Type 4: Marine Pipelines

Introduction: The primary design criteria for submerged and weighted pipelines are (a) the critical collapse pressure for empty or partially full pipelines, (b) weight of the concrete anchor and (c) spacing of the concrete anchors. Even though a marine pipeline is sometimes buried in an underwater trench, any support that the pipeline receives from the backfill material should be ignored for design purposes.

Driscopipe can be buried, rest on the bottom or floated on the surface of lakes, rivers, marshes or oceans. Its characteristics of flexibility, light weight, inertness to saltwater and chemicals, continuous pipeline due to butt fusion and the ability to float even when full of water give polyethylene many advantages.

The design of the external weights for water installations is a matter of preference. The weights are normally made to order by precast concrete manufacturers or by the contractor at the job site. These weights can be designed to hold the pipe away from the bottom using weights as legs or in a trench or directly on the bottom. It is advisable for weights for pipes larger than 12" to have reinforcing steel for strength. It is also recommended that one turn of rubber gasketing material or 2 to 3 turns of 5 to 10 mil polyethylene sheet be wrapped around the pipe under the weight to act as a cushion and prevent damage to the pipe.

Critical Collapse Pressure: A marine pipeline does not receive any structural support from the surrounding water. Therefore, an empty or partially filled non-pressure pipeline is subject to long-term hydrostatic collapse. A marine pipeline that is full of water at all times, such as an outfall or intake line, is not subject to collapse because the internal pressure will equal the external pressure at any specific depth of water.

Chart 32, shown below, gives design levels for empty or partially filled marine pipelines. These pressures represent the safe maximum differential pressures which can be applied to Driscopipe without buckling or collapsing the pipe. These values are based on extensive long-term differential pressure test data on actual lengths of pipe. The collected test data were mathematically analyzed and used to calculate performance limits for all pipe SDRs considering various degrees of original ovality. The values in Charts 32 and 33 are the calculated lower tolerance limits derived from the test data and represent the level of external differential pressure at which the risk of pipe collapse becomes insignificant. Pipe collapse in this test work was defined as that point where the major deflected diameter was 20% greater than the original undeflected diameter. Copies of the test results and data analysis are available upon request.

Chart 33

Multiplier for Temperature Rerating External Pressure Differential

Temperature °F	Temperature °C	Multiplier
50	10	1.14
73.4	23	1.00
100	38	0.79
120	49	0.62
140	60	0.50

Anchor Weights: The dry land weight of the concrete anchors may be calculated from the following formula. The designer should note that concrete varies in density between 140 lbs./cu. ft. and 155 lbs./cu.ft. and the "K" constant is an anchor constant. Where K = 1.0, neutral buoyancy is achieved. Where K = 1.3, the pipe should be adequately anchored for lakes, ponds and streams. Where current or tides are encountered, the designer may want to increase the K value to nearly 1.5 depending upon design factors and his judgment.

$$Wt^{Conc} = \frac{L(Wt^{Driscopipe} + Wt^{Product}) - (K \times Den^{Water} \times V(out)^{Driscopipe} \times L)}{\left(\frac{K \times Den^{Water}}{Den^{Conc}}\right) - 1}$$

Chart 32

Maximum External Hydrostatic Pressure Differential (on Externally Unsupported Pipe)

Feet of Water Head @ 73.4°F

Service Life	Pipe SDR 7	9.3	11	15.5	17	19	21	26	32.5
1 day	437	337	202	83	65	48	36	18	10
1 month	249	192	147	54	34	28	22	10	6
1 year	232	180	111	50	32	23	17	10	5
50 years	204	159	97	44	29	22	17	9	4

Based on critical collapse testing of actual pipe samples.
Full Vacuum is 34 feet of water.