SPIRAL RIB GALVANIZED STEEL PIPE

MANUFACTURING METHOD

Spiral Rib Galvanized Steel Pipe is produced in diameters from 24" thru 108" in accordance with ASTM A 760, Type IR Ribbed Pipe. Standard lengths are 20'. The pipe is manufactured from a continuous strip of flat galvanized steel sheet approximately 27-3/8" wide in wall thickness from 18 gage (.040") to 12 gage (.109"). The steel coil is passed through the roller dies forming rectangular ribs projecting outward from the wall and, in some cases, a half round continuous dimple midway between the ribs. The formed section is then helically wound into a pipe configuration and the edges are typically joined by lock seaming. The rectangular ribs measure approximately 3/4" wide and 1" deep with a spacing approximately 11-1/2", center-to-center, or 3/4" wide and 3/4" deep with a spacing of 7-1/2", center-to-center. The ends of pipe are either recorrugated to receive coupling bands with annular corrugations, or are flanged to fit narrow channel bands. Bands with dimples have also been used.

Several types of coatings are available to resist abrasion and corrosion. For abrasion, heavier gage steel, bituminous or cement paving in the invert and polymeric coatings have been used. Exterior protection against corrosion is usually in the form of bituminous or polymeric coatings. The bituminous coatings are applied by the dipping process. Polymeric coatings are usually applied to the flat sheet prior to forming.

QUALITY CONTROL

A constant diameter is difficult to achieve due to the path the material follows forming the product. This diameter variation may create considerable offset at the joints. In accordance with ASTM A 760, the average inside diameter shall not vary more than 1% or 1/2", whichever is greater, from the nominal diameter when measured on the inside flat sections, excluding rectangular ribs. For example, on a 72" pipe, one end could be 71-1/4" and the adjoining end could be 72-3/4", resulting in a 1-1/2" offset. During the forming process, the zinc coating may be damaged along the continuous lock seam and at the corners of each rectangular rib section. Loosely formed lock seams may also occur.

STRUCTURAL ASPECTS

Structural design is based on theories, which are highly sensitive to the quality of the bedding and backfill. It is assumed the pipe is installed in perfectly homogeneous soil and the pipe will maintain a circular shape. However, field experience has demonstrated excessive deflection, flat spots, buckling (reverse curvature) and damaged joints do occur and should be considered in evaluating structural performance. The thin wall is subject to structural damage during installation as evidenced by punctures and indent. Pipe stiffness decreases with diameter increase, further aggravating structural problems.

FIELD DEPENDENT FACTORS

Due to the low stiffness, the product is very dependent on proper (high) compaction of the backfill materials. Pipe performance often depends on the backfill to provide 95 percent of the strength of the installation, while the pipe provides the remaining five percent. This places most of the burden of performance in the field on the contractor's installation methods, type of backfill material and adequacy of field inspection. Poor site conditions such as weak native soils and groundwater further aggravate the problem.

HYDRAULIC FACTORS

Laboratory tests for full flow indicate a clear water "n" value of 0.011. For field applications, a value of 0.013, or greater, should be used to account for variations in shape, flat spots, indents, joint offsets, bends, recorrugated ends, manholes, junction structures, bed load, debris, and corrosion. For partial flow conditions, the "n" value may increase.

DURABILITY, ABRASION AND CORROSION

The base metal is galvanized on both sides with a thin coating of zinc to help resist corrosion. The sharp bends made in forming the rectangular ribs, flanges and the lock seam may damage the zinc coating when stretched during the manufacturing process. Corrosion will generally occur first at these locations. The rectangular ribs trap water at these weakened sections and the scouring action of solids, such as rock and sand, tend to abrade through the zinc coating and the base metal.

Metal pipe is also subject to corrosion due to soil potential changes along the line, stray currents and pH of the soil. Run-off water and de-icing salts can also cause serious exterior corrosion. Cathodic protection by sacrificial anode or impressed current may be required.

Bituminous coatings have been relatively ineffective, having a typical life of 0 to 10 years. Polymeric coatings also have not given the desired added protection due to delamination, pitting and crazing.

FIRE RESISTANCE

While fires may only occur infrequently, serious problems will result. Bituminous coatings support combustion and are very difficult to extinguish. Often, the pipe will collapse during or immediately after the fire.

JOINTS

Joints are very susceptible to differential movement and shape change during the backfilling operation and tend to be a major weakness of the pipe; therefore, extreme care is needed during installation. While there are several methods of coupling the pipes together, all are time consuming. A narrow one-piece band is used for diameters up to 48". Two-piece bands are used for larger diameters. Double O-ring gaskets, or a pliable mastic material, may be used to seal the joints.

As evidenced in the field, joint performance can be a major problem due to the pipe diameter varying from one end to the other. Deflection and shape of the pipe on each side of the joint can also vary, resulting in joint leaks. Such leaks may pull fines from the backfill creating voids, loss of pipe support and eventual failure.

CONCERNS

Field installation is a major concern. Spiral Rib Pipe has very little inherent strength to resist external loads and handling stresses. Its supporting strength depends on more stringent and difficult requirements for foundation preparation, bedding preparation, pipe handling and placements, backfill material and compaction requirements. Potential problems increase with increase in pipe diameter.

SPECIFICATION SUGGESTIONS

- Limit deflection to 3% using the Iowa Formula with pipe/soil stiffness correction factors.
- Require deflection check after installation.
- Specify a minimum pipe stiffness such that the pipe inherent strength be at least 10% of the soil contributing strength.
- Require an "n" factor equal to 0.013, or greater.
- Require a higher minimum gage and invert protection when flow velocity exceeds 5 fps under abrasive conditions.
- Require select pipe embedment materials to at least 12" over the top of pipe, and 1 pipe diameter on each side in good soils and 2 pipe diameters each side for poor or wet soils.