Advanced Completions & Production Optimisation for our Clients’ Reservoirs

Tendeka was established in 2009 through the consolidation of SwellFix, Sensornet and Well Technology. Strategic acquisitions of Flotech and FloQuest in the same year saw Tendeka emerge as a leading provider of completions systems and services to the upstream oil and gas industry.

With a global presence, Tendeka continues to expand its reach, develop technology and increase capability across all reservoirs.

Our clients have experienced improvements in completions performance by combining field proven technologies with innovative design. Such advancements include Autonomous Inflow Control Device (AICD) technology; wireless intelligent completion technology which contributes to the overall digital oilfield vision, and unique technology for enhancing life of water injections wells.

From simple to complex well designs, our systems have extensive track records to overcome production challenges in the most challenging operating environments.

Our commitment to developing innovative and quality technologies enables our clients to maximise production across the full spectrum of conventional and unconventional reservoirs.

With main headquarters in Aberdeen, UK, we have further offices and operations in our regions of Europe, Former Soviet Union & Sub-Saharan Africa; Middle East & North Africa; North and South America, and Asia Pacific & China.

Our global presence ensures we are well placed to meet demands and deliver measurable results to our clients, no matter where they are.

**Tendeka timeline**

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<td>Founded in 1998</td>
<td><strong>Advanced completions and production optimization technology for the global oil and gas industry</strong></td>
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Strategy, vision & mission

We deliver returns and create value for our clients by providing high quality completions and well services, and significantly improve well performance through utilisation of global footprint and extensive routes to market.

We strive to accelerate innovation and commercialisation of new technology, bringing impactful solutions to our clients across the globe.

Mission: to be the advanced technology company that optimises reservoir recovery through innovation and employee empowerment.

Vision: to optimise every drop of energy produced from the planet.

Significant milestones

Tendeka’s portfolio includes completion solutions for zonal isolation, sand and inflow control, hydraulic fracturing, wireless completions, data visualisation, reservoir monitoring and production enhancement. Operating in conventional and unconventional reservoirs, the track record speaks for itself with over 100,000 installations worldwide.

Tendeka’s significant milestones include:

- installations of the world’s first cloud-connected wireless intelligent completion
- award of the largest sand control contract in the world
- recognition as market leader in inflow control technology with installation across 5 continents
- launch of Production Enhancement division delivering significant water savings in hydraulically fractured completions
Core Values

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<th>Description</th>
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<tr>
<td>SAFETY</td>
<td>We are committed to the wellbeing of our people, contractors and visitors, the wellbeing of the environment and the achievement of zero incidents.</td>
</tr>
<tr>
<td>PEOPLE</td>
<td>We are culturally diverse and aware, our people respect each other, learn together and work together to deliver our organisation’s goals together. We are open in our communication and promote awareness of our performance and plans across the organisation.</td>
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<tr>
<td>PERFORMANCE</td>
<td>We are exceptionally focused and dynamic, we strive to deliver excellent results whether safety, environmental, operational, financial or strategic through effective leadership and teamwork. We set clear expectations and foster a culture of continuous improvement and learning to achieve our goals.</td>
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<tr>
<td>INTEGRITY</td>
<td>We are highly ethical, trustworthy, respectful and reliable in all that we do. We are accountable and responsible for our actions and honour and deliver upon our commitments.</td>
</tr>
<tr>
<td>INNOVATION</td>
<td>We are creative, and driven to continuously enhance and adapt our operations, technology and processes to better serve our clients in the global conventional and unconventional sectors.</td>
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Global Operations

Track record

- Sand Control
- Inflow Control
- Zonal Isolation
- Hydraulic Fracturing
- Wireless Completions
- Reservoir Monitoring
- Subsurface Engineering
- Production Enhancement

Over 1 million ft of sand screens installed
Over 7,000 passive ICDs and 35,000 AICDs
65,000 swellable packers installed
Fracturing system developed in-house for integration with fibre optic monitoring
World’s first wireless intelligent completions launched & deployed
Over 250 installations of fibre optic, permanent and electronic gauge monitoring
Over 100,000 installations globally
Production enhancement technologies and fluid field service support
Inflow control overview

From the liner hanger to the shoe, Tendeka provides a complete service in the design and installation of advanced completions. We have the ability and flexibility to custom-design solutions to meet each application challenge across the existing technology range and through the effective development and integration of new functionalities.

Inflow Control Device (ICD) technology is applied to enable the effective management of reservoir sweep in horizontal wells. Long horizontal wells can increase productivity and recovery of oil by increasing reservoir contact. However, uneven production due to reservoir heterogeneity, fractures or frictional pressure losses along the length of the horizontal bore can lead to early water or gas breakthrough. ICDs located along the length of the horizontal wellbore apply an engineered pressure drop to manage inflow of fluids into the completion, thereby mitigating these problems.

Tendeka provides a wide range of fully interchangeable field adjustable ICDs which are engineered for a wide range of applications, including our award-winning FloSure Autonomous Inflow Control Device (AICD) technology. They are integrated into the lower completion either with sand screens, or within short subs for non-sanding or retrofit applications.

Tendeka inflow control benefits

- Production optimisation in sandstone and carbonate reservoirs
- Increased hydrocarbon recovery
- Improved injected water sweep
- Reduced gas oil ratios and water cut
- Elimination of the requirement for wash pipe
- Effective well clean-up
- Improved sand control reliability
- Inter-zonal crossflow prevention
- Active management of injection into fractured reservoirs

Tendeka is the industry leader in AICD technology, and has installed in new wells and retrofit applications for gas and water control.
**Featured technology:**

**FloSure AICD**

The FloSure Autonomous Inflow Control Device (AICD) is an effective solution for increasing oil production over the life of the field. The FloSure AICD has been deployed successfully in light and heavy oil applications to overcome water or gas breakthrough and ensure uniform production longevity. The device preferentially chokes unwanted produced fluids whilst promoting production of oil from the entire length of the well.

The below graph is a real field example of the production benefits of AICD vs. ICD completions.

“Sometimes the simplest inventions are the best. The AICD makes oil production much more efficient - with the help of a simple mechanism.”

Production Technology Manager, Operator

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**GOR vs Oil Rate**

*Production benefits of AICD v. ICD completions*
Tendeka is recognised as a leading provider of sand face completions, delivering innovative solutions to enhance well performance and maximise hydrocarbon recovery.

Our portfolio of sand face completion technologies includes the most robust, premium screen offering, industry leading Autonomous Inflow Control Device (AICD) and swellable packer technology with a track record going back over 15 years.

The portfolio is constantly expanding to provide integrated completion solutions for sandstone reservoirs, light and heavy oil, production and injection applications, as well as greenfield and brownfield developments.

Sand control screens

Tendeka manufactures and supplies premium metal mesh and direct wrap sand screens. Our screens can be configured for deployment standalone, integral to a gravel pack, or be combined with inflow control technology. All Tendeka screens are designed, manufactured and fully qualified to meet ISO 17824 V1 standard, and have undergone rigorous testing.

Sand and inflow control

Our screens can be deployed as a stand-alone option (FloMax) or in conjunction with Tendeka’s passive (FloRight) or autonomous inflow control (FloSure) devices to regulate flow and create a highly effective sand control solution.

Tendeka sand control benefits

- High inflow with maximum plugging resistance
- Range of types to suit well characteristics
- High burst and collapse ratings
- Mechanically swaged design for maximum strength and weave integrity

OVER 1,000,000 FT
OF SAND SCREENS INSTALLED
Featured technology

Cascade³

Improve water injectivity, recovery and well life

In water injection wells, sand production occurs in the periods immediately following injection shut-down because of backflow, crossflow between zones or wells, and water hammer effects.

Conventional sand control techniques which perform well in steady state production are not designed to control transient sand production and cannot always be effective in water injection applications.

Cascade³ technology provides a unique solution to these problems by isolating fluid in the completion annulus and locking injection water into the formation to eliminate the transport mechanism for sand production entirely. The result is increased injection reliability providing ongoing waterflooding without costly re-drills or frequent well clean-outs.

SAVED CLIENT
$1.5M OPEX
BY ELIMINATING REQUIREMENT
FOR GRAVEL PACKING
WATER INJECTION WELLS
Effective open-hole zonal isolation provides well compartmentalisation critical for inflow control, intelligent completions and effective well stimulation.

Tendeka is a pioneer of swellable elastomer technology where our SwellFix and SwellRight packers continue to lead the field. Swellable packers are activated when in contact with water and / or oil to provide a cost-effective, low risk, simple-to-install zonal isolation solution. Our patented swelling elastomers have been tested to 10,000psi and 250°C, and are compatible with acid, H2S and gas.

Packers are available in slip-on designs (SwellRight sleeves) for efficient well compartmentalisation or bonded directly on pipe for when higher pressure differentials are required.

SwellRight swellable sleeves are a flexible barrier solution suitable for applications where a pressure seal or zonal isolation is required. They reduce well construction costs, extend well life, and improve well integrity. These permanent packers provide the long-term stability and reliability required to isolate producing zones.

Our SealRight range of field proven hydraulic set open hole packers are available for when immediate zonal isolation is required.
Featured technology

Lab capability

Tendeka has a state-of-the-art research and development laboratory based within its Westhill facility, near Aberdeen. The lab is fully equipped with a mixer, mill, extruder and press to enable Tendeka to mix and develop R&D swellable compounds in-house to speed up the development times for releasing new compounds to market.

Tendeka’s lab also houses the swells testing area, allowing compounds to be tested in a variety of different conditions in order to determine how our products will respond to downhole conditions. The lab includes multiple test equipment including 6 ovens and 5 oil baths to provide capability to do multiple tests in parallel at temperatures of up to 300°C. Other equipment used within the lab includes a viscometer and moisture analyser.

Tendeka takes the quality control of our elastomers extremely seriously and have invested in QC kit within the lab to ensure every batch of rubber is within our specifications. This includes a tensimeter to test the tensile properties of our rubber before and during swell as well as a rheometer to predict how the rubber compound will cure and to ensure it has been mixed correctly.
Since the early 2000s, intelligent completions have been used extensively for improved exploitation of hydrocarbon resources through shut-off of unwanted production, improved water injection placement and modification to inflow profiles to increase recovery factors. They form an integral part of many development strategies for both extending the life of existing fields and the development of new fields.

Traditionally the intelligent completion is monitored and controlled from surface using multiple hydraulic and/or electric control lines which must pass through the wellhead into the completion annulus, along the length of the upper completion, through any packers, and into the reservoir section where the interval control valves (ICVs) and downhole gauges are located. While this technology has been used with great success, there are a number of limitations associated with the use of control lines, which increase capex and opex, weaken well integrity, and limit the functionality of the intelligent completion.

PulseEight eliminates control lines, making it simpler and quicker to install. It reduces feed-throughs for better barrier integrity, and allows intelligent completions in more complex and multi-lateral wells.

PulseEight offers a unique pressure pulse telemetry system which can be applied to downhole devices for two-way communication in a flowing well. The system provides a versatile wireless alternative to existing data transfer and actuation methods within both production and injection wells.

This technology is versatile, with many applications which results in improving productivity and increasing field life.
Featured technology

*Retrofit PulseEight*

PulseEight has been developed with the aim of providing intelligent completion solutions to brownfield applications.

This inline through-tubing device can be retrofitted into existing wells on a single intervention run and set using a conventional bridge plug or lock mandrel. This addresses some of the problems faced in mature fields such as failed permanent completion equipment and outdated/inefficient technology.

Once in the well, the PulseEight device can be actuated from surface using pressure pulse commands, and send PT data back to surface. The wireless communication uses a unique semi-duplex pressure pulse telemetry for multi-phase flowing environments and utilises the existing wellhead equipment to interface with the downhole device.

In addition to this direct surface controlled operating mechanism, PulseEight can be configured to work autonomously based on changes in downhole conditions or on pre-set timer.

The performance of PulseEight can continue to be optimised throughout the period of installation by updating tool parameters remotely from surface. This provides a unique benefit over other intervention based systems where devices must be recovered to surface to reconfigure.
Distributed Temperature Sensing (DTS) allows you to continuously obtain measurements in real-time along the entire length of your wellbore. The Guardian range by Tendeka leads the way in terms of performance in DTS technology, the fastest measurement speeds available and the greatest coverage of up to 50km from a single channel.

Based on analysis of Raman Backscatter signals in an optical fibre, DTS systems use a combination of variations in backscattered light intensity and time domain reflectometry to create temperature against distance profiles. The fibre acts as both a sensing element and transmission medium.

FloQuest is a distributed and point data processing, visualisation and modelling software capable of handling large datasets efficiently. It can function as a standalone package or connect to data server for seamless data importation.

**Featured application**

**Case Study**

Permanent fiber optic solution was used as an alternative to the traditional PLT surveys. The fiber was run on the outside of the production string and in few cases the casing. Fiber optic data was then collected every 6 hours and transmitted wirelessly to Tendeka’s DataServer to allow for immediate visualisation. Using our software FloQuest, this data was then viewed, processed and interpreted to extract meaningful information.

Dormant and active zones were identified by observing temperate changes related to flow activities down hole.

Crossflow during well shut-in was clearly seen and contribution / thief zones identified.

Flow profiles based on inversion of the DTS temperature showing contribution of the different zones was provided.

Tendeka has successfully installed over 250 fibre optic installations around the world and has been a pioneer in developing methods to use this technology to optimise reservoir productivity.
Tendeka’s Subsurface Engineering Team is a globally deployed group of petroleum engineers and software developers with a vision to be the Operating Companies’ trusted advisor for the application of advanced completion technology. The team’s mission is to create sustainable value for our customers and stakeholders by providing credible assessments and by creating innovative, sound recommendations for the application of advanced well completion technology. We do this by engaging our customers’ asset teams, developing an understanding of their reservoirs, their development challenges and their performance metrics.

11 points of consideration for potential application of Tendeka’s advanced completions technology

1. Understand asset objectives + key performance indicators
2. Generate problem statements
3. Generate opportunity statements
4. Evaluate possible advanced completions solutions
5. If decision is for go ahead, apply workflow analysis / findings to clarify

- Asset objectives and challenges
- Reservoir recovery mechanism
- Reservoir heterogeneity
- Tendency for fluid coning or cusping
- Type of unwanted effluent production
- Produced fluid properties
- Evidence of unwanted effluent production/breakthrough
- Well type
- Well path, well architecture
- Economics framework
- Regulatory considerations
Hydraulic Fracturing

Tendeka has a range of completions technologies for multi-zone, hydraulic stimulation which are robust, efficient and cost-effective solutions for our clients.

Tendeka has been active with multi-stage completions technology in North America unconventional reservoirs since 2009. Our solid track record underpins our expertise and innovation in this sector.

**Fracturing products & services**

Tendeka’s range of fracturing tools ensures well integrity throughout the entire life of the well, while also reducing total well life-cycle costs. The range of tools and services includes:

- full range of frac plugs
- open hole and cased hole dropped ball system
- open hole packers
- remotely activated toe sleeves for cemented and uncemented applications
- fibre optic frac monitoring technology
- fracturing fluids

**Featured application**

**Frac Plugs**

Tendeka provides credible frac plug solutions to achieve optimal deployment and drilling or dissolution times, whilst ensuring dependable setting and pressure holding capabilities for the duration of your operation. Tendeka’s plugs are designed to be milled quickly and easily, maximising operational efficiency and increasing overall economics:

- Composite Plug
- Dissolvable Plug
- Big Bore Frac Plug
Production Enhancement

Tendeka develops, manufactures and supplies a full suite of fracturing, acidizing and EOR technologies to help E&P companies extract every drop of oil from their reservoirs.

A relatively new entrant into the production enhancement sector, Tendeka already delivers a range of solutions including:

- Water reduction technologies for fracturing operations in unconventional wells
- Fracturing optimisation fluids
- Improved oil recovery in Gulf of Mexico

Tendeka increases the value offering by combining key technologies and fluids to deliver exceptional results and streamlined operations.

**Featured application**

**MajiFrac Solution**

Our MajiFrac Solution helps E&P companies reduce the intensive water and time requirements needed to complete their unconventional wells. Along with offering production enhancement technology, Tendeka provides fluid field service support for E&P companies.

MajiFrac Solution is the smart combination of the following:

- A new thermally stable Modified Acid™ system
- Tendeka’s FracRight Composite Plug
- One of Tendeka’s MajiFrac family of high viscosity friction reducers

SAVE 50,000 BARRELS OF WATER AND REDUCE PUMPING TIMES BY 200 HOURS
Digital oilfield

Tendeka’s Digital Well Management Solutions use advanced downhole hardware, including wireless intelligent completion technology; proprietary software providing data analysis, visualisation, control and automation functions; and surface systems to enable collaboration and interface either via existing digital oilfield systems or through standalone cloud-based solutions.

Fundamental to achieving the full potential of intelligent completions is the integration with digital oilfield capabilities.

The Digital Oilfield concept can be described as the application of software, hardware and data analysis techniques to increase productivity and efficiency of oil and gas production. In effect, it is the use of remote operational monitoring, alert driven surveillance by exception and virtual collaboration to provide the link between people, processes and technology to deliver real-time optimisation. Digital Oilfield technology has been in development over the past decades and today can encompass entire oilfield assets, addressing complex challenges in data integration, systems architecture and cultural barriers.

R&D / manufacturing

Tendeka is a market leader in offering alternative solutions to the completions market, and ensures its cost-effective and scalable manufacturing model provides a competitive advantage, delivering a quick turnaround of orders for clients. To meet customer demand, Tendeka has suppliers, manufacturing plants and product warehouses in key global locations.

Tendeka has an R&D facility in Aberdeen, UK, which focuses on supporting all of our Completion Technology product lines.

It houses:

- an elastomer development laboratory to support ongoing swellable technology research
- facilities for testing the pressure, temperature and load testing capacity of downhole equipment
- water and gas flow loops for performance, erosion and plugging testing of inflow control technology
- a firmware and electronics research and test laboratory for intelligent technology development
Innovation & technology are in our DNA

Tendeka delivers advanced completions and production optimisation for your reservoirs. Regardless of early life or mature fields applications, we provide bespoke solutions and field-proven technologies to increase production of your well.

Innovative and adaptable, Tendeka is your proven completions partner

Sand Control • Inflow Control • Zonal Isolation • Wireless Completions • Reservoir Monitoring • Hydraulic Fracturing • Production Enhancement

www.tendeka.com