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IDENTITY CARD FOR DUCTAL® WHITE ULTRA-HIGH PERFORMANCE FIBER-REINFORCED CONCRETE (UHPC) (MIX NO. BFUP 5510-1 1075), MIXED WITH THE SPECIALIZED EQUIPMENT (PAN MIXER) OF BMQ MEMBER OF LAFARGE CANADA INC. (BMQ) OR APPROPRIATE EQUIPMENT SELECTED BY THE CUSTOMER DEMONSTRATING THE ABILITY TO MEET DUCTAL® WHITE PERFORMANCE CRITERIA

DOCUMENT MEETING THE REQUIREMENTS OF CSA A23.1:19 and CSA S6:19 STANDARDS

Created: October 2024

PAN OR PLANETARY MIXER



## 4. Ductal® Contact Information

| Manufacturer | Address                                                             | Contact Information                                                 |
|--------------|---------------------------------------------------------------------|---------------------------------------------------------------------|
| Ductal®      | 1522 Boulevard des Laurentides,<br>Laval, Québec, Canada<br>H7M 2N7 | Philip Sawoszczuk, P. Eng, M. Eng.<br>philip.sawoszczuk@lafarge.com |

## 5. Ductal® White UHPC Characteristics

Table 1 groups the characteristics of UHPC Ductal® White :

Table 1 – Characteristics of UHPC Ductal® White - Mix no. BFUP 5510-1 1075

| Characteristics of UHPC             | Description                    |
|-------------------------------------|--------------------------------|
| Binder Base                         | Portland Cement*               |
| Supplementary Cementitious Material | Trade Secret                   |
| Maximum Aggregate Size              | < 2.5 mm                       |
| Water/Binder Ratio                  | < 0.25                         |
| PVA Fiber Dosage                    | 39 kg/m <sup>3</sup>           |
| Volume of PVA Fiber                 | 3%                             |
| PVA Fiber Geometry                  | 0.2 mm Diameter x 12 mm Length |
| Tensile Strength of PVA Fibers      | > 900 MPa                      |

\* Portland cement meeting the requirements of the CSA A3000 standard

Table 5 - Mechanical Properties of UHPC Ductal® White , Mix No. BFUP 5510-1 1075, as Specified in Section U.4.2.2.2 of Annex U of CSA A23.1:19 - No thermal treatment

|                                               |     |     |
|-----------------------------------------------|-----|-----|
| Nominal Compressive Strength (MPa) at 28 Days | fc' | 120 |
|-----------------------------------------------|-----|-----|

| Mechanical Properties                                                                                                          | Symbol | Calculated Values |                      |                    |
|--------------------------------------------------------------------------------------------------------------------------------|--------|-------------------|----------------------|--------------------|
|                                                                                                                                |        | Average           | Characteristic Value | Standard Deviation |
| Compressive Strength (MPa) at 4 Days                                                                                           | fc'    | 96.66             | 96.27                | 0.28               |
| Compressive Strength (MPa) at 28 Days, TN28                                                                                    | fc'    | 121.62            | 117.60               | 2.87               |
| Limit of Elasticity in Bending*                                                                                                | fct,fl | 8.5               | 0.5                  | 7.5                |
| Limit of Elasticity in Tension**                                                                                               | fct,el | 5.3               | -                    | 4.7                |
| Static Modulus of Elasticity***                                                                                                | Ecm    | 45                |                      |                    |
| *Per ASTM C1609 w/ C1856 modifications.<br>**Estimated using Eq. D.2 in NF P 18-470<br>***Per ASTM C469 w/ C1856 modifications |        |                   |                      |                    |

Table 6 - Ductal® White UHPC Durability Parameters, Mixture No. BFUP 5510-1 1075, as Specified in Section U.4.1.8 of Annex U of CSA A23.1:19

| Durability Parameter                                   | Average Value       |
|--------------------------------------------------------|---------------------|
| Absorption (%)*                                        | 1.2% (28 days)      |
| Chloride Ion Penetration (coulombs), at 56 Days (TN56) | 85 (without fibers) |
| Abrasion Resistance (kg/m <sup>2</sup> )               | N/A                 |

\* Per CSA A23.2-11C *Standard Test Method for Water Content, Density, Absorption, and Voids in Hardened Concrete, Grout, or Mortar*

Table 7 - Other properties of UHPC Ductal® White , mixture no. BFUP 5510-1 1075

| Other Properties                                         | Average Value          |
|----------------------------------------------------------|------------------------|
| Shrinkage (%)*                                           | -0.006 (1 day)         |
|                                                          | -0.010 (7 days)        |
|                                                          | -0.016(14 days)        |
|                                                          | -0.017 (21 days)       |
|                                                          | -0.019 (28 days)       |
|                                                          | -0.020 (35 days) TN 35 |
|                                                          | -0.024 (56 days)       |
| Freeze-Thaw Cycle Resistance** TN28                      | Pending Results        |
| Water-Soluble Chloride Ion Content (% Mass of Cement)*** | 0.001% (28 Days)       |

\*As per ASTM C157 *Standard Test Method for Length Change Of Hardened Cement Mortar And Concrete*

\*\*As per ASTM C666 (including modifications from ASTM C1856, 300 cycles) *Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing*

\*\*\*As per CSA A23.2-4B *Sampling and Determination of Water Soluble Chloride Ion Content in Hardened Grout or Concrete*

## 9. References

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- I. CSA A23.1:19 Concrete Materials and Methods of Concrete Construction (2019)
- II. CSA S6:19 Canadian Highway Bridge Code Design (2019)
- III. ASTM C1856 Standard Practice for Fabricating and Testing Specimens of Ultra-High Performance Concrete

## 6. Components/Weights for a Batch of 505 liters (approx.) UHPC Ductal® White, Mix No. BFUP 5510-1 1075

Table 2 lists the quantities used to make a batch of 0.505 m<sup>3</sup> (approx.) of Ductal® White UHPC, mix no. BFUP 5510-1 1075, in a high shear mixer (pan mixer) designed and supplied by BMQ or equivalent equipment provided by the Customer demonstrating the ability to meet Ductal® White UHPC performance criteria.

Table 2 – Components/Weights for a Batch of 505 liters (approx.)

| Description of Components   | Dosages (kg/m <sup>3</sup> ) | Weight per Batch (kg) |
|-----------------------------|------------------------------|-----------------------|
| Ductal® White Dry Premix    | 2125                         | 1,075.00              |
| Ductal® PVA Fibers          | 39                           | 19.70                 |
| Ductal® F4 Liquid Admixture | 23<br>(max. 36)              | 11.5<br>(max. 18.2)   |
| Potable Water and/or Ice    | 180<br>(max.190)             | 91.1<br>(max.96.1)    |

The dosages have been tested and validated with BMQ equipment under fixed ambient conditions, i.e. at a temperature of 23° C and a relative humidity of 50%. All other ambient conditions or Customer mixing equipment or a combination thereof may require a slight adjustment in water or admixture.

The ambient conditions on a construction or fabrication site can influence the plastic behavior of the material as well as the gain in compressive strength. Only a Ductal® representative on site can make any modification(s) to the quantities mentioned above in order to meet the targeted performance.