Permanent and Retrievable Packer Removal

- Scope – all permanent packers and those retrievables that require more than straight pulls or J-actions.
- Reasons
- Techniques
  - Rig based
  - CT

Packer Removal Reasons

- Leaks
- Access to lower zones with full bore equipment
- Recompletion with lift systems, etc.

Removal of a Drillable Packer

1. Most common – mill over outer slips and packing element, retrieve or push to bottom.
2. Mill up with a flat bottom mill – mills the entire packer up
3. Sand line drill – drill collars with a chisel bit, run on braded line – chop the packer up.

Sand Line Drill

- Essentially a battering ram with a sharp tip.
- Series of drill collars with a rope rocket and a chisel bit.
- Picked up 30 to 40 feet above the packer or plug and dropped.
- Very effective removal.
- Used in shallow wells where cannot apply weight on a conventional mill
- May damage the casing
- May not be able to control pressure below a packer or plug when it breaks free.

Mill Over the Slips

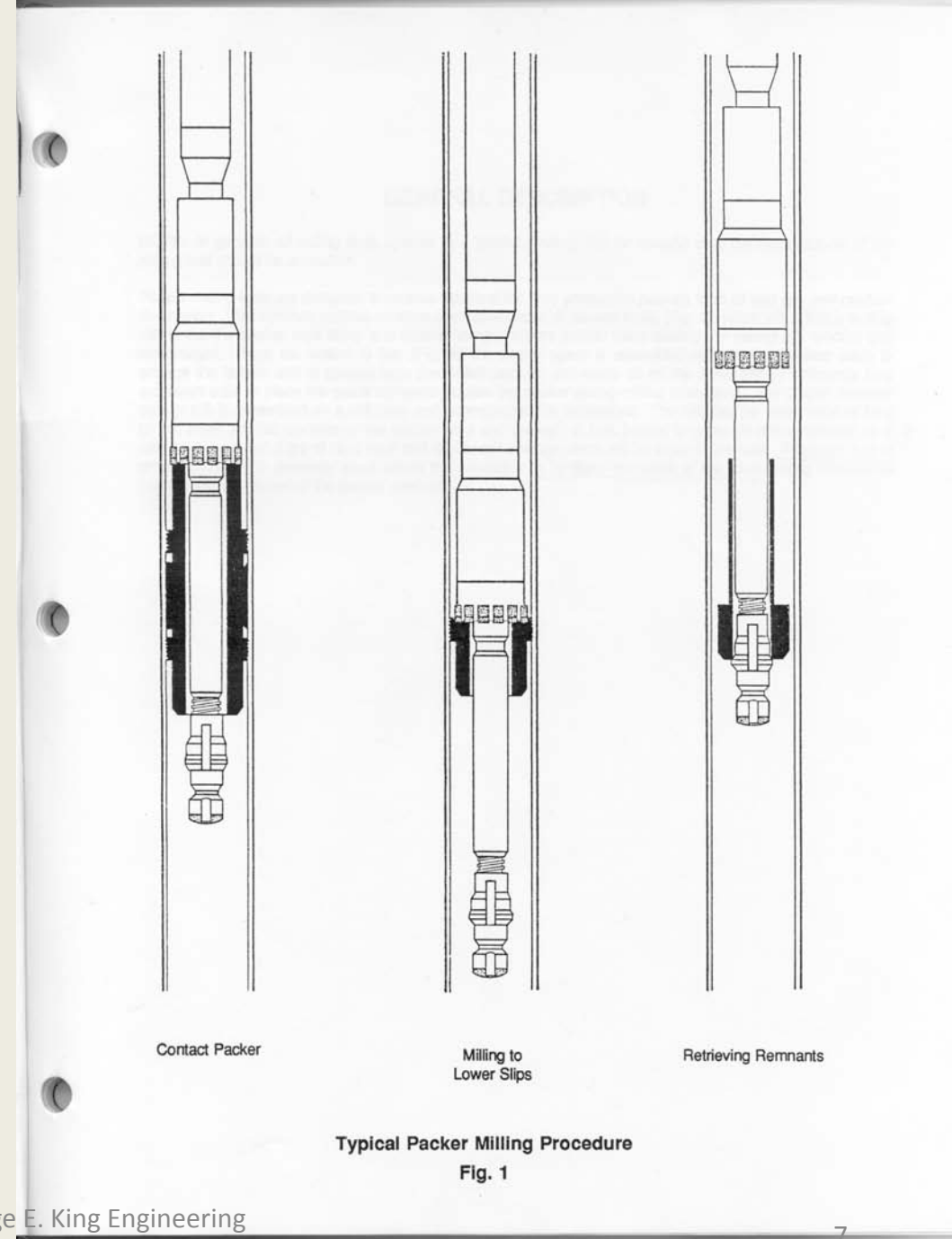
- A millshoe is run with a BHA
  - Drill Collars - weight
  - Bumper Sub - jar
  - Junk Basket – catches small debris
  - Mill Shoe – cuts slips and element
  - Extension – reaches through bore of packer
  - Packer Spear – grips packer ID after slips cut

Typical Milling String
Fig. 2

Milling Sequence – note that the milling continues until the entire unit breaks free.

There is a possibility of damage to the casing during milling. Mill faces must be shielded or held back from the casing.

Do not set another packer in the area where a packer has been set or milling has taken place.



Typical Packer Milling Procedure
Fig. 1

Push/Pull Choices

- Remove packer or push to bottom?
- Many wells do not have sufficient rat hole to push packer to bottom or packer may have a tailpipe. Also, this may interfere with later operations.
- If packer is to be pushed to bottom, a mill shoe of sufficient length is needed to completely mill through the lower slips.

Pulling a Milled Packer

- An extension and packer spear is needed.
- The packer spear is stabbed into the packer bore.
- On a plain bottom packer or packer with a mill-out extension, a collet spear is used.

Spear and Collet Considerations

- The collet is larger than the ID of the packer with a millout extension. The collet collapses on the down stroke & engages in upstroke (has safety shear release)
- A nonsealing packer extension has an ID larger than the packer bore and is at least 5 ft long – it will accept the packer spear/collet and allow sufficient length to mill over the packer (Collet is not engaged during milling).
- After packer is free, the collet engages and pulls the packer.
- Do not rotate the mill until the collet is below the packer ID and is free to turn.

The Packer Mill

- Millshoe is sized with inside cutting diameter the same as the OD of the packer mandrel.
- The packer settling sleeve, slips, cones and packing elements are milled away.
- The packer mandrel, bottom sub and tailpipe remain intact and are pulled from the well.

Special Cases

- Packer with a seal bore extension directly below the packer or a packer with a bottom sub with a crossover back to the production tubing (no larger ID below the packer bore to accept the collet) requires a grapple.
- Do not run a millout extension below a lower seal bore. The spear to pull this combination is so long that the spear may twist-off or stick.

Grapples

- The grapple spear generally grips the seal bore.
- If tailpipe is present, the grapple should engage as shallow as possible in the seal bore (the catch should be 1 to 2 feet into the seal bore).
- The spear is engaged and remains stationary as the mill burns over the packer.

Requirements

- Accurate installation drawing - ***ALL*** packer components
- ID, OD and length or each component
- Materials of construction
- Knowledge of debris on top the packer
- Deviation of the well at the packer
- Hole obstructions above and below the packer

Running Procedures

1. Make up tools – record OD, thread, length, weight,etc. on each piece
2. Use sufficient weight for application
3. Lower tools slowly past restrictions (BOP and ID changes)
4. Monitor inside and outside fluid levels.
5. Have standby fluids for sweeps and control
6. Make sure there is no trapped pressure beneath the packer or plug
7. Watch surge/swab forces when running/pulling

Packer Mill Table

Estimates are for rotary RPM ranges of 90 to 150

Packer Materials	Approximate Weight Required for Milling		Approx Time to Mill Upper Slips	
	Flat Mill Shoe	Thin Mill Shoe	Flat Mill Shoe	Thin Mill Shoe
Thin wall alum. or magnesium body w/ heat treat CI slips	100 – 200 lb for each in^2 mill face	300 lb for each in^2 mill face	1 hour per in^2 of casing ID	1/2 hour per in^2 of casing ID
Thin wall mild steel body w/ heat treat CI slips	200 – 300 lb for each in^2 mill face	400 lb for each in^2 mill face	1 hour per in^2 of casing ID	1/2 hour per in^2 of casing ID
Thick wall mild steel body w/ heat treat CI slips	400 – 500 lb for each in^2 mill face	500 lb for each in^2 mill face	1-1/2 hour per in^2 of casing ID	3/4 hour per in^2 of casing ID
Thick wall low alloy steel body w/ heat treat CI slips	500 – 600 lb for each in^2 mill face	800 lb for each in^2 mill face	2 hour per in^2 of casing ID	1 hour per in^2 of casing ID

Source – Camco 1991 permanent Packer Milling Procedure

Preparing to Mill

- Establish pump circulation the top of the packer. Get friction pressure of system.
- Circulation rate and fluid character must be sufficient to clean the mill face and the hole of steel debris.
- Wash packer top clean.
- The amount of “pumpoff” (hydraulic lift) when circulating while milling has to be offset with added weight.
- Use drill-off test to determine RPM, weight and pump pressure

Obstructions in the Packer Bore

- If obstructions in the packer bore are encountered, remove the BHA and run in with a special BHA to clean out the packer bore.
- Milling the packer spear through debris will destroy the packer spear slips.

Retrieving the Packer

- After top slips are pulled, pick straight up, to release unmilled lower slips.
- The remainder of the assembly is supported on the collet or spear and can be pulled.
- Watch swab loads during pulling.

Cutting An Interior Mandrel – Case History

- Attempted to pull a Retrievable Packer failed after a chemical cut was made in the mandrel area.
- The cut was made 4" too low.
- Solution - an RA tag should be located so that the 20" area that needs to be cut can be located.

CT Case History

- Experience with running coiled tubing through a completion that has a 2.75" minimum ID and then milling out a 7" EZSV bridge plug below the tubing end.

CT Case History

- Case:
  - A gas lift completion with a 2.75" ID X-Nipple as the minimum ID.
  - EZSV bridge plug is set inside 7", 29 ppf casing at a depth of 9950' MD (well inclination at this depth = 14 degrees).
  - The bridge plug is capped with 30 feet of cement.
  - The 3-1/2" OD (2.992" ID) tubing end is about 300 feet above the cement.
  - The desire is to mill out the cement and EZSV using coiled tubing and perf/reperf some deeper zones with through tubing guns.

Options

- EZSV's drill much better with a rock bit than with mills. Once the top slips are cut they can start to spin. Cement below helps. – David Crockett
- Why drill out full bore? If a 2-3/4" hole drilled through the concrete and EZSV could run perf guns to TD. (The 14 deg angle will keep everything on the low side of the hole. Drilling the EZSV off center with a small mill might be easier than going through the center. Sliding valve assembly is not rotionally locked and it would spin under a mill. Going to the side will cause chatter, but nothing will spin.

Other Methods

- First trip, use 2 1/2" pilot mill to drill through cement and bridge plug.
- Second and third trips use possibly a under reamer and open 2 1/2 hole in stages.
- Fourth trip, clean up trip.

Problems - Other Methods

- Bottle-beck completions with 7" liner and 3,6" nipple at the bottom of the completion string.
- The challenge is passing the nipple prior to cleaning up the liner. - Tore Hauge, Statoil

CT Removal of Packer

- use 2 7/8" Baker mud motor to make a pilot hole
- run in with an under reamer to clean the well.
- Is removing the cement and EZSV (30' interval of cement and plug) necessary? Pressure drop across the restriction would probably be close to nothing.

Nipple Milling Cautions

- Expand the nipple profile to maximum ID.
- Nipple profile was extended from 3,625" to 3,75". The increase allowed 2-7/8" motor to pass.
- Done with a 2 7/8" left turning motor and a specially made left hand step mill.
  - (In the past we have on two occasions attempted to mill a nipple profile with a right turning motor with disastrous results: We unscrewed the completion below the packer both times.)

Nipple Milling

- main lesson learned was the need for longer than normal length on each step in the step mill.
  - On the first attempt we probably had the motor and mill jumping around due to an unstable BHA.
  - On the second attempt the length on each step was increased, the BHA was more stable and we managed to mill through it.
  - The entire BHA, incl. the end connector was made for left hand operation.
  - On a prior operation we did not "reverse" the entire BHA and the whole thing just came apart.

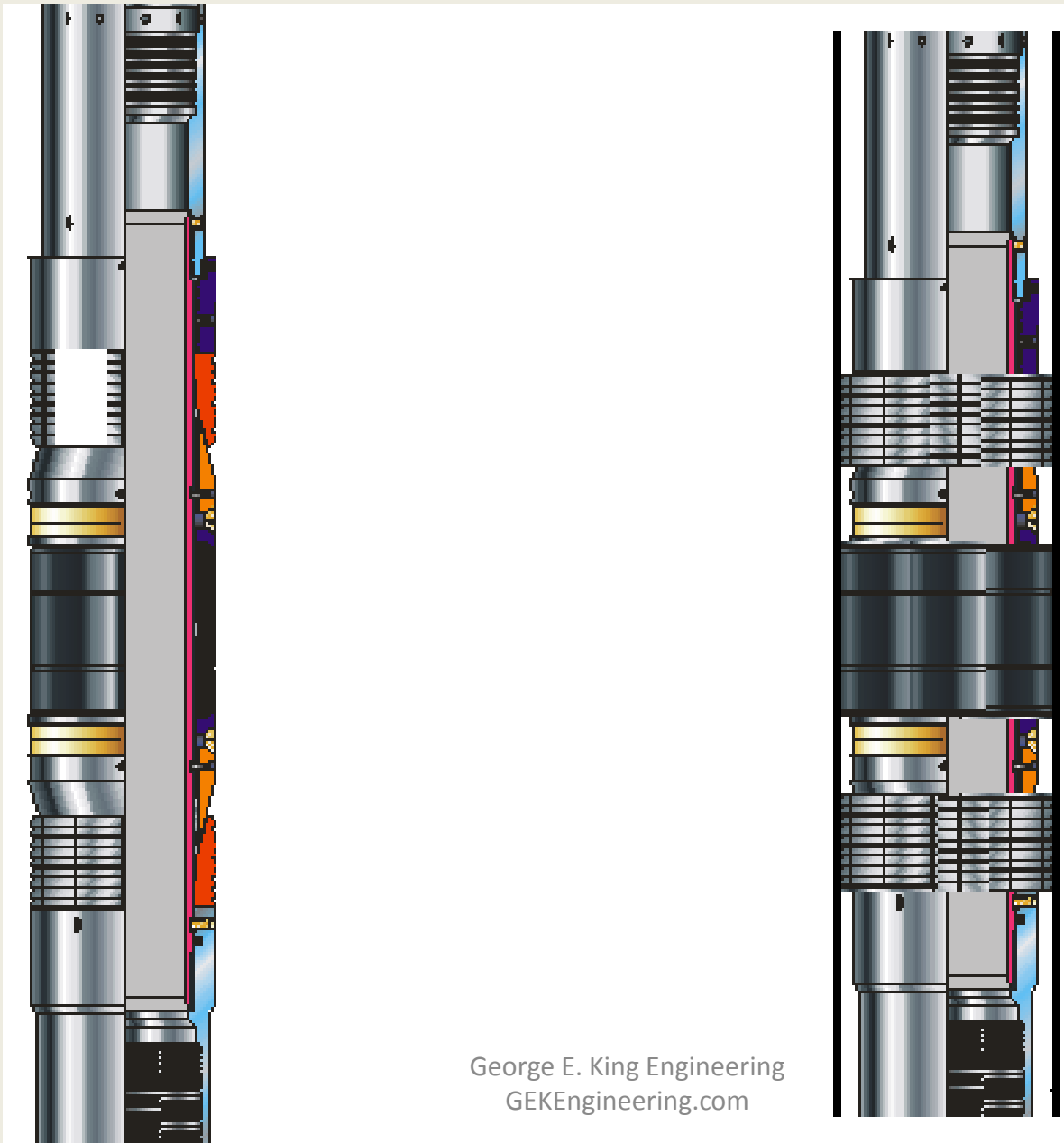
Milling (Cement)

- Next – mill cement.
- Regular 2-7/8" motor and flat bottom mill.
- Flat bottom mill worked fine for the first 7 to 8 metres (worn) and had to POOH.

Problems and Solutions

- Stabilizing and centralizing the motor may be the biggest challenge.
- If nipple is present, it would prevent use of flexible stabilisers, so the motor would probably make a hole on the "lower" part of the well bore.
- A long BHA would be recommended since the guns that will go through are long and rigid.
- Watch hole cleaning hydraulics, especially at hole diameter changes

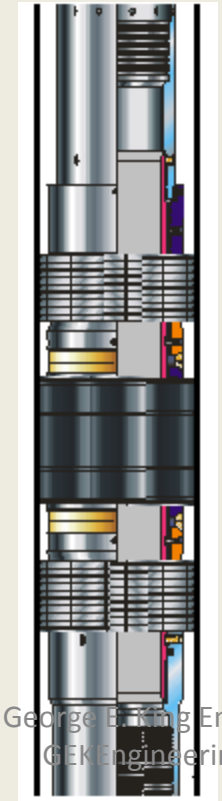
Milling the Packer – What is required?



What will be done with the milled packer?

pushed to bottom?

retrieved from the well?



Milling ZXP packer

Source: Byron Cowart - June 2000

- TIH with a short catch spear
- Engage Tieback Recepticle - Pull to tear (rip) threads and remove the tieback sleeve, TOH with sleeve
- TIH with Metal Muncher mill or equivalent. Mill +/- 30" of the packer, TOH
- TIH and cut casing below hanger, TOH
- TIH with spear and pull hanger assembly.