Technical Note PP 842-TN
RCP Resistance of DriscoPlex® 6500 Series MDPE Gas Pipe

Properties in polyethylene (PE) pipes, including toughness, durability and corrosion resistance combined with reliable leak-tight fusion joining methods have led to its extensive use for gas distribution piping. Medium-density polyethylene (MDPE) is the predominant material used for gas distribution due to factors including lower stiffness to aid in field handling and greater resistance to slow crack growth (SCG) compared to the older, vintage high-density polyethylene (HDPE) materials. Although MDPE remains the predominant material used for gas distribution applications, newer bimodal HDPE resins such as Blackstripe® 8400 and Yellowstripe® 8300 pipes offer equivalent, excellent SCG resistance.

As material properties have improved, pipes are operated at increasingly higher pressures. Higher operating pressures require consideration of the pipe's engineering properties including resistance to Rapid Crack Propagation (RCP). RCP is a mode of fast brittle fracture that can occur under certain specific conditions when combined with an initiating event such as high-speed impact that forms a crack. Once a crack forms, the energy from the pipe's pressurized contents can propagate the crack rapidly over a large distance. The crack arrests when the energy available to drive the crack becomes less than the dynamic fracture resistance of the pipe. If a force is applied to the pipe but does not result in the initiating crack, RCP will not occur. RCP is a material consideration for gas applications. RCP does not typically occur in liquid applications as the toughness and ductility of PE pipes reduce the crack velocity such that the energy dissipates before the crack can propagate (See PP-838-TN).

RCP resistance is evaluated by one of two tests to determine the critical pressure (P_C) which can propagate a crack at the test conditions. ISO 13478 test directly measures the full-scale critical pressure ($P_{C,FS}$). ISO 13477 Small Scale Steady State (S4) test uses smaller, constrained samples and the result is correlated to the FS value through the use of a factor. The standard correlation factor is 3.6, though this value has been demonstrated to likely be overly conservative for some materials including DriscoPlex® 6500 series MDPE gas pipe.

Fracture mechanics analysis and empirical data demonstrate that pipe size and wall thickness affect P_C. In general, P_C decreases as pipe diameter increases for the same DR. ASTM D2513 indicates that P_C values are applicable to all pipes with the wall thickness of the pipe tested and all thinner wall pipes.

$P_{C,FS}$ values for some common sizes for DriscoPlex® 6500 Series pipe are given in the table below. While there is currently no requirement for limiting operating pressure as a function of P_C in the US, there are practices in certain international (ISO) as well as Canadian (CSA) standards that limit the maximum operating pressure (MOP) to ≤ $P_{C,FS}/1.5$. This document provides data for the engineering community to make informed design decisions.

Full-Scale critical pressure values for DriscoPlex® 6500 Series MDPE pipe at 0 °C.

Pipe Size	*$P_{C,FS}$*
2" DR 11	173 psi (Note 1)
4" DR 11	155 psi
6" DR 11	138 psi
8" DR 11	123 psi
12" DR 11	102 psi (Note 1)

1. Calculated value determined per S4 data converted to FS with standard correlation factor.

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