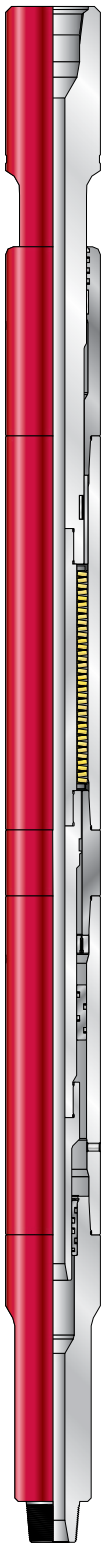
O.S.T. Shock Tool



Weatherford's shock tool plays an important role in drilling operations, extending bit, motor, and surface-equipment life by reducing bit bounce and impact loads and absorbing shock loads. The tool uses steel disk springs, hydraulic pump-open force, and a one-way dampening valve to reduce weight-on-bit (WOB) variation. During drilling, the tool is usually run partially in compression, enabling it to extend or compress as required to keep the bit on bottom for optimal rate of penetration (ROP), enhanced drilling efficiency, and reduced drilling costs.

Spring rates can be adjusted to as low as 4,000 lbf/in. (452 N•m) if required for low-WOB operations.

The one-way dampening valve restricts oil flow in one direction only, between the balancing chamber below the valve and the spring chamber above the valve. Oil restriction in the closing stroke would tend to stiffen the spring rate; but on the closing stroke, as the bit rolls over a high spot, the dampening valve allows unrestricted oil flow from the spring housing to the balance housing, allowing the tool to close against spring resistance only. The valve then seats, causing an oil restriction so that the pump-open force cannot be applied fully to reopen the tool; therefore, the bit's generated force is not stored and fully returned to the bit, as a certain amount is dissipated through the oil restriction.

Applications

- Full range of WOB applications
- Low bit weights with high pump pressures
- High-temperature holes

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Features, Advantages and Benefits

- The shock tool extends bit life and enhances ROP by reducing bit bounce, impact loads, and WOB variation through the action of steel disk springs, hydraulic pump-open force, and a one-way dampening valve.
- The tool enhances the service life and performance of surface equipment by reducing shocks and cushioning impacts.
- The tool is sprung in both directions for effectiveness with low bit weights and high pump pressures.
- Spring rates can be adjusted to as low as 4,000 lbf/in. (701 N•m) for operational flexibility.
- The one-way dampening valve allows unrestricted oil flow from the spring housing to the balance housing, allowing the tool to close against spring resistance only.
- Drilling accuracy is enhanced because the shock tool has a stabilized spline that will not build angle.
- Minimum-friction drive allows free vertical movement, enhancing the performance of this tool.
- When jarring becomes necessary, an overpull brings the retaining ring in contact with the pin on splined housing. This metal-to-metal contact causes the tool to act as an integral part of the bottomhole assembly (BHA), eliminating any adverse reaction from the spring system during jarring.

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Specifications

New OD[a] (in./*mm*)	4.844 *123.04*	6.656 *169.06*	8.156 *207.16*	9.688 *246.07*	11.500 *292.10*	12.250 *311.15*
Nominal OD (in./*mm*)	4-3/4 *120.65*	6-1/2 *165.10*	8 *203.20*	9-1/2 *241.30*	11-1/4 *285.75*	12 *304.80*
ID (in./*mm*)	1.500 *38.10*	2.520 *64.01*	2.750 *69.85*	3.000 *76.20*	3.000 *76.20*	3.000 *76.20*
Tensile yield[b] (lbf/*kN*)	328,300 *1,460*	454,800 *2,023*	825,000 *3,670*	1,350,000 *6,005*	1,482,000 *6,592*	1,482,000 *6,592*
Torsional yield[c] (lbf-ft/*kN•m*)	14,426 *20.91*	39,996 *54.22*	81,166 *110.04*	140,415 *190.37*	190,812 *258.70*	219,429 *297.50*
Maximum temperature[e] (°F/°*C*)	392° *200°*					
Pump-open area (in.^{2}/*cm*^{2})	11.0 *71.0*	19.6 *126.5*	30.7 *198.1*	41.3 *266.5*	17.7 *114.04*	17.7 *114.04*
Approximate tool length (ft/*m*)	12 *3.7*	12 *3.7*	14 *4.3*	16 *4.9*	16 *4.9*	16 *4.9*
Approximate tool weight (lb/*kg*)	600 *272*	1,000 *454*	1,800 *816*	3,000 *1,361*	4,300 *1,950*	4,845 *2,198*
Standard connections	3-1/2 IF	4-1/2 IF	6-5/8 Reg	7-5/8 Reg	8-5/8 Reg	8-5/8 Reg
Spring rate[d] (lbf/in. [*N•m*] in either direction)	18,000 *3,152*	18,000 *3,152*	18,000 *3,152*	25,000 *4,378*	35,000 *6,129*	35,000 *6,129*
Circulating pressure (psi/*bar*)	5,000 *345*					
Hydrostatic pressure (psi/*bar*)	N/A					

[a] New OD is based on nominal OD plus wear allowance.
[b] Tensile yield is based on nominal OD and the published yield strength of the material.
[c] Torsional yield is based on tool joint connections at nominal OD and is calculated per API RP7G and the published yield strength of the material.
[d] Spring rate can be adjusted to as low as 4,000 lb/in. (701 N/mm) of travel, as required for the application.
[e] The maximum temperature is available upon request only.

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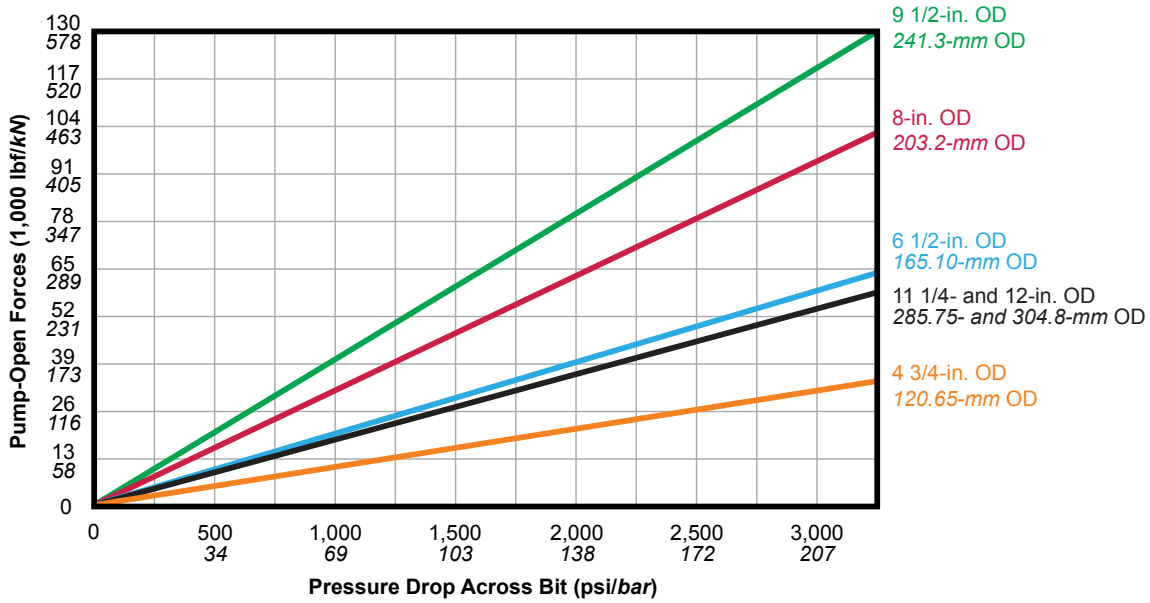
Pump-Open Force Chart



Pump-open force is created by pressure drop across the bit. The pump pressure creates a reaction force in the tool that tries to force it open. Reduce the pump to idle before attempting to jar.

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Operation

The shock tool incorporates a pressure-balancing piston that equalizes pressure inside the tool with pressure inside the drillstring. The piston also guarantees pressure lubrication throughout the tool. As a result of a difference in pressure inside and outside the tool or pressure drop across the bit, the tool tends to open an amount equal to the pressure drop across the bit, multiplied by the cross-sectional area of the splined mandrel at the seal area.

If the hydraulic force extending the tool exceeds the bit weight, the tool opens, compressing the springs, until the bit weight and load carried by the springs equal the pump-open force. If the pump-open force is less than the bit weight, the tool closes, compressing the springs until the load carried by the springs plus the pump-open force equals the bit weight.

The shock tool is preferably run next to the bit to minimize the oscillating mass, maximizing the ability of the shock-absorbing element to absorb impacts and keep the bit on bottom. If a packed hole assembly is run, the tool should be placed further up the string; however, the effectiveness of the tool will be reduced because of the larger oscillating mass.

Free vertical movement is ensured by guiding the mandrel above and below the spline drive assembly. No lateral loads are taken on drive assembly. The tool is manufactured from 4340 and 4145 quenched and tempered steel. The tool does not use any temperature-sensitive elastomers for shock absorption and may be used to 450°F (232°C) with the use of optional seals for temperatures above 275°F (135°C). The length of run between service periods should be shortened for high-temperature holes.

The tool is sprung in both directions; but when jarring becomes necessary, an overpull brings the retaining ring in contact with the pin on splined housing. This contact causes the tool to act as an integral part of the BHA, eliminating any adverse reaction from the spring system during jarring. On request, Weatherford can alter the amount of overpull required to fully extend the tool.