



Mr A Powell
GE Advanced Materials
458 Victoria Road
Gladesville

Dear Mr. Powell,

Job number JK13ATS3413

Re: Impact Testing on Polycarbonate Sheet Roofing As Per AS 1562.3:1996

BACKGROUND:

CSIRO were contracted to carry out an investigation required to assess the performance of impact tests on new and weathered 10mm polycarbonate roofing with "H bar" mounted on a steel support structure which replicates the conditions of use.

Similar tests were to be carried out on new and weathered 16mm sheets using "flexi bar" mounting on a timber support frame. All types of sheet were required to demonstrate their compliance with to AS1562.3:1996, using the methods described in AS 4040.4:1996.

SPECIMEN DESCRIPTION:

The specifications of each product roof sheet type are as follows.

New sheets:

- 16mm LTC 16/3X multiwall structure with a sheet width of 1250mm.

Weathered sheets:

- 10mm LTC twin wall structure with a sheet width of 1080mm.



- 16mm 2NS twin wall “N” structure with a sheet width of 1250mm.

The mounting hardware is of two types. On the 10mm sheet an extruded aluminium “H” bar with a central hollow section is fastened to the supporting frame. On the 16mm sheets a two piece extrusion (Flexibar) which generally forms an “H” section is used. First the lower section of the extrusion is screwed to the support frame and then sheet is trapped by the top section of the extrusion. Each type of mounting method has appropriate gaskets to seal the sheet in position.

TEST CONDITIONS:

- Product Type - 10mm sheets

Aluminium “H bars” were mounted on a steel perimeter support frame with screws at 600mm longitudinally and 200mm crosswise centres, a cushioning tape was fitted below. The “H bars” were flush with the top edge of the structural members and support the sheets allowing two-way spanning. The ends of the sheet were identically held but have short sheet section to allow propped grip of the test sheet. Gaskets surround the edges of the sheet at the “H” bars along the full perimeter of the sheet and the end short infill. The general layout of the test specimen is shown in Figure 1.



Figure 1. View of 10mm sheets on the test frame

- Product Type – 16mm sheets

The lower half of an Aluminium Flexibar with seals in place, was mounted on a timber perimeter support structure, it was screwed at 600mm centres along the support as a base for the sides of the sheets. The sheet was placed into position and the top section of the extrusion was clipped into place to clamp the sheet into its final position. The cross members had a foam tape stuck on the timber and an aluminium strip was screwed down to hold the sheet and a short section to finish the end detail.



Figure 2. View of 16mm sheets on the test frame

TEST METHOD

After construction of the test specimens the position of the impact was marked on the specimen according to AS4040.4 1996. The test bag was raised to the test height (2.5m) prior to dropping (Figure 3).



Figure 3. View of 10mm test specimen prior to dropping the bag

After the test bag was released the test specimen was examined to see if the damaged roof sheet met the required performance (Figure 4).



Figure 4. Damage to 10mm aged sheet after removal of the test bag

The same method was used for all the other specimens and the resultant damage to a 16mm aged sheet is shown in Figure 5.



Figure 5. Post test damage of a 16mm aged sheet

ASSESSMENT CRITERIA

The assessment criteria of AS 1562 Part 3, for impact tests on roofing is extracted and shown in Figure 6.

5.3.2 Assessment When tested in accordance with the load tests set out in AS/NZS 4040.4, the test specimen shall be considered to have failed the test if any one of the following occurs:

- (a) The sandbag penetrates the test specimen by damaging or dislodging the sheet specimen.
- (b) The test sheet fractures to allow a 75 mm diameter ball to pass through.
- (c) The test sheet shatters and produces splinters more than 250 mm in length.
- (d) A vertical gap, more than 300 mm high between adjacent sheets is formed.

Figure 6. Insert from AS1562.3 Sub paragraph 5.3.2

RESULTS

The following specimens passed the assessment criteria of AS 1562.3.

New sheets:

- 16mm LTC 16/3X multiwall structure with a sheet width of 1250mm.

Weathered sheets:

- 10mm LTC twin wall structure with a sheet width of 1080mm.
- 16mm 2NS twin wall "N" structure with a sheet width of 1250mm.

CONCLUSIONS

The aged sheets which were verified by Statutory Declaration (See Attachments) performed satisfactorily to the requirements of AS 1562.3:1996, the new 16mm sheets although of a slightly different construction also met the requirements of AS 1562.3:1996. The new sheet have an extra web in its design and therefore could be expected to perform equally or better than the aged profile.

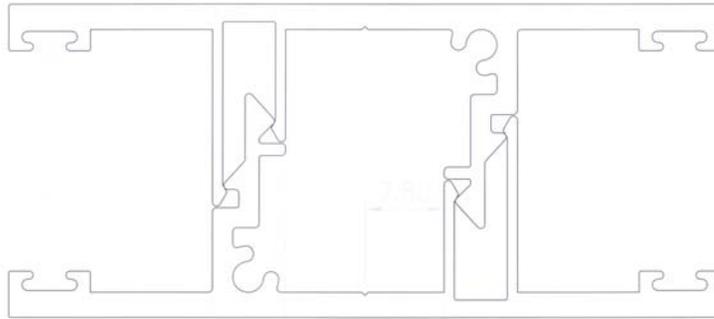


Mr Geoffrey Farrance
Laboratory Manager
Structural Engineering
19 May 2006.

ATTACHMENTS



View of New 16mm sheet prior to test, note the short section to finish the end detail



Schematic of "Flexibar"

Statutory Declaration

I, GORDON WAYNE PATERSON
(FULL NAME OF DECLARANT / PERSON MAKING THE DECLARATION)

of 13 JERICHO CRT BERWICK 3806
(ADDRESS OF DECLARANT / PERSON MAKING THE DECLARATION)

Postcode 3806

in the State/Territory of VICTORIA

Insert your occupation(s) OPERATIONS MANAGER, STUD PARK SHOPPING CENTRE

do solemnly and sincerely declare that LEXON THERMO CLEAR MATERIALS WERE USED IN THE SOUTH SKYLIGHT INSTALLED DURING THE 1996 REFURBISHMENT AT STUDPARK SHOPPING CENTRE AND ARE THE ORIGINAL SHEETS.

Facsimile of Statutory Declaration

LEGAL CLAUSES

Testing terms - Definitions and Interpretation

'Intellectual Property Rights' or 'IPR' means all intellectual property rights, including:

- (a) discoveries, inventions, patents, plant breeder's right, copyright, rights in circuit layouts, registered designs, trademarks, know-how and trade secrets; and
- (b) any application or right to apply for registration of any of the rights referred to in (a).

'Purpose' means that use set out in Clauses 5 and 5A.

'Report' means the written report containing the results from the Testing Services and any certificate summarising the Testing Services and results.

The following words have the meaning ascribed to them in the Details: **Client, Client Inputs, Division, Governing Law, Return Instructions, Testing Services, Commencement Date, Target Completion Date, Fee, and Reimbursable Expenses.**

Capitalised expressions not otherwise defined shall have the meaning ascribed to them in the Details.

Unless the context does not permit, the singular shall include the plural and vice versa and expressions inferring a gender shall include any other gender.

Headings shall not be used as an aid to interpretation.

1. CSIRO agrees to perform the Testing Services with professional care and skill in consideration for payment of the Fee. The Testing Services shall start on the Commencement Date and the Report will be delivered to the Client on the Target Completion Date.
 - 2.1 The Client will pay CSIRO:
 - (a) the Fee in the manner specified in the Details within 30 days of receipt of CSIRO's invoice; and
 - (b) the incurred Reimbursable Expenses within 30 days after receipt of CSIRO's invoice and any interest on all amounts due under this Agreement but unpaid at the aggregate rate of the Westpac Indicator Lending Rate published from time to time by Westpac Banking Corporation plus 2% per annum from the due date until the unpaid amount is paid.
 - 2.2 CSIRO agrees to provide the Client with a GST tax invoice and any other documentation required by law to enable the Client to claim an input tax credit for a taxable supply by CSIRO.
 - 2.3 If the GST payable on a taxable supply by CSIRO is varied by a change in the law, the Fee payable under this Agreement must be adjusted to reflect the variation of GST.
- 3.1 The Client, at its own cost and risk, will deliver to, and erect (where appropriate) at, CSIRO prior to the Commencement Date all Client Inputs, necessary specimens and/or information reasonably required by CSIRO to perform the Testing Services.
 - 3.2 The Client will:
 - (a) clearly label all Client Inputs with Client's name and contact details, content details and any applicable safety hazards or special procedures for handling, testing, storage, transport and disposal thereof;
 - (b) advise CSIRO in writing of any hazardous or otherwise dangerous components or properties of Client Inputs; and
 - (c) package all Client Inputs in a manner that complies with all safety and health regulations.
 - 3.3 If the Client does not provide the Client Inputs in accordance with Clause 3.2 or the information or materials provided by the Client pursuant to Clause 3.2 is incorrect or inadequate, the Client will be liable for all costs and losses associated with testing the Client Inputs, making the research area and Client Inputs safe, including any disruption to CSIRO's normal operations.
 - 3.4 CSIRO may retain Client Inputs or parts thereof for its own research and record keeping.
 - 3.5 After the end of the Agreement, CSIRO may store, dispose of or destroy the Client Inputs if:
 - (a) there are no Return Instructions in the Details; or
 - (b) the Client does not promptly make arrangement for its return in accordance with the Return Instructions.
- 4.1 Subject to CSIRO's prior receipt of all amounts due under this Agreement, CSIRO:
 - (a) assigns ownership of, but not IPR in, the Report; and
 - (b) gives the Client the right to:
 - (i) make copies of the Report for internal distribution; and
 - (ii) distribute copies of the Report to those contractors or agents who have a need to know for the Purpose, but the Client may only distribute extracts from the Report to such third parties if the Client clearly notes on the extract that it is part of a larger piece of information held by the Client which has been prepared by CSIRO.
- 4.2 CSIRO retains all IPR used and developed in the conduct of the Testing Services, including IPR in the Report and is entitled to retain copies of the Report for its own use.



- 4.3 CSIRO will maintain confidentiality of all information provided by the Client unless the information:
- (a) is in the public domain;
 - (b) is independently created or rightfully known by, or in the possession or control of CSIRO and not subject to an obligation of confidentiality on CSIRO; or
 - (c) is required to be disclosed by law.
- 4.4 After notifying the Client, CSIRO may disclose information about the Testing Services, the test results and Report to relevant authorities if CSIRO believes the information reveals a potential risk to public health or safety.
5. Subject to Clause 5A, the Client will not without the prior written consent of CSIRO but merely for its internal business operations:
- (a) use the test results or Report as a means of endorsement by CSIRO; or
 - (b) use CSIRO's name, trademark or logo.
- 5A.1 If the Client is the manufacturer, or authorised agent thereof, of the Client Inputs, the Client may:
- (a) publish the Report verbatim and in full with an added statement that the publication is a copy of the Report issued by CSIRO; and
 - (b) publish a statement that the Client Input has been tested by CSIRO in accordance with the Testing Services, provided that the statement is not misleading and deceptive and includes the Report number and where it can be inspected and obtained, otherwise, the Client may not publish the Report or any statement about CSIRO.
- 5A.2 A Report will not be used in a company prospectus or notification to a Stock Exchange document for capital raising without the prior written consent of CSIRO.
6. The Client:
- (a) acknowledges that the rights to use the Report, and any IPR subsisting in the Report, are only provided for the Purpose; and
 - (b) assumes all risk for any loss or damage resulting directly or indirectly from the Client's use or disclosure of the Report and any IPR developed in performance of the Testing Services, except to the extent caused directly by CSIRO's negligence or breach of this Agreement.
7. The Client further warrants that it has, and will maintain, appropriate insurance to cover any liability it may incur in relation to this Agreement.
8. CSIRO:
- (a) excludes all terms, conditions and warranties implied by custom, the law or statute except any consumer warranty implied by the *Trade Practices Act 1974* and corresponding legislation in other jurisdictions (**Consumer Warranty**);
 - (b) limits its liability whether at common law, in equity, pursuant to statute, for breach of any Consumer Warranty or otherwise, at CSIRO's option, to:
 - (i) the re-performance of the Testing Services; or
 - (ii) in the event that CSIRO refuses, or fails within a reasonable time, to re-perform the Testing Services, refund of the Fees paid by the Client; and in any event CSIRO will not be liable for any special, indirect or consequential damages; and
 - (c) is not liable for any failure to carry out all or part of its obligations under this Agreement where that failure is due to any cause beyond the reasonable control of CSIRO.
- 9.1 Subject to each party's right to seek urgent interlocutory relief, any dispute, controversy or claim arising between the Client and CSIRO under this Agreement or the breach, termination or invalidity thereof (**Dispute**) will be dealt with in accordance with this **Clause 9**.
- 9.2 The party claiming that a Dispute exists will give the other party formal written notice of such Dispute together with details of that Dispute. If the Dispute is not resolved by the parties within 30 days after service of the notice, the parties must refer the dispute to the Australian Commercial Disputes Centre Limited (ACDC) for mediation in accordance with the Mediation Guidelines of ACDC.
- 9.3 If the dispute is not resolved by mediation, the dispute must be referred to the Australian Commercial Disputes Centre Ltd (ACDC) for arbitration in accordance with the Arbitration Rules of ACDC. Any arbitration shall be final and binding on the parties, including any award as to costs.
10. This Agreement shall become effective when it is signed by both parties and shall continue in effect until CSIRO has provided the Report to the Client and the Client has made all payments due under Clause 2 unless sooner terminated if:
- (a) either party fails to remedy a breach of the Agreement within 30 days of the other party notifying it of such breach;
 - (b) CSIRO gives notice that the Client Inputs are unsuitable for providing the Testing Services;
 - (c) CSIRO is advised by the Client or becomes aware that the Client Inputs are subject to a dispute with a third party and elects to terminate the Agreement; or
 - (d) the Client is unable to pay its debts as and when they fall due, an event after which CSIRO will immediately terminate the Agreement.
11. Any provisions in this Agreement that create rights or obligations on any of the parties which are capable of continuing after the expiry or earlier termination of this Agreement shall do so and any accrued rights or remedies of either party will not be affected by such termination.
12. The Client acknowledges CSIRO's obligation to carry out Testing Services is limited to an obligation to do so using the resources of the Division.
13. This document records the entire agreement between CSIRO and the Client and may only be varied by written agreement of both parties.
14. This Agreement is governed by the Governing Law and the parties submit to the jurisdiction of the courts of that State or Territory.

END OF REPORT