

EquiFlow[®] Autonomous Inflow Control Devices (AICDs)

INCREASE HYDROCARBON RESERVES AND RATE OF RECOVERY

OVERVIEW

Horizontal wellbores provide access to narrow, oil-bearing formations for maximum contact with pay zones. However, when production causes unwanted water and/or gas migration to the wellbore, or creates uneven production distribution, operators turn to Halliburton EquiFlow[®] autonomous inflow control devices (AICDs). The EquiFlow AICD helps delay and reduce the flow of unwanted fluids and stimulates balanced production throughout the entire interval.

EquiFlow AICDs are Type 2* inflow control devices (ICDs) that use innovative dynamic fluidic diode technology to distinguish the types of fluids flowing through the device and optimize oil production and recovery. The EquiFlow AICD performs similarly to a standard ICD during oil production, balancing inflow, yet restricts water and gas production at breakthrough, dramatically minimizing water and gas cuts. EquiFlow AICDs use no moving parts and require no downhole orientation. Additionally, the devices provide injection capability and use the dynamic fluid properties to direct flow. All these features enhance long-term functionality and reliability.

Fluid Dynamics Technology

Used an engineered system of flow paths and channels to regulate fluid flow and incorporate three individual dynamic components — a viscosity selector, a flow switch and a flow restrictor — all functioning together to allow or restrict fluid flow without moving parts.

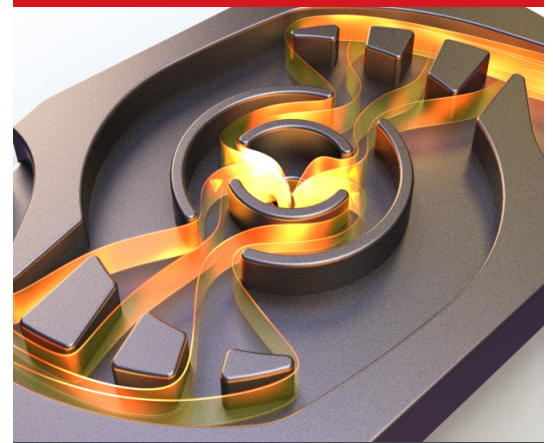
The **viscosity selector** uses a system of flow paths, which is based on fluid viscosity, density and velocity. It “identifies” the fluids flowing through the AICD, then divides the total flow between two open flow paths. Based on the fluid selector’s output, the **flow switch** passively directs the majority of the selected fluid down one of the two paths depending on the fluid’s properties. Finally, the **flow restrictor** restricts the contributing ratio of unwanted fluid (water and/or gas) entering the wellbore while oil-producing zones continue production with minimal restriction.

Advanced Completions Modeling Capabilities

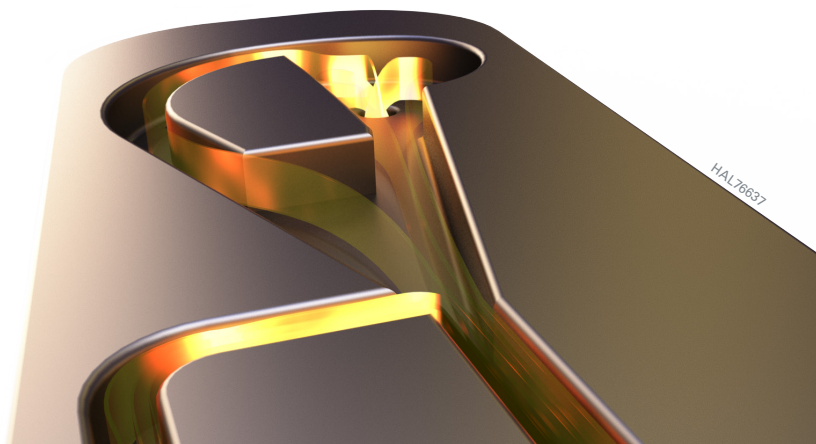
Halliburton has embedded EquiFlow[®] AICD performance into a suite of numerical simulators including NETool™ software, QuikLook[®] service, Nexus[®] software, REVEAL™ software, and DuneFront PackPro software to model near-wellbore performance, evaluate the entire field, and perform dynamic coupling using other industry reservoir software, as needed.

*In accordance with the Advanced Well Equipment Standards Group (AWES) Joint Industry Project and API SPEC 19ICD

WHAT MAKES AN ICD TRULY AUTONOMOUS?



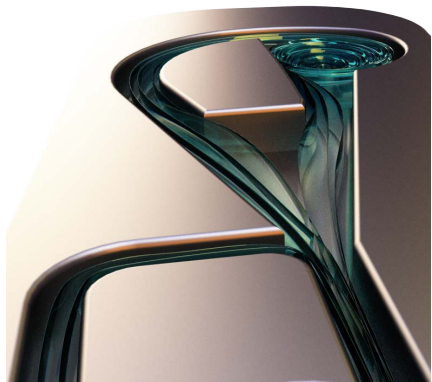
An autonomous ICD must have a geometry that alters the flow path preferentially restricting the flow of unwanted fluids.



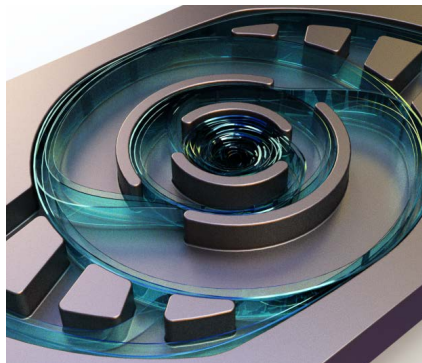
APPLICATIONS

Typical applications include wells experiencing heel-toe effects, water/gas breakthrough, permeability differences, and water or gas challenges in horizontal or layered reservoirs. The EquiFlow® AICDs have been installed in stand-alone screen (SAS) completions, openhole gravel packing (OHGP), through tubing/inner string, multilateral wells, and sandstone/carbonate formations.

The EquiFlow AICD comes in four different designs that address viscosity oil ranges from very light to very heavy oil.



EquiFlow® AICD Range 2



EquiFlow® AICD Range 3

Range 1 and Range 2

- » Fluidic sensor highly sensitive to fluid properties of very light oils
- » On/off switch upon water or gas breakthrough
- » Bi-stable switch: two stable flow patterns
- » Flow pattern has direct path to the exit
- » Second divergent path induces spinning, thus increasing pressure drop and reducing flow rate

Range 3 and Range 4

- » Gradual change in restriction of unwanted fluid
- » High pressure drop for low-viscosity fluids and low pressure drop for high-viscosity fluids
- » Two possible paths: tangential path to induce rotational motion/spinning or multiple radial passages toward a direct exit

FEATURES

- » Operates autonomously without requiring intervention
- » No moving parts, electronics, dynamic sealing surfaces, or connections to the surface
- » Functionality or efficiency unaffected by downhole orientation
- » Ceases flow restriction if unwanted fluid recedes
- » Designs available to produce oil and restrict either water or gas
- » Functions as a standard ICD before water/gas breakthrough
- » Each device functions independently for precise response to the reservoir
- » Allows injection of reservoir treating fluids
- » Self-regulating and adjustable depending on produced fluids

BENEFITS

- » Facilitates accelerated recovery
- » Maximizes ultimate recovery
- » Helps increase reliability through design simplicity
- » Minimizes undesired fluid production
- » Helps reduce costs and risks associated with unwanted fluid production
- » Delays onset of unwanted water or gas production

EquiFlow® AICD Specialized Designs and Available Sizes

Design	Oil Viscosity Range	Oil Type	Fluid Restriction	Available Sizes** (in.)
Range 1	0.3 to 1.5 cp	Very light	Gas and water*	2 3/8
Range 2	1.5 to 10 cp	Light, medium	Gas and water	2 7/8
Range 3	3 to 200 cp	Light, medium, heavy	Gas and water	3 1/2
Range 4	150+ cp	Heavy, very heavy	Gas and water	4 1/2
				5 1/2
				6 5/8

*Water restriction for differential pressure greater than 50 psi

**EquiFlow® AICD designs do not protrude into the basepipe.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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