

## **Water Ratio Testing Results**

The data that is presented in the following pages illustrates clearly the importance of mixing Grancrete accurately. Water plays a key role in making sure that the reaction goes to completion. As you will see from the data, too little water is as detrimental as too much. The range of mixing accuracy to insure the best results are just a few percentage points. This data reinforces the sensitivity of the various products to minimal changes in the amounts of water used in the mixing process. The other key component in making Grancrete is the actual mixing of the material with the water. We have found that thorough and high sheer mixing will give you the best results. For small batches (bucket size), we recommend the use of cold water which will allow for longer mixing time (2 to 3 minutes) and still enough time to work with the final product. Also, a high speed mixer (drill) with the correct size paddle should be used.

If you have any questions, please contact Jeff, Jim Paul or myself to review the data with you.

## Grancrete A Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete A

Water Ratio (by Weight)*	Water Weight added To 50 lb bag of Grancrete A	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 13%	6.5	8100	24	Very thick, not workable	7.3
@ 14%	7.0	8140	68	Very workable	7.8
@ 15%	7.5	8380	84	Very workable	8.0
@ 16%	8.0	8540	108	Workable	9.0
@ 17%	8.5	8690	140	More fluid	9.0
@ 18%	9.0	8420	>160	Very fluid	9.0
@ 19%	9.5	8430	>160	Very fluid	9.0
@ 20%	10.0	8420	>160	Very fluid	9.3
@ 24%	10.5	4500	>160	Very fluid	9.8
@ 28%	11.0	3270	>160	Very fluid	9.8

\*Water weight = X% of dry weight of materials

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete A had optimal results at 15% and 16%. This provided the best material consistency combined with compressive strength as can be seen in **BLUE**. Notice (**RED**) the difference 3% less water for a total of 13% makes in the overall performance of the material not workable. Notice (**GOLD**) the difference 2% additional water for a total of 18% makes the mix too fluid.

**Grancrete recommends that 15% or 16% be used for applications in order to achieve maximum performance from the material.**

## Grancrete B Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete B

Water Ratio* (by Weight)	Water Weight added To 50 lb bag of Grancrete B	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 14%	7.0	8370	16	Very thick, not workable	9.3
@ 15%	7.5	11310	72	Workable	9.3
@ 16%	8.0	12590	84	Very workable	9.3
@ 17%	8.5	11390	102	Workable	9.3
@ 18%	9.0	11230	106	Workable	9.3
@ 19%	9.5	10040	111	Workable	9.5
@ 20%	10.0	9600	130	More fluid	10.0
@ 21%	10.5	8340	148	Very fluid	11.3
@ 22%	11.0	6410	>160	Very fluid	12.0
@ 28%	14.0	3270	>160	Very fluid	9.8

\*Water weight = X% of dry weight of material

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete B had optimal results at 16%. This provided the best material consistency combined with compressive strength as can be seen in **BLUE**. Notice (**RED**) the difference 2% less water for a total of 14% makes in the overall performance of the material in both strength, which is reduced by almost a third, and workability, which dropped to unworkable. Notice (**GOLD**) the difference 6% additional water for a total of 22% makes in the overall performance of the material is half the strength and too fluid.

**Grancrete recommends that 16% be used for applications in order to achieve maximum performance from the material.**

## Grancrete B + Sand Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete B + Sand

Water Ratio* (by Weight)	Water Weight added to 50 lb bag of Grancrete B + Sand	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 10%	5.0	5640	<10	Too thick, not workable	8.8
@ 11%	5.5	10730	42	Thick, workable	8.8
@ 12%	6.0	9360	68	Workable	9.5
@ 13%	6.5	8040	88	Workable	9.5
@ 14%	7.0	6920	108	Workable	9.5
@ 15%	7.5	6290	128	Workable	9.3
@ 16%	8.0	4970	148	More fluid	10.3
@ 17%	8.5	3950	>160	Very fluid	12.0
@ 18%	9.0	3160	>160	Very fluid	13.3

\*Water weight = X% of dry weight of materials

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete B + Sand had optimal results at 12% and 13%. This provided the best material consistency combined with compressive strength as can be seen in **BLUE**. Notice (**RED**) the difference 1% less water for a total of 10% makes in the overall performance of the material, the strength has decreased significantly and it is not workable. Notice (**GOLD**) the difference 4% additional water for a total of 17% drops the strength by approximately 50% and creates a mix that is too fluid. **Grancrete recommends that 12% or 13% be used for applications in order to achieve maximum performance from the material in both strength and workability.**

## Grancrete HFR Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete HFR

Water Ratio* (by Weight)	Water Weight added To 50 lb bag of Grancrete HFR	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 17%	8.5	9868	21	Thick, not workable	8.3
@ 18%	9.0	8925	88	Workable	8.5
@ 19%	9.5	8852	88	Workable	8.8
@ 20%	10.0	8575	101	Workable	9.0
@ 21%	10.5	6328	124	Workable	9.0
@ 22%	11.0	4797	119	Workable	9.4
@ 25%	12.5	4444	150	Very fluid	10.7
@ 28%	14.0	3357	>160	Very fluid	10.5
@ 30%	15.0	2766	>160	Very fluid	11.0
@33%	16.5	1381	>160	Very fluid	11.0
@35%	17.5	1107	>160	Very fluid	11.6

\*Water weight = X% of dry weight of material

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete HFR had optimal results from 18% to 20%. This ratio provides the best material consistency combined with compressive strength as can be seen in **BLUE**. Notice (**RED**) the difference 1% less water, for a total of 17%, makes in the performance of the material in terms of being unworkable. Notice (**GOLD**) the difference 4% additional water for a total of 22% makes in the performance of the materials strength, being reduced by almost half. **Grancrete recommends that 18% to 20% be used for applications in order to achieve maximum performance from the material.**

## Grancrete PCW Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete PCW

Water Ratio* (by Weight)	Water Weight added To 50 lb bag of Grancrete PCW	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 17%	8.5	10,270	<10	Thick, not workable	7.5
@ 18%	9.0	10,670	<10	Workable	7.8
@ 19%	9.5	11,550	76	Workable	7.8
@ 20%	10.0	10,580	80	Workable	8.0
@ 21%	10.5	9890	91	Workable	7.0
@ 22%	11.0	9310	99	Workable	7.5
@ 24%	12.0	8410	128	Very fluid	8.3
@ 26%	13.0	7730	152	Very fluid	8.5
@ 28%	14.0	6190	>160	Very fluid	9.3
@30%	15.0	5210	>160	Very fluid	10.3

\*Water weight = X% of dry weight of material

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete PCW had optimal results from 19% to 20%. This provided the best material consistency combined with compressive strength as can be seen in BLUE. Notice (RED) the difference of 2% less water for a total of 17% causes the material to be unworkable. Notice (GOLD) the difference 2% additional water for a total of 22% results in the reduced overall strength of the material. **Grancrete recommends that 19% or 20% be used for applications in order to achieve maximum performance from the material.**

## Grancrete PCW + Sand (2:1) Mixing Strategy

### Mixing Ratios, Strength & Workability for Grancrete PCW

Water Ratio* (by Weight)	Water Weight added To 50 lb bag of Grancrete PCW + Sand	3 Day Compression Strength (ASTM C109)	% Flowability (ASTM C1437)	Material Consistency	Set Time By Touch (min)
@ 17%	8.5	2570	<10	Thick, not workable	10.0
@ 18%	9.0	6470	<10	Thick, not workable	9.8
@ 19%	9.5	11960	44	Thick, workable	9.5
@ 20%	10.0	11230	82	Workable	9.0
@ 21%	10.5	9180	88	Workable	9.0
@ 22%	11.0	8770	100	Workable	9.5
@ 24%	12.0	8720	116	Workable	9.8
@ 26%	13.0	8000	120	Workable	10.0
@ 28%	14.0	7508	148	Fluid, workable	10.3
@30%	15.0	7230	>160	Very fluid	9.8

\*Water weight = X% of dry weight of materials

Flowability – Optimal workable range between 60% and 120%, most optimal @ 100%

Grancrete PCW + Sand had optimal results at 20%. This provided the best material consistency combined with compressive strength as can be seen in **BLUE**. Notice (**RED**) the difference of 2% less water for a total of 18% surprisingly reduces the strength by almost half and makes the mix unworkable. Notice (**GOLD**) the difference 2% additional water for a total of 22% reduces the overall strength of the material significantly. **Grancrete recommends that 20% be used for applications in order to achieve maximum performance from the material in both strength and workability.**