

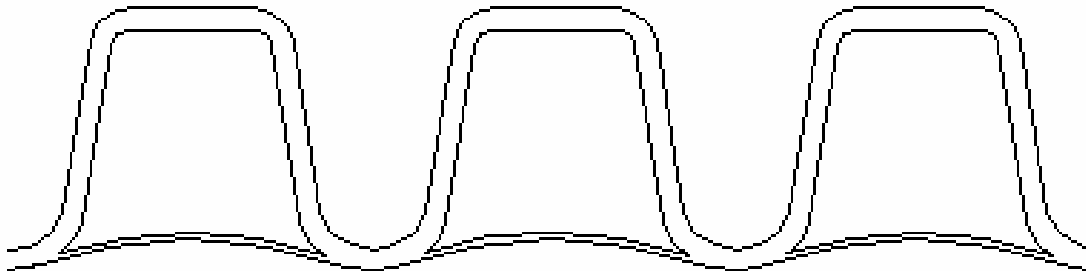
## CORRUGATED HDPE (TYPE S) PIPE REQUIREMENTS

---

After nearly seven years of intense review, the Southern California "Green Book" Specification Committee<sup>(1)</sup> established eight minimum requirements that must be met before any further consideration would be given for acceptance of Corrugated HDPE (Type S) Pipe. Those eight requirements are:

1. HDB rated resins (Hydrostatic Design Basis).
2. 46 psi stiffness, minimum for all pipe sizes.
3. Soil tight joints, joints that do not buckle.
4. Pipe design for a trench width requirement not to exceed one foot on either side of the pipe.
5. Long-term deflection shall meet the requirements of Table 306-1.2.12(A). Maximum Allowable Deflection Allowed
6. Addition of fire retardant additive materials.
7. HDPE pipe must demonstrate the ability to meet minimum service life of 50 years.
8. Absence of excessive water infiltration and exfiltration from the joints.

### TYPICAL (TYPE S) PIPE PROFILE



AASHTO Design Standards (Section 18) require the following initial and long-term (50 year) mechanical properties:

**MECHANICAL PROPERTIES FOR DESIGN**

<b>Initial</b>		<b>50 Year</b>	
Minimum Tensile Strength (psi)	Minimum Mod. of Elast. (psi)	Minimum Tensile Strength (psi)	Minimum Mod. of Elast. (psi)
3,000	110,000	900	22,000

Minimum cell class, ASTM D 3350, 315412C  
 Allowable long-term strain = 5%

**SPECIFICATION REVIEW HISTORY**

The Corrugated HDPE (Type S) Pipe industry applied to the Southern California "Green Book" Specification Committee for acceptance of their product in 1987. A Task Group was organized to specifically review their application.

That Task Group met once each month during the seven year period of time and reviewed and analyzed the design factors, material properties, and installation procedures for Corrugated HDPE (Type S) Pipe.

As requested by the pipe manufacturer's representatives, a test installation was chosen and two culverts were installed at the Miramar Landfill site in San Diego, California. A total of 251 LF of 36" pipe was installed in August 1993 by City of San Diego forces with installation direction provided by the manufacturer's representatives. Both major Corrugated HDPE (Type S) Pipe manufacturer's pipes were used. Various types of backfill material were used to represent a wide range of installation practices. The pipes were installed in a trench having approximately 5 to 7 feet of earth cover (i.e. a minimal combination of live & dead loads).

Vertical and horizontal deflection measurements were recorded by the City of San Diego personnel over a 5 month period, from September 1993 to January 1994. Percent vertical change ranged from an increase of 2.8% to a decrease of 9.9%.<sup>(2)</sup> In April 1994, a failure occurred at one location where the top of pipe was forced down to the invert, resulting in a total collapse of a portion of the pipeline.

A short video documentation of the installation, deflection measurements, inner wall buckling, tears and collapse of a portion of one test section is available, along with written deflection measurements, by writing to Rinker Materials, Engineering Department, 6560 Langfield Rd Bldg 3, Houston, Texas 77092.

## REASONS FOR REJECTION

The Southern California "Green Book" Task Group rejected the application for approval of Corrugated HDPE (Type S) Pipe on the following basis:

1. Miramar Landfill pipe failure on March 21, 1994.
2. Inspection of the installation viewed on March 22, 1994, in the City of San Marcos, California.
3. Review of the report by Hall and Foremen, Inc. on installation in Victorville, California.
4. Letters from the State Fire Marshal and Fire Chief for the City of San Diego regarding the flammability of HDPE and restriction of its uses.
5. Installation problems with HDPE: deflections greater than 3 percent short-term and 5 percent long-term; pipe buckling; excessive open joints; joints are not soil tight; infiltration and exfiltration of water; tearing of corrugations of the inner liner; circumferential cracking of inner liner; splits in inner liner; requirements for excessive trench width (2.5 to 5.0 times the diameter).
6. High degree of delamination of interior lines and outer shell, as observed at the San Marcos ADS distribution yard.
7. Inconsistency of physical properties.

## DEFLECTION LIMITS as per the SOUTHERN CALIFORNIA "GREEN BOOK"

Plastic pipe deflection limits are outlined in the "Green Book" specifications, **Section 306-1.2.12 FIELD INSPECTION FOR PLASTIC PIPE AND FITTINGS**. This Section covers 2-1/2 pages, however, only Table 306-1.2.12(A) is shown here.

**Table 306-1.2.12(A):**

Nominal Pipe Sizes	Percent Deflection Allowed
Up to and including 12-inch	5.0
Over 12-inch to and including 30-inch	4.0
Over 30-inch to and including 60-inch	3.0

## CONCLUSIONS

The consumer is advised that low stiffness Corrugated HDPE (Type S) Pipe should meet requirements similar to those required by the Southern California "Green Book" Specifications:

1. HDB Rated Resins verifying 50 year mechanical properties.
2. Minimum 46 psi stiffness.
3. Improved joints for exclusion of infiltration or exfiltration.
4. Long-term deflection of 3% - 5% maximum.
5. Minimum service life of 50 years.
6. Addition of fire retardant additive materials.

Design should evaluate all performance modes, wall crushing, deflection, strain and buckling.

Flexible pipe performance depends upon the surrounding embedment material. In addition to the design considerations listed above, proper installation procedures must be followed in order to achieve soil-pipe interaction.

## REFERENCES

- (1) Southern California "Green Book" **Standard Specifications for Public Works Construction**, written by the Joint Cooperative Committee of the American Public Works Association and the Associated General Contractors.
- (2) Report on HDPE Pipe at the Miramar Landfill, San Diego, California - prepared by Michael Dudas, City of San Diego.