating applied using stringent quality control procedures to ensure excellent bonding of the coating to the steel. These installations have proven their durability in many years of field application.

Generally, most culvert and storm sewer sites in Canada experience relatively neutral conditions. The heavy zinc coating of the standard galvanized finish provides sufficient protection in most installations.

Aluminized Steel Type 2: For more corrosive environments, Armtec recommends the use of Aluminized Steel Type 2. The aluminum coating has superior corrosion resistance than zinc galvanizing and displays better abrasion resistance. Most agencies use a service life estimate that is significantly greater than that of plain galvanized steel.

Polymer Coated CSP: In particularly aggressive environments consideration should be given to the use of polymer coated corrugated steel pipe. Polymer coated CSP utilizes galvanized steel protected by a mechanically and chemically laminated polymer film on both sides of the steel sheet. This product combines the strength of steel with the durability of high density polymer.

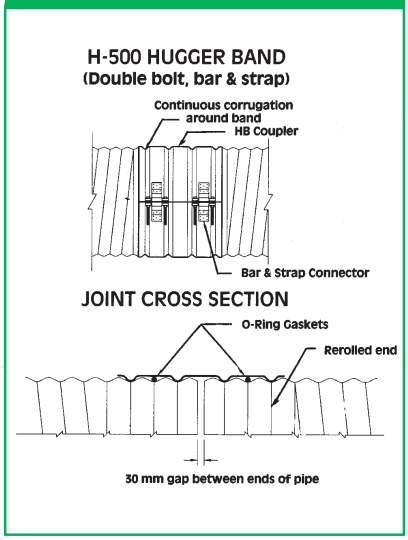
Annular Corrugated Ends: Couplers and Fittings

Hel-Cor pipe features universal annular corrugated ends, so a variety of couplings may be used for the pipe and pipe-arch.

Three types of couplers are recommended:

- Hugger Band
- Annular corrugated standard bolt and angle coupler
- Dimpled coupling band

Hugger Band: Armtec offers a highly effective Hugger Band joint. These 500 mm wide bands are recommended for storm sewers and other installations where low leakage rates and resistance to longitudinal disjointing are prime requirements. When used with O-ring gaskets, the Hugger Band provides an extremely tight joint with low infiltration and exfiltration rates.



Standard Annular Corrugated Coupler: The standard annular corrugated coupler, fitted with bolt and angle attachments, seats snugly onto the pipe-end corrugations, and is suitable for most general-purpose applications.

Dimpled Coupling Band: This coupler is used where helical and/or annular corrugated pipe ends are to be coupled. Dimpled couplers are available with steel angles or with wedge connectors as shown.

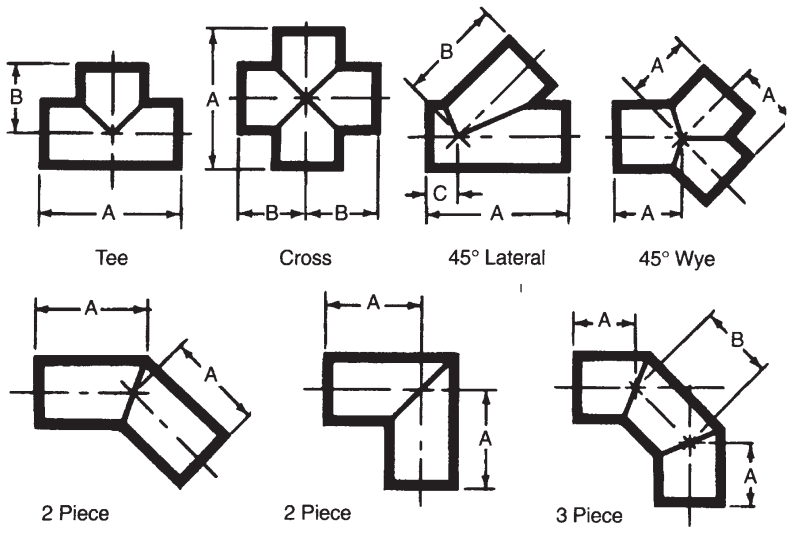
Angle Type: 300 to 1800 mm
Wedge Type: 300 to 1200 mm

Fittings

Standard fittings such as: tees, wyes, elbows, saddle branches, and reducers are available for the round pipe and pipe-arch.

Special fittings, such as manholes and catchbasins can be custom-fabricated to suit individual requirements.

Typical Fittings



End-Treatments

Armtec supplies durable, lightweight end-sections for improved hydraulic efficiency and erosion control. These sections help reduce scour at inlets and undermining at outlets, while providing an attractive, economical means of blending the culvert ends with the sloping embankment.

There are a variety of end finishes available for corrugated steel pipe. These options include skewed and bevelled ends, steel and polymer end sections and a variety of headwalls and cut off walls.

Hel-Cor Pipe and Pipe-Arch 68 mm x 13 mm Corrugations

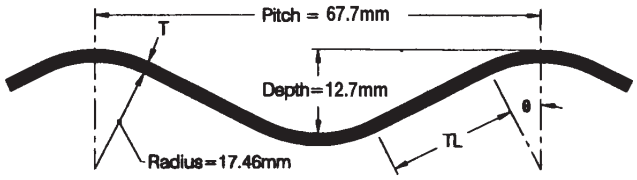


Table 2 – Section Properties

Coated Thickness (mm)	Design Thickness (mm)	Area of Section (mm^2/mm)	Moment of Inertia (mm^4/mm)	Section Modulus (mm^3/mm)	Radius of Gyration (mm)	Tangent Length (mm)	Tangent Angle ($\triangle^o$ degrees)	Developed Width Factor*
1.6	1.40	1.512	28.367	4.024	4.332	19.578	26.734	1.080
2.0	1.82	1.966	37.108	5.111	4.345	19.304	26.867	1.080
2.8	2.64	2.852	54.565	7.114	4.374	18.765	27.136	1.080
3.5	3.35	3.621	70.159	8.743	4.402	18.269	27.381	1.081
4.2	4.08	4.411	86.706	10.334	4.433	17.755	27.643	1.081

* Developed width factor measures the increase in profile length due to corrugating.

Table 3 – Handling Weight and End Area

Pipe Diameter (mm)	End Area (m^2)	Handling Weight - Galvanized (kg/m) Wall Thickness (mm)					
		1.3	1.6	2.0	2.8	3.5	4.2
150*	0.018	5.9	7.2				
200*	0.031	7.7	9.5				
250*	0.049	9.6	12				
300	0.071		14	18			
400	0.126		19	24			
500	0.196		24	30			
600	0.283		28	35	49		
700	0.385		33	41	57		
800	0.503		37	47	65		
900	0.636		42	53	73	90	
1000	0.785			58	81	100	
1200	1.131			70	97	120	
1400	1.539				113	140	168
1600	2.011				130	160	192
1800	2.545					179	215
2000	3.142						239

*38 x 6.4 corrugation profile

Hel-Cor Pipe
125 mm x 25 mm
Corrugations

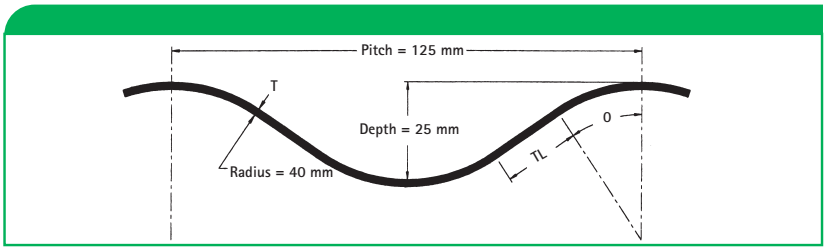


Table 4 – Section Properties

Coated Thickness (mm)	Design Thickness (mm)	Area of Section (mm^2/mm)	Moment of Inertia (mm^4/mm)	Section Modulus (mm^3/mm)	Radius of Gyration (mm)	Tangent Length (mm)	Tangent Angle ($\triangle^0$ degrees)	Developed Width Factor*
1.6	1.40	1.549	133.300	9.730	9.277	18.568	35.564	1.106
2.0	1.82	2.014	173.720	12.489	9.287	17.970	35.811	1.107
2.8	2.64	2.923	253.237	17.684	9.308	16.742	36.330	1.107
3.5	3.35	3.711	322.743	21.993	9.326	15.600	36.826	1.108

* Developed width factor measures the increase in profile length due to corrugating.

Table 5 – Handling Weight and End Area

Pipe Diameter (mm)	End Area (m^2)	Handling Weight - Galvanized (kg/m) Wall Thickness (mm)			
		1.6	2.0	2.8	3.5
1200	1.131	57	71	100	124
1400	1.539		83	116	144
1600	2.011		95	132	165
1800	2.545		106	148	185
2000	3.142		118	165	205
2200	3.801		129	181	225
2400	4.524		141	197	245
2700	5.726		159	222	276
3000	7.069			246	306
3300	8.553			270	336
3600	10.179				367

Hel-Cor Pipe Height of Cover Limits
CL-625 (CAN CSA-S6-06) and AREMA Cooper E-80 Loadings

Table 6 – 68 mm x 13 mm Corrugations

Diameter (mm)	Minimum Cover		Maximum Cover in Metres Specified Thickness in Millimetres				
	CL-625	E-80	1.60 (mm)	2.00 (mm)	2.80 (mm)	3.50 (mm)	4.20 (mm)
300	300	300	70	91			
400	300	300	53	68			
500	300	300	42	54			
600	300	300	35	45	66		
700	300	300	30	39	57		
800	300	300	26	34	50		
900	300	300	23	30	44	56	70
1000	300	300	21	27	40	50	63
1200	300	300		23	33	42	52
1400	300	500			27	35	43
1600	300	500			22	28	35
1800	500	500				22	27
2000	500	500					22

Table 7 – 125 mm x 25 mm Corrugations

Diameter (mm)	Minimum Cover		Maximum Cover in Metres Specified Thickness in Millimetres			
	CL-625	E-80	1.60 (mm)	2.00 (mm)	2.80 (mm)	3.50 (mm)
1200	300	500	18	23	34	
1400	300	500	15	20	29	35
1600	300	500	13	18	25	31
1800	300	500	12	16	22	28
2000	300	500	11	14	20	25
2200	300	700	10	12	18	23
2400	500	700		11	17	21
2700	500	700			15	18
3000	500	1000			13	16
3300	500	1000				14
3600*	700	1000				12*

* Flexibility limit exceeded – for specified use only.

1. Dead load is based on a unit weight of backfill of 19kN/m³.
2. Where Height of Cover exceeds the Diameter, a reduction load factor of 0.86 has been used.
3. Live Load includes impact.
4. Minimum cover is taken from top of pipe to profile grade or to the top of the finished granular base.
5. Special care must be taken with truck loads during construction.
6. Foundation investigation is recommended practice.
7. The above Height of Cover tables are industry standards, Local, Provincial or Federal standards may differ.

Perforated Hel-Cor® Pipe

For Ground Water Control

First introduced by Armtec in 1925, perforated corrugated steel pipe provides a lasting system to drain ground water under paved surfaces such as roadways, parking lots, airport runways, recreational areas as well as areas adjacent to buildings, bridge abutments and retaining walls. It offers exceptional performance for ground water drainage in low lying areas like parklands, farms and agricultural areas.

Perforated Hel-Cor is widely accepted as a practical, durable, economical means of controlling unwanted ground water. This solution is efficient and costs less than repeated surface repairs and virtually eliminates maintenance concerns.

Perforated pipe is available in plain galvanized for most applications. In particularly aggressive environments, it is strongly recommended that consideration be given to using either Aluminized Steel Type II.

Pipe Size Selection

For normal subdrainage, the infiltration of ground water is very slow. Therefore, approximately 150 metres of 150 mm diameter pipe may be used as an interceptor before any increase in pipe diameter is required. Where extremely pervious material is being drained or where springs are encountered, larger sizes may be required.

Placing of Perforations

Armtec recommends that the pipe be placed with the perforations down. This hinders solids from entering the pipe and keeps the water table lower.

Recommended Backfill

The trench should be excavated with approximately 100 mm of clearance at the sides of the pipe so that pervious backfill can surround the pipe. For the filter backfill, concrete sand or other commonly available coarse sand-gravel mixtures perform satisfactorily for perforated pipe in most soils.

Geotextile

Geotextile is widely used in perforated pipe applications, particularly where graded filter material is not available. Armtec can provide a low-cost knitted polyester sock to encase the pipe. More critical installations call for a high quality non-woven geotextile such as Armtec 140 to separate the trenchfill from the native material.

Pipe Outlets

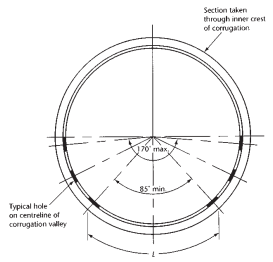
Perforated pipe's cantilever strength makes it ideal for use as a projecting pipe outlet.

Free outlets are important, and the failure of subdrains to properly function can often be attributed to plugged, damaged or improper outlets. Outlet pipes should be protected from damage by maintenance equipment. A suitable barrier such as a hinged rodent trap should be used to keep out wildlife whose nests could cause clogging.

Spacing of Laterals

Draining large, comparatively flat areas usually requires a parallel or herringbone system of drainage pipe. table No. 10 may be used as a general guide in laying out the system. The spacing used on highways and railways is controlled by the location of the water-bearing strata.

Standard Perforations



*All perforations nominal 10 mm diameter

Table 10 – Dimensions, Thicknesses and Spacing of Perforations*

Nominal Internal Diameter	Minimal No. of Rows of Perforations	Minimum Width Unperforated Segment	Normal Thickness Specified
150 mm	6	110 mm	1.3 mm
200 mm	6	150 mm	1.3 mm
250 mm	6	185 mm	1.6 mm
300 mm	6	230 mm	1.6 mm
400 mm	6	305 mm	1.6 mm

* Random hole spacing around the circumference is available on request.

Hel-Cor Installation: Bedding and Backfilling

Well graded, drainable backfill is recommended for good compaction. The designer should refer to the gradation and backfill specifications of the appropriate provincial highway standard. Stumps, rocks, frozen lumps and other debris should be removed from the bedding site.

Round pipe can be built on a flat sand cushion with rodding and tamping of the backfill around the haunches. Alternatively, the pipe can be installed on a pre-shaped granular base.

The pipe-arch bottom arc must be erected on a pre-shaped sand cushion. The support under the bottom arc should be relatively yielding but under the corner haunches the supporting ground must be highly stable. Special attention should be given to compacting the backfill around the corner arcs where the highest soil pressures develop.

Backfill should be spread in 150 mm layers alternating from one side of the pipe to the other, and should extend above the pipe to a minimum height of 300 mm or one sixth the span, whichever is greater.

Compaction using suitable mechanical equipment should be carried out to achieve the specified backfill density.

Care must be taken to ensure that the pipe or pipe-arch is not damaged by heavy equipment traffic during construction.

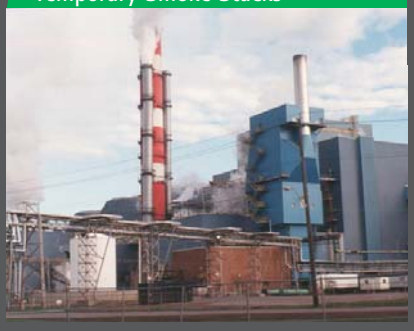
Other uses for Hel-Cor Corrugated Steel Pipe

Wind Farms

Pole Cribs

Stormwater Detention Tanks

Temporary Smoke Stacks



Relines

- Void Tubes
- Hickenbottom Drains
- Firewater Tanks
- Utilidors

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