

SUPERIOR RESERVOIR CONTACT



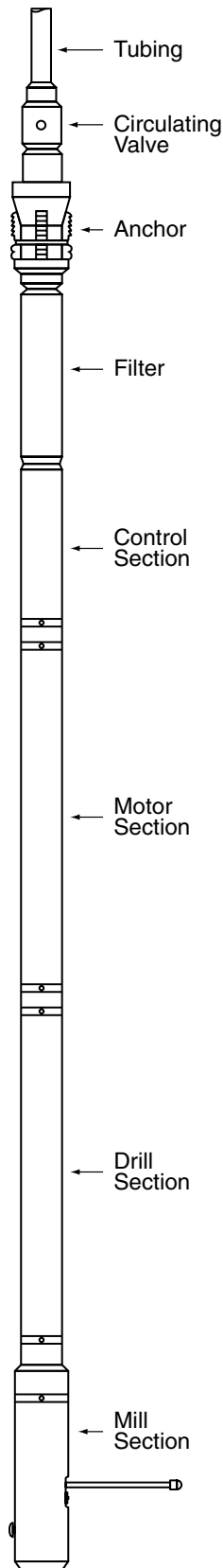
MaxPERF
DRILLING TOOL

COMPLETION & WORKOVER TECHNOLOGY

www.maxperf.ca

UNSURPASSED VALUE

INTRODUCTION



Most of the world's oil and gas wells have been damaged to some degree, either by the invasion of drilling fluids or cement into the potentially productive interval or by pore plugging as a result of the production phase. The oil and gas producer's problem in initiating and maintaining efficient production from these damaged wells is often compounded by such factors as ineffective zone boundaries, poor primary cement jobs, and damage caused by prior perforating and stimulation treatments.

In some cases the traditional completion and workover methods that have been in common use for many years will prove satisfactory in allowing an operator to produce from or inject into the target zone without the need for additional technology. As time goes on, however, producers find they are more often forced to look at alternative methods and technologies to efficiently draw hydrocarbons from the world's oil and gas fields.

Penetrators Canada Inc. has developed completion and stimulation systems that provide a more efficient method of establishing communication between the wellbore and the target zone in both producing and injection wells. This paper will focus on a brief overview of the **"MaxPERF"** tool system which can be run in new or existing wells to drill multiple radial tunnels up to **72"** laterally from the wellbore without the need for a turn radius outside the casing. The tool creates 1" (26mm) holes in the casing and .70" (17mm) diameter tunnels in the formation in a manner that is totally non-damaging to the casing and cement sheath and it can be used in open hole or cased wells whether vertical, directional or horizontal.

THE "MaxPERF" TOOL

"MaxPERF" is a downhole tool system, designed to produce clean penetrations radially from a wellbore into reservoir rock to a length of up to **72"**. The tool drills one penetration at a time, each requiring 10-20 minutes (on average) to complete, and is capable of making multiple penetrations during a single run. Factors such as depth, rock lithology, and fluid type will govern the number of penetrations that can be completed on a single trip - normally the tool will be capable of 4 - 8 penetrations per run.

This system presents a unique opportunity to expose new pay in a clean and non-damaging manner utilizing light and compatible completion fluids.

The **"MaxPERF"** tools consist of four major components plus accessories such as an anchor, filter, and circulating valve. These components are the control section, motor section, drill section and mill section.

Housed in the control section is a hydraulically actuated valve assembly that serves as the tool's "brain" allowing the tool operator to actuate the tool through its sequential functions from surface.

The motor and drill sections contain the hydraulic and mechanical means of rotating the diamond rock bit and extending or retracting it to and from the formation to drill and clean the penetration tunnels.

At the lower end of the tool is the mill section, a hydraulically operated milling tool which mills a neat 1" (26mm) hole in the production casing to allow the rock bit access to the formation.

Currently **"MaxPERF"** tools are stocked for casing sizes of 4.5" (114.3 mm) to 7" (177.8mm) O.D. and larger sizes can be accommodated on request.

ADVANTAGES OF "MaxPERF" PENETRATIONS

- ✓ Greater opportunity to reach beyond the damaged near-wellbore area
- ✓ Non-damaging to casing, cement, or formation - no debris or compaction
- no impact or explosion - a gentle method of achieving deep penetration
- ✓ Easier to maintain over time - less likely to plug off
- ✓ Lower drawdown - reduces potential coning problems
- ✓ Greater opportunity to intersect natural fractures near the wellbore
- ✓ Light compatible fluids can be used to drill into the zone

A NEED FOR THE "MaxPERF" SYSTEM

Some of the more common problems encountered at the reservoir/wellbore interface that can be resolved by using the **"MaxPERF"** system are:

- ✓ Near - wellbore damage caused by drilling fluids and cement invasion can permanently inhibit production. In many cases conventional perforations fail to reach beyond the invaded zone and explosive perforations themselves are surrounded by a compacted and damaged zone.
- ✓ During completion and production, the migration of formation fines can plug pore throats near the wellbore
- ✓ Production often results in the formation of scale, asphaltene, or paraffin deposits at the perforations
- ✓ The restrictive "bottleneck" between the reservoir and the wellbore (perforations) results in high drawdown pressures and contributes to water and gas coning
- ✓ Poor primary cement jobs or cement that is damaged (often by perforating) can make proper stimulation impossible and will very likely result in zonal communication

- ✓ Acidizing, even at low pressures, can migrate out of the zone, seeking the path of least resistance which may be through a channel in the primary cement to an undesirable zone
- ✓ It can be very difficult to re-enter a productive interval following a cement squeeze to shut-off water or gas without risking renewed zonal communication
- ✓ Today's large explosive perforating charges, designed for maximum penetration, can cause casing and/or cement damage leading to zonal communication - they also leave a compacted zone around each perforation tunnel
- ✓ Many potentially productive zones are thin and have poor containment boundaries

A CYCLE OF THE "MaxPERF" TOOL

Once the tool has been run into the well and positioned on depth, the mechanically set anchor is engaged to prevent tool movement at any time during the penetrating sequence. A surface pump (usually supplied by **Penetrators**) will then build pressure in the tubing to begin actuation of the tool's control section. The tubing-casing annulus will be left open at surface to prevent pressure build-up against the formation, casing, or BOP. Fluid returns, if any, will travel up the annulus to the rig tank. The treatment can be performed while the well is underbalanced if the well is not sour and if any fluid/gas returns to surface can be controlled without closing in the annulus.

By pumping at different pressures the tool operator is able to take the tool through a cycle of functions beginning with actuation of the milling assembly which rotates a 1" (25.4mm) mill cutter to mill a neat hole in the well casing. The hole is clean, burr-free, and causes no damage or distortion to the casing. Because the hole was created in a gentle "low force" manner it does not damage the primary cement surrounding the casing. The mill cutter is then retracted into the tool housing, rotation stops, and a hydraulically driven index carriage is shifted within the tool housing to move the milling head downward and bring a bit guide into alignment with the hole in the casing. During this indexing procedure, the tool does not move in relation to the casing - only the internal index carriage moves.

Now a hydraulic motor begins rotating the diamond rock bit and its flexible drillstem as the drillstem is extended radially through the hole in the casing. Fluid circulation is maintained down the drillstem and through the bit as the bit drills into the reservoir for a distance of up to **72"**. All cuttings are flushed from the tunnel back into the wellbore. Once drilling is complete, the drillstem and bit are hydraulically retracted back into the tool housing, the index carriage returns to the milling position, and tubing pressure is reduced to zero. The tool can then be repositioned for the next penetration. Rotation of the tubing will reorient the tool in the desired phasing. An entire milling and drilling procedure to make one tunnel normally takes 10 - 20 minutes (on average) and requires that less than 1m³ of fluid be pumped down the tubing at maximum pressures of approximately 24 mPa (3500 psi). When all the penetrations are complete, a circulating valve at the top of the tool is opened and the tool is ready for retrieval.

FLUID SELECTION

From a mechanical point of view, many different types of fluids can be used to operate the **"MaxPERF"** tool. The tool uses the fluid pumped down the tubing as the power fluid to run its hydraulics and motors and is capable of operating with fresh or brine waters, water/methanol blends, various crude oils, frac oils, diesel, etc.

The more important consideration in fluid choice is the reservoir. The **"MaxPERF"** system presents an opportunity to drill into new pay using a light compatible fluid, often while the well is in an underbalanced condition.

If the treatment is to be performed underbalanced, the fluid level in the casing should be lowered to decrease hydrostatic pressure prior to running the **"MaxPERF"** tool. During the treatment, the tubing will be full but the tool acts as a check valve keeping tubing hydrostatic pressure isolated from the well. Drilling with the **"MaxPERF"** tool can be done underbalanced if the well is not sour and if the annulus can be left open at surface to prevent pressure build-up. If fluid or gas flow up the annulus cannot be controlled and the annulus must be shut-in, the job must cease. Drilling underbalanced with the **"MaxPERF"** tool is an excellent way to expose new pay without causing damage to the formation.

In general, drilling fluids should be clean and sweet and light oils are generally recommended. **Treat each "MaxPERF" job as if the reservoir is being entered for the first time because, in fact, new pay will probably be encountered during the job.**

APPLICATIONS FOR THE *”MaxPERF”* SYSTEM

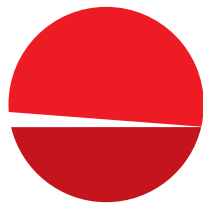
- ✓ To penetrate beyond the invaded zone in wells with near-wellbore damage
- ✓ To increase the effective wellbore radius reducing drawdown and helping to prevent coning
- ✓ To eliminate the risk of casing and cement damage caused by explosive perforating - *”MaxPERF”* causes NO casing or cement damage
- ✓ For the completion or reworking of thin zones or zones with poor boundaries where further stimulation would be too risky
- ✓ To re-enter a productive section following a remedial cement squeeze - allows access to the pay without risking damage to the newly placed cement
- ✓ Frac initiation - for zones that are difficult to break down or exhibit high treating pressures due to excess perforation friction pressures
- ✓ To eliminate the need for a frac or acid treatment in those wells where only the near-wellbore area must be penetrated
- ✓ To improve injectivity rates in injection and disposal wells
- ✓ For the completion or recompletion of coal bed methane wells
- ✓ To access new pay using light, compatible completion fluids
- ✓ Run *”MaxPERF”* on coiled tubing

REAL TIME INDICATORS

Penetrators Canada Inc. has developed and implemented into the *”MaxPERF”* tool a series of REAL TIME hydraulic indication devices. In real time these advances tell the *”MaxPERF”* operator, and in turn our client, when the tool has completed milling through the casing and it's rate of penetration while drilling into formation rock.

REAL TIME... REAL INFORMATION.

SUPERIOR RESERVOIR CONTACT



PENETRATORS



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