NATIONAL OILWELL

OPERATING MANUAL

SHOCK TOOLS

Size	Series
4 ¾”	155
6 ¼”	146
6 ½”	150
6 ¾”	147
7”	154
8” - 2 ½” BORE	148
8” - 2 ¾” BORE	160
9”	139
9 ½”	151
10”	138
11”	157
12”	143
14”	113

Reviewed and Approved By: Signature:_____ Initials: _____Date: _____

OPERATING MANUAL
SHOCK TOOLS

CONTENTS

1. INTRODUCTION

The *Griffith* Shock Tool will reduce drilling costs by extending bit life, increasing the rate of penetration and reducing drill string failures.

The tool extends bit life by reducing impact loading on the bit. Rate of penetration is increased by reducing BHA vibration and allowing optimum rotary speeds to be used. By isolating bit induced vibrations from the BHA, the Shock Tool reduces drill string fatigue failures.

2. FUNCTION

The Shock Tools are designed to operate effectively under any combination of weight on bit, bit pressure drop, mud weight or hole depth. They are not affected by the closing force of wellbore hydrostatic pressure, or the pump open force caused by the bit pressure drop.

The spring element in the Shock Tool consists of a stack of Belleville disc springs arranged to function in both directions. This arrangement automatically compensates for the pump open effect. Disc springs provide linear spring rates, high load carrying capacity and an optimum spring rate for each size of tool.

The Shock Tools are short and well supported between the mandrel and barrel to prevent lateral loads from acting on the spline drive assembly. Components are manufactured on computer controlled machine tools, from high strength, low alloy steels, to enhance accuracy and durability.

Our experience with the latest developments in sealing elastomers and surface coatings, provides our customers with solutions to problems encountered in hot and corrosive drilling environments.

3. OPERATION

3.1. GENERAL

New tools are shipped painted. The threaded ends are chemplated with iron-phosphate and coated with rust preventative coating. Thread protectors are installed to eliminate mechanical damage. The rust preventative coating must be removed using petroleum base solvent (such as Varsol) and a stiff bristle brush before the Shock Tool is installed into the drill string.

The Shock Tool must be installed in the drill string with the mandrel end up. Prior to make up, a suitable thread compound meeting A.P.I. Spec. 7, Appendix "G" should be applied to the end connections. The mandrel sealing surface should never be tonged on, used for lifting or tying down for shipment. Protect this sealing surface from possible damage during handling or storage.

If it becomes necessary to jar through the Shock Tool, the tool must be fully extended to ensure solid jarring. See table 1 for the force required to fully extend the Shock Tool:

TOOL SIZE IN (mm)	**SERIES**	**EXTENSION FORCE (lb)**	**EXTENSION FORCE (daN)**
4.75 (121)	155	29,000	13 000
6.25 (159)	146	61,000	27 000
6.50 (165)	150	61,000	27 000
6.75 (171)	147	61,000	27 000
7.00 (178)	154	61,000	27 000
8.00 (203)	148	61,000	27 000
8.00 (203)	160	54,000	24 000
9.00 (229)	139	61,000	27 000
9.50 (241)	151	83,000	37 000
10.00 (254)	138	83,000	37 000
11.00 (279)	157	38,000	17 000
12.00 (305)	143	38,000	17 000
14.00 (356)	113	44,000	20 000

TABLE 1

3.2. PLACEMENT

For maximum effectiveness the Shock Tool should be placed immediately above, or as close as possible to the bit. This minimizes the oscillating mass and provides maximum protection for the bit. The Shock Tool is sometimes placed on top of a packed bottom hole assembly. This however, will reduce its effectiveness in protecting the bit.

Improper stabilization can apply excessive bending loads on the shock tool, leading to reduced service life or damage. Avoid situations where the lower end of the Shock Tool is stabilized without further stabilization placed above.

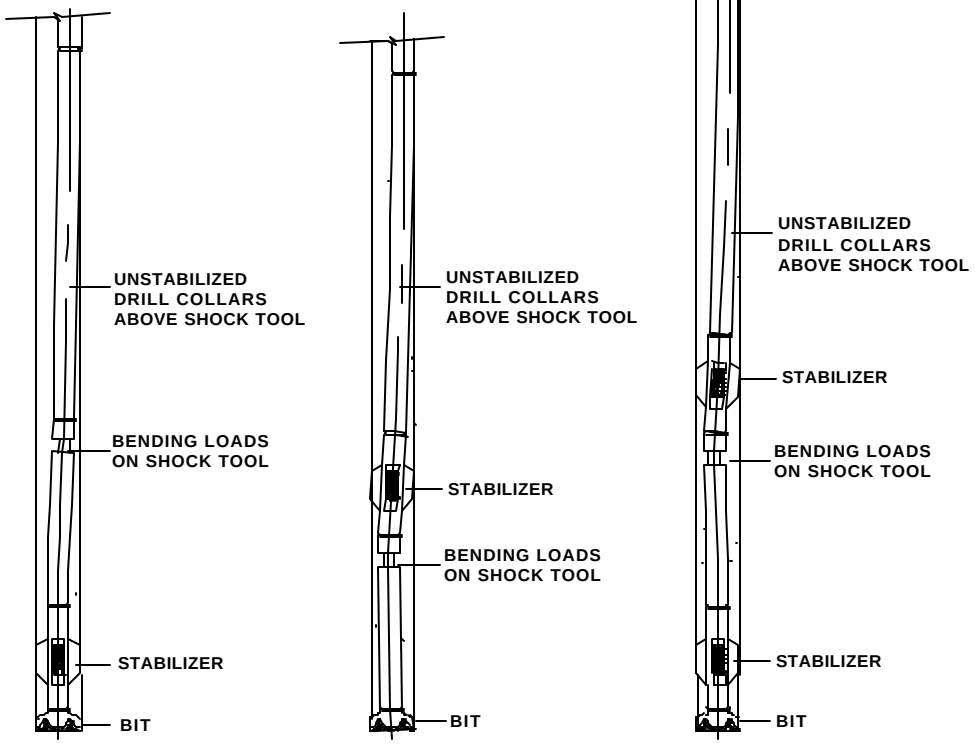
See Figure 1 for improper stabilization.

If the Shock Tool is stabilized at the lower connection, a second stabilizer must be used at the top of the Shock Tool, and a third stabilizer placed no more than thirty feet above.

See Figure 2 for recommended shock tool placement.

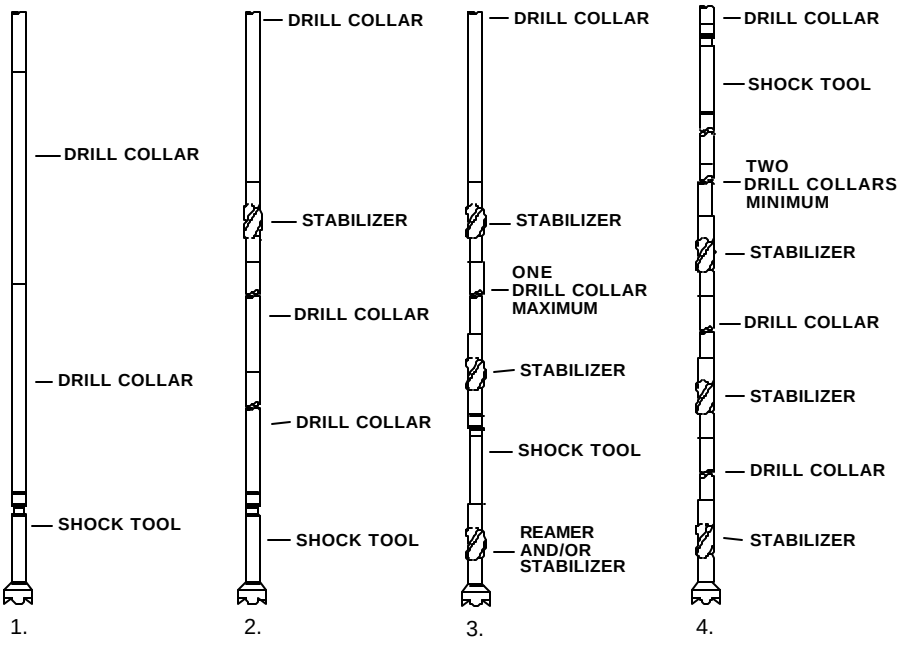
0133A01B

Figure 1
IMPROPER STABILIZATION



0133D01C

Figure 2
RECOMMENDED SHOCK TOOL PLACEMENT



3.3. SHOCK TOOL SELECTION

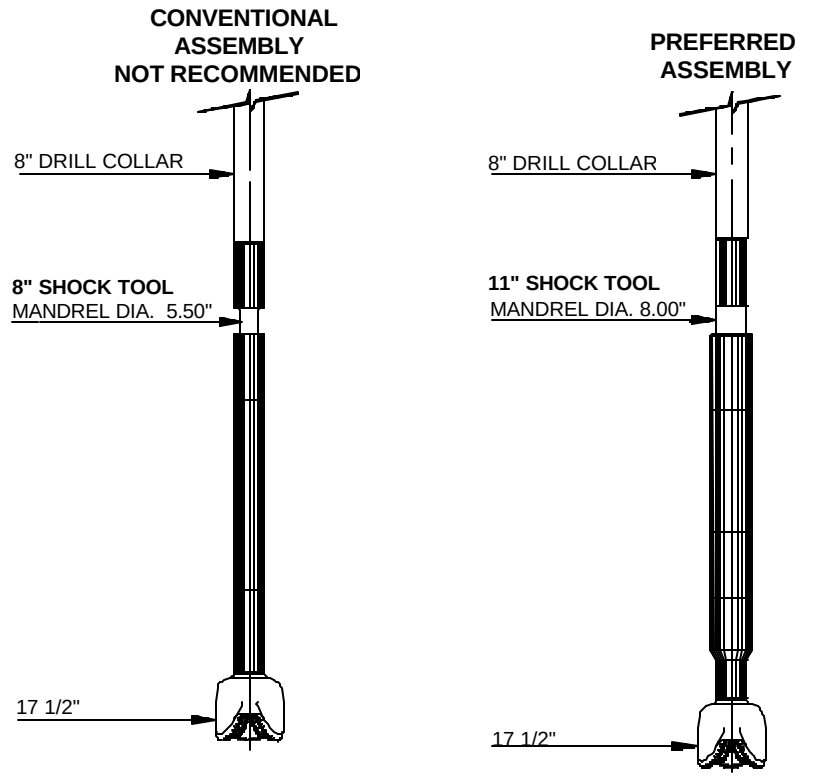
Shock Tools are commonly used with drill collars of the same diameter or smaller, as long as our recommendations for maximum hole diameter (see Section 5 – '*Specifications*') and stabilization (see Section 3.2 – 'Placement') are followed.

In some situations, it is impossible to observe these recommendations because drill collars of a suitable diameter are not available. This will cause excessive bending stress, wear and eventual damage to the Shock Tool.

For hole sizes beyond National Oilwell – Downhole Tools' published maximums, we recommend selecting a Shock Tool with a mandrel diameter equal to, or near the drill collar size. The suggested combinations of Shock Tool and drill collar diameters are listed in Table 2. For this application the mandrel and bottom sub tong area are machined to match the drill collar diameter as shown in Figure 3 and described in Table 2.

TABLE 2

DRILL COLLAR NOMINAL SIZE	SHOCK TOOL	
	NOMINAL SIZE	MANDREL DIA.
8 - 9 in (203 - 229mm)	11 in (279mm)	8.00 in (203mm)
9 - 10 in (229 - 254mm)	12 in (305mm)	8.75 in (222mm)
11 - 14 in (279 - 356mm)	14 in (356mm)	10.62 in (270mm)



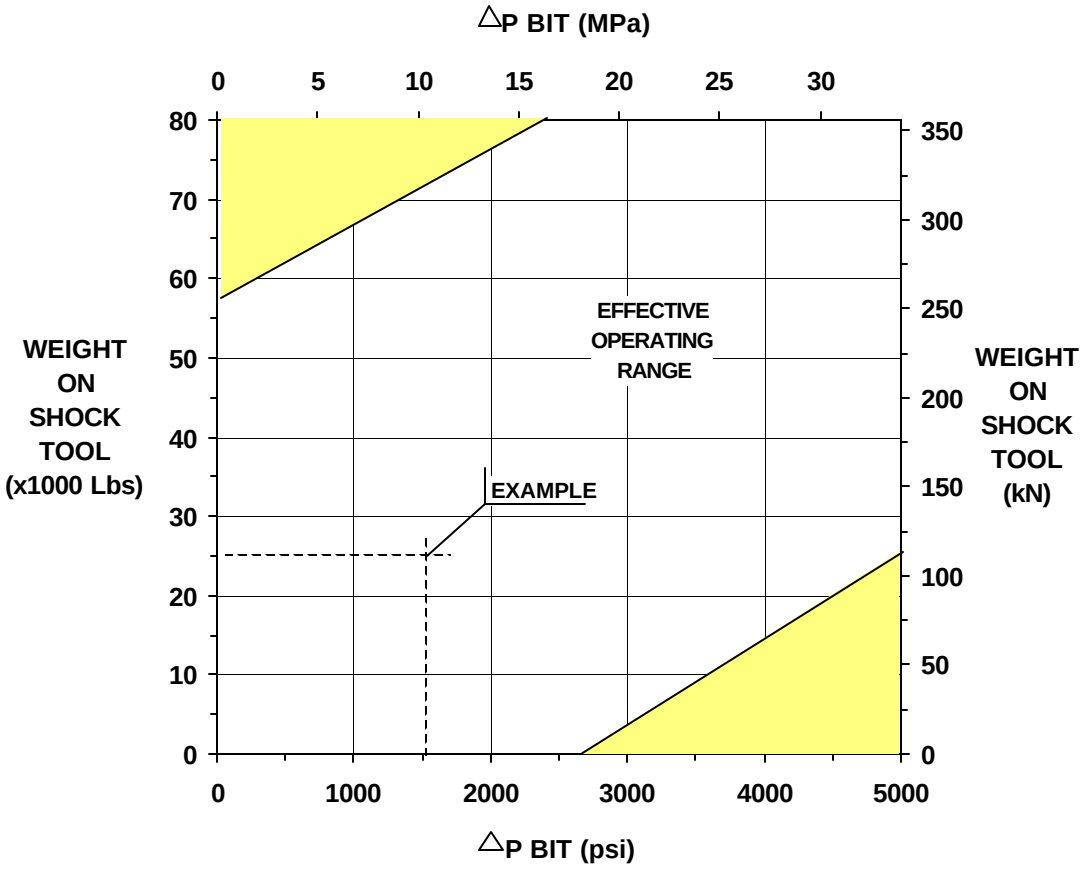
SHOCK TOOLS SELECTION FOR LARGE DIAMETER HOLES
FIGURE 3

3.4. EFFECTIVE OPERATING RANGE

Shock Tools operate effectively under conditions far exceeding those used in normal drilling operations. They are completely unaffected by extremes in hydrostatic head, and automatically compensate for the effect of pump open force. No special operating procedures or techniques are required.

Charts showing the effective operating range for each size of Shock Tool, are included in the following pages.

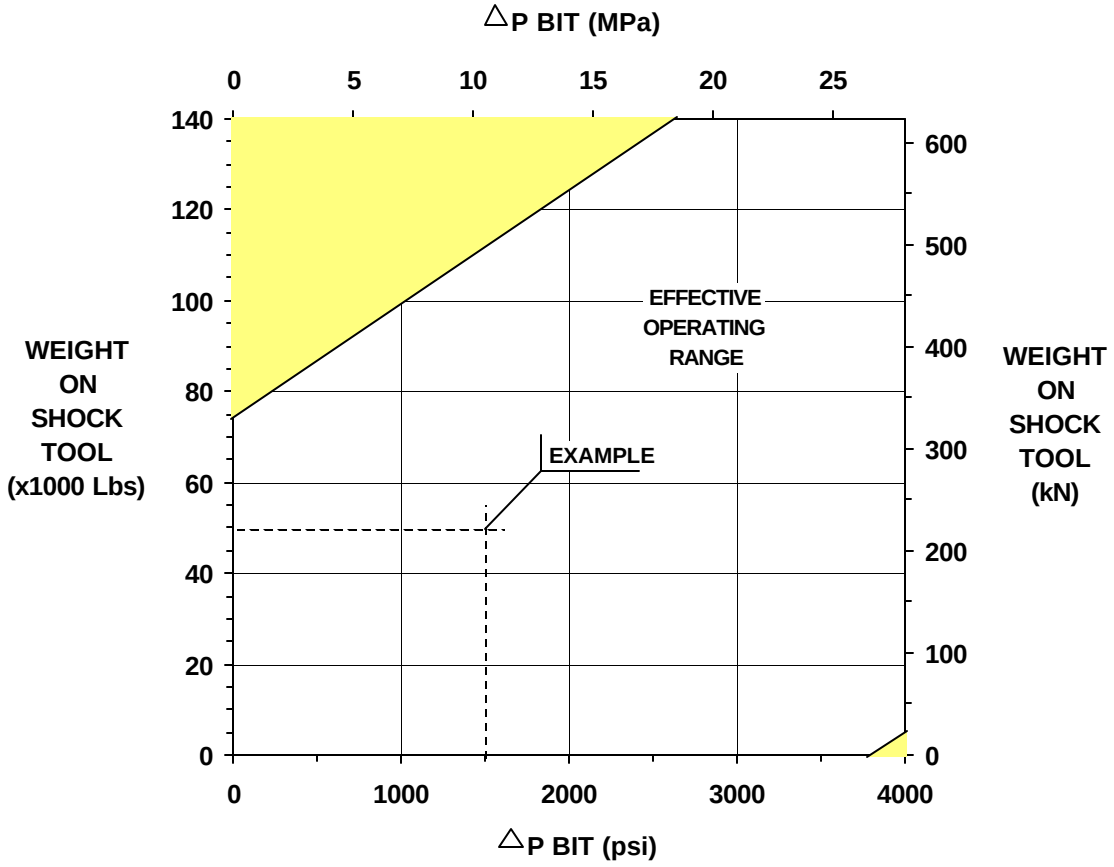
EFFECTIVE OPERATING RANGE
4 3/4" SHOCK TOOL
SERIES No. 155



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 25,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

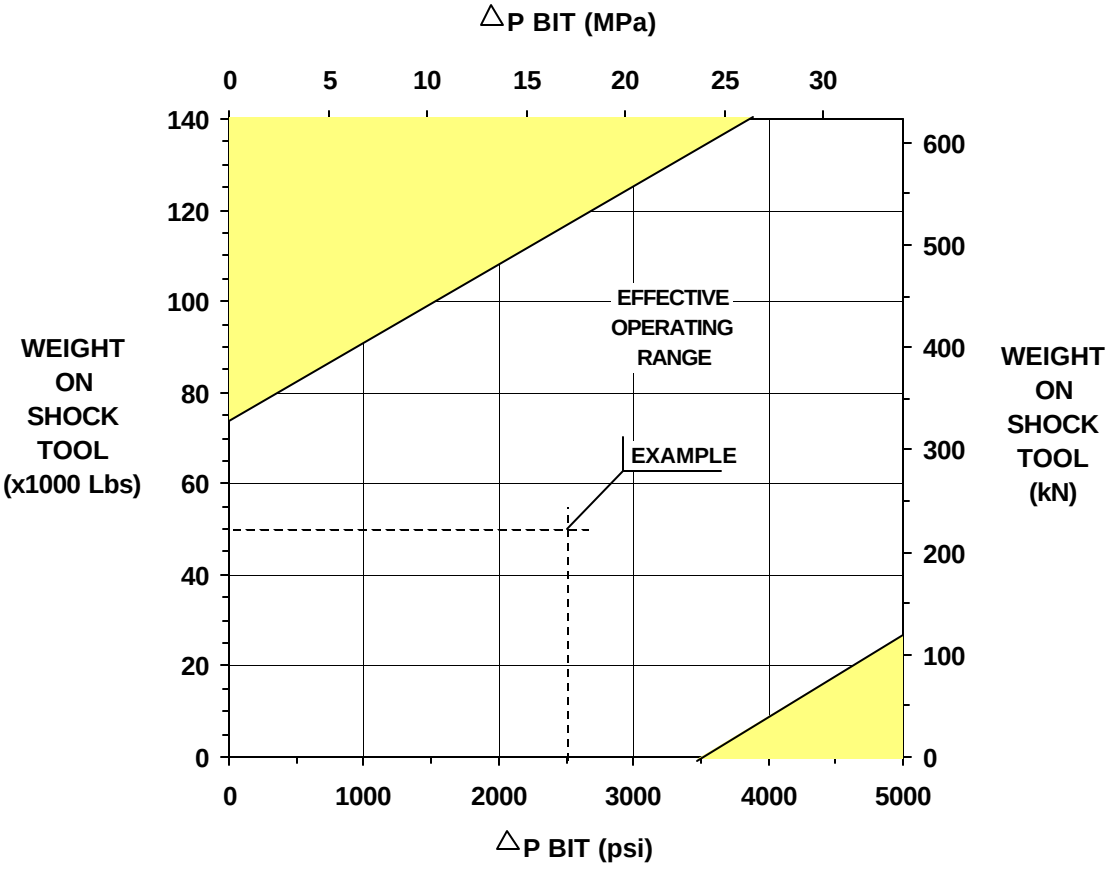
EFFECTIVE OPERATING RANGE
6 1/4" & 6 1/2" SHOCK TOOL
SERIES No. 146 & 150



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 50,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

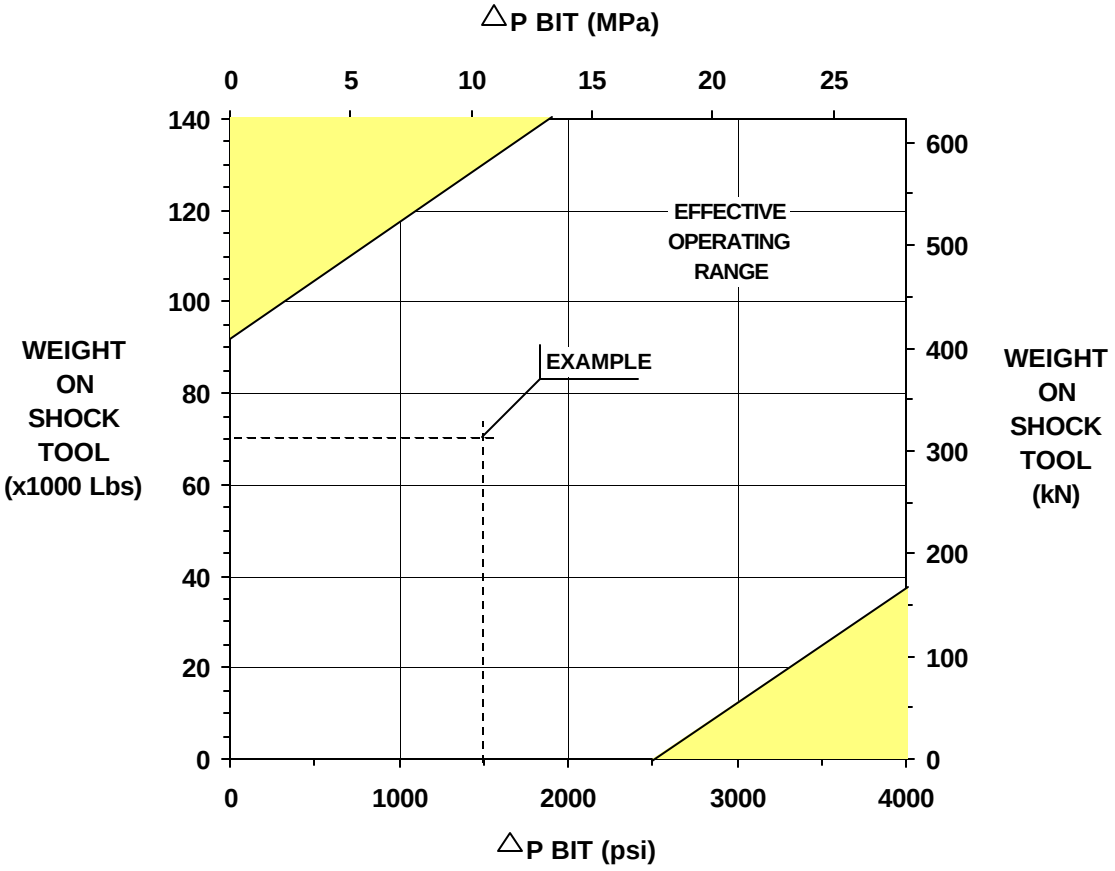
EFFECTIVE OPERATING RANGE
6 3/4" & 7" SHOCK TOOL
SERIES No. 147 & 154



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 50,000 lb WEIGHT ON TOOL WITH 2500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

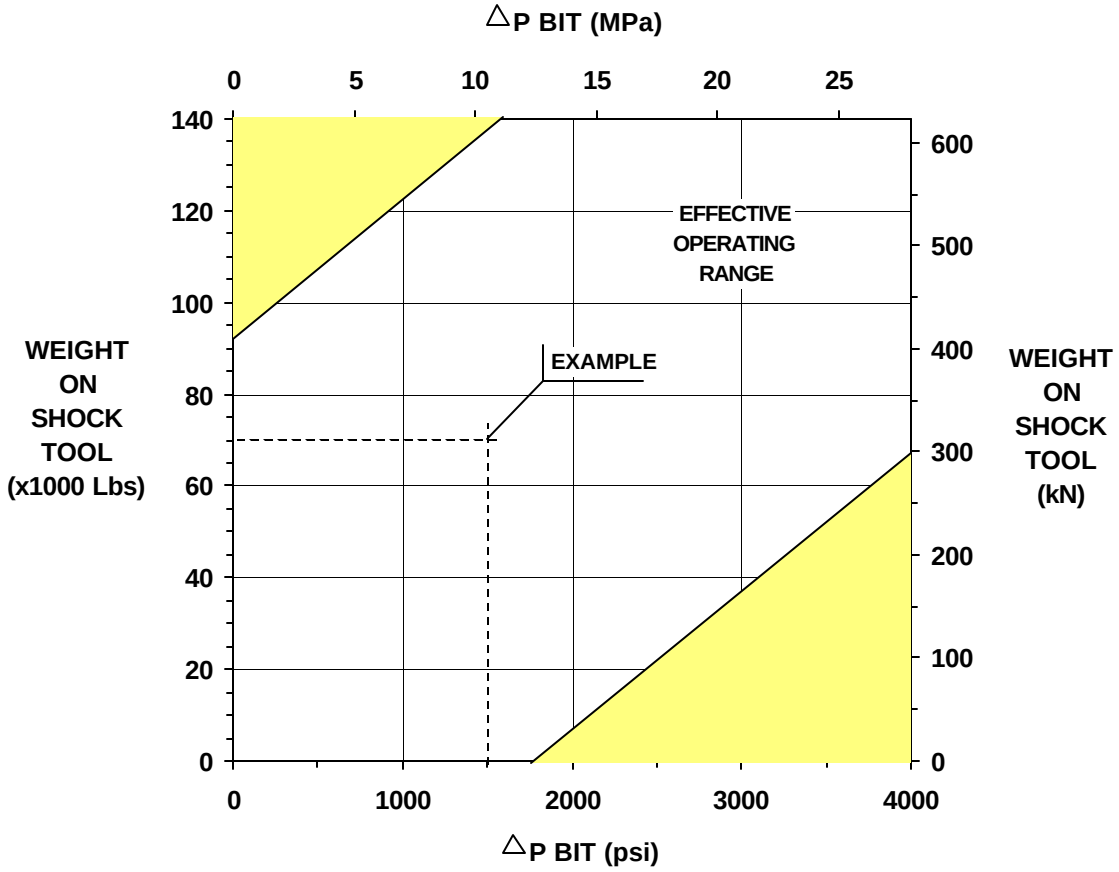
EFFECTIVE OPERATING RANGE
8" SHOCK TOOL
SERIES No. 148



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

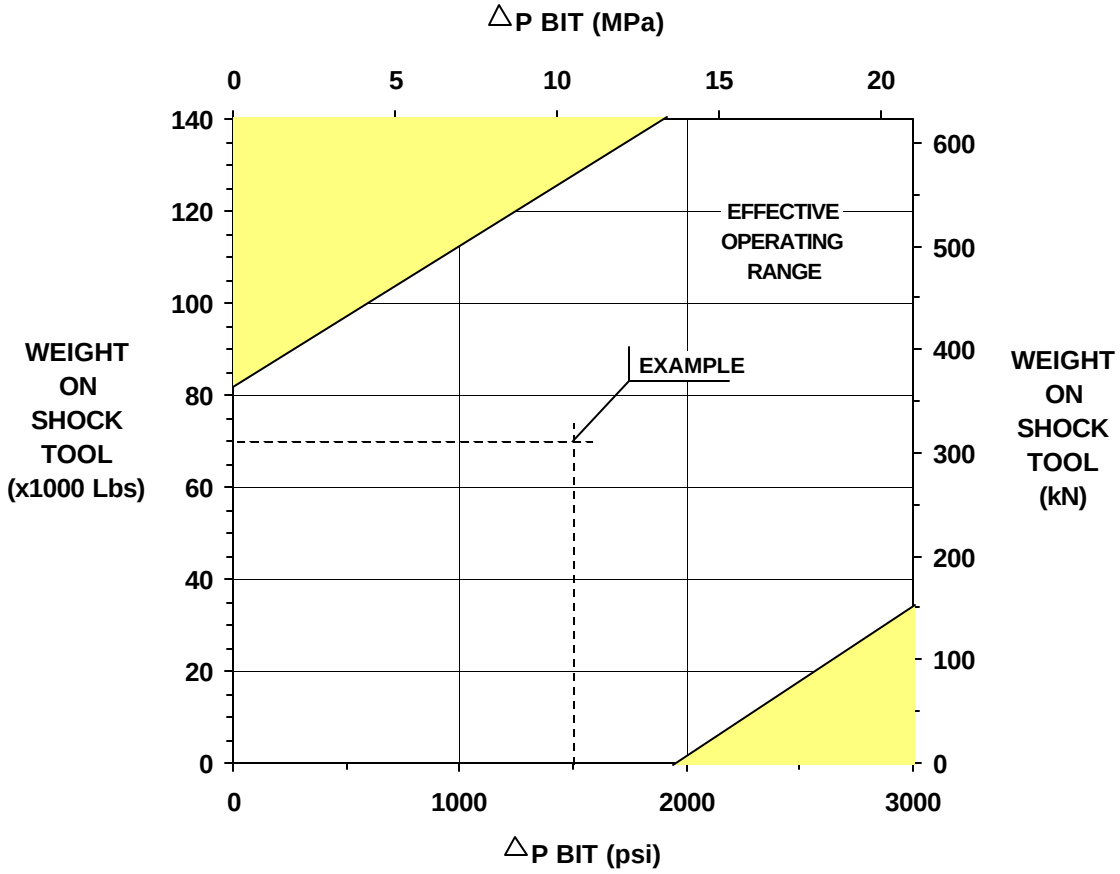
EFFECTIVE OPERATING RANGE
8" HEAVY DUTY SHOCK TOOL
SERIES No. 160



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

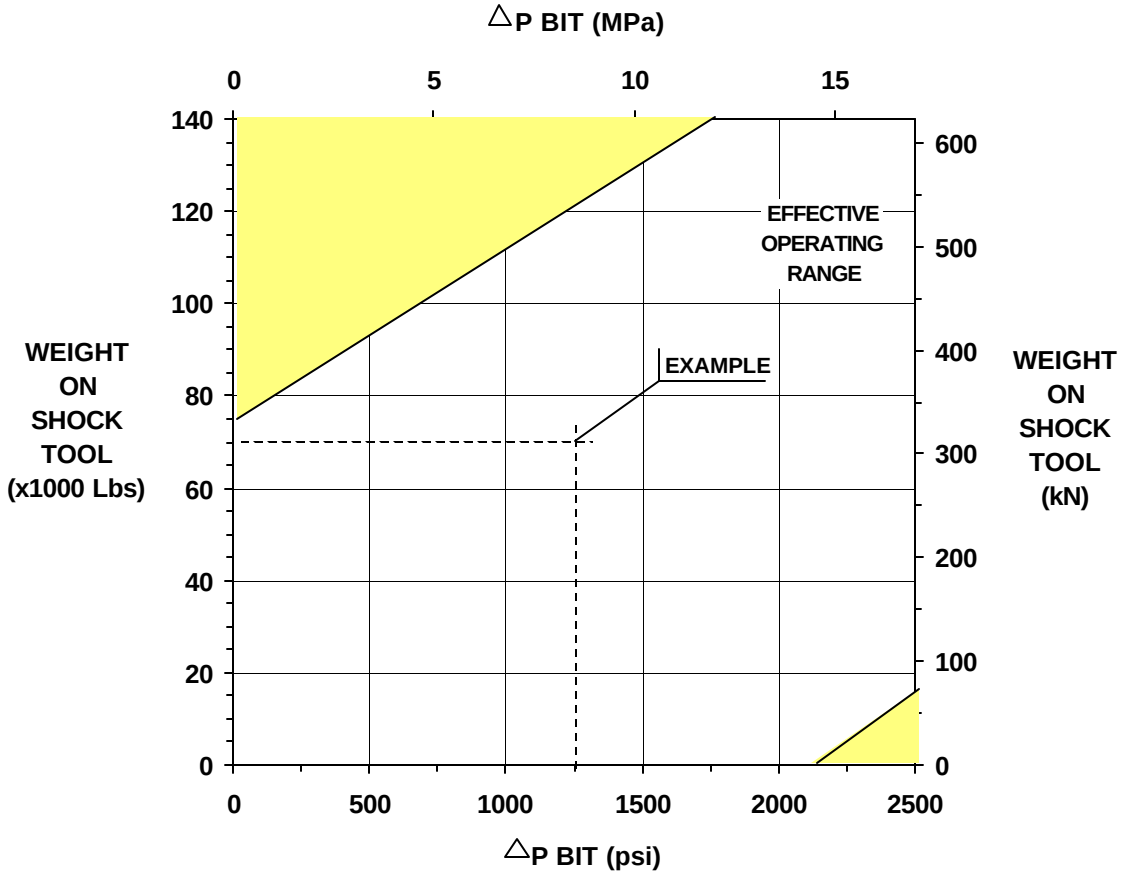
EFFECTIVE OPERATING RANGE
9" SHOCK TOOL
SERIES No. 139



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

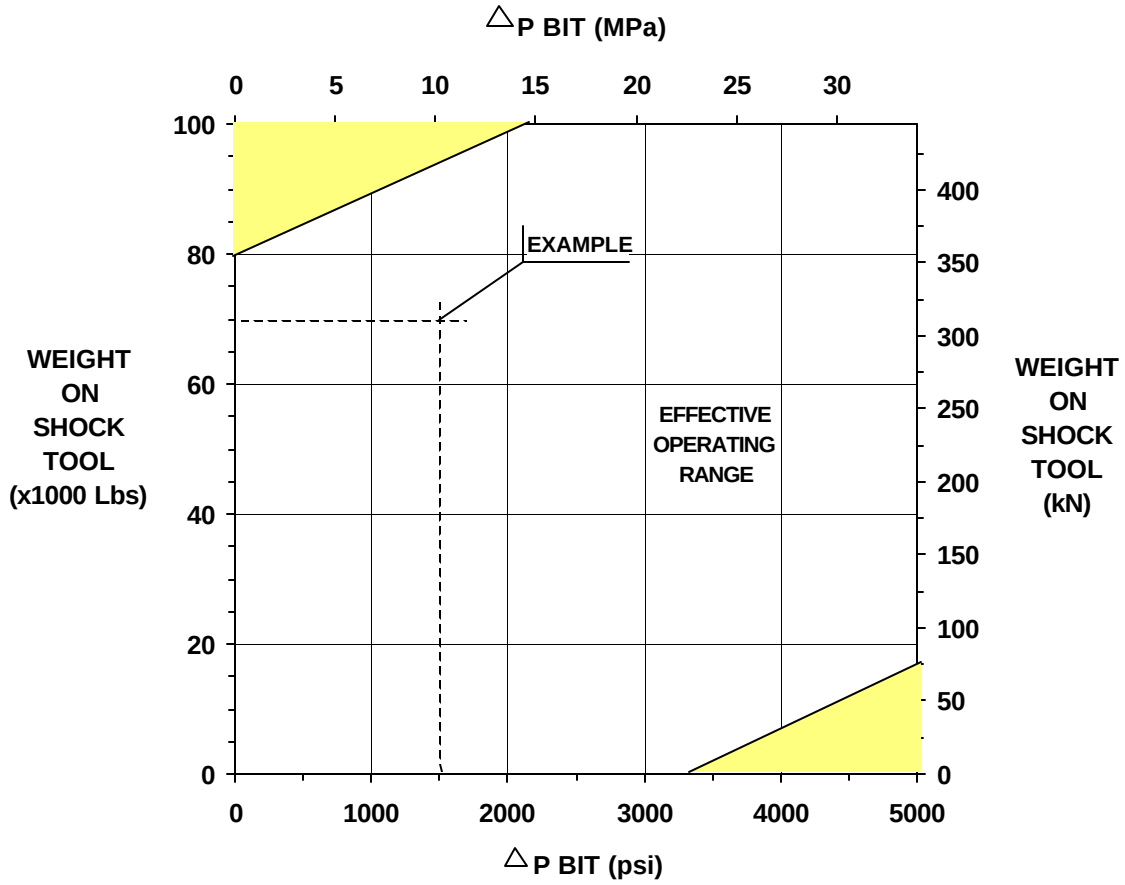
EFFECTIVE OPERATING RANGE
9 1/2" & 10" SHOCK TOOL
SERIES No. 151 & 138



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1250 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

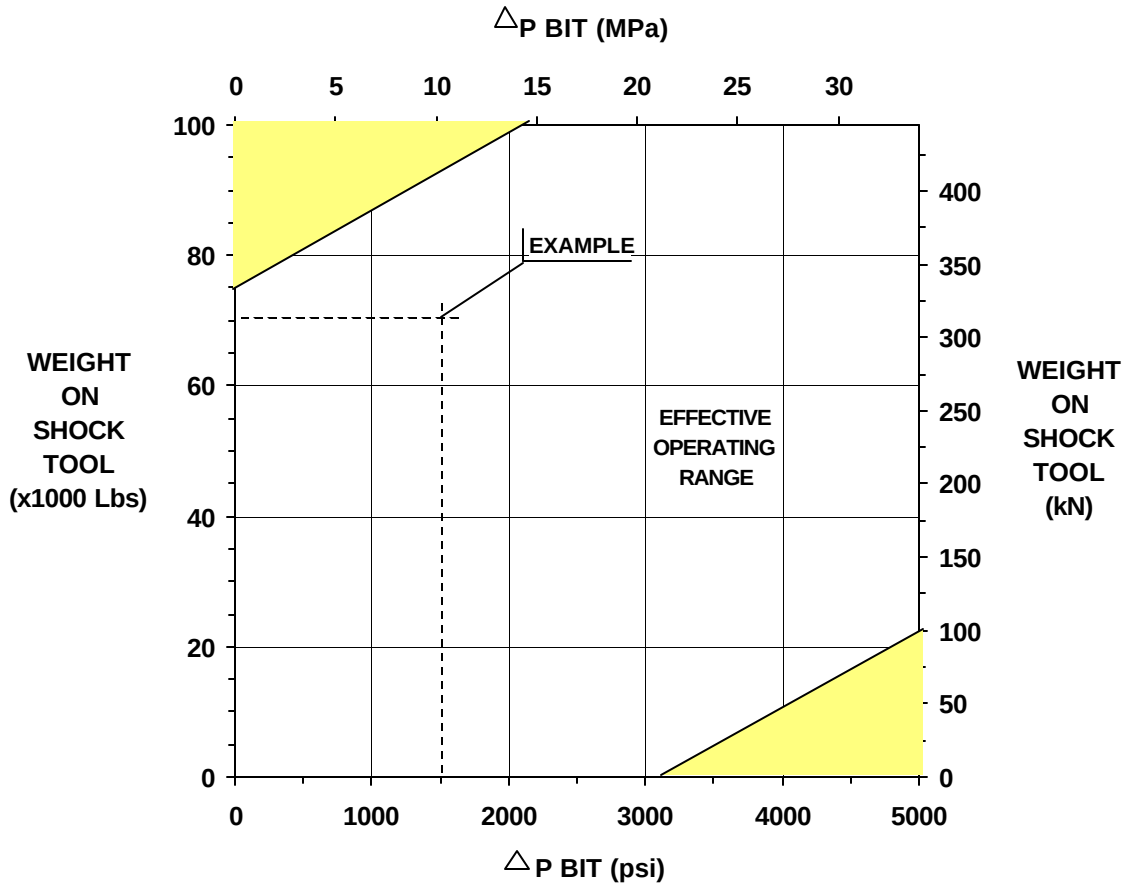
EFFECTIVE OPERATING RANGE
11" SHOCK TOOL
SERIES No. 157



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

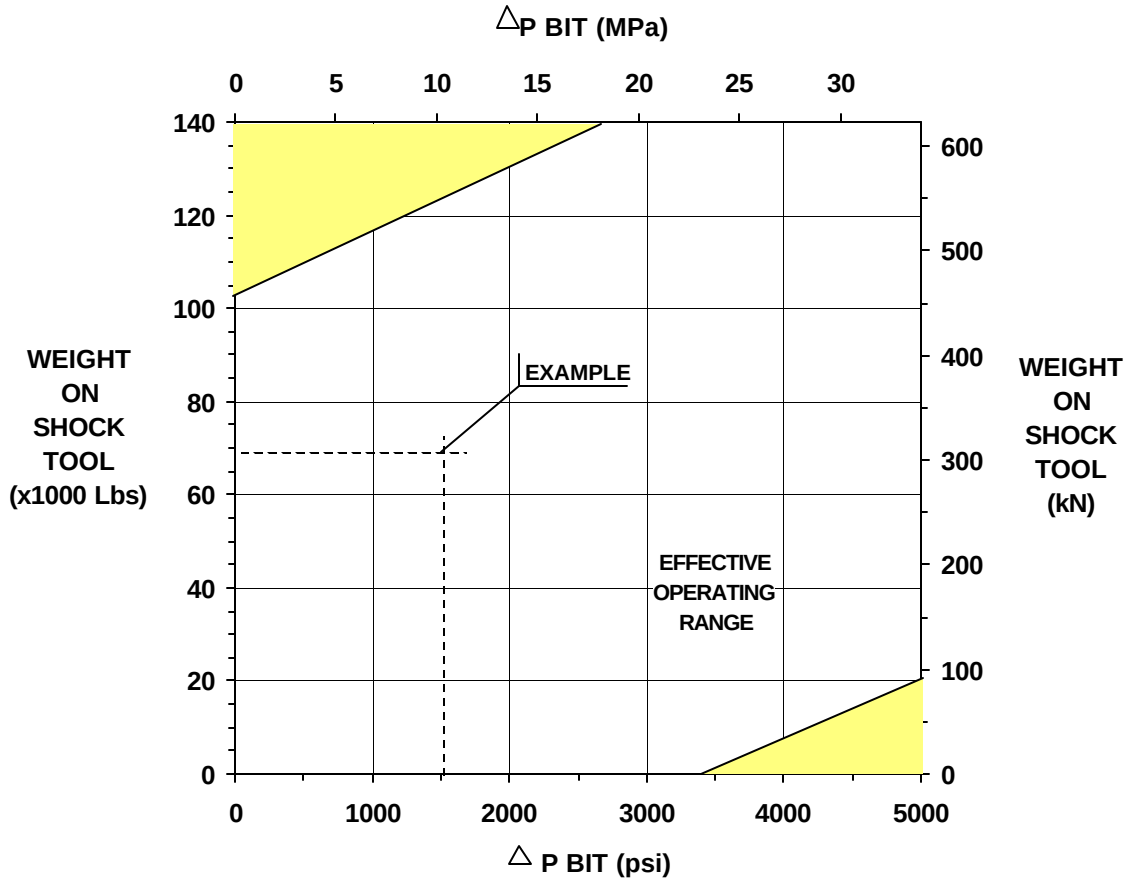
EFFECTIVE OPERATING RANGE
12" SHOCK TOOL
SERIES No. 143



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

EFFECTIVE OPERATING RANGE
14" SHOCK TOOL
SERIES No. 113



THE SHOCK TOOL WILL BE EFFECTIVE WHEN HORIZONTAL LINE FROM WEIGHT ON TOOL INTERSECTS VERTICAL LINE FROM BIT PRESSURE DROP, WITHIN NON-SHADED RANGE

EXAMPLE: 70,000 lb WEIGHT ON TOOL WITH 1500 psi BIT PRESSURE DROP. INTERSECTION FALLS WITHIN THE EFFECTIVE OPERATING RANGE

3.5. ROTATING HOURS

The maximum recommended rotating hours for Shock Tools is affected by, the size of tool, bottom hole temperature, rotary speed, and pressure differential.
The following formula should be used to calculate the maximum rotating hours: **(Not to exceed 500 HRS)**

IMPERIAL UNITS:

$$\mathbf{HRS} = 500 \times \sqrt{\frac{100}{BHT} \times \frac{75}{RPM} \times \frac{1000}{DP} \times \frac{5}{DIA}}$$

Where: **HRS** = Maximum Rotating Hours
BHT = Static Bottom Hole Temperature (Degrees F)
RPM = Rotary R.P.M.
DP = Actual Differential Pressure at Tool (P.S.I.)
DIA = Nominal Size of Shock Tool (inches)

METRIC UNITS:

$$\mathbf{HRS} = 500 \times \sqrt{\frac{38}{BHT} \times \frac{75}{RPM} \times \frac{7000}{DP} \times \frac{125}{DIA}}$$

Where: **HRS** = Maximum Rotating Hours
BHT = Static Bottom Hole Temperature (Degrees C)
RPM = Rotary R.P.M.
DP = Actual Differential Pressure at Tool (kPa)
DIA = Nominal Size of Shock Tool (mm)

Example: An 8" Shock Tool is being used where the bottom hole temperature equals 150°F, the differential pressure drop at the tool equals 1200 psi, and the rotary speed is 100 R.P.M.

$$\mathbf{HRS} = 500 \times \sqrt{\frac{100}{150} \times \frac{75}{100} \times \frac{1000}{1200} \times \frac{5}{8}}$$

$$\mathbf{HRS} = 500 \times \sqrt{.67 \times .75 \times .83 \times .63}$$

$$\mathbf{HRS} = 500 \times \sqrt{.26}$$

$$\mathbf{HRS} = 500 \times .51$$

$$\mathbf{HRS} = 255$$

3.6. INSPECTION

On each round trip the Shock Tool should be visually inspected for any indication of damage, excessive wear or leakage.

3.7. MAINTENANCE AND STORAGE

When the Shock Tool is laid down the following should be done:

1. Flush all drilling fluid from the bore with fresh water
2. Wash external surfaces of the tool
3. Apply thread compound and protectors to the tool joints

Tools stored horizontally should be rotated to a new position occasionally to prevent seals from setting and resultant fluid leakage.

4. ORDERING

Please provide the following information when ordering parts:

- Size, model and serial number of tool
- Description of part
- Part number from parts list
- Parts list number and revision
- Thread connections, if applicable
- Maximum operating temperature, if applicable (see below)

When ordering seal kits, avoid overstating the anticipated bottom hole temperature as sealing materials rated for higher temperatures have a reduced service life. Specifying higher than actual bottom hole temperatures results in both reduced time between servicing and higher seal costs.

National Oilwell – Downhole Tools normally supplies their tools with electroplated hard chrome sealing surfaces. Since hard chrome is porous by nature, chlorides can attack the underlying base metal and cause the chrome to lift. Please inform National Oilwell – Downhole Tools of the type of environment the tool with be operated in. Upon request, National Oilwell – Downhole Tools can supply tools with alternate surface coatings for extreme corrosion environments.

Orders may be placed by telephone, e-mail, fax or by written request. A purchase order number and shipping instructions must be provided at the time the order is placed.

Terms of payment are Net 30 days (OAC) from date of invoice.

All parts will be sold ExWorks our Edmonton plant.

For additional information, please contact:

MAILING ADDRESS:	National Oilwell Downhole Tools 9118 – 34A Avenue Edmonton, Alberta, Canada T6E 5P4
TELEPHONE NUMBER:	(780) 944 – 3965
FAX NUMBER:	(780) 463 – 2348
E-MAIL:	DHPSales@natoil.com

5. SPECIFICATIONS

TOOL OD	inches	**4.75**	**6.25**	**6.50**	**6.75**	**7.00**	**8.00**	**8.00**	**9.00**	**9.50**	**10.00**	**11.00**	**12.00**	**14.00**
(+API drill collar tolerance)	(mm)	**(121)**	**(159)**	**(165)**	**(171)**	**(178)**	**(203)**	**(203)**	**(229)**	**(241)**	**(254)**	**(279)**	**(305)**	**(356)**
SERIES		**155**	**146**	**150**	**147**	**154**	**148**	**160**	**139**	**151**	**138**	**157**	**143**	**113**
MAXIMUM RECOMMENDED														
HOLE DIAMETER	inches	**6 3/4**	**8 1/2**	**8 1/2**	**8 3/4**	**8 3/4**	**12 1/4**	**12 1/4**	**13 3/4**	**17 1/2**	**17 1/2**	**17 1/2**	**17 1/2**	**26**
Hole openers not recommended.	(mm)	(171)	(216)	(216)	(222)	(222)	(311)	(311)	(349)	(445)	(445)	(445)	(445)	(660)
TOOL ID	inches	**2.00**	**2.00**	**2.00**	**2.25**	**2.25**	**2.50**	**2.75**	**2.81**	**2.81**	**2.81**	**2.81**	**2.81**	**3.00**
	(mm)	(51)	(51)	(51)	(57)	(57)	(64)	(70)	(71)	(71)	(71)	(71)	(71)	(76)
LENGTH	feet	**8.5**	**9.4**	**9.4**	**9.4**	**9.4**	**9.4**	**12.5**	**9.4**	**10.8**	**10.8**	**14.0**	**12.2**	**15.0**
	(m)	(2.59)	(2.87)	(2.87)	(2.87)	(2.87)	(2.87)	(3.81)	(2.87)	(3.29)	(3.29)	(4.27)	(3.72)	(4.57)
WEIGHT	lbs	**375**	**720**	**800**	**850**	**930**	**1,200**	**1,600**	**1,500**	**2,200**	**2,300**	**3,200**	**3,400**	**5,200**
	(kg)	(170)	(330)	(360)	(390)	(420)	(540)	(730)	(680)	(1,000)	(1,000)	(1,500)	(1,500)	(2,400)
AXIAL LOAD TO FULLY	lbs	**74,000**	**100,000**	**100,000**	**100,000**	**100,000**	**125,000**	**125,000**	**110,000**	**100,000**	**100,000**	**100,000**	**100,000**	**140,000**
COMPRESS TOOL	(daN)	(33,000)	(44,000)	(44,000)	(44,000)	(44,000)	(56,000)	(56,000)	(49,000)	(44,000)	(44,000)	(44,000)	(44,000)	(62,000)
TENSILE LOAD	lbs	**380,000**	**555,000**	**555,000**	**593,000**	**593,000**	**770,000**	**872,000**	**853,000**	**1,207,000**	**1,042,000**	**808,000**	**1,337,000**	**1,865,000**
AT YIELD	(daN)	(169 000)	(247 000)	(247 000)	(264 000)	(264 000)	(342 000)	(388 000)	(379 000)	(537 000)	(463 000)	(359 000)	(595 000)	(830 000)
MAXIMUM TORSIONAL LOAD	lb.ft	**17,000**	**41,000**	**50,000**	**54,000**	**54,000**	**79,000**	**79,000**	**115,000**	**109,000**	**157,000**	**187,000**	**244,000**	**400,000**
(To yield body connections)	(N.m)	(23 000)	(56 000)	(68 000)	(73 000)	(73 000)	(107 000)	(107 000)	(156 000)	(148 000)	(213 000)	(254 000)	(331 000)	(542 000)
PUMP OPEN AREA	sq.in.	**11.0**	**15.9**	**15.9**	**17.7**	**17.7**	**23.8**	**30.7**	**30.7**	**38.5**	**41.3**	**11.0**	**11.8**	**12.6**
	(sq.cm)	(71)	(103)	(103)	(114)	(114)	(154)	(198)	(198)	(248)	(266)	(71)	(76)	(81)
SPRING RATE	lbs/in.	**29,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**31,000**	**35,000**	**25,000**	**25,000**	**15,000**	**15,000**	**22,000**
	(N/mm)	(5 100)	(6 100)	(6 100)	(6 100)	(6 100)	(6 100)	(5 400)	(6 100)	(4 400)	(4 400)	(2 600)	(2 600)	(3 900)
OPENING TRAVEL	inches	**1.0**	**1.75**	**1.75**	**1.75**	**1.75**	**1.75**	**1.75**	**1.75**	**3.3**	**3.3**	**2.5**	**2.5**	**2.0**
	(mm)	(25)	(44)	(44)	(44)	(44)	(44)	(44)	(44)	(84)	(84)	(64)	(64)	(51)
CLOSING TRAVEL	inches	**2.5**	**2.9**	**2.9**	**3.0**	**3.0**	**3.6**	**4.0**	**3.2**	**4.0**	**4.0**	**7.0**	**7.0**	**7.0**
	(mm)	(64)	(74)	(74)	(76)	(76)	(91)	(102)	(81)	(102)	(102)	(178)	(178)	(178)

Specifications subject to change without notice.