

Tempo instrumented docking perforating gun system

Improves completion efficiency and productivity by integrating plug-in guns, selective perforating, and real-time advanced downhole measurements



Temperature:
up to 375 degF



Pressure rating:
up to 25,000 psi

Applications

- Supports hollow carrier perforating gun systems
- Performs single or selective perforating applications with up to 40 guns in a single descent
- Obtains advanced measurements throughout perforating
- Enables real-time, dynamic high-speed wellbore pressure and tool acceleration measurements

Features

- Deploys both deep penetrating and big hole shaped charges
- Integrates with PURE* clean perforations system and P3* postperforating treatment
- Measures with a powered casing collar locator (CCL)
- Deploys with wireline, pumpdown, e-coil, or tractor conveyance
- Delivers continuous real-time depth, pressure, and temperature measurements during run in hole (RIH), correlating, and run out of hole

How Tempo system improves well completions

The Tempo* instrumented docking perforating gun system is the industry's first perforating gun system to fully integrate measurement capabilities and an innovatively designed plug-in gun that simplifies assembly, arming, and firing. This integration with real-time advanced downhole measurements for monitoring and confirming operations mitigate risk while increasing safety, reliability, and efficiency.

How it works

Specifically designed docking components are the key elements of the Tempo gun system's compact plug-in design. The simplified system design minimizes the potential for human error during assembly, increases reliability, and eliminates the main causes of perforating misfires: crimping and wiring. The gun design is streamlined further with fewer seals and reduced lengths, which in turn maximize the usable gun string length.

Shorter gun lengths support deploying extreme-length gun strings. Both single and selective guns can be armed offline in significantly less time than required for conventional systems, further improving safety and operational efficiency.

With its engineered controls and integrated measurement capabilities, the Tempo gun system provides the highest level of safety in compliance with API RP 67 Group 2 specifications and radio frequency (RF) protection verified by an independent third-party organization. This means that RF silence requirements are eliminated in almost all use cases and wellsite operations can usually continue uninterrupted during perforating operations. RF-safe capability enables arming in advance to improve operational efficiency and save rig time.

Integrated measurements for real-time insight

By incorporating advanced perforating measurements capability, the Tempo gun system delivers a complete suite of real-time measurements, simultaneously acquiring critical data for verifying and optimizing perforating design and execution. Fast, accurate pressure measurement verifies the dynamic underbalance needed to deliver clean perforations.

Its ruggedized measurement technology obtains pressure, temperature, CCL, and optional gamma ray before, during, and after perforation. Precise depth control is ensured by correlation using both gamma ray and CCL in standard and high-chrome tubulars for diameters up to 9 $\frac{5}{8}$ in.

What it replaces

Conventional perforating gun systems

Additional information

For PURE clean perforations system, P3 postperforating treatment, and propellant treatments, the Tempo system measures the transient wellbore pressure and transmits the data within seconds after firing. The Tempo system also records high-speed dynamic shock data to help validate gun shock modeling and optimize future operations.



Tempo docking perforating gun system.

Tempo System—Measurement Module Measurement Specifications

Pressure accuracy, psi	±40 at 1 Hz; max. range 20,000
Temperature accuracy, degF	±2 at 1 Hz; max range 350
Dynamic pressure bursts, psi	±40 at 10 kHz for 7 s; max. range 20,000
Dynamic shock bursts, g _n	±50 at 40 kHz for 6 ms; max. range 50,000

Tempo Instrumented Docking Perforating Gun System Mechanical Specifications

Outside diameter, in	2	2 $\frac{7}{8}$	3 $\frac{3}{8}$, 3 $\frac{1}{2}$, 3.67	4 $\frac{1}{2}$, 4 $\frac{5}{8}$, 4.72
Shot density (spf), phasing (°)	6, 60	3, 120; 4, 120; 4, 180; 6, 60	4, 60; 4, 180; 5, 180; 6, 60; 6, 99; 12, 135/45	4, 180; 5, 72; 12, 135/45
Charge	PowerJet* shaped charge 2006	PowerJet Nova* shaped charge 2906	PowerJet Nova 4512	PowerJet Nova 4505 PowerJet Nova 4512
	PJC2006	PowerJet Omega* shaped charge 2906	PowerJet Nova 3406	PowerJet Omega 4505 PowerJet Omega 4512
	PJT2006	PowerJet 2906	PowerJet 3406	PowerJet 4505 PowerJet 4512
	PowerFlow* shaped charge 2006	CleanPACK* perforating charge 38C	PowerFlow 3412	PowerFlow 4621
Temperature rating, degF	375	340 and 375	340 and 375	340 and 375
Pressure rating [†] , psi	20,000	15,000–25,000	15,000–25,000	8,000–20,000
Min. casing size, in	2 $\frac{7}{8}$	4 $\frac{1}{2}$	3 $\frac{3}{8}$ -in guns: 4 $\frac{1}{2}$ 3 $\frac{1}{2}$ - and 3.67-in guns: 5	6 $\frac{5}{8}$
Max. number of selective guns	40	40	40	40

[†] Configuration dependent

Tempo System—Measurement Module Mechanical Specifications

Outside diameter, in	2 $\frac{7}{8}$	2 $\frac{7}{8}$
Temperature rating, degF	350	350
Pressure rating, psi	20,000	20,000
Min. casing size, in	2 $\frac{7}{8}$	4 $\frac{1}{2}$
Max. casing size, in	4 $\frac{1}{2}$	9 $\frac{5}{8}$
Length, ft	6.48	4.98
		3.11 without gamma ray
Weight, lbm	56	80
		55 without gamma ray
Tension, lbf	25,000	40,000
Compression, lbf	25,000	21,000
Special applications	Standard and NACE MR0175 compliant for H ₂ S and CO ₂ resistance API RP 67 compliant for explosives operations Compatible with wireline release devices including WIRed* wireline inline release device, electrically controlled release devices (ECRDs), and downhole tractors	

Hazard Type Comparison

Initiator	Conventional 50-ohm detonator	Tempo perforating gun system
Stray voltage, V	0.25	40
Typical no-fire voltage, V	10	600
RF exclusion zone [†]		
Small transmitters, ft	30	0 [†]
Medium transmitters, ft	30	4
Large transmitters, ft	5,280	Offshore: 40
		Land: 200

[†] Small transmitters (handheld radios, cellular phones, Bluetooth®, WiFi, driving monitors, etc.): ≤5 W. Medium transmitters (truck and marine radios): >5 and <200 W. Large transmitters (TV and radio transmission towers and marine radar systems): ≥200 W.

[†] Although no RF hazard exists, it is not recommended to have any components with a lithium battery immediately next to a perforating gun in consideration of lithium battery fire hazards.



Advanced perforating measurement module with gamma ray for the Tempo system.

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Schlumberger