

12.6.3 Force Multiplying Tools

The purpose of force multiplying tools is to generate controlled blows onto a stuck fish. These blows can be in an upward direction, a downward direction, or selectively applied in either direction.

Force multiplying fishing tools are divided into three groups as described in the table below:

Tool	Guidelines
Jars	<ul style="list-style-type: none"> Mechanical or Hydraulic (see Stuck Pipe section of this Chapter)
Jar Accelerators (Intensifiers)	<ul style="list-style-type: none"> A gas charged (N₂) accelerator or "intensifier" may be run above the drill collars placed over the jar (between the drill collars and drill pipe), greatly increasing the effectiveness of the jarring action. These are also available in double-acting mode, to match the jar action. Typical accelerator strokes are 6 - 15" depending on the tool used. When used, less drill collars may be run without reducing the jarring impact force. Jarring can be conducted at shallower depths where less string stretch and overpull is available, preventing the jar from achieving a full blow. Use of an accelerator, by maximising the impact of the jar and reducing the shock load effect on the string, can significantly enhance the jarring impact force.
Bumper Subs	<ul style="list-style-type: none"> Often used in conjunction with jars. Provide a means of delivering upward or downward blows. The sub should be installed immediately above the fishing tool or safety joint. Its presence assists operators to release the fishing tool in the event that the fish cannot be freed. Delivers a sharp downward blow as well as transmitting torque required to break the fishing tool engagement and release it from the fish.

Table 81. Force Multiplying Fishing Tools

These tools are most effective when used by an experienced operator who can prevent severe damage to surface equipment and/or the string.

Procedure to "Bump Down" in the Hole

- Pick up the string enough to open the tool completely and take a strain or stretch in the string. This shall be the length of the stroke plus the permissible stretch in the fishing string.
- Drop the string to within 6" of the closed position of the tool and stop the string abruptly.
- If sufficient stretch has been taken in the string, the lower end of the fishing string should bump downward closing the bumper sub and, due to the elasticity of the string, deliver a series of downward blows to the tool below the sub.

Procedure to "Bump Upwards" in the Hole

- Pick up the string enough to open the bumper sub completely plus a moderate strain or stretch in the string.
- Drop the string a distance equal to the stretch taken only and stop the string abruptly. This should cause the lower end of it to spring downward closing the bumper sub slightly. The string should rebound causing the bumper sub to open quickly and deliver a solid upward blow.

12.6.4 Overshot Tools

The following general considerations shall be made when planning the use of overshot tools:

- Grapple sizing should be taken from the manufacturer's specification. However, grapple sealing ID should not be more than 1/16" less than the fish OD.
- A pack-off should always be installed in order to circulate through the fish before pulling out of the hole.
- If the hole size is appreciably larger than the overshot OD, an oversized guide may be considered.
- If the pipe is lying in a recess or against the side of the hole, a hook wall guide or bent joint may be considered.
- If the fish cannot be engaged, an extension sub and a milling guide may be considered. A milling guide should always be run with a basket grapple.
- A basket grapple with long catch stop may be considered to catch an upset or box section of a tool joint.

Guidelines Before Engaging Fish

With the overshot directly above the fish, a combination of rotating and lowering shall result in the following:

- The guide directs the fish into the overshot.
- The fish can easily pass through the grapple because of its helical shape and mode of rotation.
- Too much rotation can damage/wear the grapple.

When lowering the overshot over the fish and once a pressure increase is noted, circulation must be stopped in order to prevent damaging the seal/packer. Bleed off any pressure trapped before engaging the fish.

The penetration of the fish into the overshot grapple must be limited in order to facilitate release from the fish. If the basket grapple used is not a long catch stop type, a stop must be used to prevent the grapple going completely over the upset of the fish. Not doing this makes it almost impossible to release the overshot from the fish.

Guidelines Before Releasing Fish

Unless an upward strain is maintained, the fishing string must never be rotated to the right while an overshot is engaged on the fish, other than when attempting to come off the fish. Left hand torque tightens the grapple bite on the fish so right hand rotation can be used to release the grapple and come off the fish.

When the fish is properly located in the overshot, exert an upward pull. The grapple shall be contacted by the upward taper in the bowl and the fish held securely. The pack-off rubber seals around the fish, enabling fluid to be forced down through the fish.

Before the start of releasing operations, the weight of the fishing string should always be bumped down, to put the neutral point at the grapple.

The grapple can be freed from the bowl by lowering the string weight or bumping down against the fish. By slowly rotating to the right and slowly raising the string, the spiral grapple unwinds or the basket grapple expands disengaging the string from the fish.

12.6.5 Spears

Spears should be dressed with a pack-off rubber to circulate when required. A stop ring or stop sub should be used to prevent the spear from entering too deeply into the fish. Using these also enables setting of the jars and easier release of tool.

The fishing string should be bumped down before commencing the operation to release the spear. After the hold on the fish is broken, rotate to the right while pulling the string. The left-hand wickers on the spear slips or grapple should then screw the tool off the fish.

A circulation sub should be installed in the fishing assembly when smaller spears are used.

Procedure to Engage and Pull the Fish

To engage and pull the fish:

1. Circulate with the spear a few feet above the top of the fish. Once clean, cut the pump back (stop pump if pack-off is installed) and lower the spear into the fish.
2. Rotate the string to turn the tool one half to one full rotation to the left to set the spear. Left-hand rotation turns the mandrel of the tool through the grapple, setting it in its engaging position.
3. The fish can now be pulled as this should wedge the grapple into a positive engagement on the fish.

Procedure to Release the Fish

To release the fish:

Bump down (maximum allowable) weight of the fishing string. This breaks the engagement. Rotate two or three turns to the right and pick up the string until the spear is clear of the fish.

1. Right-hand rotation moves the mandrel up through the grapple forcing the grapple down against the release ring and puts the spear in the release position.
2. If the spear does not release, bump down while simultaneously rotating to the right and picking up the string until the spear is clear of the fish.
3. If the spear still does not come free, use of the surface jar should be considered depending on the depth of the top of fish.

12.6.6 Washover Strings

Washover strings may be used in the following situations:

- Where the formation has bridged-off and stuck the string.
- Where the string has become cemented in the hole.
- Dressing the top of the fish for latching on with an overshot

General Considerations

The considerations below should be considered when preparing to use a washover string:

Preparation	General Guidelines
Shoe Selection	<ul style="list-style-type: none"> Inside casing: hard facing only on the bottom and inside the shoe so that it does not cut on the outside diameter Open hole: hard facing can be on the inside and outside. Washing over in open hole should only be considered in exceptional circumstances
Safety Joint and Drive Sub	<ul style="list-style-type: none"> A safety joint and drive sub should be installed above the washover string to release the string if the washover string becomes stuck
Number of Joints	<ul style="list-style-type: none"> Number of joints run depending on the hole inclination and Dog Leg Severity
Rotation	<ul style="list-style-type: none"> Low RPM and weight should be used during washovers to reduce the possibility of splitting or flaring the shoe

Table 82. Preparation of Washover String

Reciprocate pipe periodically in order to monitor torque build-up and string resistance. The washover string should be kept in motion as much as possible to prevent sticking.

A junk sub should be installed above the washover string if stabiliser blades are to be washed over.

The mud may be "slicked up" by adding lubricants or changing mud rheology, allowing for hole cleaning requirements..

12.6.7 Junk Retrievers

The two main types of junk retrievers used in fishing operations are the coring type basket and the reverse circulation junk basket or jet retriever. These are described in the table below.

Junk Basket Type	Description
Coring Type	<p>The coring type basket cuts a short core. As the core is being cut, junk is forced into the barrel of the tool.</p> <p>When enough penetration has been made to retrieve the fish, stop rotation and circulation and break the core.</p> <p>The upper and lower catchers of the tool maintain the core in place.</p> <p>POOH.</p>
Reverse Circulation	<p>Mud is diverted through jets by pumping a drop ball from surface causing the mud to be directed outward and downward from the body of the tool.</p> <p>Once the junk has been washed into the tool, catch fingers prevent it from dropping out.</p> <p>This type of junk basket may also be available with a coring shoe.</p>

Table 83. Junk Basket Types.

12.6.8 Miscellaneous Fishing Tools

The following miscellaneous fishing tools may be used.

Tool	Usage
Lead Impression Blocks	<ul style="list-style-type: none"> Used if additional information regarding the top of the fish is needed
Rope Spears	<ul style="list-style-type: none"> Used to fish broken wireline from the hole A stop ring should always be run with a rope spear to prevent the spear from passing too far past the top of the wire rope After the tool has entered the wire rope, it should be rotated one or two turns only and overpull should be taken until the line comes free or breaks at the weak point
Taper Taps and Die Collars	<ul style="list-style-type: none"> These tools are difficult to release once engaged and therefore a safety joint and jar must be run with them. They should generally only be run as a last resort. External fishing tools and spears should be run first Taper taps and die collars must only be run by experienced personnel and extreme care must be exercised when they are used to avoid sticking the entire string
Junk Subs	<ul style="list-style-type: none"> Consideration should be given to running junk subs in drilling or milling strings when required

Table 84. Miscellaneous Fishing Tools and their Use.

12.7 CURING LOST CIRCULATION

Lost circulation or lost returns are the loss, to the formation, of either drilling fluids or cement slurry while drilling or completing wells.

The recommended lost circulation material (LCM) that may be used across reservoirs and other formations without causing formation damage is normally Enerseal super fine or its equivalent, Sandseal. Quantities shall be determined on site, and returns are carefully monitored. If formation damage is not a concern other types of LCM (eg. Mica) may be used.

LCM can be used either in concentrated slugs, to deal with more severe losses or as a general drilling fluid treatment to treat seepage/minor losses. When seepage losses increase to more than 20 bbls/hour, an LCM pill may be required to provide more effective prevention than can be achieved by circulating LCM in the drilling fluid.

The generic procedure for the preparation and application of an LCM pill is as follows:

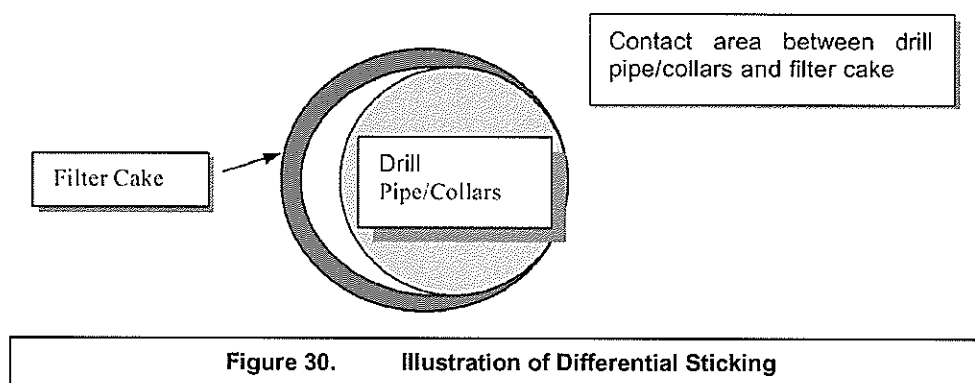
1. Mix an LCM pill in the slugging pit using the recommended LCM material (or alternative approved material where applicable). The actual concentration will be dependent upon the magnitude of the losses and the size of the jets in the drilling bit.
2. Spot the LCM pill on bottom.
3. Pull the bit above the loss zone and the top of the LCM pill.
4. Observe the well for one hour, keeping the hole full as required.
5. Gradually commence circulation and attempt to regain full returns.

12.8 DIFFERENTIAL STICKING

Differential sticking of drill pipe/collars occurs when the hydrostatic fluid pressure in a wellbore exceeds the formation pore pressure across the interval where the pipe is stationary.

In permeable formations, the drill pipe/collars block the flow of fluid from the wellbore into the formation. This flow, which can be considerable, usually results in the build up of a thick filter cake across the permeable zone. When the drill pipe/collars have been left stationary, such as during connections or when a survey is taken, the surface of the BHA along with the sealing effect of the filter cake forms an effective block reducing fluid loss to the formation.

Depending on the length of the blocked area and the differential pressure between the borehole and formation, this blockage can cause extremely high forces to build up against the drill pipe/collars resulting in the BHA becoming differentially stuck as shown in Figure 30.



Full circulation and no up/down mobility or rotary freedom, other than pipe stretch and Torque, are primary indications of differential sticking.

For differential sticking to occur, the following two conditions must exist:

- The hydrostatic pressure of the mud exceeds the pressure of the adjacent formation.
- The formation is porous and permeable (usually sandstone) at the point where the pipe is stuck.

The following conditions can result in differentially stuck pipe:

- High overbalance pressures
- Thick filter cakes
- High-solids mud
- High-density mud
- Significant pressure depletion of reservoirs

When filter cake builds-up on the formation, it increases the contact area between the wellbore and the drill pipe. Excessive drill solids and a high fluid loss increase filter-cake thickness and the coefficient of friction, making it difficult to pull or jar the drill pipe free.

If the pipe does become stuck, every effort should be made to free it immediately. The probability of freeing stuck pipe decreases rapidly with time. Early identification of the sticking mechanism is crucial, since each cause must be solved with a different measure. An incorrect solution can easily make it worse. Typically an evaluation of the events leading up to the stuck pipe incident usually indicates the cause which can lead to proper corrective measures.

Depending on the area and the severity of the pressure depletion, one or several of the following methods may reduce the chance of stuck pipe across the depleted zone. All of the conditions associated with differentially stuck pipe cannot be eliminated, consequently no unique solution exists that can be applied in all areas.

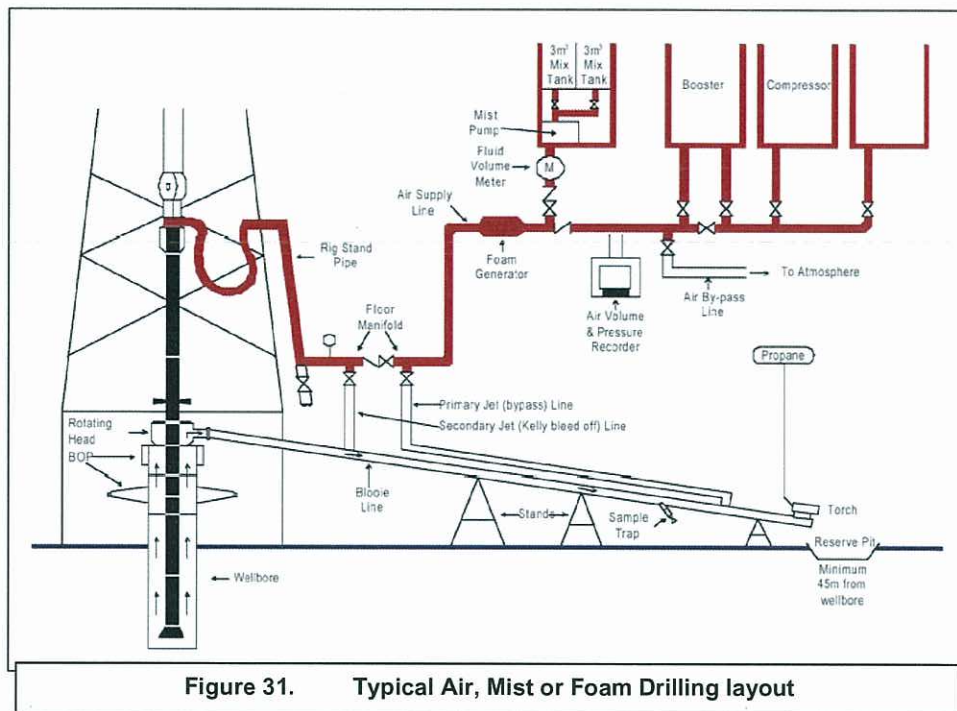
12.8.1 Preventative Measures

While drilling through areas of known pressure depletion:

1. Educate drillers so they are aware of what immediate action is required in the event of tight hole/differential sticking problems.
2. In open hole keep the pipe moving at all times.
 - Reciprocating is the preferred method as it allows you to monitor overpulls. If possible, always begin pipe motion in a downward direction.
 - While making connections minimise the time in which the drill pipe is stationary. (Rotate pipe as long as possible).
 - During well control situations, if possible close annular BOP's and reciprocate drill pipe. Obtain approval to close annular BOP's from rig contractor prior to spud.
3. Minimise the contact area of the BHA in the wellbore.
 - Use spiral drill collars and minimise unstabilised sections of the BHA. Spiral drill collars have a smaller contact area with the wall of the hole and allow fluid passage and equalising of hydrostatic fluid pressure.
 - If hole drag is not a problem, consider using under-gauge stabilisers on drill collars to keep them away from the borehole wall. The use of a packed hole assembly can reduce the number of situations that result in differential sticking by holding the drill string off the wall of the hole. Another unrelated benefit to running bit stabilising assemblies is the prevention of sudden hole angle changes (offsets and doglegs), which can lead to key seats.
 - Only run the minimum length of drill collars to provide the required bit weight. Use heavy weight drill pipe instead of long sections of unstabilised drill collars.
4. Do not program any non-essential surveys. However if surveys are required, they should be dropped prior to POOH rather than run on wireline.
5. If known depleted reservoirs have to be drilled through to reach and evaluate undepleted reservoirs, casing off of the depleted reservoirs may be necessary to avoid acute drilling problems.

12.9 AIR DRILLING

Air may be the circulating medium for drilling some wells in GSLM areas of operation.



The following general guidelines shall be adhered to whilst air drilling:

- A chart type pressure recorder is critical to monitor air pressure effectively. The recorder should be immediately downstream of the air compressors.
- It is essential to have air circulating around the bit before starting drilling. This prevents initial cuttings build-up which is a significant cause of stuck pipe, and prolongs bit life by cooling bearings and cleaning cuttings from the bit. Drilling should not begin after a connection until one of these two conditions is met.
- In order to prevent the drill string from becoming stuck as a result of pulling into and packing dry drill cuttings, never pull on the string without air circulation.
- No upper air volume limit has been established for air drilling. However, a frequent cause of failure while drilling with air is insufficient air volume to clean the hole efficiently under a varied range of drilling conditions. The air drilling contractor shall provide field data to establish the optimum values.
- Drill cuttings not removed fall back and bridge when connections are made. Should this occur, options to overcome the problem are:
 - Increase air volume.
 - Always blow the hole until the air and mist returns are clean, before making connections.

Appendix I: Stuck Pipe Analysis - Identifying Causes



Figure 32. Stuck pipe Analysis – Identifying Causes

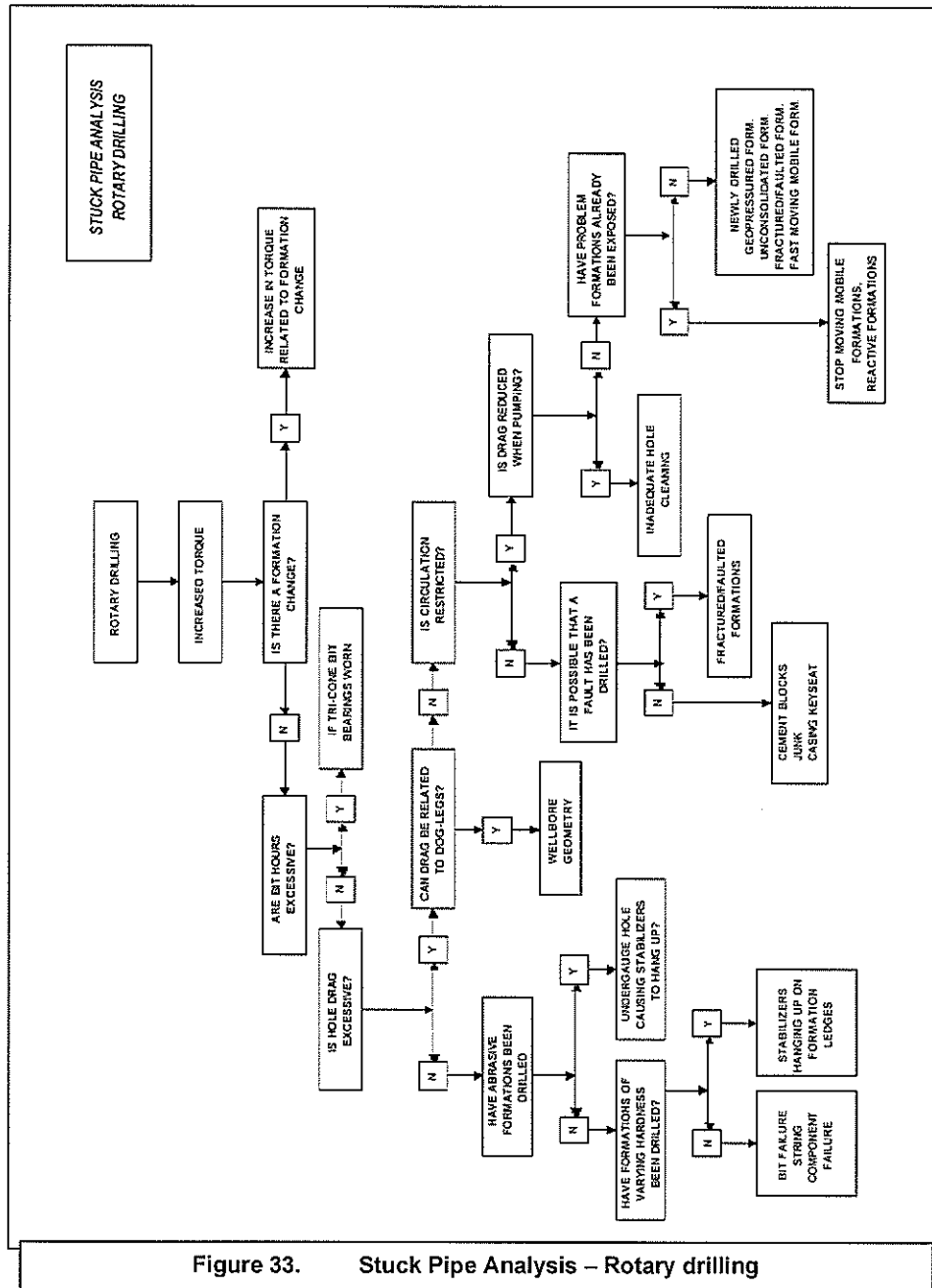
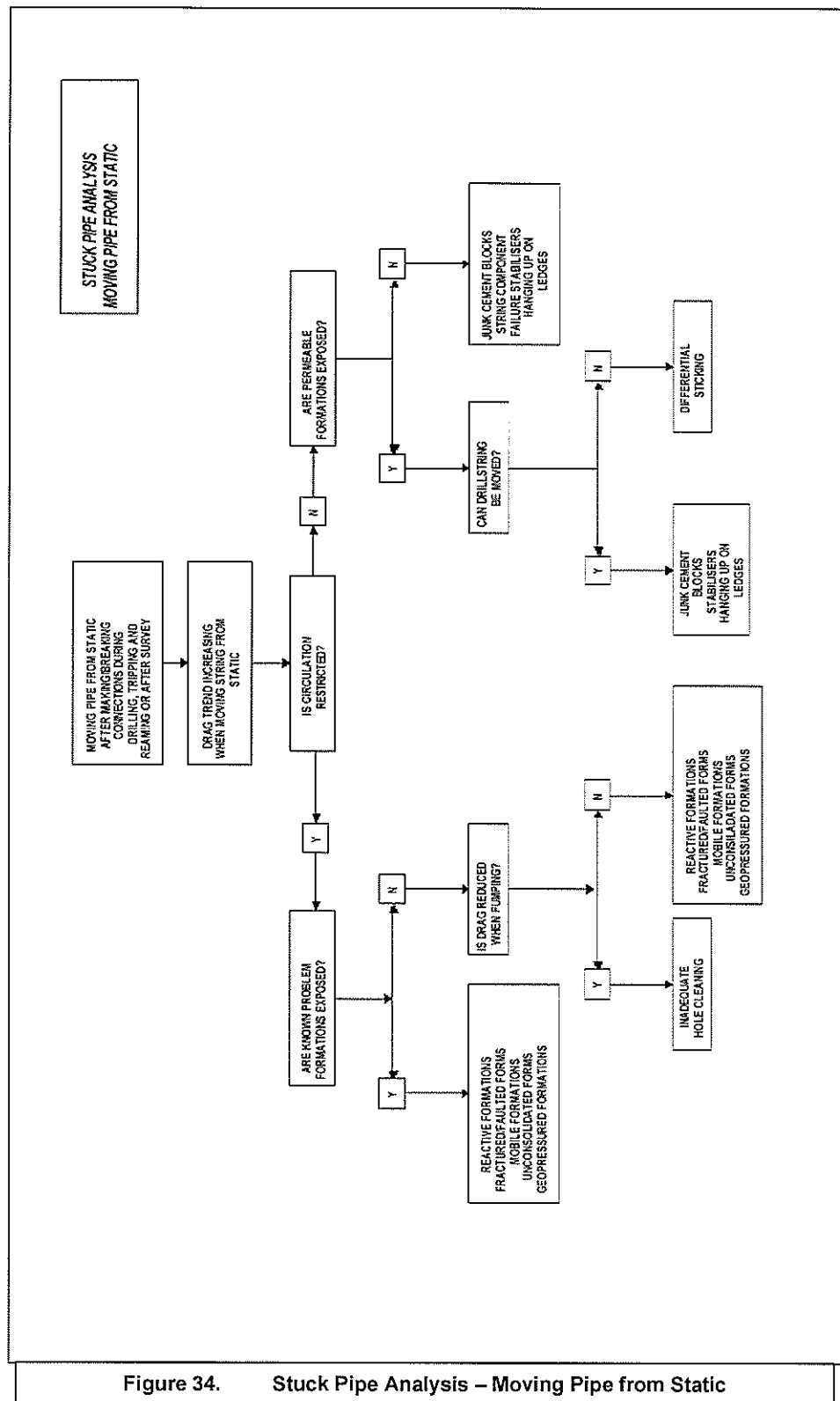
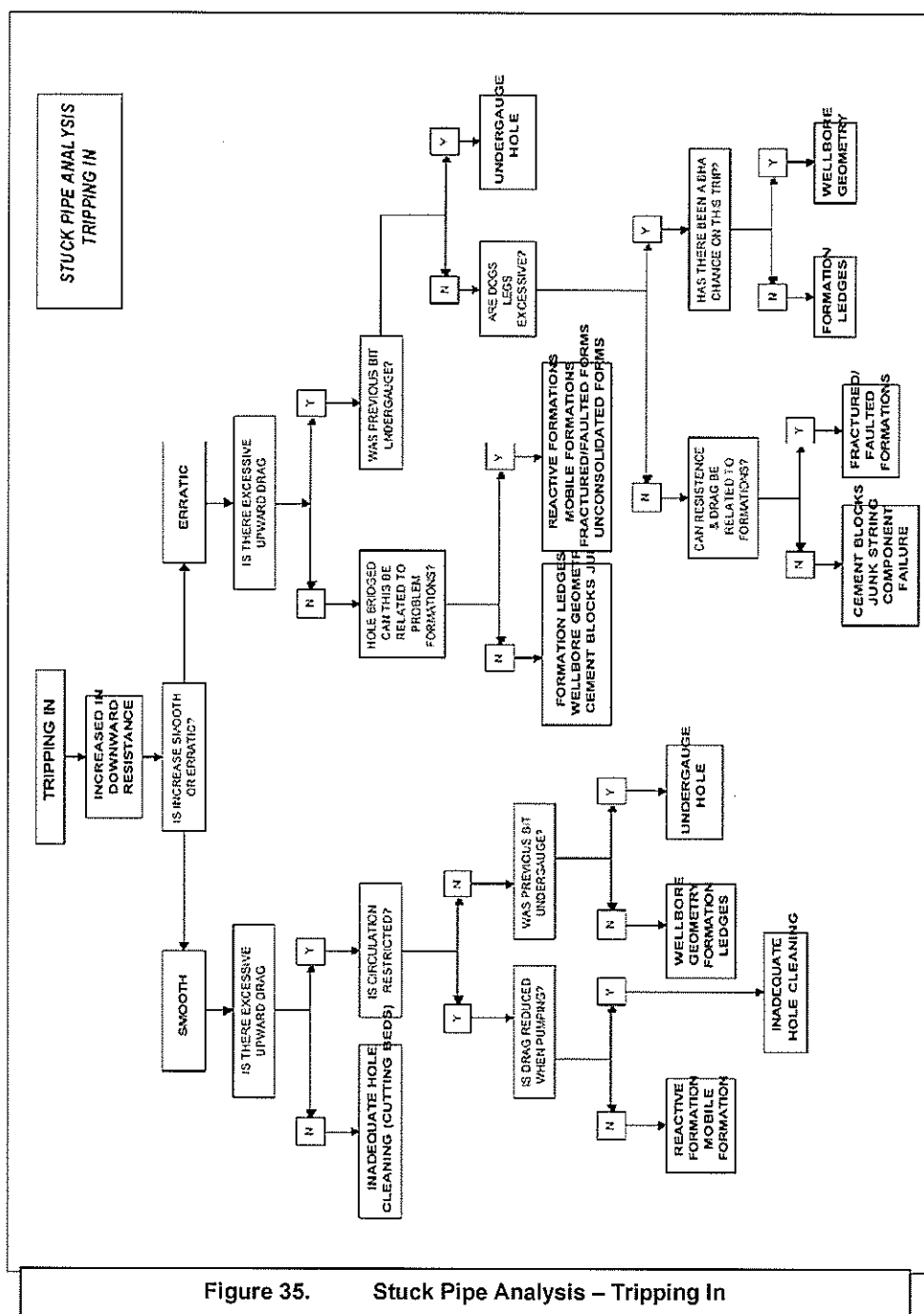
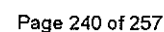
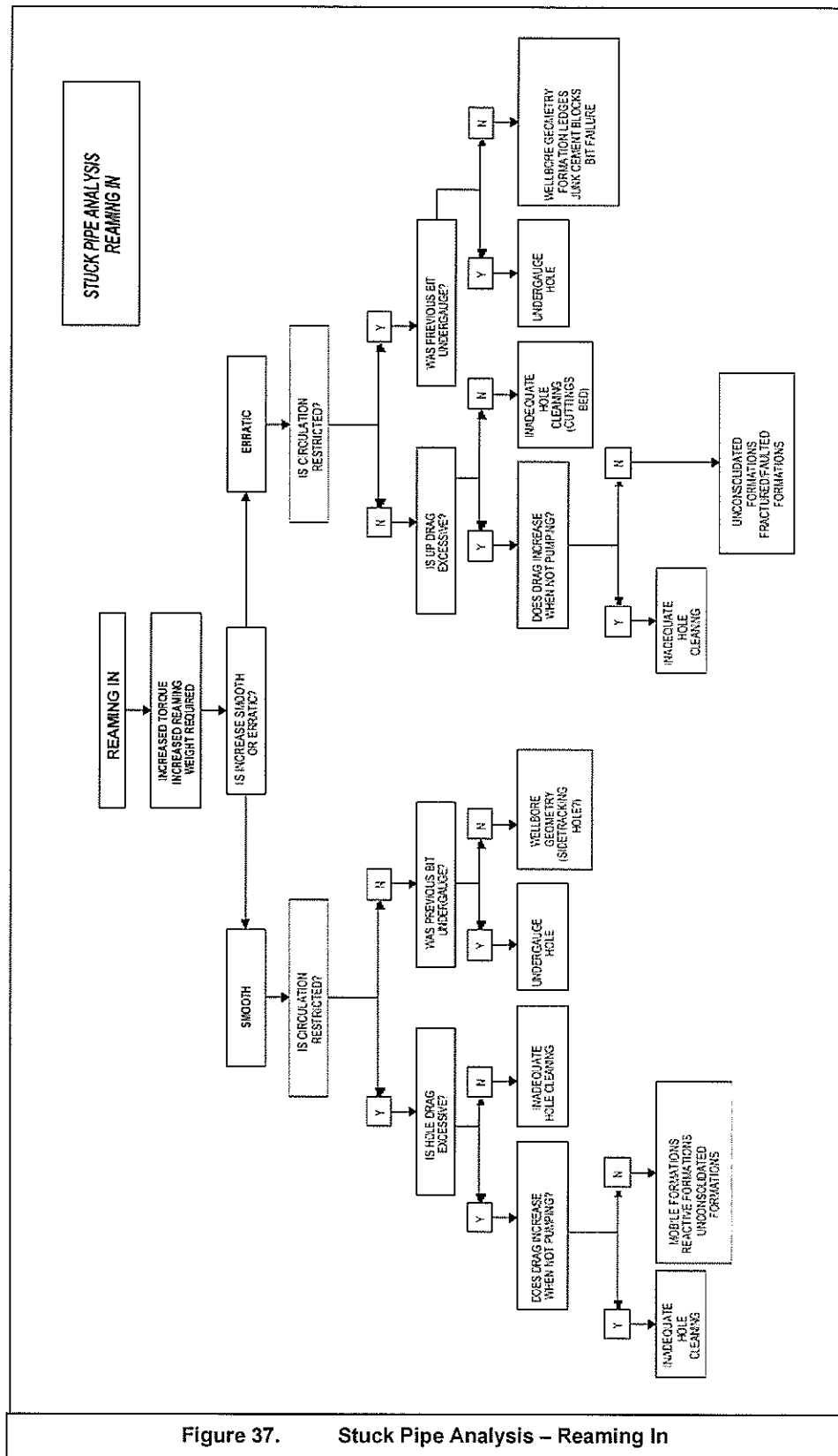


Figure 33. Stuck Pipe Analysis – Rotary drilling









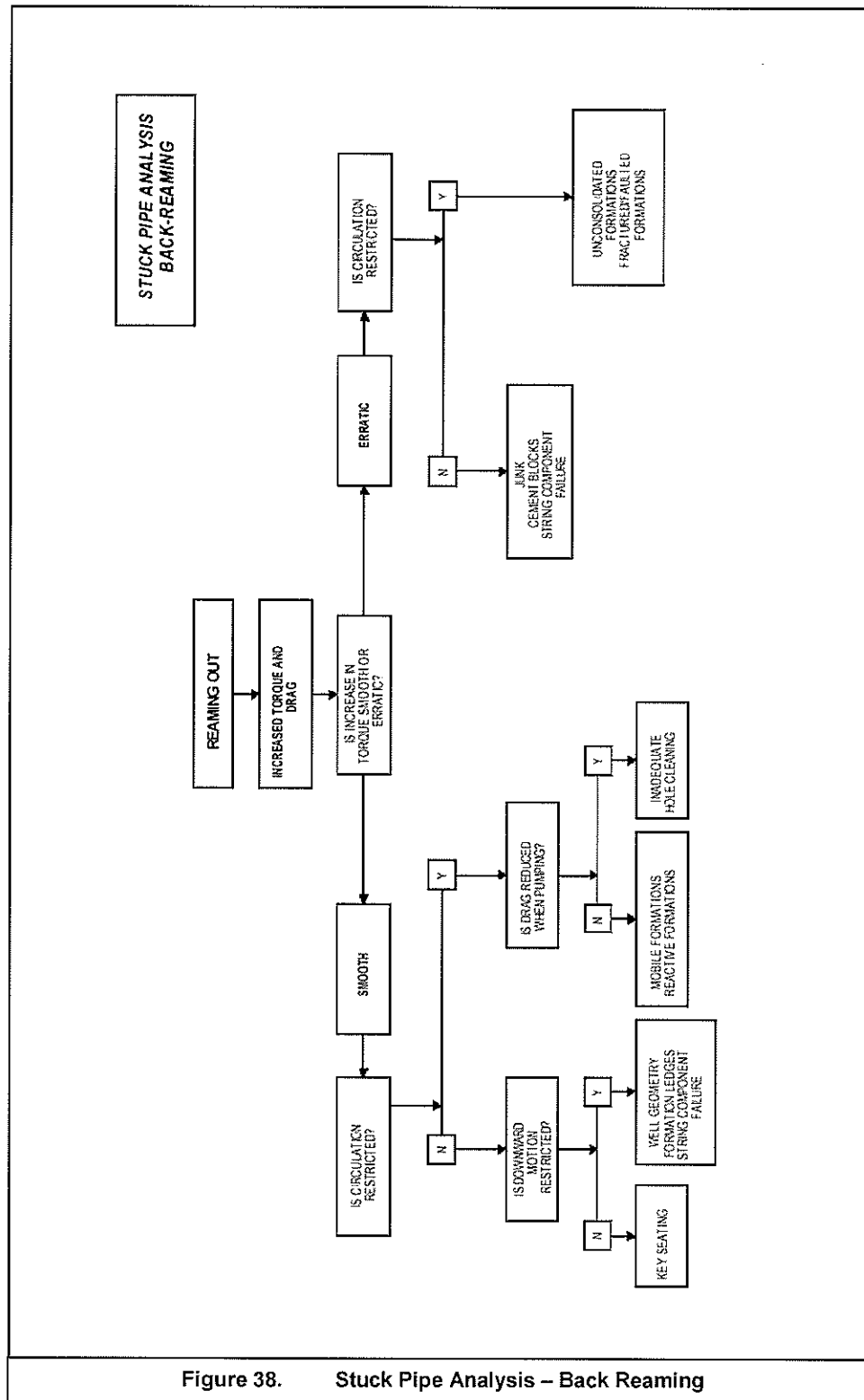
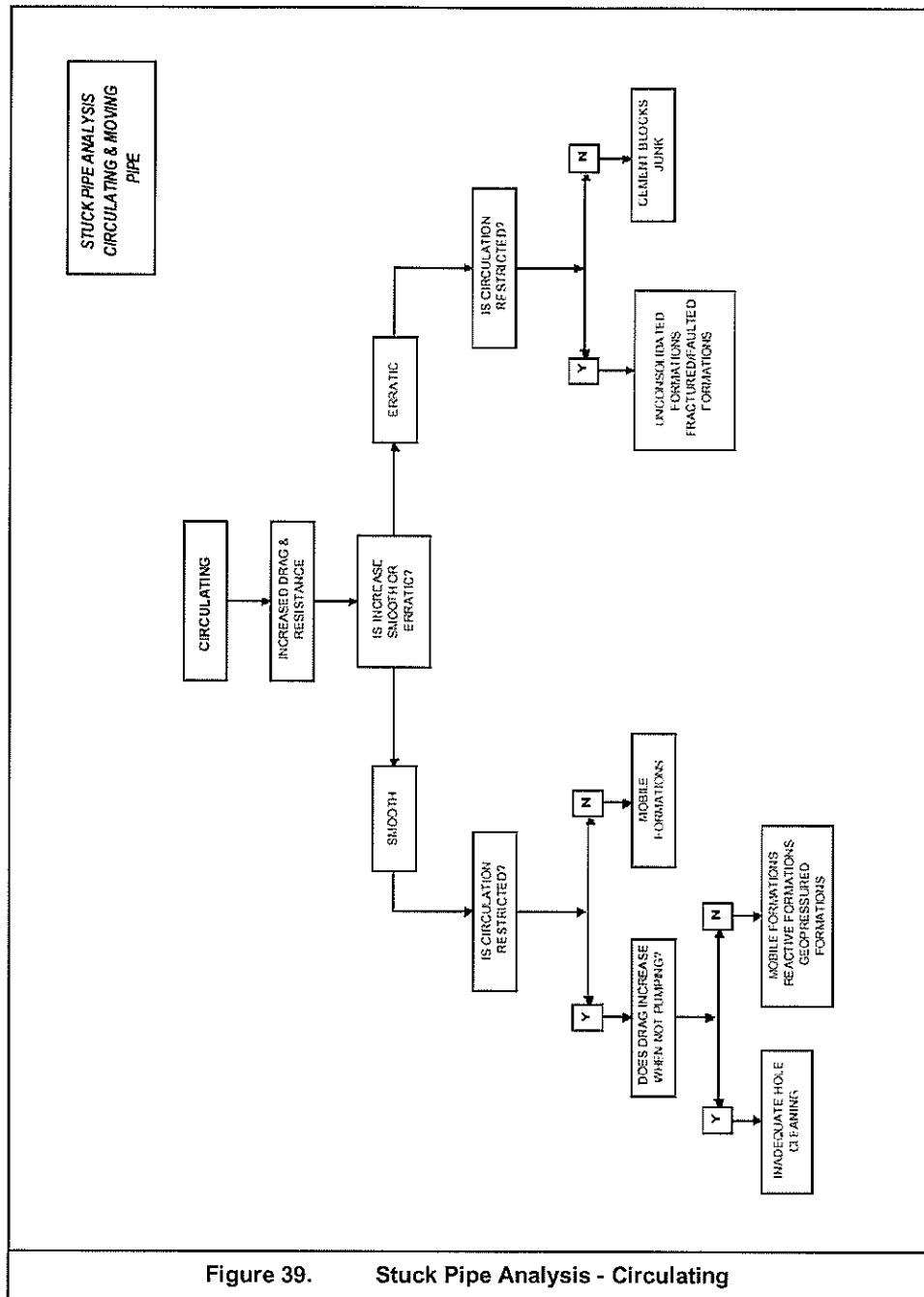


Figure 38. Stuck Pipe Analysis – Back Reaming



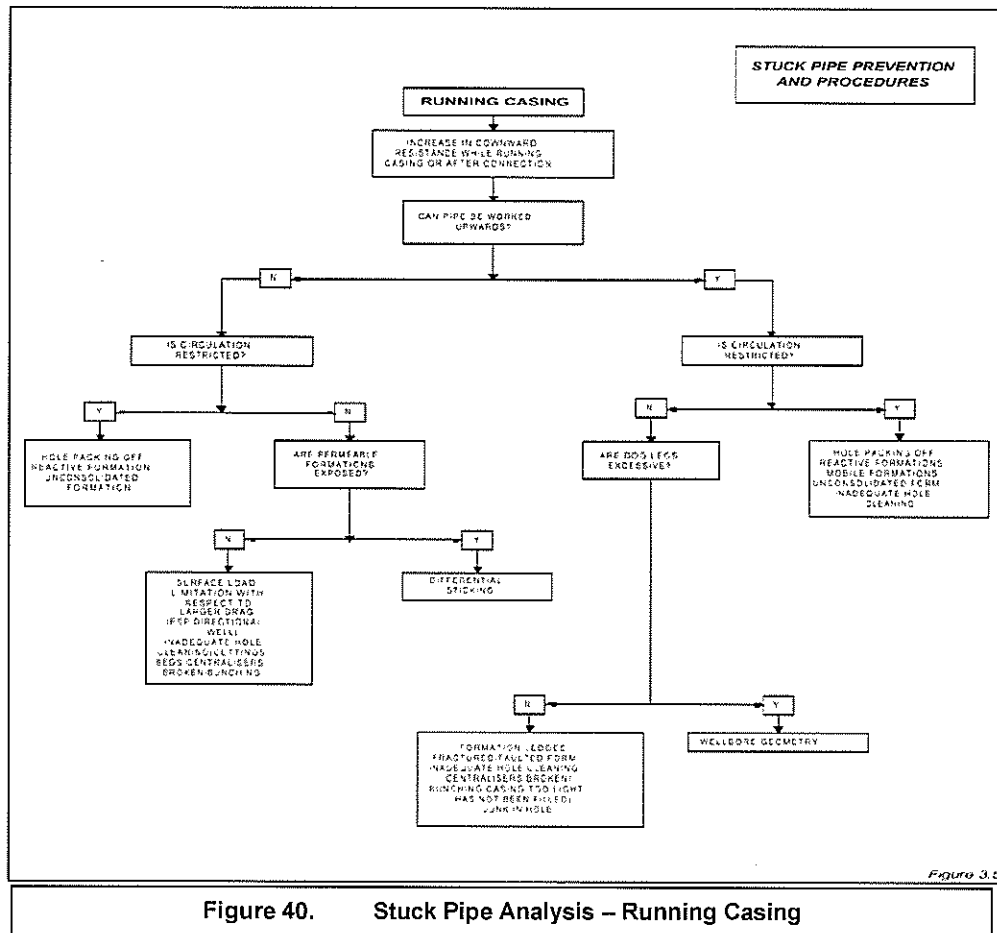


Figure 40. Stuck Pipe Analysis – Running Casing