SAFETY RULES USING GMA INFLATABLE PACKERS

1. The borehole must be cleaned before the packer is placed in the borehole. Use inflatable packers that are intended for holes with the specified dimension, note when selecting packers that the **Max Permitted Expansion Pressure** gradually drops towards the maximum diameter of the packers. Repeated inflation to maximum diameter wears packers quickly. Therefore, choose packers that have the smallest outer diameter (not inflated) as close to the borehole diameter as possible, but which can also be mounted in holes without problems.

   Also notice that chips in boreholes, or bumps / cavities in boreholes, can also damage packers during use.

2. For boreholes facing downwards, the borehole should be filled with water before grouting to avoid air pockets. The cement hose should also be filled with a cement mixture before the injection begins to avoid air pockets there as well.

3. Expand the packer to calculated **Total Expansion Pressure** taking into account; ***A)*** Planned diameter of packer, ***B)*** Hydrostatic pressure in the borehole and ***C)*** Planned injection pressure (see calculation below). Make sure that the Total Expansion Pressure **does not exceed** the Maximum permitted expansion pressure for the current diameter (see Technical Specification for the current packer).

4. Expand the packer with water, expansion of packer with air / gas can be dangerous if the packer is damaged during installation / use (if the packer's textile hose is damaged during expansion / use, the packer can be pushed out/ejected from boreholes if it has been expanded with air / gas). To avoid air pockets in the packer, especially for larger packer models, fill the packer with water as it stands vertically, remove connection and allow air to escape, repeat this procedure until the packer is completely filled with water. Then install the packer in the borehole.

5. Inflatable packer must never be expanded to its maximum diameter without sitting in boreholes / pipes!

6. When using inflatable injection packers, be at a safe distance from boreholes and packers / injection tubes / injection tubing. Staying in, or near the borehole, can be dangerous. This is especially during expansion of packers, injection or immediately after injection, and when expansion pressure in packers is reduced after use (released). Particular care should be taken when injecting at high pressures or if the hydrostatic pressure is high. **NEVER STAND IN FRONT OF THE BOREHOLE OR INJECTION TUBE / HOSE!**

7. All packers in one injection face should be placed before injection starts.

8. When grouting, you must be aware that other packers can also be pressurized due to. of connection between the boreholes. Pay attention to movements of injection tubes / hoses. If there are communicating boreholes, all boreholes should be injected at the same time.

9. Let the rock “rest” for 10 – 15 minutes after injection to let the pressure decrease/fall before reducing the expansion pressure in the packer.

10. When injecting at high pressures, make sure that the packer and other components are approved for the actual pressure and dimension. If an injection pipe is used and a safety hook is attached to the injection pipe, then attach a wire / chain and to the rock before starting the injection work.

11. If the packer during the injection starts to give in, the injection must be stopped and the packer expanded more. Pay attention so that the Max Expansion pressure for packer and current diameter is not exceeded.

Calculation formula for Expansion pressure:

T = (V1 + V2 + V3) x 1.3 where **T =** Total expansion pressure that packer needs to be inflated with.

- **V1 =** Pressure required to inflate packer to desired diameter (specified as ***"Inflation Pressure vs. outer diameter"*** in Technical Specification)
- **V2** = Hydrostatic pressure in the borehole
- **V3** = Working pressure to be used for grouting or water loss measurement
- **T** = Total expansion pressure in packer.

NOTE: The total expansion pressure must not exceed the maximum permitted expansion pressure for the packer at the planned working diameter!

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