

CASING REPAIR SYSTEMS

Inflatable Packers International

Casing Repairs

- Over the years, IPI has developed a number of well repair systems – mostly for casing problems. These include:
 - Swaged Patches
 - Relining Systems:
 - Mechanical System
 - Inflatable System
 - Screen Packer Repairs

Swaged Casing Patches

- Our Swage Patches consist of a rubber covered length of thin wall pipe that is permanently deformed by a high pressure packer to create an internal casing patch.
- The following slides show the two most usual applications; a single patch and a straddle patch.

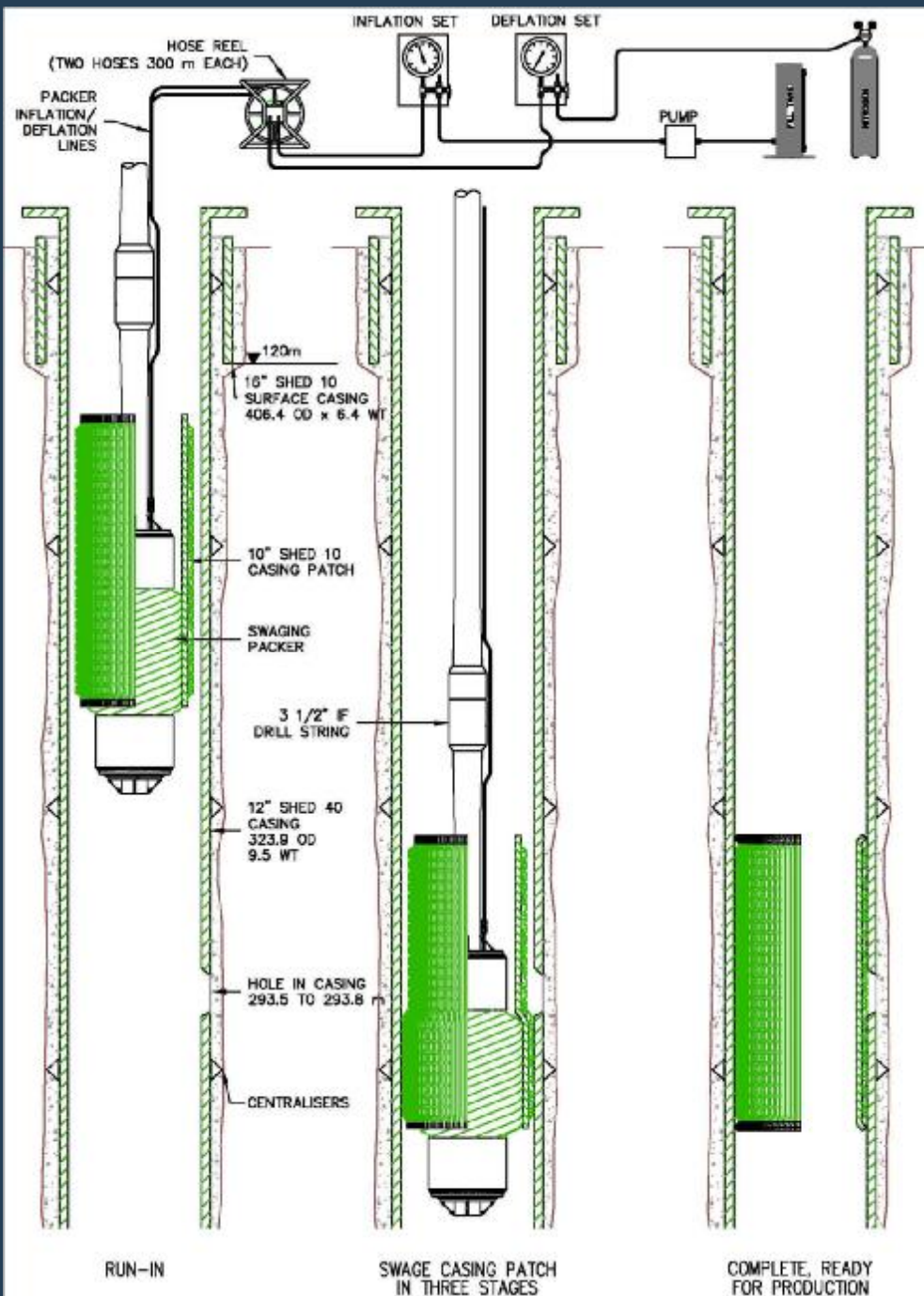
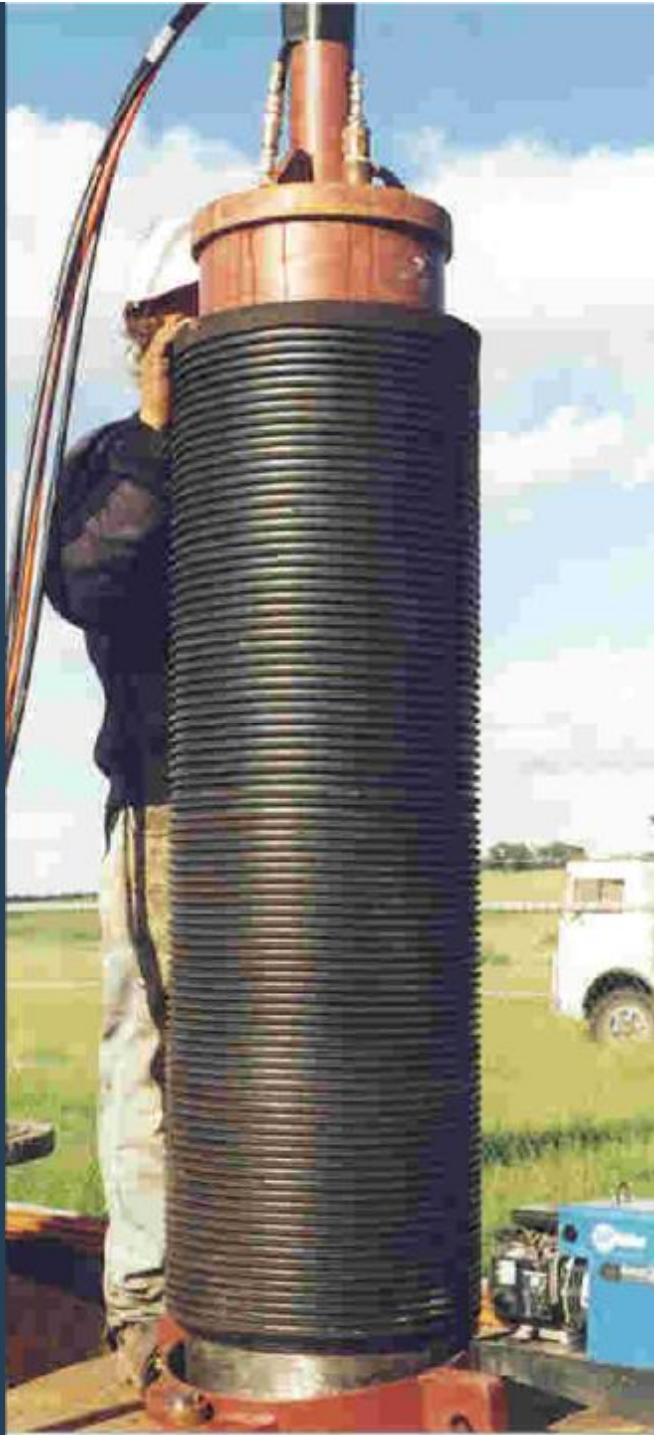


Figure 1
- Patching a
single hole
in the casing
with a
Swage Patch



*An example
of a Swage
Patch being
run in a 14"
well in
Victoria*

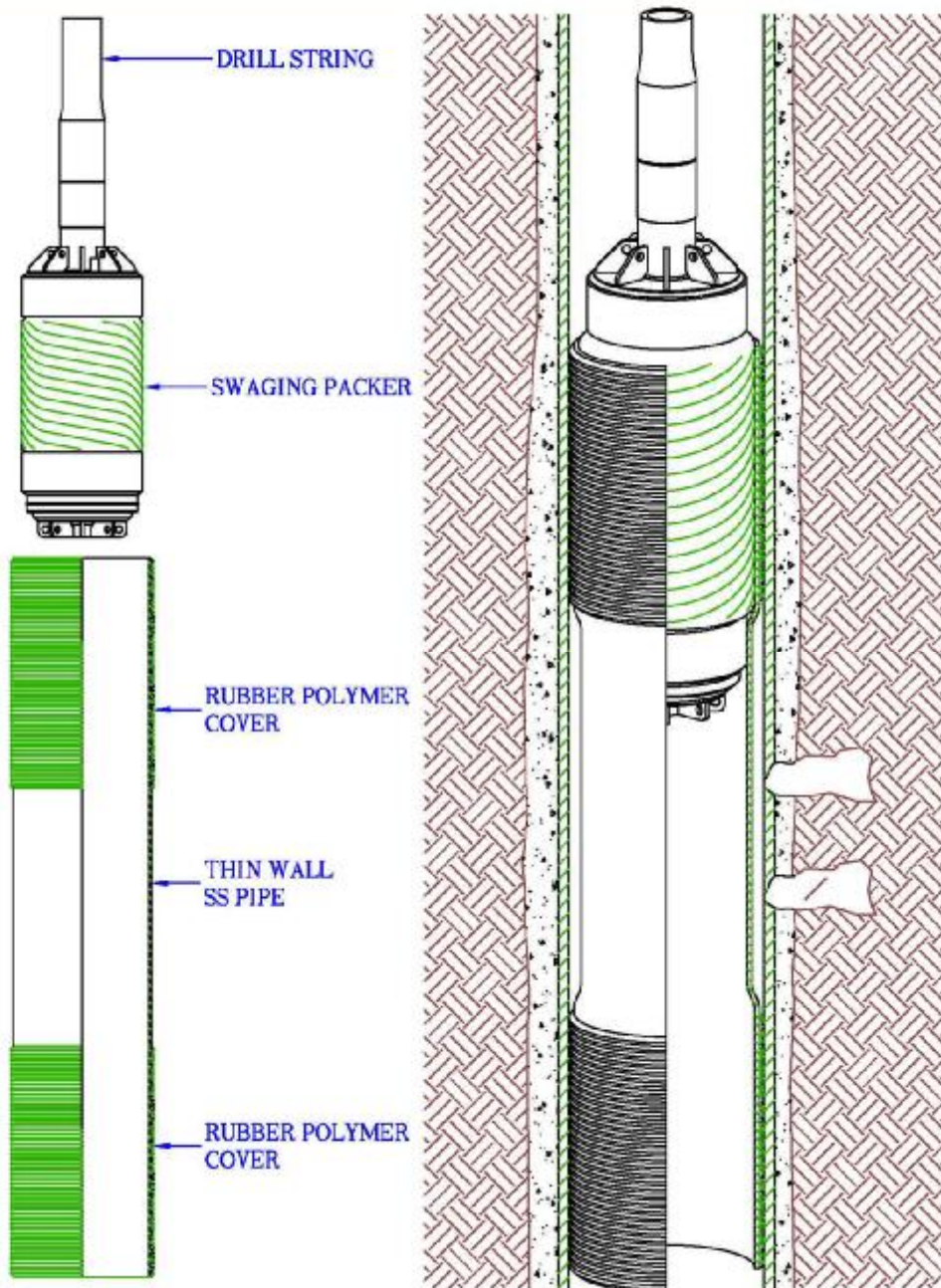


Figure 2
- Patching a series of holes in the casing with a Swage Patch

5-1/2" Casing Patch

- The following shows a series of photos taken during installation of 6 & 12 metre long patches in a 5-1/2" gas production well in Japan.
- The patches are based on 3" Sch 10 stainless steel pipe with a 4 mm thick vulcanized rubber cover.

6 m long patch being lowered into the well
with HP Swaging packer alongside.



The HP Packer being lowered into the patch



Next, the HP packer is inflated to support the patch



The HP inflation pump used for initial and final packer inflation.



Unfortunately all the action after that takes place downhole and there's nothing to show in the photos.

The remainder of the process is illustrated in the following series of photos which were taken during demonstration of our Swage Patch system in Japan for an earlier job. This was a patch based on a 12" OD x 1/8" WT stainless tube with a 6 mm thick vulcanized rubber cover.

This shows the patch installed in the 13-3/8" casing with both lying horizontal on surface.



Installing the HP Packer into the patch



The casing, patch and packer before swaging



And after swaging with the HP Packer removed

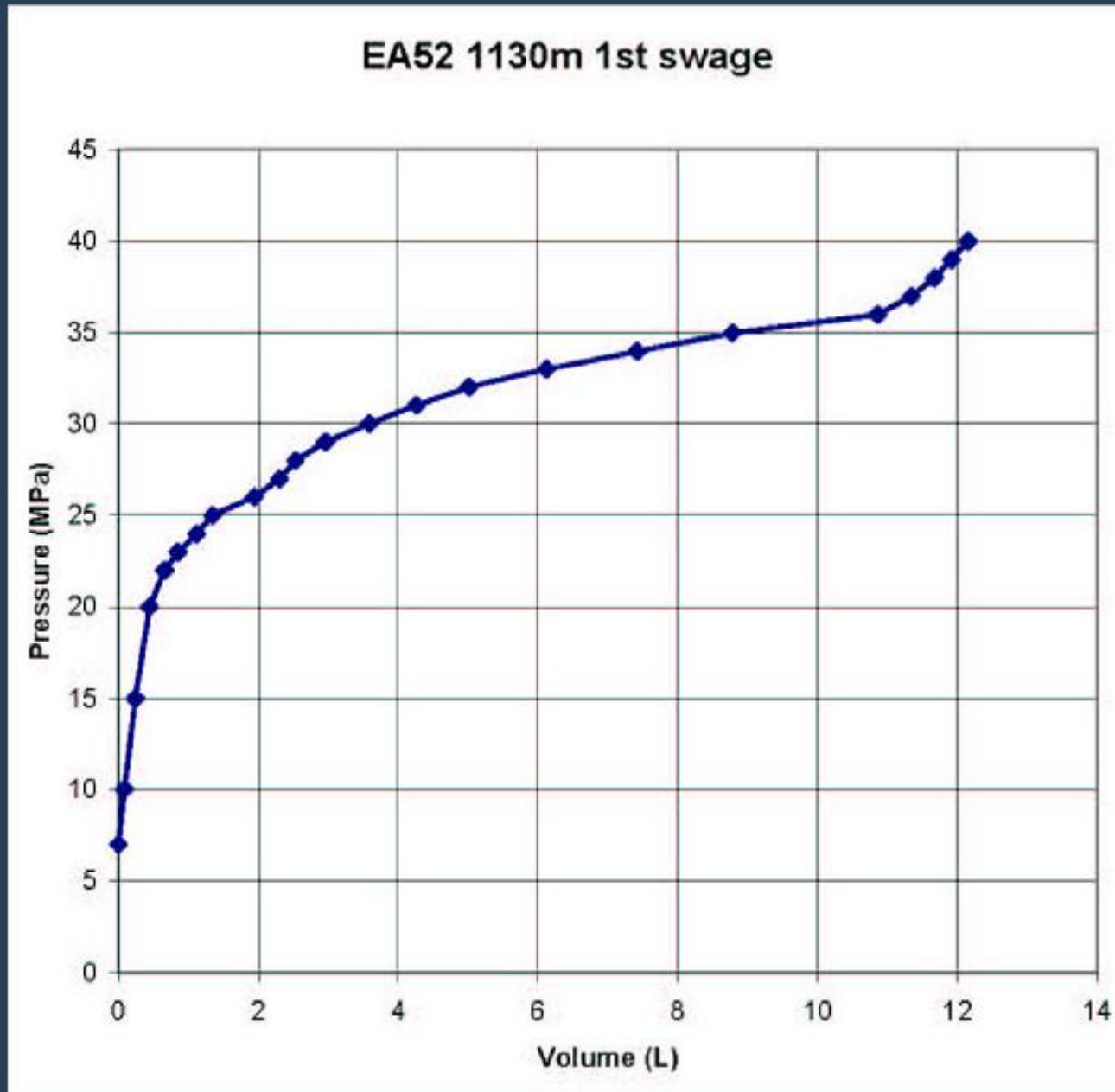


Controlling the process

By monitoring the high pressure swaging packer's pressure and the volume of the inflation fluid, very precise control is maintained over the swaging process.

Control is so precise that patches can even be set in slotted PVC without damaging the casing.

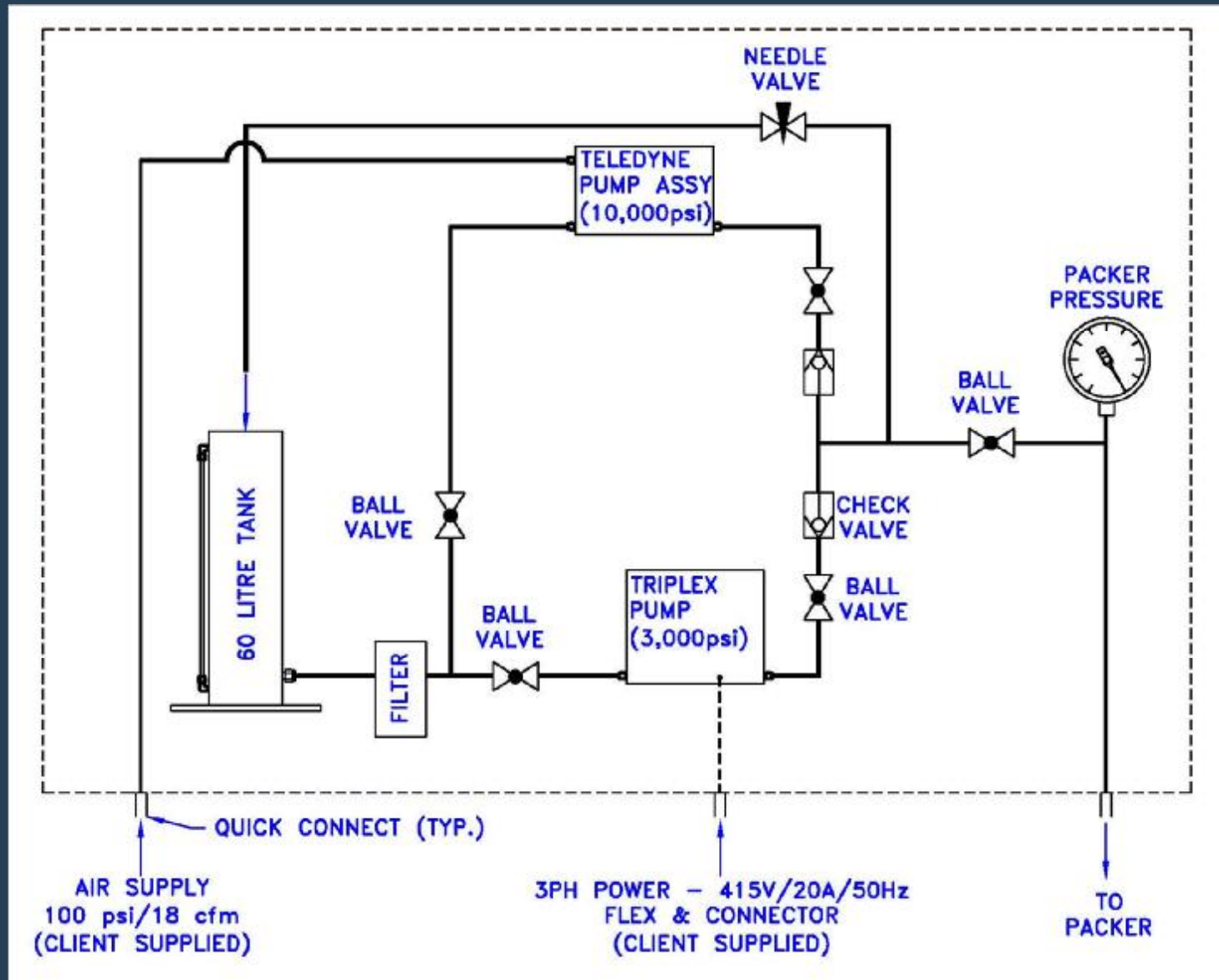
Typical P vs V chart for Swaging



Referring to the chart, it clearly shows the different stages of swaging.

- 1st steep section pressure up to patch yield
- 2nd (the largest portion) the patch swaging
- 3rd (the turn up at the end) is the patch hitting the casing wall and compressing the rubber on the patch OD

Surface Equipment



The previous slide shows a typical set up of surface equipment for swaging.

Volume and pressure are normally monitored electronically as well to aid the presentation of data.

The following slide shows a typical job report per swage.



Inflatable Packers International Pty Ltd

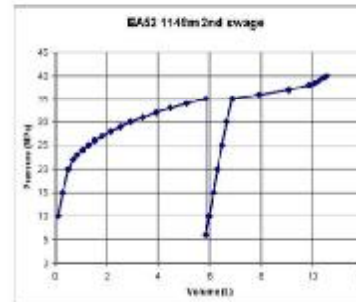
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SWAGE PATCH JOB REPORT

Customer	TOC via Cosmos Shoji
Date	04/08/06
Well No	EA-52
Patch Depth	Top of patch at 1148 metres – 6 metre long patch – 2 nd Swage

JOB RECORD

Time	Pressure (MPa)	Volume (cm)	Time	Pressure (MPa)	Volume (cm)
13:06	6	0	13:38	6	46.7
:09	10	0.9		10	49.9
:10	15	2.3		15	51.2
:11	20	4.1	:41	20	52.6
:13	22	5.6		26	53.9
:14	23	7.1		30	55.4
:15	24	8.8	:43	35	57.3
:17	26	10.7		36	58.9
:19	26	12.7		37	75.5
:20	27	15.0		38	82.3
:22	28	17.9		38.5	94.1
:23	29	21.0		39	95.4
:25	30	24.2	14:01	39.5	86.9
:26	31	28.2	14:03	40	87.9
:28	32	32.6		0	
:30	33	37.1			
:32	34	42.4			
:34	35	48.7			



Comments:

- 1) Pressure reduced manually at 13:34 to 6 MPa to try to relax packer rubber.
- 2) Chart indicates touch wall pressure for patch at approx 37.5 MPa.

Casing Re-Lining

- The basic re-lining technique presented uses an inflatable packer on the liner and a cementing valve above that to allow installation and cementing of the liner without damage to the producing/injection zone.
- Two different methods of inflating the liner packer and placing the cement are shown – one using a mechanical tool and the other an inflatable tool.

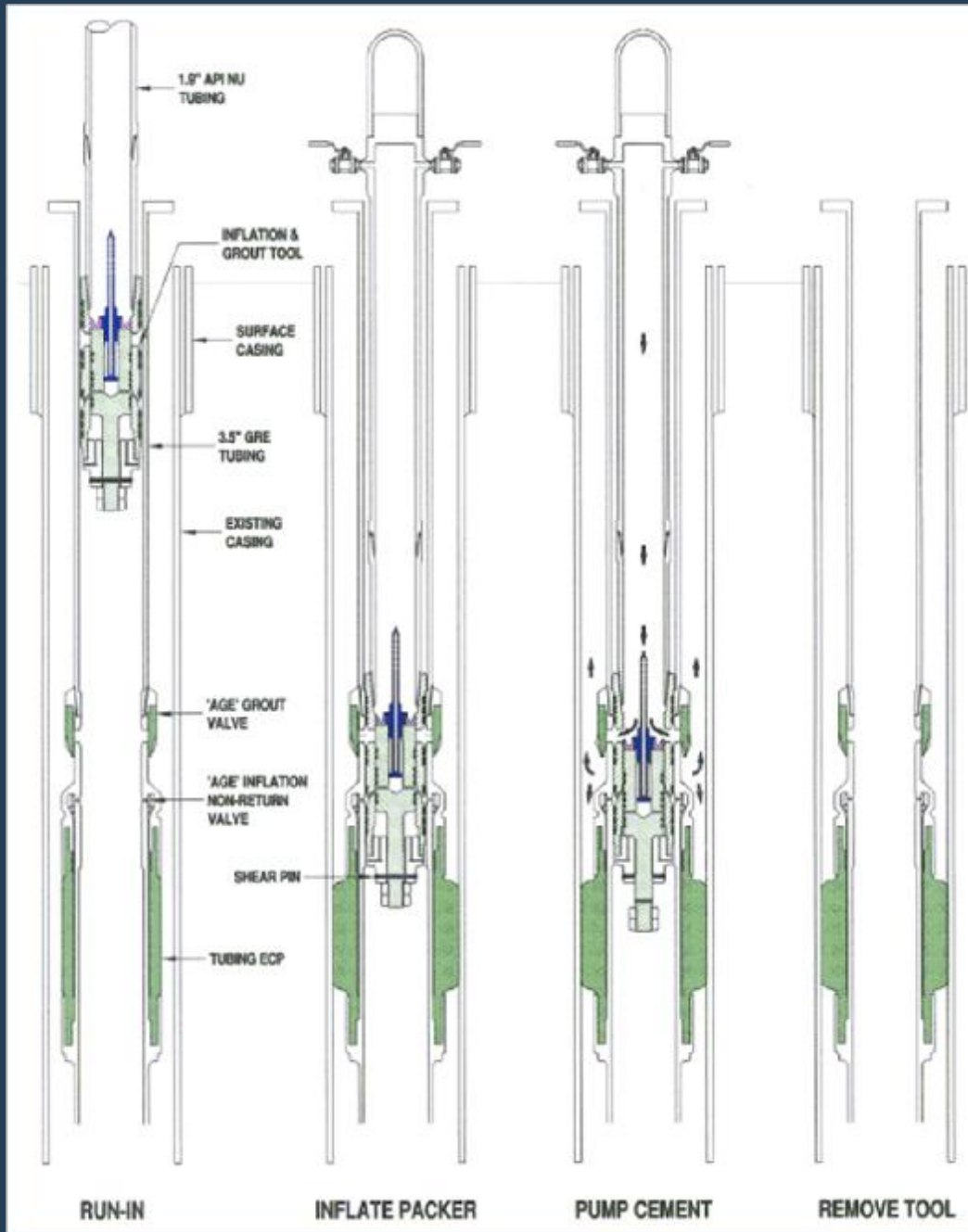


Figure 3
- using a mechanical tool for packer inflation and cementing.

Denham Town Site Bore No. 1/79 Re-line

Owner: Water Corporation

Use: Town Water Supply – brackish supply and input to desalination plant

The Well - drilled in 1979
- production rate – pumped at 800 m³/day

Background

As this bore is critical to the water supply of the Town of Denham, the Drilling Consultancy branch of the Water Corporation arranged a video inspection to assess its condition. The video revealed that the casing was in very poor condition and that some form of re-lining was required to return it to acceptable condition and ensure its long term viability.

The Drilling Consultancy branch then prepared and reviewed a number of innovative re-lining strategies, in conjunction with AGE Developments, that fulfilled the dual aims of repairing the bore while still maintaining the required production rate. A repair system and implementation program based on re-lining the well with 75 mm and 100 mm stainless steel casing was selected. AGE Developments designed and built the down-hole equipment that enabled the selected strategy to be implemented in a fast and efficient manner. The overall work program remained under the direction and supervision of the Water Corporation Drilling Consultancy branch.

This repair has now been implemented and was fully successful in both repairing the casing and maintaining production thus ensuring the integrity of this vital water supply for the Town of Denham.

Repair System

The repair system employed is shown schematically on the attached drawing. In essence, it involved:

- Running a 75 mm NB stainless steel liner to seal via an AGE M-Packer, at the top of the existing screen riser and extending back to within 120 metres of the surface. At this depth the liner is converted to 100 mm NB stainless steel pipe which runs back to surface.
- The liner incorporates an inflatable packer and grouting valve on the base immediately above the screen seal.
- After correct positioning of the liner was verified by downhole video camera inspection.
- A grouting string with a series of mechanical seals and a shear activated valve system was stabbed into the new liner adjacent to the top of the inflatable packer.
- The liner packer was inflated by pumping down through the grouting string. At a factory pre-set pressure of 1000 psi, the shear valve activated automatically shutting off the packer inflation port and opening communication to the liner/casing annulus through the grout valve.
- Pumping of water was continued to ensure that the annulus was free and unblocked. Once confirmed, the liner was then grouted into the old casing by pumping cement grout down the grout string and via the grouting valve into the annulus.
- Cement remaining in the string after grout returns were noted at the surface was displaced into the annulus by pumping water after the cement.
- After waiting for the cement to reach initial set, the grouting string was removed leaving the bore ready to produce.

An example report
on a town water
supply well
repaired using this
technique

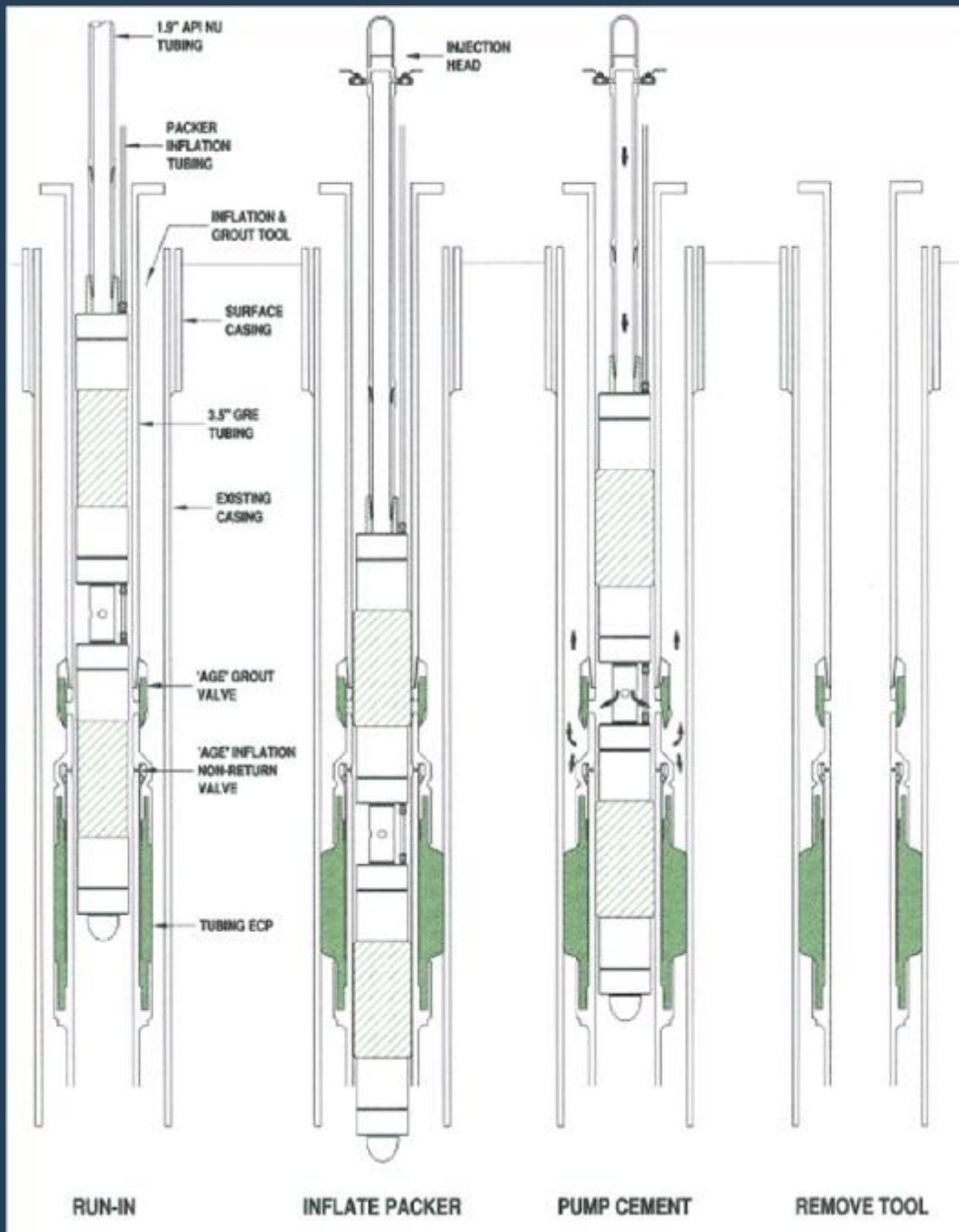


Figure 4
 - using an inflatable straddle packer for inflation and cementing

Sir James Mitchell Park Water Well Repair

Owner: City of South Perth

Use: Maintenance of parks and gardens

The Well - drilled in 1983
- production rate –

Background

It was noted that the water quality from the bore was deteriorating with, in particular, an increase in iron content. To investigate this a downhole video inspection of the well was carried out by AGE Developments.

The video showed that the 250 mm NB steel bore casing has suffered severe general corrosion. So severe, that in places the casing has completely corroded away. Fortunately, the casing was very competently grouted by the original drillers therefore withstanding collapse, remaining productive and allowing repair.

AGE Developments designed a repair system and implementation program based on re-lining the well with a stainless steel casing. This repair promises to return the water quality to original values by sealing off a lower quality upper aquifer and will also extend the life of the well for an additional 20 years or more.

Repair System

The repair system designed by AGE Developments is shown schematically on the attached drawing. In essence, it involves:

- Running a 200 mm NB stainless steel liner to seal via an AGE M-Packer, at the top of the existing screen riser and extending back to surface.
- The liner incorporates an inflatable packer and grouting valve on the base immediately above the screen seal.
- After correct positioning of the liner has been verified by downhole video camera inspection a grouting string with a series of inflatable packers is run into the new liner.
- Inflation of all string packers allows the lower two packers to isolate the inflation port for the liner packer. This packer is then inflated by pressurising this isolated zone via a hose run from the surface.
- With the liner packer inflated, the productive zone of the bore is fully protected so the liner can then be grouted into the old casing by pumping cement grout down the grout string and via the grouting valve into the annulus.
- Cement in the string is displaced into the annulus by pumping water after the cement. Note that the top string packer allows the liner to be pressurised to prevent collapse during cementing operations.
- Deflating the top packer isolating the grouting valve allows further flushing of the grout string and liner bore via a choked outlet through the top string packer.
- After waiting for the cement to reach initial set, the string packers are deflated and the grouting string is removed.
- The pump can then be re-installed by others as required.

An example report
on a parks and
gardens water
supply well
repaired using this
technique

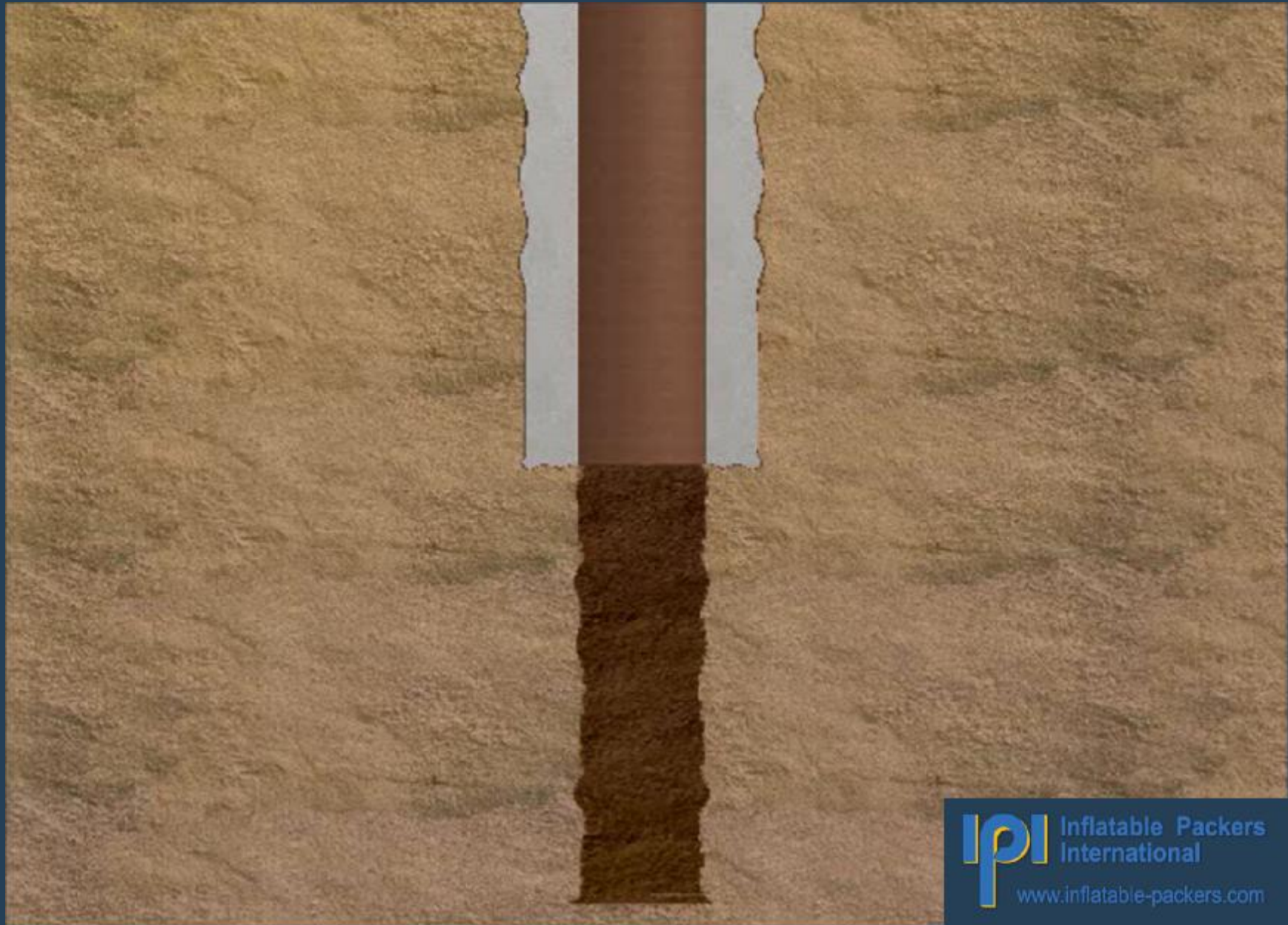
Advantages

- Packer protects aquifer from cement.
- No need to kill the well
- No need to re-develop
- Can shut off artesian flows
- No rotation required so can use simple lifting frame for most jobs
- Suits all casing types – Steel, FRP, PVC, ABS
- Fast, efficient and convenient

Slip-on ECPs



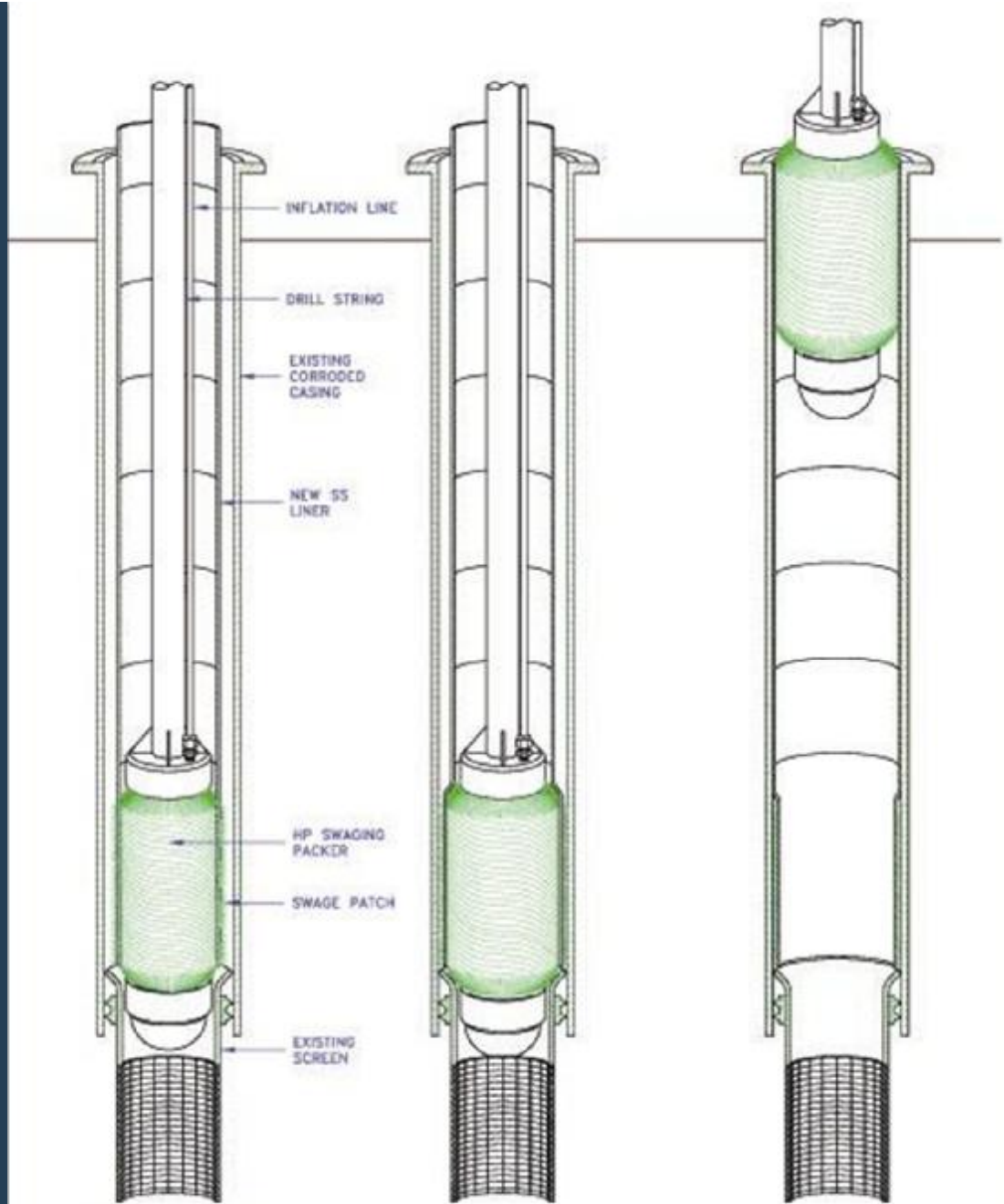
These packers are built with internal diameter large enough to allow them to be slipped onto a joint of casing and then be secured in place using a high strength, filled epoxy resin.



IPI Inflatable Packers
International
www.inflatable-packers.com

Swaged Liner

- Our swaging method may also be used to install a liner in a well with an absolute minimum of ID loss.
- The basic process is illustrated on the following slide.



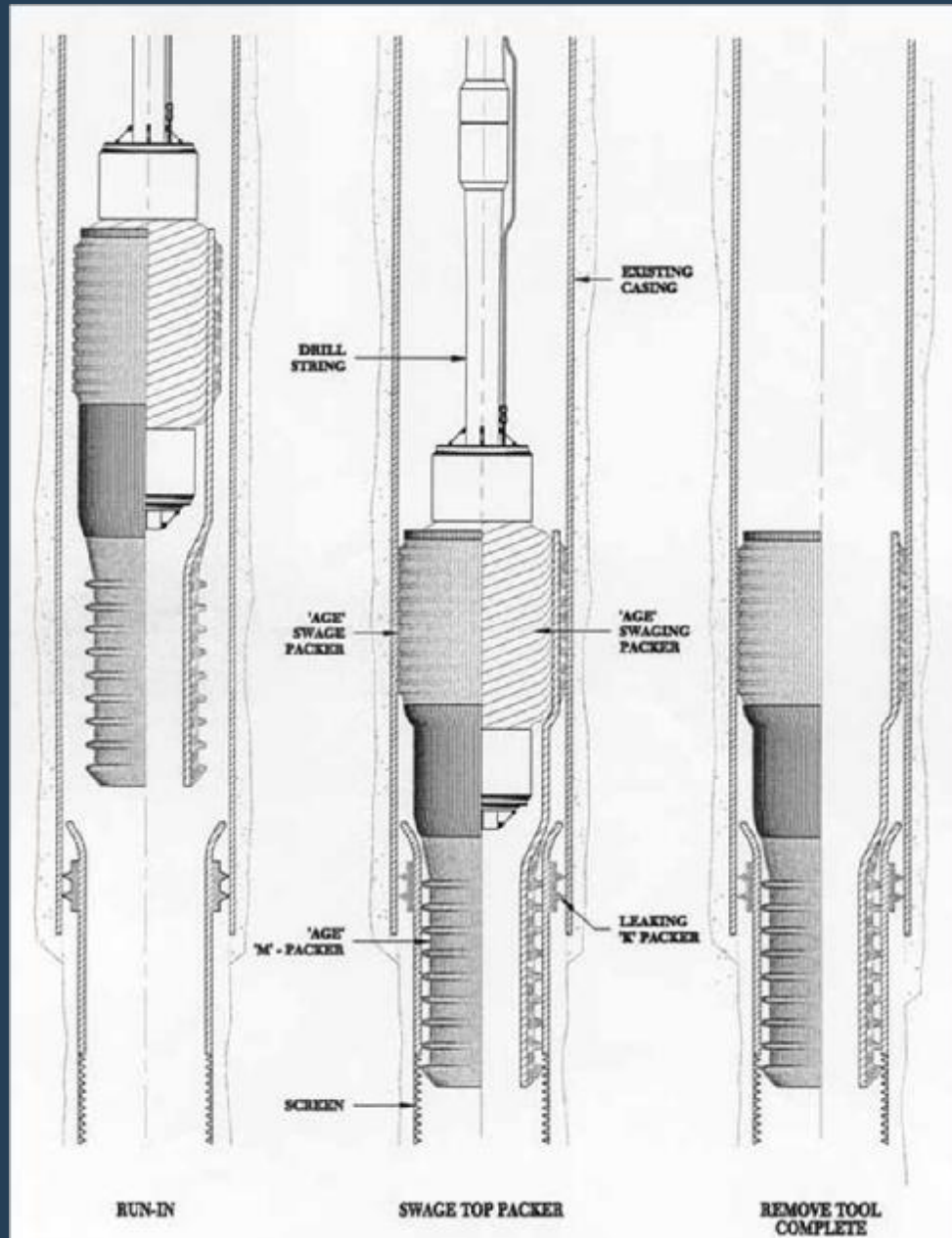
RUN IN NEW LINER
AFTER WELL CLEANING
& VIDEO INSPECTION

SWAGE BOTTOM PATCH

CONTINUE SWAGING
TO SURFACE

Swaged Screen Packer Repair

- Our swaging method may also be used to repair a leaking screen to casing seal packer as shown on the next slide



Well Preparation

- Prior to running any of these casing repair methods, a scraper/brush should be run in the well to remove loose scale on the casing wall.
- Video and caliper surveys of the casing are also strongly recommended, especially for Swage Patches.

Conclusion

Inflatable packers offer a number of options for well repair.

Each of these have their place but in combination further demonstrate the versatility of inflatable packers for well operations.