

eFire-TCP

Tubing-conveyed perforating electronic firing head

APPLICATIONS

- Wells with a small margin for applied pressure
- Deviated wells
- Wells with a partial cushion

BENEFITS

- Increased reliability because of no moving parts
- Operational efficiency by the elimination of slickline runs
- Reduced risk with no primary high explosives
- Safer, simpler operation in partially filled tubing
- Cost-effective operations with eliminated nitrogen unit requirement

FEATURES

- Insensitivity to well and pressure operations
- Underbalance control
- Postjob validation
- Facilitated redundant firing configurations
- Ability to be run on coiled tubing as a TCP head

Efficient, economical electronic firing head

The eFire-TCP* tubing-conveyed perforating (TCP) electronic firing head system combines two field-proven technologies into a single firing head: the IRIS* intelligent remote implementation system and the S.A.F.E.* slapper-actuated firing equipment. The combination of these technologies produces an efficient and economical method for a wide range of perforating operations.

For temporary or permanent completions, the eFire-TCP firing head enables perforating under less rigid conditions than with conventional methods. Designed to give the operator the flexibility to abort firing at any time during the operation, the eFire-TCP firing head offers an enhanced safety margin with precise delay times, low-pressure initiation, and insensitivity to well conditions.

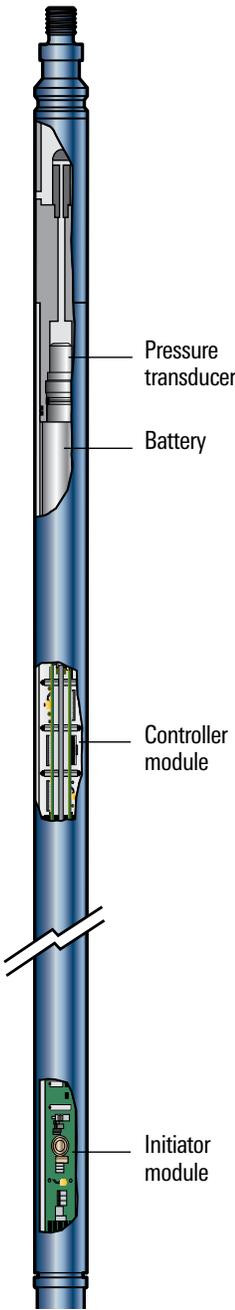
The eFire-TCP electronic firing head is an excellent choice for permanent completion perforating where traditional hydraulic firing systems are limited due to other pressure operations in the well, such as permanent packer setting. The system initiates when it receives the pressure key (signature), not an absolute pressure.

Multiple safeguards

Depending on the application, the eFire-TCP firing head and TCP guns can be conveyed downhole by a workstring or completion string. The eFire-TCP firing head is set at the surface to arm 1 h after it reaches a predetermined hydrostatic pressure level.

Low-level, coded pressure pulses in liquid-filled or partially air-filled tubing are used to communicate with the firing head. This communications system eliminates problems associated with pressure testing the tubing, high applied pressure levels while setting packers, or pressure testing the casing. In partially air-filled tubing, the firing head is activated using nitrogen bottles, eliminating the need for an onsite nitrogen-pumping unit.

A pressure transducer detects the commands sent from the surface. Two separate processors in the controller module must independently verify the unique command signature. An initiator module then converts battery power to the high voltage level required to initiate the S.A.F.E. equipment



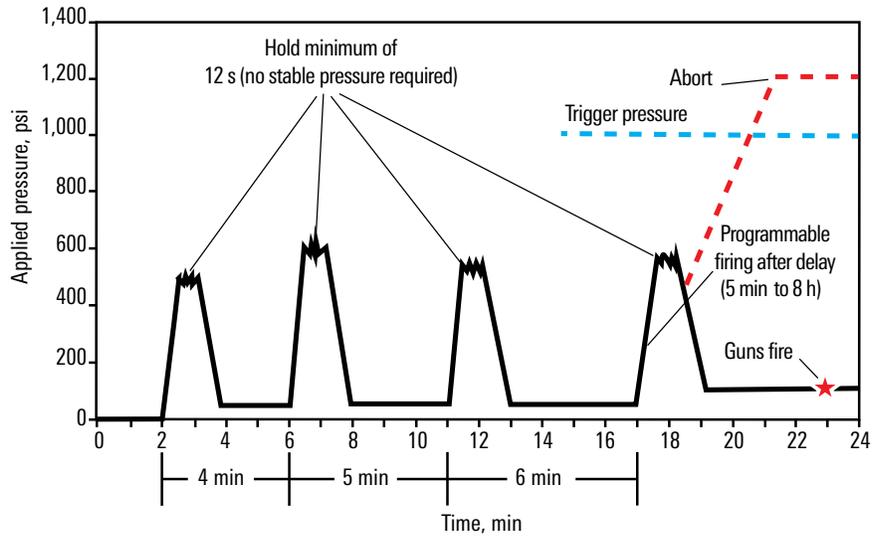
eFire-TCP firing head.

detonator, which uses an exploding foil initiator (EFI) to eliminate primary explosives associated with conventional firing heads. This S.A.F.E. equipment detonator makes the firing head insensitive to radio frequency radiation, stray voltages, welding operations, and cathodic protection systems.

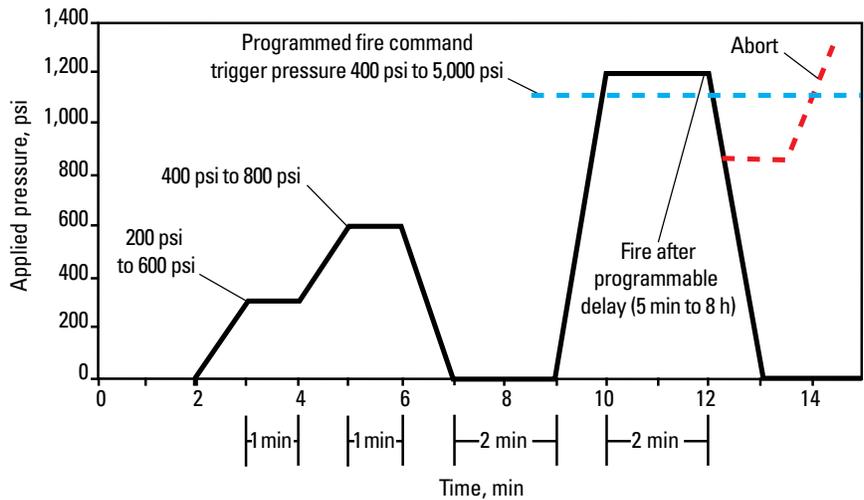
The eFire-TCP firing head can be used as a stand-alone tool inside a downhole fill sub equipped with a fluid isolation device, which reduces the chances of debris plugging the pressure path. If an application requires, the firing head can be used in combination with other Schlumberger TCP accessories such as the automatic gun release (SXAR) and the monobore anchor (MAXR).

The firing head can also record the dynamic pressure transient during perforating operations. Approximately 1 s before initiation, the tool begins to record 1,000 samples/s and continues for 6 s.

The eFire-TCP firing head's fast-pressure sampling rate is ideal for capturing the PURE* clean perforations system signature, making it perfect for use with TCP PURE systems perforating jobs.



Applied pressure versus time profile of a four-pulse fire command for a typical TCP job with liquid cushion.



Applied pressure versus time profile of a fire command for a typical TCP job with liquid cushion.

Specifications

	eFire 4, 15K	eFire 4, 25K	eFire 4, 30K
OD, in [mm]	1.71 [43]	1.76 [45]	2.12 [54]
Makeup length, ft [m]	5.76 [1.76]	6.55 [2.0]	6.53 [1.99]
Temperature, [†] degF [degC]	330 [165] for 100 h	330 [165] for 100 h	330 [165] for 100 h
Pressure, psi [MPa]	15,000 [103]	25,000 [172]	30,000 [207]
Shock rating [‡]	20 shocks, 30-ft drop	20 shocks, 30-ft drop	20 shocks, 30-ft drop
Time delay, min	5 to 480	5 to 480	5 to 480
Transient pressure recorder rate [§]	1,000 samples per second for 6 s	1,000 samples per second for 6 s	1,000 samples per second for 6 s
Battery autonomy, h	240 ^{††}	240 ^{††}	240

[†] Limited to HMX time-temperature ratings

[‡] 30-ft drop test performed onto a 1-in polypropylene plate, 1-in steel plate, and cement base

[§] One pressure sample every 6 s (during the entire job) plus 1,000 pressure samples/s during 6 s at perforation time

^{††} Battery autonomy of 500 h and 1,000 h are available options

^{‡‡} Battery autonomy of 1,000 h is an available option

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