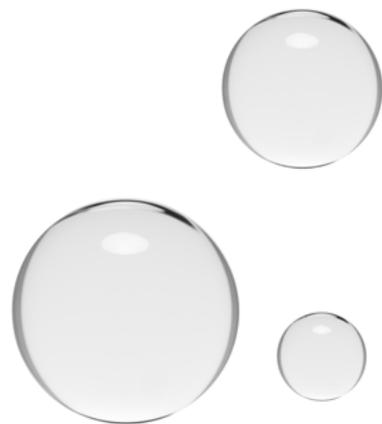


# Clear Brine Fluids

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Clearly in control



# Tough applications? The solution is clear



Clear, solids-free cesium formate brine is field proven in over 350 applications worldwide.

Cesium formate brine delivers a safe, trouble-free hydrostatic barrier for clean completions, workovers, suspensions and interventions.

With solids-free densities from 1.57 g/cm<sup>3</sup>/13.1 lb/gal to 2.30 g/cm<sup>3</sup>/19.2 lb/gal, cesium formate brine is field proven in over 350 applications. It has been used successfully in high-pressure, high-temperature (HPHT) fields at temperatures as high as 235°C/455°F and pressures up to 1,126 bar/16,331 psi with no fluid-related well control incidents ever. Its unique properties deliver a number of benefits, which make it ideally suited for clear-brine applications.

## High-density, solids-free cesium formate brine

Faster, cleaner operations

Minimises operational risk

Safer for rig crew

Negligible environmental impact

Protects against corrosion

Compatible with elastomers

Stable at high temperatures

Highly durable

Biostatic at high concentrations

Completion brine

Workover fluid

Intervention fluid

Suspension fluid

Packer fluid

# Increase effectiveness Cut cost and risk



Field research shows completion operations take significantly less time with cesium formate brine.

## Problem-free completions

High-density cesium formate brine has been successfully used in hundreds of completions across the world. In 2015, well engineering consultancy Ridge AS completed a study of 89 North Sea wells. Ridge concluded that formate fluids outperform other fluids to deliver significant rig-time savings for both openhole and cased and perforated completions by enabling more time-efficient solutions. For example, tubing-conveyed perforations in overbalanced fluid and installation of upper completions in overbalance provide significant time savings compared to installing the upper completion in underbalanced fluid and perforating underbalance on coiled tubing or wireline. Overbalanced completions in cesium formate brine also eliminate well control risk associated with underbalanced completions and environmental risk from zinc-laden halide brines. Download our 'Save Weeks Drilling and Completing' brochure from [formatebrines.com/brochures](http://formatebrines.com/brochures).

## Fast and effective workovers and interventions

Clear, non-damaging cesium formate brine creates sufficient hydrostatic pressure to provide safe, trouble-free workovers and interventions with minimal impact on the formation and downhole equipment. Our unique, high-density brine remains stable at high temperatures and effectively cleans the hole during operations.

## Successful suspensions

With its high thermal stability and ability to protect downhole metals against corrosion, cesium formate brine is exemplary for well suspensions, even in HPHT environments. It has been used in numerous operations worldwide at temperatures up to 235°C/455°F, including suspensions of 15 months' duration with no adverse effects on downhole metals.

## Safe packer fluids

High-density cesium formate brine is ideal for creating hydrostatic pressure. It lowers differential pressure across sealing elements and on the wellbore and casing to prevent collapse, and protects metals from corrosion. Formate brines have been used as packer fluids in numerous wells from the Gulf of Mexico to the North Sea, including one documented case of formate brine left downhole for six years under pressures of 965 bar/14,000 psi and temperatures of 177°C/350°F. When the production string was finally pulled from the hole it was in excellent condition – even the identification markings on the pipe were intact!

### Case: Workover and suspension

## Total Elgin/Franklin, North Sea

Cesium formate brine with density of 2.19 g/cm<sup>3</sup>/18.3 lb/gal provided effective hydrostatic well control in more than 20 HPHT workover and suspension operations in the Elgin/Franklin fields over nine years.



# Brine with benefits



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Cesium formate brine provides corrosion protection for downhole metals.

## No solids. No problems

Cesium formate brine is naturally heavy cesium formate salt dissolved in water. With this natural high density, our brine offers a clean and solids-free environment for problem-free operation of tools, valves and packers ensuring operations go smoothly from start to finish.

## Corrosion protection

Cesium formate brine is highly compatible with downhole metals. With its monovalent and alkaline properties, cesium formate brine buffered with carbonate/bicarbonate provides corrosion protection in harsh CO<sub>2</sub> and H<sub>2</sub>S environments, even maintaining favourable pH after large influxes of acid gas.

The formate ion is an antioxidant, which limits the requirement for oxygen scavengers and antioxidants. A high concentration of formate ions in the brine – up to 14 moles per liter – prevents problems that often occur when these additives become depleted.

Furthermore, concentrated formate brines do not need added biocides, which reduces costs further.



## Case: Completion

### Statoil Kvitebjørn, North Sea

Fourteen HPHT reservoir sections have been successfully drilled and twelve completed with cesium/potassium formate brine in the Kvitebjørn field since 2004, with one well completed in a record time of 12.7 days. Per Cato Berg, Lead Drilling Engineer for Kvitebjørn, says: “Supported by our tests and data, we feel that cesium formate gives the best productivity for the wells.”

Cesium formate brine’s stable nature means the risk of catastrophic, fast-acting localised corrosion associated with acidic halide brines is negligible. In more than 150 HPHT applications over 15 years there have been no recorded cases of stress corrosion cracking or pitting corrosion.

## Safer to handle

High-density cesium formate brine is much safer to handle than alternative acidic halide brines. Rig crews work more effectively as no specialist personal protective equipment is needed.

## Conserving the environment

Cesium formate brine has low environmental toxicity with the formate ion biodegrading entirely if discharged to the sea. It meets the demanding environmental standards set by CEFAS (Centre for Environment, Fisheries and Aquaculture Science) in the UK, the Norwegian Environment Agency and other such authorities across the world. Cesium formate brine has been used in highly sensitive environments from the Gulf of Mexico and North Sea to onshore use in Hungary and Papua New Guinea.

An independently conducted life-cycle assessment on formate brines concludes: “The findings of the study indicate that the discharge of moderate amounts of formate brines is not likely to lead to potentially significant negative impacts on the marine environment”. Cesium formate brine’s environmental strength is summarised by Total when it was chosen as the brine-of-choice for its Elgin, Franklin and Glenelg wells: “In deploying cesium formate brines in these fields, Total has created new Health, Safety and Environmental standards for completion and workover brines in the North Sea.”<sup>1)</sup>



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Formate brine is used in highly sensitive environments, such as the Barents Sea and Alaska.

### Thermally stable and highly durable

Cesium formate brine has been safely deployed in over 150 HPHT wells at temperatures up to 235°C/455°F. It's proved thermally stable over time having successfully withstood HPHT conditions for as long as two years.

### Compatible with elastomers and seals

Numerous field cases and research studies conducted by Baker Hughes, Shell Research, our company and others show that formate brines are well suited to the vast majority of elastomers and seals used in downhole applications. Risks of leaks, equipment damage and safety breaches are significantly reduced, leaving operations running smoothly and safely.

High-density cesium formate brine forms unique solids-free, non-damaging clear brines for multiple applications. Fully proven in numerous fields across the world, its remarkable properties translate into real benefits by cutting well construction costs, reducing HSE risk and helping optimise revenues.

#### Case: Suspension

### TXM Mako-6, Hungary

Two records were broken during this challenging well kill and suspension operation using 2.15 g/cm<sup>3</sup>/17.9 lb/gal cesium formate brine – the deepest packer ever set in Hungary at 5,198 m/17,054 ft and the highest temperature for cesium formate brine use at 235°C/455°F. The well was suspended three times, including a nine-month suspension, with no significant changes in fluid properties and composition.

Don Wright, operations manager for TXM, comments: "Cesium formate provided stable well conditions and enabled operations to progress safely and smoothly. Crew only needed to wear standard personal protective equipment, something that made working conditions much more comfortable."

#### Case: Completion

### Tapis ExxonMobil, Malaysia

Located in the South China Sea, Tapis F with reservoir temperature of 160°C/320°F, is part of Malaysia's largest oil field. After drilling a series of three wells in the low-permeability formation, CO<sub>2</sub> caused ExxonMobil to turn away from its original completion brine due to risk of CaCO<sub>3</sub> scaling. Instead, blended cesium formate brine with density of 1.71 g/cm<sup>3</sup>/14.2 lb/gal was selected to minimise formation damage and maximise production. All three completions were successfully carried out without incident.

1) Total, Drilling Contractor, May/June 2007.



performance through simplicity



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