



## Kelly isn't always an Irishman

Posted by [Heading Out](#) on July 30, 2005 - 2:09pm

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Well it's techie's time-out time again. And although tempted to wade into the CERA fray, I will put that off and instead meander back to our potential oil well. If you remember, we have bought a [drilling bit](#), and over to the side of the site we have some pumps that can deliver a flow of [drilling mud](#) to that bit. But where do we go from here?

Well this is where that tall tower known as an **oil derrick**, so emblematic of the industry, comes into the picture (for which see, for example, the picture [here](#). Because we have to now have something to attach to the drill bit that will turn it, and push it into the rock. (From which it follows that the top guy on the rig is known as the **tool pusher**). At the same time this connecting device has to be able to allow the mud to get down to the jet nozzles on the bit. The logical way of doing this is to have a tube or pipe, into which the drilling bit can be threaded on the lower end. (Which gives rise to the expression **oilfield tubulars**). Now, by attaching the mud pumps to the upper end of the pipe, we can also get the mud down into the bit. There is usually a special piece of pipe that fits between the bit itself and the main sections of the pipe, and this is called the **drill collar**.

Drill pipe comes in various sizes, depending on the hole that is being drilled, but for the sake of an example we might use a pipe that is 5.5 inches diameter on the outside and 3.25 inches wide on the inside. This would weigh around 14 lb a foot, and is normally used in 30 ft lengths. This length is a standard, and the pipe will have a threaded connection welded to each end, known as the **tool joint**. One is male and one is female, so that additional lengths of pipe may be threaded into the original piece to extend the overall length as the hole gets deeper.

I mention the length because there are several things that control the **rate of penetration (ROP)** of the bit, and one is the thrust that is applied to push the bit into the rock. This comes from the weight of the pipe that is connected to the bit, and thus is known as the **weight on bit**. However, if you do the arithmetic,  $14 \times 30 = 420$  lb. per length of drill pipe. So if we have one length of pipe we are pushing the bit into the ground with 420 lbs of weight. Add another length and we are up to 840 lb. And so it continues, except that there is, for each bit and rock, a bit weight that will cause that bit to drill at its best ROP. Typically this might be around 15 " 20,000 lb depending on hole size and rock type. But we get that weight from the pipe with only 36 lengths, or a total of around 1,000 ft of drill pipe. But we might be drilling a well that is 7,000 ft deep.

To keep the bit weight at the best level to give the fastest ROP, the driller will carry the rest of the weight of the pipe through the derrick and will adjust the weight on bit by controlling the amount of lift through a block and tackle arrangement to a **traveling block** on the top of the drill pipe. A cable connects the traveling block to a second block at the top (or **crown**) of the derrick. By making a number of loops between the traveling and crown blocks the cable can carry

up to a million pounds or more of weight. From the crown block the cable feeds back down to the reel on which it is carried. The reel and the motors that drive it are known as the **drawworks**, and the driller controls the reel rotation and thus the weight carried through the cable to the derrick, to control the amount of thrust on the bit. (Other definitions can be found [here](#) ).

There are two other things, however, that have to be controlled. Firstly the bit has to turn, and so there must be a way of rotating the pipe. This is done through a **rotary table** that sits on the **rig floor** and a special piece of pipe (some 43 ft long), known as **the Kelly**, that is connected between the swivel which sits right under the traveling block, and the first length of drill pipe (for picture see [here](#) . The pipe is square or hexagonal and will slide through the turntable as the hole gets deeper. At the same time the shape allows the turntable to grip it and turn it, and the attached drill string that connects below it to the drilling bit at the bottom of the hole.

However, since the cable and blocks cannot turn, a **swivel** connection is needed above the Kelly to let the underlying structure rotate. At the same time, by connecting the feed-lines from the mud pumps to the swivel, those lines also won't turn, as the pipe rotates and feeds forward.

So now there is a way of feeding the pipe into the hole (through the cable and drawworks), of feeding the mud to the pipe (through the swivel) and of turning the pipe (through the Kelly and the rotary table).

Bear in mind that after the drill bit has penetrated 30 ft (the length of a single length or **joint** of drill pipe) then drilling must stop. The Kelly is disconnected from the top joint, and raised while a new joint is swung in from the **catwalk** (where spare joints are stored on the rig) and connected, at the bottom end to the existing string, and at the top end to the Kelly. The drill is then ready to go forward again. While I am not up on current performance, I was once taught that a good crew cannot make more than 7 connections, or drill more than 200 ft of hole an hour.

Now also remember that if the bit needs to be changed because it wore out, or because it can't drill in the rock that it has not started to go through, then the entire string above the bit has to be removed, one joint at a time, until the bit reaches the surface. Then it is replaced, and the joint in turn have to be replaced, again one-at-a-time, until the bit hits bottom again. Now hauling the string out of the hole goes a little faster than drilling, but you can see that this process, known as **tripping**, can take more than a day. Which can be quite expensive, especially since, while you are tripping you are not making hole, and that is what the rig is being rented to do.

Well this is a bit of a hard subject to cover in less than 50 minutes, and without 60 pictures, so if there are things that are not clear, or if some of my numbers aren't quite up to date please comment or ask.

Technorati Tags: [peak oil](#), [oil](#)

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