

Downhole Chokes and Pressure Regulators

Objective: gather and condense information on design, placement, operation and retrieval of down hole chokes and pressure regulators for temperature and pressure control of the flow stream.

Summary: A flow regulator may be preferable to a downhole choke for achieving control of pressure and/or heat transfer to the upper annuli. Wireline conveyed, downhole chokes and pressure regulators have been used to control hydrates and to address other temperature and pressure problems in a number of producing environments including hydrate producing, high pressure gas wells in the Gulf of Mexico and the North Slope. Setting, operation and retrievable of flow regulators appears to be a low risk form of control with a high degree of certainty that the specified function will be controlled. The flow regulators, particularly the E-type flow regulator from Halliburton is very dependable (reference Mark Barrilleaux). The downhole chokes are also used in North Slope operations (reference Randy Valencia) to control hydrates. The chokes and regulators can be set in a profile or in pipe without profiles through use of mandrels. Other intra-company and inter-company company information are available in Coin network notes (ref: Dan Gibson's inquiry and posting of data).

Specific information:

1. Downhole chokes may be set in almost any tubular string with routine slick line operations. The typical choke is a metal housing with a shaped exit throat and a ceramic choke insert epoxied into the bottom or inlet face of the choke. The choke is screwed into a plug and latched into a profile with standard wireline running tools.
2. The downhole choke's primary use is reduction of hydrate potential. Hydrate problem control is accomplished by taking part of the flow stream pressure drop downhole, where the sharply reduced temperature produced by expanding gas will not create hydrates in the hotter downhole environment. The disadvantage to this process is the added friction pressure of the expanded fluids in the production stream and the potential loss of some of the natural gas lift.
3. Flow regulators (reference the OTIS E-type regulator) are designed to reduce surface flowline pressures to control either hydrate formation or the actual flowing pressure of the well. The unit consists of a spring-loaded flow tube that is forced off its seat by the production of the well. A predetermined spring tension (adjustable with spacers) is applied in the tool, depending on the amount of pressure differential to be carried across the tool. When the predetermined differential is reached, the seat compresses the spring, allowing the well to flow. When pressure differential to be carried across a tool exceeds the capacity of a single tool, the regulators can be run in series. The tools may be made up with a pressure equalizing feature. The regulators are wireline set, usually in a landing nipple or collar lock mandrel or slip type mandrel where no profile is available. Set depth is variable with need. Needed information to order includes: lock type and size, service (std, H₂S, CO₂, amine), temperature, pressure differential, production fluids (water-cut, GOR, specific gravities,) and set depth.
4. Downhole chokes or bottom hole choke beans are made for a specific set of flow conditions and are capable of controlling hydrate potential only during steady state flow. Unloading a static tubing string (start-up) can produce hydrates via drawdown and expansion of the fluids above the choke. Downhole chokes do not control shut-in pressures as do the flow regulators. The choke size is set according to specific information for the well. Changing flow conditions such as pressure drop and phase change require choke replacement to resize the choke to achieve the desired pressure drop. Downhole chokes may be set in X and R profiles. Set depth is usually in the lower, hotter part of the well. Needed information to order includes: lock type, size and part number, service (std, H₂S, CO₂, amine), temperature, pressure differential, bean size for bottom hole choke.

5. Where profiles do not exist in the tubing string, the use of a slip type or collar lock mandrel offers a reliable method to lock and pack-off wireline retrievable flow controls. The mandrels can be set and retrieved with wireline under pressure. An equalizing feature allows release under pressure. Both mechanical and pressure activated pack-off tools are available. Needed information to order includes: type of lock; tubing size, grade, weight and thread; service (std, H₂S, CO₂, amine), temperature and pressure rating.

References: Otis Catalogue, Conversations with Bill Kelly, Mark Barrilleaux, and Randy Valencia, Coin network data on downhole choke notes posted by Dan Gibson.