Detailed Instructions for the use of Wirelock®

With Strand or General Purpose Wire Rope

These instructions explain the proper use of WIRELOCK® for socketing wire rope terminations. When reading and following these instructions, pay close attention to warnings and safety information presented in bold print.

For maximum safety and efficiency. use **WIRELOCK®** only as instructed

1. Warning on Correct Application of WIRELOCK®

It is very important when deciding upon the use of **WIRELOCK®** to note the following:

⚠ WARNING

- **Incorrect use of WIRELOCK® can result in an unsafe termination which may lead to serious injury, death, or property damage.**
- **Do not use WIRELOCK® with stainless steel rope in salt water environment applications without reading and understanding the information given on page 7.**
- **Use only soft annealed iron wire for seizing.**
- **Do not use any other wire (copper, brass, stain-less, etc.) for seizing. Never use an assembly until the WIRELOCK® has gelled and cured.**
- **Remove any non-metallic coating from the broom area.**
- **Sockets with large grooves need to have those grooves filled before use with WIRELOCK®.**
- **Read, understand, and follow these instructions and those on product containers before using WIRELOCK®.**

2. Safety and Health Precautions for Using WIRELOCK®

It is important that certain precautions be taken when using **WIRELOCK®** for a wire rope socket termination When using the product be sure to read information on product containers and note the following:

⚠ CAUTION

- **WIRELOCK® resin, in liquid state, is flammable.**
- **Chemicals used in this product can give off toxic fumes and can burn eyes and skin.**
- **Use only in well-ventilated work areas.**
- **Never breathe fumes directly or for extended time.**
- **Always wear safety glasses to protect eyes.**
- **Always wear gloves to protect hands.**
- **Avoid direct contact with skin anywhere.**

3. Selection of Socket

3.1 **WIRELOCK®** is recommended for use with sockets that comply with International, European or National (ISO, CEN) Standards.

3.2 **WIRELOCK®** as with all socketing media, depends upon the wedging action of the cone within the socket basket to develop full efficiency. A rough finish inside the socket may increase the load at which seating will occur. Seating is required to develop the wedging action.

3.3 Measure the rope ends to be socketed. The rope end should be of sufficient length so that the ends of the unlaid wires (from the strands) will be at the top of the socket basket.

3.4 Next, apply the seizing one (1) socket basket length from the end of the rope minus one (1) rope diameter. The length of the seizing must be at least two (2) rope diameters long. Additional information can be secured from your Wire Rope Users Manual or your Wire Rope Manufacturers Catalogues or National Standard.

Seizing wire should be a soft annealed iron wire.

Seizing of Wire Rope

3.5 Plastic coated or plastic filled wire ropes must have all plastic material (non-metallic materials) removed from within the broomed area.

3.6 The socket basket should be examined prior to use and loose scale, dirt or grease removed.

3.7 Do not use oversized sockets for Wire Rope.

3.8 When socketing Strand, the time honoured method of one size up when choosing the socket is generally still applicable in the vast majority of cases. However, caution should be exercised as tests have shown that the length of the socket basket should be five (5) times the strand diameter or fifty (50) times the wire diameter, whichever is the greater.

3.9 For detailed explanation of resin socketing of Steel Wire Rope, See Appendix B.

4. Preparation of Broom

4.1 The rope is secured in a vice directly below the seizing to allow the strands to be unlaid to the seizing. they should be bent outwards to a total included angle not exceeding 60 degrees (Fig 1).

4.2 Internal leakage of resin in ropes 75mm (3") in diameter and larger can occur because of gaps between strands and the IWRC, (Independent Wire Rope Core). These gaps should be sealed (before brooming), by pushing small plugs of the sealing compound down into the served portion.

4.3 If the rope has a fibre core, it should be cut out ensuring that the remaining fibre core extends 1/2 rope diameter into the bottom of the socket. In the case of fibre cores, resin is the preferred socketing medium.

Unlay wire rope so that angle does not exceed 60° (Fig 1)

4.4 If the rope has an IWRC, the IWRC shall be completely unlaid to form part of the broom.

4.5 All the wires in each strand and in the IWRC must be unlaid completely down to the seizing to form a broom, being careful not to disturb or change the lay of the wires and strands under the seizing band. The wires should not be straightened.

Brooming is one of the most critical parts of any socketing operation.

Note: The wires must be unlaid from the end of the rope to the seizing because a good fill of resin must occur to the bottom (small end) of the socket (Fig 2). Most of the load capacity of the termination is concentrated in the bottom one third of the socket.

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4.6 Except in the case of wire ropes of coarse construction e.g., 6 x 7, it is not necessary or desirable to hook the wires in the broom. When the rope contains large numbers of wires, hooking the ends causes congestion within the socket and can create penetration problems for the socketing medium although this is less of a problem with resin than with zinc or white metal.

4.7 The open broom shall be thoroughly cleaned (degreased). **Be sure that the cleaning is confined to the broom and does not extend to the rope beyond.**

Properly Broomed Wire Rope (Fig 2)

Incorrectly Broomed Wire Rope

4.8 The method of cleaning will depend on the lubricant and/ or coating on the wire.

4.9 The methods and materials used for cleaning should comply with the current Environmental Protection regulations.

4.10 Consult your Wire Rope supplier or the Wire Rope Manufacturer for recommended materials and methods.

4.11 Do not clean the wire rope broom with acid, soda, methol hydrate, or acetone. A flux should not be used.

4.12 The wire rope broom, after cleaning and drying, should be kept in an upright position to prevent any grease, or mixture of grease and cleaner, from running back down from the main body of the rope and contaminating the clean wires.

5. Positioning of Broom and Alignment of Socket

5.1 Place rope in a vertical position with the broom end up. It is recommended that there be thirty (30) rope diameters below the socket before any bending occurs in the rope.

5.2 Close and compact the broom to permit insertion of the broomed end into the base of the fitting. Slip the fitting on, removing any temporary banding or seizing as required.

Make certain the broomed wires are uniformly spaced in the basket, with wire ends at the top edge of the basket, and that the axes of the rope and the fitting are aligned. A centralizing clamp should be used to assist in the alignment of the axes of the socket and the rope (Fig 4 and Fig 5).

Correct alignment will avoid premature failure of the assembly due to unequal loading of the wires.

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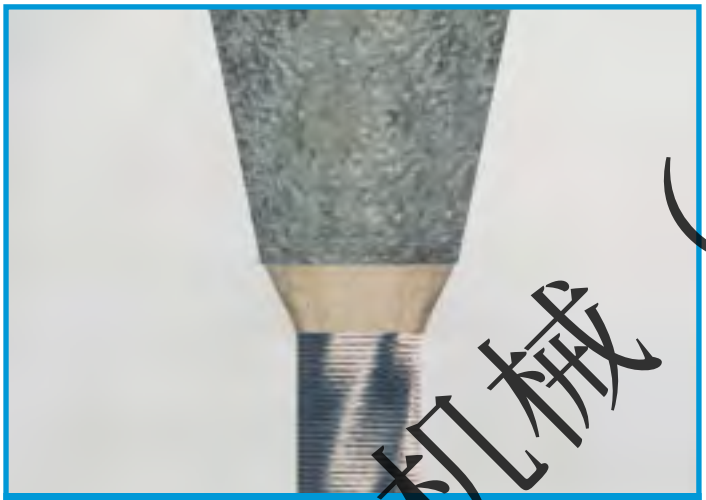
Properly positioned broom with the wire ends protruding slightly (Fig 3)

5.3 Plasticine or clay based putty, i.e. window or glazing putty, is required to seal the base of the socket prior to pouring, thus preventing resin leakage which may cause voids. (Fig. 4 and Fig. 5)



Axes of socket and rope properly aligned and sealed with plasticine (Fig 4)

Clamp used to align rope and socket before sealing with plasticine (Fig 5)

6. Materials

6.1 Always check the expiry date on the cans. Never use out of date material.

6.2 **WIRELOCK®** is formulated for mixing and pouring in the ambient temperature range; from -3°C to 43°C (27°F - 110°F). At lower temperatures the gel time will increase with decreasing temperature. Below 9°C (48°F) the gel time of approximately 20 minutes can be maintained by the use of booster packs.

⚠ CAUTION

- **Chemicals used in this product can give off toxic fumes and can burn eyes and skin.**
- **Always check the expiry date on the cans. Never use out of date material.**
- **Use only in well-ventilated work areas.**
- **Never breathe fumes directly or for an extended time.**
- **Always wear safety glasses to protect eyes.**
- **Always wear gloves to protect hands.**
- **Avoid direct contact with skin anywhere.**

6.3 At ambient temperatures below 9°C (48°F) and above 2°C (35°F), one (1) **booster pack** should be used. Below 2°C (35°F) and above -3°C (27°F), two (2) booster packs should be used. The booster pack compensates chemically for the slower gel time experienced at lower temperatures. In order to comply with all the approvals granted, **WIRELOCK®** should not be mixed and poured at temperatures below -3°C (27°F). Knowing the ambient temperature is useful, however, it should be remembered that **WIRELOCK®** will for some time afterwards tend to cure

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according to the temperature at which it, the socket and the wire rope were stored. The temperature of the socket and the rope should conform to the temperature at which the **WIRELOCK®** has been stored for the last 24 hours. When the sockets, rope and **WIRELOCK®** are stored at normal room temperature 18°C - 21°C (65°F - 70°F), booster packs must not be used even if the ambient temperature is below 9°C (48°F).

6.4 It is possible to combine various kit sizes to achieve any required volume, e.g., 2500cc=1 x 1000cc plus 3 x 500cc, etc. In this case, all of the liquid resin should be placed in the mixing container and then all of the powder added to it (or vice versa) before mixing. **Always mix all of the resin with all of the powder. Never mix less than the total contents of all cans.**

Most kits can be mixed in the original packaging (Fig 6)

6.5 With the exception of the 1000cc pack, the kits can be mixed in the original packaging by pouring the resin into the granular materials container. In the case of 1000cc, a proper mixing vessel should be used (Fig 6).

Mixing vessels should be clean. They can be of metal, polyethylene or poly-propylene. Polymerization products of styrene, i.e., styrofoam cups and similar products should not be used. A flat wooden or metal paddle, not a spike or screw driver, should be used as a stirrer.

6.6 Immediately upon pouring the resin into the granular compound (or vice versa), mix vigorously for two (2) minutes or until a homogenous mixture has been obtained. Make sure that no unmixed granular compound remains on the bottom of the mixing container. For larger sizes, a mechanical mixer is ideal.

Upon mixing, the WIRELOCK® will turn to a greenish turquoise colour. If the mix remains a pale straw yellow colour, do not use the kit. Always mix all of the resin with all of the powder. Never mix less than the total contents of both cans.

7. Use of Heat

7.1 Do not apply heat to sockets to accelerate the curing process prior to pouring. The application of external heat may cause the resin to gel before it reaches to bottom of the socket and lead to assembly failure. Used sockets cleaned out by heating should be allowed to cool to room temperature before re-use. **Hot sockets must not be used.**

8. Pouring

8.1 Once the **WIRELOCK®** is mixed, it should be poured immediately (Fig. 7) into the socket to ensure good penetration, preferably down the side of the socket to allow air to escape.

Upon mixing the compound should be poured immediately (Fig 7)

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Immediate pouring will ensure that the gelling stage occurs in the socket and not in the mixing container. Sufficient **WIRELOCK®** should be mixed so that the socket can be completely filled at one pouring. **WIRELOCK®** is designed to gel in approximately 15 minutes and to cure within 60 minutes after gel. To provide an adequate safety margin, no load should be applied to the wire rope assembly until a minimum of one (1) hour has elapsed from the time the **WIRELOCK®** gels in the socket.
As the **WIRELOCK®** cures, a chemical (exothermic) reaction occurs, causing a considerable rise in temperature.

Temperatures in excess of 100°C (212°F) may be reached in large volume kits in the mixing container. In the socket where the wires of the rope and the socket itself act as a heat sink, the maximum temperature likely to be achieved will be of the order of 70°C -80° (160°F - 175°F).

9. Movement

9.1 Movement of resin poured sockets may damage the soft resin and reduce the efficiency of the termination. Resin poured sockets should not be moved for a minimum of ten (10) minutes after the material **in the socket** has gelled.

10. Check on Penetration

10.1 A visual check for penetration of the resin into the socket bottom can be made by removing the centralizing clamp and the plasticine or putty.

11. Re-Lubrication

11.1 After removing the rope from the vice, any degreased area of the rope below the socket should be re-lubricated.

12. Loading

12.1 The rope can be put into service or proof loaded one (1) hour after the material in the socket has gelled.

12.2 Whenever possible, the assembly should be proof loaded. All slings for lifting purposes shall be proof loaded.

13. Re-use of Socket

13.1 To remove the resin from the socket:

a. Cut the rope close to the base of the socket.

b. Press the cone out of the socket or,

c. Using a gas torch, heat the exterior of the socket. Keep the torch moving around the outside of the socket to avoid any hot spots. Heat the socket until there are fumes coming from the neck of the socket and the top (wide end). When this occurs stop heating, leave for 3 to 4 minutes and then knock the cone out of the socket.

d. It is recommended that sockets subjected to heat should be normalised before re-use.

13.2 For additional information on Re-Use of sockets, See Appendix C "Technical Bulletin #1, by Crosby Group Inc. (Page 25).

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General Information

1 **WIRELOCK®** is designed to gel (Change from a liquid to a solid) in approximately 15 minutes at 18°C (65°F) **Storage**. To ensure that the kits are not adversely affected by storage they should be kept in a dry place at a temperature of between 10°C and 24°C (50°F and 75°F) and away from any source of direct heat. **WIRELOCK®**, like all polyester resins, is temperature sensitive. An increase in temperature of 10°C (15°F) shortens the gel time by approximately 50%. A decrease in temperature of 10°C (15°F) lengthens the gel time by approximately 100%.

2. KIT SIZES

100 cc
250 cc
500 cc
1000 cc
2000 cc
3000 cc

Other sizes available to order up to a maximum of 100 litres.

The specific gravity of **WIRELOCK®** is 1.73 Therefore, 1000cc's will weigh 1.73 kilos or 3.81 lbs. 250cc's will weigh

$$\frac{1.73 \times 250}{1000} = 0.43 \text{ kilos or } 0.95 \text{ lbs.}$$

3. **WIRELOCK®** Wire Rope Assemblies are 100% efficient when used with steel wire rope, galvanized wire ropes and stainless steel wire ropes. We do not advise the use of stainless steel wire rope in a salt water marine environment **without regular inspection.** In the presence of an electrolyte, i.e. sea water, electrolytic degradation of the stainless steel wire rope can occur. This phenomenon, known as crevice corrosion, will impair the integrity of the rope in the region near to the neck of the socket. Crevice corrosion also occurs when white metal is used for socketing (Zinc should not be used to socket stainless steel rope.) However the onset of crevice corrosion in resin sockets appears to be faster than when white metal is used. Other rope types do not exhibit this behavior.

Typical example of the swelling of stainless steel rope due to crevice corrosion

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4. **WIRELOCK®** is approximately 20% the weight of zinc.

5. The strength of **WIRELOCK®**, in its cured state, is not adversely affected by cold temperatures.

6. **WIRELOCK®** must be mixed and poured within the temperature range of -3°C to 43°C (27°F - 110°F). The kits are not adversely affected by storage at temperatures below -3°C (27°F). It is recommended the **WIRELOCK®** kit be stored in a cool place.

7. The operating temperature of **WIRELOCK®** is +115°C to -54°C (+240°F to -65°F). High temperature **WIRELOCK®** is available to operate continuously at 154°C (310°F) and intermittently (3 - 4 hours at a time) at 218°C (425°F). Keep in mind that zinc exhibits severe creep at 124°C (256°F) when under continuous load.

8. When cured, **WIRELOCK®** has a hardness of approximately 40 to 55 Barcol. When the resin has set fully (opaque green or mustard color) only a light scratch mark will be seen when a sharp object, such as a screwdriver blade, is scraped over the surface of the resin. On a small socket, it is quite normal to have a very thin tacky layer on the surface of the resin. The scratch test can be carried out through this layer.

9. Cracks which may appear on the top of the cured cone are surface crazing only, and are the result of heat stresses and shrinkage upon a thin layer of unfilled resin covering the tops of the wires. The crazing does not affect the strength of the termination within a socket.

10. Shrinkage of the **WIRELOCK®** cone may leave a gap between the cone and the socket wall. This is normal, particularly with large sockets and high ambient temperatures. This in no way aftects the efficiency of the assembly. Upon loading, the cone will be seated perfectly in the socket. The shrinkage of **WIRELOCK®** is between 1.5 - 2.0%. In high volume **WIRELOCK®**, the shrinkage is about 0.5%.

11. Excessive numbers of horizontal rings in the socket may increase the load required to "seat" and wedge the cone within the socket. They should be avoided whenever possible and proof loaded to 60% of catalogue if they must be used. Alternatively they should be filled in with clay, prior to placing the socket on the rope.

12. **WIRELOCK®** poured sockets should not be used in environments of strong caustic or acid solutions. **WIRELOCK®** is not affected by oils, or grease or salt water.

13. **WIRELOCK®**, used in specific applications such as well servicing, is available to order.

14. **WIRELOCK®** is, by design, a compressive resin. Therefore, when removed from the socket a **WIRELOCK®** cone, if hit by a hammer, may shatter. In a socket, even under extreme loads or shockloads, the **WIRELOCK®** cone remains solid and 100% efficient.

15. The shelf life of **WIRELOCK®** is eighteen (18) months (check label before use) from the date of manufacture.

Approvals:

- ✔ Lloyds Register of Shipping
- ✔ Det Norske Veritas
- ✔ American Bureau of Shipping
- ✔ United States Coast Guard
- ✔ Registro Italiano Navale
- ✔ Germanischer Lloyd

NATO Numbers:

100cc	8030-21-902-1823
250cc	8030-21-902-1824
500cc	8030-21-902-1825
1,000cc	8030-21-902-1826

Manufactured by:

MILLFIELD ENTERPRISES
(MANUFACTURING) LIMITED
Shelley Road, Newburn Industrial Estate,
Newburn, Newcastle upon Tyne,
NE15 9RT, United Kingdom.
Tel: + 44 (0) 191 264 8541
Fax: + 44 (0) 191 264 6962
E-Mail: info@wirelock.com
Web: www.wirelock.com

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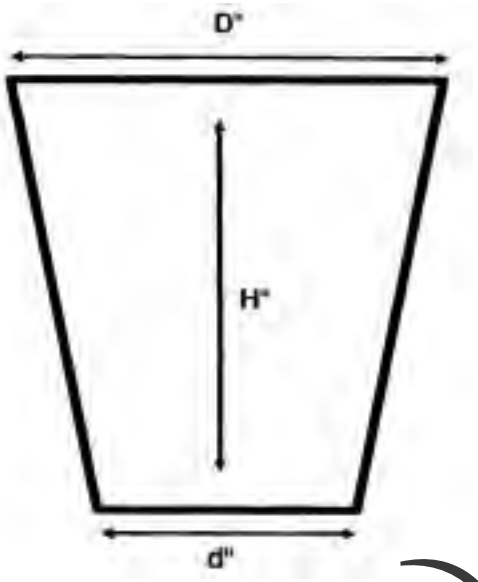
WIRELOCK®

Formula to estimate ccs required to pour standard spelter sockets



$$\frac{(D + d)^2}{4} \times H \times 3.142 = cc$$

(D, d & H are in cm)

$(D + d)^2 \times H \times 3.34$ = Socket Volume in cc

(D, d & H are in inches)

GUIDE TO AMOUNT OF WIRELOCK® REQUIRED

6.5mm (1/4")	9cc
8mm (5/16")	17cc
9.5mm (3/8")	17cc
11mm (7/16")	35cc
12.5mm (1/2")	35cc
14mm (9/16")	52cc
16mm (5/8")	52cc
19mm (3/4")	86cc
22mm (7/8")	125cc
25mm (1")	160cc
28.5mm (1 1/8")	210cc
32mm (1 1/4")	350cc
35mm (1 3/8")	350cc
38mm (1 1/2")	420cc
41mm (1 5/8")	495cc
44.5mm (1 3/4")	700cc
47.5mm (1 7/8")	700cc
51mm (2")	1265cc
54mm (2 1/8")	1265cc
57mm (2 1/4")	1410cc
60mm (2 3/8")	1410cc
63.5mm (2 1/2")	1830cc
66.5mm (2 5/8")	1830cc
70mm (2 3/4")	2250cc
76mm (3")	3160cc
82.5mm (3 1/4")	3795cc
89mm (3 1/2")	4920cc
95mm (3 3/4")	5980cc
101.5mm (4")	7730cc

NOTE - APPROXIMATE MEASUREMENTS (U.S.A.)

250 cc Kit	1 Cup
500 cc Kit	1 Pint
1000 cc Kit	1 Quart

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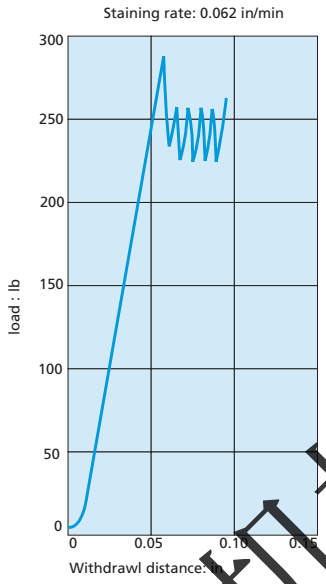
Properties of Wirelock®

Physical	
Viscosity	3 - 4 Poise
Heat Distortion Point	100°C to 115°C (212°F to 240°F)
Flexural Strength	1500 lb/sq.in.
Flexural Modulus	5.8 x 10^5 lb. sq. in.
Tensile Strength	16.15 N/mm² 1.09 T/in²
Flashpoint	32°C (89°F)
Electrical	
Dielectric Strength	230 volts/mm
Arc Resistance	191 S
Volume Restivity Greater than	14.5 $\log_{10}$ ohms/cm
Surface Resistance	14.0 $\log_{10}$ ohms/cm
Insulation Resistance	8.2 x 10^{12} $\log_{10}$ ohms/cm

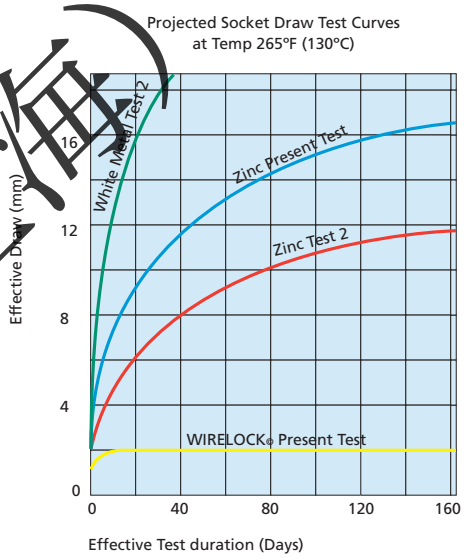
Flashpoint

Please note that this is not the auto ignition (spontaneous combustion) temperature, but the temperature above which the material will give off a significant amount of vapour.

Graph A



Graph B



The individual wires of the rope are retained by a combination of bonding and frictional forces. The frictional forces are the result of:

- Shrinkage during the curing of the resin.
- Coefficient of friction between the resin and the individual wires.

Additional forces develop due to the wedge action of the socket as the rope is loaded. (Graph A).

As **WIRELOCK®** cures, it shrinks by between 1.5% and 2.5%, (High Volume **WIRELOCK®** by less than 0.5%) and with the introduction of a hard inert filler of specific grain size, a high coefficient of friction is obtained.

WIRELOCK® has excellent penetrating qualities and can flow through the densest wire rope broom, which would impede the flow of Zinc.

The **WIRELOCK®** system is designed to have a minimal amount of creep, which ceases once the wedging and frictional forces develop for any given load.

WIRELOCK® excels in its ability to resist the action of fatigue - fatigue in a wire rope assembly is normally prevalent in the rope close to the neck of the socket. **WIRELOCK®** will minimize such problems.

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11-Mar-99

Millfield Enterprises
16 Shelley Road
Newcastle upon Tyne 15

Job No 99R007

Test Compressive Strength and Stiffness of Resin

Sample 31436/R1792/T40

The specimens were prepared, cured and sent to us by the client.

Date of test 02/03/99
Ambient conditions during the test 20°C
Testing machine Avery 2500kN Compression Testing Machine

Sample	Weight	Height (after grind)	Width	Depth	Density	Compressive Load	Compressive Strength
	g	mm	mm	mm	Mg/m³	kN	MPa
31436/R1792/T40-1	101.3	37.5	39.1	39.6	1.74	180.6	116.7
31436/R1792/T40-3	102.2	37.5	39.1	39.6	1.76	187.8	121.3
31436/R1792/T40-5	102.7	37.5	39.1	39.6	1.77	189.6	122.5
31436/R1792/T40-2	104.0	37.5	39.6	39.6	1.77	203.5	129.8
31436/R1792/T40-4	103.2	37.5	39.6	39.6	1.75	196.7	125.4
31436/R1792/T40-6	103.0	37.5	39.6	39.6	1.75	191.0	121.8
average					1.76		124.1

Sample	Min Stress	Max Stress	Mean Strain	Modulus of Elasticity
	MPa	MPa		N/mm²
31436/R1792/T40-1	0.0	58.3	0.243%	1.20E+04
31436/R1792/T40-3	0.0	60.6	0.263%	1.17E+04
31436/R1792/T40-5	0.0	61.2	0.234%	1.27E+04
average				1.21E+04

B.G.C.

Professor B G Clarke
Head of Department

Renewed
& DW
31.3.99

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15 MAR 1999

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BGC/AEB

21st September 1995

Milifield Enterprises Ltd.
26 Shelley Road
Newcastle upon Tyne
NEI5 9RT

Compression Test of Resin Cubes

40 mm nominal cubes were supplied. The specimens were cooled by immersing them in a mixture of dry ice and acetone. The temperature was monitored using a similar control specimen containing a thermistor. A specimen was placed between two platens cooled to -I8°C in a refrigerator. The control specimen was also placed between two similarly cooled platens. The specimens were loaded until failure at a rate of 72 kN/min.

Specimen	Height	Length	Width	Weight	Bulk Density	Cooling Temperature	Temperature of failure	Max Load	Failure Stress
	mm	mm	mm	g	Mg/m^3	°C	°C	kN	N/mm^2
1	39.7	39.6	40.0	110.9	1,76	-44	-30	203	128
2	39.3	39,3	39.7	108.7	1.77	-55	-30	215	138
3	39.6	39.5	39.7	107.2	1.73	-60	-30	207	132
4	39.6	39.6	39.6	108.1	1.74	-1	-28	204.5	130
5	39.8	39.6	39.7	109.1	1.74	-73	-36	200	127
6	39.7	39.9	39.7	109.2	1.74	74	-38	207	131

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Telex - 53654 (UNINEW G)