

TECHNICAL INFORMATION

Cement Grouting Procedures

WATER PRESSURE TESTING

Water pressure testing (LUGEON testing) includes investigative procedures which are performed for various stages of each grout hole prior to grouting. Appropriate grout formulations can be selected for specific stages to be grouted depending on the water pressure test results.

The following items are used to perform water pressure tests:

- water flow meter, usually calibrated in litres and m³
- pressure gauge with appropriate testing pressure range
- flow control valves, usually diaphragm type
- connection hoses
- non-pulsating water supply
- inflatable borehole packers, if required

MULTIURETHANES offers for sale or rental a range of water flow meters, complete with pressure gauges and water flow control valves. Call our technical specialists for further information about our flow meters for water pressure testing.

The results of water pressure testing are based on analysis of the following data:

- borehole length or interval being tested
- steady-state water flow rate into the interval being tested
- dynamic water pressure at which testing is performed
- static water pressure prior to conducting water test

Since the collection and calculation of water pressure test data are somewhat dependent upon site conditions and requirements, contact the technical specialists at **MULTIURETHANES** for specific advice relevant to various situations.

Typical water pressure test results allow Lugeon values to be calculated for each of the the test intervals. The following guidelines indicate how Lugeon values may be used to direct site grouting activities and the selection of various grouting materials:

<u>Value</u>	<u>Permeability</u>	<u>Criterion or Grouting Material</u>
1	1.3 x 10 ⁻⁷ m/s	Lower target permeability value
2	2.6 x 10 ⁻⁷ m/s	Upper target permeability value
4	5.2 x 10 ⁻⁷ m/s	Microfine cement grout
8	1.0 x 10 ⁻⁶ m/s	Microfine cement grout
15	2.0 x 10 ⁻⁶ m/s	Microfine cement grout
30	3.9 x 10 ⁻⁶ m/s	Cement grout with stabilizing additives
60	7.8 x 10 ⁻⁶ m/s	Cement grout with stabilizing additives
120	1.6 x 10 ⁻⁵ m/s	Cement grout with thixotropic additives



Grouting crew installing an inflatable packer prior to conducting water pressure test from within an inspection gallery located in the base of a large hydro power dam

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GROUT MONITORING EQUIPMENT

Electronic flow measuring and pressure recording equipment, in conjunction with X-Y strip-chart recorders, are recommended for all major grouting projects. The availability of instantaneous grouting data and indications of dynamic trends are useful in achieving optimum results.

MULTIURETHANES offers for sale or rental a range of electronic water flow meters, pressure transducers and strip chart recorders for grouting applications. Call our technical specialists for further information about our electronic grout monitoring equipment.

MULTIPLE HOLE GROUTING

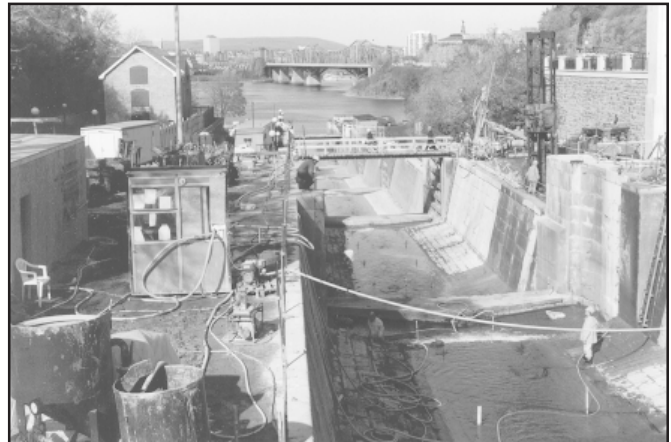
Multiple hole grouting techniques can improve grouting productivity when substrate conditions restrict grout flow rates. Improved grouting performance may also result by increasing the connection time to each grout hole.

Many grouting projects have benefited by following the recommendations of **MULTIURETHANES** and implementing the simultaneous grouting of up to six holes at the same time. Call our technical specialists for advice regarding the application of multiple hole grouting on your grouting operations.

REFUSAL TECHNIQUES

The application of long duration refusal techniques is recommended (i.e. maintaining zero flow at maximum grouting pressure) at the conclusion of each grouting operation. Improved grouting results will be achieved when grouting materials has been allowed sufficient time to undergo the pressure filtration phenomenon prior to being disconnected from the grout delivery hoses.

Call our technical specialists for specific advice regarding the application of proper refusal techniques for your grouting applications.



Grouting crew working on rehabilitation of historical masonry lock structures using ordinary and microfine cement grouts; colloidal grout plant in left foreground; grout monitoring equipment located in adjacent grout inspector's kiosk



In a shaft sinking project that encountered fractured ground at a depth of over 200 m, microfine cement grout was pre-mixed and delivered to a grout pump located at the shaft bottom; a special grout manifold was fabricated that allowed up to six holes to be grouted concurrently until grout flow reached zero flow at maximum specified grouting pressure.

WATER CUT-OFF ● SEWER REHABILITATION ● CONCRETE RESTORATION ● CRACK INJECTION ● WATERPROOFING