



## GENERAL GUIDELINES FOR EFFECTIVE MILLING

### **Good Cutting Return**

The following are guidelines for the optimum use of drilling mud to circulate steel cuttings out of the wellbore.

- A minimum annular velocity of 120 feet per minute should be maintained.
- Oil-base mud should be avoided whenever possible.
- Ordinarily, no difficulty is encountered in raising drilling cuttings or the usual cavings (if any) using normal drilling practices. Most difficulties are encountered when a light ring with a small mud pump is used in remedial work. A common remedy in such cases is to add bentonite to the mud so that the effective viscosity becomes sufficient to raise the cuttings or cavings.
- If "bird nesting" occurs around the drill string, pull up the kelly and circulate down until proper cutting return is achieved. During long milling jobs this procedure should be repeated frequently to maintain rate of penetration.
- Always inspect I.D. of subs or auxiliary tools to make sure they are full-bore and have no restrictions. Changes in cross sections can reduce fluid volume and result in poor cutting return.
- Reverse circulation is another way to remove cutting accumulation in the fish. In some cases, junk baskets, bailer, or snatchers are used to remove or catch cuttings.

### **How to Read Cuttings?**

The ideal cuttings is usually 3/32" to 1/4" thick and 2" to 4" long. If cuttings are thin or "hair-like" and penetration rates are low, weight on the tool should be increased.

If fish-scale type cuttings are being returned when pilot milling, the penetration rates should improve by decreasing weight and increasing rotary table speed. This is more common when milling H-40, J-55 and K55 pipe. When milling up N-80 or P-110, finer cutting return can be expected.

### **Recommendations on Weights and Speeds**

Generally the most efficient rates are obtained by running the rotary at 80 to 100 RPM. Milling with washover shoes is an exception; they are usually more efficient when run at 60 to 80 RPM. (As with all milling tools, speed and weight will be dictated by actual conditions.)

Always start rotating about one foot above the fish. Lower onto the fish and vary the weight to improve the penetration. Whenever possible, maintain a constant milling weight. Feed the drum slowly, allowing the drawworks to "creep"; do not drill off.

The wear pattern on the mill is a great indicator of its performance downhole. If the dressed blades show a hook wear pattern, the mill is working efficiently. If a tapered pattern exists, ease off the weight.

### **Some Factors That Affect Milling Rates**

The type and stability of the fish (cemented or not), the weight on the mill, the speed at which it is run, proper carbide dressing of the mill, as well as the weight, stiffness and vibration of the drill collars, are all factors which will affect milling rates. The hardness of the fish or cement will also affect a mill's performance.

When milling cemented casing, penetration rates can be increased by using higher weights and speeds. Unlimited casing should be milled at lower speeds with less weight. When severely corroded casing is encountered, high-speed, light run will prevent tearing or splintering the fish.

### **Encountering Rubber in the Hole**

Rubber always presents problems during milling. When milling rates decrease, cut back or shut off pump pressure. Pull kelly up and spud the mill to help get a bit on the rubber. When necessary, pull the kelly, remove the mill, and clean the fish by running a drill bit in the string.



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### Stabilizing the Mill

A mill that moves or wobbles does a poor job. Whenever possible, a stabilizer should be run two collars above the mill. The stabilizer O.D. should not exceed the dressed O.D. of the mill.

### What to Do About rough Operation

When bouncing or rough running occurs, decrease speed to 50 RPM or less and weight to 3,000 lbs, or less. After an hour, slowly increase speed and weight. If penetration is good, continue at present speed; if not, increase speed. If rough running recurs, once again decrease and gradually increase.

### Tips on Liner Hangers, Centralizers and Scratchers

Most liner hangers mill easily, but some old types have many slips and rotating parts. When these are encountered, pick up the kelly and spud the mill frequently to position the parts for effective milling. When milling centralizers and scratches, use a mill with blades that extend completely over them to ensure best results.

### PARVEEN'S Operating Recommendations for Milling

The RPM's required for good milling rates are often determined by feel or the operator's experience. When using small mills up to 8-1/2 inch diameter, operators sometimes run up to 150 RPM, but usually stay around 100 to prevent the drill pipe from whipping around. If run at high RPM, the mill can hang up and stick momentarily, and the drill pipe will twist up until the mill lets go. The string will then violently untwist, often breaking tool joints or twisting off pipe. Thus the RPM, when using small mills, is limited by the string and hole conditions.

Above 8-1/2 inch diameter, mill moving at 100 RPM begin to have very high surface speed. High speed can burn or damage the tungsten carbide.

Tungsten carbide cuts steel best at 250 to 340 surface feet per minute, or 3,000 to 4,000 inches per minute surface speed.

GENERAL OPERATING RECOMMENDATIONS FOR MILLING				
TYPES OF MILL	TABLE SPEED, r.p.m.	WEIGHTS, lbs.	MIN. VIS. OF MUD	REMARKS
JUNK MILL	100	4,000 - 10,000	50	Spud Mill from time to time
PILOT MILL	125	6,000 - 10,000	60	Vary weight to attain best cutting speed
TAPER MILL	50 - 80	2,000 - 4,000	50	Begin with light weight and low speed

CASING CUTTING CHARACTERISTICS				
CASING TYPES	AVG. CUTTING RATES WITH PILOT MILL, ft./hr.	TABLE SPEED, RPM	AVERAGE WEIGHT, lbs.	CUTTING APPEARANCE
P-110	6+	125	8,000	Long String, Sharp
N-80	6+	100	6,000	Long String, Sharp
J-55, K-55	4+	100	6,000	Med Length, Fine
H-40	1+	80	2,000	Scaly, Dull

\*NOTE:

If casing is old or excessively corroded, this rate may be higher.