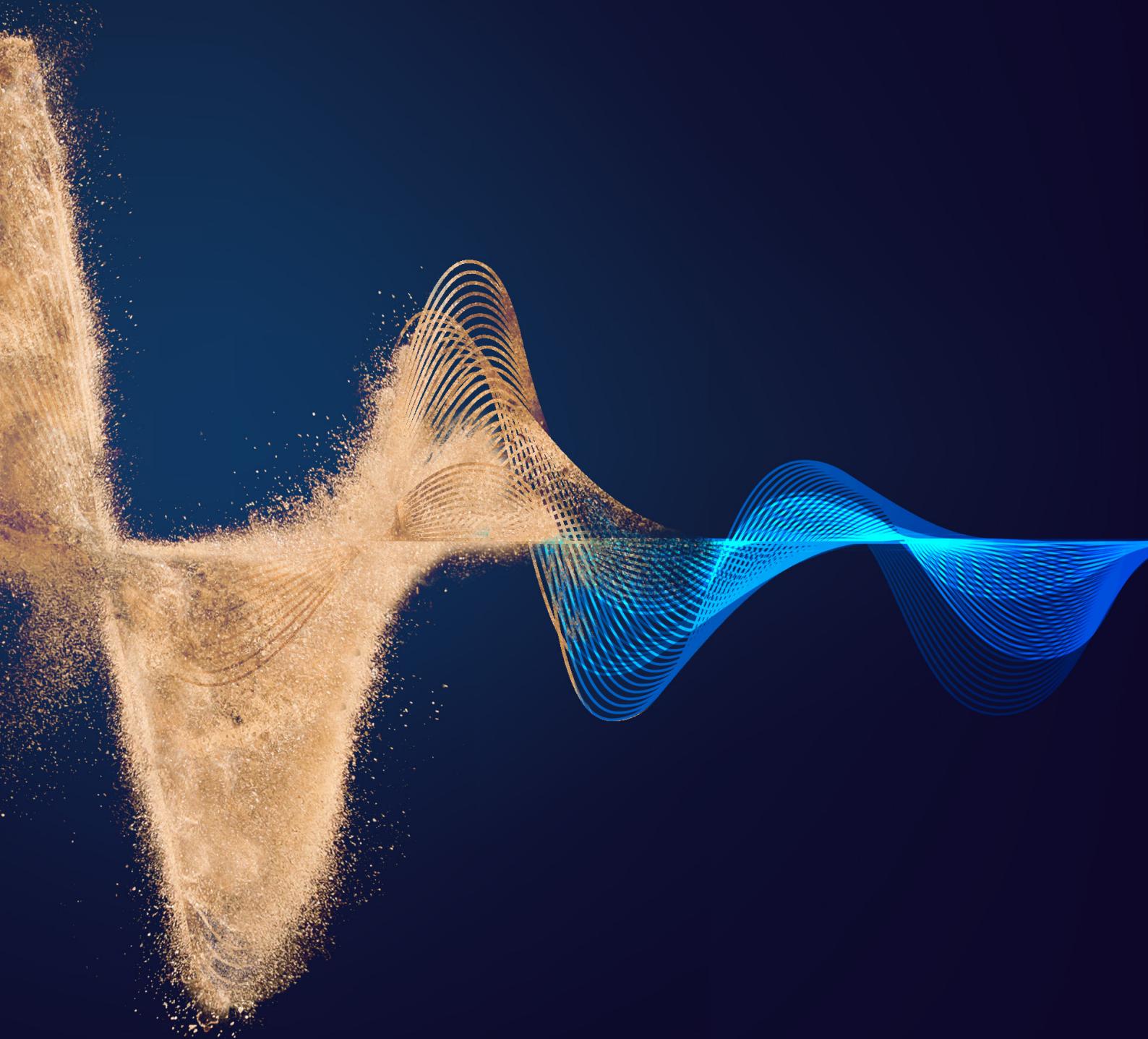


Sandbar

Find, Fix, Confirm



TGT | TENDEKA

Partnership delivering an innovative sand control solution

Sandbar is a joint solution from Tendeka and TGT Diagnostics, utilising the blend of expertise and technology to deliver precise, reliable and effective downhole sand remediation.

Sandbar Remedial Sand Control

Background

Sand production from oil and gas reservoirs is a serious issue. It can decimate productivity and erode the integrity of well completions and surface assets. Often, the first indication of sanding issues downhole are the detrimental effects that can occur at surface, such as fill in separators or erosional damage to pipework.

Thru-tubing remediation typically involves an interval approach for a problem which may be localised. Historically, this is because there is a duality of issues in the ability to accurately identify the location of sand ingress and to target a localised fix. Surface monitoring can detect when sand is being produced, but locating the source and dynamics of sand inflow downhole is essential to protecting integrity and maintaining production.

Tendeka and TGT's combined Sandbar remediation solution addresses all of these issues to offer a more precise, reliable and effective intervention-based solution.

Technology in action

The solution adopts a Find, Fix, Confirm approach, whereby TGT's Sand Flow product precisely locates sand entry to the wellbore and provides a quantitative sand count, whilst Tendeka's Filtrex remedial sand control system is precisely targeted to repair the damage. Crucially, Sand Flow is then redeployed to confirm the repair.

Find

Sand Flow diagnostics are delivered using TGT's True Flow system and the Chorus acoustic sensing platform. Chorus is deployed on wireline, capturing and decoding the acoustic signature generated by sand particles entering the wellbore and impacting the tool. It analyses the acoustic time-domain data to discriminate between sand flow and fluid flow, thus locating the sand entry points and quantifying the sand rate.

Fix

Tendeka's Filtrex is deployed into the well on coiled tubing and positioned across the target area. Dropping a ball in to the string allows pressure to be applied in two stages, firstly to set the anchor, and secondly to release the compression sleeve. Upon removal of the compression sleeve, the matrix polymer expands to contact the wellbore and the deployment string can be retrieved from the well.

Confirm

The same diagnostics are run in the Find scenario, but this time deployed through the internal diameter of the Filtrex system to confirm that no sand is entering at that depth.

Value to your business

- One-stop diagnose, fix, verify solution
- Restore integrity and productivity
- Reduce intervention time
- Improve resource efficiency, lowering emissions
- Reliable and cost-effective sand control

Locate and Quantify Sand Production in the Wellbore

Know precisely where sand is entering the well, and how much.

Overview

Surface monitoring can detect when sand is being produced, but locating the source and dynamics of sand inflow downhole is essential to protecting integrity and maintaining production. TGT's Sand Flow diagnostics reveal both the source and quantity of sand entering the wellbore, enabling operators to deal with sand more effectively and keep wells safe, clean and productive.

Sand Flow is delivered by the True Flow system and principally leverages key aspects of TGT's Chorus acoustic sensing and analysis platform. Chorus combines high-fidelity recording with machine learning to locate and quantify sand production at its source. Importantly, Chorus can reliably discriminate between normal fluid flow and sand or proppant-filled particle flow, even in the turbulent conditions that exist downhole.

Sand Flow can be used to diagnose a known sand production issue, or proactively to ensure downhole sand control measures are working.

Sound science

Fluid flow in the well system creates a rich spectrum of acoustic energy that penetrates the surroundings. The acoustic waves are encoded with information about the type of flow, and its location. Solid particles such as sand grains also generate acoustic energy when they impact solid materials, and this intermingles with the fluid energy. The challenge is to discriminate one type of energy from the other.

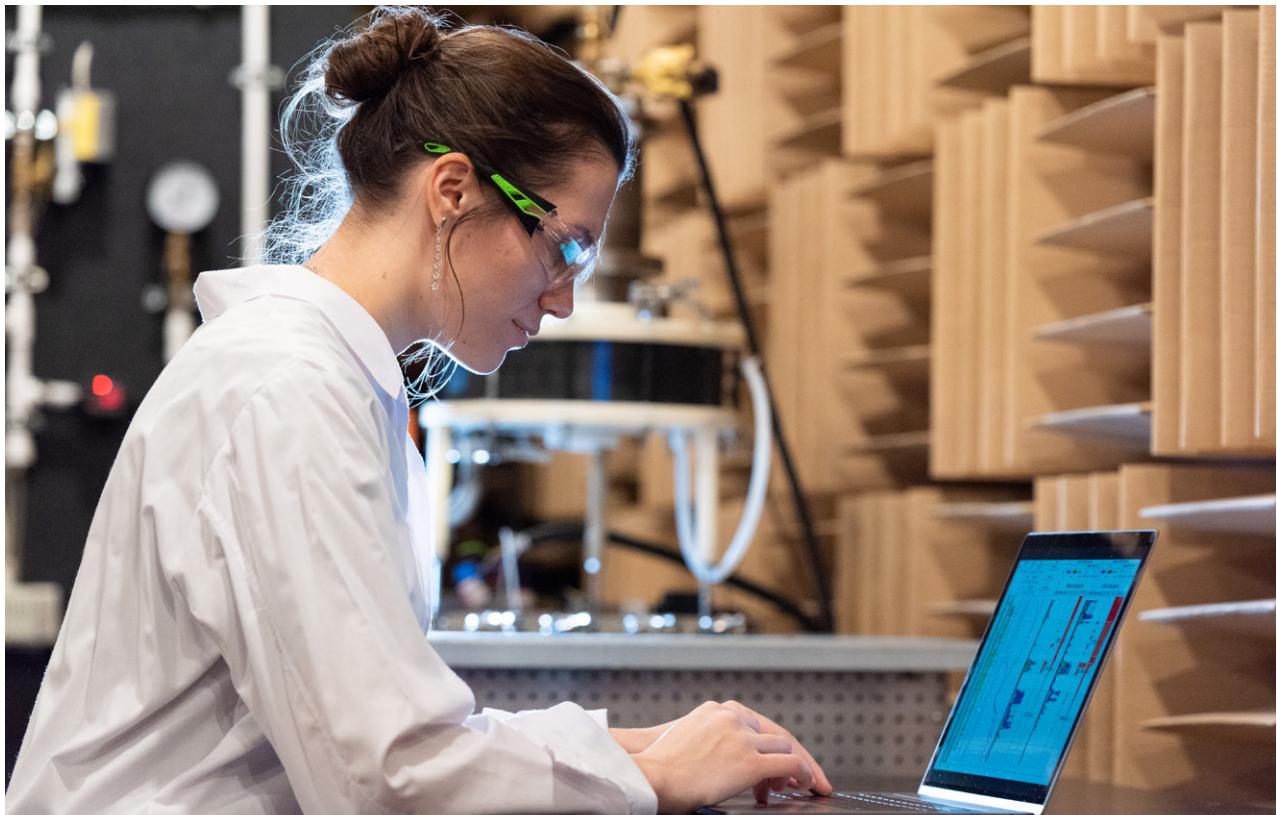
TGT scientists discovered that when the amplitude of acoustic waves are analysed in the time domain (amplitude vs. time), the signature of pure fluid flow is markedly different from the signature of fluid containing solids. Researchers used a neural network and machine learning

techniques to decode and extract the sand energy from within the broader acoustic spectrum. Different sizes of proppant grains, flow rates, fluid types and injection profiles were applied to simulate a large number of different sand flow scenarios. The result was an extensive sand flow characterisation data base and an adaptive recognition system that Chorus uses to reliably identify and quantify sand flow at the source.

Sand count and energy

Sand Flow with Chorus decodes the acoustic signature of sand grains hitting the tool body and provides two key outputs – "sand count" (grains per second) and "sand energy" (decibels). Sand energy enables the system and the analyst to distinguish between direct sand entry points (higher energy) and sand flowing along the wellbore (lower energy).

In terms of measurement specifications, the system is designed to operate in two modes – quantitative and qualitative. Quantitative mode delivers a sand count of between 15 grains per second and 1000 grains per second, provided the grain size is $>100\mu\text{m}$ and the grain velocity is $>0.8 \text{ m/s}$. Qualitative mode caters for smaller grain sizes $>50\mu\text{m}$ and lower grain velocities $>0.15 \text{ m/s}$, and delivers a 'probabilistic sand indicator' value. The vertical resolution of the measurement is 0.8m, which corresponds with the length of the Chorus tool body.



TGT is dedicated to engineering and manufacturing our products and technologies entirely in-house. In our Technology Centre we have an Anechoic Chamber that is used to help us further our acoustic diagnostic capabilities.

Filtrex - The One Trip Remedial Sand Control System

Compressible Open Cell Matrix Polymer regains sand control integrity.

Overview

Sand issues can account for up to 10% of all shut-in wells either due to failure of the existing downhole sand control or onset of sand production caused by pressure depletion and/or water production in mature basins.

The challenge to regain sand free production in existing completions without the requirement to perform a workover can be both costly and time consuming using traditional methodologies, with no single methodology offering benefits across all measures. To address this challenge, Tendeka designed the Filtrex system.

The Filtrex one trip remedial sand control system provides the flexibility to be installed thru-tubing, through tight restrictions and decompresses to be conformant with a significantly larger inner diameter (ID) of the damaged section.

The first of its kind, Filtrex provides the ability to perform sand clean out during the deployment run providing significant time savings over conventional systems. Once set, the tool requires no further intervention.

Using an open cell matrix polymer (OCMP), the system is run in hole compressed and deployed in well as a slick assembly, complete with high expansion anchor system. Once set, the OCMP expands to conform with the ID of the wellbore. The OCMP is fully protected during deployment and will not be exposed until at the correct depth. The process of expansion aids in the centralisation of the assembly allowing other sections to be easily stacked on top. Filtrex will remain at depth and retain sand whilst allowing fluid flow through the porous filter media during its time in hole. The entire system can be easily retrieved should full bore access be required in the future.

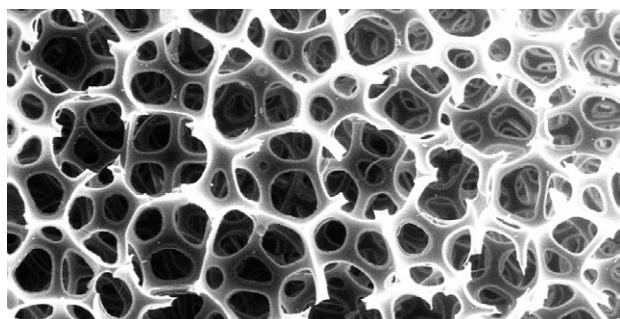
Filtrex system permits the use of larger base pipes to be used maximising productivity, and not impeding flow.

Features

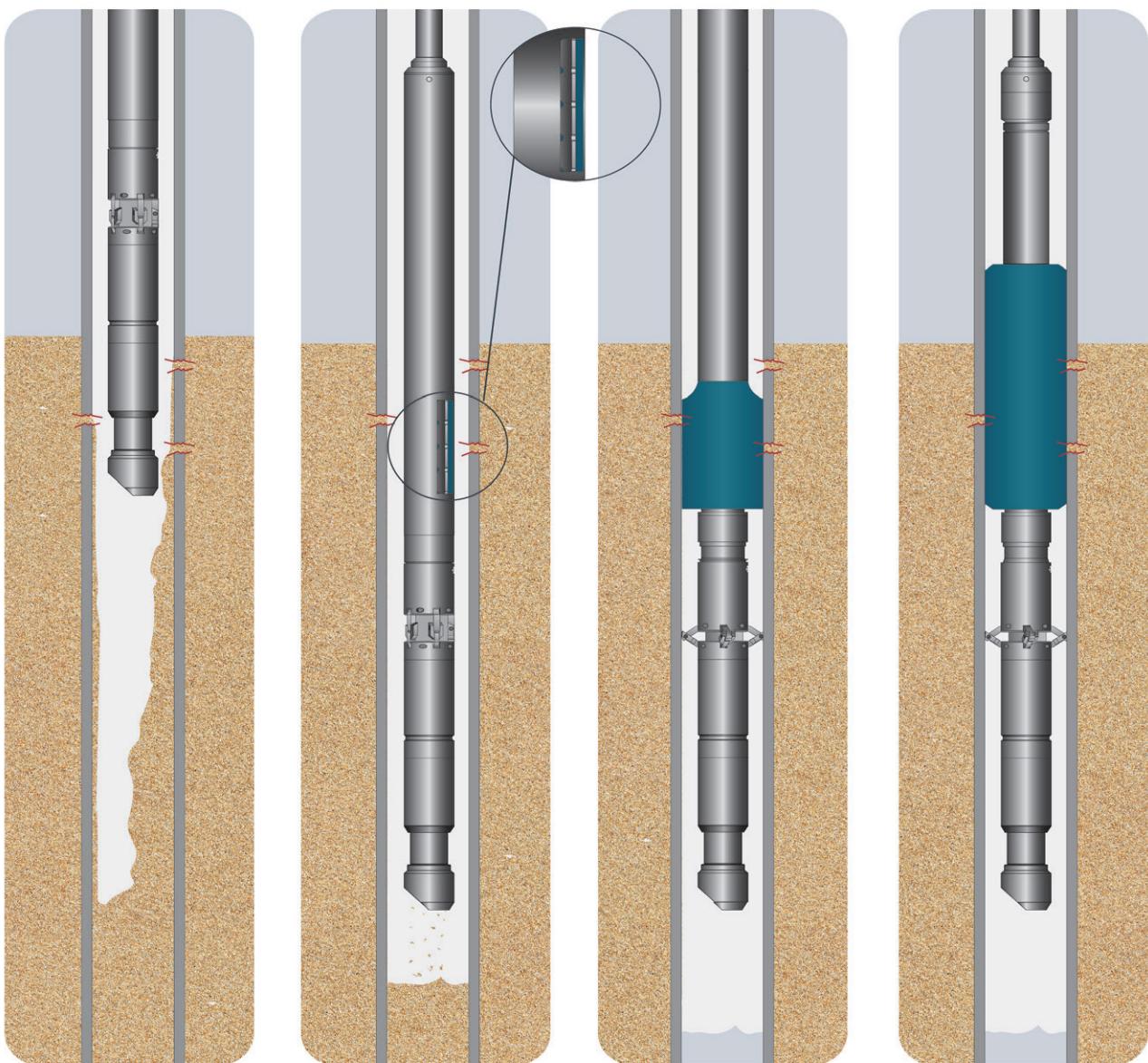
- High expansion anchor sub rated to 12T
- One trip system - sand clean out and sand control repair
- Open Cell Matrix Polymer - multi-layered porous compressible filter media
- Compatible in reservoirs up to 110°C
- Compatible with common wellbore fluids

Benefits

- Revives production
- Conforms to damaged section
- Thru-tubing design
- Retrievable
- OCMP sized appropriately to retain formation sands
- OCMP configuration bespoke to reservoir conditions
- OCMP configuration bespoke to wellbore sand composition



Filtrex, the One Trip Remedial Sand Control System, provides the flexibility to be installed thru tubing, through tight restrictions and expand into the casing ID filling all annular gaps regaining sand control. The first of its kind, the system provides the ability to perform sand clean out whilst installing the tool in one trip. Once set, the tool requires no further intervention.



Stage 1 - An existing screen or perforations can become damaged, and provide a sand breakthrough point. Once damaged, there is no sand control and sand is free to fill the wellbore. This can lead to issues on surface and can result in well abandonment.

Stage 2 - The Filtrex system is run in hole to depth using a running tool with compression outer sleeve. Prior to expansion of the system, the jetting nozzles will activate and commence sand clean out.

Stage 3 - Sand clean out is complete, and the Filtrex system is ready to be expanded. The anchor sub is activated and locked into the casing.

As the running tool is then pulled from the assembly it removes the outer protecting sleeve, allowing the multi-layer OCMP to expand to conform to the ID of the casing or liner.

Stage 4 - The running tool is fully removed allowing the full filter section to expand to the damaged section. Anchors are locked in the casing and running tool is pulled out of hole.

Sand Flow Specifications

Measurement specifications

Primary measurement principle	Acoustics
Primary outputs	Sand count, Sand energy, Sand probability
Survey mode	Memory/SRO
Survey speed	Stations
Circumferential sensing, %	100
Resolution, in (mm)	31 (800)
Grain rate per metre ¹	
Minimum, grains/s	1 ²
Maximum, grains/s	1000 ³
Sensitivity – Quantitative mode	
Minimum grain size, µm	100
Minimum sand velocity, m/s	0.8
Sensitivity – Qualitative mode	
Minimum grain size, µm	20
Minimum sand velocity, m/s	0.2

Mechanical specifications

Temperature range, degF (degC)	-4 to 302 (-20 to 150)
Maximum pressure, psi (MPa)	14,500 (100)
Housing material	Titanium
Maximum H2S content, %	30 with TFE/P duro o-rings
Operating time, hrs	15 to 30
Outer diameter, in (mm)	1.65 (42) 1.18 (30)
Tool string ⁴ length, ft (m)	16 (5)
Tool string weight, kg (lb)	40 (88)

¹ Equivalent rate across a one metre producing interval

² Equivalent to ~0.15 cc/hr of 200µm grain sand production at surface

³ Equivalent to ~55 cc/hr of 200µm grain sand production at surface

⁴ Tool string includes Chorus and Indigo modules

Filtrex Specifications

Tool OD	2.28"	2.69"	2.75"	3.625"
Min restriction tool passes through	2.313"	2.75"	2.81"	3.688"
Casing/liner setting range	3.50-4.50"	4.00-5.00"	4.00-5.50"	4.50-7.00"
Section length	6ft upwards*			
Max temp	230°F (110°C)			
Metallurgy	L-80			

*Multiple lengths and the ability to stack provides extensive coverage



Tendeka

E: sandbar@tendeka.com
www.tendeka.com

TGT

E: sandbar@tgtdiagnostics.com
www.tgtdiagnostics.com