WORK INSTRUCTIONS FOR ENGINEERS

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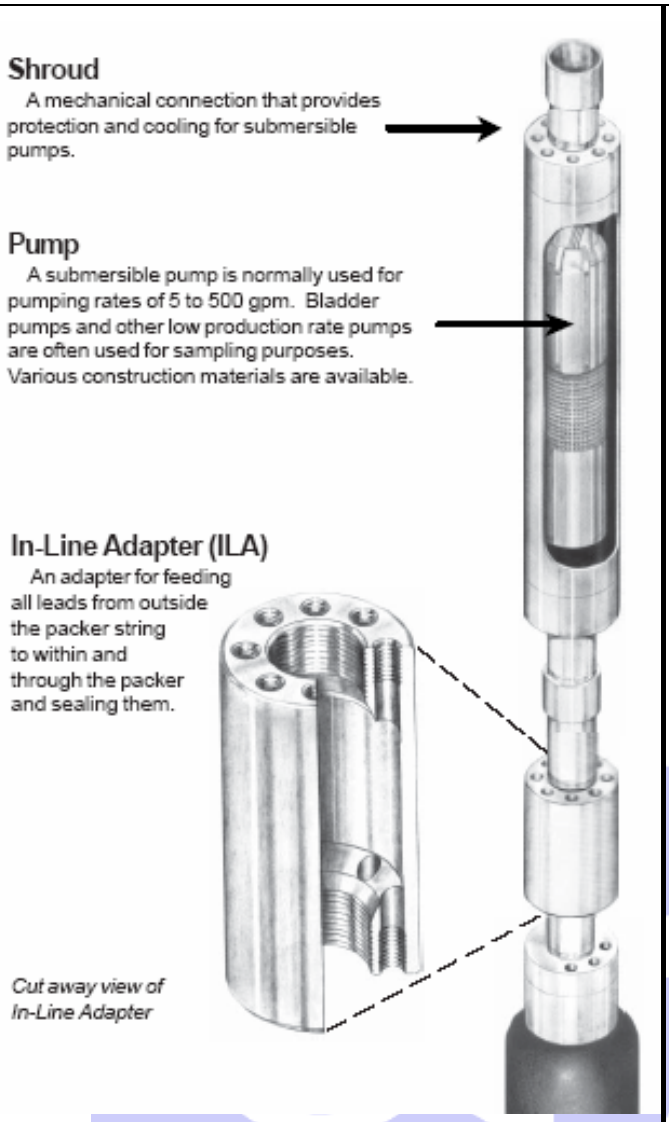
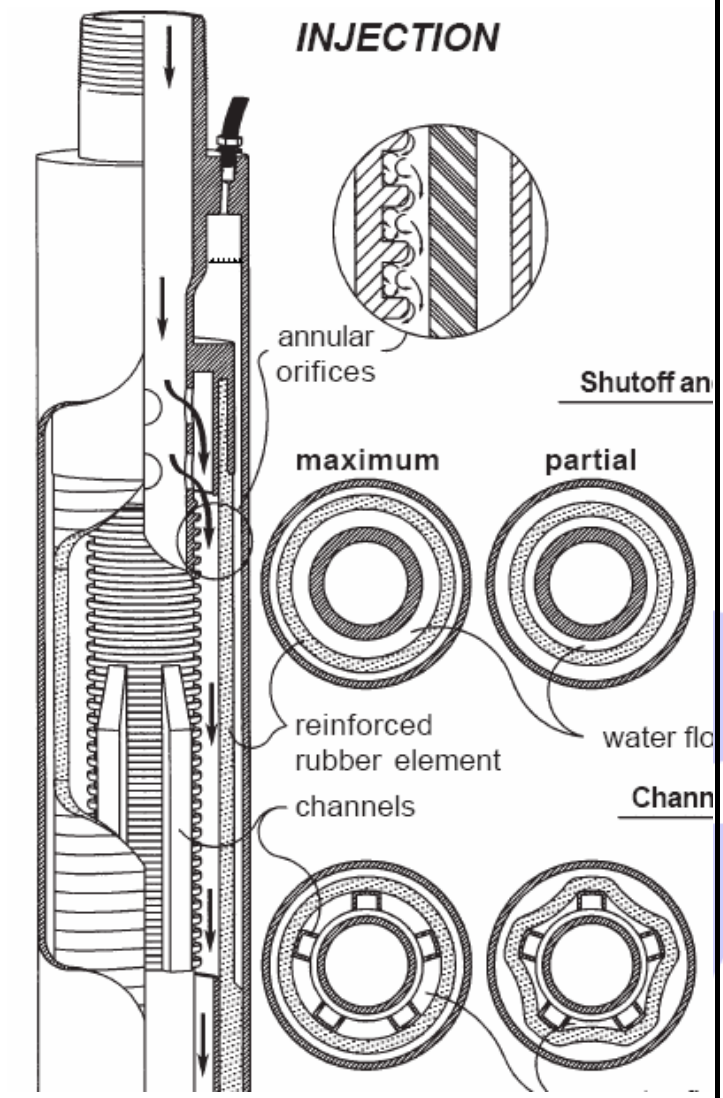
OP-3-58. CHECKLIST FOR PACKER TEST

NO.	CHECKLIST ITEMS	Checked By Engineer	Remarks
1.0	**PROJECT** **Project Name :** _____ **Project No.:** _____ **SUBCONTRACTOR** **SI Contractor** _____ **Location :** _____ **Borehole :** _____ **Water level (Before) :**_____ **Water level (After) :**_____		
2.0	**Test Equipments**		
2.1	For Single Packer and Double Packers • Inflation hoses • Injection hoses • Stuffing box • Pump - Suitable pump size : a pump of 20 l/s to 25 l/s (0.02 to 0.025m^3/s) capacity against a total head of 400 to 500kN/m^2 will generally furnish adequate water at sufficient pressure for most tests. - The pump should be able to give a steady pressure readings, e.g. a centrifugal pump. • Couplings • O-rings • An upper fixed end - Both of the rubber element ends fixed to the pipe mandrel. - Equipped with 1 or 2 inflation inlets with adapters. • An inflatable elements – with steel fittings on both sides. - For 76mm dia. borehole, recommended nominal dia. in mm = 42, 56 and 72. - For 101mm dia. borehole, recommended nominal dia. in mm = 56, 72 and 85. - The contact length with the rock (test section) = at least 5D where D = diameter of the borehole.		

	• A sliding end - Allows the element gland to slide on one end. - Make sure there is no leak path presents at the mechanical seals of the sliding end.		
2.2	Extra Equipment for Single Packer • The diffuser – made of stainless steel.		
2.3	Extra Equipments for Double Packers • Perforated central element. - The total area of the perforations is at least twice the cross sectional area of the pipe. - A 50mm diameter pipe perforated with 6mm diameter holes requires sixteen holes per 100mm length; for a 25mm diameter pipe, eight 6mm or twenty four 3mm holes per 100mm length would be adequate. • An extension kit (if needed) – for longer injection zone. • Packer end cap – for blocking flow through bottom of packers. • Inflation line in the test zone. **Caution** : If a sliding end was placed into the test zone, please keep a safety margin for the inflation line to compensate the shortening of the packer after inflation.		

2.4	 Shroud A mechanical connection that provides protection and cooling for submersible pumps. Pump A submersible pump is normally used for pumping rates of 5 to 500 gpm. Bladder pumps and other low production rate pumps are often used for sampling purposes. Various construction materials are available. In-Line Adapter (ILA) An adapter for feeding all leads from outside the packer string to within and through the packer and sealing them. Cut away view of In-Line Adapter		

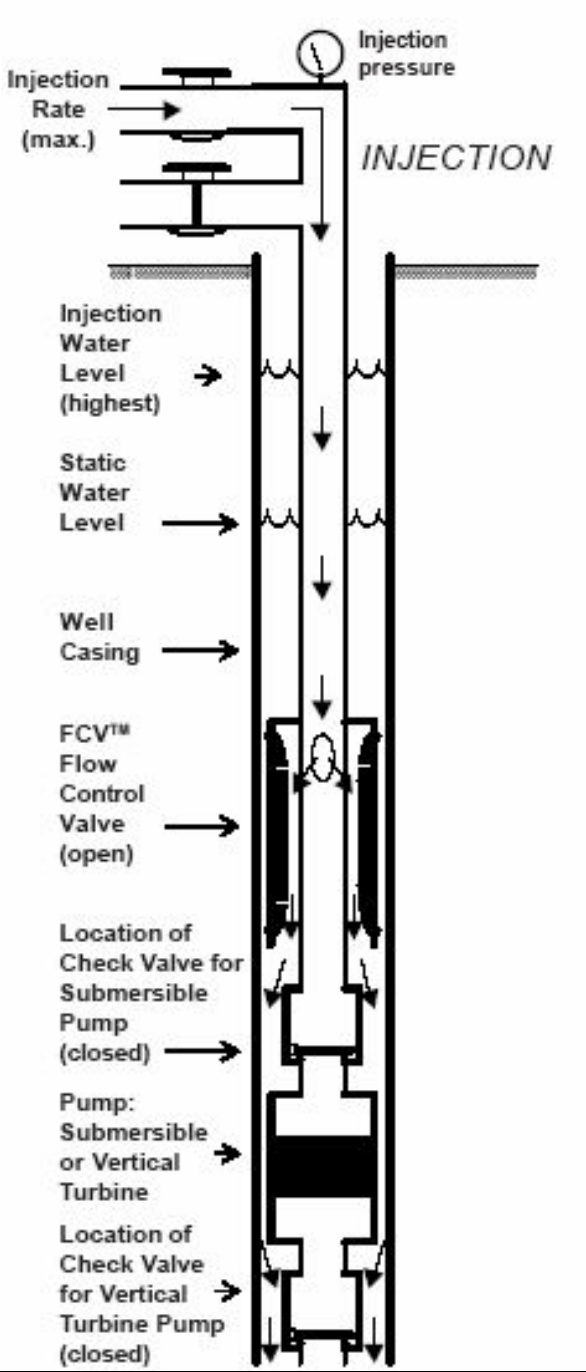


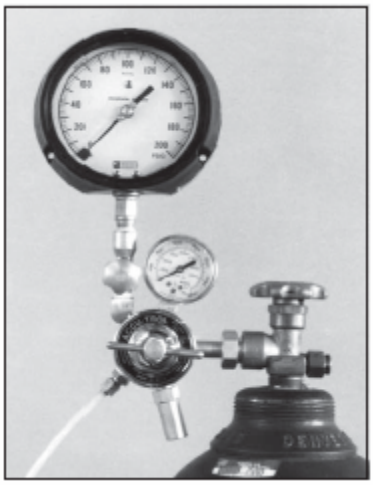
Equipments Testing

- All packers must be tested to maximum design pressure.
- Require ability to calibrate friction losses in pumping system and packer system prior to testing.
- Will need to have bypass valves installed before and after the pressure gauge/flow meter assembly in order to control pressure/flow and to protect flow meter from back pressure.

Pressure gauges should be calibrated if possible (plumbing in spare gauges and comparing measurements may be only means available on site).

3.0	**Packer Test Preparation**		
3.1	• Prepare packer assembly according to the needs. • Check inflation line connecting the packers and fittings – do not over tighten as you might strip the threads. • Check packer assembly for any leakage. Inflate to maximum gland working pressure in appropriate length and diameter of drill casing or drill rods. • Check wire line connectors on packer assembly and stuffing box components (especially seals). • Prepare and check water feeding system : tank, supply, pump, connection hoses, pressure gauges, valves and flow-meter. • Design test parameter : depth and length of tested zone, drilling bit depth, position of packers, inflation pressure and water pressure for three stages. • Drill hole preparation : Flush the drill hole with clean water in order to remove the drilling mud and cuttings). • Pull rods up to locate drill bit at selected depth. • Prepare wireline winch. • Install stuffing box on drill rods. • Measure groundwater level prior to installing packer system several times to assess static groundwater level. • Lift the packer assembly using the wireline and lower to landing ring at drill bit – check if seats on landing ring by “listening” to rods using wrench, etc. If possible, check depth marking on wire line if this has been marked for the expected depth. • Inflate packer slowly (by 50 psi steps) until working pressure has been reached. • After inflation is complete, monitor packer inflation line pressure for 2 minutes minimum to see if system is leaking. If no leaks apparent, then, • Seal stuffing box cap and attach water feed system. • Check inflation lines and inflation pressure to ensure no leaks occur, check water feeding system, prepare stop-watch and field test form.		

	• Packer system is now ready for testing.		
4.0	**Test Description (Procedure)** 		

4.1	<u>Specified the test level and length of the test section.</u> • Pump water into the test section (normaly 0.5 – 1.0m) under constant pressure. • Limit the pressure to ensure that hydraulic fracturing of the rock cannot occur. • The quantity of water pumped into the borehole in m^3/s should not exceed 0.03 times the total area of the test section in m^2. If this condition is not satisfied, a lower delivery pressure should be tried. • Observe the flow for every 5 minutes until measurements of 5 minutes interval show variations of not more than about 0.1 l/s ($1x10^{-4}m^3/s$). • Increase the pressure, usually for 5 equal increments, followed by 3 decreasing pressures. • Record the steady-state flow of each pressure.  • After the completion of the test, deflate the packer. • Do not remove the packer before complete deflation. A few minutes are needed when water has been used to inflate the packer. • Carefully clean the packer with water after each use. • Store packers away from light. • Since natural rubber is very sensitive to UV rays, packers should not be exposed to sunshine.		

5.0	**Data Interpretation**		
	• Plot the graph flow rate (q) versus total head (h). • Observed the pattern of the graph, the type of material in the test section roughly can be known. Calculate the permeability of the material (k), For L ≥ 10r ; $k = \frac{Q}{2\pi LH} \ln \frac{L}{r}$ For 10r ≥ L ≥ r ; $k = \frac{Q}{2\pi LH} \sinh^{-1} \frac{L}{2r}$ k = permeability (m/s) Q = rate of flow into the test section (m^3/s) L = length of the test section (m) H = $h_1 + h_2 - h_f$ = differential head of water (m) h_1 = gravity head (m) h_2 = pressure head at swivel (m) h_f = head loss in delivery pipes (m) r = radius of hole tested (m)		
	Signature by Engineer		