

# Government of Nunavut

## Operation and Maintenance Manual

### Volume II

**Type of Document:**

Draft

**Project Name:**

Arctic Bay Waste Water Facility

**Project Number:**

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**Date Submitted:**

04/10/11

# Table of Contents

## Manufacturing Data and Service Information

|            |   |                                           |
|------------|---|-------------------------------------------|
| Appendix A | - | Technical Specifications Pump             |
| Appendix B | - | Technical Specifications Truck Discharge  |
| Appendix C | - | Technical Specifications HDPE Pipe        |
| Appendix D | - | Technical Specifications Gabion           |
| Appendix E | - | Technical Specifications Bentofix Liner   |
| Appendix F | - | Technical Specifications Thermistors      |
| Appendix G | - | Technical Specifications Facility Sign    |
| Appendix H | - | Technical Specifications Monitoring Wells |
| Appendix I | - | Technical Specifications Nested Pipe      |
| Appendix J | - | Technical Specifications Geotextile       |

## **Appendix A - Technical Specifications Pump**

ACDEU



# Diesel Engine Driven Priming Assisted Centrifugal Pump w/Autostart Model PA6C60-4045D Size 6" x 6"



| Total Head   |      | Capacity of Pump in U.S. Gallons per Minute (GPM) at Continuous Performance |      |      |      |      |
|--------------|------|-----------------------------------------------------------------------------|------|------|------|------|
| P.S.I.       | Feet |                                                                             |      |      |      |      |
| 63.3         | 146  | 200                                                                         | 200  | 200  | 200  | 200  |
| 60.7         | 140  | 400                                                                         | 400  | 400  | 400  | 400  |
| 52.0         | 120  | 820                                                                         | 1000 | 1000 | 1000 | 1000 |
| 43.4         | 100  | 960                                                                         | 1380 | 1420 | 1420 | 1420 |
| 34.7         | 80   | 1040                                                                        | 1500 | 1770 | 1770 | 1770 |
| 26.0         | 60   | 1100                                                                        | 1510 | 1815 | 2050 | 2050 |
| 17.4         | 40   | 1140                                                                        | 1505 | 1820 | 2120 | 2250 |
| 8.7          | 20   | 1200                                                                        | 1550 | 1820 | 2150 | 2360 |
| Suction Lift |      | 25'                                                                         | 20'  | 15'  | 10'  | 5'   |

## PUMP SPECIFICATIONS

**Size:** 6" x 6" (152 mm x 152 mm) Flanged.

**Casing:** Ductile Iron No. 65-45-12. Maximum Operating Pressure 100 psi (690 kPa).\*

**Open Type, Two Vane Impeller:** Ductile Iron No. 65-45-12.

Handles 3" (76.2 mm) Diameter Spherical Solids.

**Impeller Shaft:** Stainless Steel No. 17-4 PH.

**Replaceable Wear Plate:** Ductile Iron No. 80-60-03.

**Removeable Cleanout Cover Plate:** Gray Iron No. 30.

**Intermediate Bracket:** Gray Iron No. 30.

**Seal Plate:** Gray Iron No. 30.

**Seal:** Mechanical, Oil-Lubricated. Silicon Carbide Rotating and Stationary Faces. Stainless Steel No. 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel No. 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).\*

**Shaft Sleeve:** Stainless Steel No. 17-4 PH.

**Priming Chamber:** Gray Iron No. 30.

**Discharge Check Valve:** Gray Iron No. 30 Housing w/Buna-N Flapper.

**Radial and Thrust Bearings:** Open Double Ball.

**Bearing and Seal Cavity Lubrication:** SAE No. 30 Non-Detergent Oil.

**Flanges:** Gray Iron No. 30.

**Gaskets:** Resistant Synthetic Rubber, Cork, PTFE, Vegetable Fiber, and Compressed Synthetic Fibers.

**Hardware:** Standard Plated Steel.

**Bearing and Seal Cavity Oil Level Sight Gauges.**

*\*Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

**Standard Equipment:** Gear-Driven Air Compressor. Hoisting Bail. Combination Skid Base w/Fuel Tank. Strainer. Single Ball Type Float Switch.\*\*

**\*\*50 Ft. (15 m) Standard Length; Dual Switches and Alternate Cable Lengths Available From the Factory.**

**Optional Equipment:** Battery. High Speed (55 MPH/89 KM/H) Wheel Kit with ST225/75R15 Pneumatic Tires. Over-the-Road Trailer (Meets D.O.T. and Transport Canada Requirements) Available w/Either Electric or Hydraulic Surge Brakes, Running Lights, Two Trailer Jack Stands and Safety Chains. EPS w/Submersible Transducer Liquid Level Sensor (50 Ft. [15 M] Cable Standard, Alternate Lengths Available).



SHOWN WITH OPTIONAL NPT  
SUCTION AND DISCHARGE FLANGES



## ENGINE SPECIFICATIONS

**Model:** John Deere 4045D "Power Tech".

**Type:** Four Cylinder, Four Cycle, Liquid Cooled Diesel Engine.

**Displacement:** 276 Cu. In. (4,5 liters).

**Governor:** Mechanical.

**Lubrication:** Forced Circulation.

**Air Cleaner:** Dry Type.

**Oil Reservoir:** 9 U.S. Qts. (8,5 liters) Dry;  
8 U.S. Qts. (7,6 liters) Refill.

**Fuel Tank:** 88 U.S. Gals. (330 liters).

**Full Load Operating Time:** 26.1 Hrs.

**Starter:** 12V Electric.

**Standard Features:** Low Oil Pressure, High Coolant Temperature and Start Failure Safety Shut Down Switches/Indicators. Throttle Control. Autostart Instrument Panel Includes: Tachometer, Voltmeter, Hourmeter, Coolant Temperature and Oil Pressure Indicators, Manual/Stop/Auto Key Switch, 10 Amp Fuse, Audible Startup Warning Delay. Muffler w/Guard and Weather Cap.

## JOHN DEERE PUBLISHED PERFORMANCE:

Maximum Continuous BHP 76 (57 kW) @ 2500 RPM  
Maximum Dynamic BHP 80 (60 kW) @ 2500 RPM



THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

www.grpumps.com

Specifications Subject to Change Without Notice

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## Specification Data

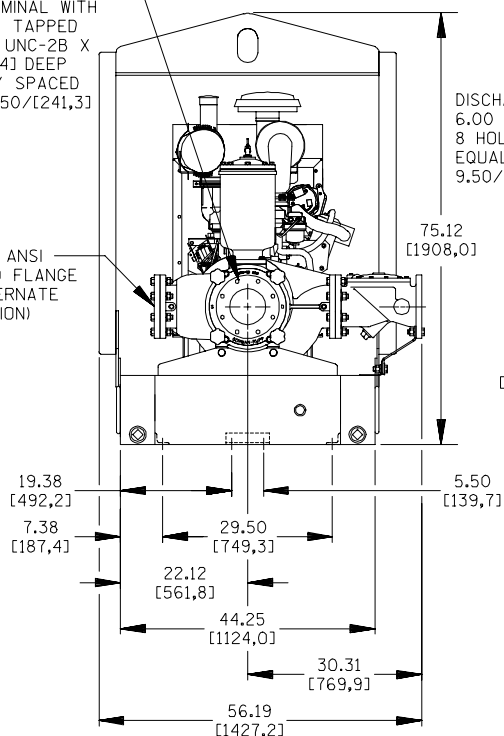
SECTION 42, PAGE 1100

APPROXIMATE  
DIMENSIONS and WEIGHTS

|                    | SKID BASE              | 2-WHEEL              |
|--------------------|------------------------|----------------------|
| NET WEIGHT:        | 3310 LBS. (1501 KG.)   | 3600 LBS. (1633 KG.) |
| SHIPPING WEIGHT:   | 3460 LBS. (1569 KG.)   | 3600 LBS. (1633 KG.) |
| EXPORT CRATE SIZE: | 247 CU. FT. (7 CU. M.) |                      |

SUCTION:  
6.00 NOMINAL WITH  
8 HOLES TAPPED  
.750-10 UNC-2B X  
.88/[22,4] DEEP  
EQUALLY SPACED  
ON A 9.50/[241,3]  
DIA. B.C.

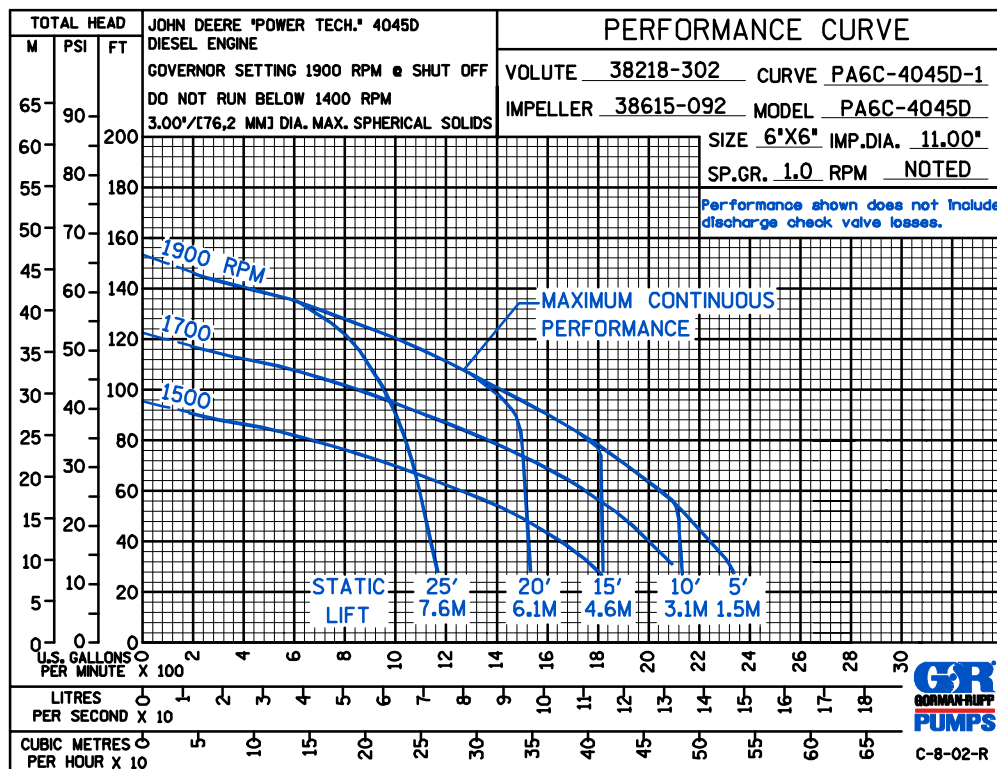
6.00 ANSI  
BLIND FLANGE  
(ALTERNATE  
SUCTION)



POWERED BY: JOHN DEERE 4045D DIESEL ENGINE.

DISCHARGE:  
6.00 NOMINAL WITH  
8 HOLES .88/[22,4] DIA.  
EQUALLY SPACED ON A  
9.50/[241,3] DIA. B.C.

DIMENSIONS:  
INCHES  
[MILLIMETERS]



THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

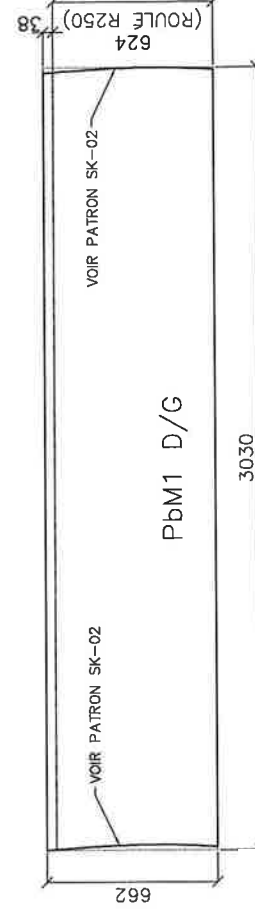
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## **Appendix B - Technical Specifications Truck Discharge**



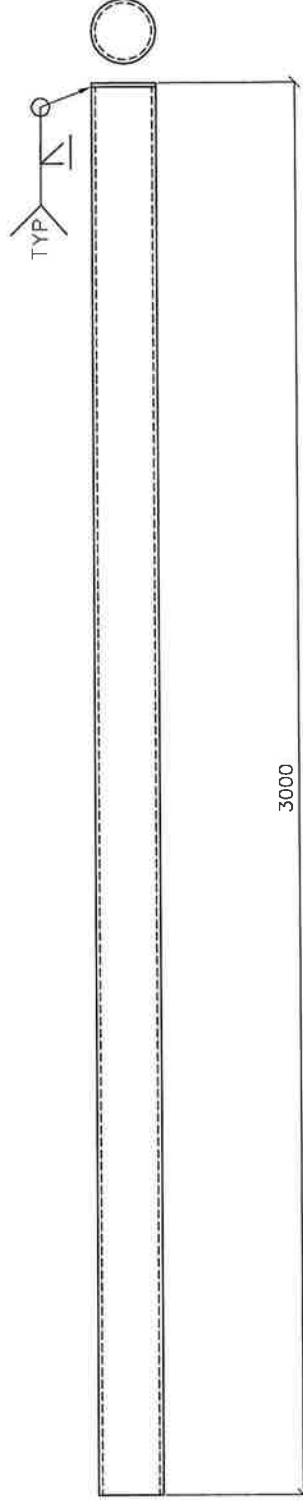


DESSIN #M1

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M3-12

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## **Appendix C - Technical Specifications HDPE Pipe**

For more information and technical assistance contact:

Performance Pipe, a division of  
Chevron Phillips Chemical Company LP  
P.O. Box 269006  
Plano, TX 75026-9006  
800.527.0662



## DriscoPlex® PE3608 / (PE3408) Pipe Pipe and Fittings Data Sheet

### Typical Material Physical Properties of DriscoPlex® PE3608 / (PE3408)

High Density Polyethylene Materials

| Property                                                       | Unit                  | Test Procedure       | Typical Value                              |
|----------------------------------------------------------------|-----------------------|----------------------|--------------------------------------------|
| Material Designation                                           | ---                   | PPI TR-4             | PE3608                                     |
| Cell Classification                                            | ---                   | ASTM D3350           | 345464C                                    |
| <b>Pipe Properties</b>                                         |                       |                      |                                            |
| Density                                                        | gms / cm <sup>3</sup> | ASTM D1505           | 0.955 (black)                              |
| Melt Index<br>Condition 190 / 2.16                             | gms / 10<br>minutes   | ASTM D1238           | 0.08                                       |
| Hydrostatic Design Basis<br>73°F (23°C)                        | psi                   | ASTM D2837           | 1600                                       |
| Hydrostatic Design Basis<br>140°F (60°C)                       | psi                   | ASTM D2837           | 800                                        |
| Color: UV Stabilizer [C]<br>[E]                                | ---                   | ASTM D3350           | Min 2% carbon Black<br>Color UV Stabilizer |
| <b>Material Properties</b>                                     |                       |                      |                                            |
| Flexural Modulus<br>2% Secant - 16:1 span; depth, 0.5 in / min | psi                   | ASTM D790            | >110,000                                   |
| Tensile Strength at Yield                                      | psi                   | ASTM D638<br>Type IV | 3200                                       |
| Elongation at Break<br>2 in / min., Type IV bar                | %                     | ASTM D638            | >700                                       |
| Elastic Modulus                                                | psi                   | ASTM D638            | >150,000                                   |
| Hardness                                                       | Shore D               | ASTM D2240           | 62                                         |
| PENT                                                           | hrs                   | ASTM F1473           | >100                                       |
| <b>Thermal Properties</b>                                      |                       |                      |                                            |
| Vicat Softening Temperature                                    | °F                    | ASTM D1525           | 256                                        |
| Brittleness Temperature                                        | °F                    | ASTM D746            | -103                                       |
| Thermal Expansion                                              | in / in / °F          | ASTM D696            | 1.0 x 10 <sup>-4</sup>                     |

Bulletin: PP 109

Revision Date September, 2006

Another quality product from



Before using the piping product, the user is advised and cautioned to make its own determination and assessment of the safety and suitability of the piping product for the specific use in question and is further advised against relying on the information contained herein as it may relate to any specific use or application. It is the ultimate responsibility of the user to ensure that the piping product is suited and the information is applicable to the user's specific application. This data sheet provides typical physical property information for polyethylene resins used to manufacture the piping product. It is intended for comparing polyethylene piping resins. It is not a product specification, and it does not establish minimum or maximum values or manufacturing tolerances for resins or for the piping product. These typical physical property values were determined using compression-molded plaques prepared from resin. Values obtained from tests of specimens taken from the piping product can vary from these typical values. Performance Pipe does not make, and expressly disclaims, all warranties, of merchantability or fitness for a particular purpose, regardless of whether oral or written, express or implied, or allegedly arising from any usage of trade or from any course of dealing in connection with the use of information contained herein or the piping product itself. The user expressly assumes all risk and liability, whether based in contract, tort or otherwise, in connection with the use of the information contained herein or the piping product itself. Further, information contained herein is given without reference to any intellectual property issues, as well as federal, state, or local laws which may be encountered in the use thereof. Such questions should be investigated by the user.

For more information and technical assistance contact:

Performance Pipe, a division of  
Chevron Phillips Chemical Company LP  
P.O. Box 269006  
Plano, TX 75026-9006  
800.527.0662



## SUGGESTED INDUSTRIES AND APPLICATIONS

| <u>Potable Water Mains</u>       | <u>Horizontal Directional Drilling (HDD)</u> | <u>Marine Service</u> |
|----------------------------------|----------------------------------------------|-----------------------|
| <u>Sliplining</u>                | <u>Water transmission Lines</u>              | <u>Pipe Bursting</u>  |
| <u>Industrial Water Mains</u>    | <u>Ash, Tailings &amp; Abrasives</u>         | <u>Mining</u>         |
| <u>Municipal Water Utilities</u> | <u>Open-cut and Bury</u>                     | <u>Culverts</u>       |
| <u>Rural Water Distribution</u>  | <u>River Crossings</u>                       | <u>Plow-in</u>        |
| <u>Mun. &amp; Ind. Sewer</u>     | <u>Trenchless Technologies</u>               | <u>Crude oil</u>      |
| <u>Fire Main Piping</u>          | <u>Rural Water Distribution</u>              | <u>Plow-in</u>        |

## Butt Fusion Conditions

- 60-90 psig (4.14-6.21 bar) interfacial fusion pressure.
- 400-450° (204-232°C) heater surface temperature range.
- Please refer to Performance Pipe's PE3608 (PE3408) fusion procedure, Bulletin PP 750.

## Available Sizes

- ¾" through 54" IPS
- 4" through 36" DIPS

## Specification Data

The resin, pipe and fitting listed may comply with one or more of the standards below.

| <u>Applicable Standards</u>          | <u>DriscoPlex® Pipe Series</u>                    | <u>PE3608<br/>(PE3408)</u> | <u>PE4710<br/>(d<sub>f</sub>)</u> |
|--------------------------------------|---------------------------------------------------|----------------------------|-----------------------------------|
| <u>ASTM F714, NSF 61, ASTM D3035</u> | 4000, 4100, 4200, 4300, 4400,<br>4500, 4600, 4700 | 0.5                        | 0.63                              |
| <u>AWWA C906, AWWA C901</u>          | 4000, 4100, 4200, 4300, 4400,<br>4500, 4600, 4700 | 0.5                        | 0.63                              |
| <u>FMA, AWWA, F714</u>               | 1500, 1600                                        | 0.5                        | ---                               |
| <u>API 15LE, ASTM D2513</u>          |                                                   |                            | 0.63                              |

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|  |      |     |  |
|--|------|-----|--|
|  | 6400 | 0.5 |  |
|--|------|-----|--|

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Revised 03-17-2008

## PE3608 (PE3408)

## IPS Size and Dimension Data

### DriscoPlex<sup>®</sup> Municipal & Industrial & Energy Series/IPS Pipe Data

Pressure Ratings are calculated using 0.50 design factor for HDS at 73°F as listed in PPI TR-4 for PE 3608 materials.

Temperature, Chemical, and Environmental use considerations may require use of additional design factors.

| Pressure Rating |                 | 100 psi<br>DR 17.0 |                 |                 | 80 psi<br>DR 21.0 |                 |                 | 65 psi<br>DR 26.0 |                 |                 | 50 psi<br>DR 32.5 |                 |                 |
|-----------------|-----------------|--------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------------|-----------------|-----------------|
| IPS Pipe Size   | Nominal OD (in) | Minimum Wall (in)  | Average ID (in) | Weight (lbs/ft) | Minimum Wall (in) | Average ID (in) | Weight (lbs/ft) | Minimum Wall (in) | Average ID (in) | Weight (lbs/ft) | Minimum Wall (in) | Average ID (in) | Weight (lbs/ft) |
| 1 1/4"          | 1.660           |                    |                 |                 |                   |                 |                 |                   |                 |                 |                   |                 |                 |
| 1 1/2"          | 1.900           |                    |                 |                 |                   |                 |                 |                   |                 |                 |                   |                 |                 |
| 2"              | 2.375           | 0.140              | 2.078           | 0.43            |                   |                 |                 |                   |                 |                 |                   |                 |                 |
| 3"              | 3.500           | 0.206              | 3.063           | 0.93            |                   |                 |                 |                   |                 |                 |                   |                 |                 |
| 4"              | 4.500           | 0.265              | 3.938           | 1.54            | 0.214             | 4.046           | 1.26            |                   |                 |                 |                   |                 |                 |
| 6"              | 6.625           | 0.390              | 5.798           | 3.34            | 0.315             | 5.957           | 2.74            | 0.255             | 6.084           | 2.23            | 0.204             | 6.193           | 1.80            |
| 8"              | 8.625           | 0.507              | 7.550           | 5.66            | 0.411             | 7.754           | 4.64            | 0.332             | 7.921           | 3.78            | 0.265             | 8.063           | 3.05            |
| 10"             | 10.750          | 0.632              | 9.410           | 8.79            | 0.512             | 9.665           | 7.20            | 0.413             | 9.874           | 5.88            | 0.331             | 10.048          | 4.74            |
| 12"             | 12.750          | 0.750              | 11.160          | 12.36           | 0.607             | 11.463          | 10.13           | 0.490             | 11.711          | 8.27            | 0.392             | 11.919          | 6.67            |
| 14"             | 14.000          | 0.824              | 12.253          | 14.90           | 0.667             | 12.586          | 12.22           | 0.538             | 12.859          | 9.97            | 0.431             | 13.086          | 8.04            |
| 16"             | 16.000          | 0.941              | 14.005          | 19.47           | 0.762             | 14.385          | 15.96           | 0.615             | 14.696          | 13.02           | 0.492             | 14.957          | 10.51           |
| 18"             | 18.000          | 1.059              | 15.755          | 24.64           | 0.857             | 16.183          | 20.20           | 0.692             | 16.533          | 16.48           | 0.554             | 16.826          | 13.30           |
| 20"             | 20.000          | 1.176              | 17.507          | 30.42           | 0.952             | 17.982          | 24.94           | 0.769             | 18.370          | 20.35           | 0.615             | 18.696          | 16.42           |
| 22"             | 22.000          | 1.294              | 19.257          | 36.81           | 1.048             | 19.778          | 30.17           | 0.846             | 20.206          | 24.62           | 0.677             | 20.565          | 19.86           |
| 24"             | 24.000          | 1.412              | 21.007          | 43.80           | 1.143             | 21.577          | 35.91           | 0.923             | 22.043          | 29.30           | 0.738             | 22.435          | 23.64           |
| 26"             | 26.000          | 1.529              | 22.759          | 51.41           | 1.238             | 23.375          | 42.14           | 1.000             | 23.880          | 34.39           | 0.800             | 24.304          | 27.74           |
| 28"             | 28.000          | 1.647              | 24.508          | 59.62           | 1.333             | 25.174          | 48.87           | 1.077             | 25.717          | 39.88           | 0.862             | 26.173          | 32.17           |
| 30"             | 30.000          | 1.765              | 26.258          | 68.44           | 1.429             | 26.971          | 56.11           | 1.154             | 27.554          | 45.78           | 0.923             | 28.043          | 36.93           |
| 32"             | 32.000          | 1.882              | 28.010          | 77.87           | 1.524             | 28.769          | 63.84           | 1.231             | 29.390          | 52.09           | 0.985             | 29.912          | 42.02           |
| 34"             | 34.000          | 2.000              | 29.760          | 87.91           | 1.619             | 30.568          | 72.06           | 1.308             | 31.227          | 58.80           | 1.046             | 31.782          | 47.44           |
| 36"             | 36.000          | 2.118              | 31.510          | 98.55           | 1.714             | 32.366          | 80.79           | 1.385             | 33.064          | 65.92           | 1.108             | 33.651          | 53.19           |
| 42"             | 42.000          | 2.471              | 36.761          | 134.14          | 2.000             | 37.760          | 109.97          | 1.615             | 38.576          | 89.73           | 1.292             | 39.261          | 72.39           |
| 48"             | 48.000          | 2.824              | 42.013          | 175.21          | 2.286             | 43.154          | 143.63          | 1.846             | 44.086          | 117.19          | 1.477             | 44.869          | 94.55           |
| 54"             | 54.000          |                    |                 |                 | 2.571             | 48.549          | 181.78          | 2.077             | 49.597          | 148.32          | 1.662             | 50.477          | 119.67          |

Performance Pipe can produce to specialized pipe dimensions. Check with your Performance Pipe contact for availability of dimensions not listed.

Visit [www.performancepipe.com](http://www.performancepipe.com) for the most current literature.





## Elbow Design Information and End Options

The design basis for forge-molded elbows and fabricated segment elbows is well known. A 90 degree elbow is one-fourth of a torus (doughnut). The wedge removed from the straight pipe to make a miter-curve causes a force imbalance within the elbow. The ell tries to straighten out, sort of like a kink in a pressurized fire-hose. The ell must be derated or extra mass added to maintain the same pressure rating as the pipe itself. The heat-fusion welds are a focus point for the bending stress trying to straighten the ell. Continuous bend pipe without mitered fusion joints offer a higher pressure rating because there is no stress intensification factor (SIF) (i.e., no joints). Forge molded ells offer the same tight radius, no fusion joint flow turbulence, no miter joint stress intensification, and full pressure rating. Fabricated miter-ells have about the same radius of curvature, 4 turbulence amplifying fusion joints close together, and must be re-rated for WPR. The END OPTIONS for elbows include butt-end, flanged, and DIMJA.

ASME B31.3-1996 Edition

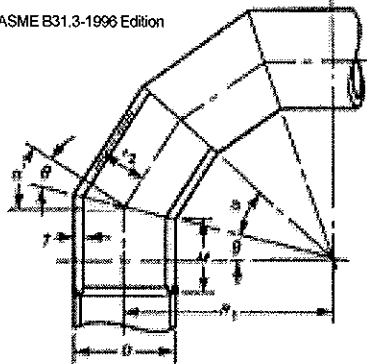


FIG. 304.23 NOMENCLATURE FOR MITER BENDS

The following nomenclature is used in the equations for pressure design of straight pipe.  
tm = minimum required thickness, including mechanical, corrosion, and erosion allowances

t = pressure design thickness, as calculated in accordance with para. 304.1.2 for internal pressure or as determined in accordance with para. 304.1.3 for external pressure

c = the sum of the mechanical allowances (thread or groove depth) plus corrosion and erosion allowance. For threaded components, the nominal thread depth (dimension h of ASME B1.20.1, or equivalent) shall apply. For machined surfaces or grooves where the tolerance is not specified, the tolerance shall be assumed to be 0.5 mm (0.02 in.) in addition to the specified depth of the cut.

T = pipe wall thickness (measured or minimum per purchase specification)

d = inside diameter of pipe. For pressure design calculation, the inside diameter of the pipe is the maximum value allowable under the purchase specification.

P = internal design gage pressure

D = outside diameter of pipe as listed in tables of standards or specifications or as measured

E = quality factor from Table A-1A or A-1B

S = stress value for material from Table A-1

Y = coefficient from Table 304.1.1, valid for  $t < D/6$  and for materials shown. The value of Y may be interpolated for intermediate temperatures. For  $t \geq D/6$ .

$$y = \frac{d + 2c}{D + d + 2c}$$

Multiple Miter Bends. The maximum allowable internal pressure shall be the lesser value calculated from Eqs. (4a) and (4b). These equations are not applicable when  $\theta$  exceeds 22.5 deg.

$$P_m = \frac{SE(T-c)}{r_2} \left( \frac{T-c}{(T-c) + 0.643 \tan \theta \sqrt{r_2(T-c)}} \right) \quad (4a)$$

$$P_m = \frac{SE(T-c)}{r_2} \left( \frac{R_1 - r_2}{R_1 - 0.5r_2} \right) \quad (4b)$$

(b) Single Miter Bends

(1) The maximum allowable internal pressure for a single miter bend with angle  $\alpha$  not greater than 22.5 deg. shall be calculated by Eq. (4a).

(2) The maximum allowable internal pressure for a single miter bend with angle  $\alpha$  greater than 22.5 deg. shall be calculated by Eq. (4c):

$$P_m = \frac{SE(T-c)}{r_2} \left( \frac{T-c}{(T-c) + 1.25 \tan \theta \sqrt{r_2(T-c)}} \right) \quad (4c)$$

c) The miter pipe wall thickness T used in Eqs. (4a), (4b), and (4c) shall extend a distance not less than M from the inside crotch of the end miter welds where

M = the larger of  $2.5(r_2 T)^{0.5}$  or  $\tan \theta (R_1 - r_2)$

The length of taper at the end of the miter pipe may be included in the distance M.

(d) The following nomenclature is used in Eqs. (4a), (4b), and (4c) for the pressure design of miter bends:

c = same as defined in para. 304.1.1

E = same as defined in para. 304.1.1

$P_m$  = maximum allowable internal pressure for miter bends

$r_2$  = mean radius of pipe using nominal wall T

$R_1$  = effective radius of miter bend, defined as the shortest distance from the pipe centerline to the intersection of the planes of adjacent miter joints

S = same as defined in para. 304.1.1

T = miter pipe wall thickness (measured or minimum per purchase specification)

$\theta$  = angle of miter cut

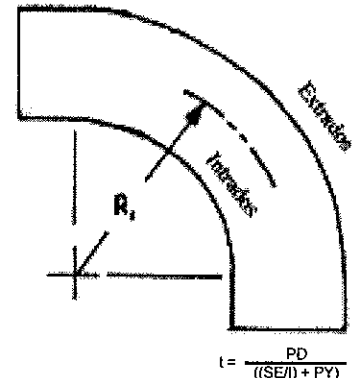
$\alpha$  = angle of change in direction at miter joint  
=  $2\theta$

For compliance with this Code, the value of  $R_1$  shall be not less than that given by Eq. (5):

$$R_1 = \frac{A}{\tan \theta} + \frac{D}{2} \quad (5)$$

where A has the following empirical values:  
for U.S. customary units:

$$\frac{(T-c), \text{ in.}}{\epsilon 0.5} \quad \frac{A}{1.0} \quad \frac{A}{2(T-c)} \quad \frac{A}{2(T-c)/3 + 1.17}$$



$$l = \frac{PD}{((SE/I) + PY)}$$

where at the intrados (inside bend radius)

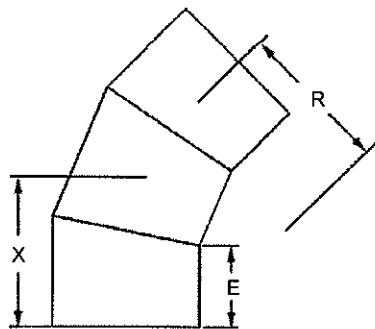
$$l = \frac{4(R/D) - 1}{4(R/D) - 2}$$

where at the extrados (outside bend radius)

$$l = \frac{4(R/D) - 1}{4(R/D) - 2}$$

and at the sidewall on the bend centerline radius,  
 $l = 1.0$ .

$R_1$  = centerline radius of bend or elbow



## IPS 45° 3 Segment Elbow Fabricated (1/8 Bend) (Dimensions in Inches)

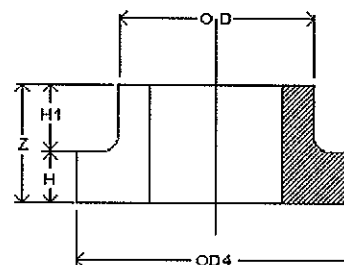
| IPS Size | R/D Ratio | R    | X    | E   | SDR   | WPR (psi) | Weight (lbs) |
|----------|-----------|------|------|-----|-------|-----------|--------------|
| 2"       | 5.4       | 12.7 | 6.6  | 4.0 | 7     | 200       | 1.5          |
|          |           |      |      |     | 9     | 160       | 1            |
|          |           |      |      |     | 11&17 | 128/80    | 1            |
| 3"       | 3.8       | 13.2 | 6.8  | 4.0 | 7     | 200       | 3            |
|          |           |      |      |     | 9     | 160       | 2            |
|          |           |      |      |     | 11&17 | 128/80    | 2            |
| 4"       | 3.0       | 13.7 | 7.0  | 4.0 | 7     | 200       | 6            |
|          |           |      |      |     | 9     | 160       | 5            |
|          |           |      |      |     | 11&17 | 128/80    | 4            |
| 6"       | 2.2       | 14.7 | 9.4  | 6.0 | 7     | 200       | 1            |
|          |           |      |      |     | 9     | 160       | 11           |
|          |           |      |      |     | 11&17 | 128/80    | 9            |
| 8"       | 1.8       | 16.0 | 10.3 | 6.5 | 7     | 200       | 24           |
|          |           |      |      |     | 9     | 160       | 19           |
|          |           |      |      |     | 11    | 128       | 16           |
|          |           |      |      |     | 17    | 80        | 12           |
| 10"      | 1.6       | 17.0 | 10.7 | 8.0 | 7     | 200       | 39           |
|          |           |      |      |     | 9     | 160       | 32           |
|          |           |      |      |     | 11    | 128       | 26           |
|          |           |      |      |     | 17    | 80        | 18           |
| 12"      | 1.5       | 19.1 | 12.8 | 8.0 | 7     | 200       | 62           |
|          |           |      |      |     | 9     | 160       | 51           |
|          |           |      |      |     | 11    | 128       | 43           |
|          |           |      |      |     | 17    | 80        | 29           |
| 14"      | 1.5       | 21.0 | 13.2 | 8.0 | 7     | 200       | 79           |
|          |           |      |      |     | 9     | 160       | 64           |
|          |           |      |      |     | 11    | 128       | 53           |
|          |           |      |      |     | 17    | 80        | 36           |
| 16"      | 1.5       | 24.0 | 14.0 | 8.0 | 7     | 200       | 112          |
|          |           |      |      |     | 9     | 160       | 91           |
|          |           |      |      |     | 11    | 128       | 76           |
|          |           |      |      |     | 17    | 80        | 51           |
| 18"      | 1.5       | 27.0 | 14.7 | 8.0 | 7     | 200       | 146          |
|          |           |      |      |     | 9     | 160       | 119          |
|          |           |      |      |     | 11    | 128       | 101          |
|          |           |      |      |     | 17    | 80        | 68           |

• IPS 3 Segment 45's Continued Next Page •

Other sizes, DR's and custom radius ell's not listed are available - Call For Quick Quote

Sizes 24" and smaller meet AWWA C906 fitting requirements, sizes 26" and larger are quoted per fitting.

## Stub Ends - Butt Fusion (Molded)

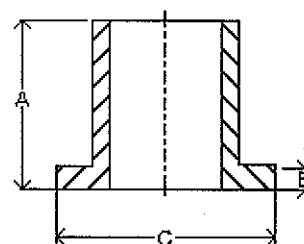


### Dimensions

| Nominal Pipe Size | OD     | OD4    | Z     | H1    | H     | Rahn Part #:<br>HDPE3408<br>Black | DR  |
|-------------------|--------|--------|-------|-------|-------|-----------------------------------|-----|
| 1-1/4" IPS        | 1.660  | 2.750  | 1.400 | 1.125 | 0.250 | SE-125                            | DR9 |
| 1-1/2" IPS        | 1.900  | 3.000  | 1.500 | 1.250 | 0.250 | SE-150                            | DR9 |
| 2" IPS            | 2.375  | 3.894  | 1.750 | 1.350 | 0.400 | SE-2                              | DR7 |
| 3" IPS            | 3.500  | 4.900  | 2.250 | 1.560 | 0.690 | SE-3                              | DR7 |
| 4" IPS            | 4.500  | 6.630  | 1.732 | 0.748 | 0.984 | SE-4                              | DR9 |
| 5" IPS            | 5.563  | 7.543  | 2.008 | 1.024 | 0.984 | SE-5                              | DR9 |
| 6" IPS            | 6.625  | 8.535  | 2.008 | 0.945 | 1.063 | SE-6                              | DR9 |
| 8" IPS            | 8.625  | 10.760 | 2.244 | 0.984 | 1.260 | SE-8                              | DR9 |
| 10" IPS           | 10.750 | 13.133 | 2.717 | 1.217 | 1.500 | SE-10                             | DR7 |
| 12" IPS           | 12.750 | 15.525 | 3.150 | 1.400 | 1.750 | SE-12                             | DR9 |
| 14" IPS           | 14.000 | 17.354 | 3.843 | 2.093 | 1.750 | SE-14                             | DR9 |
| 16" IPS           | 16.000 | 19.317 | 3.937 | 1.575 | 2.362 | SE-16                             | DR9 |
| 18" IPS           | 18.000 | 21.171 | 4.528 | 1.772 | 2.756 | SE-18                             | DR9 |
| 20" IPS           | 20.000 | 23.435 | 4.724 | 1.968 | 2.756 | SE-20                             | DR9 |

Specify SDR required when ordering.

## Flange Adapter - Butt Fusion (Molded)

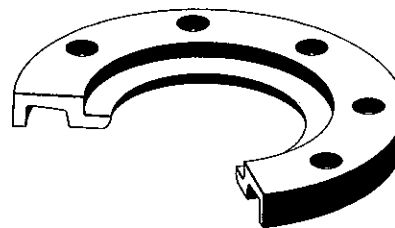
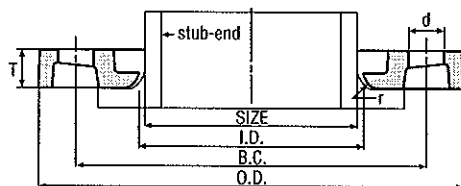


### Dimensions

| Nominal Pipe Size | A      | B     | C      | Rahn Part #:<br>HDPE3408 Black | DR  |
|-------------------|--------|-------|--------|--------------------------------|-----|
| 1-1/4" IPS        | 6.000  | 0.250 | 2.750  | 3158B-125                      | DR9 |
| 1-1/2" IPS        | 6.000  | 0.275 | 3.125  | 3158B-150                      | DR9 |
| 2" IPS            | 6.000  | 0.450 | 3.875  | 3158B-2                        | DR7 |
| 3" IPS            | 6.000  | 0.600 | 5.000  | 3158B-3                        | DR5 |
| 4" IPS            | 6.000  | 1.000 | 6.600  | 3158B-4                        | DR5 |
| 4" DIPS           | 6.000  | 1.000 | 6.600  | 3158B-4-DIPS                   | DR9 |
| 5" IPS            | 8.000  | 1.100 | 7.515  | 3158B-5                        | DR9 |
| 6" IPS            | 8.000  | 1.100 | 8.500  | 3158B-6                        | DR5 |
| 6" DIPS           | 8.000  | 1.100 | 8.500  | 3158B-6-DIPS                   | DR9 |
| 8" IPS            | 9.000  | 1.500 | 10.600 | 3158B-8                        | DR7 |
| 10" IPS           | 12.000 | 1.500 | 12.750 | 3158B-10                       | DR9 |
| 12" IPS           | 12.000 | 1.775 | 15.500 | 3158B-12                       | DR9 |

## BUP-SDR

### Convolved Flange/Backup Ring



- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** HDPE and PP thermoplastic piping systems.
- **Materials** Ductile iron, ASTM A536-84.
- **Dimensions** Mate with all 150 lb flanges, ANSI B16.5, B16.47, B16.1 AWWA C207.
- **Finish** Red oxide primed, hot dip galvanized, epoxy coated.

| Pipe Diameter | IPP Product Code | Outside Dia. O.D. | Flange Thickness T | Inside Dia. I.D. | Bolt Count N | Dia. Bolt Hole B.D. | Bolt Circle B.C. | Radius r | Weight lbs/pc | Operating <sup>1</sup> Pressure |
|---------------|------------------|-------------------|--------------------|------------------|--------------|---------------------|------------------|----------|---------------|---------------------------------|
| 1/2"          | BUP-SDR7-0050C   | 3.50              | 0.50               | 0.90             | 4            | 0.63                | 2.38             | 0.13     | 1.0           | 267                             |
| 3/4"          | BUP-SDR7-0075C   | 3.88              | 0.50               | 1.11             | 4            | 0.63                | 2.75             | 0.13     | 1.0           | 267                             |
| 1"            | BUP-SDR7-01C     | 4.25              | 0.56               | 1.38             | 4            | 0.63                | 3.13             | 0.13     | 1.0           | 267                             |
| 1 1/4"        | BUP-SDR7-0125C   | 4.63              | 0.63               | 1.72             | 4            | 0.63                | 3.50             | 0.19     | 2.0           | 267                             |
| 1 1/2"        | BUP-SDR7-0150C   | 5.00              | 0.69               | 1.97             | 4            | 0.63                | 3.88             | 0.25     | 2.0           | 267                             |
| 2"            | BUP-SDR7-02C     | 6.00              | 0.75               | 2.46             | 4            | 0.75                | 4.75             | 0.31     | 3.0           | 267                             |
| 2"            | BUP-SDR11-02B    | 6.00              | 0.50               | 2.63             | 4            | 0.75                | 4.75             | 0.20     | 1.5           | 160                             |
| 2 1/2"        | BUP-SDR7-0250C   | 7.00              | 0.88               | 2.97             | 4            | 0.75                | 5.50             | 0.31     | 4.0           | 267                             |
| 3"            | BUP-SDR7-03C     | 7.50              | 0.94               | 3.60             | 4            | 0.75                | 6.00             | 0.40     | 4.0           | 267                             |
| 3"            | BUP-SDR11-03B    | 7.50              | 0.53               | 3.75             | 4            | 0.75                | 6.00             | 0.28     | 2.5           | 160                             |
| 4"            | BUP-SDR7-04C     | 9.00              | 0.94               | 4.60             | 8            | 0.75                | 7.50             | 0.40     | 5.5           | 267                             |
| 4"            | BUP-SDR11-04B    | 9.00              | 0.55               | 4.75             | 8            | 0.75                | 7.50             | 0.28     | 3.5           | 160                             |
| 5"            | BUP-SDR7-05C     | 10.00             | 0.94               | 5.69             | 8            | 0.88                | 8.50             | 0.44     | 6.0           | 267                             |
| 6"            | BUP-SDR7-06C     | 11.00             | 1.00               | 6.75             | 8            | 0.88                | 9.50             | 0.40     | 7.0           | 267                             |
| 6"            | BUP-SDR11-06B    | 11.00             | 0.63               | 6.88             | 8            | 0.88                | 9.50             | 0.28     | 4.5           | 160                             |
| 8"            | BUP-SDR7-08C     | 13.50             | 1.12               | 8.75             | 8            | 0.88                | 11.75            | 0.40     | 11.0          | 267                             |
| 8"            | BUP-SDR11-08B    | 13.50             | 0.85               | 8.88             | 8            | 0.88                | 11.75            | 0.28     | 8.0           | 160                             |
| 10"           | BUP-SDR7-10C     | 16.00             | 1.19               | 10.92            | 12           | 1.00                | 14.25            | 0.40     | 16.0          | 267                             |
| 10"           | BUP-SDR11-10B    | 16.00             | 0.98               | 11.00            | 12           | 1.00                | 14.25            | 0.31     | 12.0          | 160                             |
| 12"           | BUP-SDR7-12C     | 19.00             | 1.50               | 12.92            | 12           | 1.00                | 17.00            | 0.40     | 23.0          | 267                             |
| 12"           | BUP-SDR9.3-12B   | 19.00             | 1.25               | 13.13            | 12           | 1.00                | 17.00            | 0.31     | 22.0          | 192                             |
| 12"           | BUP-SDR11-12B    | 19.00             | 1.25               | 13.13            | 12           | 1.00                | 17.00            | 0.28     | 20.0          | 160                             |
| 14"           | BUP-SDR7-14C     | 21.00             | 1.63               | 14.18            | 12           | 1.13                | 18.75            | 0.40     | 37.0          | 267                             |
| 14"           | BUP-SDR11-14B    | 21.00             | 1.38               | 14.38            | 12           | 1.13                | 18.75            | 0.31     | 30.0          | 160                             |
| 16"           | BUP-SDR7-16C     | 23.50             | 1.88               | 16.19            | 16           | 1.13                | 21.25            | 0.40     | 49.0          | 267                             |

1. Operating pressure on an HDPE stub-end with a safety factor of 2.

Continued for sizes 16" through 63" on pg. 12

## **Appendix D - Technical Specifications Gabion**

**GABION**  
**GALVANIZED & PVC COATED****FORWARD**

This document has been issued by MACCAFERRI CANADA LTD. in response to requests by customers for standard specifications and methods of measurement and payment and is intended as a guide only. These notes cover standard materials only. Certain clauses may not apply in their entirety to special materials. Maccaferri reserves the right to amend product specifications without notice and specifiers are requested to check as to the validity of the specifications they are using.

**NOTES:**

The following items have been changed or updated from previous versions. The current date of this specification is August 2005.

The following ASTM standards and specifications have been added or updated:

|                    |                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ASTM A975-97       | Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Polyvinyl Chloride (PVC) Coating) |
| ASTM A641/A641M-03 | Specification for Zinc Coated (Galvanized) Carbon Steel Wire                                                                                                                           |
| ASTM A370-97a      | Test Methods and Definitions for Mechanical Testing of Steel Products                                                                                                                  |
| ASTM A313/A313M-98 | Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire                                                                                                       |
| ASTM A764-95(2001) | Specification for Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs                                                                                   |
| ASTM B117-97       | Standard Practice for Operating Salt Spray (Fog) Apparatus                                                                                                                             |
| ASTM D1242-95a     | Standard Test Methods for Resistance of Plastic Materials to Abrasion                                                                                                                  |
| ASTM D1499-99      | Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics                                                                                                             |
| ASTM D2240-04      | Standard Test Method for Rubber Property—Durometer Hardness                                                                                                                            |
| ASTM D412-98a      | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension                                                                                                       |
| ASTM D746-04       | Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact                                                                                                  |
| ASTM D792-00       | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement                                                                                  |
| ASTM G152-00       | Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-metallic Materials                                                                           |
| UL 746B            | Polymeric Materials-Long Term Property Evaluation                                                                                                                                      |

## **Gabion – Galvanized & PVC Coated**

### **August 2005**

#### **1.0 Description**

This work shall consist of furnishing, assembling, and filling woven wire mesh gabions with rock as specified in the contract to the dimensions, lines and grades shown on the plans, or as determined by the engineer. These specifications are in accordance with ASTM A975-97 and include gabions as manufactured for Maccaferri Canada Ltd.

#### **2.0 Materials**

##### **2.1 Woven Mesh Gabions**

##### **2.1.1 Wire (Zinc Coated):**

All tests on the wire must be performed prior to manufacturing the mesh.

- *Tensile strength*: both the wire used for the manufacture of gabions and the lacing wire, shall have a maximum tensile strength of 515 MPa, in accordance with ASTM A641/A641M-03.
- *Elongation*: the test must be carried out on a sample at least 300 mm long. Elongation shall not be less than 12%, in accordance with ASTM A370-97a.
- *Zinc coating*: minimum quantities of zinc according to ASTM A641/A641M-03, Class III soft temper coating.
- *Adhesion of zinc coating*: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M-03.

##### **2.1.2 PVC (Polyvinyl Chloride) Coating**

- *Specific gravity*: 1.30-1.35 kg/dm<sup>3</sup> in accordance with ASTM D792-00, Table 1;
- *Hardness*: between 50 and 60 Shore D, according to ASTM D 2240-04;
- *Tensile strength*: not less than 20.6 MPa, according to ASTM D412-98a;
- *Modulus of elasticity*: not less than 18.6 MPa, according to ASTM D412-98a;
- *Abrasion resistance*: the percentage of the weight loss shall be less than 12%, according to ASTM D1242-95a.
- *Heat Aging Test*: prior to UV and abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:

- *Salt spray test*: test period 3,000 hours, test method ASTM B117-97;
- *Exposure to UV rays*: test period 3,000 hours at 63°C, test method ASTM D1499-99 and ASTM G152-00;
- *Brittleness temperature*: no higher than - 9°C, or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746-04.

The properties after aging tests shall be as follows:

- *Appearance of coated mesh*: no cracking, stripping or air bubbles, and no appreciable variation in color;
- *Specific gravity*: variations shall not exceed 6%;
- *Hardness*: variations shall not exceed 10%;
- *Tensile strength*: variations shall not exceed 25%;
- *Modulus of elasticity*: variations shall not exceed 25%;
- *Abrasion resistance*: variations shall not exceed 10%;
- *Brittleness temperature*: shall not exceed +18°C.

## 2.1.3 Galvanized and PVC coated wire mesh gabions (8 x 10 mesh type):

- *PVC coating thickness*: Nominal – 0.5 mm, Minimum – 0.38 mm
- *Mesh Wire*: Diameter – 2.70 mm internal, 3.70 mm external
- *Selvedge Wire*: Diameter – 3.40 mm internal, 4.40 mm external
- *Mesh Opening*: Nominal Dimension D = 83 mm, as per Fig. 1.

## 2.1.4 Galvanized and PVC coated lacing wire and internal stiffeners:

- *PVC coating thickness*: Nominal – 0.5 mm, Minimum – 0.38 mm
- *Lacing wire*: Diameter – 2.20 mm internal, 3.20 mm external
- *Cross Tie/Stiffener wire*: Diameter – 2.20 mm internal, 3.20 mm external
- *Preformed Stiffener*: Diameter – 3.40 mm internal, 4.40 mm external

## 2.1.5 Steel Mesh properties

- *Mesh Tensile Strength*: shall have a minimum strength of 42.3 kN/m when tested in accordance with ASTM A975 section 13.1.1.
- *Punch Test Resistance*: shall have a minimum resistance of 23.6 kN/m when tested in accordance with ASTM A975 section 13.1.4.
- *Connection to selvedges*: shall have a minimum resistance of 17.5 kN/m when tested in accordance with ASTM A975.

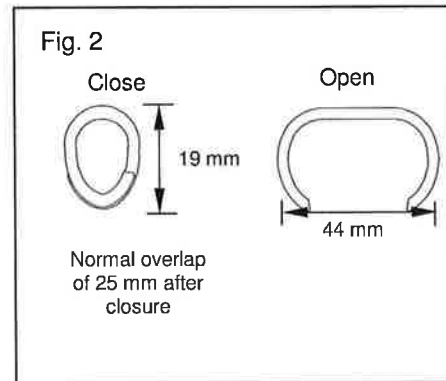
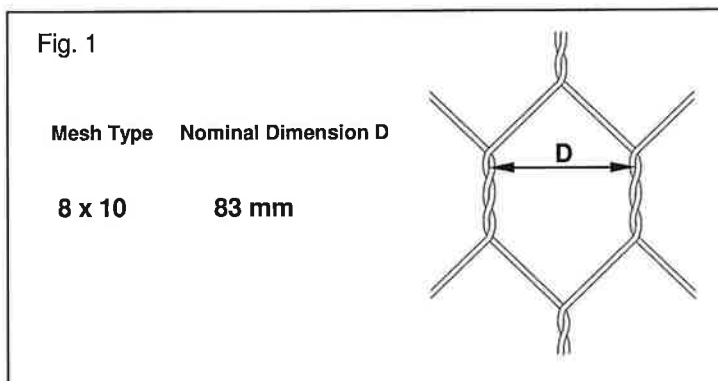
## 2.1.6 Spenax Fasteners (Overlapping Fasteners):

Overlapping stainless steel fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation. The spacing of the fasteners during all phases of assembly and installation shall be in accordance with spacing based on 17.5 kN/m, pull apart resistance for PVC coated mesh tested in accordance with ASTM A975 section 13.1.2 and with a nominal spacing of 100 mm, and not to exceed 150 mm.

- *Stainless steel fasteners*: diameter: 3.05 mm, according to ASTM A313/A313M-98, Type 302, Class I.
- *Tensile strength*: 1530 to 1744 MPa in accordance with ASTM A313/A313M-98.
- *Proper installation of rings*: A properly formed Spenax fastener shall have a nominal overlap of 25mm after closure (Fig. 2).

## 2.2 Tolerances

- *Wire*: Zinc coating, in accordance with ASTM A641/A641M-03, Class III soft temper coating.
- *Gabions*:  $\pm 5\%$  on the length, width, and height.
- *Mesh opening*: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed  $\pm 10\%$  on the nominal dimension D values (see Fig.1):





## 2.3 Standard Unit Size

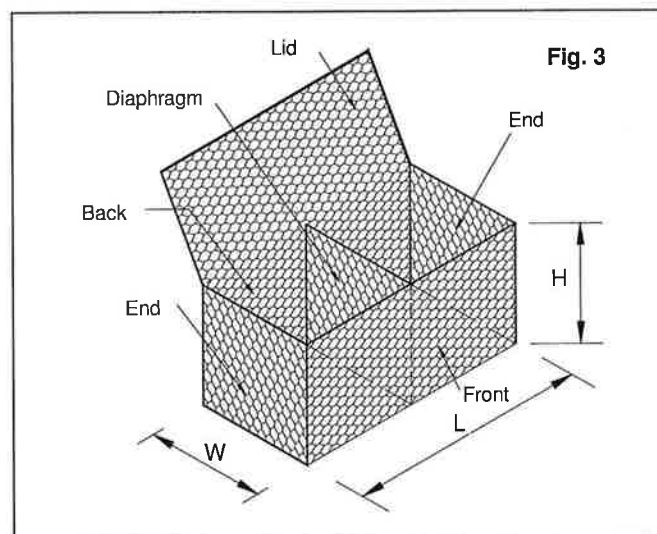
| Table of sizes for gabions |             |              |            |
|----------------------------|-------------|--------------|------------|
| L=Length (m)               | W=Width (m) | H=Height (m) | # of cells |
| 2                          | 1           | 1            | 2          |
| 3                          | 1           | 1            | 3          |
| 4                          | 1           | 1            | 4          |
| 2                          | 1           | 0.5          | 2          |
| 3                          | 1           | 0.5          | 3          |
| 4                          | 1           | 0.5          | 4          |
| 2                          | 1           | 0.3          | 2          |
| 3                          | 1           | 0.3          | 3          |
| 4                          | 1           | 0.3          | 4          |

All sizes and dimensions are nominal. Tolerances of  $\pm 5\%$  of the width, and length height, of the gabions shall be permitted.

## 2.4 Fabrication

Gabions shall be manufactured and shipped with all components mechanically connected at the production facility. The front, base, back and lid of the gabions shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvaged with wire having a larger diameter.

The gabion is divided into cells by means of diaphragms positioned at approximately 1 m centers. The diaphragms shall be secured in position to the base so that no additional lacing is necessary at the jobsite. See Figure 3.



## 2.5 Rock

The rock for gabions shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. Gabion rocks shall range between 100 mm and 200 mm. The range in sizes shall allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the

gabion exposed surface. The size shall be such that a minimum of three layers of rock must be achieved when filling a 1m high gabion.

### 3.0 Construction Requirements

#### 3.1 Assembly

Gabions are supplied folded flat and packed in bundles. The units are assembled individually by erecting the sides, ends, and diaphragms, ensuring that all panels are in the correct position, and the tops of all sides are aligned. The four corners shall be connected first, followed by the internal diaphragms to the outside walls. All connections should use lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.6.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of fasteners shall be in accordance with the manufacturer's recommendations as specified in Section 2.1.6.

#### 3.2 Installation

After initial assembly, the gabions are carried to their final position and are securely joined together along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described in Section 3.1. Whenever a structure requires more than one layer, the upper empty baskets shall also be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) described in Section 3.1.

#### 3.3 Filling

Gabions shall be filled with rock as specified in Section 2.4. During the filling operation some manual stone placement is required to minimize voids. The exposed faces of vertical structures shall be carefully hand placed to give a neat, flat, and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged.

The cells shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding 300 mm higher than the adjoining cell. It is also recommended to slightly overfill the baskets by 25 to 50 mm to allow for settlement of the rock. Behind gabion walls, compact the backfill material simultaneously to the same level as the filled gabions.

#### 3.4 Internal Connecting Wires

MacTie preformed stiffeners or lacing wire can be used as internal connecting wires when a structure requires more than one layer of gabions to be stacked on top of each other. Internal Connecting Wires with lacing wire shall connect the exposed face of a cell to the opposite side of the cell. Internal Connecting Preformed stiffeners shall connect the exposed face of a cell to the adjacent side of the cell. Preformed stiffeners are installed at 45° to the face/side of the unit, extending an equal distance along each side to be braced (approximately 300 mm). An exposed face is any side of a gabion cell that will be exposed or unsupported after the structure is completed.

##### 3.4.1 1 m High Gabions

1 m high gabions shall be filled in three layers, 300 mm at a time. Connecting wires/bracings shall be installed after the placement of each layer, that is, at 300 mm high and 600 mm high.

##### 3.4.2 0.5 m High Gabions

0.5 m high gabions do not require connecting wires/bracings unless the baskets are used to build vertical structures. In some cases, these units shall be filled in two layers, 250 mm at a time. Connecting wires shall be installed after the placement of the first layer, which is at 250 mm high.

#### 3.5 Lid Closing

Once the gabion baskets are completely full, the lids will be pulled tight until the lid meets the perimeter edges of the basket. A tool such as a lid closer can be used. The lid must then be tightly laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described in Section 3.1.

### 3.6 Mesh cutting and folding

Where shown on the drawings or otherwise directed by the engineer, the gabions shall be cut, folded and fastened together to suit site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped gabions shall be assembled, installed, filled and closed as specified in the previous sections.

### 4.0 Method of Measurement

4.1 The payment quantities for excavation shall be determined by the outside limits of the gabion structure. Quantities will be determined from cross sections and the linear distance, and paid for under the appropriate excavation bid items.

4.2 The quantity to be paid for "In place gabions" shall be the number of cubic meters of gabions measured in their final position. Project conditions and material availability will determine the actual size of gabions to be used.

4.3 Excavated material beyond the limits of the gabions shall be backfilled with gravel, crushed rock or other material approved by the engineer.

4.4 This bid price shall include the installed in place cost of all materials, equipment, and labor, including gabions, rock, and backfill material.

### 5.0 Basis of Payment

Accepted gabions will be paid for at the unit price for each pay item included in the contract.

#### Headquarters:

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|---------------|-------------------|
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| Edmonton, AB  | tel: 780-447-2719 |
| Vancouver, BC | tel: 604-683-4824 |

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**TECHNICAL DATA SHEET****MACTEX  
MX225S NONWOVEN GEOTEXTILE**

MacTex MX225S is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibres, which are formed into a random network for dimensional stability. MacTex MX225S resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. MacTex MX225S conforms to the physical property values listed below:

| PROPERTY                | TEST METHOD | UNIT                 | M.A.R.V.<br>(Minimum Average Roll Value) |
|-------------------------|-------------|----------------------|------------------------------------------|
| Weight (Typical)        | ASTM D 5261 | g/m <sup>2</sup>     | 203                                      |
| Grab Tensile            | ASTM D 4632 | kN                   | 0.711                                    |
| Grab Elongation         | ASTM D 4632 | %                    | 50                                       |
| Trapezoid Tear Strength | ASTM D 4533 | kN                   | 0.289                                    |
| Puncture Resistance     | ASTM D 4833 | kN                   | 0.40                                     |
| Mullen Burst Strength   | ASTM D 3786 | kPa                  | 2170                                     |
| Permittivity*           | ASTM D 4491 | sec <sup>-1</sup>    | 1.6                                      |
| Water Flow*             | ASTM D 4491 | l/min/m <sup>2</sup> | 4480                                     |
| AOS*                    | ASTM D 4751 | US Sieve (mm)        | 70 (0.212)                               |
| UV Resistance           | ASTM D 4355 | %/hrs                | 70/500                                   |

| PACKAGING                   |                           |
|-----------------------------|---------------------------|
| Roll Dimensions (W x L) – m | 3.81 x 109.8/ 4.57 x 91.5 |
| Square Metres Per Roll      | 418                       |
| Estimated Roll Weight – kgs | 88.6                      |

\* At the time of manufacturing. Handling may change these properties.

Seller makes no warranty, express or implied, concerning the product furnished hereunder other than at the time of delivery it shall be of the quality and specifications stated herein. *ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED.* Any recommendations made by the Seller concerning uses or applications of said product are believed reliable, and Seller makes no warranty of results to be obtained. The technical information supplied for this product type is subject to change at any time without notice.

This Data Sheet supercedes all previous Data Sheets for this style and is subject to change without notice.

MTEX-MX225S 09/04

**Headquarters:**

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**MACCAFERRI CANADA LTD.**

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**GABION MAT  
GALVANIZED & PVC COATED****FORWARD**

This document has been issued by MACCAFERRI CANADA LTD. in response to requests by customers for standard specifications and methods of measurement and payment and is intended as a guide only. These notes cover standard materials only. Certain clauses may not apply in their entirety to special materials. Maccaferri reserves the right to amend product specifications without notice and specifiers are requested to check as to the validity of the specifications they are using.

**NOTES:**

The following items have been changed or updated from previous versions. The current date of this specification is April 2006.

The following ASTM standards and specifications have been added or updated:

|                     |                                                                                                               |
|---------------------|---------------------------------------------------------------------------------------------------------------|
| ASTM A313/A 313M-98 | Standard Specification for Stainless Steel Spring Wire                                                        |
| ASTM A370-97a       | Standard Test Methods and Definitions for Mechanical Testing of Steel Products                                |
| ASTM A641/A641M-03  | Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire                                         |
| ASTM B117-97        | Standard Practice for Operating Salt Spray (Fog) Apparatus                                                    |
| ASTM D1242-95a      | Standard Test Methods for Resistance of Plastic Materials to Abrasion                                         |
| ASTM D1499-99       | Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics                                    |
| ASTM D2240-04       | Standard Test Method for Rubber Property—Durometer Hardness                                                   |
| ASTM D412-98a       | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension                              |
| ASTM D746-04        | Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact                         |
| ASTM D792-00        | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement         |
| ASTM G152-00        | Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-metallic materials. |
| UL 746B             | Polymeric Materials- Long Term Property Evaluation                                                            |

## **Gabion Mat-Galvanized & PVC Coated**

### **April 2006**

#### **1.0 Description**

This work shall consist of furnishing, assembling and filling woven wire mesh containers with rock to form gabion mats as specified in the contract in conformity with the dimensions, lines and grades shown on the plans, or as determined by the engineer and manufacturer.

#### **2.0 Materials**

##### **2.1 Woven Mesh Gabion Mats**

###### **2.1.1 Wire (Zinc Coated)**

All tests on wire must be performed prior to manufacturing the mesh.

- *Tensile strength*: both the wire used for the manufacture of gabion mats and the lacing wire, shall have a maximum tensile strength of 38 – 48 kg/mm<sup>2</sup>, in accordance with ASTM A641-97.
- *Elongation*: the test must be carried out on a sample at least 30 cm long. Elongation shall not be less than 12%, in accordance with ASTM A370-97a.
- *Zinc coating*: minimum quantities of zinc according to ASTM A641/A641M-03, Class III soft temper coating.
- *Adhesion of zinc coating*: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns round on a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M-03 for zinc coating.

###### **2.1.2 PVC (Polyvinyl Chloride) Coating**

When specified in the plans:

- *Specific gravity*: 1.30-1.35 kg/dm<sup>3</sup>, in accordance with ASTM D792-00, Table 1,
- *Hardness*: between 50 and 60 Shore D, according to ASTM D2240-04,
- *Tensile strength*: not less than 20.6 MPa, according to ASTM D412-98a,
- *Modulus of elasticity*: not less than 18.6 MPa, in accordance with ASTM D412-98a,
- *Abrasion resistance*: the percentage of the weight loss shall be less than 12%, according to ASTM D1242-95a.
- *Heat Aging Test*: prior to UV and Abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:

- *Salt spray test*: test period 3,000 hours, test method ASTM B117-97,
- *Exposure to UV rays*: test period 3,000 hours at 63°C, test method ASTM D1499-99 and ASTM G152-00.
- *Brittleness temperature*: no higher than - 9°C, or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746-04.

The properties after aging tests shall be as follows:

- *Appearance of coated mesh*: no cracking, stripping or air bubbles, and no appreciable variation in color;
- *Specific gravity*: variations shall not exceed 6%;
- *Hardness*: variations shall not exceed 10%;
- *Tensile strength*: variations shall not exceed 25%;
- *Modulus of elasticity*: variations shall not exceed 25%;
- *Abrasion resistance*: variations shall not exceed 10%;
- *Brittleness temperature*: shall not exceed +18°C.

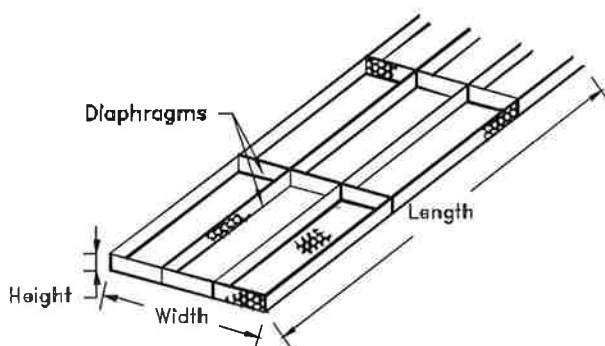
## 2.3 Standard Unit Size

| Table of sizes for gabion mats |             |              |            |
|--------------------------------|-------------|--------------|------------|
| L=Length (m)                   | W=Width (m) | H=Height (m) | # of cells |
| 30                             | 2           | 0.23         | 20         |
| 30                             | 3           | 0.23         | 30         |
| 30                             | 2           | 0.3          | 20         |
| 30                             | 3           | 0.3          | 30         |

## 2.4 Fabrication

Gabion mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the lid, which is produced separately from the base. The base, sides and ends of the gabion mats shall be woven into a single unit. The diaphragms are connected to the base in the factory. All perimeter edges of the mesh forming the base and lid shall be selvaged with selvedge wire.

The gabion mat is divided into cells by means of diaphragms. The diaphragms create cells of 1 m by 3 m. The diaphragms shall be secured in position of the base so that no additional tying is necessary at the jobsite.



## 2.5 Rock

All rock shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. Also, the size shall be such that a minimum of two layers of rock can be achieved when filling any gabion mat. Any rock smaller than the minimum size can not be less than 5% by weight; any rock greater than the maximum size can not be greater than 5% by weight, provided it is not on the exposed surface of the gabion mat.

- Gabion Mat rock shall be in the full range size of the lower and upper limits - 100-200 mm.

### **3.0 Construction Requirements**

#### **3.1 Assembly**

Gabion mats are supplied in rolls, the base in one roll and the lid in another. The units shall be assembled individually by erecting the sides, ends and diaphragms ensuring that all panels are in the correct position and the tops of all sides are aligned. The four corners of the unit shall be connected first, followed by the internal diaphragms to the sides. All connections should be accomplished using lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.5.

The recommended procedure to apply lacing wire consists of first cutting a sufficient length of wire. Secure one end of the wire by looping and twisting, then proceed to lace with alternating single and double loops every mesh opening (approximately every 100 mm) and securely fasten the other end of the lacing wire.

The installation of the fasteners specified in Section 2.1.5 shall be in accordance with the manufacturer's recommendations.

#### **3.2 Installation**

Initial assembly should occur with the gabion mats in their final position. The adjacent empty mats must be securely joined together using the same connecting procedure(s) described in Section 3.1 along the vertical and top edges of their contact surfaces.

#### **3.3 Filling**

Gabion mats shall be filled with rock as specified in Section 2.5. During the filling operation or placement some manual stone is required to minimize voids. Care shall be taken when placing fill material to ensure that the PVC sheathing is not damaged.

The cells in any row shall be filled in stages so that local deformation may be avoided. It is also recommended to slightly overfill the baskets 25 to 50 mm to allow for settlement of the rock.

#### **3.4 Lid Closing**

Once the mats are completely full, the lids shall be pulled tight using a tool such as a lid closer until the lid meets the perimeter edges of the mattress. The lid shall then be tightly laced and/or fastened along all edges, ends and tops of diaphragms in the same manner as described in Section 3.1.

#### **3.4 Mesh cutting and folding**

Where shown on the drawings or otherwise directed by the engineer, the gabion mat mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent gabion mat. The cut edges of the mesh shall be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped gabion mats shall be assembled, installed, filled and closed as specified in the previous sections.

### **4.0 Method of Measurement**

**4.1** The pay limits for excavation of gabion mats shall be a line coincident with the bottom and non-exposed side of the mattresses. Excavation quantities will be determined from the cross sections and paid for under the appropriate classified excavation items.

**4.2** The quantity to be paid for "In Place Gabion Mats" shall be the number of square meters of mattresses measured in their final position. Job conditions and availability will determine the actual size of gabion mats to be used.

**4.3** Excavated material beyond the limits of the mats shall be backfilled with gravel, crushed rock or other material meeting the approval of the engineer.

**4.4** This bid price shall include the cost of furnishing all labor, materials, and equipment including mattresses, rock, and backfill material installed in place.

---



## 5.0 Basis of Payment

Accepted gabion mats will be paid for at the unit price for each of the pay items included in the contract.

|                                                                                                                                |                                                                                                                                                                                     |                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Headquarters:</b><br>400 Collier MacMillan Drive, Unit B<br>Cambridge, ON, N1R 7H7<br>tel: 519-623-9990 / fax: 519-623-1309 | <b>MACCAFERRI INC.</b><br><br>e-mail: <a href="mailto:hq@maccaferri-canada.com">hq@maccaferri-canada.com</a><br>Website: <a href="http://www.maccaferri.com">www.maccaferri.com</a> | Halifax, NS    tel: 902-468-8615<br>Montréal, QC    tel: 450-420-1845<br>Edmonton, AB    tel: 780-447-2719<br>Vancouver, BC    tel: 604-683-4824 |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|

## **Appendix E - Technical Specifications Bentofix Liner**

# BENTOFIX TECHNOLOGIES, INC.

23 Truman Road  
Barrie, ON L4M 6E7 Canada

Tel: 705-725-1938  
Fax: 705-725-8860

## BENTOFIX® MANUFACTURING CERTIFICATION

**CUSTOMER:** TERRAFIX GEOSYNTHETICS, INC.

**PROJECT:** TERRAFIX- QUEBEC CITY

**# ROLLS:** 80

**ORDER NO.:** BH-07-24/08

**PRODUCT TYPE:** BENTOFIX® NWL

Bentofix Technologies, Inc. hereby certifies that the Bentofix® Geosynthetic Clay Liner purchased and shipped for the above referenced project does meet or exceed Bentofix Technologies, Inc.'s specifications for Bentofix®.

The Bentofix® product has been continuously inspected for the presence of needles and is certified to be needle free.

### BENTONITE testing was performed as follows:

|                  |             |                           |
|------------------|-------------|---------------------------|
| Swell Index      | ASTM D 5890 | 1/100,000 lbs (50,000 kg) |
| Moisture Content | ASTM D 4643 | 1/100,000 lbs (50,000 kg) |
| Fluid Loss       | ASTM D 5891 | 1/100,000 lbs (50,000 kg) |

### GEOTEXTILE testing on the raw materials was performed as follows:

|                    |             |                            |
|--------------------|-------------|----------------------------|
| Mass Per Unit Area | ASTM D 5261 | 1/200,000 ft² [20,000 mt²] |
|--------------------|-------------|----------------------------|

### GEOSYNTHETIC CLAY LINER testing on the finished product was performed as follows:

|                                         |             |                          |
|-----------------------------------------|-------------|--------------------------|
| Bentonite Mass Per Unit Area            | ASTM D 5993 | 1/40,000 ft² [4,000 mt²] |
| Grab Tensile/Elongation / Peel Strength | ASTM D 4632 | 1/40,000 ft² [4,000 mt²] |
| Hydraulic Conductivity                  | ASTM D 5084 | Weekly                   |
| Index Flux                              | ASTM D 5887 | Weekly                   |

*\*certified to meet the required specification of  $< 1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{s}$*

|                |             |              |
|----------------|-------------|--------------|
| Internal Shear | ASTM D 6243 | Periodically |
|----------------|-------------|--------------|

*\* hydrated 24 hours and sheared under 200 psf normal stress is certified to be 500 psf*

The LOT and ROLL numbers for this shipment are as follows:

LOT# 18072504---

ROLL# --- SEE ATTACHED---

  
BENTOFIX LAB  
APPROVAL

7-29-08

DATE

# BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD  
BARRIE, ON L4M 6E7

TEL: 705-725-1938  
FAX: 705-725-8860

## BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY  
LOT # 18072504  
STYLE: NWL  
DATE: JULY 28, 2008.

|    | BENTOFIX ROLL # | LENGTH (m) | WIDTH (m) |
|----|-----------------|------------|-----------|
| 1  | 110301          | 45.72      | 4.72      |
| 2  | 110302          | 45.72      | 4.72      |
| 3  | 110303          | 45.72      | 4.72      |
| 4  | 110304          | 45.72      | 4.72      |
| 5  | 110305          | 45.72      | 4.72      |
| 6  | 110306          | 45.72      | 4.72      |
| 7  | 110307          | 45.72      | 4.72      |
| 8  | 110308          | 45.72      | 4.72      |
| 9  | 110309          | 45.72      | 4.72      |
| 10 | 110310          | 45.72      | 4.72      |
| 11 | 110311          | 45.72      | 4.72      |
| 12 | 110312          | 45.72      | 4.72      |
| 13 | 110313          | 45.72      | 4.72      |
| 14 | 110314          | 45.72      | 4.72      |
| 15 | 110315          | 45.72      | 4.72      |
| 16 | 110316          | 45.72      | 4.72      |
| 17 | 110317          | 45.72      | 4.72      |
| 18 | 110318          | 45.72      | 4.72      |
| 19 | 110319          | 45.72      | 4.72      |
| 20 | 110320          | 45.72      | 4.72      |
| 21 | 110321          | 45.72      | 4.72      |
| 22 | 110322          | 45.72      | 4.72      |
| 23 | 110323          | 45.72      | 4.72      |
| 24 | 110324          | 45.72      | 4.72      |
| 25 | 110325          | 45.72      | 4.72      |
| 26 | 110326          | 45.72      | 4.72      |
| 27 | 110327          | 45.72      | 4.72      |
| 28 | 110328          | 45.72      | 4.72      |
| 29 | 110329          | 45.72      | 4.72      |
| 30 | 110330          | 45.72      | 4.72      |

# BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD  
BARRIE, ON L4M 6E7

TEL: 705-725-1938  
FAX: 705-725-8860

## BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY

LOT # 18072504

STYLE: NWL

DATE: JULY 28, 2008.

|    | BENTOFIX ROLL # | LENGTH (m) | WIDTH (m) |
|----|-----------------|------------|-----------|
| 31 | 110331          | 45.72      | 4.72      |
| 32 | 110332          | 45.72      | 4.72      |
| 33 | 110333          | 45.72      | 4.72      |
| 34 | 110334          | 45.72      | 4.72      |
| 35 | 110335          | 45.72      | 4.72      |
| 36 | 110336          | 45.72      | 4.72      |
| 37 | 110337          | 45.72      | 4.72      |
| 38 | 110338          | 45.72      | 4.72      |
| 39 | 110339          | 45.72      | 4.72      |
| 40 | 110340          | 45.72      | 4.72      |
| 41 | 110341          | 45.72      | 4.72      |
| 42 | 110342          | 45.72      | 4.72      |
| 43 | 110343          | 45.72      | 4.72      |
| 44 | 110344          | 45.72      | 4.72      |
| 45 | 110345          | 45.72      | 4.72      |
| 46 | 110346          | 45.72      | 4.72      |
| 47 | 110347          | 45.72      | 4.72      |
| 48 | 110348          | 45.72      | 4.72      |
| 49 | 110349          | 45.72      | 4.72      |
| 50 | 110350          | 45.72      | 4.72      |
| 51 | 110351          | 45.72      | 4.72      |
| 52 | 110352          | 45.72      | 4.72      |
| 53 | 110353          | 45.72      | 4.72      |
| 54 | 110354          | 45.72      | 4.72      |
| 55 | 110355          | 45.72      | 4.72      |
| 56 | 110356          | 45.72      | 4.72      |

# BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD  
BARRIE, ON L4M 6E7

TEL: 705-725-1938  
FAX: 705-725-8860

## BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY  
LOT # 18072504  
STYLE: NWL  
DATE: JULY 28, 2008.

|    | BENTOFIX ROLL # | LENGTH (m) | WIDTH (m) |
|----|-----------------|------------|-----------|
| 57 | 110357          | 45.72      | 4.72      |
| 58 | 110358          | 45.72      | 4.72      |
| 59 | 110359          | 45.72      | 4.72      |
| 60 | 110360          | 45.72      | 4.72      |
| 61 | 110361          | 45.72      | 4.72      |
| 62 | 110362          | 45.72      | 4.72      |
| 63 | 110363          | 45.72      | 4.72      |
| 64 | 110364          | 45.72      | 4.72      |
| 65 | 110365          | 45.72      | 4.72      |
| 66 | 110366          | 45.72      | 4.72      |
| 67 | 110367          | 45.72      | 4.72      |
| 68 | 110368          | 45.72      | 4.72      |
| 69 | 110369          | 45.72      | 4.72      |
| 70 | 110370          | 45.72      | 4.72      |
| 71 | 110371          | 45.72      | 4.72      |
| 72 | 110372          | 45.72      | 4.72      |
| 73 | 110373          | 45.72      | 4.72      |
| 74 | 110374          | 45.72      | 4.72      |
| 75 | 110375          | 45.72      | 4.72      |
| 76 | 110376          | 45.72      | 4.72      |
| 77 | 110377          | 45.72      | 4.72      |
| 78 | 110378          | 45.72      | 4.72      |
| 79 | 110379          | 45.72      | 4.72      |
| 80 | 110380          | 45.72      | 4.72      |

# BENTOFIX TECHNOLOGIES INC.

## Quality Control Certificate

| Lot #    | Roll # | Date Produced | Product      | Length               | Width             | BOL# |
|----------|--------|---------------|--------------|----------------------|-------------------|------|
| 18072504 | 110301 | 7/25/2008     | BENTOFIX NWL | 150.00 ft<br>45.72 m | 15.5 ft<br>4.72 m |      |

### FINISHED PRODUCT

| Type                                  | NWL                                                   |                          |
|---------------------------------------|-------------------------------------------------------|--------------------------|
| GCL Mass Per Unit Area<br>ASTM D 5993 | 5,009 g/m <sup>2</sup>                                | 1.025 lb/ft <sup>2</sup> |
| Grab Tensile Strength<br>ASTM D 4632  | 106 kg                                                | 233.7 lb                 |
| Elongation                            | 113 %                                                 |                          |
| Peel Strength<br>ASTM D 4632 mod      | 15.2 kg                                               | 33.5 lb                  |
| Hydraulic Conductivity<br>ASTM D 5887 | <5x10 <sup>-9</sup> cm/s                              |                          |
| Index Flux<br>ASTM D 5887             | <1x10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /s |                          |

### TOP LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080716205B-2         |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 249 g/m <sup>2</sup> | 7.34 oz/yd <sup>2</sup> |

### BOTTOM LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080717215B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 221 g/m <sup>2</sup> | 6.52 oz/yd <sup>2</sup> |

### BENTONITE

|                                                     |                        |                          |
|-----------------------------------------------------|------------------------|--------------------------|
| Lot #                                               | 422193                 |                          |
| Moisture Content<br>ASTM D 4643                     | 7.50 %                 |                          |
| Swell Index<br>ASTM D 5890                          | 30.0 ml                |                          |
| Fluid Loss<br>ASTM D 5891                           | 15.6 ml                |                          |
| Bentonite Mass Per Unit Area @ 0% mc<br>ASTM D 5993 | 4,199 g/m <sup>2</sup> | 0.859 lb/ft <sup>2</sup> |

# BENTOFIX TECHNOLOGIES INC.

## Quality Control Certificate

| Lot #    | Roll # | Date Produced | Product      | Length               | Width             | BOL# |
|----------|--------|---------------|--------------|----------------------|-------------------|------|
| 18072504 | 110301 | 7/25/2008     | BENTOFIX NWL | 150.00 ft<br>45.72 m | 15.5 ft<br>4.72 m |      |

### FINISHED PRODUCT

| Type                                  | NWL                                                   |                          |
|---------------------------------------|-------------------------------------------------------|--------------------------|
| GCL Mass Per Unit Area<br>ASTM D 5993 | 5,009 g/m <sup>2</sup>                                | 1.025 lb/ft <sup>2</sup> |
| Grab Tensile Strength<br>ASTM D 4632  | 106 kg                                                | 233.7 lb                 |
| Elongation                            | 113 %                                                 |                          |
| Peel Strength<br>ASTM D 4632 mod      | 15.2 kg                                               | 33.5 lb                  |
| Hydraulic Conductivity<br>ASTM D 5887 | <5x10 <sup>-9</sup> cm/s                              |                          |
| Index Flux<br>ASTM D 5887             | <1x10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /s |                          |

### TOP LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080716205B-2         |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 249 g/m <sup>2</sup> | 7.34 oz/yd <sup>2</sup> |

### BOTTOM LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080717215B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 221 g/m <sup>2</sup> | 6.52 oz/yd <sup>2</sup> |

### BENTONITE

|                                                     |                        |                          |
|-----------------------------------------------------|------------------------|--------------------------|
| Lot #                                               | 422193                 |                          |
| Moisture Content<br>ASTM D 4643                     | 7.50 %                 |                          |
| Swell Index<br>ASTM D 5890                          | 30.0 ml                |                          |
| Fluid Loss<br>ASTM D 5891                           | 15.6 ml                |                          |
| Bentonite Mass Per Unit Area @ 0% mc<br>ASTM D 5993 | 4,199 g/m <sup>2</sup> | 0.859 lb/ft <sup>2</sup> |



# BENTOFIX TECHNOLOGIES INC.

## Quality Control Certificate

| Lot #    | Roll # | Date Produced | Product      | Length               | Width             | BOL# |
|----------|--------|---------------|--------------|----------------------|-------------------|------|
| 18072504 | 110349 | 7/28/2008     | BENTOFIX NWL | 150.00 ft<br>45.72 m | 15.5 ft<br>4.72 m |      |

### FINISHED PRODUCT

| Type                                  | NWL                                                   |                          |
|---------------------------------------|-------------------------------------------------------|--------------------------|
| GCL Mass Per Unit Area<br>ASTM D 5993 | 4,937 g/m <sup>2</sup>                                | 1.011 lb/ft <sup>2</sup> |
| Grab Tensile Strength<br>ASTM D 4632  | 96 kg                                                 | 211.6 lb                 |
| Elongation                            | 101 %                                                 |                          |
| Peel Strength<br>ASTM D 4632 mod      | 15.1 kg                                               | 33.3 lb                  |
| Hydraulic Conductivity<br>ASTM D 5887 | <5x10 <sup>-9</sup> cm/s                              |                          |
| Index Flux<br>ASTM D 5887             | <1x10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /s |                          |

### TOP LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080722205B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 250 g/m <sup>2</sup> | 7.37 oz/yd <sup>2</sup> |

### BOTTOM LAYER

|                                   |                      |                         |
|-----------------------------------|----------------------|-------------------------|
| Type                              | Non-Woven            |                         |
| Lot #                             | 080717215B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 221 g/m <sup>2</sup> | 6.52 oz/yd <sup>2</sup> |

### BENTONITE

|                                                     |                        |                          |
|-----------------------------------------------------|------------------------|--------------------------|
| Lot #                                               | 422193                 |                          |
| Moisture Content<br>ASTM D 4643                     | 7.50 %                 |                          |
| Swell Index<br>ASTM D 5890                          | 30.0 ml                |                          |
| Fluid Loss<br>ASTM D 5891                           | 15.6 ml                |                          |
| Bentonite Mass Per Unit Area @ 0% mc<br>ASTM D 5993 | 4,131 g/m <sup>2</sup> | 0.846 lb/ft <sup>2</sup> |

# BENTOFIX TECHNOLOGIES INC.

## Quality Control Certificate

| Lot #    | Roll # | Date Produced | Product      | Length               | Width             | BOL# |
|----------|--------|---------------|--------------|----------------------|-------------------|------|
| 18072504 | 110365 | 7/28/2008     | BENTOFIX NWL | 150.00 ft<br>45.72 m | 15.5 ft<br>4.72 m |      |

### FINISHED PRODUCT

| Type                                  | NWL                                                   |                          |
|---------------------------------------|-------------------------------------------------------|--------------------------|
| GCL Mass Per Unit Area<br>ASTM D 5993 | 4,970 g/m <sup>2</sup>                                | 1.017 lb/ft <sup>2</sup> |
| Grab Tensile Strength<br>ASTM D 4632  | 92 kg                                                 | 202.8 lb                 |
| Elongation                            | 116 %                                                 |                          |
| Peel Strength<br>ASTM D 4632 mod      | 9.5 kg                                                | 20.9 lb                  |
| Hydraulic Conductivity<br>ASTM D 5887 | <5x10 <sup>-9</sup> cm/s                              |                          |
| Index Flux<br>ASTM D 5887             | <1x10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /s |                          |

### TOP LAYER

| Type                              | Non-Woven            |                         |
|-----------------------------------|----------------------|-------------------------|
| Lot #                             | 080722205B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 250 g/m <sup>2</sup> | 7.37 oz/yd <sup>2</sup> |

### BOTTOM LAYER

| Type                              | Non-Woven            |                         |
|-----------------------------------|----------------------|-------------------------|
| Lot #                             | 080717215B           |                         |
| Mass Per Unit Area<br>ASTM D 5261 | 221 g/m <sup>2</sup> | 6.52 oz/yd <sup>2</sup> |

### BENTONITE

|                                                     |                        |                          |
|-----------------------------------------------------|------------------------|--------------------------|
| Lot #                                               | 422193                 |                          |
| Moisture Content<br>ASTM D 4643                     | 7.50 %                 |                          |
| Swell Index<br>ASTM D 5890                          | 30.0 ml                |                          |
| Fluid Loss<br>ASTM D 5891                           | 15.6 ml                |                          |
| Bentonite Mass Per Unit Area @ 0% mc<br>ASTM D 5993 | 4,162 g/m <sup>2</sup> | 0.852 lb/ft <sup>2</sup> |

**BENTOFIX TECHNOLOGIES, INC.**

23 Truman Road  
Barrie, ON  
L4M 6E7 Canada

TEL: 705-725-1938  
FAX: 705-725-8860

PROJECT: TERRAFIX-QUEBEC CITY  
LOT #: 18072504

**BENTONITE LABORATORY ANALYSIS**

DATE: July 25, 2008.      RAILCAR #: BNSF 422193  
SUPPLIER: LOVELL, WY.      TYPE: BARAKADE LD 30

**SAMPLE #: 1**

1. Moisture content according to ASTM D2216 mod:  
    % of moisture      =      7.5
2. Swell Test according to ASTM D5890:  
    Swell Index      =      30 ml/2g
3. Fluid loss according to ASTM D5891:  
    Fluid Loss      =      15.6 ml

**SAMPLE #: 2**

1. Moisture content according to ASTM D2216 mod:  
    % of moisture      =      8.7
2. Swell Test according to ASTM D5890:  
    Swell Index      =      31 ml / 2g
3. Fluid loss according to ASTM D5891:  
    Fluid Loss      =      16.0 ml

TESTING COMPLETED BY: DAMON WHEELER

## **Appendix F - Technical Specifications Thermistors**



# INSTRUCTION MANUAL

## THERMISTOR STRING

### Model TH-C

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This product should be installed and operated only by qualified personnel. Its misuse is potentially dangerous. The Company makes no warranty as to the information furnished in this manual and assumes no liability for damages resulting from the installation or use of this product. The information herein is subject to change without notification.

---

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# TABLE OF CONTENTS

---

|          |                                               |          |
|----------|-----------------------------------------------|----------|
| <b>1</b> | <b>PRODUCT .....</b>                          | <b>1</b> |
| 1.1      | General description .....                     | 1        |
| 1.2      | Specifications .....                          | 2        |
| 1.3      | Operation principle .....                     | 2        |
| <b>2</b> | <b>READING PROCEDURE.....</b>                 | <b>2</b> |
| 2.1      | MB-6T Readout Unit .....                      | 2        |
| 2.2      | Ohmmeter .....                                | 3        |
| 2.3      | SENSLOG Data Acquisition System .....         | 3        |
| 2.4      | Quick verification of measurements.....       | 5        |
| <b>3</b> | <b>CONVERSION OF RESISTANCE READINGS.....</b> | <b>5</b> |
| 3.1      | Polynomial approximation .....                | 5        |
| 3.2      | Another relation.....                         | 6        |
| <b>4</b> | <b>TROUBLESHOOTING.....</b>                   | <b>6</b> |
| 4.1      | Unstable reading .....                        | 6        |
| 4.2      | No reading .....                              | 7        |
| <b>5</b> | <b>MISCELLANEOUS .....</b>                    | <b>7</b> |

# 1 PRODUCT

## 1.1 GENERAL DESCRIPTION

Roctest manufactures a thermistor string to measure the temperature at different deepness's. The thermistor string is a multi-conductor cable with individual temperature sensors distributed along the cable. The chains can be submerged underwater as well as underground. The cable is flexible even at low temperature. The thermistor arrays are customizable to the customer needs.



**Figure 1: TH-C Thermistor String**

The string is made of a thermistor embedded in a PVC cable. The sensor location is reinforced to mechanically protect the assembly. The encapsulation is flexible in order to compensate for the pressure and the deformation of the cable insulation. This compensation is required in order to be submersible, according to IP68. The thermistor used in the string has a good stability over time. The temperature value can be obtained from a portable handheld readout instrument or a complete datalogger system.

## 1.2 SPECIFICATIONS

- Operating temperature range: -40°C to +85°C
- Submersible up to 200m deep (IP68)
- Can be buried underground
- Accuracy up to  $\pm 0.05^{\circ}\text{C}$  (depends on the choice of the thermistor)
- Up to 22 sensors per cable
- Temperature drift at 25°C: less than 0.01°C after 100 months
- Rugged assembly
- Maximum diameter of the string cable: 20mm

## 1.3 OPERATION PRINCIPLE

The heart of the TH-C is a miniature thermistor. Temperature changes affect the resistance of the device, following a law described later in the manual.

*Note: The standard thermistor used in the TH-C sensor is a 3 k $\Omega$  thermistor.*

## 2 READING PROCEDURE

Different readout procedures can be used to get the temperature from the sensor resistance.

### 2.1 MB-6T READOUT UNIT

The MB-6T(L) readout unit reads the thermistor integrated in the gage, then converts the resistance value into temperature and displays the temperature in °C and °F.

Connect the jumper cable into the sockets on the front panel of the MB-6T(L). Connect the alligator clips on the jumper cable to the TH-C cable according to the pinout in the drawing provided with the equipment. The pinout and the layout is subject to change depending on the number of thermistor

Connect the shield socket on the MB-6T(L) front to the cable shield using the single lead jumper cable.

**The jumper cable should never be short-circuited when it is connected to the readout unit front panel.**



Depending of the type of thermistor used in the gage, switch the thermistor selector on the MB-6T(L) to the correct position, using the following table. Otherwise, position the selector on D and record the resistance value. The latter is to be converted subsequently, using conversion tables or polynomial equation appropriate to the thermistor type.

| Selector position | Function         |
|-------------------|------------------|
| A                 | 2 kΩ thermistor  |
| B                 | 3 kΩ thermistor  |
| C                 | 10 kΩ thermistor |
| D                 | Ohmmeter mode    |

**Table 2: Thermistor type or function vs. Selector position**

For complete details about the MB-6T(L) readout, please refer to its instruction manual.

## 2.2 OHMMETER

An ohmmeter may also be used to monitor the TH-C gage. Zero the ohmmeter by connecting together its two connecting wires.

Measure the resistance between the thermistor wires (refer to the drawing provided with the equipment). Convert the reading in ohms to temperature using conversion tables or polynomial equation appropriate to the thermistor type.

## 2.3 SENSLOG DATA ACQUISITION SYSTEM

The TH-C can also be read using a SENSLOG data acquisition system. The latter reads a  $V_{out}$  output, then converts it in ohms according to the following relation:

$$R_T = R_{25} \cdot \left( \frac{A}{V_{out}} - B \right)$$

where  $R_T$  = resistance in ohms

$R_{25}$  = resistance in ohms at 25°C depending of the type of thermistor used  
(2 000, 3 000 or 10 000 Ω)

$A, B$  = conversion factors depending on the type of thermistor

$V_{out}$  = voltage output in volts

|          | Thermistor type |      |       |
|----------|-----------------|------|-------|
|          | 2 kΩ            | 3 kΩ | 10 kΩ |
| <b>A</b> | 6.25            | 4.17 | 1.25  |
| <b>B</b> | 3.0             | 2.0  | 0.6   |

**Table 3: Conversion factors vs. Thermistor types**

Example:

With  $V_{out} = 1.00 \text{ V}$

$R_{25} = 3\,000 \, \Omega$  (3 k $\Omega$  thermistor)

We get  $R_T = 3000 \cdot \left( \frac{4.17}{1.00} - 2.0 \right) = 6\,510 \, \Omega$

## 2.4 QUICK VERIFICATION OF MEASUREMENTS

On site, even before converting raw readings into engineering values, several checks can be done to prevent a bad measurement.

- Compare readings to previous ones. Are they in the same range? Are they changing slowly or abruptly? Consider external factors that can affect the measurements like construction activities, excavations or fills...
- In any case, it is advised to take several readings to confirm the measurement. Then, repeatability can be appreciated and dummy readings erased.

## 3 CONVERSION OF RESISTANCE READINGS

A temperature reading is obtained from a resistance reading using one of the following relations.

### 3.1 POLYNOMIAL APPROXIMATION

The following polynomial approximation can be use:

$$T = C_0 + C_1X + C_2X^2 + C_3X^3 + C_4X^4 \text{ with } X = \ln \frac{R_T}{R_{25}}$$

where  $T$  = temperature in degrees Celsius

$R_T$  = resistance in ohms

$R_{25}$  = resistance in ohms at 25°C depending of the type of thermistor used  
(2 000, 3 000 or 10 000  $\Omega$ )

$C_0 = 25.032$

$C_1 = -22.756$

$C_2 = 1.4997$

$C_3 = -0.1196$

$C_4 = 0.0114$

Example:

With  $R_T = 5\,500\ \Omega$

$R_{25} = 3\,000\ \Omega$  (3 k $\Omega$  thermistor)

We get  $X = 0.6061$  and  $T = 11.8^\circ\text{C}$

### 3.2 ANOTHER RELATION

Please note that many formulae can be used to transform ohm readings in temperature readings. One of the most accurate one is:

$$T = \frac{1}{A + B \cdot \ln R_T + C \cdot \ln^3 R_T} - 273.15$$

where  $T$  = temperature in degrees Celsius

$\ln R_T$  = natural logarithm of the resistance in ohms

$A, B, C$  = constant factors

$A, B, C$  have been determined following empirical measurements. These factors will vary according to the type of thermistor (refer to table below).

The accuracy of this formula is  $\pm 0.15$  °C with a range of -50°C to +150°C.

| Thermistor type (from Dale Electronics) |                         |                        |                        |
|-----------------------------------------|-------------------------|------------------------|------------------------|
|                                         | 2 k $\Omega$            | 3 k $\Omega$           | 10 k $\Omega$          |
| <b>A</b>                                | $1,49896 \cdot 10^{-3}$ | $1,4051 \cdot 10^{-3}$ | $1,1303 \cdot 10^{-3}$ |
| <b>B</b>                                | $2,3781 \cdot 10^{-4}$  | $2,369 \cdot 10^{-4}$  | $2,339 \cdot 10^{-4}$  |
| <b>C</b>                                | $1,0668 \cdot 10^{-7}$  | $1,019 \cdot 10^{-7}$  | $8,863 \cdot 10^{-8}$  |

**Table 4: Conversion factors**

## 4 TROUBLESHOOTING

Periodically check cable connections and terminals. The transducers themselves are sealed and cannot be opened for inspection.

### 4.1 UNSTABLE READING

- Check if the same troubles occur with other gages. If so, compare cable routes or check the readout unit.
- Is the shield drain wire correctly connected to the readout unit?
- Check the battery of the readout unit.
- The sensor body may be shorted to the shield. Check the resistance between the shield drain and the sensor housing.
- Check the integrity of the cable.

## 4.2 NO READING

- Check the battery of the readout unit.
- Check if the same troubles occur with other instruments. If so, the readout unit may be suspected and the factory should be consulted.
- The sensor body may be shorted to the shield. Check the resistance between the shield drain and the sensor housing.
- Check the cable resistance. An estimation of its resistance can be calculated: the resistance of a 22 gage copper cable is approximately  $0.07\Omega/\text{m}$ . Having an idea of the temperature, convert it into ohms (using chart below for example) and add the cable resistance twice.
  - If the resistance is high or infinite, a cut cable must be suspected.
  - If the resistance is close to zero, a short must be suspected.
- Cuts or shorts are located, the cable may be spliced in accordance with recommended procedures.

## 5 MISCELLANEOUS

|                     | To Convert From                        | To                    | Multiply By |
|---------------------|----------------------------------------|-----------------------|-------------|
| LENGTH              | Microns                                | Inches                | 3.94E-05    |
|                     | Millimetres                            | Inches                | 0.0394      |
|                     | Meters                                 | Feet                  | 3.2808      |
| AREA                | Square millimetres                     | Square inches         | 0.0016      |
|                     | Square meters                          | Square feet           | 10.7643     |
| VOLUME              | Cubic centimetres                      | Cubic inches          | 0.06101     |
|                     | Cubic meters                           | Cubic feet            | 35.3357     |
|                     | Litres                                 | U.S. gallon           | 0.26420     |
|                     | Litres                                 | Can-Br gallon         | 0.21997     |
| MASS                | Kilograms                              | Pounds                | 2.20459     |
|                     | Kilograms                              | Short tons            | 0.00110     |
|                     | Kilograms                              | Long tons             | 0.00098     |
| FORCE               | Newtons                                | Pounds-force          | 0.22482     |
|                     | Newtons                                | Kilograms-force       | 0.10197     |
|                     | Newtons                                | Kips                  | 0.00023     |
| PRESSURE AND STRESS | Kilopascals                            | Psi                   | 0.14503     |
|                     | Bars                                   | Psi                   | 14.4928     |
|                     | Inches head of water*                  | Psi                   | 0.03606     |
|                     | Inches head of Hg                      | Psi                   | 0.49116     |
|                     | Pascal                                 | Newton / square meter | 1           |
|                     | Kilopascals                            | Atmospheres           | 0.00987     |
|                     | Kilopascals                            | Bars                  | 0.01        |
|                     | Kilopascals                            | Meters head of water* | 0.10197     |
| TEMPERATURE         | Temp. in °F = (1.8 x Temp. in °C) + 32 |                       |             |
|                     | Temp. in °C = (Temp. in °F - 32) / 1.8 |                       |             |

\* at 4 °C

Table 5: Conversion factors

E6TabConv-990505

## APPENDIX 1

## CONVERSION TABLE: THERMISTOR RESISTANCE vs. TEMPERATURE

| Temp.<br>°C | Reading in Ohms         |                         |                          | Temp.<br>°C | Reading in Ohms         |                         |                          |
|-------------|-------------------------|-------------------------|--------------------------|-------------|-------------------------|-------------------------|--------------------------|
|             | With a 2K<br>Thermistor | With a 3K<br>Thermistor | With a 10K<br>Thermistor |             | With a 2K<br>Thermistor | With a 3K<br>Thermistor | With a 10K<br>Thermistor |
| -50         |                         | 201100                  | 670500                   | 1           | 6208                    | 9310                    | 31030                    |
| -49         |                         | 187300                  | 670500                   | 2           | 5900                    | 8851                    | 29500                    |
| -48         |                         | 174500                  | 624300                   | 3           | 5612                    | 8417                    | 28060                    |
| -47         |                         | 162700                  | 581700                   | 4           | 5336                    | 8006                    | 26690                    |
| -46         |                         | 151700                  | 542200                   | 5           | 5080                    | 7618                    | 25400                    |
| -45         |                         | 141600                  | 440800                   | 6           | 4836                    | 7252                    | 24170                    |
| -44         |                         | 132200                  | 472000                   | 7           | 4604                    | 6905                    | 23020                    |
| -43         |                         | 123500                  | 411700                   | 8           | 4384                    | 6576                    | 21920                    |
| -42         |                         | 115400                  | 384800                   | 9           | 4176                    | 6265                    | 20880                    |
| -41         |                         | 107900                  | 359800                   | 10          | 3980                    | 5971                    | 19900                    |
| -40         | 67320                   | 101000                  | 336500                   | 11          | 3794                    | 5692                    | 18970                    |
| -39         | 63000                   | 94480                   | 315000                   | 12          | 3618                    | 5427                    | 18090                    |
| -38         | 59000                   | 88460                   | 294900                   | 13          | 3452                    | 5177                    | 17260                    |
| -37         | 55280                   | 82870                   | 276200                   | 14          | 3292                    | 4939                    | 16470                    |
| -36         | 51800                   | 77660                   | 258900                   | 15          | 3142                    | 4714                    | 15710                    |
| -35         | 48560                   | 72810                   | 242700                   | 16          | 3000                    | 4500                    | 15000                    |
| -34         | 45560                   | 68300                   | 227700                   | 17          | 2864                    | 4297                    | 14330                    |
| -33         | 42760                   | 64090                   | 213600                   | 18          | 2736                    | 4105                    | 13680                    |
| -32         | 40120                   | 60170                   | 200600                   | 19          | 2614                    | 3922                    | 13070                    |
| -31         | 37680                   | 56510                   | 188400                   | 20          | 2498                    | 3748                    | 12500                    |
| -30         | 35400                   | 53100                   | 177000                   | 21          | 2388                    | 3583                    | 11940                    |
| -29         | 33280                   | 49910                   | 166400                   | 22          | 2284                    | 3426                    | 11420                    |
| -28         | 31300                   | 46940                   | 156500                   | 23          | 2184                    | 3277                    | 10920                    |
| -27         | 29440                   | 44160                   | 147200                   | 24          | 2090                    | 3135                    | 10450                    |
| -26         | 27700                   | 41560                   | 138500                   | 25          | 2000                    | 3000                    | 10000                    |
| -25         | 26080                   | 39130                   | 130500                   | 26          | 1915                    | 2872                    | 9574                     |
| -24         | 24580                   | 36860                   | 122900                   | 27          | 1833                    | 2750                    | 9165                     |
| -23         | 23160                   | 34730                   | 115800                   | 28          | 1756                    | 2633                    | 8779                     |
| -22         | 21820                   | 32740                   | 109100                   | 29          | 1682                    | 2523                    | 8410                     |
| -21         | 20580                   | 30870                   | 102900                   | 30          | 1612                    | 2417                    | 8060                     |
| -20         | 19424                   | 29130                   | 97110                    | 31          | 1544                    | 2317                    | 7722                     |
| -19         | 18332                   | 27490                   | 91650                    | 32          | 1481                    | 2221                    | 7402                     |
| -18         | 17308                   | 25950                   | 86500                    | 33          | 1420                    | 2130                    | 7100                     |
| -17         | 16344                   | 24510                   | 81710                    | 34          | 1362                    | 2042                    | 6807                     |
| -16         | 15444                   | 23160                   | 77220                    | 35          | 1306                    | 1959                    | 6532                     |
| -15         | 14596                   | 21890                   | 72960                    | 36          | 1254                    | 1880                    | 6270                     |
| -14         | 13800                   | 20700                   | 69010                    | 37          | 1203                    | 1805                    | 6017                     |
| -13         | 13052                   | 19580                   | 65280                    | 38          | 1155                    | 1733                    | 5777                     |
| -12         | 12352                   | 18520                   | 61770                    | 39          | 1109                    | 1664                    | 5546                     |
| -11         | 11692                   | 17530                   | 58440                    | 40          | 1065                    | 1598                    | 5329                     |
| -10         | 11068                   | 16600                   | 55330                    | 41          | 1024                    | 1535                    | 5116                     |
| -9          | 10484                   | 15720                   | 52440                    | 42          | 984                     | 1475                    | 4916                     |
| -8          | 9932                    | 14900                   | 49690                    | 43          | 945                     | 1418                    | 4725                     |
| -7          | 9416                    | 14120                   | 47070                    | 44          | 909                     | 1363                    | 4543                     |
| -6          | 8928                    | 13390                   | 44630                    | 45          | 874                     | 1310                    | 4369                     |
| -5          | 8468                    | 12700                   | 42340                    | 46          | 840                     | 1260                    | 4202                     |
| -4          | 8032                    | 12050                   | 40170                    | 47          | 808                     | 1212                    | 4042                     |
| -3          | 7624                    | 11440                   | 38130                    | 48          | 778                     | 1167                    | 3889                     |
| -2          | 7240                    | 10860                   | 36190                    | 49          | 748                     | 1123                    | 3743                     |
| -1          | 6876                    | 10310                   | 34370                    | 50          | 720                     | 1081                    | 3603                     |
| 0           | 6532                    | 9796                    | 32660                    | 51          | 694                     | 1040                    | 3469                     |

Table 6: Conversion table (continued)

| Temp.<br>°C | Reading in Ohms      |                      |                       | Temp.<br>°C | Reading in Ohms      |                      |                       |
|-------------|----------------------|----------------------|-----------------------|-------------|----------------------|----------------------|-----------------------|
|             | With a 2K Thermistor | With a 3K Thermistor | With a 10K Thermistor |             | With a 2K Thermistor | With a 3K Thermistor | With a 10K Thermistor |
| 52          | 668                  | 1002                 | 3340                  | 102         | 128                  | 192.2                | 640.3                 |
| 53          | 643                  | 965.0                | 3217                  | 103         | 125                  | 186.8                | 622.1                 |
| 54          | 620                  | 929.6                | 3099                  | 104         | 121                  | 181.5                | 604.4                 |
| 55          | 597                  | 895.8                | 2986                  | 105         | 118                  | 176.4                | 587.5                 |
| 56          | 576                  | 863.3                | 2878                  | 106         | 114                  | 171.4                | 571.0                 |
| 57          | 555                  | 832.2                | 2774                  | 107         | 111                  | 166.7                | 555.1                 |
| 58          | 535                  | 802.3                | 2675                  | 108         | 108                  | 162.0                | 540.0                 |
| 59          | 516                  | 773.7                | 2580                  | 109         | 105                  | 157.6                | 524.9                 |
| 60          | 498                  | 746.3                | 2488                  | 110         | 102                  | 153.2                | 510.7                 |
| 61          | 480                  | 719.9                | 2400                  | 111         | 99                   | 149.0                | 496.4                 |
| 62          | 463                  | 694.7                | 2316                  | 112         | 97                   | 145.0                | 483.1                 |
| 63          | 447                  | 670.4                | 2235                  | 113         | 94                   | 141.1                | 469.8                 |
| 64          | 432                  | 647.1                | 2157                  | 114         | 91                   | 137.2                | 457.4                 |
| 65          | 416                  | 624.7                | 2083                  | 115         | 89                   | 133.6                | 444.9                 |
| 66          | 402                  | 603.3                | 2011                  | 116         | 87                   | 130.0                | 433.4                 |
| 67          | 388                  | 582.6                | 1942                  | 117         | 84                   | 126.5                | 421.8                 |
| 68          | 375                  | 562.8                | 1876                  | 118         | 82                   | 123.2                | 410.7                 |
| 69          | 363                  | 543.7                | 1813                  | 119         | 80                   | 119.9                | 399.6                 |
| 70          | 350                  | 525.4                | 1752                  | 120         | 78                   | 116.8                | 389.4                 |
| 71          | 339                  | 507.8                | 1693                  | 121         | 76                   | 113.8                | 379.2                 |
| 72          | 327                  | 490.9                | 1636                  | 122         | 74                   | 110.8                | 369.4                 |
| 73          | 316                  | 474.7                | 1582                  | 123         | 72                   | 107.9                | 360.1                 |
| 74          | 306                  | 459.0                | 1530                  | 124         | 70                   | 105.2                | 350.8                 |
| 75          | 296                  | 444.0                | 1479                  | 125         | 68                   | 102.5                | 341.9                 |
| 76          | 286                  | 429.5                | 1431                  | 126         | 67                   | 99.9                 | 333.0                 |
| 77          | 277                  | 415.6                | 1385                  | 127         | 65                   | 97.3                 | 324.6                 |
| 78          | 268                  | 402.2                | 1340                  | 128         | 63                   | 94.9                 | 316.6                 |
| 79          | 260                  | 389.3                | 1297                  | 129         | 62                   | 92.5                 | 308.6                 |
| 80          | 251                  | 376.9                | 1255                  | 130         | 60                   | 90.2                 | 301.1                 |
| 81          | 243                  | 364.9                | 1215                  | 131         | 59                   | 87.9                 | 293.5                 |
| 82          | 236                  | 353.4                | 1177                  | 132         | 57                   | 85.7                 | 286.0                 |
| 83          | 228                  | 342.2                | 1140                  | 133         | 56                   | 83.6                 | 279.3                 |
| 84          | 221                  | 331.5                | 1104                  | 134         | 54                   | 81.6                 | 272.2                 |
| 85          | 214                  | 321.2                | 1070                  | 135         | 53                   | 79.6                 | 265.5                 |
| 86          | 208                  | 311.3                | 1036                  | 136         | 52                   | 77.6                 | 259.3                 |
| 87          | 201                  | 301.7                | 1004                  | 137         | 51                   | 75.8                 | 253.1                 |
| 88          | 195                  | 292.4                | 973.8                 | 138         | 49                   | 73.9                 | 246.9                 |
| 89          | 189                  | 283.5                | 944.1                 | 139         | 48                   | 72.2                 | 241.1                 |
| 90          | 183                  | 274.9                | 915.2                 | 140         | 47                   | 70.4                 | 235.3                 |
| 91          | 178                  | 266.6                | 887.7                 | 141         | 46                   | 68.8                 | 229.6                 |
| 92          | 172                  | 258.6                | 861.0                 | 142         | 45                   | 67.1                 | 224.2                 |
| 93          | 167                  | 250.9                | 835.3                 | 143         | 44                   | 65.5                 | 218.9                 |
| 94          | 162                  | 243.4                | 810.4                 | 144         | 43                   | 64.0                 | 214.0                 |
| 95          | 157                  | 236.2                | 786.4                 | 145         | 42                   | 62.5                 | 208.7                 |
| 96          | 153                  | 229.3                | 763.3                 | 146         | 41                   | 61.1                 | 203.8                 |
| 97          | 148                  | 222.6                | 741.1                 | 147         | 40                   | 59.6                 | 199.4                 |
| 98          | 144                  | 216.1                | 719.4                 | 148         | 39                   | 58.3                 | 194.5                 |
| 99          | 140                  | 209.8                | 698.5                 | 149         | 38                   | 56.8                 | 190.1                 |
| 100         | 136                  | 203.8                | 678.5                 | 150         | 37                   | 55.6                 | 185.9                 |
| 101         | 132                  | 197.9                | 659.0                 |             |                      |                      |                       |

Table 6: Conversion table

## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10001      **Total length:** 12m

| Thermistor located at (m) | Color code           | Pin code |
|---------------------------|----------------------|----------|
| 10 (bottom)               | Black & White-Black  | 15-16    |
| 8                         | Black & Blue/Black   | 13-14    |
| 6                         | Black & Orange-Black | 11-12    |
| 4                         | Red & Gray-Red       | 9-10     |
| 2                         | Red & White-Red      | 7-8      |
| 1                         | Green & Red-Green    | 5-6      |
| 0,5                       | Red & Orange-Red     | 3-4      |
| 0 (ground level)          | Blue & White-Blue    | 1-2      |

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales      Date: 6/17/2010



## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10002      **Total length:** 12m

| Thermistor located at (m) | Color code           | Pin code |
|---------------------------|----------------------|----------|
| 10 (bottom)               | Black & White-Black  | 15-16    |
| 8                         | Black & Blue/Black   | 13-14    |
| 6                         | Black & Orange-Black | 11-12    |
| 4                         | Red & Gray-Red       | 9-10     |
| 2                         | Red & White-Red      | 7-8      |
| 1                         | Green & Red-Green    | 5-6      |
| 0,5                       | Red & Orange-Red     | 3-4      |
| 0 (ground level)          | Blue & White-Blue    | 1-2      |

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Certificate no: E7133E-100617-24271

Certified by: Melina Morales

Date: 6/17/2010

## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10003      **Total length:** 12m

| Thermistor located at (m) | Color code           | Pin code |
|---------------------------|----------------------|----------|
| 10 (bottom)               | Black & White-Black  | 15-16    |
| 8                         | Black & Blue/Black   | 13-14    |
| 6                         | Black & Orange-Black | 11-12    |
| 4                         | Red & Gray-Red       | 9-10     |
| 2                         | Red & White-Red      | 7-8      |
| 1                         | Green & Red-Green    | 5-6      |
| 0,5                       | Red & Orange-Red     | 3-4      |
| 0 (ground level)          | Blue & White-Blue    | 1-2      |

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales

Date: 6/17/2010

## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10004      **Total length:** 12m

| Thermistor located at (m) | Color code           | Pin code |
|---------------------------|----------------------|----------|
| 10 (bottom)               | Black & White-Black  | 15-16    |
| 8                         | Black & Blue/Black   | 13-14    |
| 6                         | Black & Orange-Black | 11-12    |
| 4                         | Red & Gray-Red       | 9-10     |
| 2                         | Red & White-Red      | 7-8      |
| 1                         | Green & Red-Green    | 5-6      |
| 0,5                       | Red & Orange-Red     | 3-4      |
| 0 (ground level)          | Blue & White-Blue    | 1-2      |

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales

Date: 6/17/2010

## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10005      **Total length:** 12m

| Thermistor located at (m) | Color code           | Pin code |
|---------------------------|----------------------|----------|
| 10 (bottom)               | Black & White-Black  | 15-16    |
| 8                         | Black & Blue/Black   | 13-14    |
| 6                         | Black & Orange-Black | 11-12    |
| 4                         | Red & Gray-Red       | 9-10     |
| 2                         | Red & White-Red      | 7-8      |
| 1                         | Green & Red-Green    | 5-6      |
| 0,5                       | Red & Orange-Red     | 3-4      |
| 0 (ground level)          | Blue & White-Blue    | 1-2      |

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales

Date: 6/17/2010

## CERTIFICATE OF QUALITY & CONFORMITY THERMISTOR STRING

**Model:** Thermistor string  
**Serial number:** 133E10006      **Total length:** 29m

| Thermistor located at (m) | Color code            | Pin code |
|---------------------------|-----------------------|----------|
| 27 (bottom)               | Black & White-Black   | 1 - 2    |
| 26                        | Blue & White/Blue     | 3 - 4    |
| 25                        | Red & Orange-Red      | 5 - 6    |
| 24                        | Green & Red-Green     | 7 - 8    |
| 23                        | Black & Blue-Black    | 9 - 10   |
| 22                        | Orange & Orange-Black | 11 - 12  |
| 21                        | Red & Gray-Red        | 13 - 14  |
|                           |                       |          |

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales

Date: 6/17/2010

# Quickstart for Installation Validation of the Thermistor String

## 1.0 Installation Validation Steps

- Installation of the loggernet software on the computer
- Connect the thermistor string to the test box (using the rectangular-shaped connector)
- Turn the power on with the terminal block blade
- Start the computer and the LoggerNet Software (setup the connection)
- Monitor data
- Collect data

## 2.0 LoggerNet Software

### 2.1 Description

The LoggerNet is a fully featured Windows-based software package that allows direct communication with the test box using a RS-232 connection. A “Connect” screen provides real-time tools to set the datalogger clock in order to send the program to the datalogger and manually collect data using a computer. In addition, data can also be retrieved automatically, based on a predefined schedule. Measurements can be viewed in real-time on both numeric and graphical displays. In addition to these basic tools, the software package includes a datalogger program editor, a report generation tool and a data viewer with basic plotting capabilities.

This application note is intended to give the user a quickstart in getting the datalogger powered up and running. However, we strongly recommend that the user read the LoggerNet manual in order to get familiar with its features.

### 2.2 Software Installation

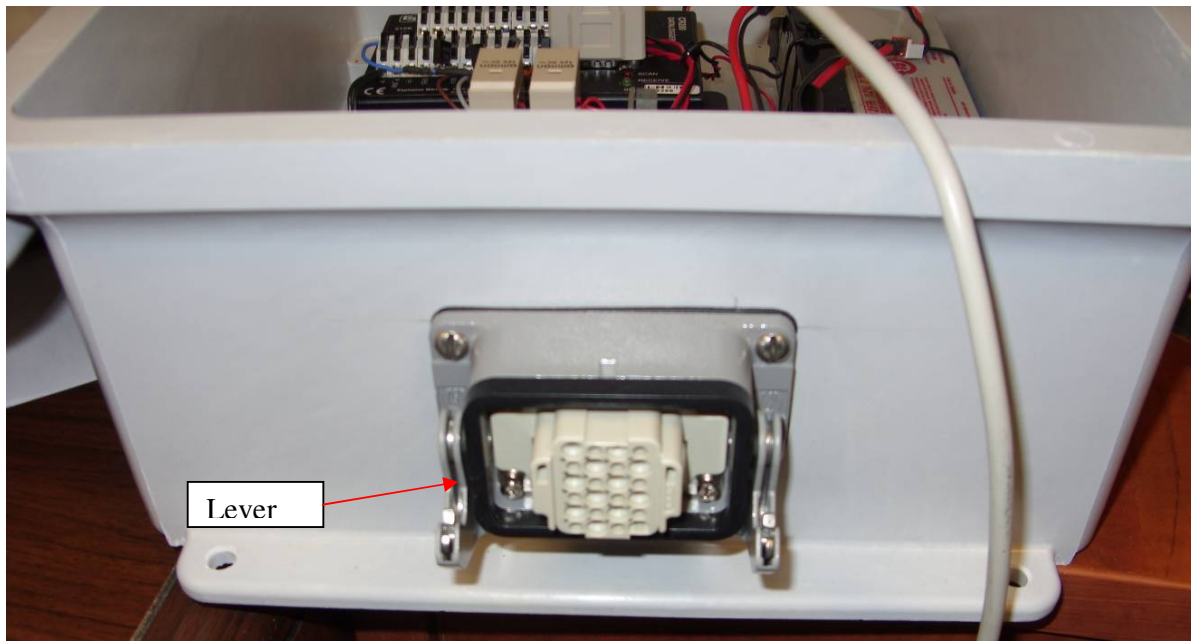
The LoggerNet is a collection of 32-bit programs designed for Intel-based computers running Microsoft Windows 2000, Windows XP or Vista.

As with all softwares, we strongly recommend that a back-up of critical files be performed before software installation. Place the installation disk in your computer's CD/DVD drive. If autorun is enabled, LoggerNet installation will start. If it does not start, select START > RUN from the Windows's START menu. Locate the SETUP.EXE file on the CD/DVD drive and click OK. Follow the instructions on the screen. Refer to the LoggerNet manual for further details.

When the installation is done, a LoggerNet icon will be placed on your desktop.

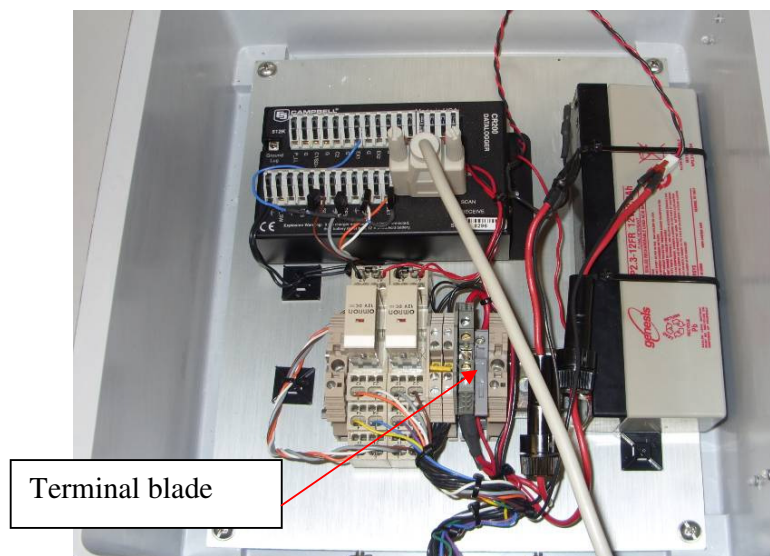


### 3.0 Connection of the Thermistor String to the Test Box



Connect the connector to the mating on the test box and lift up the lever to secure the connector in place. *NOTE: make sure to seal back the connector of the thermistor string to avoid any water infiltration in the connector before the final installation.*

### 4.0 Turn the Power On on the Test Box



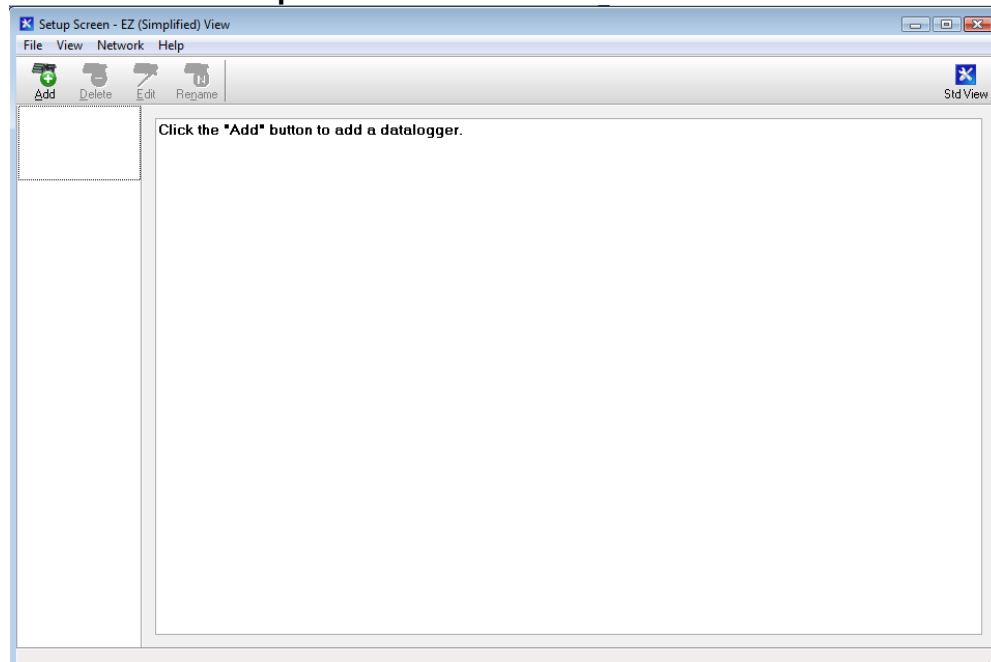
The terminal blade is used to turn the power OFF. Lower the blade to turn the unit ON. Make sure to raise the blade at the end of the test to avoid any battery drainage.

## 5.0 Setup the Connection

The hardware and software setups are done. The following steps describe the instructions to connect the datalogger, to collect or monitor data

To start the LoggerNet, double click on the LoggerNet desktop icon.

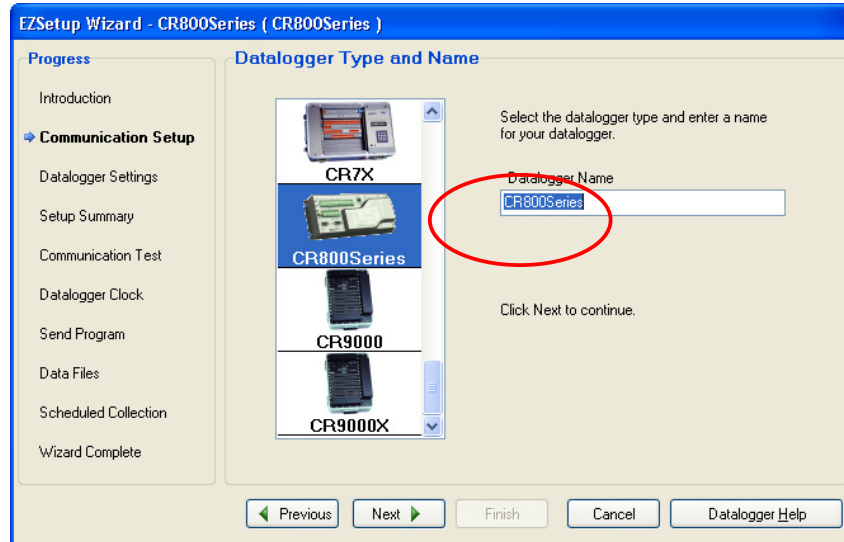
- From the **MAIN / SETUP**, click **Add** and then click **Next**, which will get you to the **Communication Setup** window.



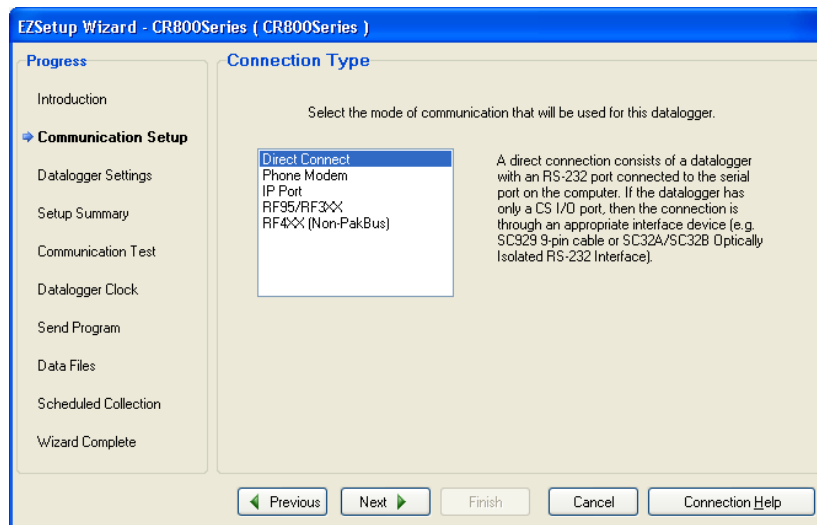
- Wait at least 15 seconds after powering up the unit before attempting to communicate with it.



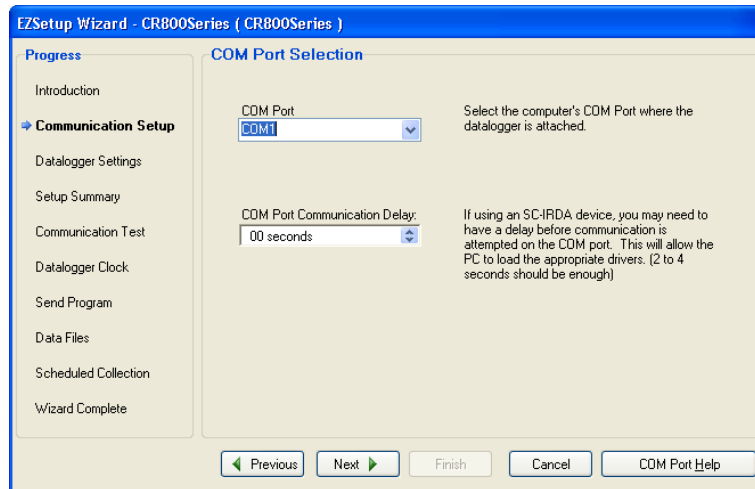
- Under **Datalogger Type and Name**, select **CR200 Series**, and next under **Datalogger Name**, choose a name that best represents your application. For example, type **Thermistor** and click **Next**. This datalogger name will be used later to connect to the Thermistor datalogger.



- Select **Direct Connect** and click **Next**.

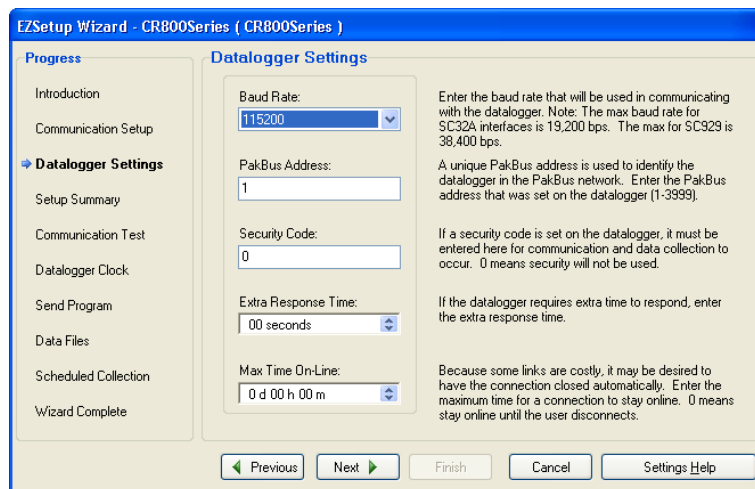


- Select the appropriate **COM port** on your computer. Usually, if you have a serial port on your computer, **COM 1** will be available. However, if you use a USB Serial adaptor, a virtual port will be created and a new COM port number will be assigned. Click **Next** when done.

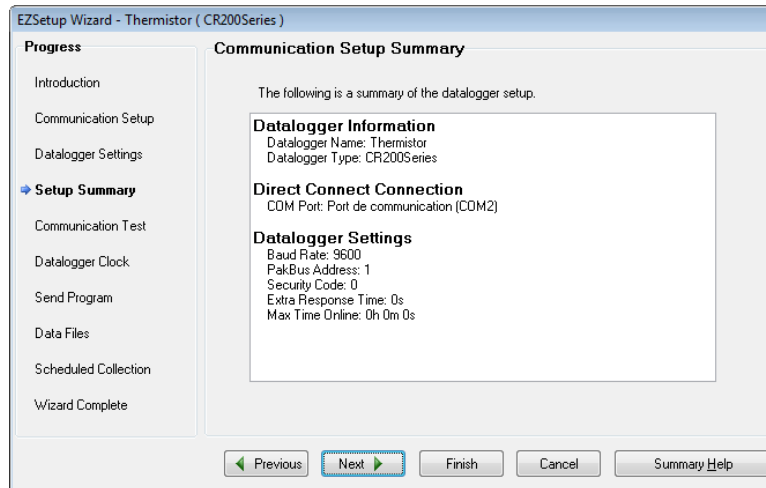


- Use the default parameters and click **Next**.

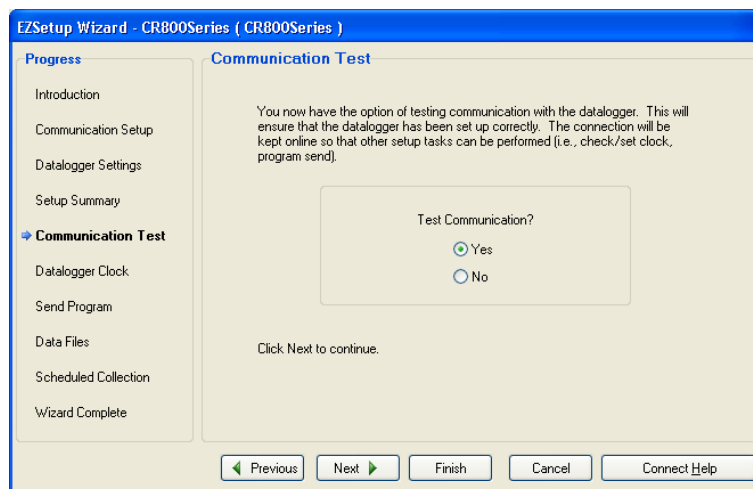
**Note:** If you use a USB Serial adapter you may need to lower the Baud Rate, in general **9600** works fine with the adapter.



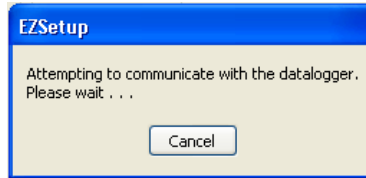
- The following window displays the Communication Setup Summary. Click **Next**.



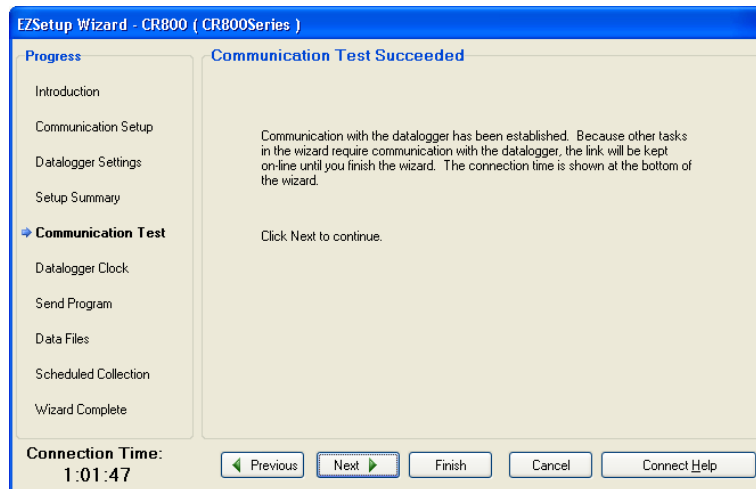
- To test the communication, select **Yes** and click **Next**.



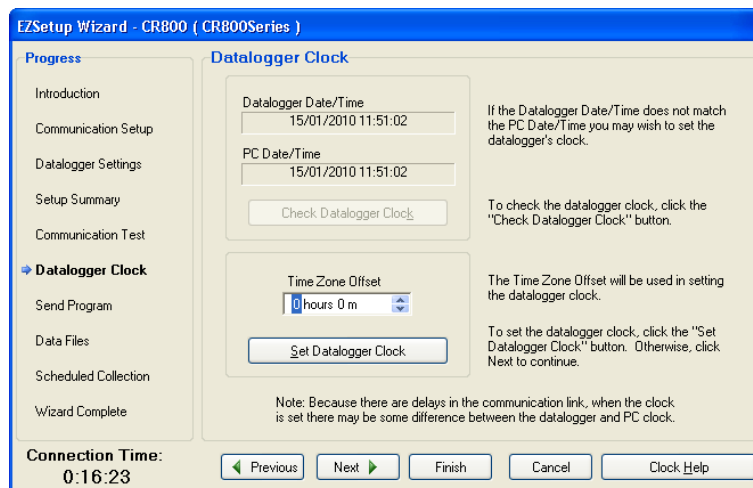
The following message will appear on the screen while your computer is attempting to communicate with the Thermistor datalogger.



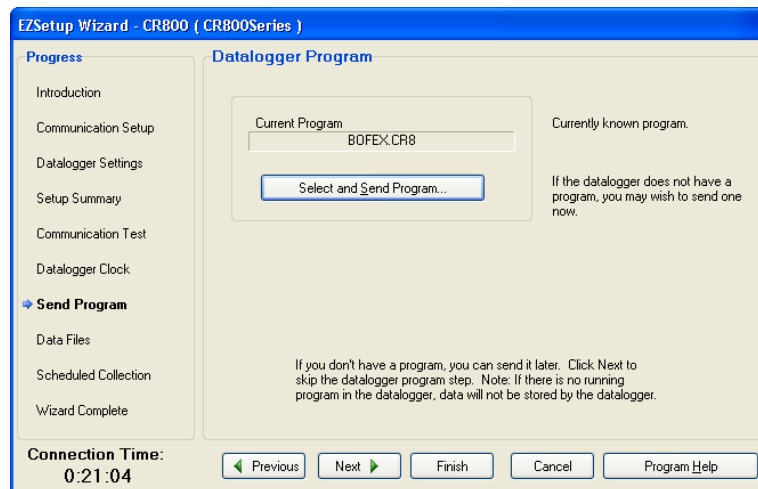
- The next windows will indicate if communication is successful. Click **Next**.



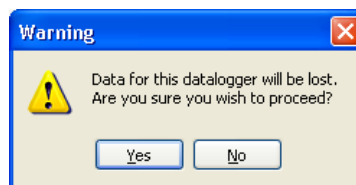
- Adjust the clock to set it at your local time zone. Make sure your computer is adjusted to your local time, then click **Set Datalogger Clock**. When done, click **Next**.



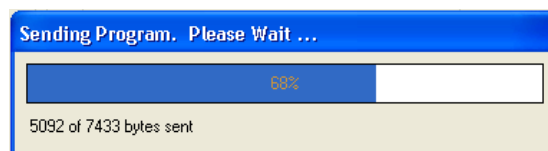
- The datalogger is usually shipped with the Application Program pre-loaded in the datalogger. The program will be displayed under **Current Program**. If it shows **no program** or if the program name shown is not for your application, you will need to upload your Application Program in the datalogger. Click **Finish** to save your settings. At this point, the datalogger setup is completed. To quit the **EZSetup** wizard, select **File** from the menu and click **Exit**. Proceed to section 4.2.



- To download your application program, click **Select and Send Program**. Locate the program on your computer's HD drive or on the one supplied by email, and click **Open**. The following warning message will be displayed on your screen. Click **Yes**.

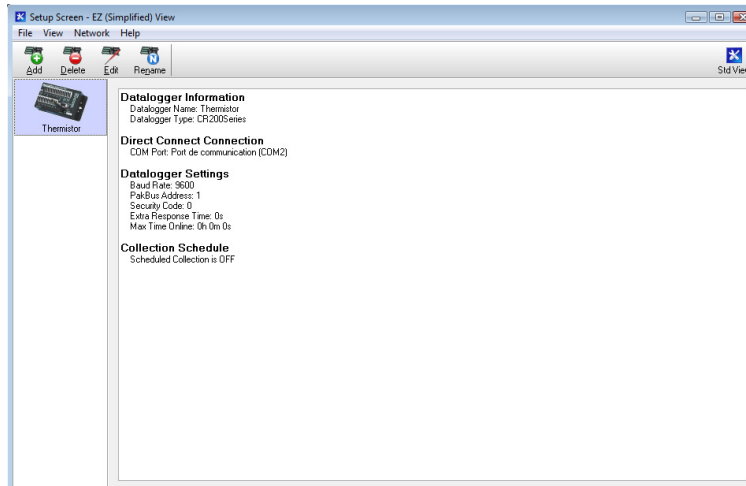


- A progress bar will display the download progress. If successful, a message will indicate it.



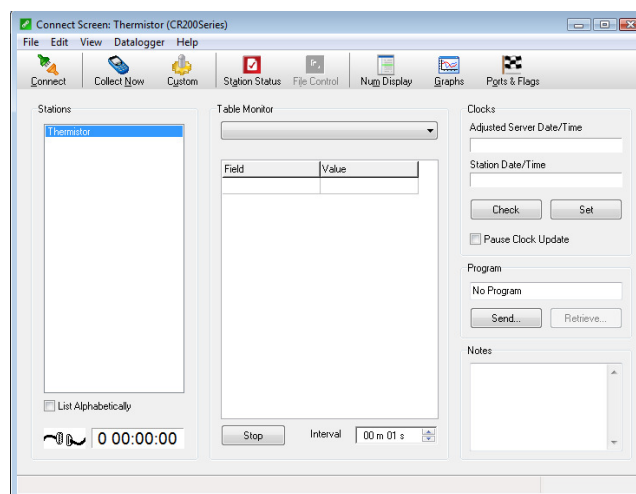
- Click **Finish** to save your settings. This completes the datalogger setup using the **EZSetup** wizard.

- To quit the **EZSetup**, select **File** from the **Menu**, and click **Exit**.

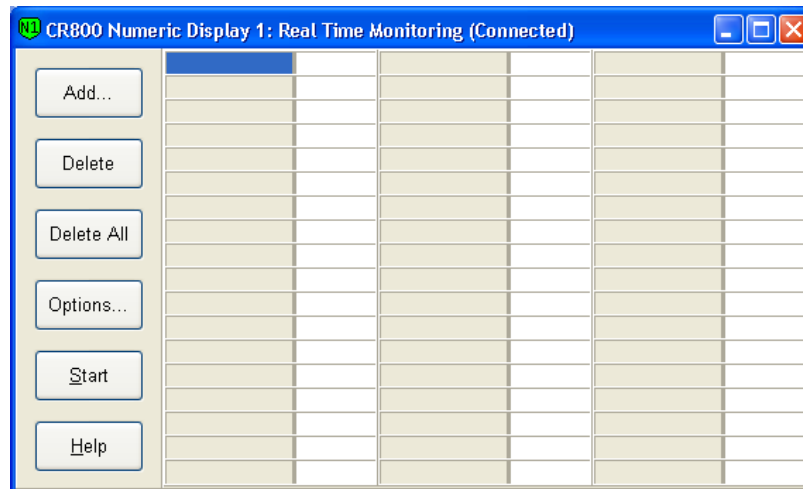


## 6.0 Monitoring Data With a Computer

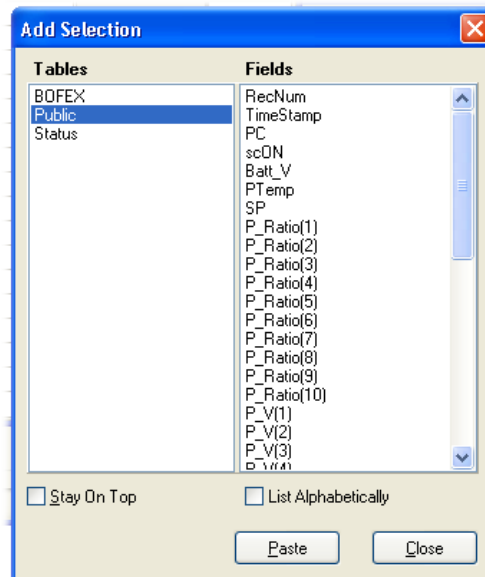
- Connect the supplied Serial Cable between the RS232 Input on the CR200 datalogger and your computer's serial port or USB Serial Adapter.
- Start the LoggerNet by double clicking on the LoggerNet desktop icon.
- From the **MAIN/CONNECT**, click on the station **Thermistor**, then **Connect**



- The cable at the bottom of the screen will be connected when the link will be established. Click **Num.Display/Display 1**. The following window should appear.



- Click the **Add** button and under **Tables**, highlight **Public**. The following window should appear.

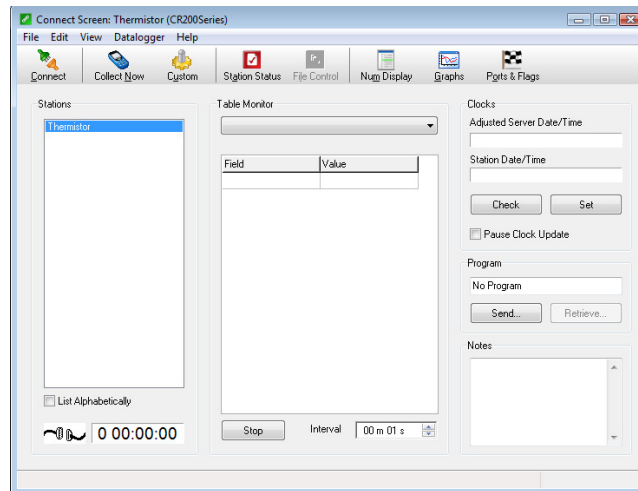


- Under **Fields**, select (highlight) the sensors (labels) you wish to view during the Test. You can use a combination of Shift & Ctrl keys on the computer's keyboard to select multiple labels. Next, on the **Display 1** window, highlight the location where you want to place the labels and finally, from the **Add Selection** window, click **Paste**. We recommend you to monitor the entire content in **Public**. The variable **Thermistor** represents the temperature and the value **Resistor** represents the resistor value of the thermistor.

## 7.0 Collect Data

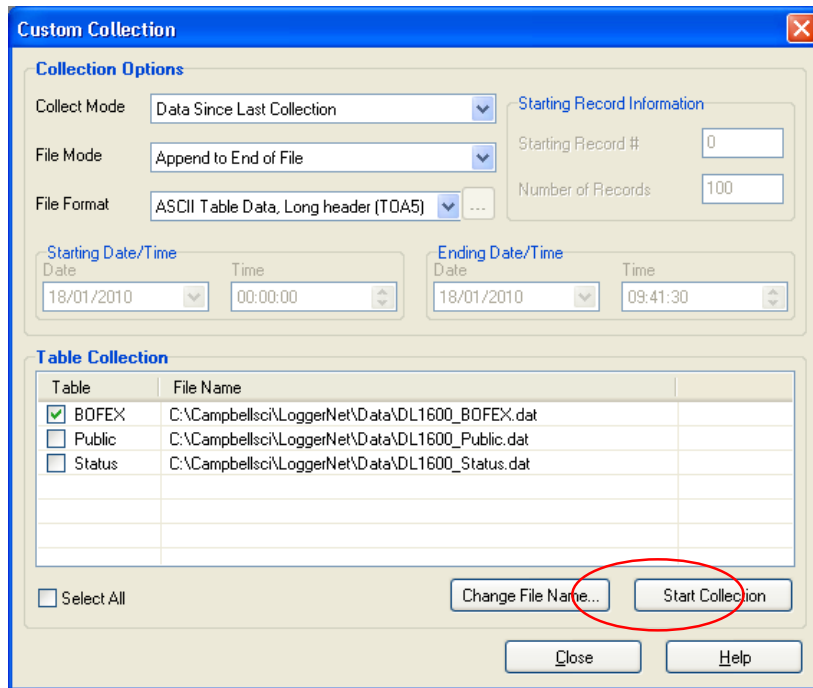
When a Test is completed, readings should be collected immediately. The following steps assume that the computer is already connected and that the LoggerNet is already running.

- From the **Connect Screen**, click the **Collect Now** button.



- Click on the Data\_X.dat file to see the content. The records are displayed in a table.
- To modify the data output, click **Custom** in the connect screen. The following screen will appear.



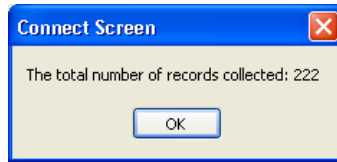


- Under **Collection Options**, make sure the following options are selected:
  - **Data Since Last Collection**
  - **Append to End of File**
  - **ASCII Table Data, Long header (TOA5)**
- Under **Table Collection**, make sure that **Data\_X** is checked and that the file path where to save the file is defined. You do not need to check the **Public** and **Status** boxes.

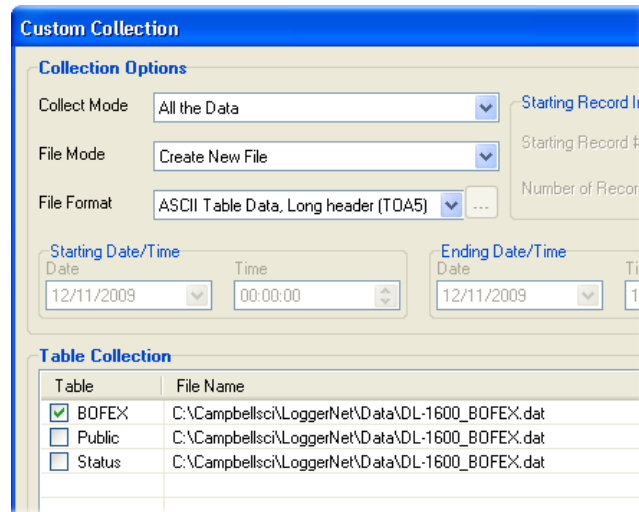
When collecting readings for the first time, you may need to collect all the data from the test box. This will set all memory pointers so that the next time you collect readings, the datalogger will know what readings were previously collected, and only new readings will be collected. All new readings will be appended to the previously collected file, or a new file will be created.

- Click **Start Collection**. The following message will appear, showing the collection progress and total records collected.

**Note:** A single record includes the timestamp, the record number, all sensors readings in Celcius degrees, and finally, the datalogger's battery voltage.



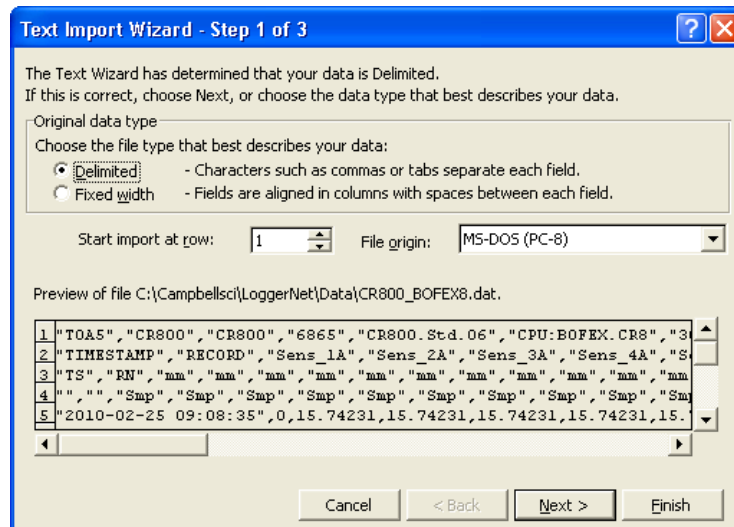
If the message window shows zero records collected, set the **Collection Options** as follow and do the **Start Collection** again.



All collected readings are saved in the file specified under Table Collection. The readings saved with the file format **ASCII Table Data, Long header (TOA5)** are separated by commas (CSV) and can be imported into Microsoft Excel for data reduction.

## 7.1 Import Readings Into Excel

- Start Excel, go to **File > Open**, in the **Files of type** field, then select **All Files (\*)**.
- Locate and select the file to import and click **Open**. The Text Import Wizard will open.



The Text Wizard has determined that your data is Delimited.  
If this is correct, choose Next, or choose the data type that best describes your data.

Original data type

Choose the file type that best describes your data:

☒ **Delimited** - Characters such as commas or tabs separate each field.  
☐ **Fixed width** - Fields are aligned in columns with spaces between each field.

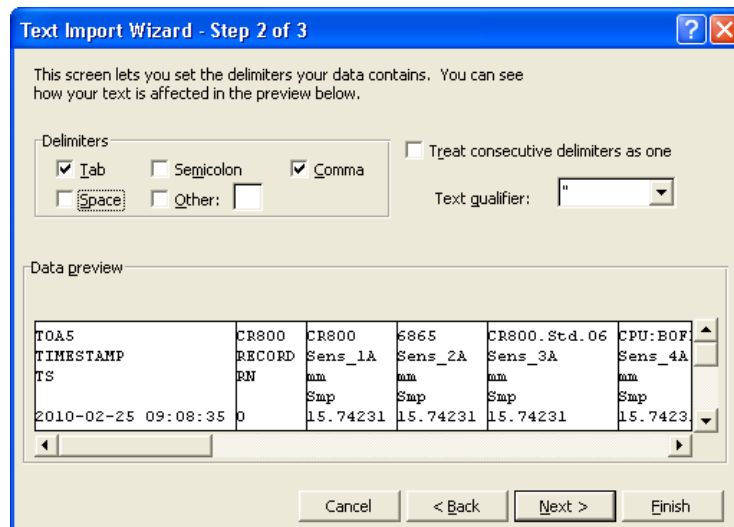
Start import at row:  File origin:

Preview of file C:\Campbellsci\LoggerNet\Data\CR800\_BOFEX8.dat.

|   |                                                                                  |
|---|----------------------------------------------------------------------------------|
| 1 | "TOA5", "CR800", "CR800", "6865", "CR800.Std.06", "CPU:BOFEX.CR8", "3            |
| 2 | "TIMESTAMP", "RECORD", "Sens_1A", "Sens_2A", "Sens_3A", "Sens_4A", "S            |
| 3 | "TS", "RN", "mm", "mm", "mm", "mm", "mm", "mm", "mm", "mm", "mm", "mm            |
| 4 | "", "", "Smp", "Smp", "Smp", "Smp", "Smp", "Smp", "Smp", "Smp", "Smp", "Smp      |
| 5 | "2010-02-25 09:08:35", "0", "15.74231", "15.74231", "15.74231", "15.74231", "15. |

Cancel < Back Next > Finish

- Select **Delimited** and click **Next**.



This screen lets you set the delimiters your data contains. You can see how your text is affected in the preview below.

Delimiters

☒ **Tab** ☐ Semicolon ☒ **Comma** ☐ Treat consecutive delimiters as one  
☐ Space ☐ Other:

Text qualifier:

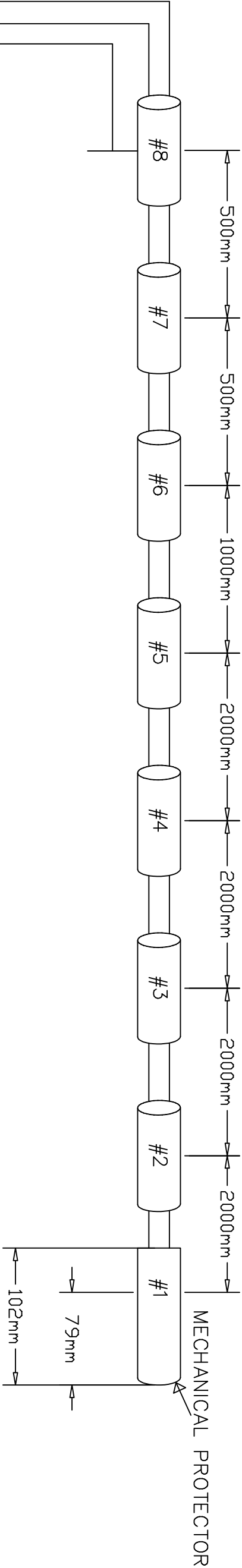
Data preview

|                     |        |          |          |              |         |
|---------------------|--------|----------|----------|--------------|---------|
| TOA5                | CR800  | CR800    | 6865     | CR800.Std.06 | CPU:BOF |
| TIMESTAMP           | RECORD | Sens_1A  | Sens_2A  | Sens_3A      | Sens_4A |
| TS                  | RN     | mm       | mm       | mm           | mm      |
|                     |        | Smp      | Smp      | Smp          | Smp     |
| 2010-02-25 09:08:35 | 0      | 15.74231 | 15.74231 | 15.74231     | 15.7423 |

Cancel < Back Next > Finish

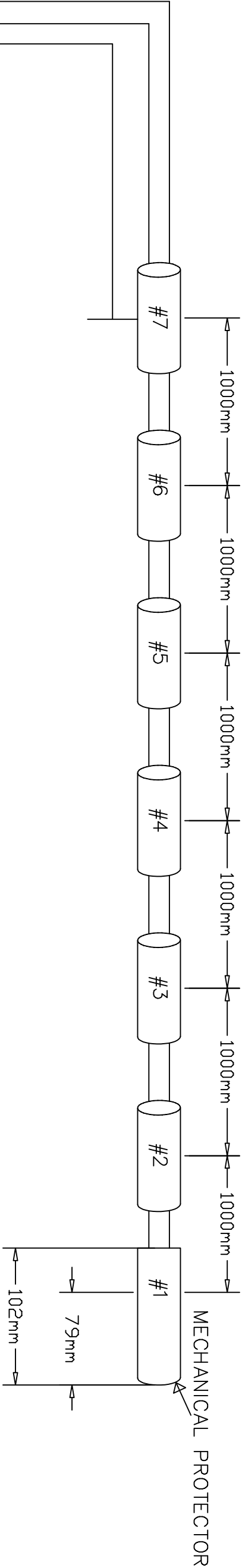
- Select **Tab**, **Comma** and click **Finish**.

|    | A                | B      | C        | D        | E        | F        | G        | H        | I        | J        | K        | L        | M       | N    |
|----|------------------|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------|------|
| 1  | TOA5             | CR800  | CR800    | 6865     | CR800    | Stc      | CPU:BOF  | 3022     | BOFEX    |          |          |          |         |      |
| 2  | TIMESTAMP        | RECORD | Sens_1A  | Sens_2A  | Sens_3A  | Sens_4A  | Sens_5A  | Sens_1B  | Sens_2B  | Sens_3B  | Sens_4B  | Sens_5B  | S_Range | Load |
| 3  | TS               | RN     | mm       | mm       | mm       | mm       | mm       | mm       | mm       | mm       | mm       | mm       | mm      |      |
| 4  |                  |        | Smp      | Smp      | Smp      | Smp      | Smp      | Smp      | Smp      | Smp      | Smp      | Smp      | Smp     | Smp  |
| 5  | 25/09/2009 09:08 | 0      | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 50      | 0    |
| 6  | 25/09/2009 09:08 | 1      | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 50      | 0    |
| 7  | 25/09/2009 09:08 | 2      | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 50      | 0    |
| 8  | 25/09/2009 09:08 | 3      | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 50      | 0    |
| 9  | 25/09/2009 09:08 | 4      | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 15.74231 | 50      | 0    |
| 10 |                  |        |          |          |          |          |          |          |          |          |          |          |         |      |



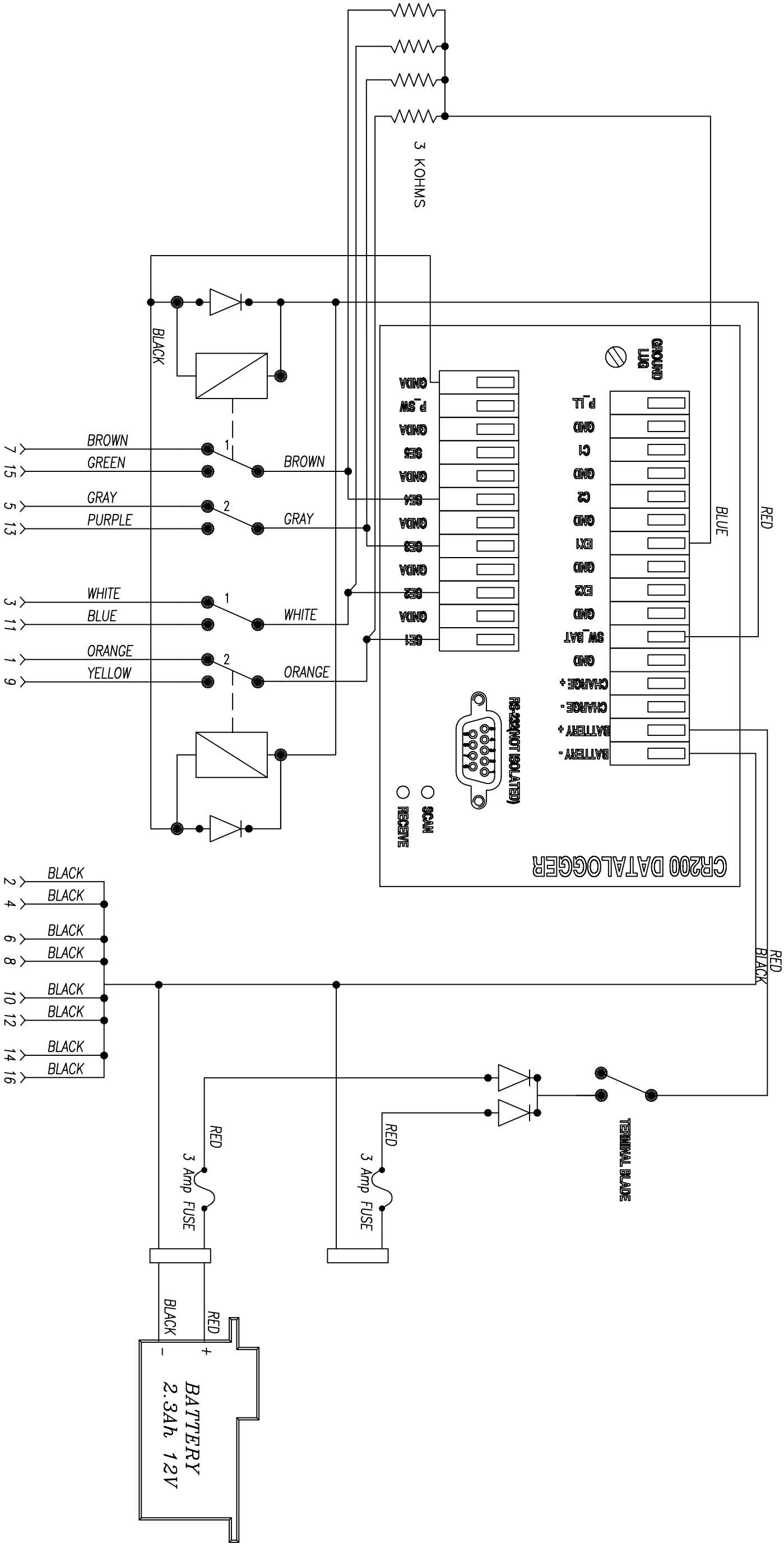
| Position / wire color |                             | Connector pin |
|-----------------------|-----------------------------|---------------|
| 10 m                  | color: black - white/black  | 15-16         |
| 8 m                   | color: black - blue/black   | 13-14         |
| 6 m                   | color: black - orange/black | 11-12         |
| 4 m                   | color: red - gray/red       | 9-10          |
| 2 m                   | color: red - white/red      | 7-8           |
| 1 m                   | color: green - red/green    | 5-6           |
| 0.5m                  | color: red - orange/red     | 3-4           |
| 0 m                   | color: blue - white/blue    | 1-2           |

|                                          |  |             |  |             |  |         |  |                             |  |                         |  |             |  |         |  |          |  |   |  |
|------------------------------------------|--|-------------|--|-------------|--|---------|--|-----------------------------|--|-------------------------|--|-------------|--|---------|--|----------|--|---|--|
| <div><div></div><div>ROCTEST</div></div> |  |             |  | APPLICATION |  |         |  | THERMISTOR STRING 12 meters |  |                         |  |             |  |         |  |          |  |   |  |
|                                          |  |             |  | TITLE       |  |         |  |                             |  |                         |  |             |  |         |  |          |  |   |  |
| REVISION                                 |  |             |  | DRAW        |  | D.LABRE |  | 10-06-18                    |  | WIRING SCHEMATIC TO DAS |  |             |  |         |  |          |  |   |  |
| NO.                                      |  | DESCRIPTION |  | DATE        |  | APPR.   |  | CHECK                       |  |                         |  |             |  | D.LABRE |  | 10-06-18 |  |   |  |
|                                          |  |             |  |             |  |         |  | DESIGNED                    |  |                         |  |             |  | D.LABRE |  | 10-06-18 |  |   |  |
|                                          |  |             |  |             |  |         |  | APPROVED                    |  |                         |  |             |  | D.LABRE |  | 10-06-18 |  |   |  |
|                                          |  |             |  |             |  |         |  |                             |  |                         |  |             |  | SCALE   |  | N/A      |  |   |  |
|                                          |  |             |  | PAGE 1 OF 1 |  |         |  | CODE NO.                    |  | 137                     |  | DRAWING NO. |  | 60499_1 |  | REV. NO. |  | 0 |  |



| Position / wire color            | Connector pin |
|----------------------------------|---------------|
| 27 m color: black - white/black  | 1-2           |
| 26 m color: blue - white/blue    | 3-4           |
| 25 m color: red - orange/red     | 5-6           |
| 24 m color: green - red/green    | 7-8           |
| 23 m color: black - blue/black   | 9-10          |
| 22 m color: black - orange/black | 11-12         |
| 21 m color: red - gray/red       | 13-14         |
|                                  |               |

|                                          |  |             |             |          |                             |             |         |
|------------------------------------------|--|-------------|-------------|----------|-----------------------------|-------------|---------|
| <div><div></div><div>ROCTEST</div></div> |  |             | APPLICATION |          | THERMISTOR STRING 29 meters |             |         |
|                                          |  |             | TITLE       |          | WIRING SCHEMATIC TO DAS     |             |         |
| REVISION                                 |  |             | DRAWN       | D. LABRE | 10-06-18                    | PAGE 1 OF 1 |         |
| NO.                                      |  | DESCRIPTION | DATE        | APPR.    | CHECK                       |             |         |
|                                          |  |             |             |          | D. LABRE                    |             |         |
|                                          |  |             |             |          | DESIGNED D. LABRE           |             |         |
|                                          |  |             | APPROVED    | D. LABRE | 10-06-18                    | SCALE       | N/A     |
|                                          |  |             |             |          |                             | CODE NO.    | 137     |
|                                          |  |             |             |          |                             | DRAWING NO. | 60499_2 |
|                                          |  |             |             |          |                             | REV. NO.    | 0       |



|                     |  |  |  | <div>APPLICATION</div> |  | <div>DATA ACQUISITION SYSTEM</div> |  |             |  |          |  |
|---------------------|--|--|--|------------------------|--|------------------------------------|--|-------------|--|----------|--|
| <div>REVISION</div> |  |  |  | DRAW                   |  | TITLE                              |  |             |  |          |  |
|                     |  |  |  | D.LABRE                |  | 10-06-18                           |  |             |  |          |  |
| NO.                 |  |  |  | CHECK                  |  | WIRING SCHEMATIC                   |  |             |  |          |  |
| DESCRIPTION         |  |  |  | D.LABRE                |  |                                    |  |             |  |          |  |
| DATE                |  |  |  | 10-06-18               |  |                                    |  |             |  |          |  |
| APPR.               |  |  |  |                        |  |                                    |  |             |  |          |  |
|                     |  |  |  | DESIGNED               |  |                                    |  |             |  |          |  |
|                     |  |  |  | D.LABRE                |  |                                    |  |             |  |          |  |
|                     |  |  |  | 10-06-18               |  |                                    |  |             |  |          |  |
|                     |  |  |  | APPROVED               |  |                                    |  |             |  |          |  |
|                     |  |  |  | D.LABRE                |  |                                    |  |             |  |          |  |
|                     |  |  |  | 10-06-18               |  |                                    |  |             |  |          |  |
|                     |  |  |  | PAGE 1 OF 1            |  | CODE NO.                           |  | DRAWING NO. |  | REV. NO. |  |
|                     |  |  |  |                        |  | 137                                |  | 60499_3     |  | 0        |  |

## **Appendix G - Technical Specifications Facility Sign**



**14 X**

## 4 TROUS

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◀<sup>ᵃ</sup> J ᵇ ᵇ ᵇ ᵇ ▶ ᵇ ᵇ ◀<sup>ᶜ</sup> ᵇ ᵇ ᵇ ᵇ

# SEWAGE TREATMENT FACILITY

**NO GATHERING  
OR  
HARVESTING**

## PANNEAU 60 X 45 CM X 3,2 MM

## TEXTE ET BORDURE NOIRS

## SUR FOND BLANC G.I.

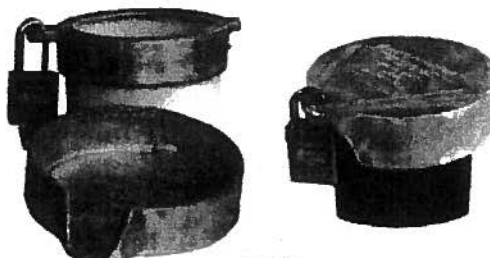
## **Appendix H - Technical Specifications Monitoring Wells**


[www.aquamerik.com](http://www.aquamerik.com)

## Well Caps

### Locking well

| ITEM             | Ø       | WEIGHT          |
|------------------|---------|-----------------|
| → <b>412LKWC</b> | 4-1/2"  | 1.7 lb (0.8 kg) |
| → <b>658LKWC</b> | 6-5/8"  | 2.1 lb (1 kg)   |
| <b>834LKWC</b>   | 8-3/4"  | 2.7 lb (1.2 kg) |
| <b>1034LKWC</b>  | 10-3/4" | 5.4 lb (2.5 kg) |
| <b>1234LKWC</b>  | 12-3/4" | 6.5 lb (2.9 kg) |



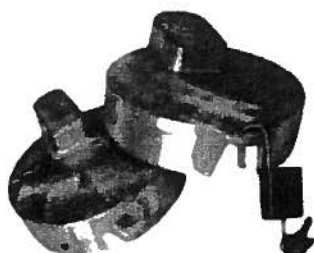
#### ACCESSORIES

|                 |                              |
|-----------------|------------------------------|
| → <b>HDPE-4</b> | DR-21 HDPE pipe, size 4-1/2" |
| → <b>HDPE-6</b> | DR-21 HDPE pipe, size 6-5/8" |
| <b>834-102</b>  | 40mm padlock #834            |



caps

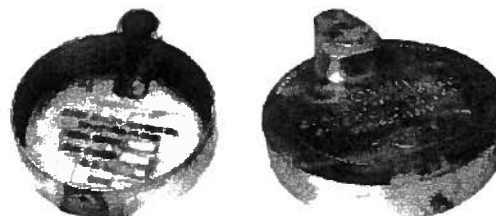
### Locking conduit well caps



| ITEM            | DIAM.  | CONDUIT |
|-----------------|--------|---------|
| <b>6LKCC1</b>   | 6"     | 1"      |
| <b>834LKCC1</b> | 8 1/4" | 1"      |
| <b>10LKCC1</b>  | 10"    | 1"      |

### Locking watertight conduit well

| ITEM          | DIAM.  | CONDUIT |
|---------------|--------|---------|
| <b>558CC1</b> | 5-5/8" | 1"      |
| <b>658CC1</b> | 6-5/8" | 1"      |
| <b>834CC1</b> | 8-3/4" | 1"      |



caps

### Watertight well caps


[www.aquamerik.com](http://www.aquamerik.com)

## Tread flush joint

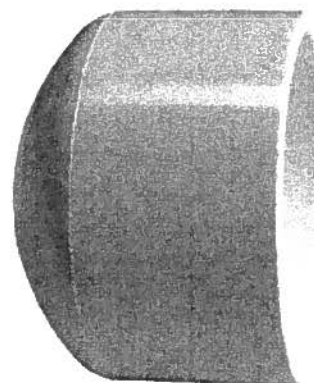
### MALE CAPS



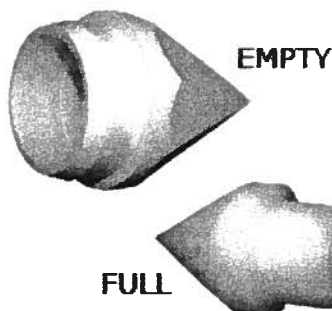
| ITEM           | DIAMETER | TYPE   |
|----------------|----------|--------|
| <b>CMS-007</b> | ¾"       | Insert |
| <b>CMS-010</b> | 1"       | Insert |
| <b>CMS-015</b> | 1½"      | Insert |
| <b>CMS-020</b> | 2"       | Insert |
| <b>CMS-030</b> | 3"       | Insert |
| <b>CMS-040</b> | 4"       | Insert |
| <b>CMS-050</b> | 5"       | Insert |
| <b>CMS-060</b> | 6"       | Insert |
| <b>CMS-080</b> | 8"       | Insert |

### FEM CAPS

| ITEM              | DIAMETER | TYPE   |
|-------------------|----------|--------|
| <b>CF447005</b>   | ¾"       | Insert |
| <b>CF447007</b>   | ¾"       | Insert |
| <b>CF447010</b>   | 1"       | Insert |
| <b>CF447015</b>   | 1½"      | Insert |
| → <b>CF447020</b> | 2"       | Insert |
| <b>CF447030</b>   | 3"       | Insert |
| <b>CF447040</b>   | 4"       | Insert |
| <b>CF447060</b>   | 6"       | Insert |
| <b>CF447080</b>   | 8"       | Insert |



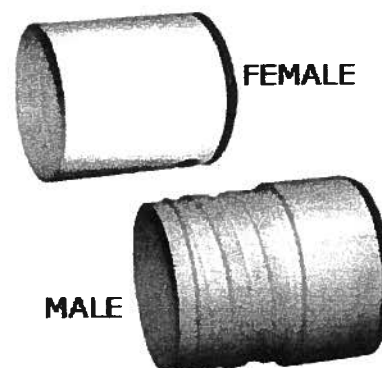
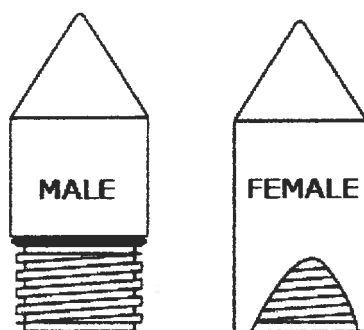
### INSERTION POINT



| ITEM           | DIAMETER | TYPE  |
|----------------|----------|-------|
| <b>PIP-007</b> | ¾"       | Full  |
| <b>PI-010</b>  | 1"       | Empty |
| <b>PIP-010</b> | 1"       | Full  |
| <b>PI-015</b>  | 1½"      | Empty |
| <b>PIP-015</b> | 1½"      | Full  |
| <b>PI-020</b>  | 2"       | Empty |
| <b>PIP-020</b> | 2"       | Full  |

**TFJ CAPS**

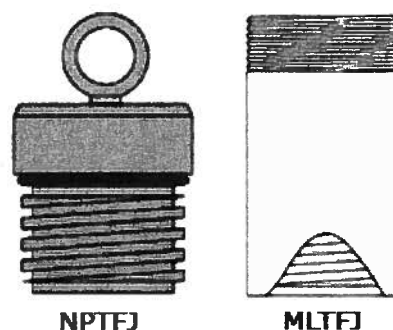
| ITEM             | DIAMETER | TYPE       |
|------------------|----------|------------|
| <b>CTFJ-007M</b> | 3/4"     | TFJ male   |
| <b>CTFJ-007F</b> | 3/4"     | TFJ female |
| <b>CTFJ-010M</b> | 1"       | TFJ male   |
| <b>CTFJ-010F</b> | 1"       | TFJ female |
| <b>CTFJ-015M</b> | 1 1/2"   | TFJ male   |
| <b>CTFJ-015F</b> | 1 1/2"   | TFJ female |
| <b>CTFJ-020M</b> | 2"       | TFJ male   |
| <b>CTFJ-020F</b> | 2"       | TFJ female |

**TFJ POINT**

| ITEM             | DIAMETER | TYPE       |
|------------------|----------|------------|
| <b>PTFJ-007M</b> | 3/4"     | TFJ male   |
| <b>PTFJ-007F</b> | 3/4"     | TFJ female |
| <b>PTFJ-010M</b> | 1"       | TFJ male   |
| <b>PTFJ-010F</b> | 1"       | TFJ female |
| <b>PTFJ-015M</b> | 1 1/2"   | TFJ male   |
| <b>PTFJ-015F</b> | 1 1/2"   | TFJ female |
| <b>PTFJ-020M</b> | 2"       | TFJ male   |
| <b>PTFJ-020F</b> | 2"       | TFJ female |

**TFJ ACCESS.**

| ITEM              | DIAMETER | TYPE      |
|-------------------|----------|-----------|
| <b>MLTFJ-020</b>  | 2"       | TFJ male  |
| <b>MLTFJ-040</b>  | 4"       | TFJ male  |
| <b>MLTFJ-060</b>  | 6"       | TFJ male  |
| <b>NPTTFJ-007</b> | 3/4"     | NPT / TFJ |
| <b>NPTTFJ-010</b> | 1"       | NPT / TFJ |
| <b>NPTTFJ-015</b> | 1 1/2"   | NPT / TFJ |
| <b>NPTTFJ-020</b> | 2"       | NPT / TFJ |
| <b>NPTTFJ-040</b> | 4"       | NPT / TFJ |



| ITEM    | DESCRIPTION                 |
|---------|-----------------------------|
| CMS-007 | Insertion male caps 3/4".   |
| CMS-010 | Insertion male caps 1".     |
| CMS-015 | Insertion male caps 1-1/2". |
| CMS-020 | Insertion male caps 2".     |



www.aquamerik.com

## Intake Screens

Aquamerik Threaded Flush Joint is manufactured on "CNC" computer controlled machines.

Close machining tolerances are maintained to ensure an exact fit every time. A taper and relief area is designed into every end to allow the joints to be positioned and started easily without cross threading.

Flush Joints eliminate the need for couplings allowing the pipe to be assembled without the use of solvents. Flush Joints also help to prevent bridging of the backfill materials and can be installed in small diameter openings.

Hybrid wells can be constructed using PVC, Stainless Steel and other materials.

**Construction:** PVC (standard), CPVC, HDPE, PP

**Pipe length:** more than 20 feet (10 feet standard)

**Pipe diameter:** 1/2" to 24".

**Construction:** Sch40 (standard) -Sch80 - SDR

**Slot Sizes:** 0.006" & + (0.010" standard)

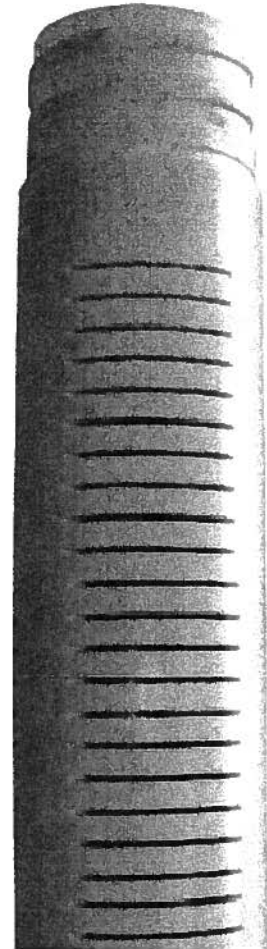
**Slot Spacing:** 0.100" & + (0.250" standard)

\*Consult factory for pipe sizes available.

Please consult us for your specific requirements. Some materials may not be available in all sizes.

**DISCOUNT AVAILABLE ON QUANTITY, DON'T HESITATE TO CALL**

**TOOL FREE: (888) 278-4776**



| <u>ITEM</u> | <u>DESCRIPTION</u>                         |
|-------------|--------------------------------------------|
| WS075-5-10  | 3/4" x 5' x 0.01" screen TFJ PVC sch 40    |
| WS075-10-10 | 3/4" x 10' x 0.01" screen TFJ PVC sch 40   |
| WS100-5-10  | 1" x 5' x 0.01" screen TFJ PVC sch 40      |
| WS100-10-10 | 1" x 10' x 0.01" screen TFJ PVC sch 40     |
| WS100-10-20 | 1" x 10' x 0.02" screen TFJ PVC sch 40     |
| WS100-10-40 | 1" x 10' x 0.04" screen TFJ PVC sch 40     |
| WS150-5-10  | 1 1/2" x 5' x 0.01" screen TFJ PVC sch 40  |
| WS150-10-10 | 1 1/2" x 10' x 0.01" screen TFJ PVC sch 40 |
| WS150-10-20 | 1 1/2" x 10' x 0.02" screen TFJ PVC sch 40 |

WS150-10-40 1½" x 10' x 0.04" screen TFJ PVC sch 40  
 WS200-5-10 2" x 5' x 0.01" screen TFJ PVC sch 40  
 → WS200-10-10 2" x 10' x 0.01" screen TFJ PVC sch 40  
 WS200-10-20 2" x 10' x 0.02" screen TFJ PVC sch 40  
 WS200-10-40 2" x 10' x 0.04" screen TFJ PVC sch 40  
 WS200-10-80 2" x 10' x 0.08" screen TFJ PVC sch 40  
 WS300-5-10 3" x 5' x 0.01" screen TFJ PVC sch 40  
 WS300-10-10 3" x 10' x 0.01" screen TFJ PVC sch 40  
 WS300-10-20 3" x 10' x 0.01" screen TFJ PVC sch 40  
 WS300-10-40 3" x 10' x 0.01" screen TFJ PVC sch 40  
 WS400-5-10 4" x 5' x 0.01" screen TFJ PVC sch 40  
 WS400-10-10 4" x 10' x 0.01" screen TFJ PVC sch 40  
 WS400-10-20 4" x 10' x 0.02" screen TFJ PVC sch 40  
 WS400-10-40 4" x 10' x 0.04" screen TFJ PVC sch 40  
 WS600-5-10 6" x 5' x 0.01" screen TFJ PVC sch 40  
 WS600-10-10 6" x 10' x 0.01" screen TFJ PVC sch 40  
 WS600-10-20 6" x 10' x 0.02" screen TFJ PVC sch 40  
 WS600-10-40 6" x 10' x 0.04" screen TFJ PVC sch 40  
 WS800-10-10 8" x 10' x 0.01" screen TFJ PVC sch 40  
 WS800-10-20 8" x 10' x 0.02" screen TFJ PVC sch 40  
 WS800-10-40 8" x 10' x 0.04" screen TFJ PVC sch 40  
 WS075-5 Screen PVC ¾" diam. x 5'  
 WS075-10 Screen PVC ¾" diam. x 10'  
 WS100-5 Screen PVC 1" diam. x 5'  
 WS100-10 Screen PVC 1" diam. x 10'  
 WS150-5 Screen PVC 1 ½" diam. x 5'  
 WS150-10 Screen PVC 1 ½" diam. x 10'  
 WS200-5 Screen PVC 2" diam. x 5'  
 WS200-10 Screen PVC 2" diam. x 10'  
 WS300-5 Screen PVC 3" diam. x 5'  
 WS300-10 Screen PVC 3" diam. x 10'  
 WS400-5 Screen PVC 4" diam. x 5'  
 WS400-10 Screen PVC 4" diam. x 10'  
 WS600-5 Screen PVC 6" diam. x 5'  
 WS600-10 Screen PVC 6" diam. x 10'  
 WS800-5 Screen PVC 8" diam. x 5'  
 WS800-10 Screen PVC 8" diam. x 10'

**Last Update: January 20, 2010**



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## Bentonite

| <u>ITEM</u> | <u>DESCRIPTION</u>                          |
|-------------|---------------------------------------------|
| MEDIUM      | Holeplug 3/8", bag of 50 lb.                |
| COARSE      | Holeplug 3/4", bag of 50 lbs.               |
| B313        | Quik-gel 200 mesh, bag of 50 lbs.           |
| B304        | Benseal #8, bag of 50 lbs.                  |
| GRA-38      | Granular bentonite, 3/8", bucket of 50 lbs. |

**Last Update: January 29, 2010**



## TABLEAU DE RÉFÉRENCE



### PRODUIT

### DESCRIPTION

#### Agent de scellement et de colmatage

| PRODUIT        | DESCRIPTION                        | RÉDUCTEUR DE FILTRANT | VISCOSITÉ / ÉPAISSISSANT | FORAGE AIR / MOUSSE | CIMENTATION ET COLMATAGE | COLMATAGE DE BASSIN | STABILISATION DES SOLS | HOMOLOGUE NSF | PUITS D'EAU | TROUS DE TIRS SISMQUES | EXPLORATION MINÉRALE | FORAGE HORIZONTAL | PUITS FORÉS ET FOND | PUITS DE REMÉDIATION | PUITS DE CONTRÔLE | EAU DOUCE | EAU SAUMÂTRE | EAU SALÉE |
|----------------|------------------------------------|-----------------------|--------------------------|---------------------|--------------------------|---------------------|------------------------|---------------|-------------|------------------------|----------------------|-------------------|---------------------|----------------------|-------------------|-----------|--------------|-----------|
| Pellets 1/4" ® | Granule de bentonite sodique       |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |
| Pellets 3/8" ® | Granule de bentonite sodique       |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |
| Pellets 1/2" ® | Granule de bentonite sodique       |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |
| Coarse         | Ben. sodique calibrée -3/4" + 3/8" |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |
| Holeplug ®     | Ben. sodique calibrée -3/8" + 1/4" |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |
| Casina Seal ®  | Mélange ben. sodique (cal. 8 à 14) |                       |                          |                     |                          |                     |                        |               |             |                        |                      |                   |                     |                      |                   |           |              |           |

#### Agent de cimentation souterraine

|             |                                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|---------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Aquaguard ® | Ciment de bentonite sodique (cal. 30) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|---------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Produit gélifiant; améliorant la viscosité (ht rend.)

|             |                                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|---------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Quick Gel ® | Bentonite sodique traitée, haut rend. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|---------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Produit gélifiant; améliorant la viscosité

|            |                                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|------------|-----------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Aqua Gel ® | Montmorillonite sod. traitée (cal. 200) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|------------|-----------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Agent moussant

|              |                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------------|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Drill Foam ® | Agent moussant biodégradable |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--------------|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Agent stabilisateur; améliorant la viscosité

|           |                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| E-Z Mud ® | Émulsion de polymères liquide PHPA |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Agent de mouillage

|           |                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|-------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Con Det ® | Surfactant soluble dans l'eau |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|-------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

#### Fluide de forage horizontal

|           |                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Boregel ® | Fluide de forage |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

Fonction principale

Fonction secondaire

### TABLEAU DU TAUX D'APPLICATION DES PRODUITS ENVIROPLUG

#### AUSSI DISPONIBLE:

- ENVIROPLUG GRANULE
- ENVIROPLUG GROUT
- DÉTERGENT
- THERM-EX GROUT
- PERCOL 728
- PRO-YIELD
- ZETAG 7692
- TRUBORE
- WYOMING GEL
- PRO-FARM
- PRO-PAC
- POLY-PRO
- HYDROGEL
- SODA-ASH

| Diamètre du trou | Aquaguard           |                    | Holeplug          |                    | Coarse            |                    |
|------------------|---------------------|--------------------|-------------------|--------------------|-------------------|--------------------|
|                  | Gal. / pied de trou | Pied de trou / sac | LB / pied de trou | Pied de trou / sac | LB / pied de trou | Pied de trou / sac |
| 2.50"            | 0.25                | 68.00              | 2.50              | 20.00              | NR                | NR                 |
| 3.50"            | 0.50                | 34.00              | 5.50              | 10.00              | 4.25              | 11.75              |
| 4.00"            | 0.65                | 26.00              | 6.50              | 7.50               | 5.50              | 9.00               |
| 4.50"            | 0.83                | 20.50              | 8.50              | 5.75               | 7.00              | 7.00               |
| 5.00"            | 1.00                | 17.00              | 10.75             | 5.00               | 8.75              | 5.75               |
| 5.50"            | 1.23                | 13.80              | 12.50             | 4.00               | 10.50             | 5.50               |
| 6.00"            | 1.50                | 11.30              | 15.50             | 3.25               | 12.50             | 4.00               |
| 6.50"            | 1.70                | 10.00              | 20.50             | 2.50               | 14.75             | 3.50               |
| 8.00"            | 2.60                | 6.50               | 28.00             | 1.75               | 22.50             | 2.25               |
| 8.50"            | 2.90                | 5.90               | 32.00             | 1.50               | 25.25             | 2.00               |
| 10.00"           | 4.10                | 4.10               | 41.00             | 1.25               | 34.75             | 1.50               |
| 12.00"           | 5.90                | 2.90               | 80.00             | 0.75               | 50.00             | 1.00               |
| 16.00"           | 10.40               | 1.60               | 94.00             | 0.50               | 89.00             | 0.50               |



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## Filtration sands and gravels



The Aquamerik filtration Sand is composed of silica whole grains crystalline of a great hardness.

They are durable and dense, which enables them to be resistant to degradation.

Each grade is washed, dried and classified according to the most strict quality control. This sand is adequate for the use in the filters with pressure and density. It is also used in the filters of swimming pool like in various industrial processes and auxiliary applications.

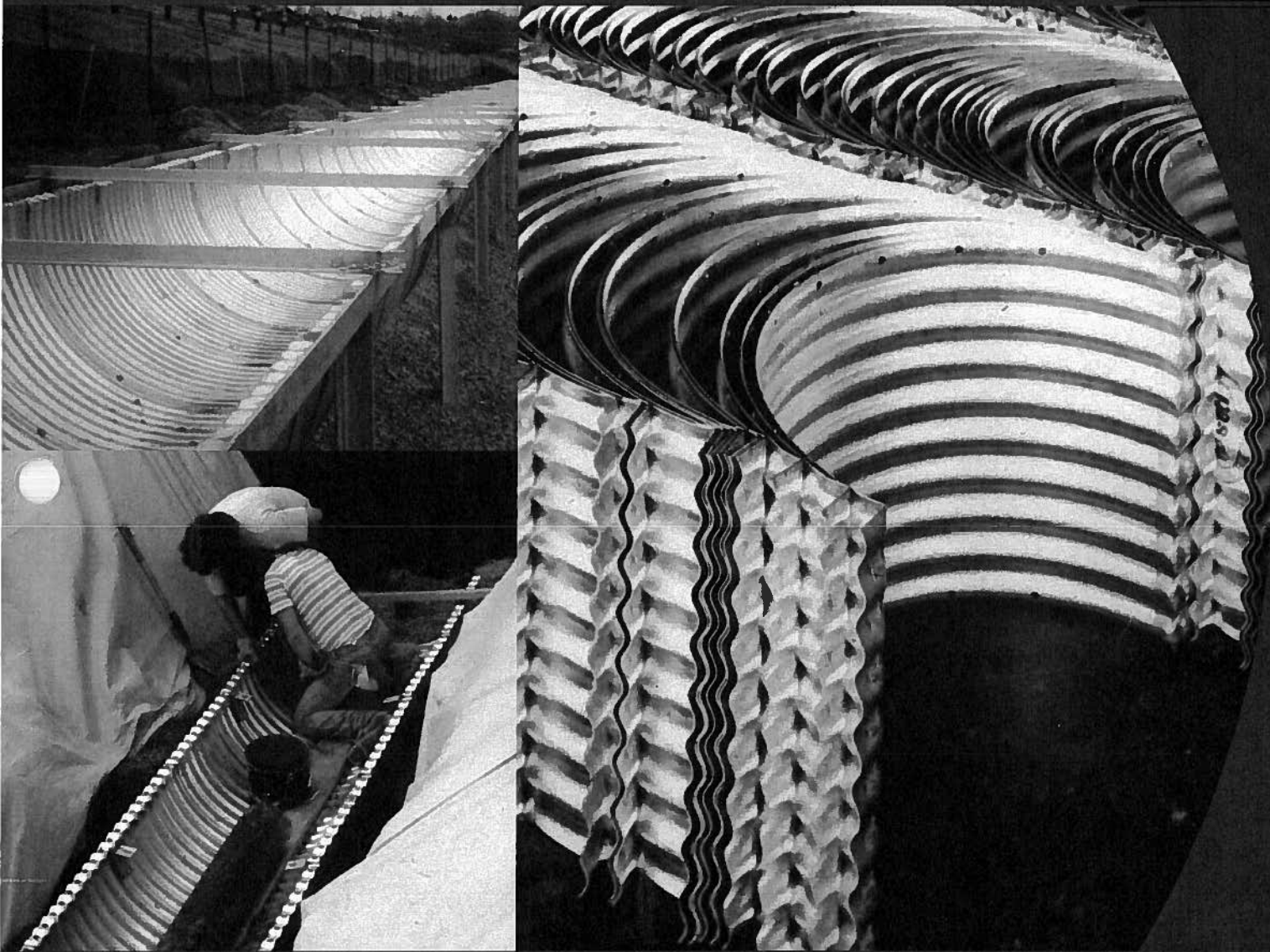
Moreover, our sands meet AWWA B-100, ANSI and NSF-61 standards. Shipped in 50 and 100 lbs bags, 3000 lbs available upon request.

These sands can also be used in the systems of industrial and municipal drinking water filtration. They are available in granulometry going from: 0.40mm, 1.5mm to 1/16"

| <u>ITEM</u> | <u>DESCRIPTION</u>                                               |
|-------------|------------------------------------------------------------------|
| 507-22      | Filtration sand, 0.45 - 0.55 mm (0.017 - 0.021"), 50 lbs.        |
| 507-45      | Filtration sand, 0.45 - 0.55 mm (0.017 - 0.021"), 100 lbs.       |
| 520-22      | Filtration sand, 0.65 mm (0.025"), 50 lbs.                       |
| → SA-1      | Filtration sand, 0.65 - 0.75 mm (0.025 - 0.029"), 50 lbs.        |
| 521-22      | Filtration sand, 0.75 mm (0.029"), 50 lbs.                       |
| 521-45      | Filtration sand, 0.75 mm (0.029"), 100 lbs.                      |
| 516-22      | Filtration sand, 0.80 - 1.2 mm (0.031 - 0.047"), 50 lbs.         |
| 516-45      | Filtration sand, 0.80 - 1.2 mm (0.031 - 0.047"), 100 lbs.        |
| 509-22      | Filtration sand, 0.90 - 1.6 mm (0.035 - 0.063"), 50 lbs.         |
| 509-45      | Filtration sand, 0.90 - 1.6 mm (0.035 - 0.063"), 100 lbs.        |
| 530-22      | Filtration sand, 1.4 mm (0.055"), 50 lbs.                        |
| 529-22      | Filtration sand, 1.4 - 1.66 mm (0.035 - 0.065"), 50 lbs.         |
| 529-45      | Filtration sand, 1.4 - 1.66 mm (0.035 - 0.065"), 100 lbs.        |
| 510-22      | Filtration sand / gravel, 1.6 - 3.2 mm (1/16 - 1/8"), 50 lbs.    |
| 510-45      | Filtration sand / gravel, 1.6 - 3.2 mm (1/16 - 1/8"), 100 lbs.   |
| 525-22      | Filtration sand/gravel, 1.7 - 3.35 mm (0.067 - 0.131"), 50 lbs.  |
| 524-22      | Filtration sand / gravel, 2.00 - 4.75 mm (0.078-0.187"), 50 lbs. |
| 512-22      | Filtration gravel, 3.2 - 6.4 mm (1/8 - 1/4"), 50 lbs.            |
| 512-45      | Filtration gravel, 3.2 - 6.4 mm (1/8 - 1/4"), 100 lbs.           |

## **Appendix I - Technical Specifications Nested Pipe**

# FLANGED NESTABLE CORRUGATED STEEL PIPE



# FLANGED NESTABLE CORRUGATED STEEL PIPE

**Flanged Nestable Corrugated Steel Pipe** consists of half-round sections with side flanges that can be easily bolted together to form a circular corrugated steel pipe.

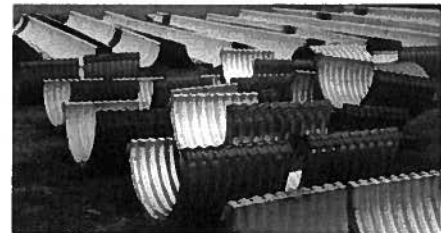
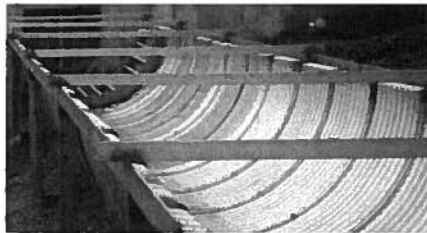
Flanged Nestable Pipe has many uses – as culverts, storm sewers, drains, casing and utilidors. The product is especially useful where a casing is to be installed around an existing utility without disturbing its operation.

The 610 mm long sections, all galvanized to Z 610, provide a product that is highly durable under normal conditions and which has proven itself since it was first produced in the early 1930's. Flanged Nestable is also available in Aluminized Steel Type II for added durability.

The sections are shipped nested and bundled together to save space during shipping. This results in cost savings, especially where the product is being shipped long distances to remote northern areas or overseas.

**FASTENING METHOD:** Flanged Nestable Pipe is easily assembled and no special instructions are necessary. Simple tools such as spud or socket wrenches are all that is required.

**FLANGED NESTABLE PIPE SPECIFICATIONS:** Half round sections are manufactured from 68 mm x 13 mm corrugated galvanized or Aluminized Type II in accordance with CSA G401 corrugated steel pipe products. Five corrugation long pieces are used on the top at both ends to introduce a circumferential seam stagger. The 50 mm wide flanges have slotted holes spaced at 68 mm centre to centre on both sides and are bolted together using galvanized 10 mm diameter bolts and nuts. All circumferential laps should be in the direction of flow.



## H2O Live Load Steel Thickness of Flanged Nestable Pipe (mm)

| DIAMETER<br>mm | AREA<br>m <sup>2</sup> | HEIGHT OF COVER ABOVE TOP OF PIPE IN METRES |     |     |     |     |
|----------------|------------------------|---------------------------------------------|-----|-----|-----|-----|
|                |                        | 3                                           | 4.5 | 6.0 | 7.5 | 9.0 |
| 300            | .07                    | 1.6                                         | 1.6 | 1.6 | 1.6 | 1.6 |
| 400            | .13                    | 1.6                                         | 1.6 | 1.6 | 1.6 | 1.6 |
| 450            | .16                    | 1.6                                         | 1.6 | 1.6 | 2.0 | 2.0 |
| 500            | .20                    | 1.6                                         | 1.6 | 1.6 | 2.0 | 2.0 |
| 600            | .28                    | 1.6                                         | 1.6 | 2.0 | 2.0 | 2.0 |
| 700            | .38                    | 2.0                                         | 2.0 | 2.0 | 2.0 | 2.8 |
| 800            | .50                    | 2.0                                         | 2.0 | 2.0 | 2.8 | 2.8 |
| 900            | .64                    | 2.0                                         | 2.0 | 2.0 | 2.8 | 2.8 |
| 1000           | .79                    | 2.0                                         | 2.0 | 2.8 | 2.8 | 2.8 |
| 1200           | 1.13                   | 2.8                                         | 2.8 | 2.8 | 2.8 | 3.5 |
| 1400           | 1.51                   | 2.8                                         | 2.8 | 2.8 | 3.5 | 3.5 |
| 1600           | 2.01                   | 2.8                                         | 2.8 | 3.5 | 3.5 | 3.5 |

**Note:** 1. Minimum Cover is 300 mm up to 1200 mm diameter and 500 for 1400 mm and 1600 mm diameter.  
2. Structures should be backfilled with well compacted granular backfill to a minimum of 95% Standard Proctor Density.

## Approximate Weights kg/m

| DIAMETER<br>mm | WALL THICKNESS mm |     |     |     |
|----------------|-------------------|-----|-----|-----|
|                | 1.6               | 2.0 | 2.8 | 3.5 |
| 300            | 18                | 22  | 31  | 39  |
| 400            | 22                | 28  | 39  | 49  |
| 450            | 24                | 31  | 43  | 54  |
| 500            | 27                | 34  | 48  | 60  |
| 600            | 31                | 39  | 54  | 68  |
| 700            | 36                | 45  | 62  | 79  |
| 800            | 41                | 51  | 70  | 89  |
| 900            | 45                | 56  | 77  | 97  |
| 1000           | 48                | 61  | 83  | 101 |
| 1200           | 59                | 74  | 102 | 126 |
| 1400           | 68                | 85  | 118 | 146 |
| 1600           | 78                | 97  | 134 | 166 |



**Head Office: 370 Speedvale Ave. W., P.O. Box 3000, Guelph, Ontario N1H 6P2**  
**[www.armtec.com](http://www.armtec.com)**

**Sales Offices:**

Nanaimo, Prince George, Langley, Edmonton, Calgary, Lethbridge, Saskatoon, Winnipeg, Thunder Bay, Sudbury, Guelph, Toronto, Peterborough, Chesterville, Forest, Orangeville, Comber, Montreal, Quebec City, St. Clet, Sackville, Truro, Summerside, Bishop's Falls and St. John's.

FNP/BP/30C/0607

## **Appendix J - Technical Specifications Geotextile**

**7612**
**Texel®**  
 A DIVISION OF  
 UNE DIVISION DE **ADS INC.**

## IDENTIFICATION DU PRODUIT

## EMBALLAGE ET EXPÉDITION

|                               |                                          |                           |                                                                                                                 |
|-------------------------------|------------------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------|
| Nom et code du produit:       | 7612 / 21902                             | Format:                   | Rouleaux                                                                                                        |
| Description:                  | 7612 3.50M PP GR H 100M BNQ 701          | Dimensions <sup>2</sup> : | 3.50 m X 100 m (ASTM D461.8 et .9)                                                                              |
| Type de produit: <i>model</i> | Non-tissé aiguilleté, Monofilament court | Emballage:                | Sac de plastique                                                                                                |
| Type de fibre:                | Polypropylène                            | Étiquetage:               | Des étiquettes identifiant le produit sont placées sur la queue du sac, sur le côté du rouleau et dans le tube. |
| Armature:                     | Aucune                                   |                           |                                                                                                                 |

FONCTION PREMIÈRE

☒ Séparation☐ Filtration☐ Imperméabilisation☐ Drainage☐ Protection☐ Renforcement

## SPÉCIFICATIONS DU PRODUIT

| PROPRIÉTÉS                               | MÉTHODE DE TEST | FRÉQUENCE | RÉSULTATS      | MIN <sup>1</sup> -MOY-MAX |
|------------------------------------------|-----------------|-----------|----------------|---------------------------|
| <b>Physiques</b>                         |                 |           |                |                           |
| Épaisseur <sup>2</sup>                   | ASTM D5199      | Standard  | 1.4 mm         | MIN                       |
| <b>Mécaniques</b>                        |                 |           |                |                           |
| Tension (SP)                             | ONGC 148.1-7.3  | Standard  | 800 N          | MIN                       |
| Tension (ST)                             | ONGC 148.1-7.3  | Standard  | 800 N          | MIN                       |
| Allongement à la rupture (SP)            | ONGC 148.1-7.3  | Standard  | 56% - 84%      | MIN-MAX                   |
| Allongement à la rupture (ST)            | ONGC 148.1-7.3  | Standard  | 56% - 84%      | MIN-MAX                   |
| Déchirure (SP)                           | ONGC 4.2-12.2   | Standard  | 360 N          | MIN                       |
| Déchirure (ST)                           | ONGC 4.2-12.2   | Standard  | 360 N          | MIN                       |
| Résistance à l'éclatement (Mullen)       | ONGC 4.2-11.1   | Standard  | 2275 kPa       | MIN                       |
| <b>Hydrauliques</b>                      |                 |           |                |                           |
| Diamètre d'ouverture de filtration (FOS) | ONGC 148.1-10   | 1 / an    | 70 µm - 130 µm | MIN-MAX                   |
| Perméabilité                             | ONGC 148.1-4    | 1 / an    | 0.96 s-1       | MIN                       |
| Perméabilité <sup>2</sup>                | ONGC 148.1-4    | 1 / an    | 0.20 cm/s      | MIN                       |

MIN<sup>1</sup> : valeurs minimales de la tolérance 95 de la spécification GCTTG 3001-06 en fonction de la valeur nominale de certification.<sup>2</sup>: Cette caractéristique ne fait pas partie de la certification à la spécification GCTTG 2001-06.

• Cette information technique provient du manufacturier et a été transcrite par Texel Géosol. L'utilisateur est par conséquent invité à s'assurer d'obtenir la dernière mise à jour.

• Le manufacturier n'offre aucune garantie et n'assume aucune responsabilité relative à l'usage, à l'installation et/ou à la convenance d'utilisation.

• Le manufacturier doit être informé de tout défaut ou non-conformité du produit avant son installation. Sa responsabilité se limite au remplacement du produit non-conforme ou défectueux.

• La conformité aux spécifications est basée sur un intervalle de confiance de 95% sur un lot.

- Les produits Texel sont fabriqués au Québec depuis 1967  
et sont contrôlés par un service de qualité certifiée.

Veuillez consulter notre représentant technique pour plus  
d'informations sur les produits Texel Géosol et sur les projets  
réalisés depuis près de 45 ans avec les géosynthétiques Texel Géosol.

Pour le service de coupe et couture  
en usine ou au chantier, veuillez  
consulter nos représentants.

distribué par:



Certifié ISO 9001 : 2008

• Tél.: (418) 658-0200 / 1 800 463-0088 • Téléc.: (418) 658-0477  
• [www.texelgeosol.com](http://www.texelgeosol.com) • [info@texelgeosol.com](mailto:info@texelgeosol.com)

MISE À JOUR CHEZ TEXEL GÉOSOL  
EN DATE DU: 2008-08-19 / 2010-09-07  
VÉRIFIÉ PAR: RT



TEXEL TECHNICAL DATA SHEET

# 7612

**Texel**<sup>®</sup>  
A DIVISION OF  
UNE DIVISION DE **APS INC.**

**PRODUCT IDENTIFICATION**

**PACKING AND SHIPPING**

|                        |                                             |                           |                                                                                                          |
|------------------------|---------------------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------|
| Product name and code: | 7612 / 21902                                | Format:                   | Rouleaux                                                                                                 |
| Description:           | 7612 3.50M PP GR H 100M BNQ 701             | Dimensions <sup>2</sup> : | 3.50 m X 100 m (ASTM D461.8 et .9)                                                                       |
| Product type:          | Needle punched nonwoven, short staple fiber | Packing:                  | Plastic bag                                                                                              |
| Fiber composition:     | Polypropylene                               | Labeling:                 | Tags identifying the product are placed: on the tail of the bag, on one side of the roll and in the core |
| Reinforcement:         | None                                        |                           |                                                                                                          |

FIRST FUNCTION

☒ Separation

☐ Filtration

☐ Proofing

☐ Drainage

☐ Protection

☐ Reinforcement

**PRODUCT SPECIFICATIONS**

| PROPERTIES                               | TEST METHOD    | FREQUENCY | RESULTS        | MIN <sup>1</sup> -MOY-MAX |
|------------------------------------------|----------------|-----------|----------------|---------------------------|
| <b>Physical</b>                          |                |           |                |                           |
| Thickness <sup>2</sup>                   | ASTM D5199     | Standard  | 1.4 mm         | MIN                       |
| <b>Mechanical</b>                        |                |           |                |                           |
| Elongation at break (CD)                 | CGSB 148.1-7.3 | Standard  | 800 N          | MIN                       |
| Elongation at break (MD)                 | CGSB 148.1-7.3 | Standard  | 800 N          | MIN                       |
| Tensile strength (CD)                    | CGSB 148.1-7.3 | Standard  | 56% - 84%      | MIN-MAX                   |
| Tensile strength (MD)                    | CGSB 148.1-7.3 | Standard  | 56% - 84%      | MIN-MAX                   |
| Tear strength (CD)                       | CGSB 4.2-12.2  | Standard  | 360 N          | MIN                       |
| Tear strength (MD)                       | CGSB 4.2-12.2  | Standard  | 360 N          | MIN                       |
| Bursting strength (Mullen)               | CGSB 4.2-12.2  | Standard  | 2275 kPa       | MIN                       |
| <b>Hydraulic</b>                         |                |           |                |                           |
| Diamètre d'ouverture de filtration (FOS) | CGSB 148.1-10  | 1 / yr    | 70 µm - 130 µm | MIN-MAX                   |
| Perméabilité                             | CGSB 148.1-4   | 1 / yr    | 0.96 s-1       | MIN                       |
| Perméabilité <sup>2</sup>                | CGSB 148.1-4   | 1 / yr    | 0.20 cm/s      | MIN                       |

MIN<sup>1</sup>: minimum values of tolerance 95 specification GCTTG 3001-06 based on the nominal value of certification.

<sup>2</sup>: This feature is not part of the certification specification GCTTG 2001-06.

• This technical information comes from the manufacturer and was transcribed by Texel Geosol. The user is consequently invited to ensure himself to obtain the last update.

• The manufacturer does not offer any guarantee and does not assume any comparative responsibility with use, the installation and/or the suitability of use.

• The manufacturer must be informed of any default or nonconformity of the product before its installation. Its responsibility is limited to the replacement of the product not-in conformity or defective.

• The conformity to the specifications is based on a confidence level of 95% within a lot.

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