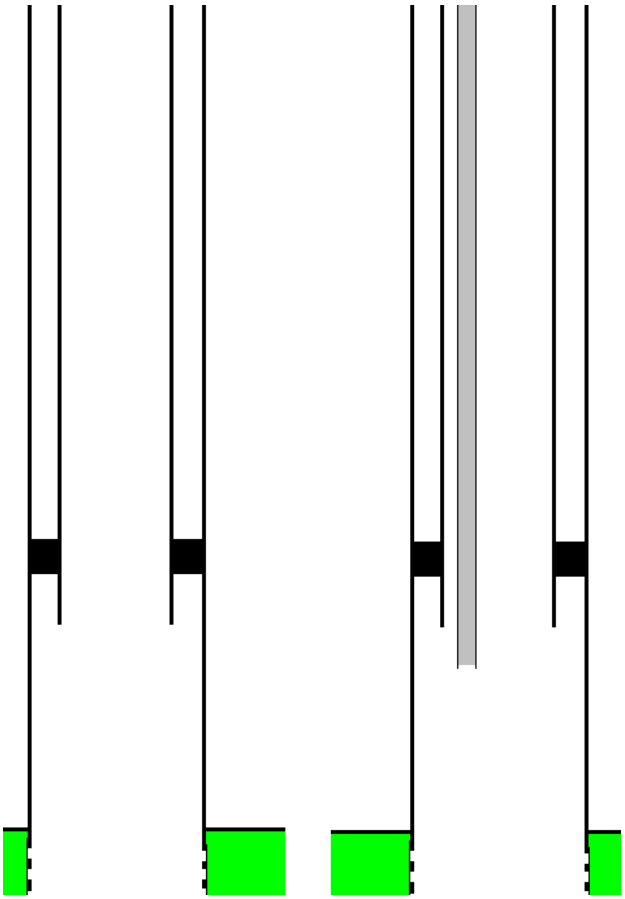
Velocity Strings

A velocity or siphon string is a small tube, usually 1” to 3-1/2” in diameter that is placed into the production tubing to increase the flow velocity to the critical velocity needed to lift liquids from the well. The flow may be up the annulus of the velocity string / production tubing, up the velocity string or manifolded together. Access via wireline is usually lost, but the well flow is usually improved. If the well doesn't flow on start-up or after a workover with the wellbore dry, a velocity string won't help. Velocity strings help stabilize a flowing well but other methods are often needed to kick a well off. Velocity strings are used to increase gas velocity above the critical flow velocity required to remove the liquids but won't help in kicking off a dead well if rocking won't help.



A velocity or siphon string occupies part of the existing tubular string, increasing the flow velocity in the remaining area and enabling the removal of liquids from a gas well.

Sizing is done with flow programs such as the Turner Correlations (World Oil, 1966) for well flowing pressures above 1000 psi, or the Coleman correlation for well flowing pressures below about 1000 psi. Friction pressure is often severe with the smaller strings. If used or sized improperly, the velocity string could increase tubing friction excessively and actually reduce production.

The method of hanging the velocity string for land based wells varies with the application. Normal installation is to hang the velocity string through the existing master valve, using a small spool with a profile to accept the velocity tubing hanger donut. A small master valve and regular annular valves are mounted on the spool to control the flow and to give flow path options. Problems in hang-off have included debris in the slips and poor conformation of the slips to the often ovaled shape of the used coiled tubing. Hang-off is critical and the system for hang-off must match the type, shape, weight and size of tube being used, the flow paths to be used and whether injection will be needed. For off-shore wells, velocity strings are more complicated since off-shore wells require a subsurface safety valve. In these cases, the velocity string is often suspended from a point below the SSSV.

For areas of hydrate production, ice plugs that form around the coil can exert a piston force on the coil, collapsing the CT string and wadding it up like a paper straw wrapper. This must be considered and prevented.

For offshore wells or other locations where a subsurface safety valve is used, the velocity string may be run on tubing or coiled tubing and the string may be suspended from an anchor in the tubing set immediately below the ScSSV. In these cases, hang-off and depth control are critical. If a profile is used to suspend the string, a profile with a no-go is needed. There have been about 10 velocity string hang-offs in the GOM where the top of the velocity string is below the ScSSV.

The most frequent problem with velocity strings is corrosion. Most of this problem comes from the use of thin wall coiled tubing as strings and the use of worn-out CT work strings at the end of their life. Most strings are generally used work strings, often heavily cycled and work hardened and fatigued. Also, the residual curvature in the strings makes the CT lay in an unpredictable fashion against the production tubing, leading to trapped water contact and wetted surface corrosion. Most failures are from CO_2 corrosion. Life of a CT velocity string in wells with 3 to 7 psi CO_2 partial pressure is 2 to 4 years. Extended life has been seen in wells with less CO_2 content but hardening of the string, leading to brittle behavior continues to be a problem.

Velocity strings have characteristically been primitive in design and application, but high quality jointed hang-offs are practical. Constant diameter strings are the norm, but tapered ID and OD strings are possible and practical.