PolyPipe

WHAT YOU NEED TO KNOW ABOUT RCP

RCP (Rapid Crack Propagation) refers to a rare but significant catastrophic pipe failure mode that results in a rapidly progressing crack (typically >300 ft/sec) when a pressurized pipeline is subjected to a sudden or intense impact. RCP can also be the result of a pre-existing flaw or crack in the pipe. RCP can occur in most piping materials including steel and PVC pipes. RCP is generally of greater concern in piping systems that are used to convey compressed gasses. The rapid energy dissipation from a compressed gas provides the energy required to sustain crack growth.

RCP is dependent on: service temperature, internal operating pressure, pipe size/wall thickness, and pipe material properties (i.e. resistance to RCP).

- **As service temperature decreases, the potential for RCP increases.**
- **As internal pressure increases, the potential for RCP increases.**
- **As pipe diameter and wall thickness increases, the potential for RCP increases.**
- **The material properties of bimodal resins substantially reduce the potential for RCP.**

PolyPipe® **PolyTough 1** (PE2708), manufactured from Dow Chemical® CONTINUUM™ DGDA 2420 bimodal medium density resin offers outstanding resistance to RCP. The following table and charts compare the resistance to RCP of traditional unimodal PE 2708 resins to the PolyPipe® **PolyTough 1** PE 2708.

Critical Temperature (Tc) and Critical Pressure (Pc) are determined in accordance with ISO 13477 and 13478. Data are reported either as full-scale (FS), ISO 13478, or Small Scale Steady State (S4), ISO 13477. The S4 test is more stringent than the FS test and is relatively easy to conduct; therefore, the majority of the RCP data are generated by the S4 test. Since the S4 test is more conservative when correlating with FS test, S4 data are widely used. FS data are the reference data.

An RCP event is possible if:

- **The pipeline system is operating below the critical temperature, or**
- **The pipeline system is operating or being pressure tested above the critical pressure.**

The following table shows the comparison of critical pressure and critical temperature values of PolyTough 1 PE 2708 bimodal resins and other typical unimodal PE 2708 resins. The data presented are for 12" IPS SDR 11 pipes

PE Material	S4 Critical Pressure ($P_{c,S4}$) @ 32˚F	Full Scale* Critical Pressure ($P_{C,FS}$) @ 32°F	Critical Temperature ($T_{C,S4}$) @ 75psig
Unimodal MDPE	>15 psig	>90 pisg	<60˚F
Bimodal MDPE	>145 psig	560 psig	<28˚F

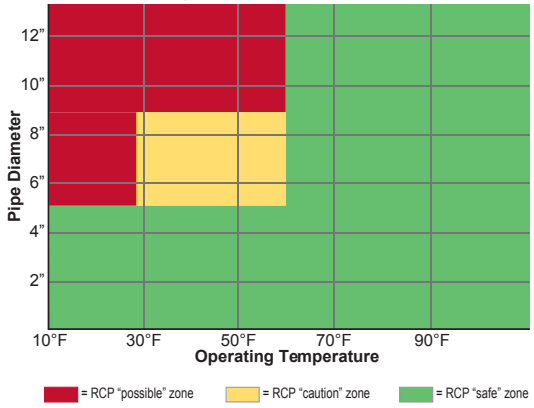
*FS PC calculated from S4 PC.

RCP is not typically a concern for pipe diameters smaller than 4". The following graphs compare the relationship of pipe size to temperature and pressure conditions under which an RCP event is possible.

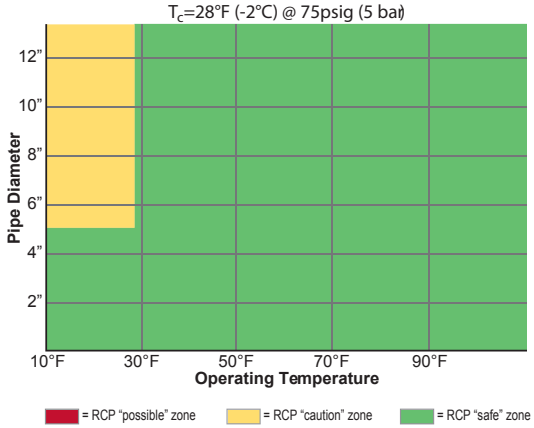
CRITICAL TEMPERATURE:

At operating temperatures below 60°F, it is possible to have an RCP event in a piping system manufactured using unimodal PE 2708 resins. Comparatively, RCP is not a concern in a piping system using bimodal PE 2708 resins until operating temperatures drop below 28°F, regardless of operating pressures.

Unimodal PE 2708
T_c=60°F(15°C) @ 73psig (5 bar)



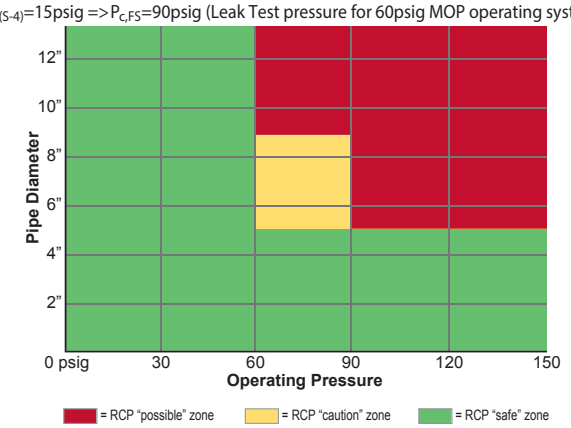
***PolyTough 1* Bimodal PE 2708**
T_c=28°F (-2°C) @ 75psig (5 bar)



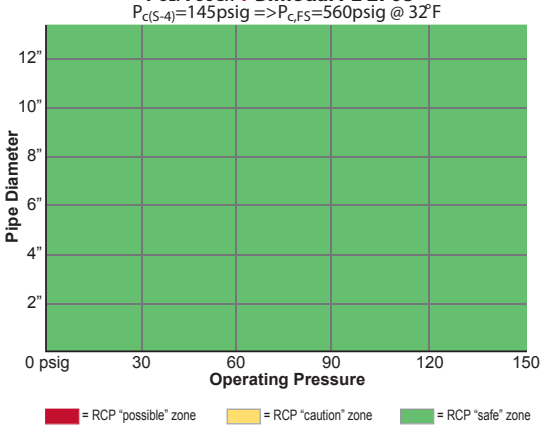
CRITICAL PRESSURE:

RCP can occur in a piping system manufactured from unimodal PE 2708 resin when the operating pressure or the test pressure is greater than 90 psig @ 32°F. Additionally, there is a "cautionary" zone between 60 psig and 90 psig that must be considered as a 1.5:1 RCP design safety factor is required. There is no concern about a pressure related RCP event occurring in a PolyPipe® PolyTough 1 (PE 2708) piping system as the critical pressure value for the bimodal resin is 560 psig @ 32°F.

Unimodal PE 2708
$P_{c(S-4)}$=15psig =>$P_{c,FS}$=90psig (Leak Test pressure for 60psig MOP operating system) @ 32°



***PolyTough 1* Bimodal PE 2708**
$P_{c(S-4)}$=145psig =>$P_{c,FS}$=560psig @ 32°F



CONCLUSION:

Field occurrences of RCP are rare; however, when they occur they can be devastating. The invention of bimodal materials, and specifically bimodal MDPE materials, now provides an engineering solution to a potentially hazardous field event.

Contact PolyPipe® for more information or samples of bimodal MDPE pipe.