

HYDROSTATIC TEST REPORT

DATE: 12-23-09 RK

Couplings: Male thread: 4" Campbell Long Shank Crimpology Nipple, both ends
- Fitting/ferrule system rated to 500 psi. WP

Hose: Oilfield Hydraulic Fracturing Hose: 4" Goodyear Oilfield Frac Hose with ARC rated to 400 psi.

Attachment: Crimped: plated steel long ferrules

Goal: To exceed 1600 psi. (hose WP of 400 psi. @ 4 to 1 Safety Factor)

Results: Hose exceeded 4 times WP. Hose burst at 1751 psi.

This test was conducted to ASTM D380 standards with the possible exception of slow pressurization. See engineering details below.

HOSE: 4" Goodyear Oilfield fracturing hose, 400 psi WP initial length of 24-9/16." Layline has ARC# 543-710-123. This hose has a slick inner tube, of nitrile rubber. It also has an outer cover which is more slick to the feel than a more standard rubber outer wrap, this difference in outer cover friction may possibly have an effect on retention based on reduced friction buildup between the inside of the ferrule and the outer hose surface.

END CONNECTION #1: Assembled by Campbell, with an HALPS-16C, a long shank Crimpology nipple with an FPS400456L plated steel long ferrule. Assembly was not difficult, in fact, the natural ID of this hose is slightly on the high range, the ferrule was very snug, however the fitting slipped right in. The hose wall on this end measured between .407" and .427" for a .417" average. The current crimp chart was interpolated and this end was crimped to $\phi 4.927$ " on a Custom Crimp CC-600 using 120 dies in multiple hits to ensure an accurate size. Crimp diameter was verified within .010". No noise was heard during the crimp process. This end was connected to our tester manifold using a 4" female NPT x 3/4" ground joint spud adapter connected through our usual 3/4" ground joint style connection on the tester. Pipe dope and Teflon tape was used on the NPT threads. See first connection photo. The tester nut was hand tight.

END CONNECTION #2: As above with the following exceptions. The hose wall on this end measured between .404" and .412" for a .408" average. The same chart as above was also interpolated for a crimp diameter of $\phi 4.913$ " using the same crimper, dies and methods. This end was connected to a 4" female NPT valve adapter with valve attached. As above, pipe dope and Teflon tape was used on the NPT threads. See second connection photo.

TEST: The assembly was filled with water and air was evacuated from the system by use of the valve at the free end. Due to cool room and component conditions, water of about 73°F was flowed through the assembly for slightly over 1 hour to both push the air out and equalize temperature. Note a temperature drop between thermometer and hose is 2-3°F, so actual test temperature of the hose is as close to 70° F as possible. See inlet temp and in tester photos. The assembly was crimped 24 hours before the test.

Pressure was raised steadily but was slowed due to significant expansion of the hose and the amount of water required to producing this expansion. This hose does not have any spiral wires, hence its expansion is expected to be greater than a similar hose with wires. Two pictures were captured around 1450 psi to show this expansion relative to the outside of the ferrule. See End 1 1450-psi and End 2 1490-psi photos.

Pumping continued and additional photos were attempted just above 1700 psi when the hose actually burst. The hose burst with a rather violent rupture leaving a large hole very near the exact center of the 16" exposed length. **The highest pressure recorded was 1751 psi.** See hose burst, close-up-1, close-up-2, burst location and peak photos.

The outer cover that the layline is printed on can be clearly seen around the burst area, as this cover ripped and pulled away from the outer layer of the hose, see close-up-3 photo.

There was very minimal hose movement under the ferrule on both ends of this assembly. Based on the initial marks made at the ferrule ends and marks or measurements made at the ferrule slots. Movement was measured to be 1/32" at the first connection and 1/16" at the second connection. See end 1 ferrule slot start, end 1 ferrule slot finish, end 1 ferrule mark finish and end 2 ferrule mark finish photos.

Certainly using this fitting and hose combination at 400 psi @ 70° F as rated by the hose working pressure would be considered safe and adequate.

Prepared by Randi Kremer, Engineer