DIVISION 31 05 05

DEMOLITION

PART 1 GENERAL

A. Work covered by this section includes the removal of all existing items and material, including existing structures, concrete sidewalk, irrigation system, asphalt and compacted gravel areas, pipes, poles, equipment, and all other items shown on the drawings or necessary to accomplish the intended works under this contract.

PART 2 BARRIERS AND DUST PARTITIONS

A. Barriers, barricades and dust partitions to protect the Owner's property from damage from demolition operations shall be erected. The Contractor shall maintain any existing buildings completely weatherproof, dustproof, and secure from unauthorized entry at all times during the period of demolition and construction of new work.

PART 3 DEMOLITION WORK

A. All portions of existing buildings and other structures as indicated and as required to accomplish the new work shall be demolished and removed. The Contractor shall provide protection to persons and property and the existing buildings by providing shoring, bracing, barricades, temporary walls and partitions, and other protective materials and devices as required to provide the protection and security specified. All active utilities to remain shall be protected and preserved in operating condition, including but not limited to electric services, water mains, sewers, drains, manholes, catch basins, valves, valve boxes, poles, guys and other appurtenances. Any damage to such utilities and to work under this contract shall be repaired at no additional cost to the Owner. Demolition material and debris shall not be allowed to accumulate on the site. Materials resulting from the demolition operations, except salvage materials to be delivered to the Owner, shall become the property of the Contractor and shall be removed from the site.

B. Before demolition operations begin, the Contractor shall arrange for an inspection and decision covering all salvage items by an authorized representative of the Owner, the Engineer, and the Contractor.

END OF SECTION

DIVISION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. Clearing and grubbing shall consist of the removal and disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or rights-of-way of any excavation, borrow area, or embankment.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.1 CLEARING

A. Clearing shall consist of the felling and cutting up, or the trimming of trees, and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the drawings to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off one foot above the original ground surface. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent interference with the construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left standing, shall be thoroughly protected by barriers or by such other means as the circumstances require. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others.

3.2 GRUBBING

A. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from the site as indicated on the drawings. In foundation areas, stumps, roots, logs or other timber, matted roots, and other debris not suitable for foundation purposes shall be excavated to a depth of not less than 18 inches below any sub grade, shoulder or slope. All depressions excavated below the original ground surface for or by the removal of stumps and roots, shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.

3.3 DISPOSAL OF CLEARED AND GRUBBED MATERIAL

A. Saw logs, pulp wood, cord wood or other merchantable timber removed incidental to clearing and grubbing shall become the property of the Contractor and may be sold by him, provided such disposal is otherwise in accordance with these specifications. All

incombustible matter removed shall be hauled away and deposited at locations approved by the Engineer. Combustible matter may be burned or may be disposed of as stated above. Burning shall be done at such time and such manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of Local, State and Federal Governments pertaining to the burning. No burning will be allowed on the site.

END OF SECTION

DIVISION 31 22 00

GRADING

PART 1 – GENERAL (Not Used)

PART 2 – DESCRIPTION

A. This section covers grading for the roadways, parking areas, drives and/or walks, including all excavations, formation of embankments, preparation of subgrade for pavements and finishing and dressing of graded earth areas, shoulders, and ditches. Work in connection with excavation, trenching, and backfilling for utility lines is specified under section entitled "Chapter 2 Earthwork."

B. In the course of preparing the site to final grades, the Contractor shall work in close coordination with the representative of the geotechnical engineer to identify problem areas and to properly prepare subgrade soils for their use in supporting the loads to be imposed. Preparation of soils may include proof rolling; in-place compaction; removal, replacement and compaction; removal, importation of borrow and compaction; or other method approved by the geotechnical engineer.

PART 3 – PRODUCTS (Not Used)

PART 4 – SELECTION OF BORROW MATERIAL

A. Borrow material shall be selected to meet the requirements and conditions of the particular fill for which it is to be used. The material shall consist of sand soils or sand-clay soils capable of being readily shaped and compacted to the required densities and shall be free of roots, trash and any other deleterious material. All fill soil to be utilized shall be subject to approval prior to their use. Any necessary clearing, grubbing, disposal of debris and satisfactory trimming and drainage of the borrow areas shall be considered incidental to operation of the borrow excavation and shall be performed by the Contractor at no additional cost to the Owner. On-site excavated materials may be used as borrow provided that they are approved for use as backfill by the geotechnical engineer.

B. Borrow Area(s): Borrow material shall be furnished by the Contractor from private sources selected by the Contractor and shall consist of a suitable material of the type mentioned above. The Contractor shall obtain from the Owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expenses of developing the sources, including rights-of-way for hauling.

PART 5 – EXECUTION (Not Used)

PART 6 – CONSERVATION OF TOPSOIL

A. Except where otherwise noted on the plans, topsoil shall be removed without contamination with subsoil and spread on areas already graded and prepared for topsoil or shall be transported and deposited in storage piles convenient to areas that are to receive application of topsoil later, or at locations indicated. Topsoil shall be stripped to a depth determined by the geotechnical engineering firm's field

representative and when stored, shall be kept separate from other excavated materials and piled free of roots, stones, and other undesirable materials.

PART 7 – EXCAVATION

A. Classification: Excavation will be classified as common excavation or rock excavation in accordance with the following definitions.

1. Common Excavation: shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline, or clam shell) appropriate to the character of the materials and the site conditions.

2. Rock Excavation: shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

3. Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

4. The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

5. For the purpose of this classification, the following definitions shall apply:

   a. Heavy Ripping Equipment: Shall be defined as rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of at least 200 net horsepower (at the flywheel).

   b. Wheel Tractor-Scraper: shall be defined as self-loading (not elevating) and unloading scraper having a struck bowl capacity of at least 12 yards.

   c. Pusher Tractor: shall be defined as a track type tractor having a power rating of at least 200 net horsepower (at the flywheel) equipped with appropriate attachments.

A. Excavation of every description regardless of material encountered within the grading limits of the project, shall be performed to the lines and grades indicated. Suitable excavated material shall be transported to and placed in fill areas within the limits of the work. When directed, unsuitable material encountered within the limits of the work shall be excavated below the grade shown and replaced with suitable material. Materials considered unsuitable are those conforming to Classes PT, OH, CH, MH, or OL as described under the Unified Soil Classification System. Rock encountered in the grading process that is not gradable using conventional equipment (including rippers) shall be blasted. Such material removed and the

selection material ordered as replacement shall be included in excavation. Unsuitable and surplus excavation material not required for fill shall be disposed in designated waste or spoil areas. During construction, excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Material required for fills in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor, as specified herein.

B. Blasting: The transportation, handling, storage and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations. Blasting shall be done in such a way as to prevent damage to the work and existing structures and utilities or unnecessary fracturing of the foundation and shall conform to any special requirements of this specification.

C. Excavation of Ditches and Gutters: Ditches and gutters shall be cut accurately to the cross-sections and grades indicated by the drawings. All roots, stumps, and other foreign matter in the sides and bottom of ditches and gutters shall be cut one foot below finish grade. Care shall be taken not to over-excavate ditches and gutters below the grades indicated. Any excessive ditch and gutter excavation due to removal of roots, stumps, etc., or due to over-excavation shall be backfilled to grade either with suitable material, thoroughly compacted, or with suitable stone or cobble to form an adequate gutter paving, as directed. The Contractor shall maintain all ditches and gutters excavated under this specification free from detrimental quantities of leaves, sticks, and other debris until final acceptance of the work. Suitable earth material excavated from ditches and channel changes shall be placed in embankments. Excavated material shall not be deposited within a distance from the edge of any excavation of less than 1-1/2 times the depth of the excavation. When storm drain pipe terminates in a new ditch, the headwall or end section together with ditch pavement shall be constructed immediately as called for on the plans. Ditch slopes and disturbed earth areas shall be grassed as required under section entitled "Grassing." The Contractor shall be responsible for maintaining these newly constructed ditches and take immediate action subject to approval to keep erosion of the ditch bottom and slopes to a minimum during the life of the contract. No additional compensation will be given to the Contractor for the required maintenance.

D. Compaction: In parking and slab areas where excavation is required to reach finished grades, the upper 12 - 18 inches of material shall be scarified and recompacted to a minimum of 98 percent of standard proctor maximum dry density.

PART 8 – PROTECTION OF EXISTING SERVICE LINES AND UTILITIES STRUCTURES

A. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation that are to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense. In the event that the Contractor damages any existing utility lines that are not shown, or the locations of which are not known to the Contractor, report thereof shall be made immediately to the Engineer.

PART 9 – FILLING AND BACKFILLING

A. Preparation of Ground Surface for Fill: All vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish and other

unsuitable material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. In no case will unsuitable material remain in or under the fill area. Sloped ground surfaces steeper than 1 vertical to 4 horizontal on which fill is to be placed shall be plowed, stepped or benched, or broken up as directed, in such manner that the fill material will bond with the existing surface. Prepared surfaces on which compacted fill is to be placed shall be wetted or dried as may be required to obtain the compaction specified.

B. Proofrolling: After the subgrade has been stripped of topsoil, associated root mat and debris, evaluate all at grade or fill areas by proofrolling. Proofrolling will consist of patrolling the subgrade areas utilizing a fully loaded tandem-axle dump truck (20 ton minimum) during a period of dry weather. Areas which rut or deflect excessively under the wheelload of the proofrolling vehicle will not be considered suitable for the placement of fill or structures and will therefore require remediation. It may be possible to compact the existing soils in place, or these soils may have to be removed and replaced with suitable soils. The decision on the type of remediation will be made in the field in consultation with the geotechnical engineer. All proofrolling will be performed in the presence of the geotechnical engineer.

C. Fill: Fills and embankments shall be constructed at the locations and to lines and grades indicated. The completed fill shall correspond to the shape of the typical section indicated or shall meet the requirements of the particular case. Suitable material removed from the excavation shall be used in forming the fill. Fill material shall be reasonably free from roots, other organic material and trash, and from stones having maximum dimension greater than 6 inches. No frozen material will be permitted in the fill. Stones having a maximum dimension larger than 4 inches shall not be permitted in the upper 6 inches of fill or embankment. The material shall be placed in successive horizontal layers of 8 inches in loose depth for the full width of the cross section and shall be compacted as specified below.

D. Backfill Adjacent to Structures: Backfill adjacent to structures shall be placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures. Slopes bounding or within areas to be backfilled shall be stepped or serrated to prevent sliding of the fill. During backfilling operations and formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be used. Backfill for storm drains and subdrains, including the bedding, shall conform to the additional requirements as specified.

PART 10 – COMPACTION

A. Structural Fill: Each layer of the fill or embankment, except in areas indicated as not requiring compaction, shall be compacted by rolling with an approved tamping roller, heavy rubber-tired roller, three-steel wheeled power roller, vibratory roller or other compaction equipment, whichever is best suited for the types of soil encountered. Compact all fill to a minimum of 95 percent of Standard Proctor maximum dry density. Compact the upper 12 to 18 inches of fill for paved and building areas to 98% of Standard Proctor maximum dry density.

B. Field Control: In all fill areas field density tests will be performed in a sufficient number, as recommended by the geotechnical engineer, (minimum of one test for every 2,000 cubic yards of fill or 500 cubic yards in building area) to ensure that the specified density is being obtained. These tests will be made at the expense of the contractor and will be in accordance with ASTM D 698.

PART 11 – FINISHED EXCAVATIONS, FILLS, AND EMBANKMENTS

A. All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either bladegrader or scraper operations, supplemented with hand raking and finishing, except as otherwise specified. The finished surface shall be not more than 0.10 foot above or below the established grade or approved cross section. Ditches and gutters shall be finished so as to permit adequate drainage. The surface of areas to be grassed shall be finished to smoothness suitable for the application of grassing materials. The surface of embankments or excavated areas for road construction or other areas to be paved on which a base course or pavement is to be placed shall not vary more than 0.05 foot for the established grade and approved cross section. In areas where the bulking of soil as a result of grassing operations will tend to retard surface drainage along the edge of pavements, the finished grades shall be left 0.1 foot below grade prior to grassing.

PART 12 – DISPOSAL OF WASTE MATERIAL

A. All vegetation, roots, brush, sod, broken pavements, curbs and gutter, rubbish, and other unsuitable or surplus material stripped or removed from the limits of construction shall be disposed of off the site, except where otherwise approved in writing by the Engineer. The material shall be dumped, spread, and leveled to drain. Surplus excavation shall be hauled to, compacted in accordance with overall and overlot areas and sloped to drain in the disposal area where directed. The unsuitable material shall be leveled to drain and firmed under the normal operation of spreading and hauling equipment. Any trees, stumps, brush, down timber, etc., in the area to be used for disposal shall be cleared by cutting (to within six (6) inches of the ground) and shall be disposed of by removal from the property. Clearing and disposal of trees, stumps, etc. shall comply with the applicable portions of the clearing and grubbing specifications.

PART 13 – PLACEMENT OF TOPSOIL

A. Topsoil shall be placed on all shoulders, slopes, ditches, landscaped areas, and other earth areas graded under this contract, excluding borrow areas, unless otherwise specified on the plans. Topsoil shall be uniformly placed, in 12 inch loose layers maximum, on these areas to a depth of not less than four (4) inches after compaction as specified below. The material shall be free from clods of soil, matted roots, roots greater than 2 inch in diameter, and any other objectionable material which might hinder subsequent grassing and mowing operations. The material shall be placed, leveled, and lightly compacted with at least one pass of a cultipacker or light pneumatic-tired roller, to required cross sections, but shall be left one-tenth (0.1) of a foot below the finished earth grade.

PART 14 – PROTECTION

A. Newly graded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades re-established to the required elevations and slopes, at no additional expense to the Owner.

END OF SECTION

DIVISION 31 23 00

EXCAVATING, TRENCHING AND BACKFILLING FOR PIPE LINES

PART 1 - GENERAL

1.1 This section covers excavation, trenching and backfilling for pipe lines, complete.

1.02 EXISTING IMPROVEMENTS:

A. Maintain in operating condition and protect from damage existing improvements including utilities, roads, streets, sidewalks, drives, power and telephone lines, gas lines, water lines, sewers, gutters and other drains encountered, and repair, to the satisfaction of the Engineer, aerial, surface or subsurface improvements damaged during the course of the work. Where and if shown on the plans, the locations and existence or nonexistence of underground utilities are not guaranteed. Contact the various utility companies to determine and verify said information prior to proceeding with the work. Make reasonable and satisfactory provisions for the maintenance of traffic on streets, drives, walkways and at street crossings and if necessary to provide temporary walkways and bridges for crossing of the open trench as directed.

PART 2 - PRODUCTS

2.1 This section omitted.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Excavation of every description and of whatever substances encountered is to be performed to the depths indicated on the drawings or as specified herein. Excavation shall be made by the open cut method except as otherwise specified or shown on the drawings. Excavation methods are to comply with these specifications and to the requirements of OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations.

B. Excavated materials not required for fill or backfill are to be removed and wasted as directed. Keep the banks of shallow trenches as nearly vertical as practicable and properly sheeted and braced where required. Except where otherwise indicated, trench bottoms are not to be less than 12 inches wider nor more than 16 inches wider than the outside diameter of the pipe to be laid therein, and excavated true to line, so that a clear space of not less than 6 inches nor more than 8 inches in width is provided on each side of the pipe. The bottom of trenches are to be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Dig bell holes after the trench bottom has been graded. Excavate bell holes only to an extent sufficient to permit accurate work in the making of the joints and to insure that the pipe, for a maximum of its length will rest upon the prepared bottom of the trench. Depressions for joints other than mechanical are to be made in accordance with the recommendations of the joint manufacturers for the particular joint used. Excavation for structures and other accessories shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment or timber which may be used to hold the bank and protect them. Where damage is liable to result from withdrawing sheeting, the sheeting will be ordered to be left in place. Except at

locations where excavation of rock from the bottoms of trenches is required, take caution not to excavate below the depths indicated. Where rock excavation is required, excavate rock to a minimum overdepth of 4 inches below the normal required trench depth. The overdepth rock excavation and excess trench excavation must be backfilled with loose, moist earth, thoroughly tamped. Rock is defined as materials which are so hard or cemented that the excavation of such material requires blasting. The excavation is to proceed in a conventional manner with satisfactory effort made to remove hard materials before the Engineer makes a determination of need for blasting. Predrilling and blasting will be allowed, if evidence is provided for the Engineers review that boring logs will show that excavating the material is possible. Evidence will be provided for the Engineer's review and approval before predrilling and blasting is undertaken. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials of common excavation is classified as rock excavation. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe, as determined by the Engineer or indicated on the drawings, is encountered in the trench bottom, remove the soil to a depth required for the lengths designated by the Engineer, and the trench backfilled to trench bottom grade, as specified, with coarse sand, fine gravel, or other suitable material. Backfill with earth under structures will not be permitted and unauthorized excess excavation below the levels indicated for the foundation of structures will be filled with sand, gravel, or concrete, as directed.

C. Grading and Stacking: Grading in the vicinity of trench excavation will be controlled to prevent surface ground water from flowing into the trenches. Remove water accumulated in the trenches by pumping or by other approved methods. During excavation, store material suitable for backfilling in an orderly manner at a distance from the edges of trenches to avoid overloading and prevent slides or cave-ins. Remove material unsuitable for backfilling, as determined by the Engineer, from the job site and dispose of in a manner as approved by the Engineer.

D. Shoring and Sheeting: Shoring, sheeting, and bracing required to perform and protect the excavation and to safeguard employees and the public shall be performed. The failure of the Engineer to direct the placing of protection will not relieve the responsibility for damage resulting from its omission.

E. Whenever sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below the elevation of the top of the pipe will not be disturbed or removed. Cut off sheeting left in place not less than 1 foot below finished grade. No sheeting will be removed until the excavation is substantially backfilled as specified.

F. Water Removal: Where water is encountered, prevent from accumulating in excavated areas by pumping, well-pointing and pumping, or by other means approved by the Engineer as to capacity and effectiveness. Discharge water removed from excavations at points where it will not cause injury to public or private property, or the work completed or in progress. Under no circumstances will trench bottoms be prepared, pipes laid, or appurtenances installed in water. Water is not allowed to rise in unbackfilled excavations after pipe or structures have been placed.

G. Blasting: Explosives are to be used only within legal limitations. Before explosives are used, necessary permits for this work must be secured and precautions taken in the blasting operations to prevent damage to private or public property or to persons. Full liability is assumed for damage that occurs during the use of explosives. No blasting is allowed within 50 feet of pipe already laid in the trench.

H. Tree Protection: Take caution to protect the roots of trees to be left standing. Within the branch spread of the tree, trench is to be opened only when the work will be

installed immediately. Prune injured roots cleanly and place backfill as soon as possible.

3.2 BACKFILLING:

A. Do not backfill in trenches and other excavations until required tests are performed and the work has been approved by the Engineer. Carefully backfill trenches with the excavated materials approved for backfilling consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials. No material is to be used for backfilling that contains mulch, other unstable materials, stones, blasted rock, broken concrete or pavement, or other hard materials having a dimension greater than 4 inches; or large clods of earth, debris, frozen earth or earth with an exceptionally high void content.

B. For backfill up to a level 1 foot over the top of pressure pipelines and 2 feet above the top of gravity pipelines, only selected materials are to be used. Select materials shall be finely divided material free from debris, organic material and stone, which is suitable job excavated material or provided from other sources. Place the backfill in uniform layers not exceeding 6 inches in depth. Each layer will be moistened and carefully and uniformly tamped with mechanical tampers or other suitable tools. Place and tamp each layer under the pipe haunches with care and thoroughness so as to eliminate the possibility of voids or lateral displacement.

C. Then place and compact the remainder of the backfill material above the level specified above. In areas not subject to traffic, place the backfill in 12 inch layers and each layer moistened and compacted to a density approximating that of the surrounding earth. Under roadways, driveways, paved areas, parking lots, along roadway shoulders and other areas subject to traffic, place the backfill in 6 inch layers and each layer must be moistened and compacted to a density of at least 95% standard proctor so that traffic will be resumed immediately after backfilling is completed. Reopen trenches which are improperly backfilled, or where settlement occurs, to the depth required for proper compaction, then refill and compact with the surface restored to the required grade compaction. Along portions of the trenches not located in roadways, the ground is to be graded to a reasonable uniformity and the mounding over the trenches left in a neat condition satisfactory to the Engineer.

D. Sheeting not specified to be left in place is to be removed as the backfilling progresses. Remove sheeting in a manner as to avoid caving of the trench. Voids left by the removal of sheeting and shoring will be carefully filled and compacted. Where, in the opinion of the Engineer, damage is liable to result from withdrawing sheeting, the sheeting will be ordered to be left in place.

3.3 BORING AND JACKING:

A. Where required by the drawings, the pipeline will be installed in a steel casing, placed by boring and jacking. Where boring is required under highways, the materials and workmanship will be in accordance with the standards of the South Carolina Department of Transportation or the Town of Bluffton, South Carolina. Boring and jacking under railroads will be governed by the 2008 A.R.E.A. standards and those of the railroad involved. The steel casing will be in accordance with ASTM A252 to the thicknesses shown on the drawings.

3.4 PAVEMENT REMOVAL AND REPLACEMENT:

A. Where necessary existing pavements shall be removed and replaced, the applicable standards of the South Carolina Department of Transportation or the Town of Bluffton,

South Carolina are to govern this work. Saw joints, unless joints equally uniform in the opinion of the Engineer result from other means. Pavement repairs will consist of a concrete slab no less than 6 inches thick or compacted graded aggregate at least 9 inches thick, as indicated on the drawings. Where the parent pavement is concrete, the slab surface will be smoothly finished flush with the surrounding pavement. Where the parent pavement is asphalt, the concrete slab will be raked finished and topped with 1 inch of surface mix asphalt paving rolled flush with the surrounding pavement.

END OF SECTION 31 23 00

DIVISION 31 25 00

EROSION CONTROL MEASURES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers erosion control measures required on the job as shown on the plans. These measures are minimum requirements and may be augmented by the Engineer if positive control is not established.

B. The initial construction on the site is tentatively scheduled to begin on or about June 01, 2020. Final stabilization of the soils should be obtained by November 01, 2020.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.1 EROSION AND SEDIMENTATION CONTROL PLAN

A. Earth areas which are not to be paved should be grassed at the earliest possible time during the construction phase, so as to minimize exposure to rainfall and runoff.

B. Temporary berms, wherever possible, should be constructed at the end of each day of grading, in order to contain sediment and slow down erosion in the cut and fill areas, should rainfall occur during the night. Berms should also be constructed, where needed, to prevent sediment from being transported onto areas outside the actual construction limits.

C. Silt and erosion barriers of the type which tend to filter suspended solids from the water flowing through them should be employed to the extent necessary to contain most of the water-borne silt. Examples of this type of barrier include silt fence, hay or straw bales, windrows of limbs and laps, and stone or rubble riprap.

D. Sediment basins should be constructed if necessary and removed when final stabilization is attained.

3.2 ELEMENTS OF THE PLAN

A. The plans for the prevention of erosion and sedimentation for this site are depicted on Sheet(s) C5.0, C5.1 and C5.2 of the plans. The elements of the plan are discussed as follows, and are listed in chronological order, as far as is practical. The construction activities should proceed in the order listed.

1. Begin grading operations in the vicinity of the silt barriers shown on the drawings. Immediately after the area has been cleared for their placement, install dams and berms consisting of hay or straw bales or silt fences to be silt barriers as shown on the drawings.

2. As grading operations commence, the topsoil should be stripped and stockpiled in mounds surrounded by berms. Berms or windrows should be constructed each afternoon at approximately 100 foot intervals across the graded areas, except in the low-lying areas of the project. This action will tend to check erosion should rainfall be experienced during the night.

3. Construction on the storm sewer lines should be commenced as soon as grading operations have been substantially completed. The disturbed strip along each line which is located outside of paving should be grassed immediately upon the completion of trench backfilling, as described below.

4. A graded depression around each catch basin on the site should be used to contain sediment during construction. Type A inlet protection should be installed around each catch basin site as soon as the drainage pipes have been laid in accordance is SCDHEC Best Management Practices.

5. As soon as the graded areas which are not to be paved, to be built upon, or to receive underground utilities have been brought to final grade, four inches of topsoil should be spread over these areas. Grassing operations should be begun immediately, as described in the grassing specifications. Slopes should receive a similar treatment as soon as the installation of the utilities has ended.

6. Should seasonal limitations prevent the establishment of the permanent grass cover, the area to be grassed should be covered with a temporary grass cover; then the permanent grass should be established as soon as its growing season is reached.

7. The Type A inlet protection described above should not be removed until the surrounding pavement base material has been placed and is ready for priming.

8. All silt retention basins, traps, barriers, etc., should be inspected daily and cleaned at least weekly.

9. All work shall be in accordance with good grading practice and should conform to accepted practices in Erosion Control.

END OF SECTION

DIVISION 32 11 16.16

GRADED AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers a graded aggregate base course to receive bituminous paving under another section, complete.

B. The graded aggregate base course shall conform to all applicable specifications of Section 300 and 306 of the Standard Specifications for Highway Construction of the South Carolina State Highway Department, Latest Edition.

PART 2 PRODUCTS

2.1 MATERIALS

A. MATERIALS FOR BASE COURSE: Materials for the graded aggregate base course shall be in accordance with Section 306 of the Standard Specifications for Highway Construction of the South Carolina State Highway Department. No blast furnace slag is allowed.

PART 3 EXECUTION

3.1 SUBGRADE

A. The subgrade to receive the graded aggregate base course shall be constructed in accordance with requirements of Section 306.8 of the Standard Specifications for Highway Construction of the South Carolina State Highway Department.

B. The aggregate base course shall be compacted to a minimum of 98% maximum density ASTM D-698 at an optimum moisture content of ± 2%.

3.2 CONSTRUCTION OF BASE COURSE

A. Construction for the graded aggregate base course shall be in accordance with Section 306.09 of the Standard Specifications for Highway Construction of the South Carolina State Highway Department.

END OF SECTION

DIVISION 32 12 16

BITUMINOUS PAVING

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the construction of pavement for all roads and parking areas, complete.

B. Construction of the subgrade, base course and paving of the roadways and parking areas shall be undertaken immediately after completion of all storm drain lines and structures, all curbs and gutters, all yard piping, conduits and other facilities passing beneath paved areas, and all structural slabs and foundations required within or adjacent to the paved areas.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

A. The asphalt concrete mixture shall conform to the South Carolina Department of Transportation, Standard Specifications for Highway Construction, for Type I asphalt concrete. The job mix shall be approved by the Engineer and no material shall be used until approved.

B. A complete asphaltic concrete mix design shall be prepared in accordance with South Carolina Highway Department Standards. The asphaltic concrete design shall include asphaltic cement content, aggregate content and gradation, Marshall stability, flow, air voids, etc.

PART 3 EXECUTION

3.1 SEASONAL LIMITATIONS

A. No bituminous mixtures shall be applied for surface treatment between October 21st and April 10th, except as directed by the Engineer.

3.2 WEATHER LIMITATIONS

A. Bituminous mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen or shows any evidence of excess moisture nor when the moisture on the surface to be paved would prevent proper bond nor when the air temperature is less than 45 degrees F. in the shade away from artificial heat.

3.3 APPLICABLE SPECIFICATIONS

A. All work and materials required under this section of the specifications shall conform to the applicable sections of the Standard Specifications of the South Carolina Department of Highways, the latest edition.

3.4 SUBGRADE

A. The subgrade shall be prepared as specified under the sections of the above specifications covering subgrade preparation, including but not limited to Section 306.08.

B. The existing subgrade and engineered fill shall be compacted to 98% of maximum density ASTM D-698 at optimum moisture content of 2%.

3.5 CURBS AND GUTTERS

A. After the subgrade has been compacted and approved by the Engineer, curbs and gutters shall be placed where shown on the plans and constructed in accordance with the requirements of the section, "Curbs and Gutters, Concrete."

3.6 PRIME COAT

A. A prime coat of 0.3 to 0.8 gallons per square yard of medium curing cut-back asphalt (RC-250 or emulsion grades RS-2 or SS-1) shall be applied with a pressure distributor at a temperature between 80 degrees F. and 140 degrees F. The prime coat shall be applied to the previously prepared base course when the atmospheric temperature is above 50 degrees F.

3.7 SURFACE COURSE

A. The mixture shall be transported from the mixing plant to the point of use in approved vehicles. Loads shall not be of such size or weight as to interfere with the efficient operation of the spreader. Loads shall not be sent out so late in the day as to prevent the completion of spreading and compaction of the mixture during daylight, unless artificial light is provided. The mixture shall be delivered at a temperature between 225 degrees F. and 325 degrees F. and within 20 degrees F. of the temperature set at the mixing plant.

B. Upon arrival at the point of dumping, the mixture shall be dumped into the hopper and spread by mechanical pavers, true to line, grade and cross section specified and to the loose depth that will secure a compacted thickness of 1-½ inches. The hot mixture shall be free from lumps and shall be spread while it is in a workable condition.

C. After the mixture has been screeded and before roller compaction is started, the surface shall be checked, all fat spots and irregular areas removed and replaced with satisfactory material. All irregularities in alignment and grade along the outside edge shall also be corrected by the addition or removal of mixture before the edge is rolled. Pavement overlay shall be accomplished in accordance with South Carolina Department of Highways Standard Specifications.

D. While the mixture is hot, it shall be compacted thoroughly and uniformly by rolling. The surface of the compacted mixture shall be smooth, and true to crown and grade. Any mixture that becomes loose or broken, mixed with dirt or is in any way defective, shall be removed and replaced with fresh hot mixture which shall be immediately compacted to conform to the surrounding area. Any area showing an excess of bituminous materials shall be removed and replaced, and the edges shall be kept to a reasonable straight line and trimmed.

E. The density after compaction shall be at least 97 percent of the laboratory-density as determined by the Marshall Mix design procedure described in ASTM D-1559.

F. Protection of Pavement: The newly finished pavement shall be protected from vehicular traffic of any kind until the pavement has cooled and hardened and in no case less than 6 hours.

G. Tolerances: The finished surface shall not vary more than 0.5 inch in 10 feet from the true profile and cross section. Surface shall be sloped in every area, so that no puddles of water shall exist after rainfall.

3.8 TESTS

A. The above work will be subject to thickness and compaction tests as deemed necessary by the Engineer. Such tests will be at the expense of the Contractor.

B. Asphaltic concrete mixture shall be tested for asphalt content, gradation, Marshall stability, air voids, and physical requirements. Engineer shall observe asphaltic concrete placement for procedure employed and compliance with indicated cross section and grade. Field density and extraction tests shall be conducted to determine percent of compaction. Asphaltic mixture shall be tested in accordance with ASTM D-2172 or AASHTO T-164 and AASHTO T-30. Optimum asphalt cement shall be tested in accordance with the Marshall Method.

C. The testing laboratory and its engineer shall certify in writing to the owner that the aggregate base and asphaltic concrete have been installed in accordance with the plans and contract documents.

D. Certification shall be accompanied by copies of aggregate and asphaltic concrete tests and analysis.

E. The pavement system shall be warranted against defects in material and workmanship for a period of two years following the date of final acceptance.

3.9 STRIPING, PAINTING, AND SIGNS

A. Cleaning: Sweep and clean surface to eliminate loose material and dust.

B. Handicapped parking markings described below and as indicated on the drawings shall be painted with a blue traffic marking paint. Paint shall be Sherwin-Williams "Pro-Mar" Traffic Marking Paint, Series B29.Y.2, or Glidden Traffic Paint #63228. Two (2) coats of paint shall be applied to a minimum of 15 mil dry film thickness. Stall width and depth and drive widths indicated are minimum and must not be reduced.

C. Provide "Handicapped Parking" sign with identifying handicapped symbol at handicapped parking spaces. Sign shall be 12" x 18", .080 aluminum with baked enamel finish. Signs shall be in accordance with MUTCD specifications.

END OF SECTION

DIVISION 32 13 13

CONCRETE CONSTRUCTION - CIVIL

PART 1 GENERAL

1.1 DESCRIPTION

A. The work included under this section will be all plain and reinforced concrete work of every description throughout the site work portion of the project and including pavement slabs resting on earth grade, and storm sewer structures.

PART 2 PRODUCTS

2.1 REINFORCED STEEL MATERIALS

A. Reinforcing steel shall be deformed bars meeting ASTM A-15 latest for open hearth, intermediate grade, new billet bars, or ASTM A-16 latest for all rail steel bars. Bars shall be free from flaws, cracks or other defects of rolling, shall be true to size and shape, and shall be free from heavy dirt, paint, grease, oil or other destroyers of bond. They shall be prefabricated to detail and delivered on the job plainly tagged and ready to set. Furnish shop detail drawings, all according to ACI 315, latest, in quadruplicate and obtain approval before fabricating bars.

B. All reinforcing steel will be unless otherwise noted herein, of size and spacing as called for on the drawings.

C. All reinforcing when delivered to the job shall be systematically piled and kept free from dirt or grease, should any reinforcement become dirty or greasy or objectionably rusty, it shall be thoroughly cleaned before being placed in the work.

2.2 PORTLAND CEMENT MATERIALS

A. General: All cement used for structural and architectural concrete work shall be Portland cement conforming to the American Society for Testing materials specification C-150 (latest edition), Types I, or III, or air entrained cement ASTM C-175 (latest edition), Type IA or IIIA.

B. Cement shall be delivered on the job in bags containing one cubic foot (approximately 94 lbs.) each (unless a special arrangement to use bulk cement has been developed.). Each consignment of cement shall be so piled as to be segregated from every other consignment and shall be housed in a waterproof shed and stored on a floor or platform above the general ground level and shall be well protected from dampness. No cement which has partially hardened or been otherwise damaged shall be used on this job. Retempering of cement shall not be permitted under any circumstances.

2.3 FINE AGGREGATE MATERIALS

A. Fine aggregate shall preferably be sand and particles shall be coarse, sharp and clean. Limestone screenings, pulverized rock, or fine gravel will not be accepted. Sand shall be free from dust, loam, dirt, vegetable matter, or any other foreign or deleterious material. When dry, sand shall pass a screen having 3" square mesh and not more than 6 percent shall pass a 100 mesh screen. Decantation tests may be made to limit the amount of loam.

2.4 COARSE AGGREGATE MATERIALS

A. Aggregate used in concrete work shall be either screened, crushed rock, or natural gravel, washed and graded. In any case, coarse aggregate shall be regularly graded from a maximum of 1" down to a minimum of 3", and shall be clean, hard and durable, free from any long splintery pieces (or a maximum of 5% by weight), and free from dust, dirt, vegetable or organic matter. Mixed aggregate will not be permitted, such as a crushed run stone or bank run gravel, because of the uneven ratio of fine to coarse materials. Coarse aggregates shall be cleaned, screened and regarded for uniformity.

2.5 AIR ENTRAINMENT

A. The concrete shall be air-entrained with air content from 3 percent to 5 percent total air as determined by the method of ASTM C231. No other admixture is to be used without prior approval of Engineer.

2.6 WATER

A. It is anticipated that tap-run water will be used for mixing concrete, but any water that is potable shall be deemed suitable for this purpose.

2.7 WELDED WIRE FABRIC

A. Welded wire fabric shall be rectangularly welded wire of gauges and spacing specified and shall be delivered on the job in rolls and there straightened and placed. Tags designating the wire size and spacing shall be left on each roll until ready for use. Welded wire fabric shall be with end laps of one full mesh tip to tip for longitudinal selvage wires and wiring all laps securely together. Tuck ends of welded wire mesh well down into edge beams or walls. Do not leave unreinforced border strips.

PART 3 EXECUTION

3.1 SUBGRADE

A. The subgrade shall be well drained and compacted and prepared in accordance with other sections of specifications.

3.2 FORMS

A. All forms, including those for edge slabs, shall be constructed to accurate dimension of smooth, dressed and seasoned lumber, which shall be free of defects, knots, etc.

B. All forms shall be substantially and solidly placed to prevent movement or deflection.

C. All forms shall be carefully plumbed immediately before the concrete is poured and shall be constantly checked during time of pouring, so that movements and deflections may be observed and corrected.

D. The forms shall be constructed that the finished concrete surface when forms are removed, shall be free of honeycombs.

E. The forms shall be vigorously rapped during the placing of the concrete to eliminate air pockets, honeycombs, etc.

F. All projecting corners shall be chamfered. Wood for all chamfered corners, etc., shall be clear white pine. Earth trenches may not be used without forms unless by the special permission of the Engineer.

3.3 PLACING OF REINFORCEMENT

A. Placing of reinforcing shall be done carefully and accurately and exactly as detailed, and all properly secured against displacement during the pouring of concrete. All bars shall be evenly spaced and all work shall be well wired in place with non-slip ties and properly supported. Where reinforcing rests upon earth grade, it shall be properly and securely wired together at each intersection and supported on brick bats to permit concrete to flow under the same.

B. Before being covered with concrete, all reinforcement shall be adjusted to proper height and location and maintained so until covered.

3.4 CONCRETE

A. Measuring Concrete Materials: The method of measuring the materials including water for concrete or mortar, shall be one which will ensure separate and uniform proportion of each of the materials at all times, controlling by weight.

B. Proportion: Conforming to ACI Standards, concrete shall be proportioned by the water-cement ratio method. The proportioning of materials shall be based on the requirements for a plastic and workable mix with the use of not less than 52 sacks of cement per cubic yard and not more than 6.2 gallons of water per sack of cement, including the surface water carried by the aggregate. The proportion of fine to coarse aggregate shall be adjusted to produce maximum workability, but in no case shall the ratio of fine to coarse aggregate be outside the limits of a to 2 and the coarse aggregate 2 to b of the total fine and coarse aggregate. Concrete shall be placed with a slump of approximately 4" if manually spaded into place and 3" if internal vibrators are used.

C. Concrete shall develop an ultimate compressive strength of at least 3,000 or 4,000 pounds per square inch, pursuant with site plan details, in standard 6" x 12" cylinders at 28 days moist cured in the laboratory.

D. Placing Concrete: Concrete shall be placed in a manner that will permit the most thorough compacting and shall be worked into all the recesses. Concrete shall be placed in its final position as soon as possible after mixing and must be in place within 12 hours after the water has been added to the dry materials. It should be placed in one continuous operation from construction joint to construction joint.

E. Joints: Joints shall be formed, not simply stopped off, and such forms shall generally be perpendicular to stress lines. Construction joints are best made at joints of minimum shear, as for example midspan of slabs, joist, and beams. If joints are made at any other point, the Engineer will design a shear-key of concrete with crossed reinforcing bars to develop the shear.

F. Internal vibration is desirable, providing that it is not overdone. Care should be taken to keep the vibrators off the reinforcing steel. If internal vibrators are not available, hand spading of the concrete into all recesses will be required.

G. Where work is stopped so that the concrete has hardened before placing is resumed, the surface shall be left level or square by roughened and covered with wet burlap. When starting again to place, clean the surface of all foreign matter and 2 laitance, slush with a thin layer of mortar mix made with one-part cement and two parts of sand. Furnish and set dowels in all construction joints as called for on the plans or as directed by the Engineer.

3.5 FINISHING

A. All floors shall be finished as follows:

1. Interior floor slabs shall have a "Steel Troweled Finish."

2. Exterior slabs, sidewalks and pads shall have a "Broom or Belt Finish."

3. Ramps shall be finished with "Detectable Warnings" as specified in ADA (American with Disabilities Act) paragraph 4.29.

   a. Provide contrasting color with adjoining surfaces.

4. Exterior pavement, drive or parking lot approaches shall have a uniform gritty texture produced by two (2) passes of a damp burlap or cotton fabric, unless otherwise directed by local or state authorities.

5. Light pole bases shall have an architectural concrete "As-Cast" finish, patches shall match surrounding color and texture.

6. Exterior Garden Shop concrete floor slab finish shall be "Broom Finish."

3.6 CURING

A. All concrete trim shall be protected by wet burlap or canvas covering from sun, wind, and rain and this shall be frequently wetted in dry and hot weather so that the entire surface is kept wet for a period of one week, or liquid curing compound satisfactory to the Engineer shall be used, applied as directed.

3.7 PROTECTION FROM WEATHER

A. All concrete work shall be discontinued during freezing weather. All work recently built must be properly protected. All work injured by the weather must be taken down and rebuilt at this contractor's expense.

3.8 CLEANING

A. On completion of this contract, clean down all exposed concrete work and remove from the premises form lumber, cement sacks, scutan paper and other debris caused by this work.

END OF SECTION

DIVISION 32 16 13

CURBS AND GUTTERS, CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers construction of Portland cement concrete curbs and gutters, complete.

B. Concrete shall have a slump of not more than 3 inches. The concrete mixtures shall have an air content by volume of 4.5 percent, plus or minus 1.5 percent, based on measurement made on concrete immediately after discharge from the mixer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. The subgrade shall be constructed true to grade and cross section. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent roadway or street and shall be placed and compacted to conform with applicable requirements of "Graded Aggregate Base Course" with the following modifications. The subgrade for curb and gutter shall extend in all cases at least one foot in width back of the curb or gutter or valley pavement. The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb, gutter, or combination curb and gutter. The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is placed. In cold weather, the subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORMS

A. Forms shall be of wood or steel, straight, and of sufficient strength to resist springing during depositing and consolidating the concrete. The outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Straight forms of wood shall be two inch nominal surface plank, and of steel, shall be of approved section with a flat surface at the top. Rigid forms shall be provided for curb returns except that benders or thick plank forms may be used for curb or curb returns with a radius of ten feet or more, when grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of ninety degrees cannot be used. Back forms for curb may be made of one half inch benders, for the full height of the curb, cleated together. Curb forms shall be carefully set to alignment and grade and to conform to the dimensions of the curb. Forms shall be held rigidly in place by the use of stakes placed at intervals not to exceed four feet. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. The forms on the front of the curb shall be removed not less than two hours nor more than six hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified in the Finishing paragraph. Gutter forms shall not be removed for twelve hours

after the concrete has been placed. Forms shall not be removed while the concrete is sufficiently plastic to slump in any direction. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.3 JOINTS

A. Expansion joints and contraction joints shall be constructed at right angles to the line of curb, gutter, and combination curb and gutter. Dowels, tie bars and reinforcement when required will be shown on the plans and shall be installed in accordance with the applicable details.

1. Contraction Joints: Contraction joints shall be constructed by means of one-eighth inch thick separators, of a section conforming to the cross section of the curb, gutter, entrance pavements, and combination curb and gutter. Contraction joints shall be so placed that monolithic sections between curb returns will not be less than five feet nor greater than fifteen feet after the concrete has set sufficiently to preserve the width and shape of the joint. After separator plates have been removed, all exposed edges of joints shall be rounded with the proper edging tool to a radius of one-fourth inch.

2. Expansion Joints: Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of the curb, gutter, entrance, and combination curb and gutter.

3. Expansion joint filler, unless otherwise specified, shall conform to ASTM Standard D1751-60 or D1752-60 or shall be resin impregnated fiberboard conforming to the physical requirements of ASTM Standard D1752-60. Expansion joints shall be provided in curb and combination curb and gutter at the ends of all returns. Expansion joints at least one half inch in width shall be provided at intervals not exceeding fifty feet. Expansion joints shall be provided in nonreinforced concrete gutter at the locations indicated.

3.4 CONSTRUCTION

A. Curbs, Gutters and Combination Curb and Gutters: Shall be of the dimensions and sections shown on the drawings.

B. Reconstruction: Where the plans provide for reconstruction of existing curb or combination curb and gutter and the limit of new work specified does not fall on a joint, the entire section shall be removed and the new curb, combination curb and gutter or entrance pavement shall join the old curb at the first joint line beyond the specified limit.

C. Placing Concrete: The faces and adjacent edges of abutting rigid pavements and structures shall be painted with an approved bituminous material prior to placing concrete. Concrete shall be placed in the forms to the specified depth in six inch layers and thoroughly consolidated by tamping and spading so that there are no rock pockets at forms, and mortar entirely covers the top surfaces. Concrete may be compacted by means of mechanical vibrators.

D. Finishing: The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of one-fourth inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. The floated surfaces shall then be brushed with a fine hair brush with longitudinal strokes. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks

have been removed. The surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float. Except at grade changes or curves, the finished surfaces shall not vary, from the testing edge of a ten foot straightedge, more than one-eighth inch for gutter and entrance and one-fourth inch for top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected. Visible surfaces and edges of the finished curb, gutter, and combination curb and gutter shall be free of blemishes and form and tool marks, and shall be uniform in color, shape, and appearance.

E. Curb forming machines for constructing curb and gutter will be approved based on trial use on the job. Use of the equipment shall be discontinued at any time during the construction if the equipment produces unsatisfactory results, and the work shall be removed and reconstructed for the full length between regularly scheduled joints. Removed portions shall be disposed of as directed.

3.5 CURING AND PROTECTION

A. Curing: Immediately after the finishing operations, the exposed concrete surfaces shall be cured by one of the following methods as the Contractor may elect:

1. Mat Method: The entire exposed surface shall be covered with cotton mats conforming to Federal Specification DD-M-148 or with two or more layers of burlap conforming to Federal Specification CCC-C-467b having a combined weight of fourteen ounces or more per square yard when dry. Mats shall overlap each other at least six inches. The mat shall be thoroughly wetted with water prior to placing on the concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than seven days.

2. Impervious Sheeting Method: The entire exposed surface shall be wetted with a fine spray of water and then covered with waterproof paper conforming to ASTM Standard C171 63, or with wetted polyethylene coated burlap or polyethylene sheeting conforming to the water retention requirements of ASTM Standard C 171-63; polyethylene sheeting and polyethylene film bonded to burlap shall be not less than 0.004 inch thick.

   Sheets shall be laid directly on the concrete surface with a light colored side up and overlapped twelve inches when a continuous sheet is not used. The curing medium shall not be less than eighteen inches wider than the concrete surface to be cured and shall be securely weighted down by placing a bank of moist earth on the edges just outside the forms and over the transverse laps of form closed joints. Sheets shall be satisfactorily repaired or replaced if damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than seven days.

3. Membrane Curing Method: The entire exposed surfaces shall be covered with a clear membrane forming curing compound. The curing compound shall be applied in two coats by hand operated pressure sprayers at the coverage of approximately two hundred square feet per gallon for both coats. The second coat shall be applied in the direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform continuous coherent film that will not check, crack, or peel and shall be free from pin holes and other imperfections. Concrete surfaces that are subjected to heavy rainfall within three hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above at no additional cost to the Owner. Joint openings shall be sealed at the top by inserting moistened paper or fiber rope

or covering with strips or waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound from entering the joint. Concrete surfaces to which membrane curing compounds have been applied shall be adequately protected for seven days from pedestrian and vehicular traffic and from any other action which might disrupt the continuity of the membrane. Any area covered with curing compound and damaged by subsequent construction operations within the seven day period shall be resprayed as specified above at no additional expense to the Owner.

B. Protection: After curing, debris shall be removed and the backfill shall be placed as indicated. The completed curb, gutter, and combination curb and gutter shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Curb, gutter, and combination curb and gutter that are damaged shall be remove and reconstructed for the entire length between regularly scheduled joints, not by refinishing the damaged portion. Removed damaged portions shall be disposed of as directed.

3.6 SEALING JOINTS

A. The sealing of expansion joints in curb and gutter sections will not be required. Any expansion joint material protruding after the concrete is cured shall be trimmed flush with the surface. Expansion joints in the valley pavement shall be sealed with an approved joint sealer, conforming to Federal Specification SS-S-164. The joint opening shall be thoroughly cleaned of all foreign material before the sealing material is placed. The sealing shall be done in such manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the exposed surfaces of the concrete shall be removed immediately and the exposed concrete surfaces cleaned.

END OF SECTION

DIVISION 33 42 11

STORM SEWER SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the storm drainage system, including pipe culverts and appurtenant structures, complete.

PART 2 PRODUCTS

2.1 PIPE MATERIALS FOR CULVERTS AND STORM DRAINS:

A. Pipe for Culverts and Storm Drains: Pipe for culverts shall be reinforced concrete pipe of the class or D-load strength indicated and shall conform to ASTM C76 or AASHTO M 170 with the following additional requirements. Pipe shall have a readily visible line at least 12 inches in length painted or otherwise applied on the inside and outside of the pipe at each end by the manufacturer, so that, when the pipe is laid in its proper position, the lines will be at the top of the pipe. The line shall be accurately located to indicate the position where the pipe reinforcing steel is nearest to the exterior surface of the pipe.

B. Pipe may also be HDPE pipe which shall conform to the latest AASHTO M-294 and F2306 specifications.

2.2 MATERIALS FOR DRAINAGE STRUCTURES

A. Drainage structures, where indicated in the plans shall be of the following types, constructed of the materials specified for each type and in accordance with the details shown on the plans.

1. Inlets shall be constructed of reinforced concrete, plain concrete or brick complete with frames and covers.

2. Headwalls shall be constructed of brick, reinforced concrete or plain concrete as indicated.

B. Forms shall be made of sound lumber and constructed to the shape, form, line, and grade required, and shall be maintained sufficiently rigid to prevent deformation under load, and inspected for approval prior to placement of concrete. Water shall be removed from excavations before concrete is placed. Concrete shall be conveyed from mixer to forms as rapidly as practicable without segregation or loss of ingredients. Concrete shall be placed in layers not over 18 inches deep and shall be spaded and compacted as directed. The concrete covering over steel reinforcing shall be as shown on the plans, but where not shown, it shall be not less than 1 inch for covers and not less than 1-½ inches for walls and flooring. Concrete deposited directly against the ground shall have a thickness of at least 3 inches between the steel and the ground. Expansion joint filler shall be preformed bituminous fiberboard, or wood board except where specifically noted on the drawings. Surfaces exposed to view shall be a smooth finish with all blemishes removed. All concrete surfaces shall be cured for at least 7 days by covering with waterproof paper, or kept moist with cotton mats or burlap as approved.

C. Mortar for connections to drainage structures shall be composed of one part by volume of Portland cement and two parts of sand. The Portland cement shall conform to ASTM C150-65, Type I or II. The sand shall conform to AASHO Standard M 45, and shall be of an approved gradation. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 25 percent of the volume of cement used. Hydrated lime shall conform to Federal Specification SS-L-351, Type M, or ASTM Standard C141-61, Type A. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar, but shall in no case exceed 7 gallons of water per sack of cement. Water shall be clean and free of injurious acids, alkalies and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. In pipe too small for a man to work inside, wiping may be done by dragging an approved swab or long handled brush through the pipe as work progresses. The mortar bead on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING FOR DRAINAGE STRUCTURES

A. Excavation and backfilling for drainage structures shall conform to the applicable requirements specified herein-before in the section, "Excavation, Trenching and Backfilling for Pipe Lines." Trenches and pits shall be of sufficient size to permit the placing and removal of forms for the full width and length of structure footings and foundations, as shown on the drawings. The dimensions and elevations indicated on the drawings are approximate only and may be changed when deemed necessary to secure satisfactory foundations. Bracing, sheeting and shoring shall be provided where required.

3.2 INSTALLATION OF PIPE

A. Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipe lines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. **Full responsibility for the diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor.** All pipe in place shall have been approved before backfilling. When storm drain pipe terminates in a new ditch, the headwall or end section, together with ditch pavement, if specified, shall be constructed immediately as called for on the plans. The Contractor will be responsible for maintaining these newly constructed ditches and take immediate action subject to approval to keep erosion of the ditch bottom and slopes to a minimum during the life of the contract. No additional compensation will be given to the Contractor for the required maintenance.

1. Jointing: For concrete and reinforced concrete pipe, joints shall be of the Bell and Spigot type and installed according to manufacturer's recommendations using Portland cement mortar.

2. Alignment: Elliptical concrete pipe with circular reinforcing and circular concrete pipe with elliptical reinforcing shall be so placed that the reference lines designating the top of the pipes will be not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. In all backfilling

operations that Contractor shall be responsible for preventing damage to or misalignment of the pipe.

3.3 TESTS FOR PIPE

A. Responsibility and Certifications: The Contractor shall be responsible for having the pipe he proposes to furnish tested to demonstrate conformance to the applicable specifications. Certified copies of the test reports shall accompany each load of pipe and shall be delivered to the Engineer for review before the pipe is installed.

B. Strength tests for reinforced concrete pipe shall be the tests of ASTM C-76.

C. Strength tests for HDPE pipe shall be the tests of AASHO M-294.

3.4 TESTING

A. Displacement Test: Mains will be checked to determine whether any displacement of the pipe has occurred (a) after the trench has been backfilled to two feet above the pipe and tamped as specified; and (b) upon completion of the project. The test will be as follows: A light will be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows any misalignment, displaced pipe, or any other defects, the defects designated by the engineer shall be remedied by the Contractor at his expense.

END OF SECTION

1-0 SPECIFICATIONS
TABLE OF CONTENTS

ADS N-12® ST IB PIPE (ASTM F2648) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 ST IB pipe (per ASTM F2648) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 ST IB pipe (per ASTM F2648) shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10-inch, the joint shall be soil-tight using an engaging dimple connection. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

Fittings

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS N-12® WT IB PIPE (PER ASTM F2648) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 WT IB pipe (per ASTM F2648) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 WT IB pipe (per ASTM F2648) shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F2306.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high-density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

ADS N-12® ST IB PIPE (PER AASHTO) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 ST IB pipe (per AASHTO) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 ST IB pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.

- 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S or SP.
- 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or SP, or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10-inch, the joint shall be soil-tight using an engaging dimple connection. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

Fittings

Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

Material Properties

Material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

**All diameters available with or without perforations.

ADS N-12® WT IB PIPE (PER AASHTO) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 WT IB pipe (per AASHTO) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 WT IB pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.

- 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S.
- 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings

Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

ADS N-12® MEGA GREEN™ ST IB PIPE SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 MEGA GREEN™ ST IB pipe for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 MEGA GREEN ST IB pipe shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10-inch, the joint shall be soil-tight using an engaging dimple connection. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

Fittings

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS N-12® MEGA GREEN™ WT IB PIPE SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 MEGA GREEN™ WT IB pipe for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 MEGA GREEN WT IB pipe shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F2306.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

ADS N-12® WT SERIES 35 PIPE SPECIFICATION

Scope

This specification describes 4- through 24-inch (100 to 600 mm) ADS N-12 WT Series 35 pipe for use in gravity-flow land drainage applications.

Pipe Requirements

N-12 WT Series 35 pipe shall have a smooth interior and annular exterior corrugations.

- 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S.
- 12- through 24-inch (300 to 600 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined with the N-12 WT Series 35 joint meeting the requirements of AASHTO M252, AASHTO M294 or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

Bells shall be bell-bell couplers manufactured from PVC. Bell-bell couplers shall be installed on one side by the manufacturer.

Fittings

Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Joint connections shall utilize a PVC bell-bell coupler and valley gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

Material Properties

Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 24-inch (300 to 600 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 24-inch (300 to 600 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

Bells shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the specified coupler. The pipe stock used to manufacture the bell-bell coupler shall meet the performance requirements for fabricated fittings as specified in ASTM D3034.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 24-inch (100 to 600 mm) diameters shall be one foot (0.3 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD), or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)								
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

ADS N-12® PLAIN END PIPE (PER ASTM F2648) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 plain end pipe (per ASTM F2648) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 plain end pipe (per ASTM F2648) shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined with coupling bands covering at least two full corrugations on each end of the pipe. Standard connections shall meet or exceed the soil-tight requirements of ASTM F2648.

Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to ASTM F2306.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS N-12® PLAIN END PIPE (PER AASHTO) SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 plain end pipe (per AASHTO) for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 plain end pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.

- 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S or SP.
- 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or SP, or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined with coupling bands covering at least two full corrugations on each end of the pipe. Standard connections shall meet or exceed the soil-tight requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306.

Material Properties

Material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

**All diameters available with or without perforations.

ADS N-12® MEGA GREEN PLAIN END PIPE SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 MEGA GREEN™ plain end pipe for use in gravity-flow land drainage applications.

Pipe Requirements

ADS N-12 MEGA GREEN plain end pipe shall have a smooth interior and annular exterior corrugations.

- 4- through 60-inch (100 to 1500 mm) pipe shall meet ASTM F2648.
- Manning's "n" value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined with coupling bands covering at least two full corrugations on each end of the pipe. Standard connections shall meet or exceed the soil-tight requirements of ASTM F2648.

Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to ASTM F2306.

Material Properties

Material for pipe production shall be an engineered compound of virgin and recycled high density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4- through 10-inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The design engineer shall verify compatibility with overall system including structural, hydraulic, material, and installation requirements for a given application.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.02. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)													
Pipe I.D. in (mm)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	4.8 (122)	6.9 (175)	9.1 (231)	11.4 (290)	14.5 (368)	18 (457)	22 (559)	28 (711)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 60-inch are ±1 inch. Contact a sales representative for exact values

**All diameters available with or without perforations.

ADS RETENTION/DETENTION PIPE SYSTEM SPECIFICATION

Scope

This specification describes ADS Retention/Detention Pipe Systems for use in non-pressure gravity-flow storm water collection systems utilizing a continuous outfall structure.

Pipe Requirements

ADS Retention/Detention systems may utilize any of the various pipe products below:

- N-12® ST IB pipe (per AASHTO) shall meet AASHTO M294, Type S or ASTM F2306
- N-12 ST IB pipe (per ASTM F2648) shall meet ASTM F2648
- N-12 MEGA GREEN™ ST IB shall meet ASTM F2648
- N-12 WT IB pipe (per AASHTO) shall meet AASHTO M294, Type S or ASTM F2306
- N-12 WT IB pipe (per ASTM F2648) shall meet ASTM F2648
- N-12 MEGA GREEN™ WT IB shall meet ASTM F2648

All products shall have a smooth interior and annular exterior corrugations. All ST IB pipe products are available as perforated or non-perforated. WT IB pipe products are only available as non-perforated.

Product-specific pipe specifications are available in the Drainage Handbook Section 1 *Specifications*.

Joint Performance

Plain End/Soil-tight (ST IB)

ST IB pipe shall be joined using a bell & spigot joint. The bell & spigot joint shall meet the soil-tight requirements of ASTM F2306 and gaskets shall meet the requirements of ASTM F477.

Plain End pipe & fittings connections shall be joined with coupling bands covering at least two full corrugations on each end of the pipe. Gasketed soil-tight coupling band connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Watertight (WT IB):

WT IB pipe shall be joined using a bell & spigot joint. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Pipe & fitting connections shall be with a bell and spigot connection utilizing a welded bell and valley or saddle gasket. The joint shall meet the watertight requirements of ASTM D3212 and gaskets shall meet the requirements of ASTM F477. Detention systems are subject to greater leakage than typical single run storm sewer application and therefore are not appropriate for applications requiring long-term fluid containment or hydrostatic pressure. For additional details refer to Technical Note 7.01 *Rainwater Harvesting with HDPE Cisterns*.

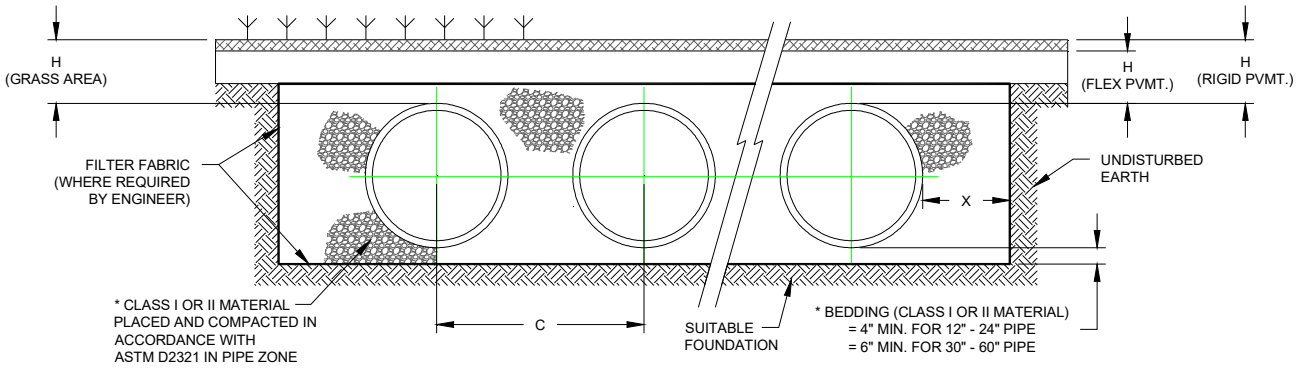
Fittings

Fittings shall conform to ASTM F2306 and meet joint performance requirements indicated above for fitting connections. Custom fittings are available and may require special installation criterion.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in non-traffic areas for 12- through 60-inch (300 to 1500mm) diameters shall be one foot (0.3m). Minimum cover in trafficked areas for 12- through 36-inch (300 to 900mm) diameters shall be one foot (0.3m) and for 42- through 60-inch (1050 to 1500mm) diameters, the minimum cover shall be two feet (0.6m). Backfill shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material, with the exception that 60-inch fittings shall use Class 1 (compacted) material only. Minimum cover heights do not account for pipe buoyancy. Refer to ADS Technical Note 5.05 HDPE Pipe Flotation for buoyancy design considerations. Maximum cover over system using standard backfill is 8 feet (2.4m); contact a representative when maximum fill height may be exceeded. Additional installation requirements are provided in the Drainage Handbook Section 6 Retention/Detention.

TYPICAL RETENTION/DETENTION CROSS SECTION



MINIMUM H (GRASS) = 12" FOR 12" THROUGH 60" HDPE PIPE
MINIMUM H (FLEX PVMT), H (RIGID PVMT) = 12" FOR UP TO AND INCLUDING 36" HDPE PIPE
= 24" FOR 42" THROUGH 60" HDPE PIPE

MAXIMUM FILL HEIGHT LIMITED TO 8-FT OVER FITTINGS FOR STANDARD INSTALLATIONS. CONTACT REPRESENTATIVE WHEN MAXIMUM FILL HEIGHTS EXCEED 8-FT FOR INSTALLATION CONSIDERATIONS.

* CLASS I BACKFILL REQUIRED AROUND 60" DIAMETER FITTINGS.

ADDITIONAL REFERENCES

Drainage Handbook Section 6 *Retention/Detention*

Technical Note 6.01 *Retention/Detention System Maintenance*

Technical Note 7.01 *Rainwater Harvesting with HDPE Pipe*

Standard Detail 701 Retention-Detention System (Plan View)

Standard Detail 702 Retention-Detention System (Cross-Section)

Standard Detail 703 Retention-Detention System (Riser & Cleanout)

Standard Detail 704 Flowable Fill Installation (Nyloplast Riser)

All references are available for download at www.ads-pipe.com

ADS HP STORM 12”- 60” PIPE SPECIFICATION

Scope

This specification describes 12- through 60-inch (300 to 1500 mm) ADS HP Storm pipe for use in gravity-flow storm drainage applications.

Pipe Requirements

ADS HP Storm pipe shall have a smooth interior and annular exterior corrugations.

- 12- through 60-inch (300 to 1500 mm) pipe shall meet ASTM F2881 or AASHTO M330
- Manning’s “n” value for use in design shall be 0.012

Joint Performance

Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881 or AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

Fittings

Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD), or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.04. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Pipe I.D. in (mm)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Average Pipe I.D. in (mm)	12.2 (310)	15.1 (384)	18.2 (462)	24.1 (612)	30.2 (767)	36.0 (914)	42.0 (1067)	47.9 (1217)	59.9 (1521)
Average Pipe O.D. in (mm)	14.5 (368)	17.7 (450)	21.4 (544)	28.0 (711)	35.5 (902)	41.5 (1054)	47.4 (1204)	54.1 (1374)	67.1 (1704)
Minimum Pipe Stiffness * @ 5% Deflection #/in./in. (kN/m^2)	75 (517)	60 (414)	56 (386)	50 (345)	46 (317)	40 (276)	35 (241)	35 (241)	30 (207)

*Minimum pipe stiffness values listed; contact a representative for average values.

ADS SANITITE® HP 12”- 60” PIPE SPECIFICATION

Scope

This specification describes 12- through 60-inch (300 to 1500 mm) ADS SaniTite HP pipe for use in gravity-flow sanitary sewer applications.

Pipe Requirements

ADS 12”-30” (300 to 750mm) SaniTite HP dual wall pipe shall have a smooth interior and annular exterior corrugations; 30”-60” (750 to 1500mm) SaniTite HP triple wall pipe shall have a smooth interior and exterior surfaces with annular inner corrugations.

- 12- through 30-inch (300 to 750 mm) dual wall pipe shall meet ASTM F2764
- 30- through 60-inch (750 to 1500 mm) triple wall pipe shall meet ASTM F2764
- 12- through 60-inch (300 to 1500 mm) pipe shall have a minimum pipe stiffness of 46 pii when tested in accordance with ASTM D2412.
- Manning’s “n” value for use in design shall be 0.012.

Joint Performance

Pipe shall be joined using a bell and spigot joint meeting the requirements of ASTM F2764. The joint shall be watertight according to the requirements of ASTM D3212, with the addition of a 15 psi pressure requirement. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

Fittings

Fittings shall conform to ASTM F2764. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Polypropylene compound for pipe and fitting production shall be an impact modified copolymer meeting the material requirements of ASTM F2764.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500mm) diameter the minimum cover shall be 2-ft (0.6m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.05. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Pipe I.D. in (mm)	12 (300)	15 (375)	18 (450)	21 (535)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Average Pipe I.D. in (mm)	12.1 (307)	14.9 (378)	18.0 (457)	21.1 (536)	24.1 (612)	30.1 (765)	35.7 (907)	41.8 (1062)	47.3 (1201)	59.3 (1506)
Average Pipe O.D. in (mm)	14.5 (368)	17.6 (447)	21.2 (538)	24.8 (629)	28.0 (711)	35.5 (902)	41.5 (1054)	47.4 (1199)	54.1 (1374)	67.1 (1705)

***OD values listed above are NOT for manhole connector sizing. See ADS Standard Detail 205A-F for the recommended manhole connector based on product and diameter.**

ADS N-12® LOW HEAD PIPE SPECIFICATION

Scope

This specification describes 24- through 60-inch (600 to 1500 mm) ADS N-12 Low Head pipe for use in low head / low pressure applications.

Pipe Requirements

N-12 Low Head pipe shall have a smooth interior and annular exterior corrugations.

- 24- through 60-inch (600 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306 with the modifications listed herein.
- Manning's "n" value for use in design shall be 0.012.
- Where low head applications sustain continuous pressure, the sustained pressure shall not exceed 5psi and the surge pressure shall not exceed 10 psi.

Joint Performance

Pipe shall be joined using a bell and spigot joint meeting the requirements of AASHTO M294 or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

Fittings

Fittings shall conform to AASHTO M294 or ASTM F2306. Bell and spigot connections shall utilize a welded or integral bell and inline, valley, or saddle gaskets meeting the watertight joint performance requirements of ASTM D3212.

Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

Material Properties

Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 435400C for the corrugated exterior profile, and 445464C, for the interior liner as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 24- through 60-inch (600 to 1500mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.4 and 5.1 of AASHTO M294 and ASTM F2306 respectively. The interior liner resin shall have a material designation code of PE3408/PE3608 by the Plastic Pipe Institute and a Hydrostatic Design Basis of 1600 psi.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exceptions that minimum cover in traffic areas for 24- through 48-inch (600 to 1200mm) diameters shall be one foot (0.3m) and for 60-inch (1500mm) diameter the minimum cover shall be 2-feet (0.6m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the installation guidelines.

Pipe Dimensions

Pipe I.D. in (mm)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)
Pipe O.D.* in (mm)	27.8 (719)	36 (914)	42 (1067)	48 (1219)	54 (1372)	67 (1702)
Minimum Pipe Stiffness @ 5% Deflection #/in./in. (kN/m^2)	28 (195)	28 (195)	22 (150)	20 (140)	18 (125)	14 (95)

*Pipe O.D. values are provided for reference purposes only, values stated for 24 through 60-inch are ±1 inch. Contact a sales representative for exact values

ADS SINGLE WALL HEAVY DUTY PIPE SPECIFICATION

Scope

This specification describes 3- through 24-inch (75 to 600 mm) ADS single wall high density corrugated polyethylene heavy duty pipe for use in gravity-flow land drainage applications.

Pipe Requirements

ADS single wall high density corrugated polyethylene heavy duty pipe shall have annular interior and exterior corrugations.

- 3- through 24-inch (75 to 600 mm) pipe shall meet ASTM F667.

Joint Performance

Joints for 3- to 24- inch (75 – 600 mm) shall be made with split or snap couplings. Standard connections shall meet the requirements of the ASTM F667. Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to ASTM F667.

Material Properties

Pipe and fitting material shall be high density polyethylene conforming with the minimum requirements of cell classification 323410C or 333410C as defined and described in the latest version of ASTM D3350.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 3- through 24-inch (75 to 600 mm) diameters shall be one foot (0.3 m). Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.03. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)										
Pipe I.D. in (mm)	3 (75)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)
Pipe O.D.* in (mm)	3.6 (91)	4.6 (117)	5.8 (147)	7.0 (178)	9.5 (241)	12.0 (305)	14.5 (368)	18.0 (457)	22.0 (559)	28.0 (711)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 24-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS SINGLE WALL HIGHWAY PIPE SPECIFICATION

Scope

This specification describes 3- through 24-inch (75 to 600 mm) single wall high density corrugated polyethylene highway pipe, for use in gravity-flow land drainage applications.

Pipe Requirements

ADS single wall high density corrugated polyethylene highway pipe shall have annular interior and exterior corrugations.

- 3- through 10-inch (75 to 250 mm) pipe shall meet AASHTO M252, Type C or CP.
- 12- through 24-inch (300 to 600 mm) pipe shall meet AASHTO M294, Type C or CP.

Joint Performance

Joints for 3- to 24- inch (75 – 600 mm) shall be made with split or snap couplings. Standard connection shall meet the soil-tightness requirements of AASHTO M252 or M294. Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to AASHTO M252 or AASHTO M294.

Material Properties

Pipe and fittings shall be made of polyethylene compounds that comply with the cell classification 424420C for 4- through 10-inch (100 to 250mm) diameters, or 435400C for 12- through 24-inch (300 to 600mm) diameters, as defined and described in ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 24-inch (300 to 600mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 of AASHTO M294.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines with the exception that minimum cover in trafficked areas for 3- through 24-inch (75 to 600 mm) diameters shall be one foot (0.3 m). Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.03. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

Nominal Diameter, in (mm)										
Pipe I.D. in (mm)	3 (75)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)
Pipe O.D.* in (mm)	3.6 (91)	4.6 (117)	5.8 (147)	7.0 (178)	9.5 (241)	12.0 (305)	14.5 (368)	18.0 (457)	22.0 (559)	28.0 (711)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 24-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS GRAIN-AIRE® PIPE SPECIFICATION

Scope

This specification describes 12- through 36-inch (300 to 900 mm) ADS Grain-Aire pipe for use in metering air and providing uniform flow air in flat storage structures.

Pipe Requirements

ADS Grain-Aire pipe shall have a smooth interior and annular exterior corrugations covered with a polypropylene protective screen to provide unrestricted air flow.

Joint Performance

Pipe shall be joined with split or snap couplers covering at least two full corrugations on each end of the pipe.

Material Properties

Pipe and fittings shall be high density polyethylene conforming with the minimum requirements of cell classification 424400C as defined and described in the latest version of ASTM D3350.

Perforations

Nominal Diameter	Corrugations Per Foot	Number of Holes Per Foot	Min. Hole Diameter	Open Area Per Foot
12"	6.3	36	7/16"	5.4
15"	4.7	24	5/8"	7.36
18"	4.7	24	5/8"	7.36
24"	4.7	24	5/8"	7.36
30"	2.9	32	1/2"	6.28
36"	2.4	32	1/2"	6.28

Protective Screen

Material	Polypropylene	
Bursting Strength (lbs/in^2)	484	ASTM D3786
Weight (oz/yd^2)	5.3	ASTM D3776
% Open Area	25	ASTM D475
Tensile Strength (lbs) (Grab Test)	425 (Wrap)	ASTM D5034
	273 (Fill)	

ADS ADVANEDGE® PIPE SPECIFICATION

Scope

This specification describes 12- and 18-inch (300 and 450 mm) ADS AdvanEDGE oblong corrugated pipe for use in subsurface drainage applications.

Product Requirements

ADS AdvanEDGE shall have annular interior and exterior corrugations.

- 12- and 18-inch (300 to 450 mm) shall meet ASTM D7001.

ADS AdvanEDGE outside dimensions shall be 1.5” thick by 12.5” wide or 1.5” thick by 18.5” wide. AdvanEDGE shall have internal bracing adjoining each long wall to prevent crushing under typical loading. AdvanEDGE shall be made available with or without an external geotextile wrap.

Material Properties

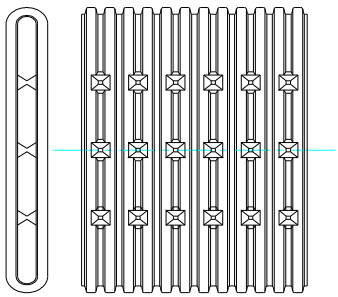
All pipe and fittings shall be made of polyethylene with a minimum cell classification of 424420C as defined and described in the latest version of ASTM D3350.

Perforations

Nominal Pipe Size, in (mm)	12 (300)	18 (450)
Slot Length (avg), in (mm)	1.125 (29)	1.125 (29)
Slot Width (avg), in (mm)	0.125 (3.2)	0.125 (3.2)
Water Inlet Area (approx.), in^2/ft	15	20

Filter Fabric

Fabric Properties	Test Method	Minimum Average Roll Values
Grab Tensile Strength (lbs.) (weakest principle direction)	ASTM D4632	120
Grab Elongation (%) (weakest principle direction)	ASTM D4632	60
Trapezoidal Tear (lbs.) (weakest principle direction)	ASTM D4533	40
Puncture (lbs.)	ASTMD4833	30
Permittivity (sec^{-1})	ASTM D4491	0.7
AOS (U.S. Sieve Size)	ASTM D4751	60
U.V. Resistance	ASTM D4355	70



ADS SB2® PIPE SPECIFICATION

Scope

This specification describes ADS SB2 pipe available in 8- and 10-inch (200 and 250 mm) diameters for use in on-site waste disposal applications.

Pipe Requirements

ADS SB2 pipe shall have a corrugated interior and corrugated exterior a pre-installed septic fabric.

- 8- and 10-inch (200 and 250 mm) pipe shall meet the requirements of ASTM F667.
- There shall be two ½ inch (12.7 mm) holes 120 degrees apart on the length of the pipe.
- The 8-inch (200 mm) and 10-inch (250mm) pipe shall have 1.0 square inches per foot of open area.

Joint Performance

Pipe shall be joined with internal or external snap couplers covering at least two full corrugations on each end of the pipe.

Fittings

Fittings shall conform to ASTM F667.

Material Properties

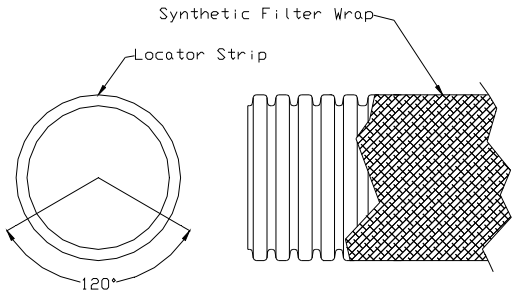
Pipe material shall be high density polyethylene conforming with the minimum requirements of cell classification 424410C as defined and described in the latest version of ASTM D3350; or ASTM D1248 Type III, Class C, Category 4, Grade P33.

Filter Fabric Properties

Material	Nylon (100%)
Fabric	Spun Bond
Fiber Size (denier per filament)	5
Weight (ounces per yd^2, ASTM D3776)	0.85
Burst Strength (pounds per in^2, ASTM D3786)	28
Air Permeability (CFM per ft^2, ASTM D737)	650
Equivalent Opening Size (Army Corps of Engineers, W 02215)	50
Water Flow Rate (gal/min/ft^2, ASTM D4491)	163
Melt Temperature (ASTM D3786)	218˚ C (425˚ F)

Installation

Installation shall be in accordance with ADS recommended installation instructions and those issued by a local health department. For leachfield applications, installation shall be in accordance with ASTM F481 and as regulated by regional, state, and local agencies. Proper authorization for specific applications and designs should be obtained prior to installation to ensure suitability in certain locales. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the installation guidelines.



ADS 3000 TRIPLEWALL® PIPE SPECIFICATION

Scope

This specification describes 3- and 4-inch (75 and 100 mm) ADS 3000 TripleWall pipe for use in gravity-flow drainage and leach field applications.

Pipe Requirements

ADS 3000 TripleWall pipe shall have a smooth interior and exterior.

- 3- and 4-inch (75 and 100 mm) pipe shall meet the requirements of ASTM F810.
- Manning's "n" value for use in design shall not be less than 0.009.

Joint Performance

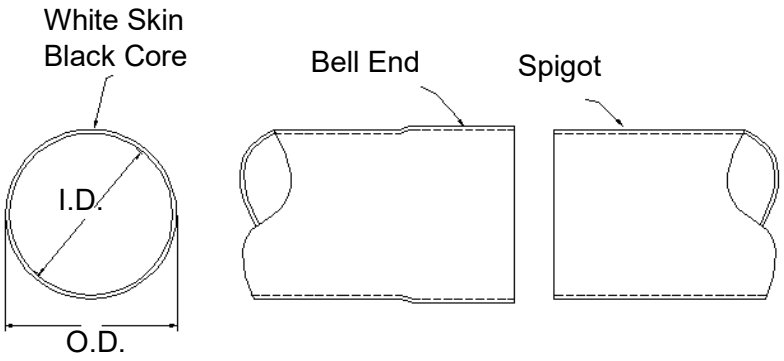
Pipe joints shall be bell-and-spigot. Bell ends shall be integrally formed on the pipe at one end to form a soil-tight connection.

Material Properties

Pipe material shall be high-density polyethylene conforming with the minimum requirements of cell classifications 424410C or E as defined and described in the latest version of ASTM D3350. The material formulation shall include recycled polyethylene.

Installation

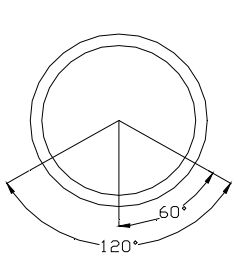
For gravity-flow drainage applications, installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines with the exception that minimum cover in traffic areas shall be one foot (0.3 m). For leachfield applications, installation shall be in accordance with ASTM F481 and as regulated by regional, state, and local agencies. Proper authorization for specific applications and designs should be obtained prior to installation to ensure suitability in certain locales. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the installation guidelines.



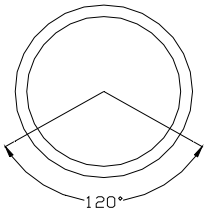
Perforation Options*

Nominal Diameter, in (mm)		
Nominal Pipe I.D. in (mm)	3 (75)	4 (100)
Average Pipe I.D. in (mm)	2.875 (73)	3.875 (98.5)
Average Pipe O.D. in (mm)	3.250 (83)	4.215 (107)

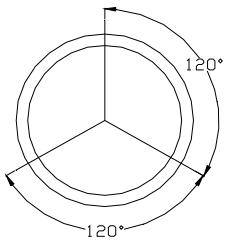
*Perforation sizes are based on customer requirements and availability by region.
**All diameters available with or without perforations



Option 1:
3 Hole, 120°



Option 2:
2 Hole, 120°



Option 3:
3 Hole, 360°

ADS SMOOTHWALL SEWER & DRAIN PIPE SPECIFICATIONS

Scope

This specification describes ADS Smoothwall Sewer & Drain pipe in 3- through 6-inch (75 to 150mm) diameters for use in gravity flow drainage and leach field applications.

Pipe Requirements

ADS Smoothwall Sewer & Drain pipe shall have a smooth interior and exterior.

- 3- through 6-inch (75 to 150mm) pipe shall meet the requirements of ASTM F810.
- Manning's "n" value for use in design shall not be less than 0.009.

Joint Performance

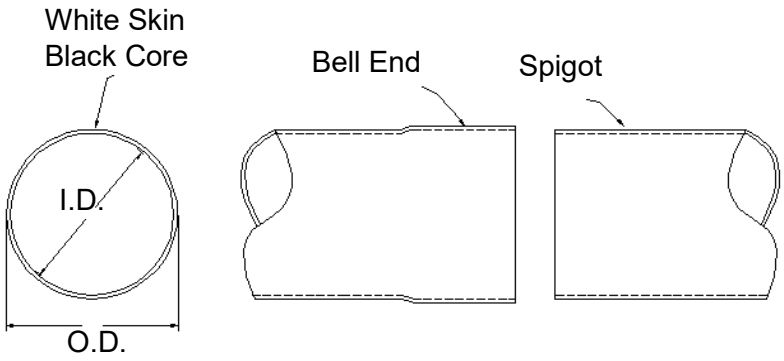
Pipe joints shall be bell-and-spigot. Bell ends shall be integrally formed on the pipe at one end to form a soil-tight connection.

Material Properties

Pipe material shall be high-density polyethylene conforming with the minimum requirements of cell classifications 424410C or E as defined and described in the latest version of ASTM D3350. The material formulation shall include recycled polyethylene.

Installation

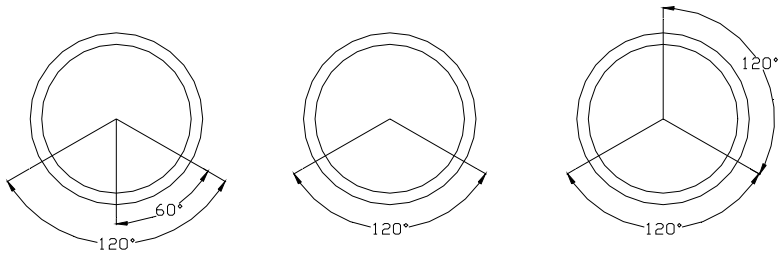
For gravity-flow drainage applications, installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines with the exception that minimum cover in traffic areas shall be one foot (0.3 m). For leachfield applications, installation shall be in accordance with ASTM F481 and as regulated by regional, state, and local agencies. Proper authorization for specific applications and designs should be obtained prior to installation to ensure suitability in certain locales. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.



Perforation Options**

Nominal Diameter, in (mm)			
Nominal Pipe I.D. in (mm)	3 (75)	4 (100)	6 (150)
Average Pipe O.D. in (mm)	3.250 (83)	4.215 (107)	6.275 (159)
SDR Rating*	38	38	43
Pipe Stiffness pii (kPa)	19 (131)	11 (76)	8 (55)

*Check with a sales representative for availability by region; other SDR rated pipe may be available.
**Perforation sizes are based on customer requirements and availability by region.
***All diameters available with or without perforations



Option 1: 3 Hole, 120°
Option 2: 2 Hole, 120°
Option 3: 3 Hole, 360°

ADS CHANNEL-FLOW® PIPE SPECIFICATIONS

Scope
This specification describes ADS Channel-Flow pipe in 4-inch (100 mm) diameter for use in on-site waste applications.

Pipe Requirements
ADS Channel-Flow pipe shall have a corrugated interior and corrugated exterior.

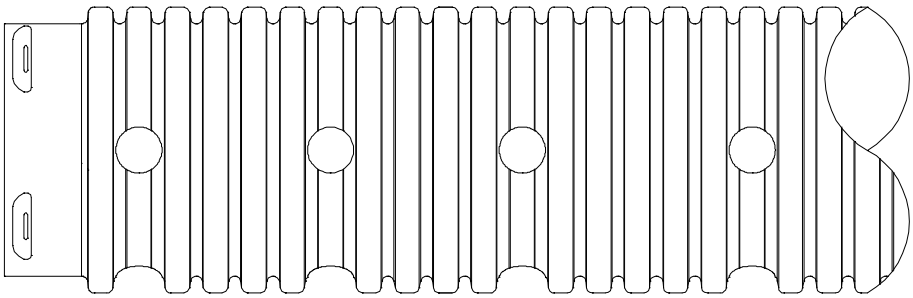
- 4-inch (100 mm) pipe shall meet the requirements of ASTM F667 and SCS 606.
- Perforations shall be spaced every 4.2-inches (107 mm) on the length of the pipe.

Joint Performance
Pipe shall be joined with self-coupling stubs located at the ends of each pipe section.

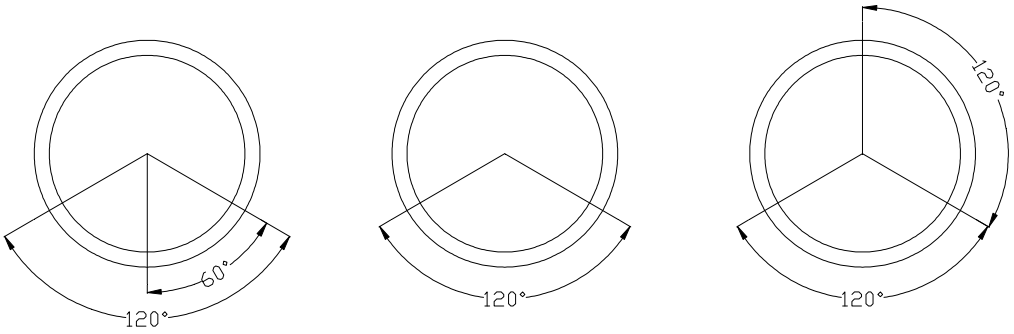
Fittings
Fittings shall conform to ASTM F667.

Material Properties
Pipe material shall be high density polyethylene conforming with the minimum requirements of cell classification 424410C as defined and described in the latest version of ASTM D3350; or ASTM D1248 Type III, Class C, Category 4, Grade P33.

Installation
Installation shall be in accordance with ASTM F481 and those issued by the local health department.



Perforation Options*



Option 1
(3) 1/2"(12.7mm)
Holes

Option 2
(2) 1/2" (12.7mm)
Holes

Option 3
(3) 1/2"(12.7mm)
Holes

*Check with sales representative for perforation option availability by region.

ADS CHANNEL-MUCK PIPE SPECIFICATIONS

Scope

This specification describes ADS Channel-Muck pipe in 4- through 6-inch (100 to 150mm) diameters for use in agricultural drainage applications.

Pipe Requirements

ADS Channel-Muck pipe shall have a corrugated interior and corrugated exterior.

- 4- through 6-inch (100 to 150mm) pipe shall meet the requirements of ASTM F667 and SCS 606.
- There shall be three perforations every 4.2-inch (107 mm) on the length of the pipe.

Joint Performance

Pipe shall be joined with self-coupling stubs located at the ends of each pipe section.

Fittings

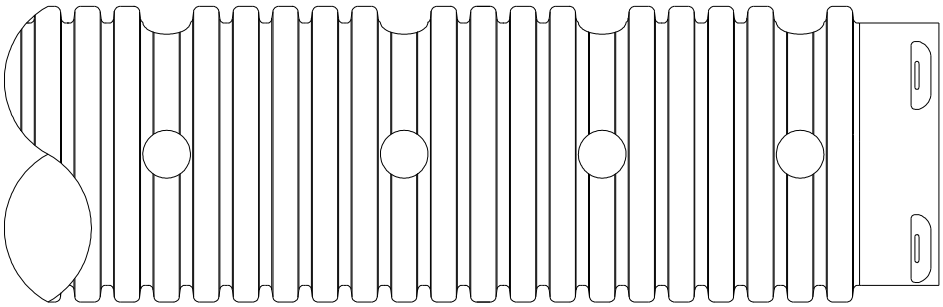
Fittings shall conform to ASTM F667.

Material Properties

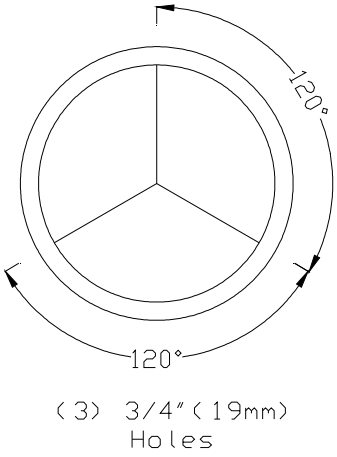
Pipe material shall be high density polyethylene conforming with the minimum requirements of cell classification 424410C as defined and described in the latest version of ASTM D3350; or ASTM D1248 Type III, Class C, Category 4, Grade P33.

Installation

Installation shall be in accordance with ADS recommended installation instructions and those issued by regional, state or local agencies.



Perforation Options*



* Check with sales representative for perforation option availability by region.

ADS DURASLOT® PIPE SPECIFICATION

Scope

This specification describes 4- through 36-inch (100 to 900 mm) ADS DURASLOT pipe for use in surface drain applications.

Pipe Requirements

DURASLOT pipe, as manufactured and distributed by ADS, Inc., shall have a smooth interior and annular exterior corrugations with an aluminum slot grate frame mounted longitudinally along the length of the pipe to accept the grate while maintaining the original pipe diameter.

- 4- through 10-inch (100 to 250mm) pipe shall meet AASHTO M252, Type S.
- 12- through 36-inch (300 to 900 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

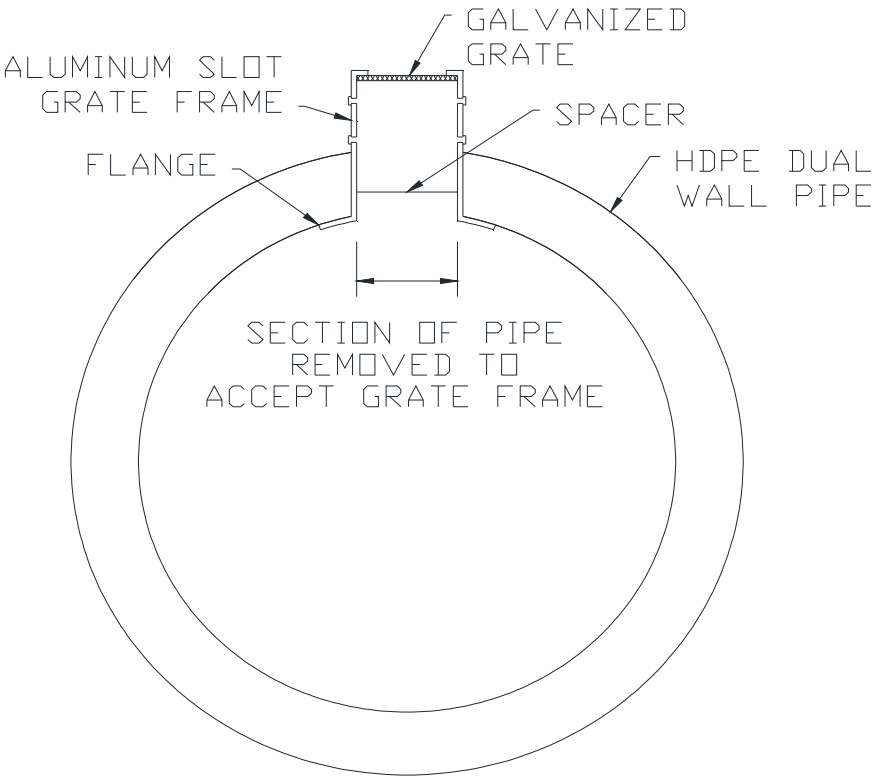
The aluminum slot grate frame shall be manufactured from 0.063" tempered commercial aluminum meeting the requirements of ASTM B209, consisting of two parallel plates separated by spacers spanning the slot on 6" centers. The grate shall be ½ - #13 galvanized steel. The grate shall have a diamond-shaped opening and be ADA compliant. The flange at the bottom of the aluminum slot grate frame shall be riveted to the pipe with a minimum of two rivets per linear foot.

Fittings

DURASLOT fittings shall be modified from fittings which conform to AASHTO M252, AASHTO M294, or ASTM F2306.

Installation

Installation shall be in accordance with ADS recommended installation instructions. Contact your local ADS representative or visit www.ads-pipe.com for a copy of the latest installation guidelines.

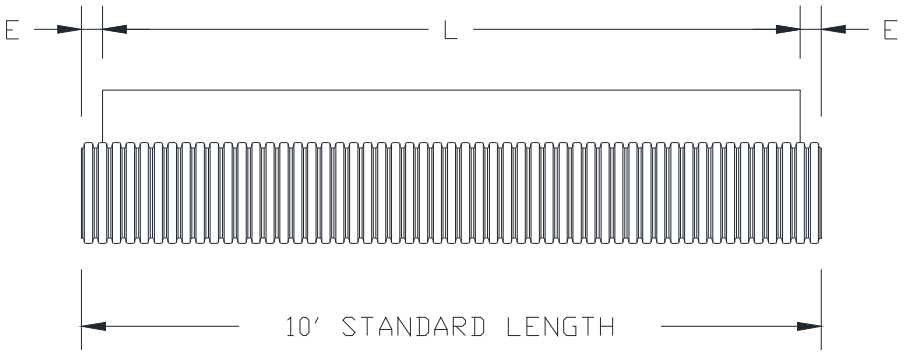


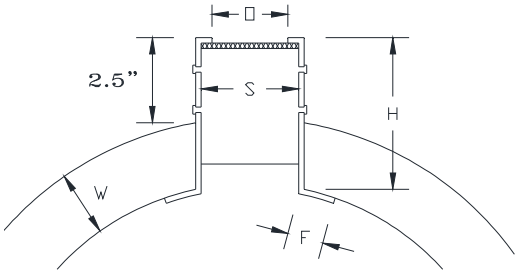
ADS DURASLOT® STANDARD DIMENSIONS

	Nominal Pipe Diameter									
	4”	**6”**	**8”**	**10”**	**12”**	**15”**	**18”**	**24”**	**30”**	**36”**
L (Drain Grate Length)	118”				116”					
E (Pipe End Length)	1”				2”					
H (2.5” slot)	2.75”	3”	3”	3”	3.5”	3.75”	4”	4.75”	5”	5.25”
H (6.0” slot)	6.25”	6.5”	6.5”	6.5”	7”	7”	7”	7.25”	8.25”	8.25”
W (Pipe Width w/ Corrugation)	0.34”	0.46”	0.61”	0.73”	1.15”	1.30”	1.57”	1.86”	2.55”	2.85”
F (Flange Length)	0.5”	0.75”	0.75”	0.75”	0.75”	0.75”	0.75”	1.0”	1.0”	1.0”
0 (Opening Width)	1.25”	1.75”	1.75”	1.75”	1.75”	1.75”	1.75”	1.75”	1.75”	1.75”
S (Slot Width)	1.75”	2.25”	2.25”	2.25”	2.25”	2.25”	2.25”	2.25”	2.25”	2.25”

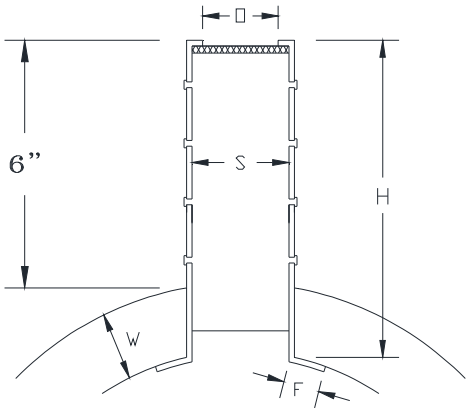
Note:

1. Variable and custom slot heights upon request. Production of variable and custom slots will require approval by engineering services and fabrication. Signed shop drawings also required from interested party.
2. Other grate material options upon request. Contact local ADS representative for availability of grate material option.





4” – 10”



12” – 36”

ADS POST TENSIONING DUCT SPECIFICATION

Scope

This specification describes 2-inch (50 mm) ADS Post Tensioning Duct for use in tension cable shield applications.

Pipe Requirements

ADS Post Tensioning Duct shall have spiral corrugated interior and exterior corrugations. Minimum inside diameter and average outer diameter shall be 1.91-inches and 2.3-inches respectively. Average pipe stiffness at 5% deflection shall be 80pii when tested in accordance with ASTM D2412. Average weight shall be 0.19 pounds per foot.

Joint Performance

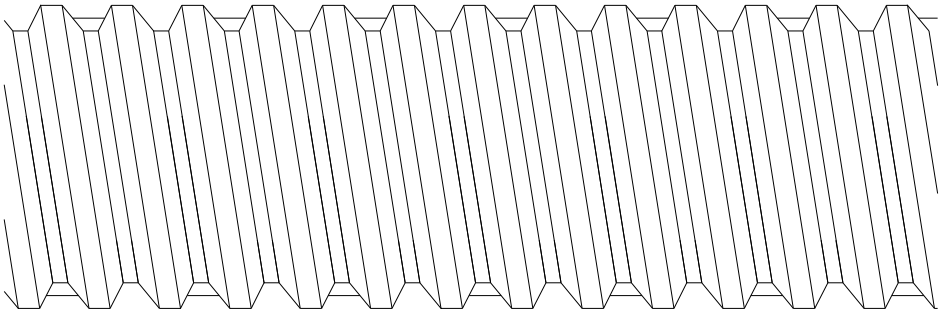
Pipe shall be joined with an external coupler covering at least two full corrugations on each end of the pipe. Standard (non-gasketed) connections shall meet the soil-tightness requirements of AASHTO M252.

Material Properties

Pipe and fitting material shall be high density polyethylene conforming with the minimum requirements of cell classification 435400C as defined and described in the latest version of ASTM D3350.

Installation

Installation shall be in accordance with state or local regulations and those issued by the design engineer.



ADS TURF-FLOW PIPE SPECIFICATION

Scope

This specification describes 2-inch (50 mm) ADS Turf-Flow Pipe for use in recreational turf drainage applications.

Pipe Requirements

ADS Turf-Flow shall have spiral corrugated interior and exterior corrugations. Minimum inside diameter and average outer diameter shall be 1.91-inches and 2.3-inches respectively. Average pipe stiffness at 5% deflection shall be 50 pii when tested in accordance with ASTM D2412. Average weight shall be 0.13 pounds per foot. The material formulation shall include recycled polyethylene.

Joint Performance

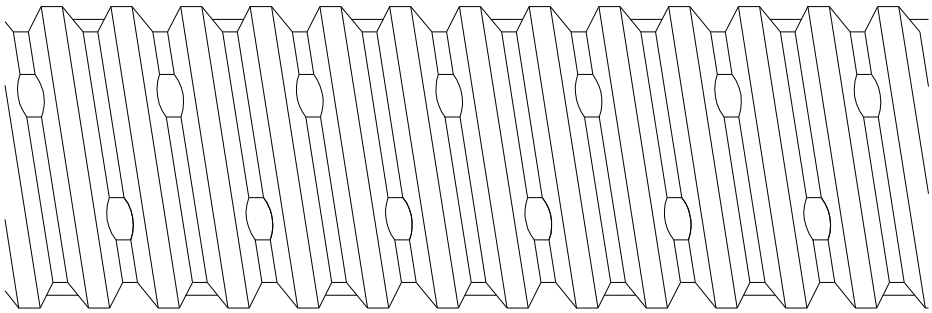
Pipe shall be joined with an external coupler covering at least two full corrugations on each end of the pipe. Standard (non gasketed) connections shall meet the soil-tightness requirements of AASHTO M252.

Material Properties

Pipe and fitting material shall be high-density polyethylene conforming with the minimum requirements of cell classification 424410C as defined and described in the latest version of ASTM D3350.

Installation

Installation shall be in accordance with state or local regulations and those issued by the design engineer.



Perforations

Perforation Type	Narrow Slots	Wide Slots
Slot Length (Max), in. (mm)	0.75 (19)	0.75 (19)
Slot Width (Max), in. (mm)	0.015 (.38)	0.19 (4.8)
Water Inlet Area (Min), in^2/ft (cm^2/m) *	0.11 (2.3)	1.34 (28.3)

* Minimum value recommended for design purposes. Actual perforation inlet area may be greater.

Hydraulic Data

Recommended Design Manning's "n"	0.017
Conveyance Number**, k	0.23

** Flow Rate, Q (cfs) = (Conveyance Number, k) * ($Slope^{1/2}$)

See Hydraulics section of the Drainage Handbook for additional information

ADS INJECTION MOLDED FITTING SPECIFICATION

Scope

This specification describes 4- through 12-inch (100 to 300 mm) ADS Injection Molded Fittings for use in joining gravity-flow drainage and sewer pipe. Available fittings include tees, wyes, bends, couplers, and reducing fittings.

Fitting Requirements

ADS Injection Molded Fittings shall have a smooth interior and exterior.

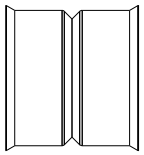
- 4- through 10-inch (100 to 250mm) shall meet the fitting requirements of AASHTO M252.
- 12-inch (300mm) shall meet AASHTO M294 or ASTM F2306.

Joint Performance

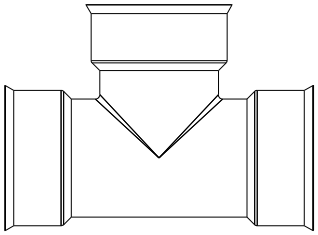
The fittings shall provide a joint meeting AASHTO M252, AASHTO M294 or ASTM F2306. For non-gasketed fittings, dimples in the bell shall engage the corrugation to provide a soil-tight connection. For gasketed fittings, the joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of EPDM meeting the requirements of ASTM F477. Gaskets shall be supplied by the pipe manufacturer. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

Material Properties

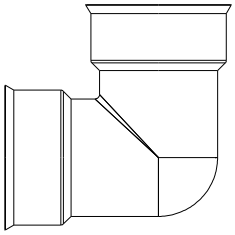
Material for fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 314420C or 314420E for 4- through 12-inch (100 to 300mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%.



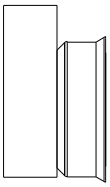
SIZE-ON-SIZE OR REDUCING
BELL-BELL COUPLER



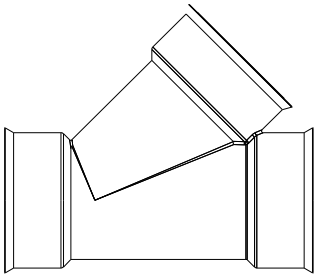
SIZE-ON-SIZE OR REDUCING TEE



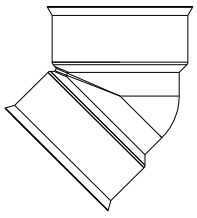
90-DEG BEND



SPIGOT-BELL REDUCER



SIZE-ON-SIZE OR REDUCING
45-DEG WYE

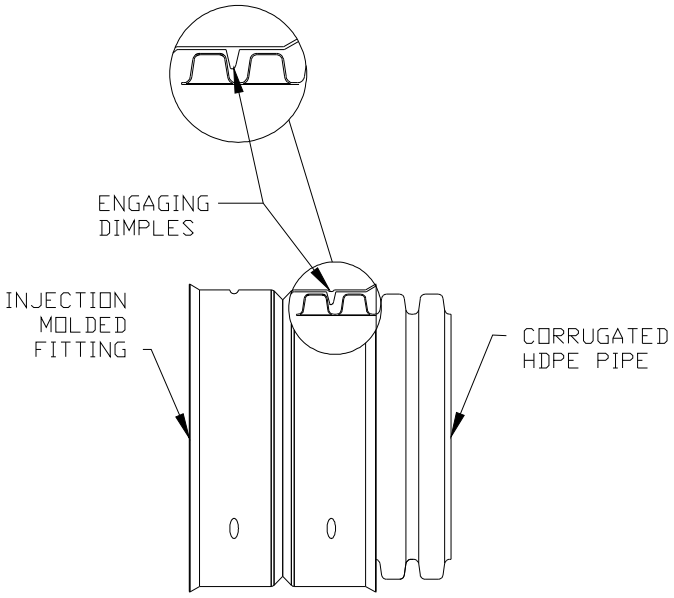


45-DEG BEND

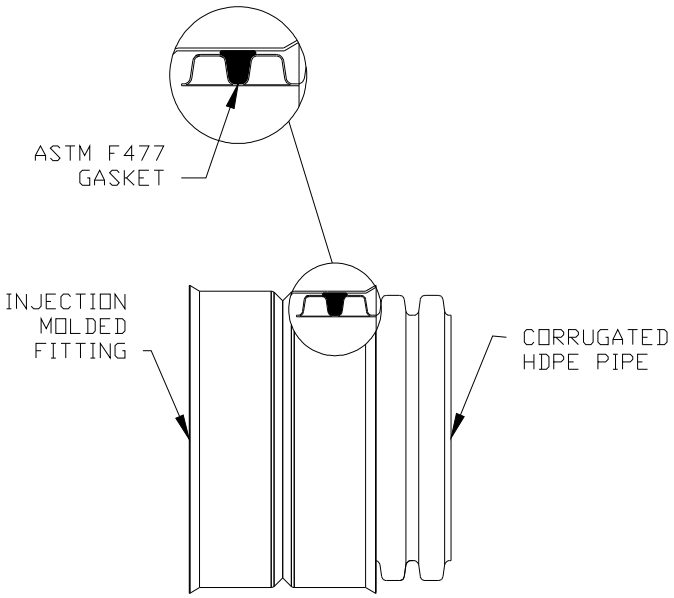
Refer to the Product Catalog for a complete listing of available fittings. Availability may vary for each fitting type based on diameter or joint performance.

INJECTION MOLDED FITTINGS JOINT SYSTEM

(Joint configuration & availability subject to change without notice. Product detail may differ slightly from actual product appearance.)



SOIL-TIGHT (ST)
JOINT CONFIGURATION



WATERTIGHT (WT)
JOINT CONFIGURATION

MAR MAC® POLYSEAL REPAIR COUPLER SPECIFICATION

Scope

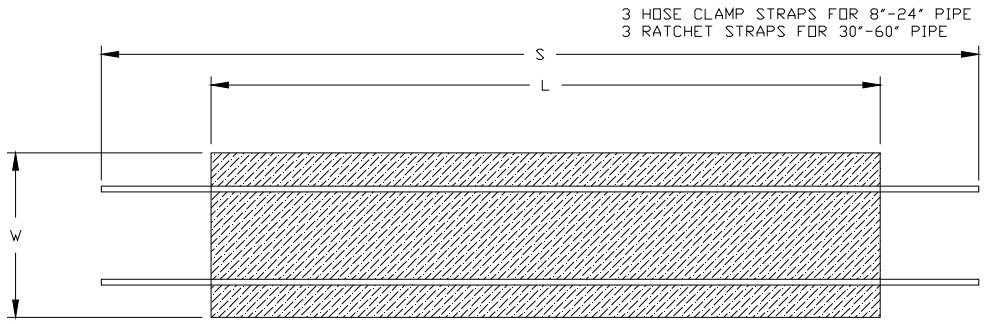
The Mar Mac Polyseal Repair Coupler is a connection for 8- through 60-inch (200 to 1500 mm) ADS N-12 pipe.

Material Properties

The Mar Mac Coupler, as manufactured by Mar Mac® Construction Products, Inc. and distributed by ADS, Inc., consists of a mastic adhesive base layer, a cross-laminated polyethylene middle layer and a spun-bonded geotextile polypropylene cloth outer layer.

Installation

Installation shall be in accordance with Mar Mac Construction Products, Inc. recommended installation instructions. Polyseal repair coupler, in conjunction with corrugated HDPE pipe, is considered a soil-tight connection unless otherwise approved by local governing body.



		Standard		Double Wide	
Nominal Pipe Diameter*, in. (mm)	Strap Length (S) in. (mm)	Length (L) in. (mm)	Width (W) in. (mm)	Length (L) in. (mm)	Width (W) in. (mm)
8 (200)	40 (1016)	35 (889)	4 (101)	n/a	n/a
10 (250)	40 (1016)	42 (1067)	6 (152)	n/a	n/a
12 (300)	50 (1270)	52 (1321)	7 (178)	52 (1321)	12 (305)
15 (375)	58 (1473)	62 (1575)	10 (254)	62 (1575)	14 (355)
18 (450)	71 (1803)	75 (1905)	10 (254)	75 (1905)	16 (406)
24 (600)	93 (2362)	94 (2387)	12 (305)	94 (2387)	20 (508)
30 (750)	125 (3175)	125 (3175)	15 (381)	125 (3175)	24 (609)
36 (900)	141 (3581)	141 (3581)	18 (457)	141 (3581)	30 (762)
42 (1050)	161 (4089)	161 (4089)	20 (508)	161 (4089)	30 (762)
48 (1200)	183 (4648)	183 (4648)	20 (508)	183 (4648)	32 (813)
60 (1500)	219 (5562)	222 (5639)	28 (711)	222 (5639)	46 (1168)

*4", 6" and 54" standard couplers may be available by special order. Contact an ADS representative.

ADS PVC COUPLING SPECIFICATION

Scope
This specification describes the PVC Coupling for use in joint repair of surface drainage applications.

Requirements
PVC couplings are manufactured from SDR 35 Sewer PVC pipe stock.

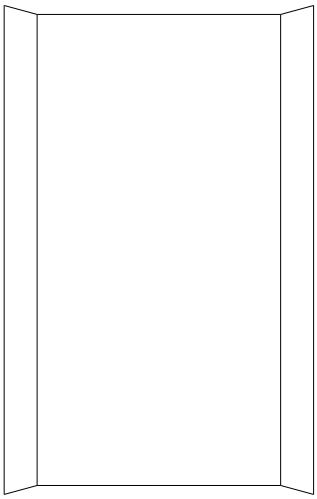
All PVC couplings shall be manufactured to meet the mechanical property requirement for fabricated fittings as described in ASTM D3034 and F679.

Joint Performance
Joints created by the PVC coupler shall be manufactured with a bell coupling sized to accept dual wall corrugated HDPE pipe with a rubber gasket. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly Gaskets supplied with the coupling shall meet the requirements of ASTM F477.

The joint shall be watertight according to the laboratory requirements of ASTM D3212. Joints shall remain watertight when subjected to a 1.5 degree axial misalignment.

Material Properties
PVC coupling shall be manufactured from SDR 35 Sewer PVC pipe stock meeting ASTM D3034 for 4- through 15-inch diameters or F679 for 18- through 24-inch diameters.

Installation
Installation shall be in accordance with ADS pipe installation instructions using typical flexible pipe installation methods. Contact your local ADS representative or visit www.ads-pipe.com for latest installation instructions.



ADS WATERSTOP™ GASKET SPECIFICATION

Scope

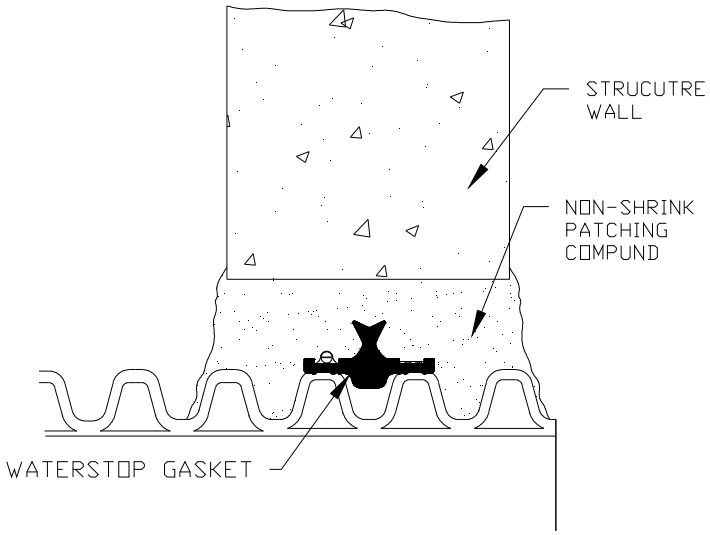
This specification describes the ADS WaterStop gasket available in 12- to 60- inch (300 to 1500 mm) diameters and used for a field installed seal that prevents water infiltration or exfiltration at manhole connections.

Material Properties

The ADS WaterStop gasket is made of a polyisoprene compound which meets the physical property requirements of ASTM C923.

Installation

Installation shall be in accordance with ADS recommended installation instructions. Contact your local ADS representative or visit www.ads-pipe.com for a copy of the latest installation guidelines.



Nominal Pipe I.D., in.	Recommended Minimum Hole Diameter, in.	Minimum Distance Pipe Invert to Structure Invert, in
12	19.5	3.7
15	23	4
18	26.5	4.2
24	33.3	4.5
30	40.5	5.2
36	47	5.5
42	53	5.7
48	59	5.7
54*	65	6.4
60	72	6.4

* Check with Sales Representative for availability

ADS FLARED END SECTION SPECIFICATION

Scope

This specification describes 12- through 36-inch (300 to 900mm) ADS Flared End Sections for use in culvert and drainage outlet applications.

Requirements

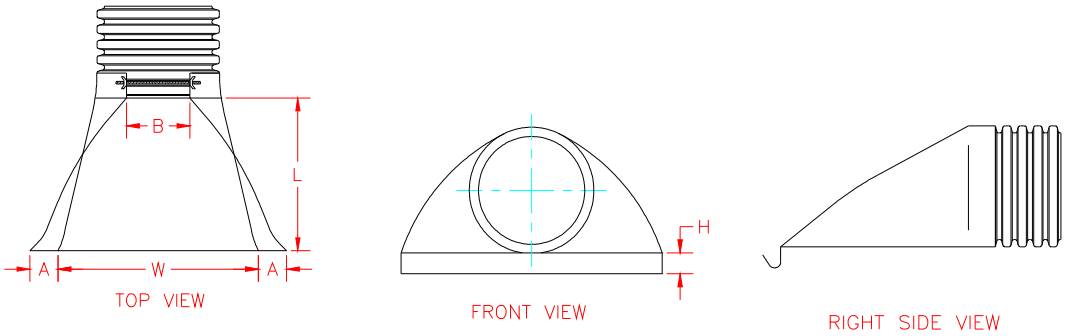
The ADS Flared End Section shall be high density polyethylene meeting ASTM D3350 minimum cell classification 213320C; contact manufacturer for additional cell classification information. When provided, the metal threaded fastening rod shall be stainless steel.

Installation

Installation shall be in accordance with ADS installation instructions and with those issued by state or local authorities. Contact your local ADS representative or visit www.ads-pipe.com for the latest installation instructions.

	PIPE DIAMETER, in (mm)					
Diameter in (mm)	12 (300)	15 (375)	18 (450)	24 (600)	30 (750)	36 (900)
A in (mm)	6.5 (165)	6.5 (165)	7.5 (191)	7.5 (191)	7.5 (191)	7.5 (191)
B (max) in (mm)	10.0 (254)	10.0 (254)	15.0 (381)	18.0 (475)	22.0 (559)	25.0 (635)
H in (mm)	6.5 (165)	6.5 (165)	6.5 (165)	6.5 (165)	8.6 (218)	8.6 (218)
L in (mm)	25.0 (635)	25.0 (635)	32.0 (813)	36.0 (914)	58.0 (1473)	58.0 (1473)
W in (mm)	29.0 (737)	29.0 (737)	35.0 (889)	45.0 (1143)	63.0 (1600)	63.0 (1600)

*Product detail may differ slightly from actual product appearance



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ADS MITERED END SECTION SPECIFICATION

Scope

This specification describes 12- through 60-inch (300 to 1500mm) Mitered End Sections for use in culvert and drainage outlet applications.

Requirements

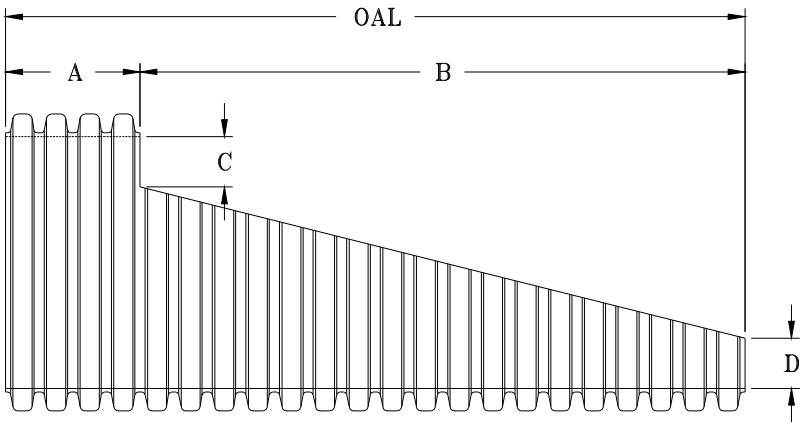
The invert of the pipe and the end section shall be at the same elevation. Mitered End Section shall be high-density polyethylene conforming with the minimum requirements of cell classification 335400C as defined and described in ASTM D3350 except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

Installation

Installation shall be in accordance with ASTM D2321 and ADS installation guidelines. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the installation guidelines.

Nominal Dimensions										
	Slope x:1		Slope 2:1		Slope 3:1		Slope 4:1		Slope 6:1	
Pipe Dia. (in)	C* (in)	D (in)	B (in)	OAL (in)	B (in)	OAL (in)	B (in)	OAL (in)	B (in)	OAL (in)
12	3	3	12	20	18	26	24	32	36	44
15	4	4	14.8	24.5	22	31.9	29.4	39.1	41.6	51.4
18	4.2	4	21	33	30	42	39	51	60	72
24	6	6	24	40	36	52	48	64	72	88
30	6	6	36	52	56	72	72	88	108	124
36	6.9	6	48.1	64.6	73.9	92.3	96.9	115.4		
42	5.2	6	64.4	82	93.6	111.3	122.9	140.5		
48	5.4	6	76.1	93.6	111.2	128.7	146.4	163.9		
54	5.4	6	85.1	108.4						
60	3.6	6	100.6	123.9						

*The “C” dimension varies slightly for some diameters depending on the slope



Note: ADS recommends that the product be installed with a concrete collar/edge to support and close corrugations per DOT specifications. The Channel at the bottom of the taper must be shaped to prevent toe lift by the inlet water flow.

ADS TAYLOR END PLUG PRODUCT SPECIFICATION

Scope

This specification describes 4- through 60-inch (100 to 1500mm) ADS End Plugs, as manufactured by Taylor Made Plastics, Inc., for use in temporary storm drainage, gravity-flow applications.

Requirements

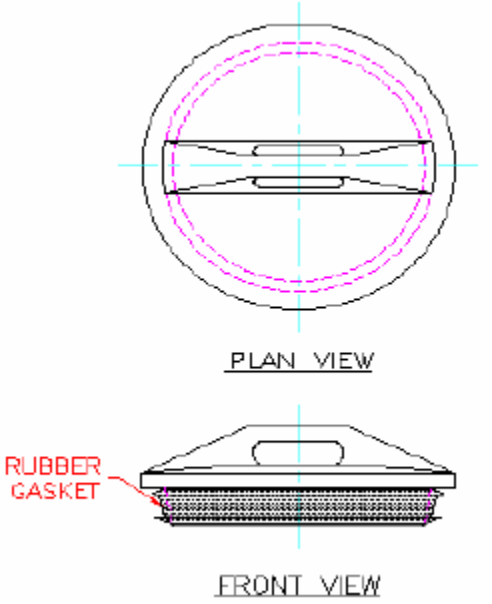
End Plug shall be made of polyethylene with a gasket sized in order to fit in the spigot end of corrugated polyethylene pipe.

Joint Performance

The end plug shall provide a soil-tight joint per ASTM F2306.

Installation

Installation shall be in accordance with Taylor Made Plasitcs, Inc installation instructions. End plugs are not intended for permanent use or vertical applications.



ADS STORM WATER QUALITY UNIT PRODUCT SPECIFICATION

Scope

This specification describes 36- through 60-inch (900 to 1500 mm) Storm Water Quality Units for use in on-site point source storm water treatment applications.

Requirements

Storm Water Quality Units shall have a smooth interior and annular exterior corrugations meeting the requirements of ASTM F2737.

The unit shall have at least three containment zones, each zone separated from the next by use of a weir or baffle plate

Weir and baffle plates shall be welded at all interfaces between the plate and water quality unit. First weir plate shall incorporate a saw tooth design and shall be reinforced with stiffeners positioned horizontally on the downstream side of the plate to be retained.

Storm Water Quality Units shall provide adequate clean-out and inspection access.

Joint Performance

Connections for the bypass line and the unit shall utilize the same joint quality as specified for the main storm sewer pipe. Couplers for the bypass line may be either split couplers, in-line bell couplers, snap couplers, bell-bell couplers, or welded bell couplers.

Material Properties

Material for pipe and fittings used to produce Storm Water Quality Units shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500mm) diameters as defined and described in the latest version of ASTM D3350. The pipe material shall be evaluated using the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively. All smooth baffle and weir plates shall be high density polyethylene.

Installation

Installation shall be in accordance with the ADS recommended installation guidelines, utilizing a class I (ASTM D2321) structural backfill material or flowable fill (CLSM –Controlled Low Strength Material). Contact your local ADS representative or visit www.ads-pipe.com for the latest installation instructions.

Performance

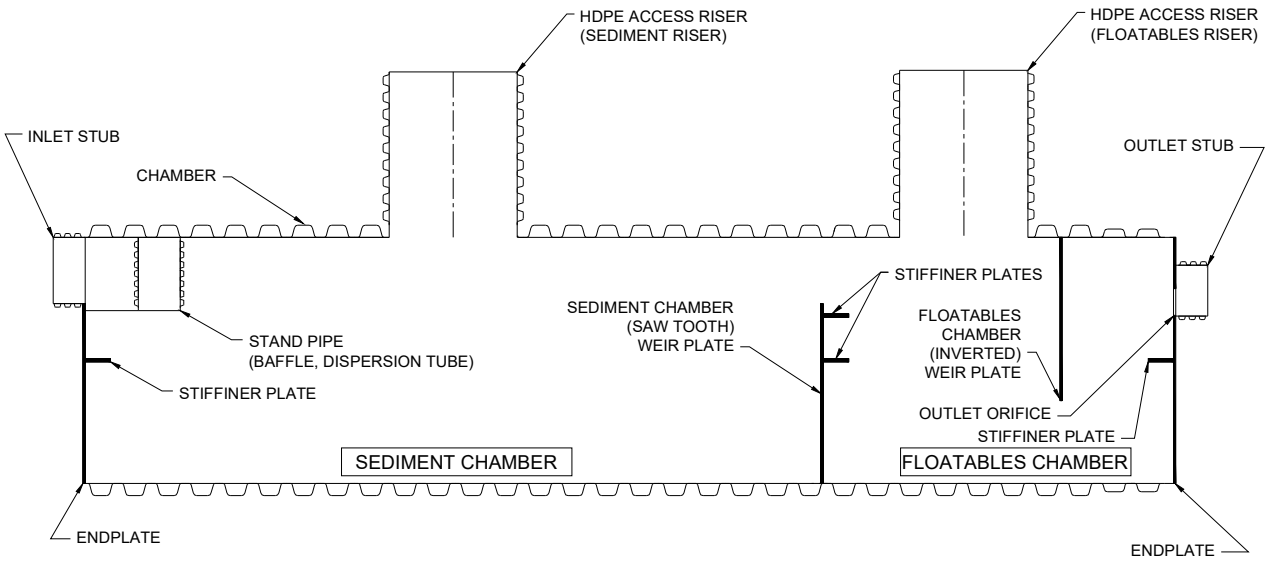
Water Quality Units shall remove a minimum of 80% of the first flush total suspended solids (TSS) based on flow rates and corresponding sieve sizes shown in Table 1. Water Quality units shall be installed “offline” to prevent re-suspension of solids in high flow situations. Offline installation shall be constructed utilizing an ADS By-Pass structure. Flow through the unit shall be controlled by an orifice fabricated on the outlet end of the structure.

Table 1: Storm Water Quality Unit Dimensions and Specifications (based on mathematical calculations)

I.D. (in)	Inlet Size (in)	Outlet Size (in)	Length (ft)	Treated Flow Rate (cfs)	Sediment Volume (ft^3)	Floatables Volume (ft^3)	Sieve Size
36	10	10	20	1.50	65	30	140
	10	10	40	2.38	137	63	140
	10	10	20	0.70	65	30	200
	10	10	40	1.60	137	63	200
42	12	12	20	1.73	83	38	140
	12	12	40	3.66	175	81	140
	12	12	20	0.86	83	38	200
	12	12	40	1.83	175	81	200
48	12	12	20	2.26	116	55	140
	12	12	40	3.94	245	115	140
	12	12	20	1.13	116	55	200
	12	12	40	2.39	245	115	200
60	15	15	20	2.95	183	87	140
	15	15	40	6.23	385	184	140
	15	15	20	1.47	183	87	200
	15	15	40	3.12	385	184	200

ADS STORM WATER QUALITY UNIT

(Unit configuration & availability subject to change without notice. Product detail may differ slightly from actual product appearance.)



ADS GREASE INTERCEPTOR PRODUCT SPECIFICATION

Scope

This specification describes the 750-, 1000-, and 1500-gallon ADS Grease Interceptor for on-site use trapping floatable grease and oils in water treatment applications.

Requirements

Grease Interceptors shall meet requirements specified in ASTM F2649. Grease Interceptors shall have a smooth interior and annular exterior corrugations using pipe that meets AASHTO M252 Type S, AASHTO M294 Type S, or ASTM F2306. The inlet and outlet of the unit shall utilize 8-inch SDR 32.5 HDPE pipe. A weir plate shall be installed with an orifice centrally located to control flow into the last chamber. At the weir plate, a vertical half-round pipe shall be installed to minimize contaminants through the orifice.

Joint Performance

Connections to the inlet and outlet shall utilize couplers with the same joint performance as the main sewer pipe.

Material Properties

Material for pipe and fittings used to produce the Grease Interceptor shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100- to 250-mm) diameters, and 435400C for 12- through 60-inch diameters as defined and described in the latest version of ASTM D3350. The pipe material shall be evaluated using the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.

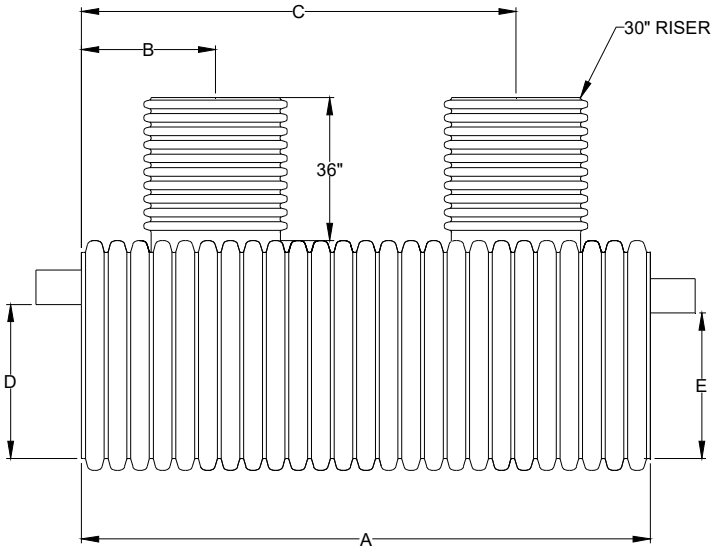
Installation

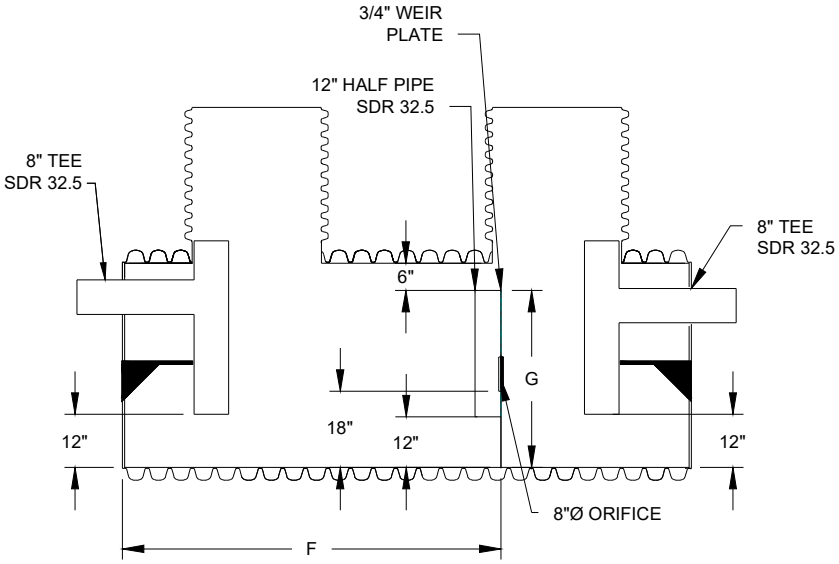
Installation shall be in accordance with the ADS recommended installation guidelines, utilizing a class I (ASTM D2321) structural backfill material or flowable fill (CLSM –Controlled Low Strength Material). Contact your local ADS representative or visit www.ads-pipe.com for the latest installation instructions.

Grease Interceptor Dimensions and Specifications

Volume (gal)	Chamber Diameter (in)	Inlet Diameter (in)	Outlet Diameter (in)	A	B	C	D	E	F	G
750	48	8	8	131”	31”	100”	35.7”	33.7”	88”	41.7”
1000	48	8	8	173.25”	31”	142”	35.7”	33.7”	116”	41.7”
1500	60	8	8	156”	31”	123”	35.7”	47.5”	105”	53.5”

(Unit configuration & availability subject to change without notice. Product detail may differ slightly from actual product appearance.)





ADS BIODIFFUSER™ SEPTIC LEACHING CHAMBER SPECIFICATION

Scope

This specification describes the Standard, High-Capacity, Bio 2, and Bio 3 BioDiffuser units for use in onsite wastewater disposal applications.

Chamber Requirements

BioDiffuser chambers are manufactured from high-density polyethylene with an open bottom, solid top and louvered sidewalls. Sidewall louvers shall be designed to minimize soil intrusion.

Chamber shall meet the load rating of H-10 (16,000 lb per axle) with a minimum of 12-inches (0.3m) of cover when tested in accordance with IAPMO PS 63 and installed in accordance with ADS installation procedures.

The 16" high capacity chamber is also available in H-20 (32,000 lb per axle) rated version. To order the H-20 ARC chamber model, please contact an ADS representative.

Chamber Connection

Each chamber shall interlock with the beginning of the next chamber by overlapping post and dome while engaging overlapping flanges.

Material Properties

Each chamber shall be manufactured from high density polyethylene resin as defined and described in IAPMO PS 63.

Installation

Installation shall be in accordance with ADS installation procedures and those issued by the local health department regulations.

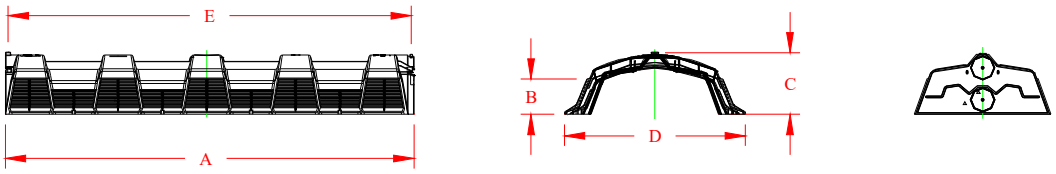
Chamber Dimensions

	11" Standard Model No. 1100BD	16" High Capacity Model No. 1600BD	Bio 2 (15" Narrow) Model No. 1500BD	Bio 3 (22" Narrow) Model No. 2200BD
Length (A)	76"	76"	87"	87"
Repeat Length (E)	75"	75"	86"	86"
Side Wall Height (B)	6.4"	11.2"	9.0"	9.0"
Overall Height (C)	11"	16"	12"	12"
Overall Width (D)	34"	34"	15"	22"
Capacity	9.2 cu ft (68.8 gal)	13.6 cu ft (101.7 gal)	5.0 cu ft (37.4 gal)	8.5 cu ft (63.6 gal)
Weight	27 lbs	35 lbs	19 lbs	28 lbs
Units/Pallet	27	45	90	70
Truck Load Quantity*	39 pallets	18 pallets	14 pallets	14 pallets

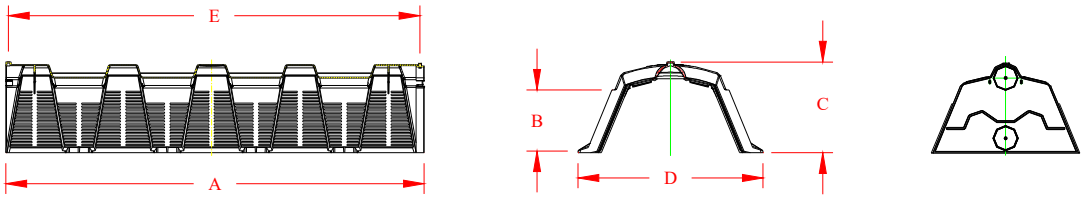
**End Caps may reduce truck load pallet quantity.*

(Unit configuration & availability subject to change without notice. Product detail may differ slightly from actual product appearance.)

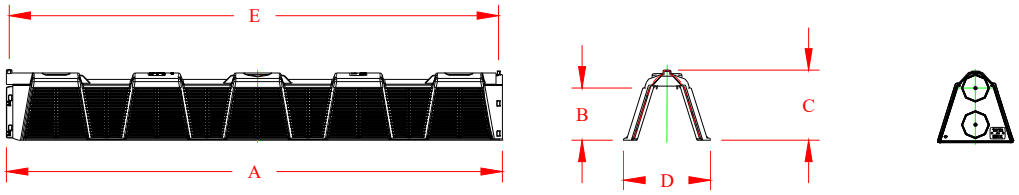
11” Standard Chamber



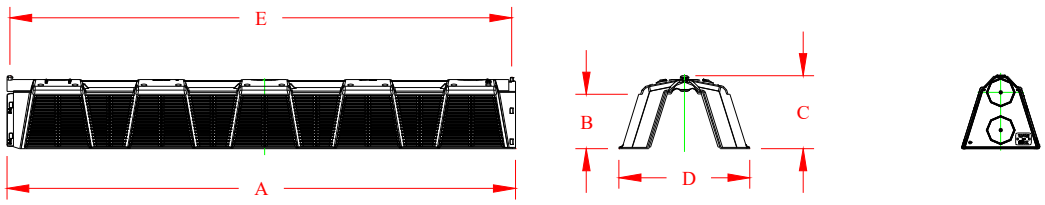
16” High Capacity Chamber



Bio 2 (15” Narrow) Chamber



Bio 3 (22” Narrow) Chamber



ADS ARC ™ SEPTIC LEACHING CHAMBER SPECIFICATIONS

Scope

This specification describes the Arc chamber units for use in onsite wastewater disposal applications.

Chamber Requirements

Arc chambers are manufactured from high-density polyethylene with an open bottom, solid top and louvered sidewalls. Sidewall louvers shall be designed to minimize soil intrusion.

Chamber shall meet the load rating of H-10 (16,000 lb per axle) with a minimum of 12 inches of cover when tested in accordance with IAPMO PS 63 and installed in accordance with manufacturers installation procedures.

Chamber Connection

Each chamber shall interlock with an integral articulating joint. Articulating joints shall have a free range of horizontal rotation of 20 degrees, with a maximum of 10 degrees in either direction. Articulating joint shall be constructed by placing the dome with engaging knuckle of the incoming chamber over the post end of the previously-installed chamber.

Material Properties

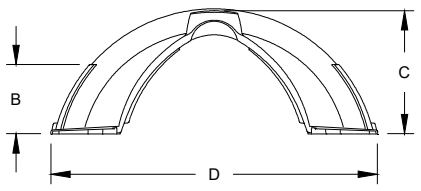
Each chamber shall be manufactured from high-density polyethylene as defined and described in IAPMO PS 63.

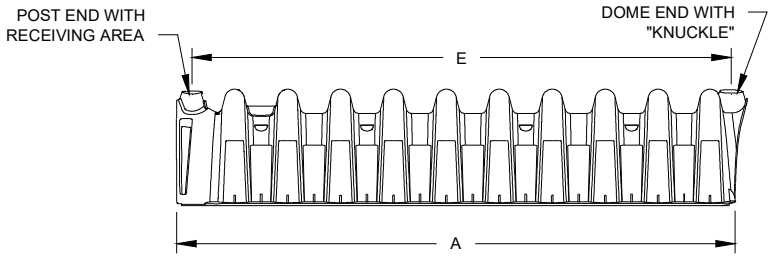
Installation

Installation shall be in accordance with ADS installation procedures as well as all state and local health department regulations.

	Arc 18	Arc 24	Arc 36	Arc 36 HC	Arc 36 LP
Length (A)	67 in	67 in	63 in	63 in	63 in
Repeat Length (E)	60 in	60 in	60 in	60 in	60 in
Side Wall Height (B)	7.7 in	7.5 in	7.13 in	10.75 in	5.5 in
Overall Height (C)	12 in	12 in	13 in	16 in	8 in
Overall Width (D)	16 in	22.5 in	34 in	34 in	34 in
Capacity	3.42 cu ft (25.6 gal)	5.02 cu ft (37.5 gal)	8 cu ft (60.1 gal)	10.7 cu ft (80 gal)	5.80 cu ft (43.4 gal)
Pallet Quantity	135 chambers	120 chambers	70 chambers	60 chambers	60 chambers
Truck Load Quantity*	16 pallets	16 Pallets	24 Pallets	24 Pallets	24 Pallets

**End Caps may reduce truck load pallet quantity.*





ADS SUMP PUMP WELL SPECIFICATION

Scope

This specification describes the ADS sump pump well for use in residential drainage applications.

Requirements

The sump pump well shall be available in both 14-gallon (53 liters) and 19-gallon (72 liters) sizes. Each well shall have three pre-formed inlet collars sized to fit 4-inch (100mm) corrugated polyethylene drainage lines. Each well shall have a molded side panel designed to accept the outside basement perimeter line at any elevation along the well wall. Both wells shall have a twist-locking lid.

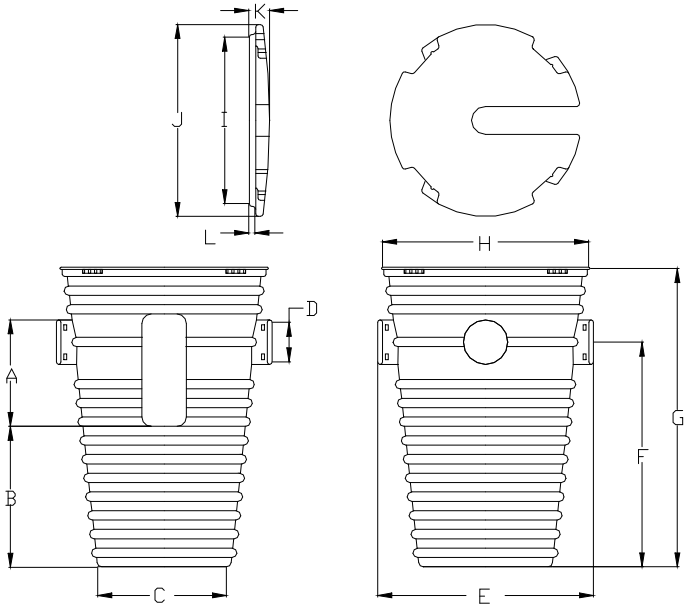
Material Properties

Sump pump well material shall be high density polyethylene.

Installation

Installation shall be in accordance with ADS installation instructions and those issued by regional, state, or local agencies.

	A	B	C	D	E	F	G	H	I	J
14-gallon	12”	8”	14.25”	4.75”	20.38”	18.13”	24”	20.88”	18.38”	20.5”
53 liters	305mm	203mm	362mm	121mm	518mm	460mm	610mm	530mm	467mm	521mm
19-gallon	12”	13”	14.25”	4.75”	20.38”	24”	31.75”	20.88”	18.38”	20.5”
72 liters	305mm	330mm	362mm	121mm	518mm	610mm	806mm	530mm	467mm	521mm



ADS RADON DUAL PURPOSE VENTED SUMP SPECIFICATION

Scope

This specification describes the ADS Radon Dual Purpose Vented Sump System for use in residential drainage and ventilation of toxic or noxious gas applications.

Requirements

The Radon Dual Purpose Vented Sump shall be available in 14-gallon (53 liter) capacity. The sump well shall have three pre-formed inlet collars sized to fit 4-inch (100 mm) corrugated polyethylene drainage lines. Each well shall have a molded side panel designed to accept the outside basement perimeter line at any elevation along the well wall. The lid shall be pre-drilled to accept 1¼-inch (32mm), 1½-inch (38mm), 2 inch (50mm), or 3-inch (75mm) vent and discharge pipes. Rubber o-rings for these pipes, as well as rubber pump wire plug shall be included with the lid kit.

Material Properties

Radon Dual Purpose Vented Sump shall be high density polyethylene.

Installation

Installation shall be in accordance with ADS installation instructions and those issued by regional, state, or local agencies.

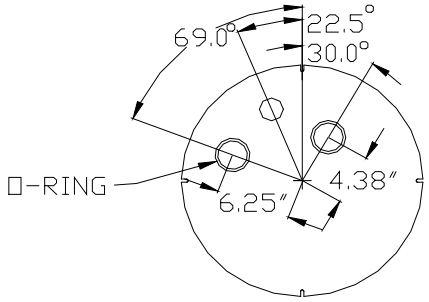
	A	B	C	D	E	F	G	H
14-gallon 53 liter	12” 305mm	8” 203mm	14.25” 362mm	4.75“ 121mm	20.38” 518mm	18.13” 460mm	24” 610mm	20.06” 510mm

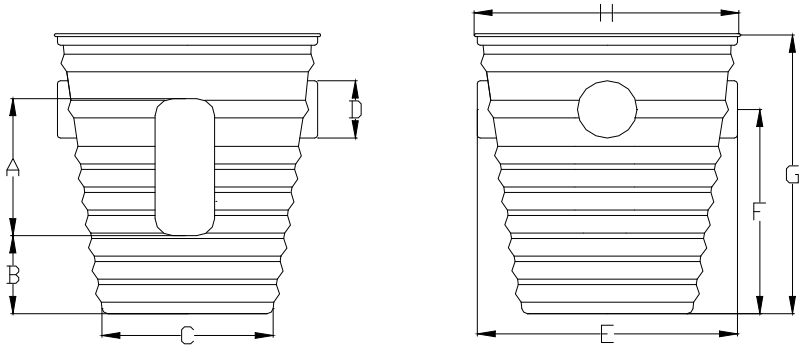
Items Included With Lid Kit

Qty.	
1	Gasket for 4” Sch 40 or SDR 35 PVC inlet line
1	Gasket for 2” and 3” Sch 40 PVC vent pipe
1	Gaskets for 2”, 1 ½”, and 1 ¼” Sch 40 PVC pump discharge pipes
1	Electrical Cord Stopper
1	1” Adhesive Foam Tape

Items Needed For Lid Kit (Sold Separately)

Qty.	
4	Hex Head Lag Screws ¼” x 1 ½” (minimum)
4	Flat Washers ¼”
4	Concrete Floor Anchors





ADS SEWAGE EJECTOR SUMP SPECIFICATION

Scope

This specification describes the ADS Sewage Ejector Sump System for use in residential sewage applications.

Requirements

The Sewage Ejector Sump shall be available in 19-gallon (72 liter) capacity. The sump well shall have one pre-drilled inlet hole with an o-ring gasket adapter for standard 4-inch (100mm) SDR 35 sewer pipe or a PVC hub for standard 4-inch (100mm) schedule 40 sewer pipe. Each well shall have three molded side panels designed to accept an extra inlet line at 90-degree increments around its circumference. The lid shall be pre-drilled to accept 1¼-inch (32mm), 1½-inch (38mm), 2-inch (50mm) or 3-inch (75mm) vent and discharge pipes. Rubber o-rings for these pipes, as well as rubber pump wire plug shall be included in the lid kit.

Material Properties

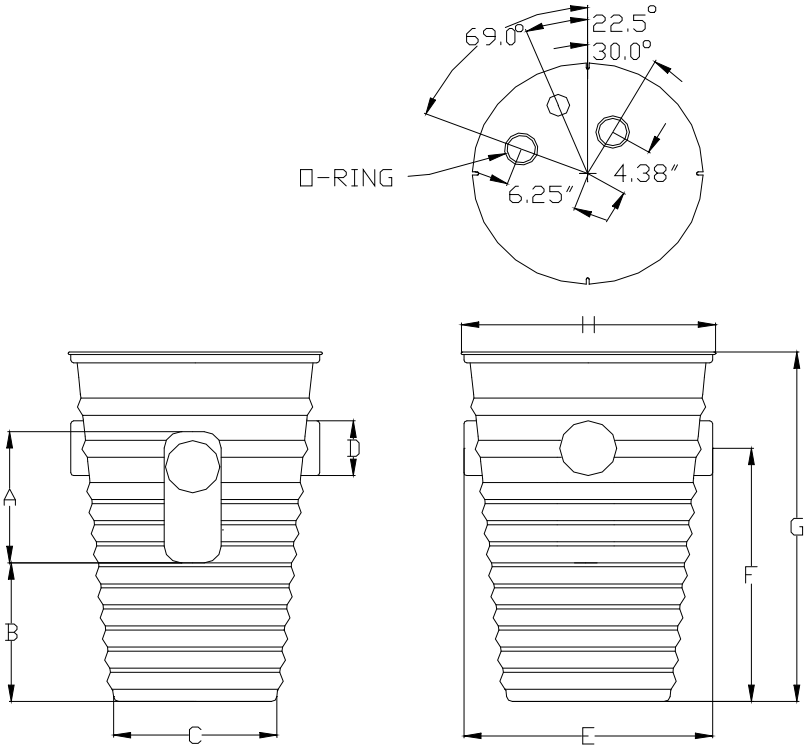
Sewage Ejector Sump shall be high-density polyethylene.

Installation

Installation shall be in accordance with ADS installation instructions and those issued by regional, state, or local agencies.

	A	B	C	D	E	F	G	H
19-gallon 72 liter	12” 305mm	13” 330mm	14.25” 362mm	4.75” 121mm	20.38” 518mm	24” 610mm	31.75” 806mm	20.06” 510mm

Items Included With Lid Kit



ADS METER PIT SPECIFICATION

Scope

This specification describes 18-, 21-, and 24-inch (450, 525, and 600mm) Meter Pit for use as meter enclosures.

Requirements

ADS Meter Pits shall be white in color. Meter pits shall have a smooth interior and annular exterior corrugations. Based on ASTM D 2412 at 5% deflection the pipe stiffness for 18-inch (450 mm), 21-inch (525 mm), and 24-inch (600 mm) Meter Pits shall be 40 pii (275 N/m/mm), 34 pii (235 N/m/mm), and 34 pii (235 N/m/mm) respectively. The pits shall be available in 24, 30, 36, 48 inch, and 12 foot (0.6, 0.8, 0.9, 1.2, and 3.7 m) lengths. Meter Pits shall be notched at 0 and 180 degrees at the base to accommodate inlet and outlet pipes.

Material Properties

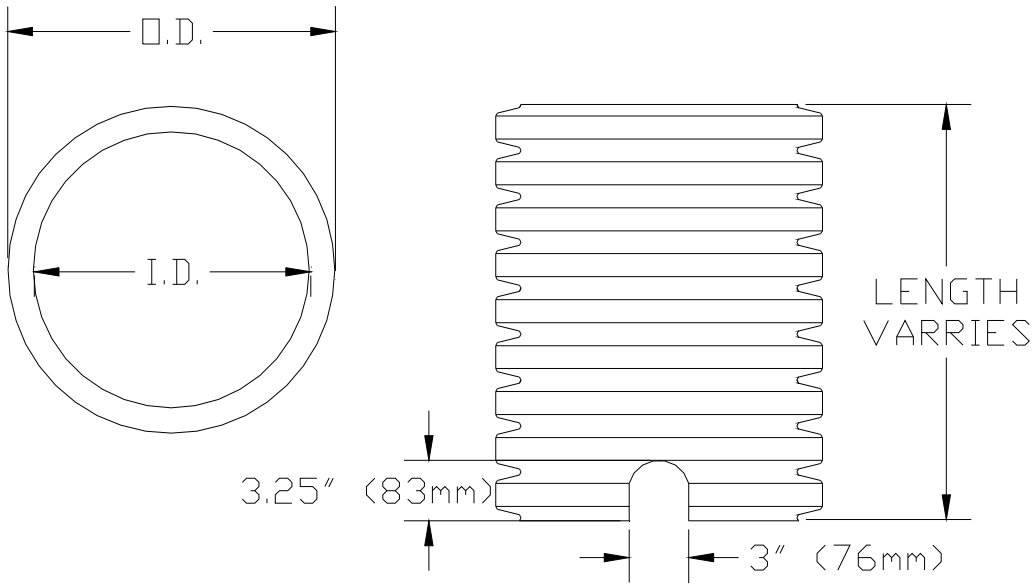
Meter pits shall be high density polyethylene conforming with the minimum requirements of cell classification 424420 B as defined and described in the latest version of ASTM D3350.

Installation

Installation shall be in accordance with ADS installation instructions or those issued by regional, state, or local agencies.

Nominal Dimensions

Inner Diameter	18" 450mm	21" 525mm	24" 600mm
Outer Diameter	21.5" 546mm	25" 635mm	28.4" 721mm



Warning: This product is not supplied with a grate or lid for means of termination at the ground surface. It is the sole responsibility of the installer/user of this product to adequately insure the product has been covered and secured at the top of the structure/product. Poor installation or failure to adequately cover and secure this product may result in injury to persons and property.

ADS FILTER SOCK SPECIFICATION

Scope

This specification describes 2- through 48-inch (50- to 1200 mm) ADS SOCK synthetic wrap.

Filter Fabric Requirements

The ADS SOCK shall meet the requirements of ASTM D6707.

ADS sock products as listed on this specification meet Ontario Provincial Standard Specification 1860, Material Specifications for Geotextiles, dated March 1998.

Filter Fabric Properties

Property	Test Method	
Material	-	Polyester
Fabric	-	Knitted
Permitivity (min.)	ASTM D4491	5.5 sec^{-1}
Puncture Resistance (min.)	ASTM D6241	1000 N
AOS (max.)	ASTM D4751	0.600 mm 30 U.S. Sieve
FOS (max.)	CAN/CGSB-148.1, M10-94	450 microns
Mass (relaxed)	ASTM D3887	3.0-3.9 oz/yd^2 101.7-132.2 g/cm^2
Mass (applied minimum)		2.7-3.5 oz/yd^2 91.5-118.7 g/cm^2
Thickness (min.)	ASTM D4491	24.0 mils 609.6 microns
Permeability (K) (min.)	ASTM D4491	0.390 cm/sec
Burst Strength (min.)	ASTM D3786	760 kpa
Air Permeability (min.)	ASTM D737	700 ft^3/ft^2/min 213 m^3/m^2/min
Water Flow Rate (min.)	ASTM D4491 (2" constant head)	300 gal/min/ft^2 12,224 L/min/m^2
Yarn Denier	-	150
Specific Gravity	-	1.3
Melt Temperature	-	450° F 232° C

5-0 INSTALLATION

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BUYER/USER IS RESPONSIBLE FOR SERVICEABILITY OF THE PRODUCT IN ANY GIVEN APPLICATION. SELLER IS NOT RESPONSIBLE FOR INJURY OR DAMAGE RESULTING FROM IMPROPER INSTALLATION, NONCOMPLIANCE WITH THESE GUIDELINES FOR INSTALLATION OF PRODUCT, OR USE OUTSIDE THE GUIDELINES SET FORTH HEREIN.

5-1 OVERVIEW OF INSTALLATION CONSIDERATIONS

Installation of ADS pipe is in most respects very much like that of any quality pipe installation. The strength of a pipe system shall be considered a combination of the pipe itself and the backfill envelope. Proper construction maximizes the drainage capabilities designed into the pipe by maintaining alignment and load-carrying ability.

Recommendations for proper backfill and installation for ADS products are based primarily on the requirements of ASTM D2321 "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe", CSA B182.11-11 "*Standard Practice for the Installation of Thermoplastic Drain*, and BNQ 1809-3 *"Construction Work-General Technical Specification- Drinking Water and Sewer Lines"*. These handbooks are not intended to replace standard industry or project specifications, but to provide guidance based on our experience, research and recommendations for proper product performance.

The elements regarding backfill that are addressed in this section are as follows:

Proper backfill material selection - A variety of materials can be used as structural backfill with the final decision, many times, based on what is most available locally. Native soil may be an appropriate material providing it meets the basic criteria established in this section.

Proper backfill compaction - Compaction forces out air and moisture to provide a more stable structure. Minimum compaction levels are based on the material characteristics and the design load; some situations may require the use of mechanical compactor while others require simply tamping the material to eliminate voids.

Proper backfill structure - An adequate quantity of structural backfill is necessary to ensure adequate support. Undisturbed native soil from a trench wall often provides additional support. Typical trench dimensions and the effect of the trench wall are discussed in this section.

In addition, this section discusses job-site handling, trench construction and pipe installation for ADS products, compaction methods, and several specialized installation considerations.

Federal regulations covering safety for construction are published in the Safety and Health Regulations for Construction under the Department of Labor, Occupational Safety and Health Administration (OSHA). These regulations define practices, which must be followed.

5-2 PRE-INSTALLATION STORAGE AND HANDLING

Thermoplastic pipes such as polyethylene and polypropylene are lightweight and easy to use. While no special care is needed in handling and installation a few precautions should be set forth.

- Follow all applicable safety regulations when handling pipe.
- The pipe shall not be dropped from the delivery truck into an open trench, or onto uneven surfaces.
- Avoid dragging or striking the pipe against another pipe or object.
- Avoid dragging the pipe across the ground.
- Avoid any impact to the bell or spigot.
- Do not drive over the pipe prior to installation.
- Inspect the pipe and joining systems before installation.
- Care shall be taken to not over home the pipe during assembly.

Many ADS drainage products are available palletized allowing for convenient transporting and orderly storage. If the products were not received on a pallet, the pipe should be carefully stacked. One method commonly used is to secure the bottom lengths of pipe together side-by-side, or use stop blocks, and then place additional pipe on top. Where pipe is stock piled, the total pile height shall not exceed 5-feet and the pipe must be adequately restrained to prevent pile collapse. Do not walk on stock piled pipe. Additional handling and storage information is available upon request.

Ambient temperature extremes do not affect the strength or handling characteristics of ADS pipe products. Cold temperatures can affect the impact resistance of some thermoplastics, although polyethylene and polypropylene remain highly impact resistant. In-house quality checks on polyethylene products demonstrate that the impact resistance at zero degrees F (-18C) is many times that required by specification. Additionally, hot weather, especially when coupled with direct sunlight, will raise the pipe temperature, but will not significantly affect handling or installation behavior.

Depending on the product, either carbon black or another UV stabilizer is added to the polyethylene or polypropylene to protect against ultraviolet light; unprotected plastic can become less impact resistant over time. Such additives are required by the specification and protect the pipe during storage periods at the manufacturing facility and at the job site. Ultraviolet light is no longer an issue after installation.

Long-term exposure to ultraviolet light causes slightly different results. The UV stabilizer protects the pipe for several years, after which the impact strength of the exposed layer, generally 0.001-inch (0.03mm), is significantly reduced. This damaged layer then functions in shielding the remainder of the pipe wall from any further damage. There are HDPE

culverts, currently under observation, that were installed in 1974. The culverts have retained nearly all of their original strength characteristics and support strong evidence of continued service.

5-3 LINE AND GRADE

Storm drain and sewer pipe systems are designed to provide hydraulic capacity based on pipe size and slope. The alignment or line of the pipe is the horizontal location of the pipe while the grade is the vertical slope of the pipe. In order for a pipe system to function as designed, it is important to install the pipe to the proper line and grade.

Generally, no special practices are required to maintain line and grade; however, certain installation techniques can greatly increase the system performance and rate of installation.

Alignment is established by a field survey. Once the trench is excavated on line, the pipe bedding shall be placed to proper thickness. The top of the bedding shall be adjusted to allow for the difference between the plan invert (flowline) and pipe profile wall thickness. To determine the dimension to be subtracted from the pipe inverts indicated on the plans when checking bedding elevations measure the distance from the interior side of the liner to the crown of the corrugation.

5-4 TRENCH EXCAVATION

The width of the trench depends on the pipe diameter, backfill material, and the method of compaction. Trenches that are too narrow will not allow for proper pipe installation, whereas trenches that are overly wide are unnecessarily costly. As a practical matter, standard bucket sizes may also factor into the decision. The design engineer may modify the trench widths based on an evaluation of the competency of the in-situ materials, the quality and compaction level of the backfill, the design loads and the compaction equipment to be used. In lieu of the engineer's recommendations or governing agency specifications, the following trench widths are suggested in table 5-1.

Table 5-1
Minimum Trench Widths

Nominal Pipe Diameter, in. (mm)	Minimum Trench in. (m)	Nominal Pipe Diameter, in. (mm)	Minimum Trench in. (m)
4 (100)	21 (0.5)	24 (600)	48 (1.2)
6 (150)	23 (0.6)	30 (750)	56 (1.4)
8 (200)	26 (0.7)	36 (900)	64 (1.6)
10 (250)	28 (0.7)	42 (1050)	72 (1.8)
12 (300)	30 (0.8)	48 (1200)	80 (2.0)

15 (375)	34 (0.9)	54 (1350)	88 (2.2)
18 (450)	39 (1.0)	60 (1500)	96 (2.4)

Trench widths should only be wide enough to permit the adequate placement and compaction of the embedment materials. This ideal trench width is normally referred to as the minimum trench width. It is designated in accordance with national standards and generally assures the width allows for backfill material to flow on either side of the pipe and permits the compaction of this material. If the width is not sufficiently wide for the materials and proposed compaction methods a wider trench allowing for proper installation shall be constructed.

In very poor native soils (for example; peat, muck, or highly expansive soils), a wider trench width with possibly filter fabric may be required. This wider trench width shall be based on an evaluation of the in-situ soil, and the design and construction loads.

Trench widths for pipe are often determined by the bucket size available for the excavator. In many cases, the bucket width can significantly exceed the ideal trench width. Wide trenches are not only costly to excavate and fill with backfill material they actually reduce the structural integrity of the pipe/backfill system. This fact is noted in the AASHTO *LRFD Bridge Construction Specification*, Section 30, "Trenches shall be kept to the specified width as any increase in trench width will increase the load on the pipe."

Years of consolidation create a very stable soil environment. The desire is to destroy as little of that stability as necessary when digging the trench. Stable trench walls actually enhance the structural integrity of the system when the trench is relatively narrow. Overly wide trenches also require more backfill material and more compaction which are typically not as stable as the undisturbed native material. A stable trench wall is characterized as one that can stand without support; however this does not refer to the possible need of trench wall supports to comply with OSHA.

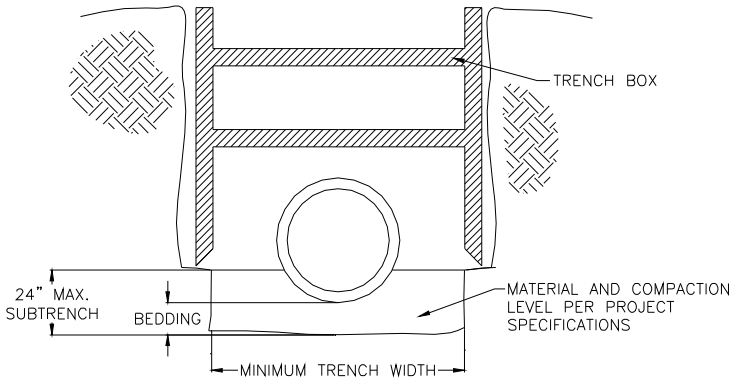
It should be noted that although the pipe will have less load in a narrow trench condition, a wide trench application is used for the design methodology for thermoplastic pipe found in *AASHTO LRFD Bridge Design Specifications* Section 12. This point is clearly illustrated in Section 12.12, "narrow trenches yield a desirable level of conservatism, since the transfer of the load to in-situ trench wall is not considered in flexible pipe design."

The depth of the trench is dictated by the geography of the site and the pipe slope required. However, if an adequate foundation for the pipe is not available at the desired depth, additional excavation will be needed. Rock outcroppings, muck, and other unsuitable materials do not provide proper support. They shall be removed and replaced with suitable granular material. Refer also to Figure 5-1.

Trenching shall be completed in existing soils with sidewalls reasonably vertical to the top of the pipe. For positive projection embankment

installations, the embankment material shall be placed and compacted to a minimum of one (1') foot above the pipe and the trench excavated into the embankment. When excavation depths or soil conditions require shoring or use of a trench box, the bottom of the shoring or trench box should be placed no lower than the top of the pipe. This prevents disruption of the backfill envelope when removing the shoring or trench box. Dragging the trench box shall only be done if it does not damage the pipe or disrupt the backfill, otherwise, the box shall be lifted vertically into its new position. If this practice cannot be followed, consideration should be given to leaving the shoring in place. When the trench box must be located below the top of the pipe, the most effective way to maintain a sound system is to provide a 'sub trench' within which to place the pipe and backfill. For safety, the bottom of the trench box should not be greater than 24" above the bottom of the trench. For more information on the use of trench boxes, refer to Technical Note 5.01: *Recommended Use for Trench Boxes*.

Figure 5-1
Typical Sub Trench Installation



5-5 BACKFILL ENVELOPE CONSTRUCTION

Backfill construction shall be evaluated as part of the structural design of polyethylene and polypropylene pipe like it is for other pipe materials. ASTM D2321/ CSA B182.11-11 serve as the basis for installation recommendations in trafficked installations. Acceptable backfill materials and construction methods are very similar or, in many cases, identical to those required for other types of pipe material.

The primary purpose of the backfill envelope is to provide long-term support to the pipe. In a properly constructed backfill envelope, the loads are distributed across the crown of the pipe to the material along the sides and then to the pipe bedding and foundation. This load arching effect reduces the total load applied to the pipe.

The load that a flexible pipe will carry is related to the backfill envelope construction. The load-carrying capacity of a pipe/backfill system will be

determined by a combination of the backfill material, the level of compaction, and the placement of the backfill material. However, the type of application may also influence what type of backfill is required. These and other related issues are discussed in subsequent paragraphs in this section.

BACKFILL MATERIAL

Material selection is the first and most important step to creating a structurally sound backfill envelope. In general, backfill material should be of an aggregate nature, able to be compacted, if necessary, into a structurally sound structure. A variety of materials, including some native soils, meet these requirements.

Backfill offers passive resistance, termed the “modulus of soil reaction”. The modulus of soil reaction is determined by a combination of the material and the amount of compaction. The type of material (sand, gravel, clay, etc.) and compaction level (standard Proctor density) determine overall strength of the backfill. Some research indicates that other factors, such as the beneficial effects of trench walls, may add to the conservancy of the backfill strength, although those relationships are often neglected. (This information assumes the trench walls are at least as strong as the backfill material.)

The strength of the backfill can be described using different parameters. One way is by describing it in terms of the modulus of soil reaction (E’), which is an empirical value developed by the Bureau of Reclamation to calculate deflection. Another parameter used to describe backfill strength is the secant constrained soil modulus (M_S). Values for M_S and E’ are discussed further in the Structures chapter of this handbook.

Recommendations for soil type and compaction level will vary based on the application and product; Appendix A-5 provides product-specific guidelines and literature references. Shallow, non-trafficked installations may not require the same level of backfill quality, but any modifications should be discussed with ADS engineers prior to establishing backfill criteria on a particular project. Installations involving higher loads sometimes require a higher soil strength; ADS engineers can also provide additional guidance on backfill requirements in these situations.

As discussed in the Structures section of this handbook, it is the combination of the type of material and compaction level that will determine the soil strength. When a variety of options will work in a particular installation, the final decision can depend on what is most available locally in order to keep the cost of the installation to a minimum. Native soil may be specified depending on the ADS product being installed, the application and when following the requirements of Table 5-2 and the respective technical literature as listed in Appendix A-5. Using native soil eliminates the cost of imported backfill material and the effort spent grading or hauling the excavated material off site. If the native material is not acceptable, then appropriate material will need to be brought in.

Flowable fill, also known as controlled low strength material (CLSM), controlled density fill (CDF) and slurry fill, is another, more specialized, type of backfill material that is increasing in use throughout the country. This material is a mixture of soil, cementitious material, and water. With acceptable in-situ material, flowable fill trench widths can be reduced. Although the structural integrity of flowable fill is excellent, it will misalign or float the pipe unless precautions, such as weighting the pipe or pouring the flowable fill in lifts, are taken. For more information on the use of flowable fill refer to Technical Note 5.02: *Flowable Fill Backfill for Pipe*.

Table 5-2
Classes of Embedment and Backfill Materials

ASTM D2321[A] (CSA B182.11) Class	Description	ASTM D2487 Notation	Description	AASHTO M43 Notation	AASHTO M145 Notation	BNQ 2560	ASTM D2321 [A] (CSA B182.11) Percentage Passing Sieve Sizes 1 ½ in. (40mm)	3/8" (9.5mm)	No. 4 (4.75mm)	No. 200 (0.075 mm)	Atterberg Limits LL	PI	Coefficients Cu	Cc
I[B]	Crushed rock, angular[C]	N/A	Angular crushed stone or rock, crushed gravel, crushed slag; large voids with little or no fines	5, 56, 57[D], 6, 67[D]	N/A		100%	≤25%	≤15%	<12%	Non Plastic		N/A	
II	Clean, coarse-grained soils	GW	Well-graded gravel, gravel-sand mixtures; little or no fines	5, 6	A1, A3	CG-14, MG-20	100%		<50% of "Coarse Fraction"	<5%	Non Plastic		>4	1 to 3
		GP	Poorly-graded gravels, gravel-sand mixtures; little or no fines	56, 57, 67									<4	<1 or >3
		SW	Well-graded sands, gravelly sands; little or no fines						>50% of "Coarse Fraction"				>6	1 to 3
		SP[F]	Poorly-graded sands, gravelly sands; little or no fines										<6	<1 or >3
	Coarse-Grained Soils, borderline clean to w/fines	GW-GC, SP-SM	Sands and gravels which are borderline between clean and with fines	N/A			100%		Varies	5% to 12%	Non Plastic		Same as for GW, GP, SW and SP	
III	Coarse-grained soils with fines	GM	Silty gravels, gravel-sand-silt mixtures	Gravel & sand with <10% fines	A-2-4, A-2-5, A-2-6, or A-4 or A-6 soils with more than 30% retained on #200 sieve		100%		<50% of "Coarse Fraction"	12% to 50%	N/A	<4 or <"A" Line	N/A	
		GC	Clayey gravels, gravel-sand-clay mixtures									<7 & >"A" Line		
		SM	Silty sands, sand-silt mixtures						>50% of "Coarse Fraction"			>4 or <"A" Line		
		SC	Clayey sands, sand-clay mixtures									>7 & >"A" Line		
	Inorganic fine-grained soils	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity						100%	> 30% (Retained)	<50	<4 or <"A" Line		
		CL	Inorganic clays of low to medium plasticity; gravelly, sandy, or silty clays; lean clays							> 30% (Retained)		>7 & >"A" Line		
IV[E]	Inorganic fine-grained soils	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity	N/A	A-2-7 or A-4 or A-6 soils with 30% or less retained on #200 sieve		100%		100%	< 30% (Retained)	<50	<4 or <"A" Line	N/A	
		CL	Inorganic clays of low to medium plasticity; gravelly, sandy, or silty clays; lean clays	N/A								>7 & >"A" Line		
V[G]	Inorganic fine-grained soils	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	N/A	A5, A7		100%		100%	>50%	>50	<"A" Line	N/A	
		CH	Inorganic clays of high plasticity, fat clays	N/A								>"A" Line		
	Organic soils or Highly organic soils	OL	Organic silts and organic silty clays of low plasticity	N/A			100%		100%	>50%	<50	<4 or <"A" Line	N/A	
		OH	Organic clays of medium to high plasticity, organic silts	N/A							>50	<"A" Line		
		PT	Peat and other high organic soils	N/A										

Notes:

A) Refer to ASTM D2321 / CSA B182.11/ BNQ 2560 for more complete soil descriptions.
B) Class I materials allow for a broader range of fines than previous versions of D2321 / B182.11. When specifying class I material for infiltration systems, the engineering shall include a requirement for an acceptable level of fines.
C) All particle faces shall be fractured.
D) Assumes less than 25% passes the 3/8" sieve.
E) Class IV materials require a geotechnical evaluation prior to use and should only be used as backfill under the guidance of a qualified engineer.
F) Uniform fine sands (SP) with more than 50% passing a 100 sieve behave like silts and should be treated as Class III soils if allowed.
G) Class V materials shall not be permitted as bedding and backfill material.

Backfill Placement

Storm and sanitary sewers, as well as drainage lines are sometimes placed on foundations that settle and shift in a non-uniform manner. Fortunately, flexible pipe can accommodate many of these changes without detrimental effects. The best construction practices, however, involve placing the pipe on a firm foundation for maximum performance and structural integrity throughout the design life.

In some cases it may be necessary to perform subsurface evaluations of the soil conditions where muck, rock, or other unsuitable conditions are suspected. Zones of soft material, such as muck, allow the pipe to settle, potentially affecting the structural integrity and hydraulic characteristics of the system. Rock and rock protrusions apply point loads where they contact the pipe that can affect the hydraulics or structural integrity of the system. It is recommended that unsuitable foundation material be excavated before installation of the pipe proceeds. Where a rock or unyielding or soft foundation is present, the design engineer or a geotechnical engineer shall be consulted to determine the extent to which the undesirable material is to be excavated.

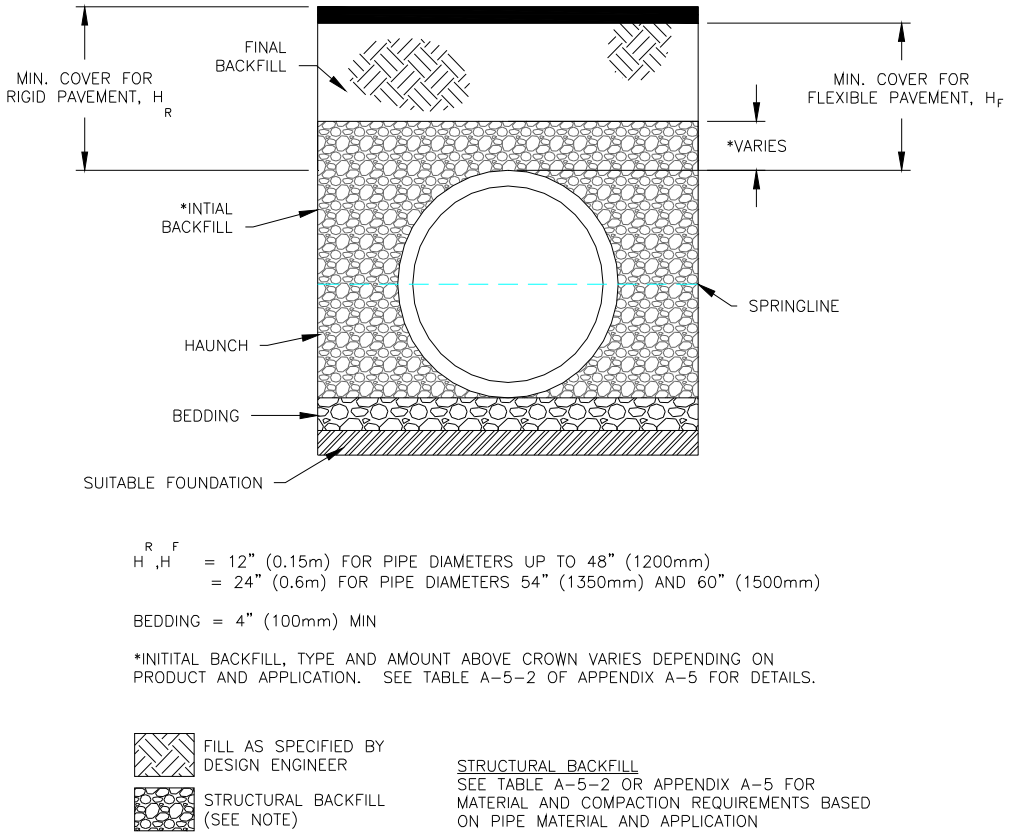
Bedding

If no undesirable foundation material is found, a minimum of 4- to 6-inches (0.1 - 0.15m) of bedding shall be placed and compacted on the foundation to equalize load distributions along the invert of the pipe. Refer to Figure 5-2 for a pictorial description of backfill terminology.

A stable and uniform bedding shall be provided for the pipe and any protruding features of its joints and/or fittings. The middle of the bedding, under the pipe invert, equal to 1/3 of the pipe O.D. should be loosely placed, with the remainder compacted to minimum standard proctor density as listed in Appendix A, Table A-5-2. The same class of material recommended for the initial backfill is suitable for the bedding; however, the compaction requirements for the bedding may be higher than compaction requirements for the initial backfill to ensure the stability of line and grade. Refer to Appendix A-5, Table A-5-2 for product-specific installation recommendations for each zone.

Note: Where using open-graded material (class I with little fines for example) in any fill zone, additional precaution must be taken to reduce or eliminate the risk of migration of fines from adjacent material. Precautionary steps could include the use of geotextile between the varying fill materials, gradation selection to prevent the migration of fines, or other precautionary measures. Refer to ASTM D2321 / CSA B182.11 for more complete information.

Figure 5-2
Typical Backfill Structure



Haunch Backfill

The next layer of backfill, the haunching, is the most important since it is this layer that provides the pipe with support against the soil and traffic loadings. Haunching shall be placed in lifts of 4- to 6-inches (0.10 - 0.15m) and compacted in accordance with product specific guidelines listed in Appendix A-5, Table A-5-2 to achieve required depth of fill. Construction of each lift should be repeated up to the spring line.

Initial Backfill

Initial backfill extends from the spring line, and depending on product and application, to the crown of the pipe or six inches (0.15m) above the crown of the pipe. This area of the backfill anchors the pipe and ensures that loads are distributed as evenly as possible into the haunching. The same material used in the haunching shall be used for the initial backfill. Where differing materials are used, backfill material size should be selected as to prevent migration of fines or a geosynthetic shall be used to separate the backfill zones. Additionally, it is crucial to obtain similar backfill strength between fill zones if differing materials are used. Using the same material throughout the embedment zone is recommended for all ADS products; however, using different materials between the haunch and initial backfill zones may be accomplished under strict guidelines that

are outlined in the appropriate product's fill height table technical note. See Table A-5-1 for a list of fill height table technical notes.

When using a material that requires compaction it is important not to use mechanical compaction equipment directly on the pipe itself. Initial backfill shall be placed in lifts of 4- to 6-inches (0.10 - 0.15m) and compacted in accordance with product-specific guidelines in Appendix A-5, Table A-5-2 to achieve required depth of fill. Tamp to achieve the specified compaction, or shovel into the area, eliminating voids, if the material doesn't require mechanical compaction. Construction of each lift should be repeated until the initial backfill zone is completed.

Flowable fill can be used throughout the pipe zone as an alternative to compacted granular material, however special precautions are necessary for a successful installation. Flowable fill may cause the pipe to float or misalign. Therefore the pipe will need to be weighted with sandbags or held with some type of anchoring system. The flowable fill may also be poured in layers that are allowed to cure before the next layer is poured to help reduce the tendency for the pipe to float. As with any backfill material, proper installation of the flowable fill around the pipe is critical to the structural performance of the pipe. For additional information on the use of flowable fill, refer to Technical Note 5.02: *Flowable Fill Backfill for Pipe*.

Final Backfill

Final backfill, which extends from the initial backfill layer to the ground surface, does not directly support the pipe. Excavated materials may be of adequate quality for final backfill, depending on the intended use at the surface. Selection, placement and compaction of final backfill shall be as directed by the design engineer. When placing final backfill, consideration needs to be given to compaction equipment and construction loads operating over top of the pipe. Proper compaction of the final backfill area is not nearly so critical for the pipe as in the other layers; however, if roads or drives will be crossing the pipe, a relatively high degree of compaction is needed to prevent pavement settlement.

Minimum Cover

For traffic applications total minimum cover is 12-inches (0.3m) for single run applications for 4- to 48-inch (100mm-1200mm) diameters pipe. For 54- and 60-inch (1350mm and1500mm) diameter pipe total minimum cover is 24-inches (0.6m) for single run applications. Total minimum cover is measured from top of pipe to bottom of flexible pavement or to top of rigid pavement.

When no pavement will be installed, but vehicle traffic is expected (e.g. gravel driveway), a total minimum cover of 18-inches (0.5m) for 4- to 48-inch (100-1200mm) diameters and 30-inches (0.8m) for 54- and 60-inch (1350mm and 1500mm) diameters is recommended to minimize rutting. If the ground surface is truly green space or a landscape area, minimum cover may be 12-inches (0.3m) from top of pipe to ground surface for all diameters. These recommendations assume the pipe is installed in accordance with manufactures recommendations and may not address the cover needed to prevent flotation.

Table 5-3
General Recommendations for Installation and Use of Soils and Aggregates[1]

Backfill Zone	Class 1	Class 2	Class 3[2]
General Restrictions	Acceptable and common where no migration is probable or when combined with a geotextile filter media.	Where hydraulics gradient exists check gradation to minimize migration.	Do not use where water condition in trench may cause instability and/or prevent proper placement and compaction..
Foundation	√ Suitable as foundation and for replacing over-excavated and unstable trench bottoms as restricted above and as directed by design engineer.	√ Suitable as foundation and for replacing over-excavated and unstable trench bottoms as restricted above and as directed by design engineer.	√ Suitable as foundation and for replacing over-excavated and unstable trench bottoms as restricted above and as directed by design engineer.
Bedding	√ *- 4" for 12"-24" pipe* *6" for 30" to 60" pipe* *- Loosely place middle 1/3*OD with remainder compacted*	√ *- 4" for 12"-24" pipe* *6" for 30" to 60" pipe* *- Loosely place middle 1/3*OD with remainder compacted*	√ *- 4" for 12"-24" pipe* *6" for 30" to 60" pipe* *- Loosely place middle 1/3*OD with remainder compacted*
Haunch	√ *- Work in around pipe by hand to provide uniform support* *- knife in to remove any voids*	√ *- Work in around pipe by hand to provide uniform support* *- knife in to remove any voids*	√ *- Work in around pipe by hand to provide uniform support* *- knife in to remove any voids*
Initial Backfill	√ *- knife in to remove any voids*	√	√
	For compaction and material recommendations, refer to product-specific guidelines in Appendix A-5, Table A-5-2		
Relative Compaction Effort	Low	Moderate	High
	For compaction and material recommendations, refer to product-specific guidelines in Appendix A-5, Table A-5-2		
Final Backfill	√ *- Place and compact as required by the engineer*	√ *- Place and compact as required by the engineer*	√ *- Place and compact as required by the engineer*

√ = Material may be suitable. Ultimately, the design engineer must determine the acceptable backfill material based on specific project conditions and structural requirements for the product.

1) Refer to Table 5-2 for more complete soil requirements.
2) Class 3 is not recommended for all products. Refer to Appendix A-5, Table A-5-2A & B for product-specific recommendations.

COMPACTION

The level of compaction will vary depending on the material and installation requirements, see product specific guidelines in Appendix A-5, Table A-5-2 for minimum compaction requirements based on soil type and application. Crushed stone or similar materials are usually not compacted, but do require care during installation to eliminate large voids in the backfill envelope. Using a shovel to 'slice' or ‘knife’ the material under and around the pipe is many times sufficient.

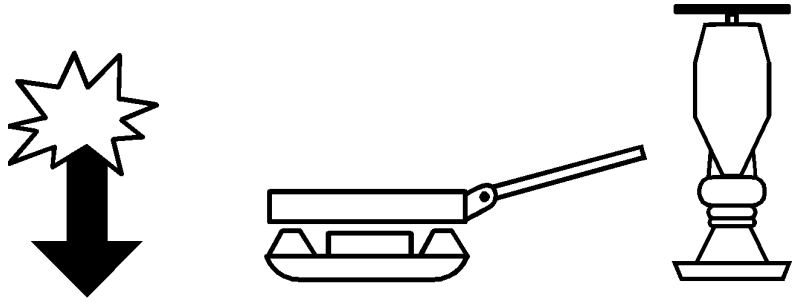
For other materials, compaction methods will depend primarily on the amount of compaction, or modulus of soil reaction, required and the moisture level of the material. At optimum moisture levels, some Class II and III soils can be compacted to minimum recommended levels simply by walking on each backfill lift. While this technique may not be acceptable for all installations, the point is that compaction need not always require a great deal of extra effort or mechanical equipment. If, however, mechanical compaction equipment is needed in the backfill envelope or elsewhere on the site, the subsequent paragraphs provide guidance on compaction equipment and the soils for which they are most appropriate.

MECHANICAL COMPACTION EQUIPMENT

Hand Tampers and Hand-Held Power Tampers: Compaction of the haunch layer may require a small tamping mechanism to obtain the specified compaction in a confined area. A hand-held pole or two-by-four can be used to compact the haunching. Tampers for horizontal layers shall not weigh more than twenty pounds (89N) and the tamping face shall be limited to an area no larger than 6-inch by 6-inch (0.15 by 0.15m).

Rammers or rammer plates (Figure 5-3): Impact action is used to force out air and water from between soil particles to consolidate the fill. This equipment works well on cohesive or high-clay content soils. Care should be taken not to use rammer-type compactors directly on the pipe. For heavy-duty compaction equipment, such as a Ho-pac® or equivalent type compactors, a minimum of 4-feet (1.2m) of backfill shall separate the pipe from the equipment at all times.

Figure 5-3
Rammer Compactors

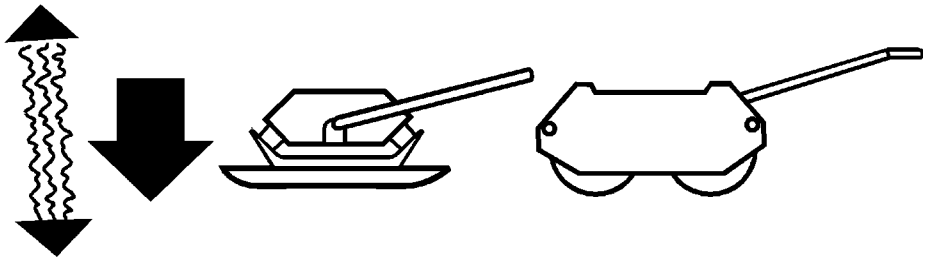


Static Compactors (Figure 5-4): Consolidation with static compactors occurs as a result of the rolling weight of the equipment itself. Sheeps-foot rollers employ projecting feet to concentrate the weight of the machine. Static compactors are most valuable when used on non-cohesive backfill away from the pipe. Other methods of compaction should be used near the pipe.

Figure 5-4
Static Compactors

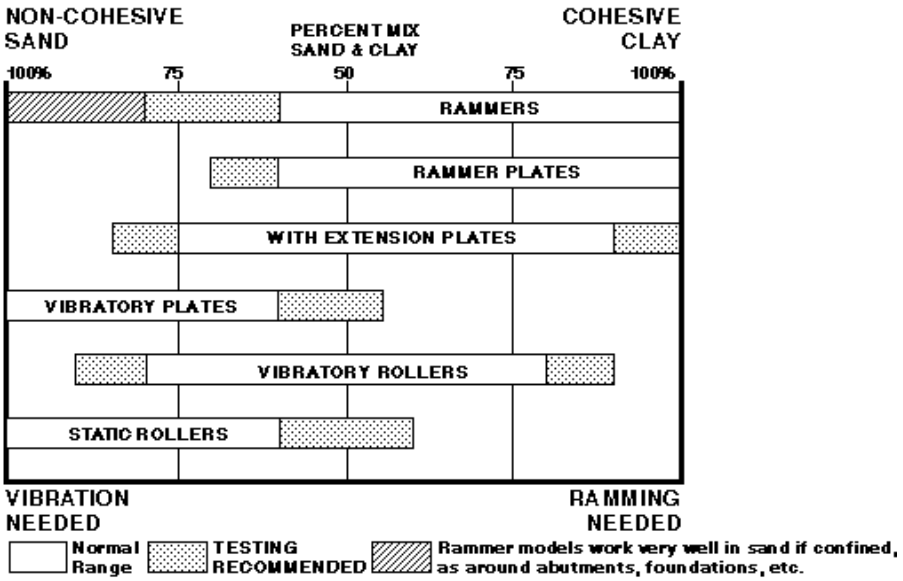
Vibrating Compactors (Figure 5-5): The motion of vibrating rollers or plates "shake" the soil particles into a more dense arrangement and works best with non-cohesive fills. Depending on the size and weight of the machine, vibrating compactors may be used close to the pipe. As always, care should be taken not to impact the pipe directly with a great deal of force.

Figure 5-5
Vibrating Compactors



Selecting the right equipment for the fill material is the key to achieving the most efficient compaction. For soil mixtures, the component having the highest percentage will dictate what type of compaction equipment is needed. Table 5-4 provides guidance in the selection of compaction equipment.

Table 5-4
Compaction Equipment Selection Guide



5-6 JOINTS

Joints serve several purposes in a pipe system. Their primary purpose is to preserve the structural integrity by keeping the embedment material out of the system. Well-designed joints also preserve the hydraulic properties of the pipe by maintaining alignment between pipe ends. Joints can keep effluent inside the pipe, which is necessary when environmental issues are a concern. Site-specific requirements or local regulations will usually dictate the performance of joint required. Joint configuration details are available in the respective product specification located in Section 1.

N-12 PLAIN END (SOIL-TIGHT COUPLERS)

ADS N-12 plain end pipe joint use external coupling bands, such as a split band coupler, that meet the soil-tight requirements of AASHTO M252, AASHTO M294 , ASTM F2306, CSA B182.8, or BNQ 3624-120. Typically, soil-tight joints are used with perforated systems where soil migration is not a design concern.

N-12 ST IB (GASKETED SOIL-TIGHT COUPLERS)

The N-12 ST IB joining system is designed to perform in demanding soil conditions. The gasket meets all the testing requirements of ASTM F477. The gasket, combined with an interference fit, provides outstanding joint performance meeting or exceeding the soil-tight joint performance requirements of AASHTO M252, AASHTO M294, ASTM F2306, CSA B182.8, or BNQ 3624-120.

N-12 WT IB (GASKETED WATERTIGHT COUPLERS)

The ADS 4- through 60-inch (100mm - 1500mm) N-12 WT IB joint meets the watertight joint performance requirements of AASHTO M252, AASHTO M294, ASTM F2306, CSA B182.8, and BNQ 3624-120. This joint shows no leakage when pressurized to 10.8 psi (74.5 kPa) under the laboratory conditions established in ASTM D3212.

This level of watertightness is recommended for systems that require a very tight joint for normal storm drainage conditions or other site and/or environmental reasons.

HP STORM (GASKETED WATERTIGHT COUPLERS)

The ADS 12- through 60-inch (300mm - 1500mm) N-12 HP meet the watertight joint performance requirements of ASTM D3212. This joint shows no leakage when pressurized to 10.8 psi (74.5 kPa) under the laboratory conditions.

This level of watertightness is recommended for systems that will be pressure tested, or that require a very tight joint for other site and/or environmental reasons.

SANITITE (GASKETED WATERTIGHT COUPLERS)

The ADS 24- through 60-inch SaniTite joint meet the watertight joint performance requirements of AASHTO M252, AASHTO M294, ASTM F2306, CSA B182.8,and BNQ 3624-120. This joint shows no leakage when pressurized to 10.8 psi (74.5 kPa) under the laboratory conditions established in ASTM D3212.

This level of watertightness is recommended for systems that will be pressure tested to sanitary sewer standards, or that require a very tight joint for other site and/or environmental reasons. A longer bell design and two gaskets are used for SaniTitie pipe.

SANITITE HP (GASKETED WATERTIGHT COUPLERS)

The ADS 12- through 60-inch SaniTite HP joint meet the watertight joint performance requirements of ASTM D3212. This joint shows no leakage when pressurized to 10.8 psi (74.5 kPa) under the laboratory conditions established in ASTM D3212.

This level of watertightness is recommended for systems that will be pressure tested to sanitary sewer standards, or that require a very tight joint for other site and/or environmental reasons. A longer bell design and two gaskets are used for SaniTitie HP pipe.

N-12 LOW HEAD (GASKETED WATERTIGHT COUPLERS)

The ADS 24- through 60-inch (600mm - 1500mm) N-12 Low Head IB joint meet the watertight joint performance requirements of AASHTO M252, AASHTO M294, and ASTM F2306. This joint shows no leakage when pressurized to 10.8 psi (74.5 kPa) under the laboratory conditions established in ASTM D3212.

This level of watertightness is recommended for systems that will be under continuous pressures less than 5psi and surge pressures of 10psi or that require a very tight joint for other site and/or environmental reasons. A longer bell configuration with two gaskets is used for N-12 Low Head pipe.

Guidelines for deciding what joint performance is appropriate in a particular application are provided in Table 5-5.

Table 5-5
Guidelines for Joint Performance Selection

Joint Performance Options					
Project Conditions	**Soil Tight**		**Water Tight**		
	N-12 Plain End (4”-30”)	**N-12 ST IB Gasketed (4”-60”)**	**N-12 WT IB (4”-60")**	**HP STORM SaniTite or SaniTite HP** (12”-60”)	**N-12 Low Head (24”-60”)**
SOIL FACTORS					
Potential for small or negligible soil migration (e.g., gravel, medium to coarse sands, cohesive soil).	√	√	√	√	√
Potential for moderate soil migration (e.g., fine sands, silts).	N/R	√	√	√	√
Potential for severe soil migration (e.g., very fine sands, non-cohesive fines).	N/R	N/R	√	√	√
EFFLUENT CONDITIONS					
Effluent is permitted to infiltrate into ground; poses little or no environmental concern.	√	√	√	√	√
Effluent has potential to cause groundwater or other contamination.	N/R	N/R	√	√	√
PRESSURE CONDITIONS					
Installation will operate under non-pressure conditions.	√	√	√	√	√
Installation will operate under non-pressure conditions; minimized leakage desired.	N/R	√	√	√	√
Installations with low temporary pressures due to operational events and ASTM D3212 joint quality required. Installed system to be hydrostatic pressure tested with an associated leakage allowance.	N/R	N/R	√	√	√
Installations with continuous pressure (≤5psi) or frequent surge pressure (≤10psi)	N/R	N/R	N/R	N/R	√

√ The most restrictive of the project conditions will ultimately determine minimum joint quality. Ultimately, the design engineer must determine the acceptable joint quality for the project.

N/R Not recommended by manufacturer. Final approval contingent on design engineer.

Where more than one product or joint design will be acceptable in a particular installation, the most cost effective alternative should be selected. Bell-and-spigot joints shorten installation duration and reduce

labor because they require little time and effort to assemble; the result can be significant overall cost savings.

5-7 OTHER INSTALLATION CONSIDERATIONS

Not all drainage projects can be considered "typical" installations. Unusual soil conditions cannot always be found until the actual excavation is made. More complicated pipe configurations may be needed to arrive at the desired drainage pattern or to increase the capacity of an existing drainage network. ADS cannot anticipate all situations encountered on specific installations; however, several common questions are answered in the following material. Contact the ADS Applications Engineering Department or visit our website at www.ads-pipe.com for answers to other unique conditions.

CONSTRUCTION AND PAVING EQUIPMENT

Some construction vehicles, such as many types of paving equipment, are not as heavy as the design load. For situations with relatively light construction vehicles, the minimum cover criteria discussed in Section 2: *Structures* can be decreased during the construction phase; however, rutting may still occur at the surface. Table 5-6 presents the surface applied loads and the corresponding minimum cover that can be permitted on a temporary basis. *These criteria should only be employed during construction; finished projects should always meet minimum cover requirements for the anticipated final-use loading conditions. Vehicles exceeding criteria in Table 5-6 must not be permitted to drive over the installation.*

Table 5-6
Temporary Cover Requirements for Light Construction Traffic

Type of Vehicle	Vehicular Load at Surface, psi(kPa)	Temporary Minimum Cover, in (mm) for:	
		4"-48" (100mm-12mm) Pipe	54"-60" (1350mm-1500mm) Pipe
Semi-tractor[1]	75 (517)	9 (230)	12 (300)
Loaded pick-up truck[2]	50 (345)	6 (150)	9 (230)
Skid steer loader[3]	25 (172)	3 (80)	6 (150)

1. Based on typical 3-axel day-trip tractor without trailer.
2. Chevy® 3500 Series, fully loaded
3. Bobcat® T180 Model skid steer loader

Very heavy construction traffic poses additional concern for buried flexible pipe when buried at shallow depths. The extremely high loads created by construction vehicles can potentially reduce the safety factors below reasonable levels in minimum cover conditions. It is recommended that three feet (0.9m) of cover be used over the pipe in installations involving construction vehicles between 30T and 60T (267-534kN). For heavier vehicles a greater amount cover is required. The amount of cover is dependent on the load and loading footprint. This additional cover can

simply be mounded and compacted over the pipe during the construction phase and then graded following construction. If, in a particular installation the pipe already has minimum amounts of cover, no additional precautions are needed.

JOINING DIFFERENT PIPE TYPES OR SIZES

Drainage systems often involve connecting pipe of different materials or sizes. Options to make these transitions are often limited by the joint quality required. One very common method of connecting different types of pipe of the same size, and in some cases different sizes, is through the use of a concrete collar. This generally provides a minimum silt-tight joint quality but ultimately depends on workmanship. A concrete collar is formed by butting the two pipe ends together, wrapping the junction with a geotextile to keep out most soil and concrete, and then pouring a concrete collar that covers both pipe ends.

Another option may be using fittings or adapters specifically designed for this application. ADS offers a selection of fittings designed to make the transition from one material directly to another. In other cases an ADS fitting may need to be used in combination with another manufacturer's gasket to complete the transition. Transitions made in this manner may be more watertight than a concrete collar.

FIELD CONNECTIONS

Field connections may be necessary to complete pipe runs for short pipe lengths or for repairs to pipe damaged during construction. Field connections and repairs should be performed with couplers compatible to the overall system. See Technical Note 5.03, 5.12 and 5.13 for *Thermoplastic Pipe Repair Options* for more details on field cuts and connections.

CURVILINEAR INSTALLATIONS

ADS pipe can be laid on a curved alignment as a series of tangent (straight sections) deflected horizontally at each joint. However, the amount of joint articulation is dependent on the type of joint selected. See Table 5-7 for minimum bend radii based on joint type.

Table 5-7
Bend Radii for ADS Thermoplastic Pipe

Pipe Diameter, In (mm)	Joint Type	Maximum Deflection at Joint (deg)	Radius, ft (m), per pipe length		
			10 ft (3m)	13 ft (4m)	20 ft (6m)
4 – 36 (100 – 900)	N-12 (split band or bell-bell couplers)	3	191 (58)	248 (76)	382 (116)
42 – 60 (1050 – 1500)	N-12 (split band or bell-bell couplers)	1.5	382 (117)	497 (152)	764 (233)
4 – 24 (100 – 600)	N-12 ST IB or N-12 WT IB (bell & spigot)	1.5	n/a	497 (152)	764 (233)
30 – 60 (750 – 1500)	N-12 ST IB or N-12 WT IB (bell & spigot)	1	n/a	745 (227)	1146 (349)
12 – 60 (300 – 1500)	HP STORM, SaniTite, SaniTite HP or Low Head, (extended bell & spigot)	3	n/a	248 (76)	382 (116)

Bend radii calculated with joint articulations only. Calculations do not assume any bend in the pipe wall. Joint deflections based on joint profiles and accounts for possible field variances.

MANHOLE AND CATCH BASIN CONNECTIONS

Manholes and catch basins can be more costly than other alternatives but also allow grade and directional changes in addition to changes in pipe material and size. Consideration shall be given to the project performance specified when selecting manhole connections. For connection options, refer to Appendix A, Table A-5-1 for list of list of technical literature associated with the appropriate product.

VERTICAL INSTALLATIONS

ADS thermoplastic pipe is sometimes installed vertically for use as catch basins or manholes, meter pits, and similar applications. Vertical installations do not behave the same as pipe that is installed horizontally because the pipe/soil interaction is different. The soil surrounding a vertical pipe locks into the corrugations, allowing the pipe to move along with the soil consolidation that occurs over time. This movement can cause a rippling of the interior liner that generally does not affect the performance of the finished installation.

Installation requirements are especially important for vertical installations. Backfill material and compaction levels will determine the performance of the finished installation. Backfill shall extend a minimum of one-foot (0.3m) completely around the vertical structure. Only Class 1 or 2 backfill material is recommended and should be compacted to minimum 90% SPD.

Additional general applications limits include the following:

- Height of the vertical structure must not exceed eight feet (2.4m), unless the design is reviewed by the ADS Application Engineering Department.

- If traffic will be driving over a vertical structure, a concrete collar or similar structure designed to transmit the load into the ground must be used. Traffic loads must *not* be transmitted directly into the pipe wall.
- Cast iron frames holding grates or lids must be seated on a concrete collar or similar structure so that the weight of the frame and grate or lid is transferred into the ground, *not* to the vertical pipe.

Vertical installations of any ADS fitting should first be reviewed for suitability with ADS Application Engineering. This includes, but is not limited to, tees, elbows, and reducers of any combination. Improper application or inadequate installation may affect the function of the part or the drainage system. There may also be other product performance limits depending on the application. Contact ADS for further information.

GROUNDWATER

Excessive groundwater hinders proper placement and compaction of bedding and backfill. ADS thermoplastic pipe will float in standing water; therefore, it is imperative that a dry trench be provided. In order to insure a stable trench bottom, the water level in the trench shall remain below the bedding during the installation procedure. It may be necessary to provide sump pumps, well points, deep wells, geofabrics, underdrains or a diversion ditch to insure a dry trench. The project engineer shall be consulted to determine appropriate dewatering methods given specific project conditions.

FLOTATION

Pipe of any material and size can float under the right conditions. The soil type and density, amount of cover, height of the water table, pipe weight, and the amount of effluent in the pipe will all have an effect on the flotation potential.

The pipe property affecting flotation is its weight where heavier products are not as likely to float. One of the primary installation benefits of ADS polyethylene pipe is its light weight. The same quality that provides easy handling and installation also provides it with a greater opportunity to float. Table 5-8 gives approximate weights by inside diameter for ADS thermoplastic pipes.

Table 5-8
Approximate Weight of ADS Thermoplastic Pipes

Inside Diameter in (mm)	Approximate Weight* lb/ft (kg/m)		
	Single Wall	**Dual Wall**	**Triple Wall**
4(100)	0.31 (0.46)	0.44 (0.65)	N/A
6(150)	0.58 (0.86)	0.85 (1.3)	N/A
8(200)	1.2 (1.8)	1.5 (2.2)	N/A
10(250)	1.8 (2.7)	2.3 (3.4)	N/A
12(300)	2.9 (4.3)	3.3 (4.9)	N/A
15(375)	4.0 (5.9)	4.6 (6.8)	N/A
18 (450)	6.0 (8.9)	6.4 (9.5)	N/A
24 (600)	11.2 (16.7)	11.0 (16.4)	N/A
30 (750)	N/A	15.4 (22.9)	20.7 (30.8)
36 (900)	N/A	19.8 (29.4)	24.2 (36.0)
42 (1050)	N/A	26.4 (39.3)	N/A
48 (1200)	N/A	31.3 (46.6)	41.8 (62.3)
54 (1350)	N/A	34.6 (51.5)	N/A
60 (1500)	N/A	45.2 (67.3)	55.0 (81.9)

* Weights are for reference purposes only. Actual values will vary. For product-specific weights, contact an ADS Representative

In order to evaluate for possible flotation problems many factors were considered and several assumptions had to be made based on typical installation conditions. A detailed list of the design assumptions and other design considerations are available in Technical Note 5.05: *Pipe Flotation*. A summary of the fill required to prevent flotation is shown in Table 5-9. Note that in many cases, less than one foot (0.3m) is needed to prevent flotation but for structural purposes, minimum cover requirements will be greater based on pipe diameter and loading conditions. Due to many factors affecting flotation, several assumptions had to be made. For a detail list of the assumptions made, please refer to Technical Note 5.05: *Pipe Flotation*.

In spite of their light weight, ADS products will not float when adequate cover is placed on the pipe. Additionally, if effluent were in the pipe, as would be likely in the case of a fully saturated soil, its weight would further hinder flotation.

A second very important variable is the burial depth. During installation when the pipe has not yet been covered over with soil, flotation potential increases. If conditions on a specific project differ greatly from these and flotation is believed to be a valid consideration, ADS Application Engineers are available to help determine the extent of the problem.

Table 5-9
Minimum Cover Required to Prevent Flotation

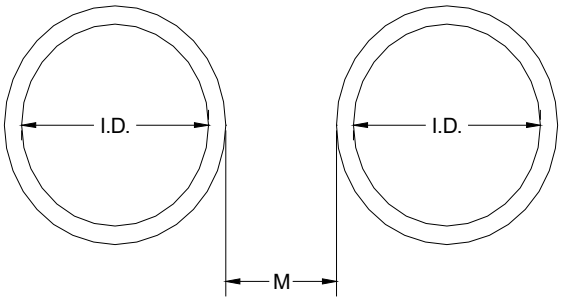
Diameter in. (mm)	Cover in. (mm)	
	Single Wall	Dual or Triple Wall
4 (100)	3 (77)	3 (77)
6 (150)	4 (102)	4 (102)
8 (200)	6 (152)	5 (127)
10 (250)	7 (178)	7 (178)
12 (300)	9 (229)	9 (229)
15 (375)	11 (280)	11 (280)
18 (450)	13 (330)	13 (330)
24 (600)	17 (432)	17 (432)
30 (750)	N/A	22 (559)
36 (900)	N/A	25 (635)
42 (1050)	N/A	29 (737)
48 (1200)	N/A	33 (838)
60 (1500)	N/A	40 (1016)

PARALLEL PIPE INSTALLATIONS

Sewer pipes can be installed parallel when the capacity supplied by one of the pipes is not sufficient, such as in a relief situation.

A minimum amount of backfill is needed to provide adequate side support and a minimum spacing is also needed to compact the fill properly to develop this support. Generally, accepted minimum spacings are shown in Figure 5-6. These recommendations assume there are no fittings connecting the two adjacent runs; if fittings are used, spacing recommendations will differ and are outlined in Section 6: *Retention/Detention.*

Figure 5-6
Minimum Pipe Spacing



UP TO 24" (600mm) I.D.: M=12" (0.3mm)
MORE THAN 24" (600mm) I.D.: M=½ I.D.

STEEP SLOPE INSTALLATIONS

In applications where a steep slope is necessary, generally slopes equal to or greater than 12%, precaution must be taken to ensure the application conditions will not adversely affect the pipe structure or flow characteristics. One design consideration should be proper venting. The pipe must be properly vented to ensure negative pressure does not form inside the pipe. Venting can be provided along the pipe slope, at the head of the slope, or by designing the flow in the slope to not flow more than 75% full in peak design flow conditions. Next, thrust blocks must be used at all fittings and grade changes. Change in flow direction can cause excessive force against the pipe wall; therefore thrust blocks must be used to dissipate this energy. Thrust blocks should be constructed as designed and specified by the project engineer for the specific project conditions. Finally, consideration must be given to pipe slippage along the slope. Pipe slippage can result in slope failure of the surrounding soil, structural damage of the pipe wall, or compromising of joint quality for the overall system. Pipe should be restrained through the use of concrete blocks or pipe anchors.

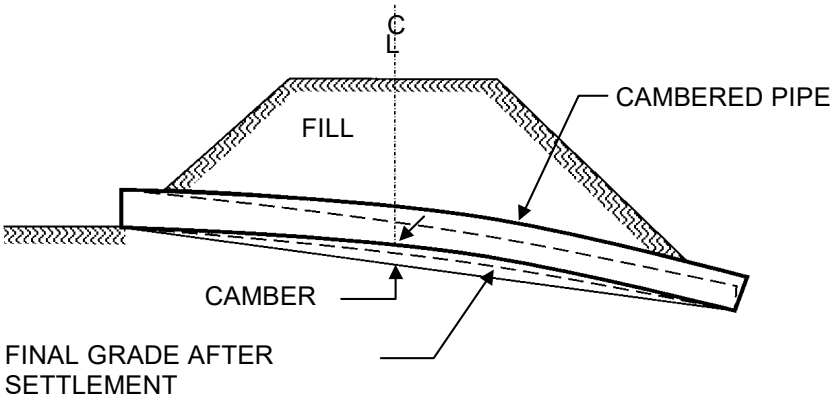
Note: Twelve percent grade is listed for reference purposes only, additional design consideration may be necessary for slopes less than 12% where slope stabilization, negative pressure, or water hammer, may be of concern.

CAMBERED INSTALLATIONS

Some pipe installations may need to design for uneven settlement regardless of the backfill envelope quality and construction. High embankments are especially prone to uneven settlement because the load on the pipe near the center of the embankment will be greater than at the top of the slope. In order to eliminate low pockets under the embankment, the pipe should be cambered.

Cambering is the process of installing the pipe so that the expected settlement will create the design slope. It can be achieved by installing the upstream half of the pipe on a flat grade and downstream half on a grade that is larger than design, as shown in Figure 5-7. Corrugated pipe, because of its flexibility, can be cambered quite easily. A qualified soils engineer should be consulted for this specialized situation.

Figure 5-7
Cambered Pipe Installations



SLIPLINING

Due to abrasive or corrosive environments, premature deterioration of some types of pipe may occur. In lieu of a total replacement, sliplining the existing pipe with ADS thermoplastic pipe is often an economical and efficient way to significantly extend a culverts' service life. Typically, ADS thermoplastic pipe can only be used for open-ended applications where the pipe does not need to be bent for installation. Other considerations during design and pre-construction should include the inside and outside diameter of the carrier pipe and new slipline pipe, length of installation and grout installation. For more information, refer to Technical Notes 5.06, and 5.14, *Sliplining Considerations* for more details.

POST-CONTRUCTION INSPECTION

Generally, no post construction is necessary for ADS pipe installations; however it is good practice to perform a visual inspection to insure proper line and grade have been achieved. It is important to understand that under normal conditions, any deflection will be realized within the first thirty (30) days after installation. This affords the inspector the opportunity to inspect the pipe shortly after installation with the ability to note deficiencies before the project is complete. The inspection should be performed after the pipe has been laid and backfilled, but may be before final paving has been placed.

The following outlines various inspection methods commonly specified for flexible pipes (plastic or metal). Additional post-installation inspection and testing information is available in Technical Note 5.07: *Post Installation Testing for HDPE Pipe,* Technical Note 5.08: *Laser Profiling of Flexible Pipe,* 5.17: *Post Installation Testing SaniTite HP Pipe and* 5.20: *Post Installation Testing of HP Storm*

Visual Inspection

A visual inspection will usually reveal improper line and grade as well as excessive deflection. For most projects, which specify a soil-tight or silt-tight joint performance, a visual inspection is sufficient to insure a successful installation. Caution is advised when inspecting pipe or entering manhole or inlet structures to insure compliance with all OSHA regulations.

Infiltration/Exfiltration Testing

For systems designed for watertight applications without specifying any ASTM specification for testing, an infiltration/exfiltration test is a simple and easy method of insuring proper joint performance. For an exfiltration test, a run of piping is tested by filling the system with water from structure to structure (manhole or inlets), with appropriate bulk heads or pipe bladders to seal off the pipe from the structure. Allow the system to stabilize for 24 hours, measuring the water level at the beginning of the test and then measuring the water level again after a specified period of time. The drop in water level can then be converted to gallons leakage/ inch pipe diameter/ mile length of pipe /day and compared to the permissible level established for the project. In the absence of a specified level, 200-gal/ in. dia. of pipe/ mi of sewer/ day is commonly considered watertight for storm and sanitary sewer applications. An acceptable ASTM specification for testing infiltration/exfiltration is ASTM F2487.

Air Testing

After the pipe has been laid and backfilled, each section of the pipeline between manholes may be tested using standard procedures for a low pressure air test. Individual joints may also be tested with appropriate equipment. This test is usually for systems where performance standards require watertight joints. ASTM F1417 may be used for air testing these systems and shall be completed from structure to structure or for individual joints. Fabricated structures and fittings shall not be tested to avoid damaging these components.

ASTM F1417 specifies a 3.5 psi air pressure be held for a specified length of time based on the pipe diameter with a maximum 0.5 psi pressure drop. Although the diameters listed in ASTM F1417 only include up to 36-inch (900mm), linear interpolation for larger diameters is generally acceptable. Pipe diameters greater than 36-Inch shall be tested in accordance to ASTM F3058 *Preliminary field Testing of Thermoplastic Pipe Joints for Gravity Flow (Non-Pressure) Sewer Lines*.

5-8 APPENDIX A-5

Table A-5-1A
Available U.S. Product-Specific Technical Literature & Detail Drawings

	Storm Sewer			Sanitary Sewer		Irrigation
Product	N-12 Pipe per ASTM F2306 /AASHTO	N-12 Pipe & Mega Green per ASTM F2648	HP STORM	Sanitite®	Sanitite® HP	N-12 Low Head Pipe
Minimum & Maximum Cover	Technical Note 2.01	Technical Note 2.02	Technical Note 2.04	Technical Note 2.01	Technical Note 2.05	Technical Note 2.01
Trench Installation Details	STD-101	STD-101A	STD-101D, 101E	STD-101	STD-101F	STD-101
Connections to Manholes & Structures	200 Series	200 Series	200 Series	200 Series	200 Series	200 Series

Table A-5-1B
Available Canadian Product Specific Technical Literature & Detail Drawings

	Storm Sewer		Sanitary Sewer
Product	N-12 Pipe per CSA B182.8	Sanitite® HP	Sanitite® HP
Minimum & Maximum Cover	Technical Note 2.01C	Technical Note 2.05C	Technical Note 2.05C
Trench Installation Details	STD-101	STD-101F	STD-101F
Connections to Manholes & Structures	200 series	200 series	200 series

Table A-5-2A
Minimum Installation Requirements for ADS Thermoplastic Products (U.S.)

		AASHTO or ASTM F2306	ASTM F2648 or Mega Green	HP STORM for Storm Drainage	SaniTite & SaniTite HP for Sanitary Sewer	N-12 Low Head
Minimum Cover (≤2-ft) Backfill Recommendations	**Bedding**	Class 1, 2 or 3 loosely placed in middle 1/3, 90% SPD in remainder	Class 1 or 2 loosely placed in middle 1/3, 90% SPD in remainder	Class 1, 2 or 3 loosely placed in middle 1/3, 90% SPD in remainder	Class 1 or 2 loosely placed in middle 1/3, 90% SPD in remainder	Class 1 or 2 loosely placed in middle 1/3, 90% SPD in remainder
	Haunch & Initial Backfill	Class 1 Class 2 @ 90% Class 3 @ 90% SPD	Class 1 Class 2 @ 90% SPD	Class 1 Class 2 @ 90% Class 3 @ 90% SPD	Class 1 Class 2 @ 90% SPD	Class 1 Class 2 @ 90% SPD
Maximum Cover Backfill Recommendations	**Bedding**	Class 1, 2 or 3 loosely placed in middle 1/3, 90% SPD in remainder	Class 1, 2 or 3 loosely placed in middle 1/3, Class 1, 2 @ 90% or Class 3 @ 95% SPD in remainder	Class 1, 2, 3 or 4 loosely placed in middle 1/3, Class 1, Class 2 or Class 3 @ 90% or Class 4 @ 95% SPD in remainder	Class 1 or 2 loosely placed in middle 1/3, 90% SPD in remainder	Class 1, 2 or 3 loosely placed in middle 1/3, 90% SPD in remainder
	Haunch & Initial Backfill	Class 1 Class 2 @ 85% Class 3 @ 90% SPD	Class 1 Class 2 @ 90% Class 3 @ 95% SPD	Class 1 Class 2 @ 85% Class 3 @ 90% Class 4 @ 95% SPD	Class 1 compact Class 2 @ 90% SPD	Class 1 Class 2 @ 85% Class 3 @ 90% SPD

1) Table provides minimum compaction levels for the respective soil class; higher compaction levels than stated are acceptable and may be necessary depending on fill height.

2) For additional information, refer to the product specific Technical Note on minimum & maximum cover recommendations.

Table A-5-2B Minimum Installation Requirements for ADS Thermoplastic Products (Canadian)

		CSA B182.8	BNQ 1809
Minimum Cover (≤2-ft) Backfill Recommendations	Bedding	Class 1, 2 or 3 90% SPD	MG-20 or CG-14 @ 90% SPD
	Haunch & Initial Backfill	Class 1 Class 2 @ 90% Class 3 @ 95%	MG-20 or CG-14 @ 90% SPD
Maximum Cover Backfill Recommendations	Bedding	Class 1, 2 or 3 90% SPD	MG-20 or CG-14 @ 90% SPD
	Haunch & Initial Backfill	Class 1 Class 2 @ 90% Class 3 @ 90%	MG-20 or CG-14 @ 90% SPD

1) Table provides minimum compaction levels for the respective soil class; higher compaction levels than stated are acceptable and may be necessary depending on fill height.

2) For additional information, refer to the product specific Technical Note on minimum & maximum cover recommendations.

OTHER TECHNICAL RESOURCES

(APPLICABLE TO ALL ADS PRODUCTS)

ADS Technical Notes

Technical Note 5.01: *Recommended Use of Trench Boxes*

Technical Note 5.02: *Flowable Fill Backfill for Thermoplastic Pipe*

Technical Note 5.03: HDPE *Pipe Repair Options*

Technical Note 5.04: HDPE and HP *Connections to Manholes and Structures*

Technical Note 5.05: *Pipe Flotation*

Technical Note 5.06: Culvert *Sliplining with HDPE Pipe*

Technical Note 5.07: *Post-Installation Testing for HDPE*

Technical Note 5.08: *Laser Profiling of Flexible Pipe*

Technical Note 5.09: *Utility Crossings*

Technical Note 5.10: *Integral Bell Transition for HDPE*

Technical Note 5.11: *Sliplining Extended Lengths with HDPE Pipe*

Technical Note 5.12: *HP Storm Drainage Pipe Repair OPtions*

Technical Note 5.13: *SaniTite HP Sanitary Sewer Pipe Repair Options*

Technical Note 5.14: *Culvert Sliplining with HP Pipe*

Technical Note 5.15: *Integral Bell Transitions for HP Storm Pipe*

Technical Note 5.16: *Methods for Sealing Vent Tubes*

Technical Note 5.17: *Post Installation Testing of SaniTite HP*

Technical Note 5.18: *Lining of Casings with SaniTite HP Pipe*

Technical Note 5.20: *Post Installation Testing of HP Storm*

TECHNICAL NOTE

Minimum and Maximum Burial Depth for Single Wall Corrugated HDPE Pipe

TN 2.03
July 2009

Introduction

The information in this document is designed to provide answers to general cover height questions; the data provided is not intended to be used for project design. The design procedure described in the *Structures* section (Section 2) of the Drainage Handbook provides detailed information for analyzing most common installation conditions. This procedure should be utilized for project specific designs.

The two common cover height concerns are minimum cover in areas exposed to vehicular traffic and maximum cover heights. Either may be considered "worst case" scenario from a loading perspective, depending on the project conditions.

Minimum Cover in Traffic Applications

Pipe diameters from 3- through 24-inch (75-600 mm) installed in traffic areas (AASHTO H-25 or HS-25 loads) must have at least one foot (0.3m) of cover over the pipe crown. The backfill envelope must be constructed in accordance with the *Installation* section (Section 5) of the Drainage Handbook and the requirements of ASTM D2321. The backfill envelope must be of the type and compaction listed in Table 2-3 of the Drainage Handbook. In Table 1 below, this condition is represented by a Class III material compacted to 90% standard Proctor density, although other material can provide similar strength at slightly lower levels of compaction. Structural backfill material should extend six inches (0.15m) over the crown of the pipe; the remaining cover should be appropriate for the installation and as specified by the design engineer. If settlement or rutting is a concern, it may be appropriate to extend the structural backfill to grade. Where pavement is involved, sub-base material can be considered in the minimum burial depth. While rigid pavements can be included in the minimum cover, the thickness of flexible pavements should not be included in the minimum cover.

Additional information that may affect the cover requirements is included in the *Installation* section (Section 5) of the Drainage Handbook. Some examples of what may need to be considered are temporary heavy equipment, construction loading , paving equipment and similar loads that are less than the design load, the potential of pipe flotation, and the type of surface treatment which will be installed over the pipe zone.

Table 1
Minimum Cover Requirements for ADS Single Wall Highway and Heavy Duty Pipe with AASHTO H-25 or HS-25 Load

Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)
3 (75)	1 (0.3)
4 (100)	1 (0.3)
6 (150)	1 (0.3)
8 (200)	1 (0.3)
10 (250)	1 (0.3)

Inside Diameter, ID, in.(mm)	Minimum Cover ft. (m)
24 (600)	1 (0.3)
12 (300)	1 (0.3)
15 (375)	1 (0.3)
18 (450)	1 (0.3)

Note: Minimum covers presented here were calculated assuming Class III backfill material compacted to 90% standard Proctor density around the pipe and a minimum of 6-inches (0.15m) structural backfill over the pipe crown, as recommended in Section 5 of the Drainage Handbook, with an additional layer of compacted traffic lane sub-base for a total cover as required. In shallow traffic installations, especially where pavement is involved, a good quality compacted material to grade is required to prevent surface settlement and rutting.

Maximum Cover

Wall thrust generally governs the maximum cover a pipe can withstand and conservative maximum cover heights will result when using the information presented in the *Structures* section (Section 2) of the Drainage Handbook.

The maximum burial depth is highly influenced by the type of backfill and level of compaction around the pipe. General maximum cover limits for ADS Single Wall Highway and Heavy Duty pipes are shown in Table 2 for a variety of backfill conditions.

Table 2 was developed assuming pipe is installed in accordance with ASTM D2321 and the *Installation* section (Section 5) of the Drainage Handbook. Additionally, the calculations; assume zero hydrostatic load, incorporate the maximum safety factors represented in structures section of the Drainage Handbook, and assume the native soil is of adequate strength and is suitable for installation. For applications requiring fill heights greater than those shown in Table 2, contact the ADS Regional Engineering or Application Engineering departments.

Table 2
Maximum Cover for ADS Single Wall Heavy Duty and Highway Pipe, ft (m)

Diameter in (mm)	Class 1		Class 2			Class 3		
	Compacted	Dumped	95%	90%	85%	95%	90%	85%
4 (100)	41 (12.5)	13 (4.0)	27 (8.2)	18 (5.5)	13 (4.0)	19 (5.8)	13 (4.0)	11 (3.9)
6 (150)								
8 (200)	38 (11.6)	12 (3.7)	25 (7.6)	17 (5.2)	12 (3.7)	18 (5.5)	12 (3.7)	10 (3.0)
10 (250)								
12 (300)								
15 (375)								
18 (450)								
24 (600)	32 (9.8)	11 (3.4)	21 (6.4)	15 (4.6)	11 (3.4)	16 (4.9)	11 (3.4)	9 (2.7)

Notes:

1. *Results based on calculations shown in the Structures section of the ADS Drainage Handbook. Calculations assume no hydrostatic pressure and a density of 120 pcf (1926 kg/m^3) for overburden material.*
2. *Installation assumed to be in accordance with ASTM D2321 and the Installation section of the Drainage Handbook.*
3. *Backfill materials and compaction levels not shown in the table may also be acceptable. Contact ADS for further detail.*
4. *Material must be adequately "knifed" into haunch and in between corrugations. Compaction and backfill material is assumed uniform throughout entire backfill zone.*
5. *Compaction levels shown are for standard Proctor density.*
6. *For projects where cover exceeds the maximum values listed above, contact ADS for specific design considerations.*
7. *Calculations assume no hydrostatic pressure. Hydrostatic pressure will result in a reduction in allowable fill height. Reduction in allowable fill height must be assessed by the design engineer for the specific field conditions.*
8. *Fill height for dumped Class I material incorporate an additional degree of conservatism that is difficult to assess due to the large degree of variation in the consolidation of this material as it is dumped. There is limited analytical data on its performance. For this reason, values as shown are estimated to be conservatively equivalent to Class 2, 85% SPD.*

DRAIN BASIN INSTALLATION GUIDE

Nyloplast drain basins are custom built for each application. Our PVC products are more durable and corrosion-resistant than concrete or brick and mortar basins. With a faster installation, lower installed cost, and great field and project support teams, Nyloplast is the clear choice for your drainage needs.

FIELD ADJUSTMENTS:

- Nyloplast Basins are lighter weight than traditional precast and are safer to handle and install. They also require a much smaller footprint to store the materials on construction sites.
- Excavation around the structure is the same as the pipe trench width because Nyloplast Basins will allow for size on size pipe to structure connections unlike precast.
- Since it is very common for the actual elevation of the job site to deviate from the plans used to make a drain basin takeoff, Nyloplast drain basins are designed for easy adjustment in the field. In the event the elevation is less than expected, the drain basin can be cut down to size. If the elevation is greater than anticipated, we offer riser sections of up to 6' (1.8 m) in 1' (.3 m) increments, which can be used to extend a drain basin.

Part Number	Product Description
2908AG_ _	8" (200 mm) Riser Section
2910AG_ _	10" (250 mm) Riser Section
2912AG_ _	12" (300 mm) Riser Section
2915AG_ _	15" (375 mm) Riser Section
2918AG_ _	18" (450 mm) Riser Section
2924AG_ _	24" (600 mm) Riser Section
2930AG_ _	30" (750 mm) Riser Section

Note: Blanks are the riser's height, choose from 01-07 (one foot- two feet).

- Connecting pipes to Nyloplast structures in the field is made easy with "Add-A-Branch™" and INSERTA TEE® taps. Nyloplast will provide water tight connections to numerous types and diameters (4"-24" (100-600 mm)) of pipe in the field if angles or elevation changes occur.
- Installation of Nyloplast requires no additional grout work or curing time and install 3-4 times faster than traditional brick and mortor or precast structures.

Step-by-Step Process

STEP 1: Excavate Drain Basin location to depth. Provide a stone base. (Width of excavation can be the same width as pipe trench)

STEP 2: Set Drain Basin in place and level.

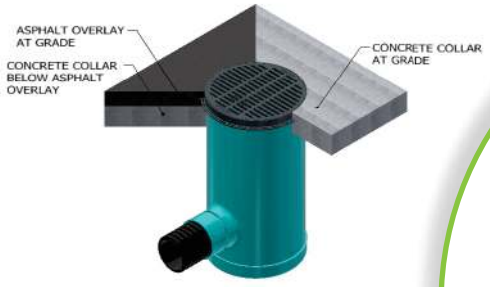
STEP 3: Install provided F-477 gasket for HDPE/PP corrugated pipe into last corrugation of the pipe. Lube the gasketed pipe and the inside of the drain basin bell.

STEP 4: Backfill the back side of structures and push the pipe home to the seat position. Re-check Drain Basin depth, level and position.

STEP 5: Backfill uniformly around structures with class I, II, or III material and compact in lifts according to ASTM D2321.

STEP 6: The drain basin body can be cut at the time of the final grade or raised with riser. No brick, stone or concrete block will be required to set the grate to the final grade height.

NOTE: For H-20 or heavier load rated installations, set elevation of frame and grate. Then pour a concrete collar around and knife flowable fill under edges to support the frame.



Try the Online Drain Basin Configurator at www.basinconfigurator.com. Create a custom drain basin in minutes and get the documentation needed to specify parts and get pricing.

Ask a local representative for a complete listing of specifications, details and pricing. Visit www.nyloplast-us.com or call 866-888-8479 for project support.

THE MOST **ADVANCED** *NAME IN WATER MANAGEMENT SOLUTIONS®*

Advanced Drainage Systems, Inc.
www.ads-pipe.com
www.nyloplast-us.com

Nyloplast®

Product Guide

*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

4DS®

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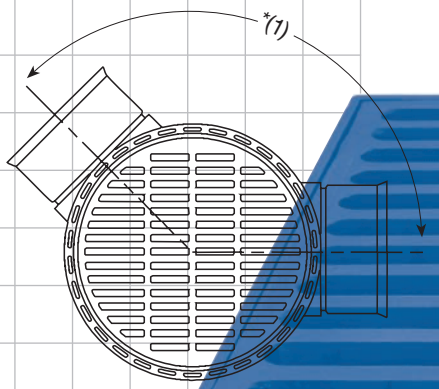
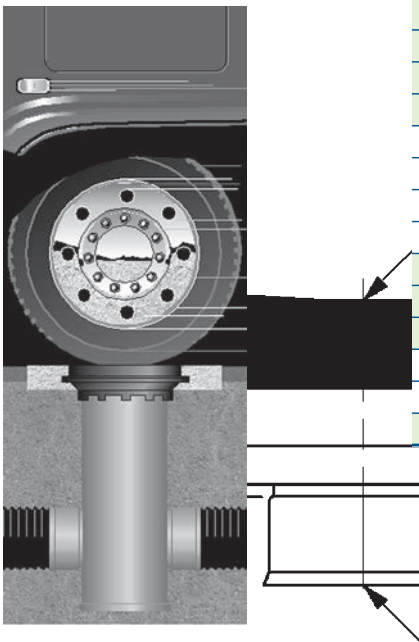


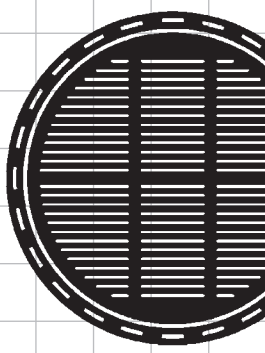
Quick Reference
Minimum Angle Chart

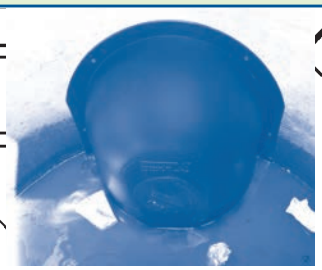
Minimum Angle Between Adapters

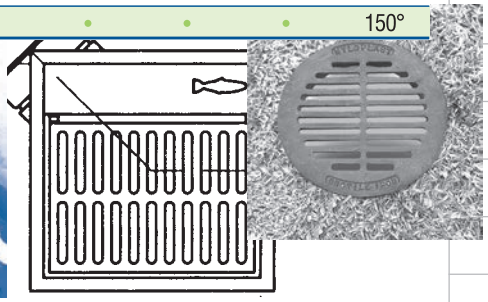
This chart is not for Snout or Weir Structures.
Contact Nyloplast for Snout and Weir Structure minimum angles.

Adapter Size	8" Basin Min Angle	10" Basin Min Angle	12" Basin Min Angle	15" Basin Min Angle	18" Basin Min Angle	24" Basin Min Angle	30" Basin Min Angle
4"-04"	70°	55°	50°	42°	35°	25°	24°
4"-06"	75°	70°	55°	47°	40°	29°	25°
4"-08"	100°	80°	65°	55°	45°	35°	28°
4"-10"	•	95°	75°	62°	52°	40°	32°
4"-12"	•	•	85°	70°	55°	45°	40°
4"-15"	•	•	•	80°	65°	51°	44°
4"-18"	•	•	•	•	76°	60°	50°
4"-24"	•	•	•	•	•	75°	62°
4"-30"	•	•	•	•	•	•	75°
6"-06"	90°	75°	65°	55°	44°	33°	30°
6"-08"	115°	85°	75°	63°	51°	39°	34°
6"-10"	•	105°	85°	70°	55°	43°	38°
6"-12"	•	•	95°	75°	63°	48°	45°
6"-15"	•	•	•	86°	72°	56°	48°
6"-18"	•	•	•	•	84°	63°	55°
6"-24"	•	•	•	•	•	77°	66°
6"-30"	•	•	•	•	•	•	75°
8"-08"	165°	90°	80°	70°	55°	44°	35°
8"-10"	•	115°	88°	76°	63°	48°	45°
8"-12"	•	•	102°	83°	70°	52°	48°
8"-15"	•	•	•	95°	78°	60°	55°
8"-18"	•	•	•	•	90°	70°	60°
8"-24"	•	•	•	•	•	82°	70°
8"-30"	•	•	•	•	•	•	80°
10"-10"	•	160°	90°	82°	70°	53°	48°
10"-12"	•	•	115°	85°	75°	58°	50°
10"-15"	•	•	•	103°	85°	65°	58°
10"-18"	•	•	•	•	97°	72°	65°
10"-24"	•	•	•	•	•	88°	75°
10"-30"	•	•	•	•	•	•	85°
12"-12"	•	•	150°	90°	82°	64°	56°
12"-15"	•	•	•	112°	87°	69°	60°
12"-18"	•	•	•	•	102°	78°	68°
12"-24"	•	•	•	•	•	92°	80°
12"-30"	•	•	•	•	•	•	90°
15"-15"	•	•	•	150°	90°	77°	69°
15"-18"	•	•	•	•	110°	84°	75°
15"-24"	•	•	•	•	•	98°	85°
15"-30"	•	•	•	•	•	•	96°
18"-18"	•	•	•	•	150°	90°	78°
18"-24"	•	•	•	•	•	108°	88°
18"-30"	•	•	•	•	•	•	100°
24"-24"	•	•	•	•	•	150°	90°
24"-30"	•	•	•	•	•	•	115°
30"-30"	•	•	•	•	•	•	150°







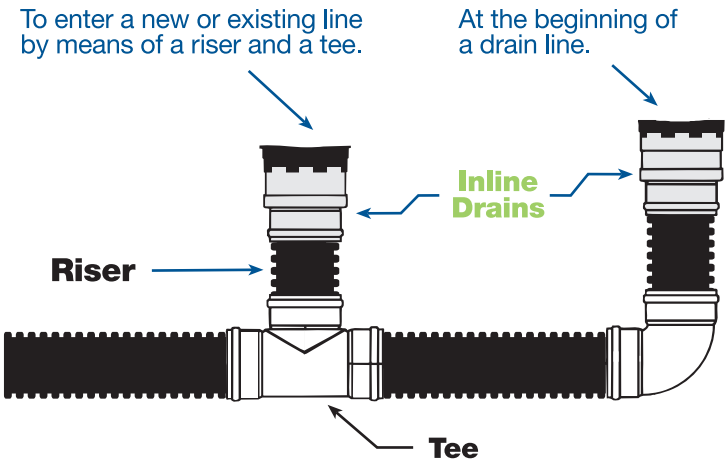


HOW DO YOU BUILD A PART NUMBER?
See page (32) for Inline Drains

Part#/Prefix	Product Description	Available Outlets
2708AG__X	8” Inline Drain	4” thru 8”
2710AG__X	10” Inline Drain	4” thru 10”
2712AG__X	12” Inline Drain	4” thru 12”
2715AG__X	15” Inline Drain	4” thru 15”
2718AG__X	18” Inline Drain	4” thru 18”
2724AG__X	24” Inline Drain	4” thru 24”
2730AG__X	30” Inline Drain	4” thru 30”

Includes any grate option except bronze and domed. Bronze grates are available in 8”, 10”, 12”, or 15” for Drain Basins and Inline Drains only.

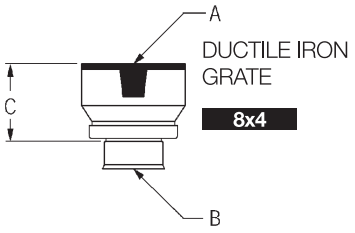
When are Inline Drains Used?

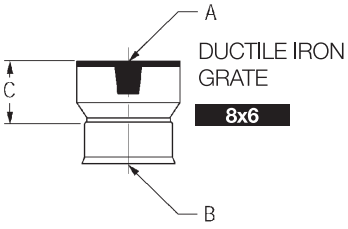


8” & 10” Inline Drains

Part#/Prefix	Product Description	Avaliable Outlets
2708AG__X	8” Inline Drain	4”thru8”
2710AG__X	10” Inline Drain	4”thru10”

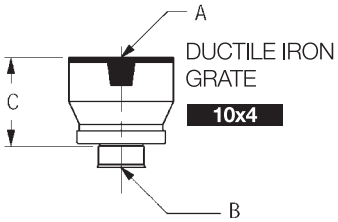
8” Inline Drains

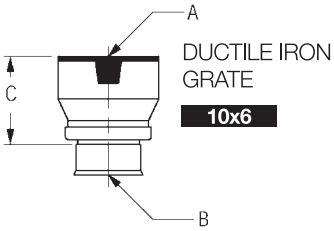


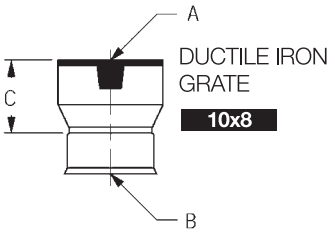


A	B	C
8"	4"	7.50"
8"	6"	5.25"
8"	8"	6.50"

10” Inline Drains





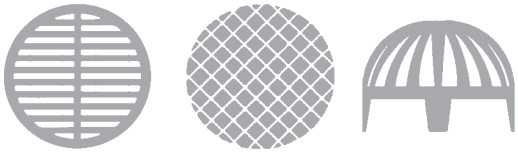


A	B	C
10"	4"	8.75"
10"	6"	8.75"
10"	10"	8.00"

8” & 10” Grate Options

Light Duty Bronze Grate Available (see pg. 24)

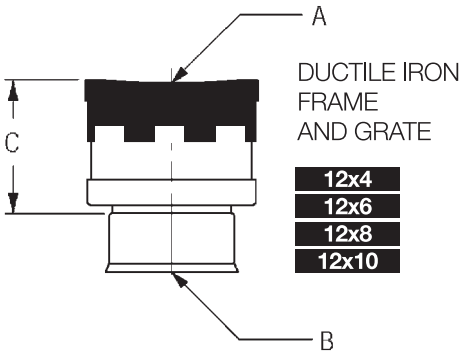
(see pg. 23 for detailed explanation)

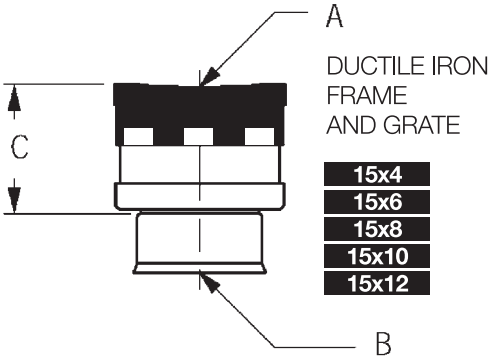


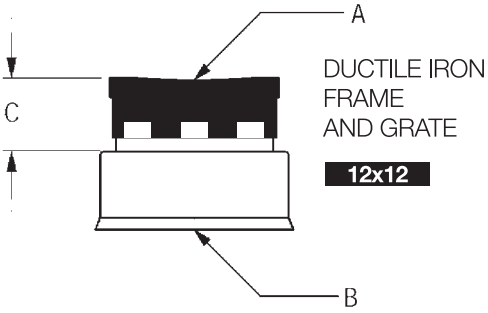
Standard Solid Domed

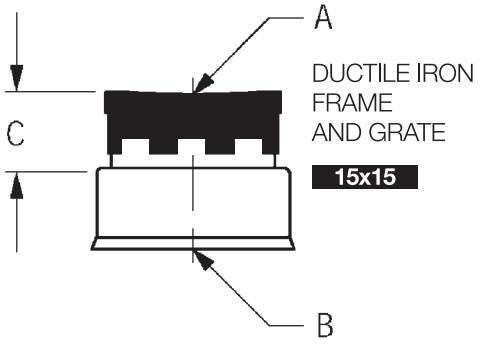
12" & 15" Inline Drains

Part#/Prefix	Product Description	Avaliable Outlets
2712AG__X	12" Inline Drain	4" thru 12"
2715AG__X	15" Inline Drain	4" thru 15"









A	B	C
12"	4"	10.50"
12"	6"	11.50"
12"	8"	11.50"
12"	10"	11.25"
12"	12"	6.00"

A	B	C
15"	4"	13.25"
15"	6"	12.75"
15"	8"	12.25"
15"	10"	13.50"
15"	12"	12.75"
15"	15"	7.00"

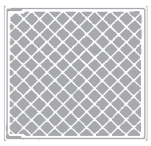
12" & 15" Grate Options

Light Duty Bronze Grate Available (see pg. 24)

(see pg. 23 for detailed explanation)

Standard H-20 Rated

Pedestrian H-10 Rated

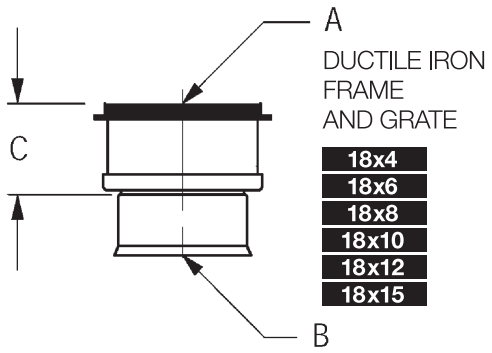


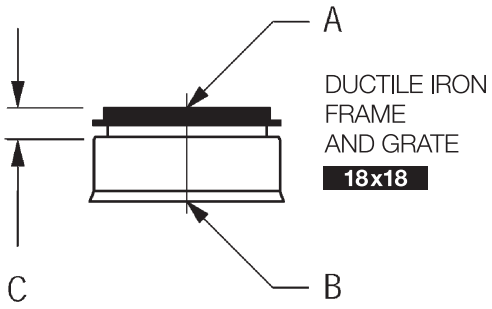
Solid

Domed

18" Inline Drains

Part#/Prefix	Product Description	Avaliable Outlets
2718AG__X	18" Inline Drain	4" thru 18"





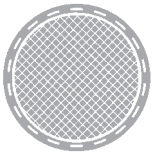
A	B	C
18"	4"	14.00"
18"	6"	14.00"
18"	8"	14.00"
18"	10"	14.00"
18"	12"	14.00"
18"	15"	13.50"
18"	18"	8.25"

18" Grate Options

(see pg. 23 for detailed explanation)

Standard
H-20 Rated

Pedestrian
H-10 Rated

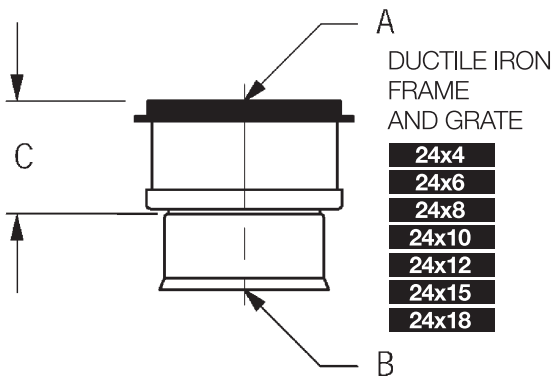


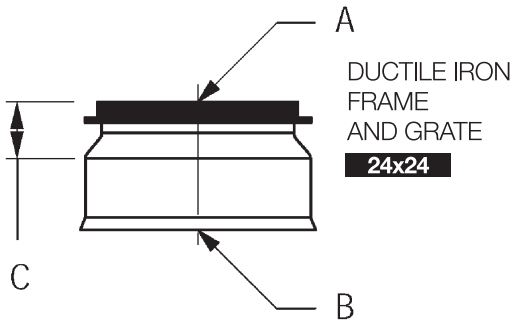
Solid

Domed

24” Inline Drains

Part#/Prefix	Product Description	Avaliable Outlets
2724AG__X	24” Inline Drain	4” thru 24”

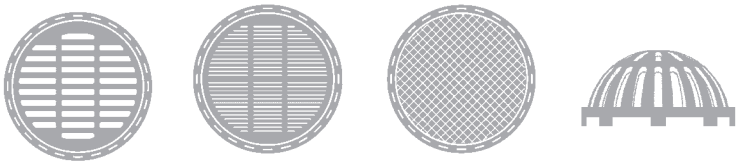




A	B	C
24"	4"	15.00"
24"	6"	15.00"
24"	8"	15.00"
24"	10"	15.00"
24"	12"	15.00"
24"	15"	15.00"
24"	18"	10.00"
24"	24"	10.25"

24” Grate Options

(see pg. 23 for detailed explanation)



Standard H-20 Rated

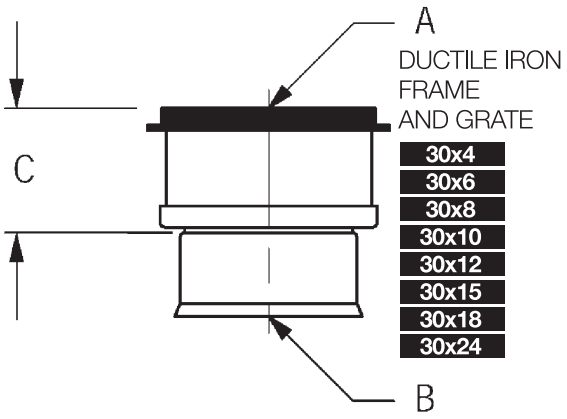
Pedestrian H-10 Rated

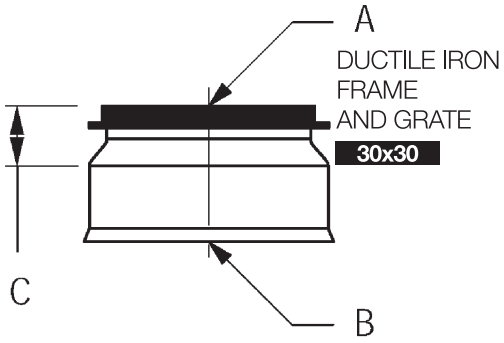
Solid

Domed

30” Inline Drains

Part#/Prefix	Product Description	Avaliable Outlets
2730AG__X	30” Inline Drain	4” thru 30”





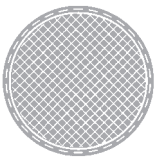
A	B	C
30"	4"	15.25"
30"	6"	15.50"
30"	8"	15.75"
30"	10"	16.00"
30"	12"	16.50"
30"	15"	17.00"
30"	18"	17.75"
30"	24"	14.00"
30"	30"	9.50"

30” Grate Options

(see pg. 23 for detailed explanation)


Pedestrian H-20 Rated


Standard H-20 Rated


Solid


Domed

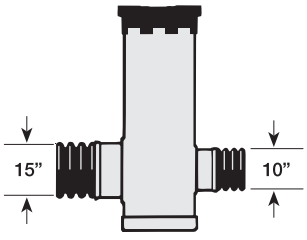
HOW DO YOU BUILD A PART NUMBER?
See page (32) for Drain Basins

A riser will be supplied with structures over 84".

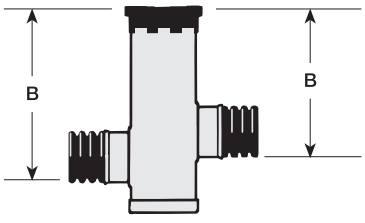
Part#/Prefix	Product Description	Available Outlets
2808AG_ _X	8" Custom Basin	4" thru 8"
2810AG_ _X	10" Custom Basin	4" thru 10"
2812AG_ _X	12" Custom Basin	4" thru 12"
2815AG_ _X	15" Custom Basin	4" thru 15"
2818AG_ _X	18" Custom Basin	4" thru 18"
2824AG_ _X	24" Custom Basin	4" thru 24"
2830AG_ _X	30" Custom Basin	4" thru 30"

Includes any grate option except bronze and domed. Bronze grates are available in 8", 10", 12", or 15" for Drain Basins and Inline Drains only.

When are Drain Basins Used?

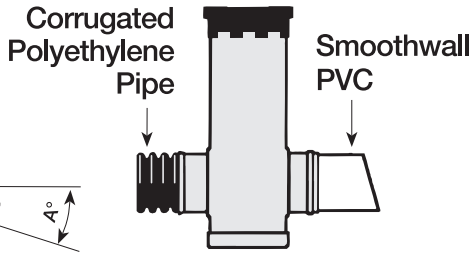


Change Diameter



Change Elevation

Change Direction

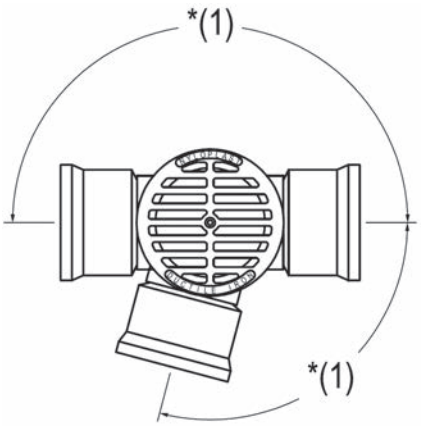


Change Pipe

8” & 10” Drain Basins

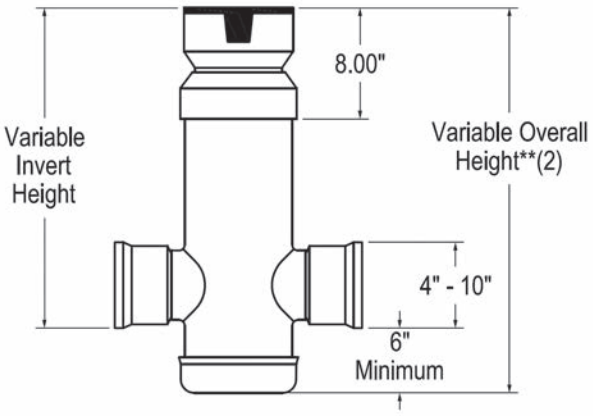
Part#/Prefix	Product Description	Available Outlets
2808AG__X	8” Custom Basin	4” thru 8”
2810AG__X	10” Custom Basin	4” thru 10”

All 8” & 10” custom basins will have a drop-in grate



*(1) Adapters can be mounted on any angle 0° to 359°.

To determine minimum angle between adapters please see chart on page (1).



**(2) Maximum recommended overall height 10’

8” & 10” Grate Options

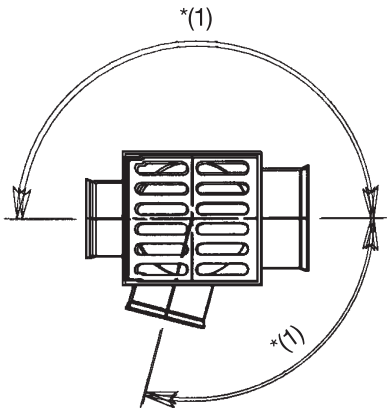
Light Duty Bronze Grate Available (see pg. 23-24)

(see pg. 23 for detailed explanation)

Standard Solid Domed

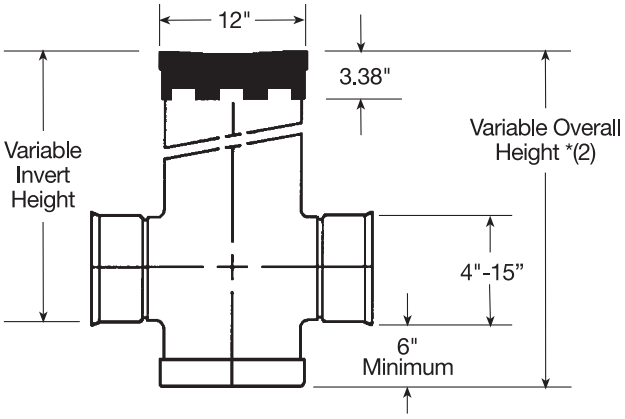
12" & 15" Drain Basins

Part#/Prefix	Product Description	Available Outlets
2812AG_ _X	12" Custom Basin	4" thru 12"
2815AG_ _X	15" Custom Basin	4" thru 15"



*(1) Adapters can be mounted on any angle 0° to 359°.

To determine minimum angle between adapters please see chart on page (1).

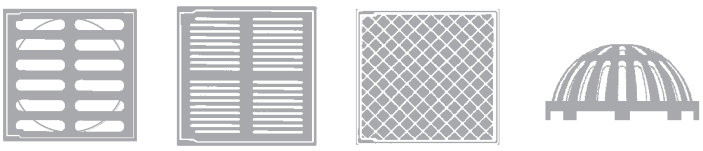


*(2) Maximum recommended overall height 10'

12" & 15" Grate Options

Light Duty Bronze Grate Available (see pg. 23-24)

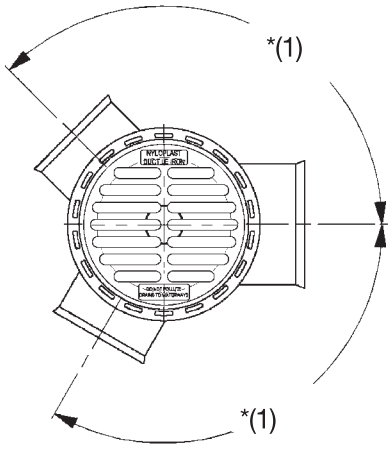
(see pg. 23 for detailed explanation)



Standard H-20 Rated | Pedestrian H-10 Rated | Solid | Domed

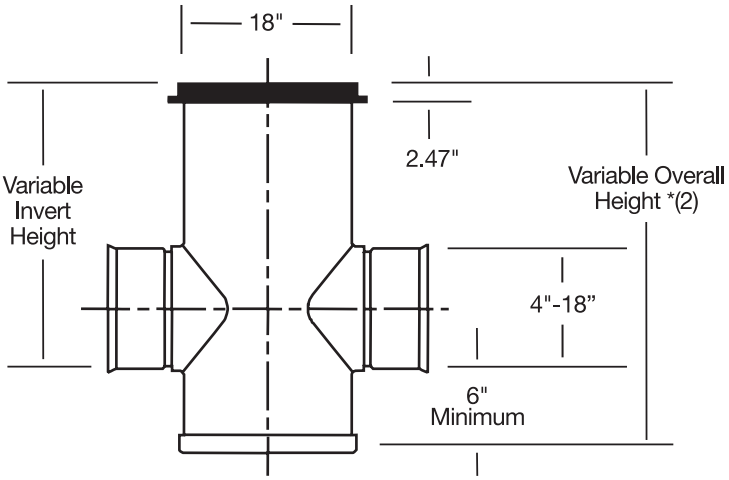
18” Drain Basins

Part#/Prefix	Product Description	Available Outlets
2818AG__X	18” Custom Basin	4” thru 18”



*(1) Adapters can be mounted on any angle 0° to 359°.

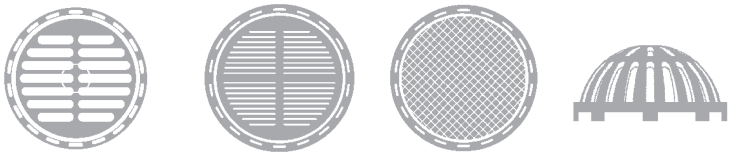
To determine minimum angle between adapters please see chart on page (1).



*(2) Maximum recommended overall height 10'

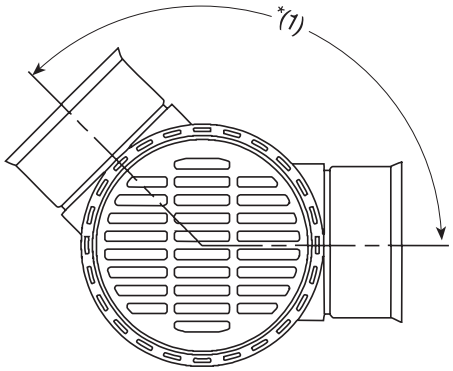
18” Grate Options

(see pg. 23 for detailed explanation)



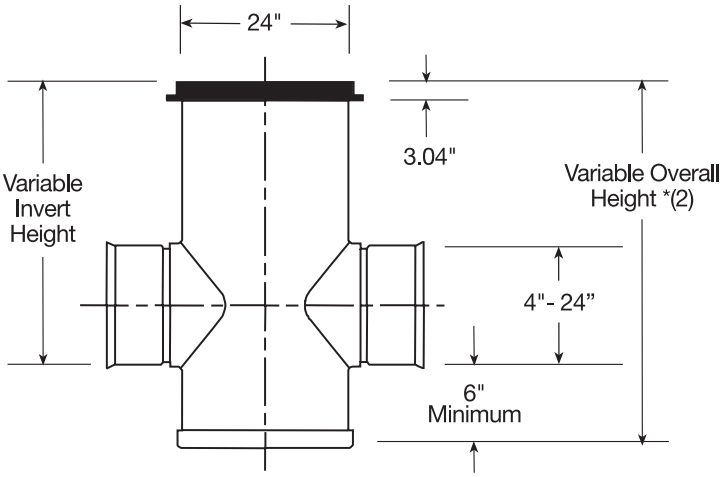
Standard H-20 Rated | Pedestrian H-10 Rated | Solid | Domed

Part#/Prefix	Product Description	Available Outlets
2824AG__X	24" Custom Basin	4" thru 24"



*(1) Adapters can be mounted on any angle 0° to 359°.

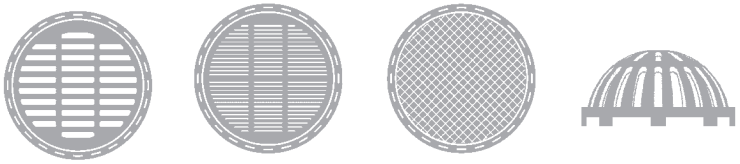
To determine minimum angle between adapters please see chart on page (1).



*(2) Maximum recommended overall height 10'

24" Grate Options

(see pg. 23 for detailed explanation)



Standard H-20 Rated

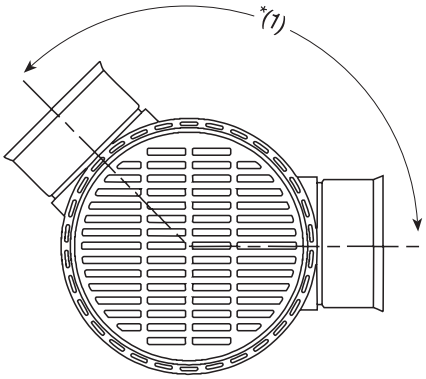
Pedestrian H-10 Rated

Solid

Domed

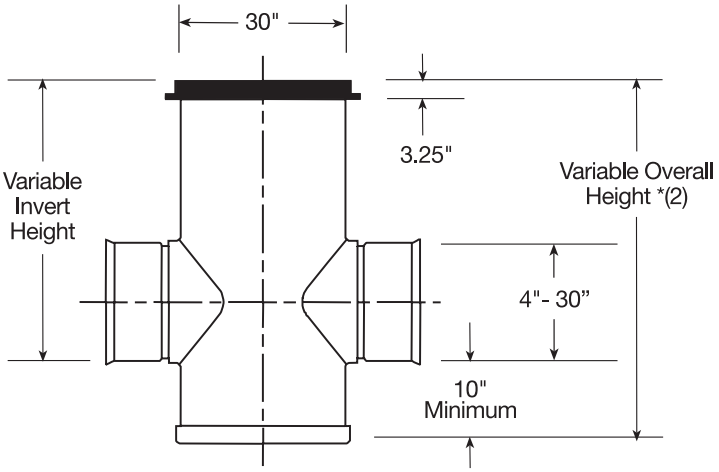
30” Drain Basins

Part#/Prefix	Product Description	Available Outlets
2830AG__X	30” Custom Basin	4” thru 30”



*(1) Adapters can be mounted on any angle 0° to 359°.

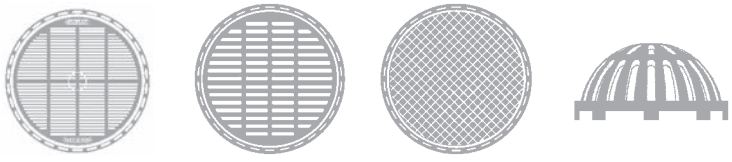
To determine minimum angle between adapters please see chart on page (1).



*(2) Maximum recommended overall height 10'

30” Grate Options

(see pg. 23 for detailed explanation)



Pedestrian H-20 Rated | Standard H-20 Rated | Solid | Domed

Curb Inlet Structures

HOW DO YOU BUILD A PART NUMBER?
See page (33) for Curb Inlet Structures

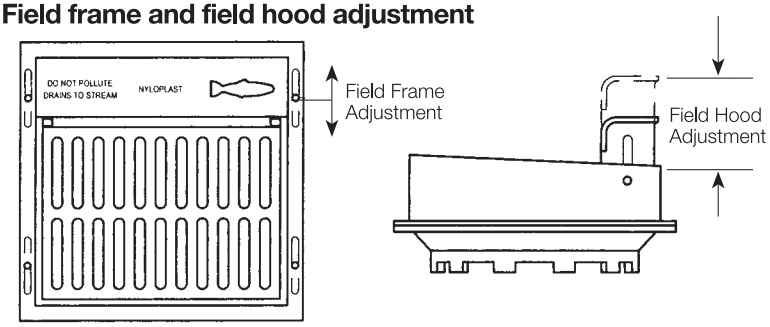
A riser will be supplied with structures over 84".

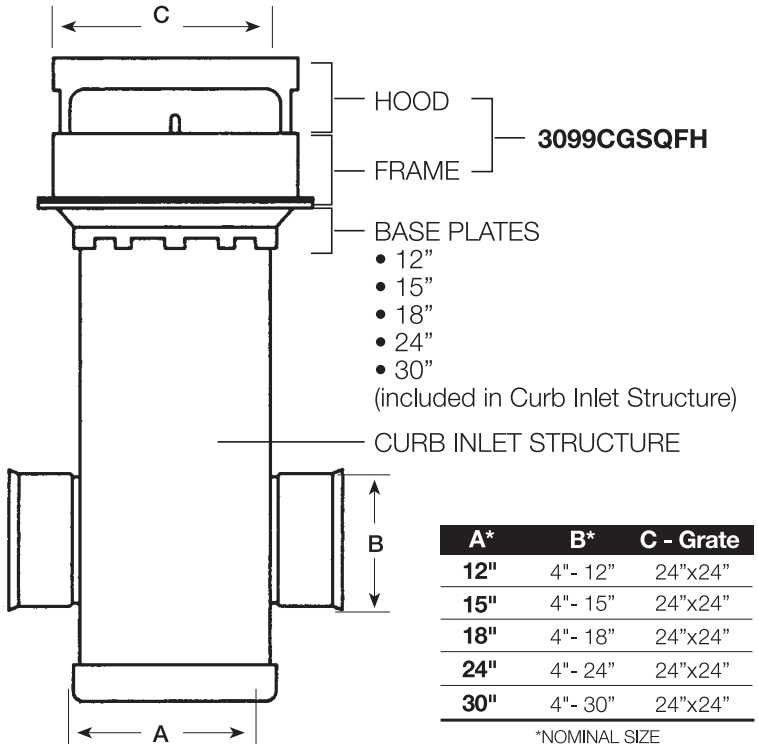
Part#/Prefix	Product Description	Available Outlets
12" Curb Inlet Structure (page 15)		
3012AGS__X	2'x2' Series Square Grate	4" thru 12"
15" Curb Inlet Structure (page 15)		
3015AGS__X	2'x2' Series Square Grate	4" thru 15"
18" Curb Inlet Structure (page 15)		
3018AGS__X	2'x2' Series Square Grate	4" thru 18"
18" Curb Inlet Structure (page 16)		
3018AGR__X	2'x3' Series Rectangular Grate	4" thru 18"
24" Curb Inlet Structure (page 15)		
3024AGS__X	2'x2' Series Square Grate	4" thru 24"
24" Curb Inlet Structure (page 16)		
3024AGR__X	2'x3' Series Rectangular Grate	4" thru 24"
30" Curb Inlet Structure (page 15)		
3030AGS__X	2'x2' Series Square Grate	4" thru 30"
30" Curb Inlet Structure (page 16)		
3030AGR__X	2'x3' Series Rectangular Grate	4" thru 30"

Curb Inlets with 2'x2' Grate

See chart on page (14) for 2'x2' part numbers

Field frame and field hood adjustment



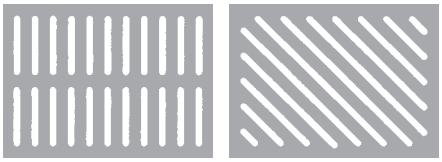


A*	B*	C - Grate
12"	4"- 12"	24"x24"
15"	4"- 15"	24"x24"
18"	4"- 18"	24"x24"
24"	4"- 24"	24"x24"
30"	4"- 30"	24"x24"

*NOMINAL SIZE

2'x2' Grate Options

(see pg. 23 for detailed explanation)

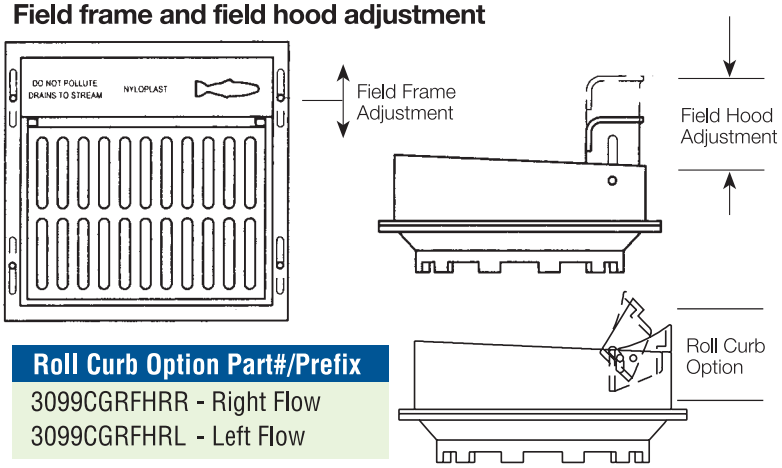


Standard H-20 Diagonal Flow H-20

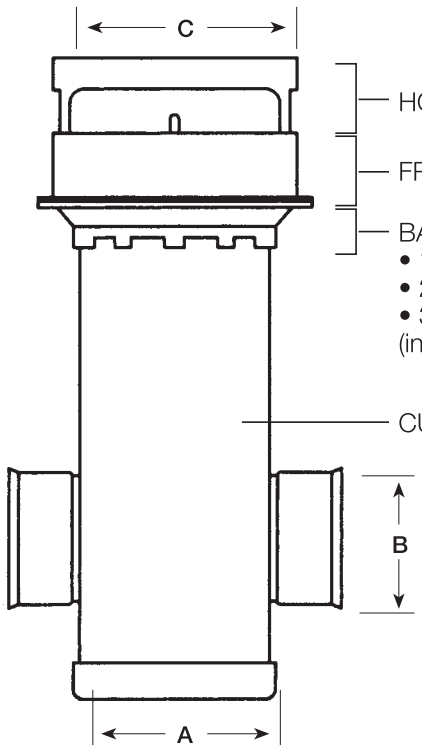
Curb Inlets with 2’x3’ Grate

See chart on page (14) for 2’x3’ Curb Inlet part numbers

Field frame and field hood adjustment



Roll Curb Option Part#/Prefix
3099CGRFHRR - Right Flow
3099CGRFHRL - Left Flow

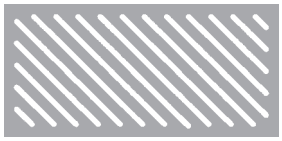


A*	B*	C - Grate
18"	4"- 18”	24”x36”
24"	4"- 24”	24”x36”
30"	4"- 30”	24”x36”

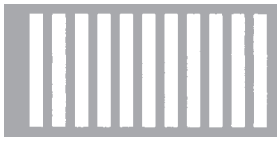
*NOMINAL SIZE

2’x3’ Grate Options

(see pg. 23 for detailed explanation)

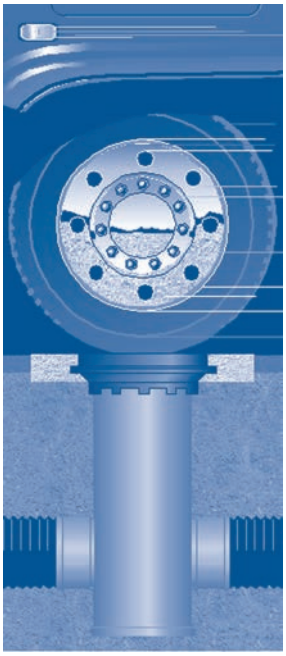


Diagonal Flow



High Flow Vane
(Roll Curb - right flow or left flow)

Road & Highway Structures



HOW DO YOU BUILD A PART NUMBER?
See page (34) for Road & Highway Structures

A riser will be supplied with structures over 84".

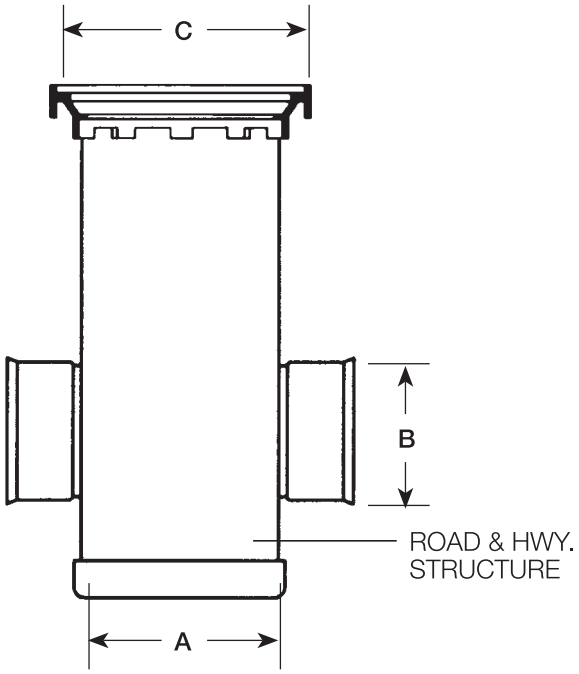
Part#/Prefix	Product Description	Available Outlets
12" Road & Hwy. Structure (page 18)		
3212AGS__X	2'x2' Series Square Grate	4" thru 12"
15" Road & Hwy. Structure (page 18)		
3215AGS__X	2'x2' Series Square Grate	4" thru 15"
18" Road & Hwy. Structure (page 18)		
3218AGS__X	2'x2' Series Square Grate	4" thru 18"
18" Road & Hwy. Structure (page 19)		
3218AGR__X	2'x3' Series Rectangular Grate	4" thru 18"
24" Road & Hwy. Structure (page 18)		
3224AGS__X	2'x2' Series Square Grate	4" thru 24"
24" Road & Hwy. Structure (page 19)		
3224AGR__X	2'x3' Series Rectangular Grate	4" thru 24"
30" Road & Hwy. Structure (page 18)		
3230AGS__X	2'x2' Series Square Grate	4" thru 30"
30" Road & Hwy. Structure (page 19)		
3230AGR__X	2'x3' Series Rectangular Grate	4" thru 30"

For Steel Bar Grate And Frame

Part#/Prefix	Product Description
3299CGSQFSB__	2' x 2' Steel Bar Grate with Frame
3299CGRFSB__	2' x 3' Steel Bar Grate with Frame

Road & Highway with 2'x2' Grate

See chart on page (17)
for 2'x2' Road & Highway Structure part numbers



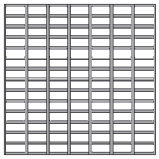
A*	B*	C - Grate
12"	4"- 12"	24"x24"
15"	4"- 15"	24"x24"
18"	4"- 18"	24"x24"
24"	4"- 24"	24"x24"
30"	4"- 30"	24"x24"

*NOMINAL SIZE

2'x2' Grate Options

(see pg. 23 for detailed explanation)

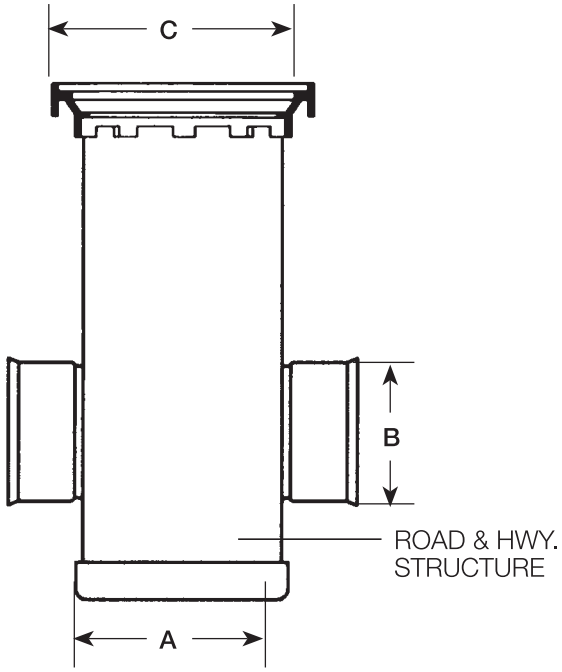
Ductile Iron Grate



Steel Bar Grate

Road & Highway with 2’x3’ Grate

See chart on page (17)
for 2’x3’ Road & Highway Structure part numbers

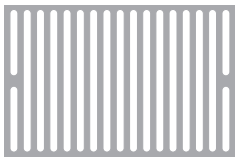


A*	B*	C - Grate
18"	4"- 18”	24”x36”
24"	4"- 24”	24”x36”
30"	4"- 30”	24”x36”

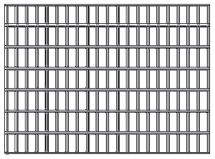
*NOMINAL SIZE

2’x3’ Grate Options

(see pg. 23 for detailed explanation)

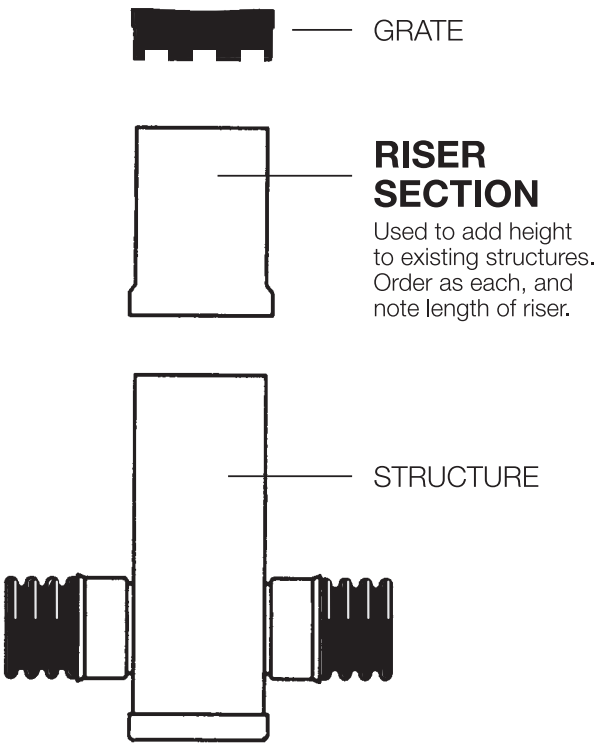


Ductile Iron Grate



Steel Bar Grate

HOW DO YOU BUILD A PART NUMBER?
See page (32) for Riser Section



Riser Section Overview Chart

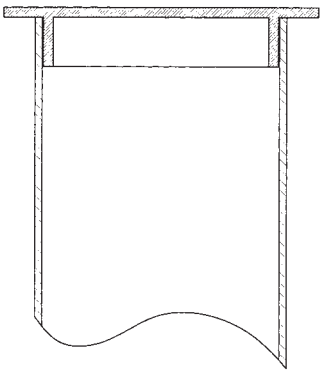
Part#/Prefix	Product Description
2908AG__X	8” Riser Section
2910AG__X	10” Riser Section
2912AG__X	12” Riser Section
2915AG__X	15” Riser Section
2918AG__X	18” Riser Section
2924AG__X	24” Riser Section
2930AG__X	30” Riser Section

Drop In Grates

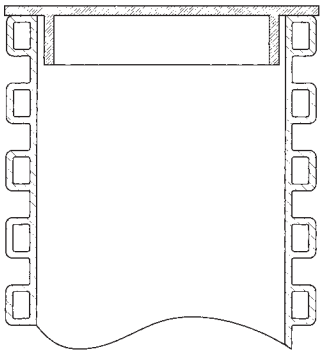
(see pg. 23 for detailed explanation)

Drop in grates are ductile iron. These are for light duty, turf and landscape applications only.

Fits Inside Sewer SDR-35 Pipe



Fits Inside Corrugated Polyethylene Pipe



Drop In Grates Overview Chart

Part#/Prefix	Product Description
0601DI	6” Drop In Grate
0801DI	8” Drop In Grate
1001DI	10” Drop In Grate
1201DI	12” Drop In Grate
1501DI	15” Drop In Grate
1801DI	18” Drop In Grate
2401DI	24” Drop In Grate

Grates for Inline Drains and Drain Basins

Formula: __ **99 CG x** Blank= size of grate.
Choose from 08,10,12,15,18,24,30 depending on size of structure

(x) = Style.
- **S** Standard
- **SL** Standard Locking
- **P** Pedestrian - available in 8"- 24"
- **PL** Pedestrian Locking - available in 8"- 24"
- **C** Solid Cover
- **CL** Solid Cover Locking
- **B** Bronze - available in 8", 10", 12" & 15"
- **BL** Bronze Locking - available in 8", 10", 12" & 15"
- **D** Domed - available in 8"- 30"
- **DL** Domed Locking - available in 8"- 30"

Drop-In Grates

Formula: __ **01 DI** Blank= size of grate.
Choose from 06,08,10,12,15,18,24 depending on size of pipe

Curb Inlet Grate Assembly

Order 3099CGSQFH and either 3099CGSQ or 3099CGSQDF:

3099CGSQFH	2'x 2' Frame & Hood Assembly	(12" - 30")
3099CGSQ	2'x 2' Standard Grate	(12" - 30")
3099CGSQDF	2'x 2' Diagonal Flow Grate	(12" - 30")

or

Order 3099CGRFH and choose either 3099CGRDF or 3099CGRHF:

3099CGRFH	2'x 3' Frame & Hood Assembly	(18" - 30")
3099CGRFHR	2'x 3' Frame & Adjustable Roll Curb Assembly - Right Flow	(18" - 30")
3099CGRFHL	2'x 3' Frame & Adjustable Roll Curb Assembly - Left Flow	(18" - 30")
3099CGRDF	2'x 3' Standard Grate	(18" - 30")
3099CGRHF	2'x 3' High Flow Vane Grate	(18" - 30")

Road & Highway Grate Assembly

Order 1 each of the following:

3299CGSQF12	12" Road & Hwy Square Grate and Frame
3299CGSQF15	15" Road & Hwy Square Grate and Frame
3299CGSQF18	18" Road & Hwy Square Grate and Frame
3299CGSQF24	24" Road & Hwy Square Grate and Frame
3299CGSQF30	30" Road & Hwy Square Grate and Frame
3299CGSQSB__	2' x 2' Steel Bar Grate with Frame
3299CGRF18	18" Road & Hwy Rectangle Grate and Frame
3299CGRF24	24" Road & Hwy Rectangle Grate and Frame
3299CGRF30	30" Road & Hwy Rectangle Grate and Frame
3299CGRSB__	2' x 3' Steel Bar Grate with Frame

Grate Options

for Inline Drains & Drain Basins

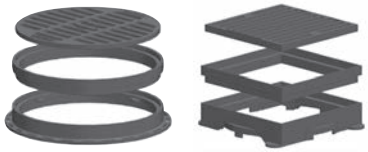
Grate Markers

Public education and outreach is part of the NPDES requirement. Storm drain marking is an established method of involving the public and increasing community awareness about non-point source pollution.

Many Nyloplast castings come with a recessed area on the grate designed to accomodate these grate markers.

Nyloplast keeps inventory of only the featured marker shown below, however, other markers may be purchased in 100 piece lots as custom orders.
Call for details.

Grate Riser Extentions



Round Road & Hwy.

Extension rings can be used to quickly raise the grade of existing grates when resurfacing is required. Nyloplast extension rings are only to be used with Nyloplast ductile iron castings.

Size	Part #
18" Round with 2.0" Rise	1899CGER200
24" Round with 2.0" Rise	2499CGER200
30" Round with 2.0" Rise	3099CGER200
18" Round with 1.5" Rise	1899CGER150
24" Round with 1.5" Rise	2499CGER150
30" Round with 1.5" Rise	3099CGER150
Road & Highway	
2'x 2' with 2.0" Rise	3299CGSQER200
2'x 3' with 2.0" Rise	3299CGSREER200

8" & 10" Dome Light-Duty

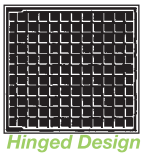
8" & 10" Standard Light-Duty
(also available in bronze)

8" & 10" Solid Light-Duty

12" & 15" Dome Light-Duty

12" & 15" Standard H-20
Hinged Design

12" & 15" Pedestrian H-10
Also available in bronze
(bronze are not hinged and are locking)
Hinged Design



12" & 15" Solid H-20
Hinged Design

18", 24" & 30" Dome Light-Duty

18", 24" & 30" Standard H-20

18", 24" & 30" Pedestrian H-10

18", 24" & 30" Solid H-20

Pedestrian Safe (ADA Compliant)

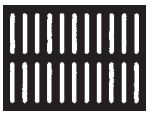
Bicycle Safe

Light Duty 7,500 lb

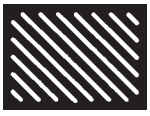
Medium Duty H-10

Heavy Duty H-20

Curb Inlet and Road & Highway Grates



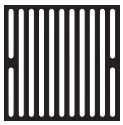
Curb Inlet 2'x 2' Standard Grate



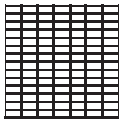
Curb Inlet 2'x 2' Diagonal Flow Grate

Curb Inlet 2'x 3' Diagonal Flow Grate

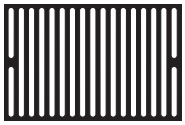
Curb Inlet 2'x 3' High Flow Vane Grate
Roll Curb
right flow or left flow



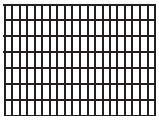
Road & Hwy. 2'x 2' Square Grate



Road & Hwy. 2'x 2' Steel Bar Grate and Frame



Road & Hwy. 2'x 3' Rectangular Grate



Road & Hwy. 2'x 3' Steel Bar Grate and Frame

Grate Only Part Numbers and Description

Part#	Product Description
0899CGS	8" Standard Light-Duty Grate
0899CGC	8" Solid Cover
0899CGD	8" Domed Grate
0899CGB	8" Bronze Light-Duty Grate
1099CGS	10" Standard Light-Duty Grate
1099CGC	10" Solid Cover
1099CGD	10" Domed Grate
1099CGB	10" Bronze Light-Duty Grate
1299CGS	12" Standard H-20 Grate
1299CGP	12" Pedestrian Grate
1299CGC	12" Solid H-20 Cover
1299CGD	12" Domed Grate
1299CGPB	12" Bronze Light-Duty Grate
1599CGS	15" Standard H-20 Grate
1599CGP	15" Pedestrian Grate
1599CGC	15" Solid H-20 Cover
1599CGD	15" Domed Grate
1599CGPB	15" Bronze Light-Duty Grate
1899CGS	18" Standard H-20 Grate
1899CGP	18" Pedestrian Grate
1899CGC	18" Solid H-20 Cover
1899CGD	18" Domed Grate
2499CGS	24" Standard H-20 Grate
2499CGP	24" Pedestrian Grate
2499CGC	24" Solid H-20 Cover
2499CGD	24" Domed Grate
3099CGS	30" H-20 Standard Grate
3099CGP	30" Pedestrian Grate
3099CGC	30" Solid H-20 Cover
3099CGD	30" Domed Grate
3099CGSQ	Curb Inlet 2'x2' Square w/ Standard Grate
3099CGSQDF	Curb Inlet 2'x2' Square w/ Diagonal Flow Grate
3099CGSQFH	Curb Inlet 2'x2' Square Frame & Hood
18BASEG	Base Plate 2'x2' for 18" Structure
24BASEG	Base Plate 2'x2' for 24" Structure
30BASEG	Base Plate 2'x2' for 30" Structure
3099CGRDF	Curb Inlet 2'x3' Rectangular w/ Diagonal Flow Grate
3099CGRHF	Curb Inlet 2'x3' Rectangular w/ High Flow Vane Grate
3099CGRTWG	Curb Inlet 2'x3' Rectangular w/ Two Way Grate
3099CGRFH	Curb Inlet 2'x3' Rectangular Frame & Hood
3099CGRFHRL	Roll Curb Inlet 2'x3' Rectangular Frame - Left
3099CGRFHRR	Roll Curb Inlet 2'x3' Rectangular Frame - Right
18BASER	Base Plate 2'x3' for 18" Structure
24BASER	Base Plate 2'x3' for 24" Structure
30BASER	Base Plate 2'x3' for 30" Structure
Grate excludes base plate	
3299CGSQF12	12" Road & Hwy Square Grate and Frame
3299CGSQF15	15" Road & Hwy Square Grate and Frame
3299CGSQF18	18" Road & Hwy Square Grate and Frame
3299CGSQF24	24" Road & Hwy Square Grate and Frame
3299CGSQF30	30" Road & Hwy Square Grate and Frame
3299CGSQSB_ _	2' x 2' Steel Bar Grate with Frame
3299CGRF18	18" Road & Hwy Rectangle Grate and Frame
3299CGRF24	24" Road & Hwy Rectangle Grate and Frame
3299CGRF30	30" Road & Hwy Rectangle Grate and Frame
3299CGRSB_ _	2' x 3' Steel Bar Grate with Frame

Locking - Add "L" to the end of any grate #

Rubber Sleeve

Stainless Steel Band

Gasketed PVC Hub

INSERTA TEE® Manifold Adaptors Fit Any Mainline or Structure

Air-Testable, Watertight and Versatile

INSERTA TEE is a three piece service connection consisting of a PVC Hub, Rubber Sleeve and Stainless Steel Band. INSERTA TEE is compression fit into the cored wall of a mainline and requires no special tooling. INSERTA TEEs are designed to connect 2" (51 mm) through 30" (750 mm) services to all known solidwall, profile, closed profile and corrugated pipe manufactured today.

INSERTA TEE allows for tapping of existing lines without disturbing the bedding. It eliminates glues, epoxies, grout and awkward gaskets and the need to retighten bands around the mainline.

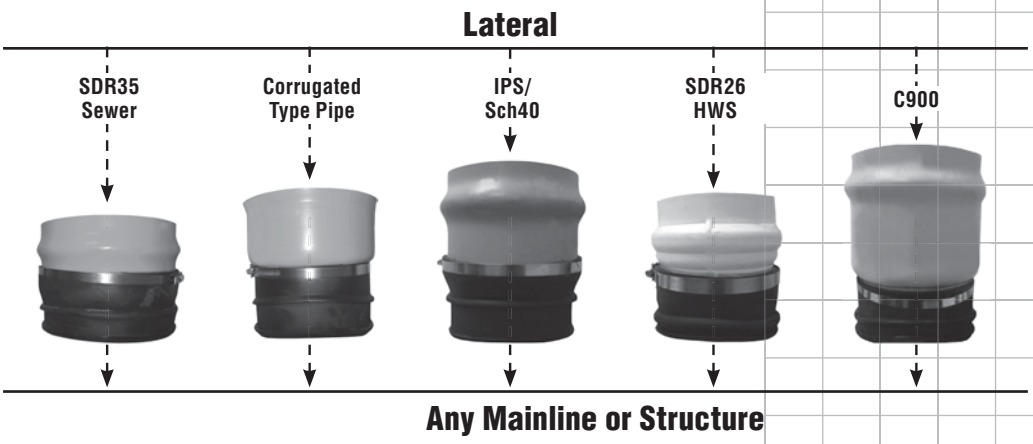
INSERTA TEE is designed to match the internal radius of any pipe and services can be connected where needed. It allows for easier grading of the mainline. It also greatly reduces costs by reducing labor hours and pipe materials. Hole saws are available for sale for all sizes of INSERTA TEEs. The use of installation methods or hole saws not purchased from Inserta Fittings will void the performance warranty of the product.

Applications:

- Sanitary Sewers
- Pipe Bursting (HDPE/PVC)
- Fold-and-Formed Products
- Manholes
- Drainage
- Catch Basins
- Storm Sewers
- Sliplining
- Cured-In-Place Products
- Wet Wells
- Irrigation
- Electrical Vaults Available 2009

INSERTA TEE Fittings For All Gravity Flow Pipe And Manholes

Ductile Iron	Spirolite	Ultra Rib™	Pro 21®
Fiberglass	Hi Q®/Sure-Lok®	PermaLok®	Polyethylene
PVC	Vylon®	Corrugated Metal	Truss®
Ultra Corr™	N-12®	Solflo® Max	A2000®
GOLDFLO®	Kor-Flo™	Concrete	Clay
Weholite®	Asbestos Cement	HP Storm	SaniTite® HP
DuroMaxx®			



EnviroHood Structure

The Nyloplast EnviroHood™ is an innovative stormwater management device attached to the inside of a catch basin or manhole designed to prevent the outflow of floating debris and oil.

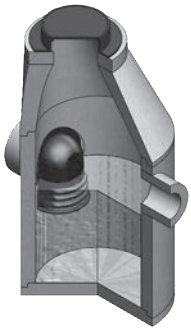
The need for cleaner stormwater has caused municipal leaders to demand forward-thinking solutions to improve their overall water quality. The EnviroHood offers lower installed costs and less intrusive installations than competitive devices.

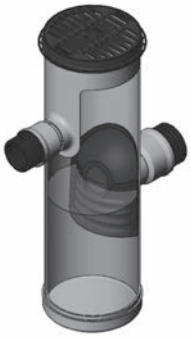
Engineered for Optimal Performance

The innovative design incorporates the same proven corrugation technology used on ADS N-12® pipe products. This delivers maximum strength to weight ratio and ensures the structure is capable of supporting the hydraulic forces of a rainfall event.

Features & Benefits:

- Molded from High Density Polyethylene (HDPE) for lightweight and sturdy design
- Corrugated design eliminates flat surfaces and provides increased structural capacity
- Effective low-cost solution for storm water treatment
- Easy to clean
- Highly corrosion-resistant for long service life





How to Order an EnviroHood Structure

Verify that requirements of the Drain Basin are met:

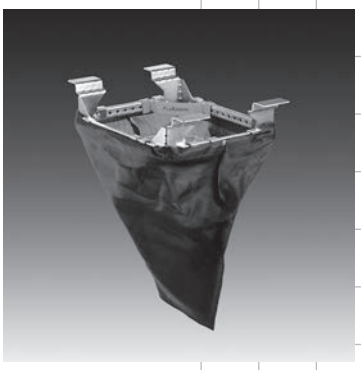
1. Size of Basin (must be 18", 24" or 30")
2. Number of Stubs
3. **Contact Nyloplast for EnviroHood and Weir** minimum angles (standard chart does not apply).
4. Sump depth sufficient (see table page 28 for minimum sump requirement)

- Must have part # and price on individual line on order.
- The **EnviroHood** should be ordered on the specific **EnviroHood** order form on page 33
- Part # specifies the size of stub, but should also be notated on the drawing / order form must also signify which stub will accept the **EnviroHood.**

FLEXSTORM® CATCH-IT® Reusable Inlet Protection

State DOTs and Municipalities across the country now have a universal structural BMP to address the issue of storm sewer inlet protection: FLEXSTORM CATCH-IT Inlet Filters—the temporary and reusable solution.

The FLEXSTORM CATCH-IT system is the preferred choice for temporary inlet protection and storm water runoff control. FLEXSTORM CATCH-IT Inlet Filters will fit any drainage structure and are equipped with high-efficiency filter bags. Whether you're the specifier or the user, it's clear to see how FLEXSTORM CATCH-IT Inlet Filters outperform the competition.



Applications:

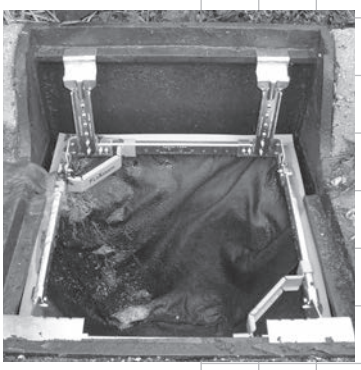
- DOT
- Commercial
- Industrial
- Residential Developments
- Road Construction
- Parking Lots
- Maintenance

Features

- **Configurable:** steel frames configured and guaranteed to fit ANY storm drainage structure
- **Adjustable:** although shipped to fit your inlet, rectangular framing may be field adjusted in 1/2" increments if necessary
- **Reusable:** galvanized framing will last year after year in harsh conditions, while geotextile filter bags are easily replaced after several years of use
- **Effective:** works below grade; overflow feature allows streets to drain with full bag; third party testing results of the FX filter bag show 82%
- **Affordable:** low per-unit cost; installs in seconds; easily maintained with Universal Removal Tool (no machinery required)

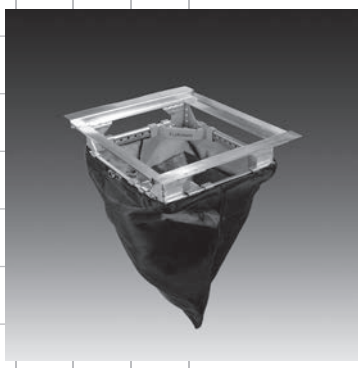
Benefits

- Reduce jobsite flooding and keep projects running
- Minimize residential complaints with cleaner, dryer streets during all construction phases
- Prevent hazardous road icing conditions by eliminating ponding at curb inlets
- Significantly reduce cleanup costs
- Prevent siltation and pollution of rivers, lakes, and ponds
- Helps prevent fines; NPDES PHASE II Compliant
- Lowest cost alternative for the highest level of Inlet Protection
- Available through 5,000 ADS distributors nationwide
- Ships within 48 hours



FLEXSTORM® PURE Permanent Inlet Protection

The FLEXSTORM PURE system is the preferred choice for permanent inlet protection and storm water runoff control. Constructed of versatile stainless steel, FLEXSTORM PURE Inlet Filters will fit any drainage structure and are available with site-specific filter bags providing various levels of filtration. Whether you're the specifier or the user, it's clear to see how FLEXSTORM PURE Inlet Filters outperform the competition.

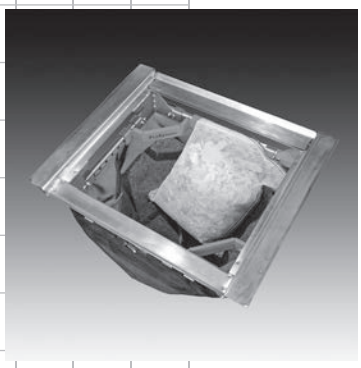


Applications:

- Car Washes
- Commercial
- Loading Ramps
- Industrial
- Gas Stations
- Parking Lots
- Dock Drains
- Maintenance

Features

- Stainless Steel filter framing is custom configured to fit perfectly into any drainage structure, whether a standard design or obstructed inlet opening
- Filtered Flow Rates and Ultimate Bypass Rates are designed to meet your specific inlet requirements
- Multiple Filter Bags are available targeting site specific removal of trash, litter, leaves, or small particles, oil and grease
- Filters work below grade with an ultimate bypass allowing inlet area to drain with a full bag
- Units install in seconds and are easily maintained with the FLEXSTORM Universal Removal Tool (no heavy machinery required)



Benefits

- Receive payback on your investment: durable stainless steel framing provides extended service life while replaceable filter bags handle loads with a safety factor of 5
- Meet stringent removal requirements:
  - –FX filter bags are rated for > 80% removal efficiency of street sweep-size particles
  - –PC/PC+ filter bags have been tested to 99% TSS removal of OK-110 US Silica Sand and 97% TPH (total petroleum hydro-carbon) removal
- Help prevent fines: FLEXSTORM Inlet Filters comply with EPA NPDES initiatives as a temporary or permanent BMP
- Available through 5,000 ADS distributors nationwide
- If not in stock, orders up to 100 pcs can ship within 48 hours

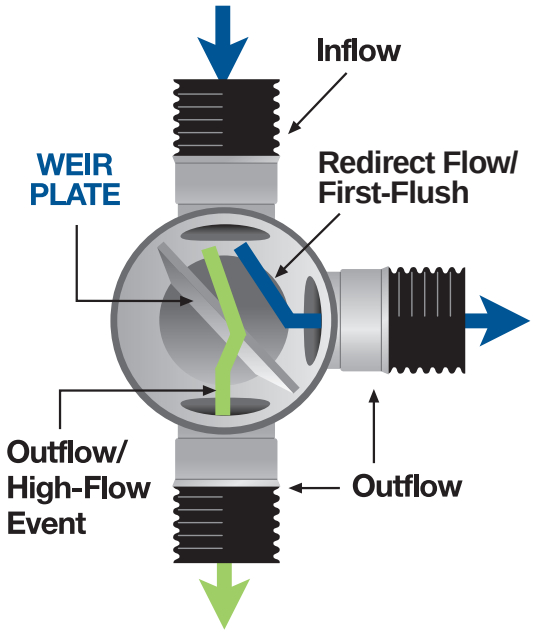
Weir Structure

How the Weir Structure Works:

- Storm water flows into the Nyloplast catch basin structure.
- The water flow is diverted to a desired outlet from the catch basin, typically to a water quality device, in order to effectively capture pollutants during the "first flush" of a storm event.
- The Weir Structure may also serve to restrict or regulate the flow of water exiting the drainage system. The restriction is determined by height of the weir and/or the size of the orifice hole in the weir plate.

Weir Structure Benefits:

- Simple and effective method to direct the inlet flow into a storm water management system or water quality device.
- Simple and effective method to regulate outlet flow from a storm water management system.
- Enhances ability of a water quality device to capture pollutants from storm event.
- Allows for flexibility to re-direct water flow during a high-flow event.
- Proven technology used for many years in the irrigation market.
- Nyloplast can customize Weir Structures (at the direction of the design engineer) to provide a variety of weir functions for site-specific needs, including "key way slot" and "v-notch" weir designs, and high flow or low flow orifice hole designs to further regulate the flow of storm water.



How to Order a Weir Structure

Verify that requirements of the Drain Basin are met:

1. Size of Basin
2. Number of Stubs
3. Contact Nyloplast for Snout and Wier minimum angles (standard chart does not apply).

- Get pricing estimate. (Pricing aid will be supplied for this procedure. If price cannot be determined, contact Nyloplast.)
- The Weir Structure should be ordered on the specific Weir Structure order form on page 33
- Contact Nyloplast for lead-time and relay information to customer. This will be determined on a case-by-case scenario.

Weir - Overview Chart

Part#/Prefix	Product Description
24" Drain Basin with Weir Structure	
2824AG _ _ XWE	24" Custom Basin with Grate & Weir
30" Drain Basin with Weir Structure	
2830AG _ _ XWE	30" Custom Basin with Grate & Weir
24" Curb Inlet Structure with Weir - 2'x 2' Series Square Grate	
3024AGS _ _ XWE	24" Curb Inlet Sturcture with Grate & Weir
24" Curb Inlet Structure with Weir - 2'x 2' Series Rectangular Grate	
3024AGR _ _ XWE	24" Curb Inlet Sturcture with Grate & Weir
30" Curb Inlet Structure with Weir - 2'x 2' Series Square Grate	
3030AGS _ _ XWE	30" Curb Inlet Sturcture with Grate & Weir
30" Curb Inlet Structure with Weir - 2'x 3' Series Rectangular Grate	
3030AGR _ _ XWE	30" Curb Inlet Sturcture with Grate & Weir
24" Road & Highway Structure with Weir - 2'x 2' Series Square Grate	
3224AGS _ _ XWE	24" Road & Highway Structue with Grate & Wier
24" Road & Highway Structure with Weir-2'x 3' Series Rectangular Grate	
3224AGR _ _ XWE	24" Road & Highway Structue with Grate & Wier
30" Road & Highway Structure with Weir - 2'x 2' Series Square Grate	
3230AGS _ _ XWE	30" Road & Highway Structue with Grate & Wier
30" Road & Highway Structure with Weir - 2'x 3' Series Rectangular Grate	
3230AGR _ _ XWE	30" Road & Highway Structue with Grate & Wier

Pour Ring

The pour ring is used with 8" and 10" structures.
This allows for removal of the grate when body is encased.

Part#/Prefix	Product Description
2708AGCPR	8" pour ring
2710AGCPR	10" pour ring

Perforations

Perforations can be added to any structure for an additional charge. (Holes are 3/8 inch diameter)

Please make note on the drawing/order and include information or diagram for placement. Consult the **Perforation Schedule** below details.

Basin Size	Angle Between Holes	No. of Holes	Distance Between Holes	Diameter of Holes
8"	90	4	2.00	0.375
10"	90	4	2.00	0.375
12"	60	6	2.00	0.375
15"	60	6	2.00	0.375
18"	45	8	2.00	0.375
24"	45	8	2.00	0.375
30"	36	10	2.00	0.375

Alternate Pipe Connections

An additional charge per adapter applies to all products adapting to:

- 4"- 24" gasketed C900 / C905
- 4"- 24" gasketed IPS
- 24" DWV
- 24" gasketed SWR
- RCP, CMP, Others

Drain Basin Configurator

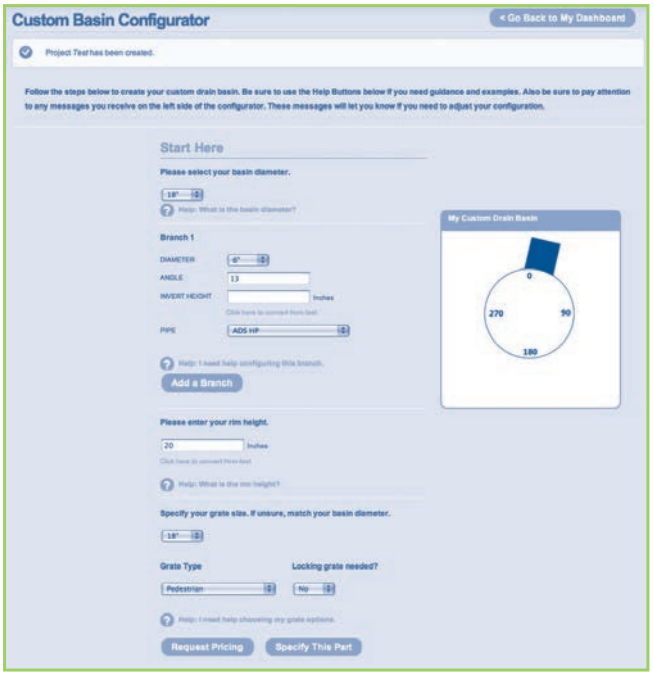
Do-It-Yourself Nyloplast Drain Basin Configurator

The Basin Configurator design program automatically designs a Nyloplast drain structure quickly and easily online. Entering just minimal information enables the proprietary software to customize a basin for any project. Input sections include type of pipe, basin diameter, and details for each branch including diameter, angle plus invert height. Any miscalculations are reduced as the program automatically guides you to suggested measurement(s). The program then provides a drawing and list of components that can be immediately ordered or saved in the user's private account.

The Custom Basin Configurator can be found at ***www.ads-pipe.com***, or at ***www.basinconfigurator.com***

Features & Benefits:

- Automatic design is quick and easy
- Customizable for any project
- Private online accounts can store multiple projects
- Custom products can be ordered immediately or saved for a later date
- Products arrive on the job site ready to install
- Installation is quick, safe and simple
- Minimal labor contributes to immediate cost savings all around



How to Build a Part Number

Prefixes:

27 = Inline Drain
28 = Drain Basin
29 = Riser
30 = Curb Inlet Structure
32 = Road & Highway Structure

Inline Drains

Formula: 27__ __ AG__ __ X

The first set of blanks is the size of the body
(Choose from 08,10,12,15,18,24,30)

The second set of blanks is the size of pipe adapting to
(Choose from 04,06,08,10,12,15,18,24,30)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
O = Big O / Armtec

If type of pipe does not fit any of these, leave X blank and note type of pipe and outside diameter of pipe.

Drain Basins

Formula: 28__ __ AG__ __ X

The first set of blanks is the size of the body
(Choose from 08,10,12,15,18,24,30)

The second set of blanks is the number of branches (Choose from 01 thru 05)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
DR = ADS / Hancor single wall pipe

If branches are mixed (two or more different types of pipe), leave X as blank.

If type of pipe does not fit any of these, please note type of pipe and outside diameter of pipe and call Nyloplast at **(866) 888-8479** for technical assistance.

Risers

Formula: 29__ __ AGX

The blanks are the size of the body (Choose from 08,10,12,15,18,24,30)
The **X** represents **01** = 1 foot, **02** = 2 foot.
Please order as Qty of each and line note the height of the riser.

Example: 3 each 2912AG (12" riser section)
Line note: 3 each - 2 ft tall

How to Build a Part Number

Prefixes:

27 = Inline Drain
28 = Drain Basin
29 = Riser
30 = Curb Inlet Structure
32 = Road & Highway Structure

Curb Inlet Structures

2'x 2' Series Square Grate

Formula: 30__ __AGS __ __ X

The first set of blanks is the size of the body
(Choose from 12,15,18,24,30)

The second set of blanks is the number of branches (Choose from 01 thru 05)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
DR = ADS / Hancor single wall pipe

If branches are mixed (two or more different types of pipe), leave X as blank.

If type of pipe does not fit any of these, please note type of pipe and outside diameter of pipe and call Nyloplast at **(866) 888-8479** for technical assistance.

Curb Inlet Structures

2'x 3' Series Rectangular Grate

Formula: 30__ __AGR __ __ X

The first set of blanks is the size of the body
(Choose from 18,24,30)

The second set of blanks is the number of branches (Choose from 01 thru 05)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
DR = ADS / Hancor single wall pipe

If branches are mixed (two or more different types of pipe), leave X as blank.

If type of pipe does not fit any of these, please note type of pipe and outside diameter of pipe and call Nyloplast at **(866) 888-8479** for technical assistance.

Prefixes:

27 = Inline Drain
28 = Drain Basin
29 = Riser
30 = Curb Inlet Structure
32 = Road & Highway Structure

Road & Highway Structures

2'x 2' Series Square Grate

Formula: 32__ __ AGS __ __ X

The first set of blanks is the size of the body
(Choose from 12,15,18,24,30)

The second set of blanks is the number of branches (Choose from 01 thru 05)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
DR = ADS / Hancor single wall pipe

If branches are mixed (two or more different types of pipe), leave X as blank.

Road & Highway Structures

2'x 3' Series Rectangular Grate

Formula: 32__ __ AGR __ __ X

The first set of blanks is the size of the body
(Choose from 18,24,30)

The second set of blanks is the number of branches (Choose from 01 thru 05)

The **X** represents the type of pipe adapting to. Replace **X** with one of the following:

N = ADS / Hancor dual wall pipe
D = DWV PVC (Sch 40 or Sch 80)
S = SWR PVC (ASTM D 3034: SDR 35 SWR & SDR 26 SWR PVC)
DR = ADS / Hancor single wall pipe

If branches are mixed (two or more different types of pipe), leave X as blank.

If type of pipe does not fit any of these, please note type of pipe and outside diameter of pipe and call Nyloplast at **(866) 888-8479** for technical assistance.

Drainage Structure Cost Comparison



Pre-Cast Concrete

Materials Cost

CONCRETE BOX
Complete w/ Bottom,
Adapter Top and Outlets _____

Frame & Grate or
Frame, Grate & Hood _____

5g Buckets of Non-Shrink Grout
@ $_____ per Bucket _____

Grade Rings or Brick _____

Installation Cost

TRACK HOE & OPERATOR
Equipment, Wages, Benefits
& Taxes
____ hours @ $_____ per hr. _____

LABORER; 1, 2, 3 MEN
Wages, Benefits & Taxes
(Knock Out Holes, Set the Structure,
Installing Frame & Grate and
Grouting Inlets & Outlets)
____ hours @ $_____ per hr. _____

TOTAL COST _____

Built-In-Place

Materials Cost

BRICK STRUCTURE
Brick _____
Mortar _____

Frame & Grate or
Frame, Grate & Hood _____

CAST-IN-PLACE
Framing Lumber _____
Concrete _____

Installation Cost

TRACK HOE & OPERATOR
Equipment, Wages, Benefits
& Taxes
____ hours @ $_____ per hr. _____

LABORER; 1, 2, 3 MEN
Wages, Benefits & Taxes
____ hours @ $_____ per hr. _____

TOTAL COST _____

Drainage Structure Cost Comparison

Nyloplast® PVC Structure

Materials Cost

COMPLETE UNIT
Basin,Frame, Grate
and Hood, ASTM
F-477 Gasket ---------- _____

H-20 RATED
1/3 Cubic Yard of Concrete
(for H-20 Rated Only) ---------- _____

Installation Cost

RUBBER-TIRE BACK HOE & OPERATOR
Equipment, Wages, Benefits & Taxes
____ hours* @ $_____ per hr. ----- _____

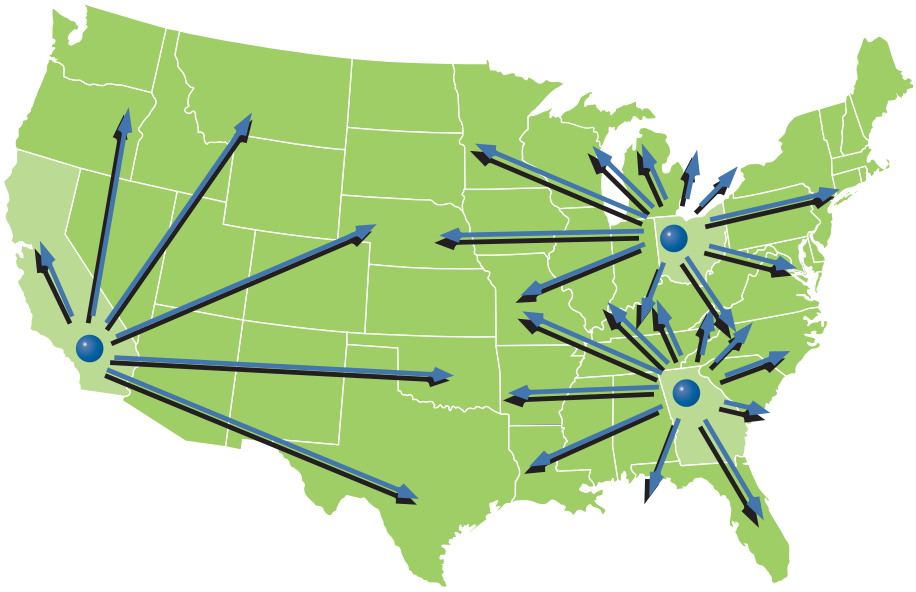
LABORER; 1, 2 MEN
Wages, Benefits & Taxes
____ hours* @ $_____ per hr. ------ _____

*Hours to Install

Inline Drain	.77 hr.
Drain Basin (Non H-20 Rated)	1 hr.
Drain Basin (H-20 Rated)	1.33 hr.
Road & Highway	1.5 hr.
Curb Inlet	1.75 hr.

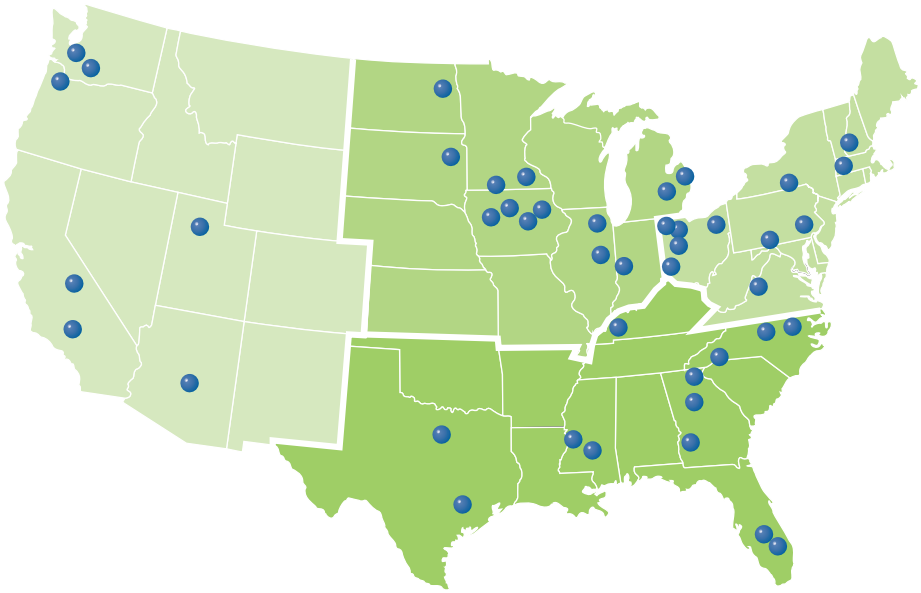
TOTAL COST _____

Manufacturing and Service Locations



Strategic Nyloplast Locations

The strategic location of Nyloplast's manufacturing facilities located in Buford, Georgia, Bakersfield, California and Findlay, Ohio makes for fast arrival just about anywhere in North America. In fact, once you've worked with our products and experienced our service, we're confident you'll be impressed.



ADS and Hancor Pipe Manufacturing Locations

Customer Service Locations

- **Northeast Zone Office** Findlay, OH • 1-888-367-7473
- **Midwest Zone Office** London, OH • 1-800-733-9554
- **Southern Zone Office** Franklin, TN • 1-800-733-9987
- **Western Zone Office** Vancouver, WA • 1-800-733-8523

Terms & Conditions

Freight Policy:

For Nyloplast structures, *freight prepaid* on orders *$2,500 and over*, FOB Buford, GA, Bakersfield, CA or Findlay, OH. This includes any orders shipping from other facilities within the continental US.

This policy may change without notice. Always confirm Nyloplast freight policy before ordering.

Return Policy:

Due to the fact that each structure is custom made, drain basins, curb inlet structures, road and highway structures, EnviroHood structures, weir structures are all *Non-cancelable* and *Non-returnable*.

Returns of Inline Drains or Grates
must be pre-approved by Nyloplast Management. Standard restocking fee on Inline Drains and Grates is 25%. All products should be returned to the Nyloplast plant in Buford, GA, Bakersfield, CA or Findlay, OH unless the product is a standard stocking item at the nearest pipe plant or distribution center. All return freight to be paid by customer.

Interactive CD Rom Available

We are always working to improve the tools and information available for our customers. The latest interactive CD Rom gives you technical information, photographs and drawings to assist you in specifying storm drainage products for all your future projects.

For a copy of our latest CD Rom and other promotional literature please call us at: **(866) 888-8479**

Nyloplast®
A division of ADS

3130 Verona Avenue • Buford, Georgia 30518 • (866) 888-8479 / (770) 932-2443 - Fax: (770) 932-2490

www.Nyloplast-US.com

Advanced Drainage Systems, Inc.
4640 Trueman Blvd. Hilliard, OH 43026

1-800-821-6710

www.ads-pipe.com

Supplemental Technical Specification for

Flowable Fill

SCDOT Designation: SC-M-210 (06/11)

1. SCOPE

1.1. This work consists of furnishing flowable fill as an alternate to compacted soil as approved by the Resident Engineer. Applications for this material include beddings, encasements, and closures for tanks and pipe, and general backfill for trenches and abutments.

2. REFERENCED DOCUMENTS

2.1. SCDOT Standard Specification Section 210

2.2. SCDOT Standard Specifications Division 700

2.3. SCDOT Qualified Product Lists 1, 3, 5, 6, 28, and 31.

3. SUBMITTALS

3.1. Provide mix designs for review to the Structural Materials Engineer at the Office of Materials and Research (OMR) at least 14 days prior to need. Provide copies of mix designs being submitted for review to the Resident Engineer.

4. MATERIALS

4.1. Use materials that meet the requirements of Division 700 of the Standard Specifications with the following exceptions:

4.1.1. *Fine Aggregate* – Any clean fine aggregate from an SCDOT-approved source, as shown on Qualified Product List 1, with 100% passing a 3/8 sieve and no more than 15% passing a No. 200 sieve may be used. Other fine aggregate gradations requirements are waived.

4.1.2. *Air Entraining Admixtures* – High air generators or foaming agents as shown on Qualified Product List 31 may be used. Admixtures as given on Qualified Product List 5 are also approved for use in flowable fill.

5. DELIVERY, STORAGE, AND HANDLING

5.1. All delivery, storage, and handling requirements are as given in Division 700, except that the revolution counter requirements are waived. Deliver flowable fill using concrete construction equipment. Place flowable fill by chute, pumping, or other methods approved by the Resident Engineer. When placing through water, tremie flowable fill.

6. MIX DESIGN

6.1. Flowable fill will consist of a mixture of Portland cement, fly ash, fine aggregate, air entraining admixture, and water. Flowable fill is intended to contain a low cementitious content for reduced strength development.

6.2. Flowable fill is available in either Excavatable or Non-Excavatable proportions as specified by the Resident Engineer. The following table lists mix design proportion ranges for both types of flowable fill.

Table 1 – Mix Designs for Flowable Fill			
	Excavatable		**Non-Excavatable**
	Air Entrained	**Non-Air Entrained**	
Type 1 Portland Cement*	50-100 lbs/yd^3**	20-40 lbs/yd^3	75-150 lbs/yd^3
Fly Ash	0-600 lbs/yd^3	250-600 lbs/yd^3	150-600 lbs/yd^3
Water	See Note 1.	See Note 1.	See Note 1.
Air***	15-35%	Not applicable	5-20%
28-day Compressive Strength***	150 psi Maximum	150 psi Maximum	150 psi Minimum
Unit Weight (Wet)***	90-100 lbs/ft^3	Not applicable	100-125 lbs/ft^3

Note 1. – Select water content as necessary to produce a consistency that will result in a flowable, self-leveling product at the time of placement.

*Other types of Portland cement meeting the requirements of Division 700 may be used with prior approval of the Structural Materials Engineer.

**When using less than 75 lbs/yd^3 of Portland cement, the combined quantity of Portland cement and fly ash must be at least 100 lbs/yd^3.

***The requirements for air, 28-day compressive strength, and unit weight are for laboratory design only and are not jobsite acceptance requirements.

6.3. When low density flowable fill is specified, use an approved high air generator or foaming agent as given in Qualified Product List 31 and the following mix proportions:

Table 2 – Mix Designs for Low Density Flowable Fill	
Type 1 Portland Cement*	60 lbs/yd^3 Minimum
Air**	20-40%
28-day Compressive Strength**	50 to 145 psi
Unit Weight (Wet)**	Less than 90 lbs/ft^3

*Other types of Portland cement meeting the requirements of Division 700 may be used with prior approval of the Structural Materials Engineer.

**The requirements for air, 28-day compressive strength, and unit weight are for laboratory design only and are not jobsite acceptance requirements.

Because of its high air content, the ability to pump low density flowable fill while maintaining the required air content is limited. Ensure that the flowable fill supplier is aware of any planned pumping of this material well in advance of placement.

6.4. Flowable fill may also be specified as Rapid Set (RS) or Normal Set (NS). A minimum compressive strength of 35 psi is required at 16 hours for Type RS or at 48 hours for Type NS when cured under standard laboratory conditions. Report the laboratory compressive strength at these times as part of the mix design submittal.

7. ACCEPTANCE

7.1. Prior to construction, the Structural Materials Engineer at OMR must have appropriately reviewed the mix design.

7.2. Furnish a delivery ticket to the Resident Engineer for each load of flowable fill delivered to the work. Ensure that each ticket contains the following information:

- Project designation
- Date
- Time
- Class and quantity of flowable fill
- Quantity of water withheld

Supplemental Specification

December 2, 2011

Permanent Pavement Markings

Section 624

624.1 Description

Apply durable permanent markings to roadways designated in the Plans or Special Provisions. Apply lines at the widths and patterns shown in the Plans or as indicated in the Standard Drawings. For resurfacing projects, the existing markings may be used as a guide for placement of the new markings.

624.2 Materials

624.2.1 Permanent Pavement Marking Materials

Use one of the following three binder materials: thermoplastic, epoxy or polyurea. Apply thermoplastic or epoxy markings which meet the binder material requirements of Section 626, Epoxy Pavement Markings, and Section 627, Thermoplastic Pavement Markings, of the Standard Specifications. Apply polyurea pavement marking materials from the following approved suppliers: Epoplex - LS 90, 3M - Stamark LPM Series 1200, or other manufacturer's materials under project specific, conditional approval.

624.2.2 Drop-on Glass Beads

Use drop-on glass beads for thermoplastic and epoxy markings meeting the material requirements of Sections 626 and 627 of the Standard Specifications for AASHTO Type I beads, respectively. Use drop-on glass beads for polyurea pavement markings meeting the material requirements of Section 626 for AASHTO Type I beads.

In addition to the material requirements of Sections 626 and 627 of the Standard Specifications for AASHTO Type I beads, the following additional requirements shall be met:

- Drop-on glass beads shall not contain more than 200 ppm (total) arsenic, 200 ppm (total) antimony or 200 ppm (total) lead when tested to EPA methods 3052 and 6010B.

- 20% by volume of the Type I drop on glass beads shall have a refractive index of 1.9 or greater. The beads may be applied to the permanent marking in a uniform blend or using a double drop application.

Ensure that all beads have the appropriate performance enhancing coatings recommended by the bead manufacturer for the type of binder material selected.

624.3 Equipment

Use equipment to apply the permanent pavement markings that meets the requirements of the following Sections of the Standard Specifications:

- Section 626.3 - Epoxy and Polyurea
- Section 627.3 - Thermoplastic

624.4 Construction

624.4.1 Application of Permanent Pavement Markings

Apply the permanent pavement markings in accordance with the requirements of the following Sections of the Standard Specifications:

- Section 626.4.2 - Epoxy and Polyurea
- Section 627.4.4 and 627.4.5 - Thermoplastic

Do not apply thermoplastic pavement markings on portland cement concrete surfaces.

Immediately before the application of the new pavement marking material, clean the rumble strips with a broom and/or jet of compressed air. Ensure that the pavement surface is free of all dust, dirt and any other loose material immediately prior to marking application.

624.4.2 Application of Drop-on Glass Beads – Permanent Markings

Use a single drop application of AASHTO Type I glass beads for all marking materials.

Mechanically apply Type I beads to the surface of the pavement marking material immediately after the material is applied to the pavement surface and while the marking material is still wet or, in the case of thermoplastic, in a molten state. Ensure that the beads are held by, and mechanically embedded in, the surface of the marking material. Make certain that the beads are uniformly distributed over the entire surface of the marking using a single drop application. Uniformly apply the Type I glass beads at a rate of 8 to 10 lbs. per 100 square feet of marking.

For epoxy markings, consider application of additional AASHTO Type III or IV beads meeting the material requirements of Section 626 of the Standard Specifications using a double drop method to aid in reducing no track time. If using a double drop method, uniformly apply the large beads first at a rate of 8 to 10 lbs. per 100 square feet of marking immediately followed by the application of the small beads. Make sure that all beads are properly embedded at 60% of their diameter. When using this double drop large/small bead combination is, the 20% by volume mix of high index beads requirement of Section 624.2.2 will be waived.

Ensure that all beads have the appropriate performance enhancing coatings for the type of material selected.

624.5 Retro-Reflectivity Requirements

Measure marking retro-reflectivity using a Delta Light and Optics LTL-2000 or LTL-X hand held retroreflectometer.

Ensure that the markings achieve the initial minimum retroreflectance values shown in the following table. Make certain that these values are obtained within 30 days of marking placement, as measured with a LTL 2000 or LTL-X Retroreflectometer. Mark certain that the finished markings are uniformly retro-reflective as determined by visual inspection.

	Retro-reflectivity (mcd/lux/m2)	
	White	**Yellow**
Single Drop	375	250

Ensure that the markings maintain the minimum retroreflectance values shown in the following table for a period of 180 days. Take measurements within 30 days of the end of the observation period.

	Retro-reflectivity (mcd/lux/m2)	
	White	**Yellow**
Single Drop	325	200

The retro-reflectivity requirements do not increase if a double drop system is used to aid in reducing the no-track time of epoxy marking

624.6 Measurement

Measurement of permanent pavement markings is on a linear foot basis of actual line applied for each individual line.

624.7 Payment

Payment for the accepted quantities of permanent pavement markings will be on a linear foot basis for the width of lines listed in the bid item “Permanent Pavement Markings. Payment for symbols or work messages will be on a per each basis. See following table for pay items:

Supplemental Specification

Item Number	Pay Item	Unit
6241005	4" WH.BRKNLINE PERM.PAVEMENT MARKING	LF
6241007	6" WH.BRKNLINE PERM.PVMT.MARKING	LF
6241010	4" WH SLD LNE PVT EL PERM.PVMT.MARKING	LF
6241012	6" WH SLD LNE PVT EL PERM.PVMT.MARKING	LF
6241015	8" WH. SLDLNES PERM.PVMT.MARKING	LF
6241020	12" WH.SLDLNES PERM.PVMT.MARKING	LF
6241023	12INX18IN WH.TRIANG.YIELD BAR PERM.PVMKG	LF
6241025	24" WH SLDLNES PERM.PVMT.MARKING	LF
6241030	WHITE SGL ARROWS PERM.PVMT.MARKING	EA
6241031	WH.SGL.FISH-HOOK PERM.PVMT.MARKING	EA
6241035	WH.WORD MESS"ONLY"-PERM.PVMT.MARKING	EA
6241036	WH.MESS"STOP AHEAD"PERM.PVMT.MARKING	EA
6241037	WH.WORD MESS. -"SCHOOL"-PERM.PVMT.MARKNG	EA
6241038	WH.WRD.MESS."LANE ENDS-FT"-PERM.PVMT.MKG	EA
6241039	WH.WORD MESS"STOP"-PERM.PVMT.MARKING	EA
6241040	WH.COMBO.ARROWS PERM.PVMT.MARKING	EA
6241041	WH.COMBO.FISH-HK.PERM.PVMT.MARKING	EA
6241043	WH.LANEDROP ARRW PERM.PVMT.MARKING	EA
6241045	R.R.CROSS.SYMBOLS-PERM.PVMT.MARKNG	EA
6241050	HANDICAP SYMBOL-PERM.PVMT.MARKING	EA
6241064	4" YEL.BRKN.LINES.PERM.PVMT.MARKING	LF
6241066	6" YEL.BRKN.LINES.PERM.PVMT.MARKING	LF
6241074	4"YEL.SLD.LNES.- PERM.PVMT.MARKING	LF
6241076	6"YEL.SLD.LNES.- PERM.PVMT.MARKING	LF
6241078	8"YEL.SLD.LNES.- PERM.PVMT.MARKING	LF
6241079	12"YEL.SOLID LNE PERM.PVMT.MARKING	LF
6241080	24"YEL.SOLID LNE PERM.PVMT.MARKING	LF

Access as Quick as

Click, Click...You're In!

WITH CLICK2ENTER

YOUR MOBILE OR PORTABLE RADIO IS THE KEY

• Click2Enter taps the state-of-the-art electronics now designed into modern scanner radio technology to give public safety personnel (Law Enforcement, Fire, Ambulance/ Rescue or any authorized user) a quick, safe, reliable and stealthy means to activate gates and security control mechanisms using their portable or mobile radios.

• Click2Enter does away with the cumbersome keys, remote control actuators and access control codes required by other systems because every emergency response vehicle already has the "key"–their radio transmitter (mobile or portable). No need to buy extra equipment or modify your radios.

• The technology is secure. Public safety agencies are issued FCC-assigned radio frequencies for restricted use only. Possession of transmitting devices by non-authorized personnel is tightly controlled and transmitting on those frequencies by outsiders is against the law (both Federal and State statutes).

• Click2Enter responds only to the frequencies and sub-audible private line codes currently programmed into its memory. Editing those frequencies can be done with any RS-232 keyboard interface and standard modem protocol software.

• You now have near-instant access to secure areas to deal with emergencies as they occur. To activate the Click2Enter, the operator must be proximate to the device. A single or double pulse of your radio transceiver is all that is required to initiate immediate entry.

Innovative Reliable Flexible Safe Quick

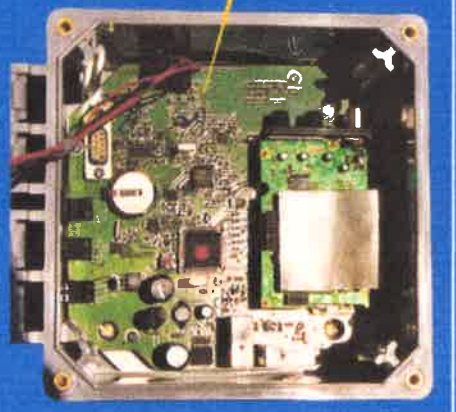
ACCESS USING YOUR TRANSMITTER RADIO
for **PUBLIC SAFETY** *and* **AUTHORIZED USERS**

Click2Enter, Inc.
U.S. Patent #5,955,947 and #5,903,216
PO Box 1532 Sonoma, CA 95476
Tel 707 939-3800 Fax 707 996-3739
info@click2enter.net
www.click2enter.net
Toll Free
877-939-3800

Click2Enter-I SPECIFICATIONS

- Scanner/receiver radio.
- Variable activation range via programming.
- One or two radio transmission "clicks" for activation.
- 50 channel capacity.
- Mutual aid compatible.
- Independent relay control for roll-up doors.

- Bright activation LED and power LED.
- Time/day/agency memory recall.
- CTCSS, PL/DPL private line (PL) programming capability.
- Auto detect and load of private line codes.
- Compatible with analog or digital radio transmitters, using private line sub-audible transmissions.
- Will operate with carrier only for use with digital radio systems.
- Able to use talk around carriers (car to car) of trunk line radio systems. Also able to operate in on-trunk mode.
- Able to receive radio transmissions to include 900 MHz bands.
- Able to use aircraft AM band frequencies for airport access control operations.
- Latch open and close features.
- Enhanced user-programmable latch open feature lets you specify gate open periods from one minute to unlimited.
- Ability to handle high power mobile transmitters and lower power hand held portable transmitters.



- Proprietary programming software built into each unit.
- Field programmable using a Windows CE PDA or laptop computer.
- Programmable via RS-232 interface.
- User-selected PIN for security of programmed frequencies.
- Able to capture and exhibit activation data log, via software.
- Computer software programmable using standard terminal emulation software (Hyper-Terminal).

- Ability to adapt and use 12V to 24V DC (Click2Enter-I power will be a regulated 12V DC).
- Lightning surge current protected (current/surge limiting circuit).
- Reflective logo for night identification.
- Unit enclosed in a NEMA Type 4 box, with security screws supplied.
- Relay or dry contact ready.
- Extra set of relay contacts to activate a multitude of devices.
- Separate device available to perform external test/operation of Click2Enter-I.
- Five year manganese dioxide lithium battery for memory backup.
- Retrofit kits available for operation beyond temperature range specifications (hot & cold).

Click2Enter adapts the technology inherent in most radio broadcast equipment to work as a radio control mechanism, but one with built-in security features.

Click2Enter will authorize access only after it verifies the FCC-assigned carrier frequency and agency assigned sub-audible communication (private line code) of the transmitter seeking entry. (It takes one or two separate radio pulses and verifications to complete the authorization sequence.)

Click2Enter can afford access to any public safety agency as long as their frequencies are programmed into its memory, thus solving the mutual aid problem which limits the effectiveness of competing devices.

Programming the Click2Enter is easy. All you need is an RS-232 keyboard interface and standard modem protocol software.

Click2Enter®

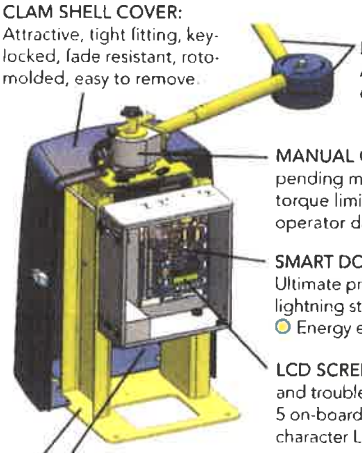
Click2Enter, Inc.
TOLL FREE
877-939-3800

Highest Customer Satisfaction

Elegant Reliablity

See the latest from HySecurity at www.hysecurity.com

Distributed by:



CLAM SHELL COVER: Attractive, tight fitting, key-locked, fade resistant, roto-molded, easy to remove.

PINCH REDUCTION ARM: Tubular, with elbow cover.

MANUAL OVERRIDE: Patent-pending manual override and torque limiting clamp (to reduce operator damage if gate is hit).

SMART DC CONTROLLER: Ultimate protection against lightning strikes and power surges. ○ Energy efficient and solar ready.

LCD SCREEN: Easily program and troubleshoot operator using 5 on-board buttons and 32 character LCD.

24V-UPS: Two 8 Ah batteries std. (located behind control box) or room for 2 extended backup 50 Ah batteries.

CHASSIS: 1/4-inch, heavy duty, low flex and corrosion resistant with large, easy access conduit opening.

COMPUTER INTERFACE (S.T.A.R.T.) FOR SETUP AND DIAGNOSTICS

Smart DC Controller reports many faults and conditions including:

- Open or close limit reached
- Tailgating
- Vehicle detector or loop malfunction
- Loitering
- Gate forced open
- AC power loss

Smart Touch Analyze and Retrieve Tool allows users to upload latest operator software, download fault logs, generate diagnostics, and program the operator using a laptop.

SwingSmart DC™ Models

Model	SwingSmart DC 20	○ Solar Model SwingSmart DCS 20
Gate Size	1,300 lb (590 kg) for 12 ft (4 m) gate 800 lb (363 kg) for a 16 ft (5 m) gate 600 lb (272 kg) for a 20 ft (6 m) gate	1,300 lb (590 kg) for 12 ft (4 m) gate 800 lb (363 kg) for a 16 ft (5 m) gate 600 lb (272 kg) for a 20 ft (6 m) gate
Open/Close Time	Adjustable 10 to 15 seconds Open/Close time set independently	Adjustable 10 to 15 seconds Open/Close time set independently
Duty Cycle	Continuous	Continuous
Horsepower	1/2 hp	1/2 hp
Standard Battery Backup Cycles*	Up to 300 cycles after AC power loss	N/A
Extended Battery Backup Cycles*	Up to 1,200 cycles after AC power loss	N/A
Temp. Rating	-13°F to 158°F (-25°C to 70°C)	-13°F to 158°F (-25°C to 70°C)
Certification	500,000 cycles	500,000 cycles
Voltage Input	115V or 230V, 50/60 Hz Call for 208V 50/60 Hz	24V solar panels
Accessory Power	12VDC and 24VDC and 24VAC 1 A each	12VDC and 24VDC 1 A each
Communication	USB, RS-232, RS-485, Ethernet option	USB, RS-232, RS-485, Ethernet option
UL 325 Listing	Usage Class I, II, III, IV	Usage Class I, II, III, IV
Warranty	5 year (7 year single-family residential)	5 year (7 year single-family residential)

*SwingSmart DC is exceptionally energy efficient, however actual battery backed up cycles will depend on gate resistance to travel, cycle length, battery longevity, ambient temperature, accessories drawing battery power and frequency of gate cycles during power outage.

OPTIONAL ACCESSORIES: HY-5A intelligent vehicle detectors, extended battery backup, solar model. Compatible with most available access control, safety, vehicle detection and many other accessories.

SYSTEM SUPPORT: Contact HySecurity for CAD drawings, installation information, tech manuals, help with specialty site requirements or other support. Visit hysecurity.com or call to speak with a HySecurity representative today.

HySecurity
Simple. Reliable. Secure.

Call HySecurity for an operator/parts distributor near you.
phone **800-321-9947** fax **888-321-9946**
www.hysecurity.com • **info@hysecurity.com**

COMMERCIAL

SwingSmart DC™

Residential/Commercial

HySecurity Advanced Technology for Commercial and Residential Customers

HySecurity's operators *secure the world's critical infrastructure and key assets where ultimate reliability is vital. Places like the Pentagon, international airports and nuclear power plants.*

SwingSmart DC *delivers that same uncompromising quality to commercial and residential customers, where ease of use, elegant operation, low maintenance and high reliability are expected.*

Visit www.hysecurity.com

For specifications, tech support, pictures and email subscriptions

Operates after power loss - Standard feature! Uninterruptible battery power provides up to 300 gate cycles after AC loss. SwingSmart can also power your access control and safety devices.

Program your gate to run your way. 30+ easy to program menu options including photo eye and detector logic, fail secure or fail open, and many valuable functional and security alert options.

Choose your speed. Independently adjustable open and close speeds from a fast 10 seconds to 15 seconds. Dual gates automatically synchronize to open and close in flawless perfection.

Power and finesse. High torque DC motor and microprocessor controlled acceleration and deceleration combine to reliably handle gates up to 20 ft or 1,300 lbs. Extra power to overcome wind resistance.

Solar power or low voltage. Too far from AC power? With adequate sun, pair SwingSmart DCS (Solar) with solar panels or use our low voltage kit to eliminate expensive deep trenching.

Eliminate costly, energy-hog heater. Wide temperature rating from below freezing -13F to scorching 158F means SwingSmart works when others die.

HySecurity

Simple. Reliable. Secure.

At a remarkably affordable price

Call HySecurity for an operator/parts distributor near you at 800-321-9947

KNOX-BOX®

Rapid Entry System

Helping the Fire Department Protect Your Property

Knox-Box® 3200 Series

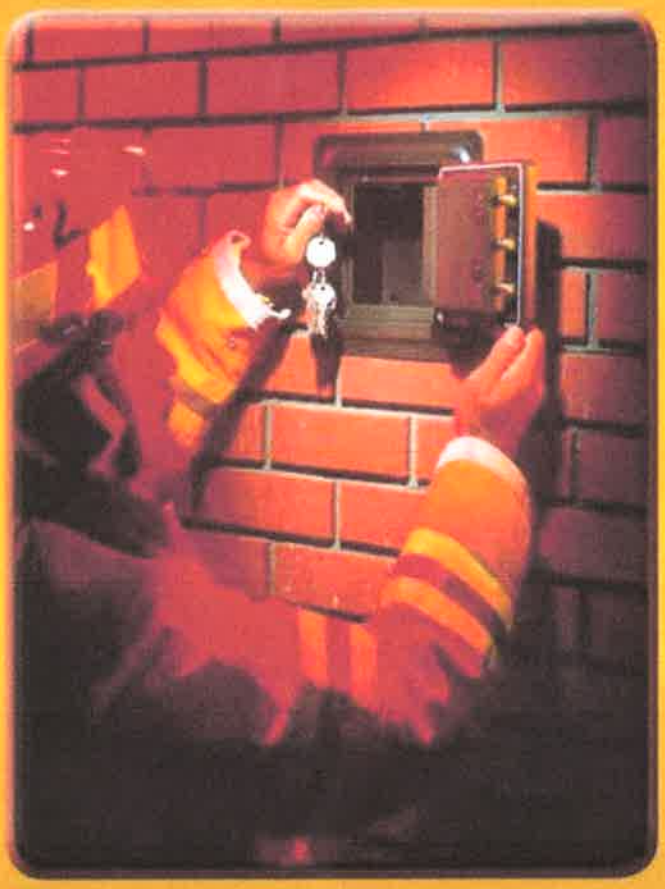
FDC Protection Products

Knox-Vault® 4100 Series

Padlocks · Key Switches

Knox-Vault® 4400 Series

Master Key Retention



Knox Elevator Lobby Box

Electrical Shutdown

KNOX-BOX® access provides faster emergency response without forced entry damage.

Knox Cabinets

Knox Residential Products

KNOX®

Serving Fire Departments Since 1975

The Complete UL Listed, One-Key Fire Department Emergency Access System.

KNOX®
Serving Fire Departments Since 1975

Knox-Box® 3200 Series

Surface Mount

3200 Series KNOX-BOX®

This leading high security, heavy-duty key box is used for most commercial applications including businesses, schools, government and public buildings, community associations and apartment complexes.

KNOX-BOX® - 3200 SERIES

Dimensions: Surface - Lift-Off Door 5"H x 4"W x 3-3/4"D
Hinged Door 4"H x 5"W x 3-3/4"D
Recessed - 7"H x 7"W (flange only)

Weight: Approx. 10 lbs.

Options:
- Hinged or lift-off door models.
- UL listed alarm tamper switches that connect to building's security system.
- Recessed Mounting Kit for new concrete or masonry construction.

Finish: Knox-Coat® proprietary coating system with 6 times longer protection than standard powder coat.

Colors: Dark bronze, black or aluminum.

Hinged Door Recessed Mount

Hinged Door Surface Mount

Lift-off Door Surface Mount

Knox-Vault® 4100 Series

Interior Closeup

NEW 4100 Series KNOX-VAULT®

A new Knox-Box that's for those applications where a 3200 Series is too small yet the 4400 Series is too large. In addition to keys and access cards, the 4100 also holds the Knox FDC Keywrench allowing departments to keep a keywrench on site.

KNOX-VAULT® - 4100 SERIES

Dimensions: Surface - 6"H x 6"W x 4-1/2"D
Recessed - 8-1/2"H x 8-1/2"W(flange only) x 4-1/2"D

Weight: Approx. 19 lbs.

Options:
- UL listed alarm tamper switches that connect to building's security system.
- Recessed Mounting Kit for new concrete or masonry construction.
- Access card/Keywrench holder
- Dual lock options.

Finish: Knox-Coat® proprietary coating system with 6 times longer protection than standard powder coat.

Colors: Dark bronze, black or aluminum.

Recessed Mount

Surface Mount

Knox-Vault® 4400 Series

Recessed Mount

4400 Series KNOX-VAULT®

Key vaults protect building keys, access cards and floor plans for larger businesses, industrial properties, public buildings and universities.

KNOX-VAULT® - 4400 SERIES

Dimensions: Surface - 7"H x 7"W x 5"D
Recessed - 9-1/2"H x 9-1/2"W(flange only) x 5"D

Weight: Approx. 29 lbs.

Options:
- UL listed alarm tamper switches that connect to building's security system.
- Recessed Mounting Kit for new concrete or masonry construction.
- Dual lock options.

Finish: Knox-Coat® proprietary coating system with 6 times longer protection than standard powder coat.

Colors: Dark bronze, black or aluminum.

Dual Lock Option Surface Mount

Recessed Mount

Fire departments across the country use the Knox® System to prevent costly forced entry damage while protecting property and lives. Knox key boxes, vaults and cabinets hold building entrance keys, electronic access cards and vital emergency information. Knox key switches and padlocks provide fire department access through property gates.

As the property owner, you purchase a KNOX-BOX® device then mount it near your building entrance or property gate according to fire department guidelines. Firefighters use a unique high security Knox® Master Key to open KNOX-BOX devices in their jurisdiction.

KNOX® PADLOCK

3772 Shrouded All Weather Use | 3770 All Weather Use | 3771 Interior Use

Knox® padlocks secure equipment lockers, restricted utility areas and fire access gates.

KNOX® ALL WEATHER SHROUDED PADLOCK – Model 3772

Dimensions: 3/4" H shackle clearance, 7/16" diameter stainless steel shackle with protective shroud cover

Finish: Brass body with EPDM rubber lock and body cover with stainless steel shackle and brass cylinder.

KNOX® ALL WEATHER PADLOCK – Model 3770

Dimensions: 1-13/16" H shackle clearance, 7/16" diameter stainless steel shackle

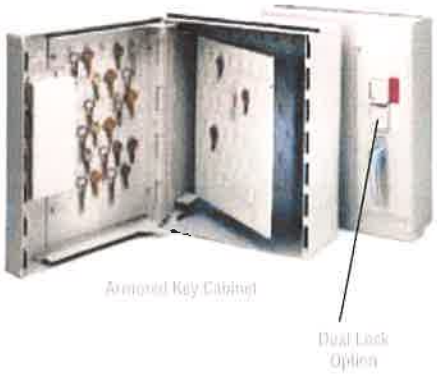
Finish: Brass body and lock cover, EPDM rubber body cover with stainless steel shackle and brass cylinder.

KNOX® INTERIOR LIGHT DUTY PADLOCK – Model 3771

Dimensions: 2-3/8" H shackle clearance, 5/16" diameter hardened steel shackle.

Finish: Steel body with hardened steel shackle.

KNOX® CABINET



Armored Key Cabinet

Dual Lock Option

Knox® cabinets provide onsite, high security storage for MSDS, Haz-Mat data, pre-fire plans and key storage for industrial and commercial sites and government installations.

KNOX® CABINET - 1300 SERIES

Dimensions: 18"H x 14-1/2"W x 5" or 7"D

Weight: Approx. 65 lbs.

Options:
- UL listed alarm tamper switches for connection to building's security system.
- Single lock standard, dual lock and other lock options available.
- 40 hook key back panel and 78 hook swing panel available. Total capacity 231 keys with expansion panels.
- Model 1201 Weather Housing should be used for unprotected outdoor installations.

Finish: Knox-Coat® proprietary coating system.

Color: Light grey.

KNOX® KEY SWITCH

Key Switch / Heavy Stainless Cover

Excellent gate override for gated communities, apartment complexes, parking garages, pedestrian gates, emergency machinery shutdown and industrial gated areas.

KNOX® KEY SWITCH - 3500 SERIES

Dimensions: Requires 2" recessed depth x 3/4" diameter.

Switch: S.P.S.T. 7A res. 4A ind. at 28VDC. 7A res. or ind. at 115VAC, 60Hz. UL and CSA listed. Two position key removal.

Mounting: Key switch is designed to be recess mounted. Face plate and lock cover ensures weather resistant operation.

Options: Momentary switch available. For custom switch applications, consult factory.

For contractor specs or custom items, contact factory at 800-552-5669.

Knox® Padlocks

Knox® Cabinet

Knox® Key Switches

Knox® FDC Caps and Plugs

KNOX® LOCKING FDC PRODUCTS

Knox locking FDC products protect both the intake and discharge sides of water based fire protection systems from vandalism and prevent excessive service calls. The locking FDC plug with ***Swivel-Guard™*** covers the entire swivel connection making the set screws inaccessible and minimizing the theft of the brass connection.

KNOX® FDC PLUG - 3000 SERIES

Dimensions: 1-1/2" and 2-1/2" male plug.
Weight: Approx. 3 lbs.
Properties: Solid stainless steel with stainless front cover
Finish: Bright stainless or chrome-like stainless
Option: Swivel-Guard™

KNOX® StorzGuard®

Dimensions: 4" & 5" Storz connections
Weight: 5 lbs.
Properties: Hard-anodized aluminum

KNOX® SecureCap®

Dimensions: 2-1/2" female cap
Weight: 7 lbs.
Properties: Stainless steel exterior with solid brass threads

Knox® Residential

Lift-off Door Surface Mount

Hinged Door with Temporary Door Hanger

KNOX® RESIDENTIAL

The residential key box is used for fire and medical emergencies on single family homes and apartment complexes. For residential use only, it holds a maximum of two keys. It can be mounted permanently near the door or directly on the door or if the key box is needed only for a short-term illness, it is available with a temporary door hanger.

KNOX® RESIDENTIAL - 1650 SERIES

Dimensions: Lift-Off 5"H x 4"W x 2-3/4"D. Hinged 4"H x 5"W x 2-3/4"D. Recessed 7"H x 7"W (flange only). Door hanger model has door bracket designed to fit over maximum 1-7/8" thick door.
Weight: Approx. 7 lbs.
Options: Hinged or lift-off door models.
Finish: Knox-Coat® proprietary coating system with 6 times longer protection than standard powder coat.
Color: Dark bronze, black or aluminum.

COMING SOON
KNOX® ELECTRICAL SHUTDOWN SWITCH

The 4500 remote electrical shutdown box houses an electrical service disconnect switch that can be used by first responders during an emergency.

COMING SOON
KNOX® ELEVATOR/LOBBY BOX

The Knox UL listed high security box is designed specifically for the elevator lobby where elevator keys and additional keys can be stored according to the latest IFC standard. The box is UL1037 compliant.

For Order Information, Please Call Your Fire Department or Visit www.knoxbox.com

KNOX®
Serving Fire Departments Since 1975

MADE IN THE U.S.A.

Knox Company • 1601 W. Deer Valley, Phoenix, AZ 85027 • 800-552-5669 • Fax 623-687-2299 • www.knoxbox.com • E-mail: info@knoxbox.com

IRB-MON

UNIVERSAL UL325-2016 PHOTOEYE

Applications

The IRB-MON provides a universal solution for entrapment protection. One photoeye covers the entire spectrum of possible requirements for monitored and non-monitored photo eyes, simplifying inventory management and product training.

The IRB-MON is an external entrapment protection device type B1, non-contact sensor for use with automatic gates and doors. The device is UL325-2016 compliant and suitable for use with both operators that require monitored entrapment protection and those that do not require monitored operation.

There are four monitoring interfaces:

1. Normally closed:	Cycle power to the transmitter while monitoring the receiver contacts for proper operation
2. Two-wire pulsed (2 freq):	Provides 300Hz "heartbeat" unobstructed, 0Hz obstructed over power supply lines
3. Two-wire pulsed (3 freq):	Provides 300Hz "heartbeat" unobstructed, 2Hz obstructed and 0Hz failure over power supply lines
4. Resistive termination:	Provides a 10k Ohm resistance when unobstructed

The long range and thru-beam features combined with the installer mode switch settings provide a flexible solution to all external entrapment protection needs.
A robust, NEMA 4X enclosure provides the durability required for high-reliability entrapment protection applications. Lens-less design minimizes fogging and false triggering caused by small objects and provides for easy alignment.

IRB-MON

EMX
INDUSTRIES

EMX Industries, Inc.
4564 Johnston Parkway, Cleveland, Ohio 44128
P. 800 426 9912 **F.** 216 518 9884
Sales Inquiries: salessupport@emxinc.com **Technical Support:** technical@emxinc.com
www.emxinc.com

Competitive Advantage

The major advantage of the IRB-MON is its flexibility; this photoeye covers the whole spectrum of UL situations.

- Monitored application per UL325-2016 as applied to overhead door and gate operators
- Non-monitored UL325 for gate operators prior to new 2016 requirements
- Non-UL installation

Distributors and dealers need only one photoeye to cover all these applications.

Accessories


IRB-HD


IRB-SH


IRB-SP


IRB-BR

Technical Data

Operating range	up to 115 ft. (35m)
Detection angle	24°
Sensitivity adjustment	potentiometer
Power indicator	Green LED
Detect indicator	Green LED
Mode selection switch	3 modes, relay output, pulsed (3 frequency), pulsed (2 frequency)
Relay output operation	Light on/dark on selection
Relay output	Form C contacts (NO, COM, NC)
Resistive termination	10k Ohm across NO contact
Power protection	Thermal fuse
Transmitter power cycle	>300mS (for use in configuration 0 Monitored)
Power supply	6...35 VDC, 12...24VAC (configuration 0-relay only)
Current (config. 1 and 2)	15mA (12VDC, includes TX and RX wired in parallel)
Current (config. 0)	60mA (relay activated)
Operating temperature	-40°F...170°F (-40°C...77°C)
Environmental	NEMA 4X
Dimensions (L x W x H)	2.3" (57mm) x 2.6" (65mm) x 3.7" (94mm)
Weight	TX - 0.35 lbs (159 g), RX 0.35 lbs (159 g)
Connections	TX-2 terminal, RX-5 terminal

Ordering Information

- IRB-MON Safety Photo Beam
- IRB-HD-SET Gold anodized aluminum protective hood
- IRB-SH-SET Gray powder coat steel hood
- IRB-BR "L" shaped mounting bracket
- IRB-SP Liquid tight strain relief connector
- IRB-S Set of nylon mounting screws with nuts

MADE IN USA