Image Cover Sheet

CLASSIFICATION UNCLASSIFIED	**SYSTEM NUMBER** 509570

TITLE

COMPOSITES TESTING FOR QUALIFYING WHEAT STARCH AS AN ALTERNATIVE BLAST MEDIA

System Number:

Patron Number:

Requester:

Notes:

DSIS Use only:

Deliver to:

National Defence
Research and
Development Branch

Défense nationale
Bureau de recherche
et développement

TECHNICAL MEMORANDUM 97/256
November 1997

COMPOSITES TESTING FOR QUALIFYING WHEAT STARCH AS AN ALTERNATIVE BLAST MEDIA

Alan J. Russell

**Defence
Research
Establishment
Atlantic**

**Centre de
Recherches pour la
Défense
Atlantique**

Canada

DEFENCE RESEARCH ESTABLISHMENT ATLANTIC

9 GROVE STREET

P.O. BOX 1012
DARTMOUTH, N.S.
CANADA B2Y 3Z7

TELEPHONE: (902) 426-3100
FACSIMILE: (902) 426-9654

CENTRE DE RECHERCHES POUR LA DÉFENSE ATLANTIQUE

9 GROVE STREET

C.P. BOX 1012
DARTMOUTH, N.É.
CANADA B2Y 3Z7

National Defence
Research and
Development Branch

Défense nationale
Bureau de recherche
et développement

COMPOSITES TESTING FOR QUALIFYING WHEAT STARCH AS AN ALTERNATIVE BLAST MEDIA

Alan J. Russell

November 1997

Approved by T. Foster: *Signature on File*
Head/ Dockyard Lab (Esquimalt)

TECHNICAL MEMORANDUM 97/256

Defence
Research
Establishment
Atlantic

Centre de
Recherches pour la
Défense
Atlantique

Canada

COMPOSITES TESTING FOR QUALIFYING WHEAT STARCH AS AN ALTERNATIVE BLAST MEDIA

Abstract

The results of mechanical testing carried out in order to qualify wheat starch based blast media for removing paint coatings from the carbon/epoxy components on the CF-188 aircraft are reported. Wheat starch has potential advantages over currently used plastic blast media in as far as it comes from a renewable resource and is bio-degradable. In this investigation, coatings to CF-188 aircraft specifications, were applied to both monolithic and honeycomb sandwich test panels and then completely removed by blasting with wheat starch media. Several different blasting conditions were evaluated by carefully controlling parameters such as pressure, angle of attack and travel rate. Tension, compression, flexure and fatigue tests were then carried out in order to evaluate any loss of strength or stiffness. While deficiencies in the manufacture of some of the test panels reduced the sensitivity of some of these tests, no deleterious effects of wheat starch blasting were evident in any of the test results.

Résumé

On signale les résultats d'essais mécaniques réalisés en vue de l'agrément de l'amidon de blé comme matériau de décapage de revêtements de peinture déposés sur des élents en carbone-époxy de l'avion CF-188. Comme il est tiré d'une ressource renouvelable et qu'il est biodégradable, l'amidon de blé peut constituer un matériau de décapage plus avantageux que les matériaux couramment employés pour le décapage des éléments en plasitique. Dans cette étude, on a appliqué sur des panneaux d'essai monolithiques et des panneaux d'essai en sandwich à nid d'abeille des revêtements conformes aux spécifications pour l'avion CF-188, que l'on a ensuite complètement décapés au jet en utilisant de l'amidon de blé comme matériau de décapage. On a évalué plusieurs conditions de décapage différentes en réglant avec soin des paramètres comme la pression, l'angle d'attaque et la vitesse de déplacement. On a aussi effectué des essais de traction, de compression, de flexion et de résistance à la fatigue afin d'évaluer toute perte de résistance ou de rigidité. Même si la sensibilité de certains de ces essais était réduite par la présence de défauts survenus lors de la fabrication de certains des panneaux d'essai, aucun effet néfaste du décapage au jet d'amidon de blé n'a été décelé dans les résultats obtenus.

DREA TECHNICAL MEMORANDUM 97/256

COMPOSITES TESTING FOR QUALIFYING WHEAT STARCH AS AN ALTERNATIVE BLAST MEDIA

by

Alan J. Russell

EXECUTIVE SUMMARY

1. This technical memorandum reports the results of a series of qualification tests designed to demonstrate the suitability of wheat starch based blast media for removing paint coatings from the carbon/epoxy components on the CF-188 aircraft. Deficiencies in some of the test panels supplied by McDonnell Douglas, funding shortfalls at QETE and the closure of the Defence Research Establishment Pacific and all contributed to the delays in completing this tasking.

2. As a qualified coatings removal process, wheat starch blasting offers significant advantages over other technologies in terms of reducing costs and minimizing environmental impact. The use of starch based blast media was pioneered in Canada by Ogilvie Mills (Montreal) who later sold the business rights to CAE.

3. None of the tests reported herein show any deleterious effect of using wheat starch blast media for the removal of coatings from the carbon/epoxy structure of the CF-188 aircraft, provided that the blasting conditions employed are no more severe than those described in the present study.

TABLE OF CONTENTS

INTRODUCTION

This technical memorandum reports the results of mechanical testing carried out to determine the suitability of wheat starch based blast media for removing paint coatings from the carbon/epoxy components on the CF-188 aircraft. These components include the inner and outer wing skins and most of the flight control surfaces and external doors. Wheat starch has potential advantages over currently used plastic blast media in terms of its impact on the environment. Not only does it come from a renewable resource but its bio-degradability significantly reduces problems and costs associated with disposal of spent blast media. At a joint meeting between representatives of DND, McDonnell Douglas (McAir) and the US Naval Air Warfare Center (NAWC) it was agreed that qualification testing would follow a similar approach to that used for plastic media blasting on the F-18 [1]. There were therefore two distinct criteria used to evaluate possible blasting damage to the aircraft's AS4/3501-6 carbon/epoxy composite structure; one relying on microscopic examination of the surface and the other involving a number of different mechanical tests of blasted panels. It was also agreed that McAir would be responsible for supplying the test panels, CAE Enviro-Strip would carry out the blasting and DND would undertake the testing. This report summarizes the results of the mechanical testing part of this project. Table 1 list the various composites' tests to be carried out as well as the panel lay-ups, specimen dimensions and blasting parameters evaluated. Preliminary tests [2] were used to establish appropriate blasting conditions for the wheat starch media and Table 2 summarizes the blasting parameters that were found to be suitable and were therefore evaluated in this investigation.

Table 1. Summary of Mechanical Tests

Test	Panel Lay-up	Specimen Dimensions	Test Variables*	Number of Specimens per test condition
Tensile	$[67.5\pm22.5,-67.5,\mp22.5,67.5]_S$	25 x 225	N	12
Compressive	$[67.5\pm22.5,-67.5,\mp22.5,67.5]_S$	12.7 x 80	N	12
Flexure	$[0_2\pm45,0,\pm45]_S$	25 x 100	N, P, A	16
Fatigue	$[67.5\pm22.5,-67.5,\mp22.5,67.5]_S$	25 x 225	N	8
Flatwise Tension	$[0/90/90/0]_T$	50 mm ϕ	N, P, A	3
Sandwich Beam Flexure	$[\pm45,0]_S$	25 x 560	N, P, A	3 tension 3 compression

* N = number of passes, P = pressure, A = angle

Table 2. Blasting Conditions

Number of Passes	Pressure (psi)	Angle (degrees)	Feed Rate (lbs/min)	Rate of Travel (inches/sec)	Stand off (inches)
1 or 10	30 or 40	45 or 90	12	1.2 for 30 psi 1.6 for 40 psi	3

For those tests where the number of passes, blasting pressure and angle of attack were all varied the 2x2x2 possible combinations resulted in eight different blasting conditions being employed on eight separate panels. Control specimens were cut either from portions of the blasted panels, which were masked to prevent removal of the paint, or from completely separate panels. After receiving the first of the test panels it became apparent that many of them were of poor quality. As well as large variations in thickness between similar panels, some panels contained numerous elongated voids close to the surface. The flexure test panels in particular, were deemed unacceptable and replacement panels were fabricated in-house. The flatwise tension panels also contained voids but because of the nature of the test, with failure generally occurring close to the bondline, these panels were used. Where possible the test specimens were cut from those areas with the fewest voids.

TENSION AND COMPRESSION TESTS

Six different panels, each 300 mm x 450 mm, were required for the tension and compression tests. One third of each panel was masked off for control specimens prior to blasting at 30 psi and an angle of 45 degrees. Three of the panels were given a single pass and the other three received ten passes. Tension tests were carried out in accordance with ASTM D-3039 and compression tests in accordance with ASTM D-695. The only difficulty encountered with these tests was that a very close tolerance on the length of the compression specimens was needed in order to consistently obtain satisfactory failures. With too long a specimen a buckling type of failure occurred in the top, unsupported portion of the specimen and if the length was reduced too much the fixture bottomed out before failure occurred. From Table 3, which shows the mean and standard deviations of the strength and moduli values obtained, it can be seen that no statistically significant effect of the blasting was found in either tension or compression.

Table 3. Summary of Tension and Compression Tests Results

Property	Control	Single Pass	10 Passes
Tensile Modulus (GPa)	62.4±1.2	63.1±1.8	63.3±1.3
Tensile Strength (Mpa)	595±20	591±14	587±18
Compression Modulus (GPa)	51.8±2.6	50.5±2.0	52.1±1.1
Compression Strength (MPa)	469±16	457±28	474±10

FLEXURE TESTS

Flexure tests were carried out in accordance with ASTM D-790 using the four point bend arrangement shown in Figure 1. Specimens were cut from 9 separate panels, eight of which had been wheat starch blasted under the conditions shown in Table 4. No particular problems were encountered while carrying out the flexure tests. However, the use of a painted panel for the control specimens made a direct comparison with the blasted panel data more difficult than it would have been if the panel had never been coated. From Table 5, which summarizes the flexure test data, it can be seen that the control panel (#9) gave, on average, both a higher failure load as well

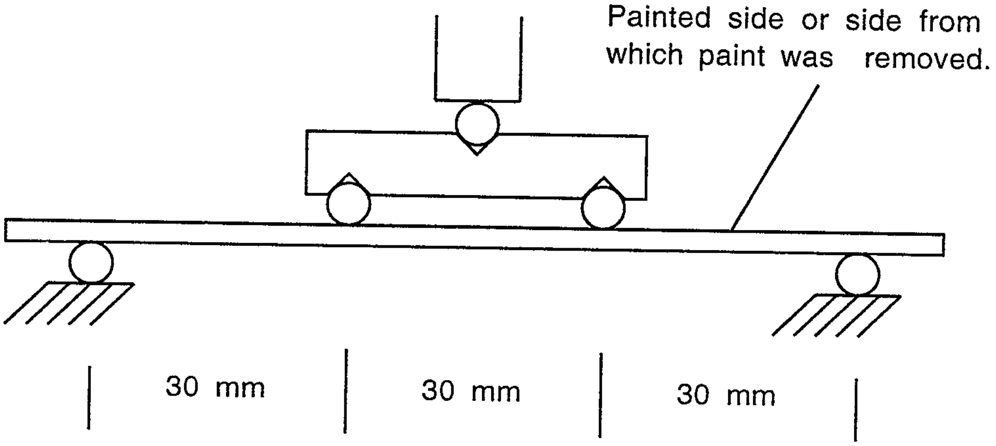

Figure 1. Flexure test configuration.

Table 4. Blasting Conditions used for Flexure Test Panels.

Panel #	# of Passes	Angle (degrees)	Pressure (psi)	Travel Rate (inches/sec)	Feed Rate (lbs/min)	Stand off (inches)
1	10	45	30	1.2	12	3
2	10	45	40	1.6	12	3
3	10	90	30	1.2	12	3
4	10	90	40	1.6	12	3
5	1	90	40	1.6	12	3
6	1	90	30	1.2	12	3
7	1	45	30	1.2	12	3
8	1	45	40	1.6	12	3
9	C	o	n t	r	o l	s

as a higher deflection at failure. After reducing the thickness by 0.12 mm to allow for the layer

Table 5. Flexure Test Data (Mean ± s.d. of 16 specimens per panel)

Panel #	Failure Load (kN)	Maximum Displacement (mm)	Thickness (mm)	Modulus at 0.6% Strain (GPa)	Failure Stress (MPa)	Strain to Failure (mm/m)
1	1.40±0.03	11.1±0.4	2.07±0.03	96.6±2.9	1226±39	13.5±0.4
2	1.38±0.04	11.0±0.3	2.08±0.02	94.2±1.9	1191±29	13.5±0.3
3	1.38±0.04	11.0±0.4	2.11±0.03	90.1±2.5	1154±29	13.7±0.5
4	1.35±0.03	10.9±0.4	2.10±0.02	90.4±2.6	1137±18	13.5±0.5
5	1.38±0.03	11.1±0.3	2.08±0.03	93.7±3.9	1191±31	13.6±0.4
6	1.37±0.04	10.8±0.2	2.08±0.02	94.4±3.2	1180±34	13.2±0.3
7	1.37±0.04	10.8±0.3	2.10±0.02	92.1±2.8	1158±28	13.4±0.4
8	1.36±0.04	10.9±0.4	2.10±0.02	91.0±2.3	1148±36	13.4±0.4
9	1.45±0.05	11.9±0.7	2.22±0.02	77.9±2.1	1102±43	15.6±1.0
9*	1.45±0.05	11.9±0.7	2.10±0.02	92.0±2.5	1231±48	14.8±0.9

* Control panel data corrected for paint thickness

of paint, the failure stress of 1231 MPa, is still 5% higher than that of the other panels (1173±29 Mpa) and the strain to failure of 14.8 mm/m is still 10% higher than the average of the blasted panels. This does not necessarily mean that the wheat starch stripping has weakened the panels. For example, the layer of paint could have inhibited microbuckling of the fibres directly and/or reduced the contact stresses under the inner loading points.

FATIGUE TESTING

The 25 x 225 mm tension-tension fatigue specimens were machined from the same test panels as the tension and compression specimens. Tests were carried out under load control at a frequency of 4 Hz and an R-ratio of 0.1. After a few preliminary tests it was established that a maximum load of 18 kN gave the desired life of approximately 10^5 cycles. The results of these tests are shown in Figure 2 in the form of a plot of failure probability versus number of cycles. Unexpectedly, the data appear to show a statistically significant increase in fatigue life after a single pass and an even greater increase after ten passes.

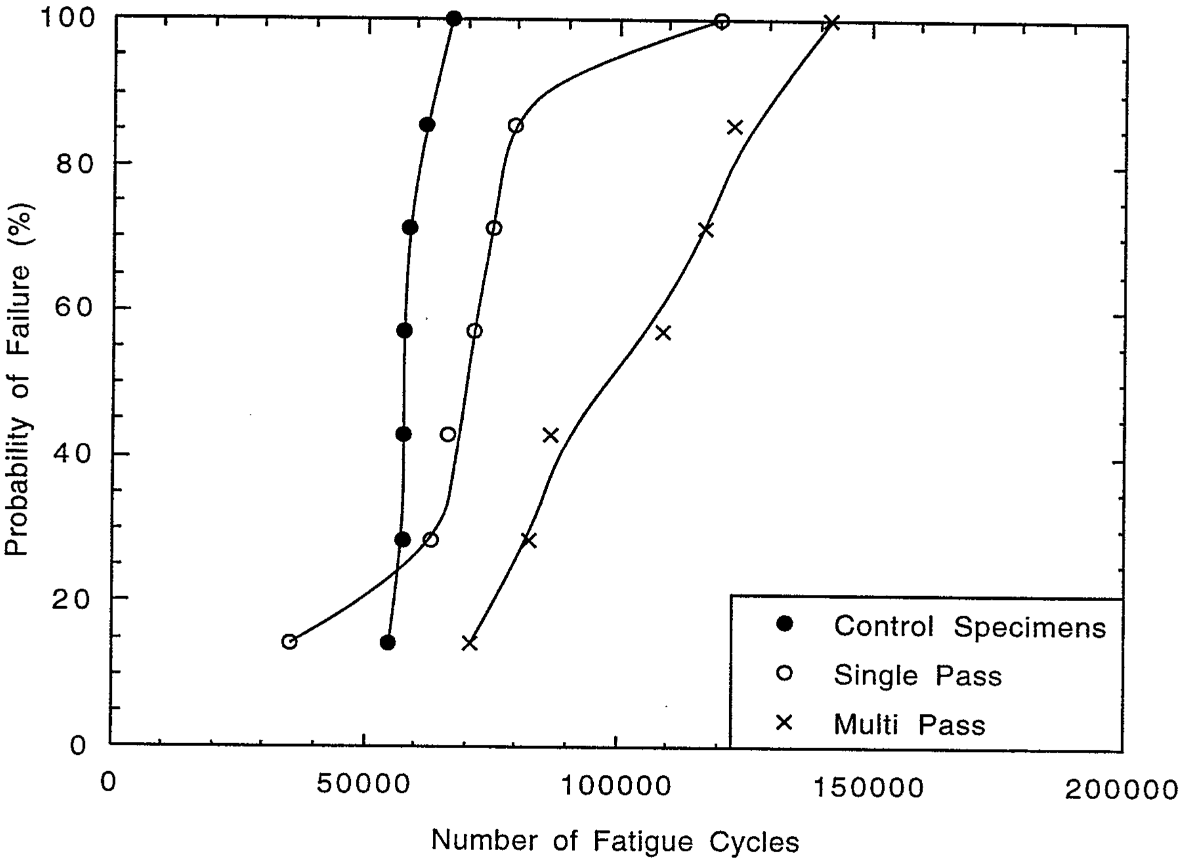

Figure 2. Tension - tension fatigue data.

Through correspondence with both McAir and NAWC it was learned that for upcoming AV8B qualification tests a 38 mm wide specimen containing a 6.37 mm diameter hole in the centre would be fatigued under fully reversed tension / compression loading. Although, there was insufficient material remaining to machine full length specimens of this kind, somewhat shorter specimens were machined from the same panels as the tension-tension specimens and loaded using hydraulic wedge grips. These specimens were cycled between +15 kN and -15 kN at 4 Hz until failure. Although these tests resulted in more scatter (probably because of the short gripping length) there was still an apparent benefit to blasting as shown in Figure 3. In a further attempt to understand the reason for this, a third set of tests were carried out using specimens from different panels. The results of these tests, which are shown in Figure 4, displayed much less variation between the blasted and control panels although the ten pass specimens still appeared to last slightly longer than the controls. However, the most prominent feature of this third data set was the much greater range of lifetimes compared to the original tension - tension results. When the number of cycles to failure was plotted against specimen thickness, Figure 5, it was discovered that the large variation in material thickness was responsible for the scatter in the data, with the thicker specimens lasting significantly longer than the thinner ones. The original tension - tension data when plotted in the

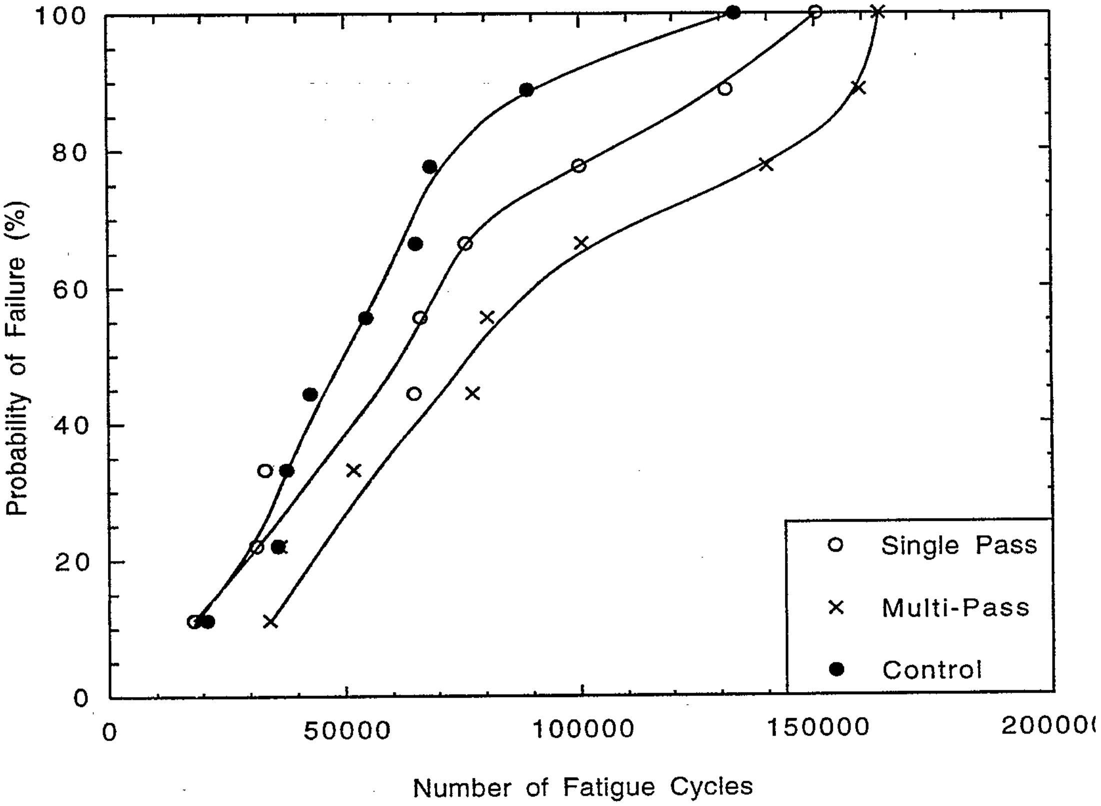

Figure 3. Open hole tension - compression fatigue life.

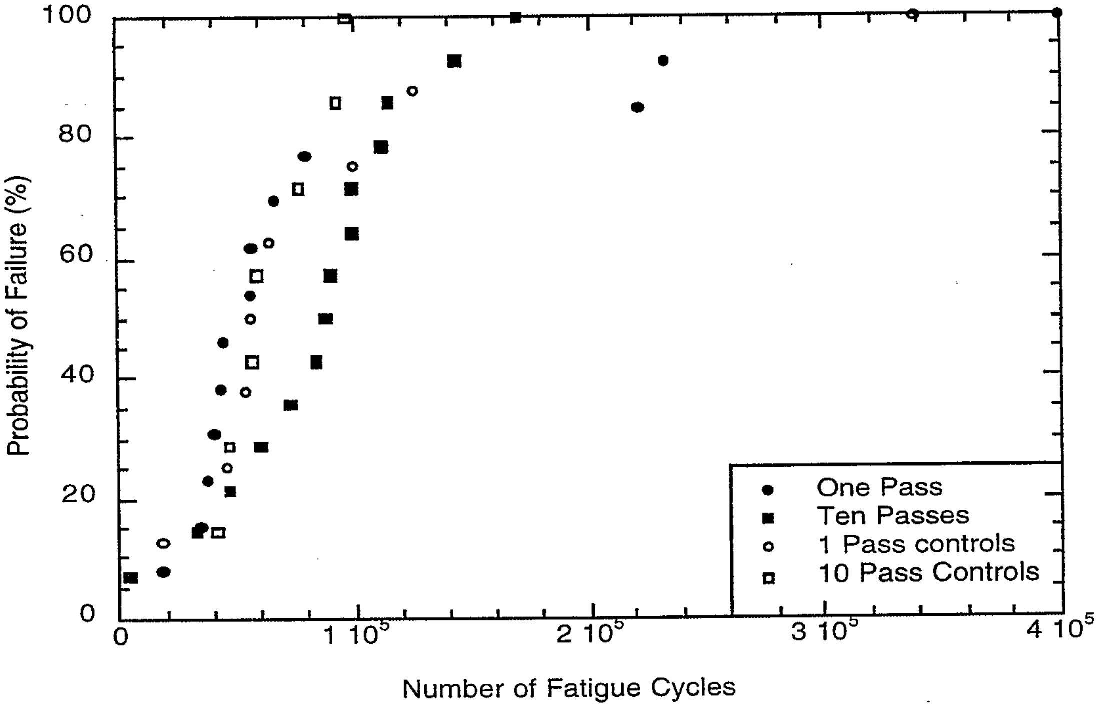

Figure 4. Tension - tension fatigue - Data set 2.

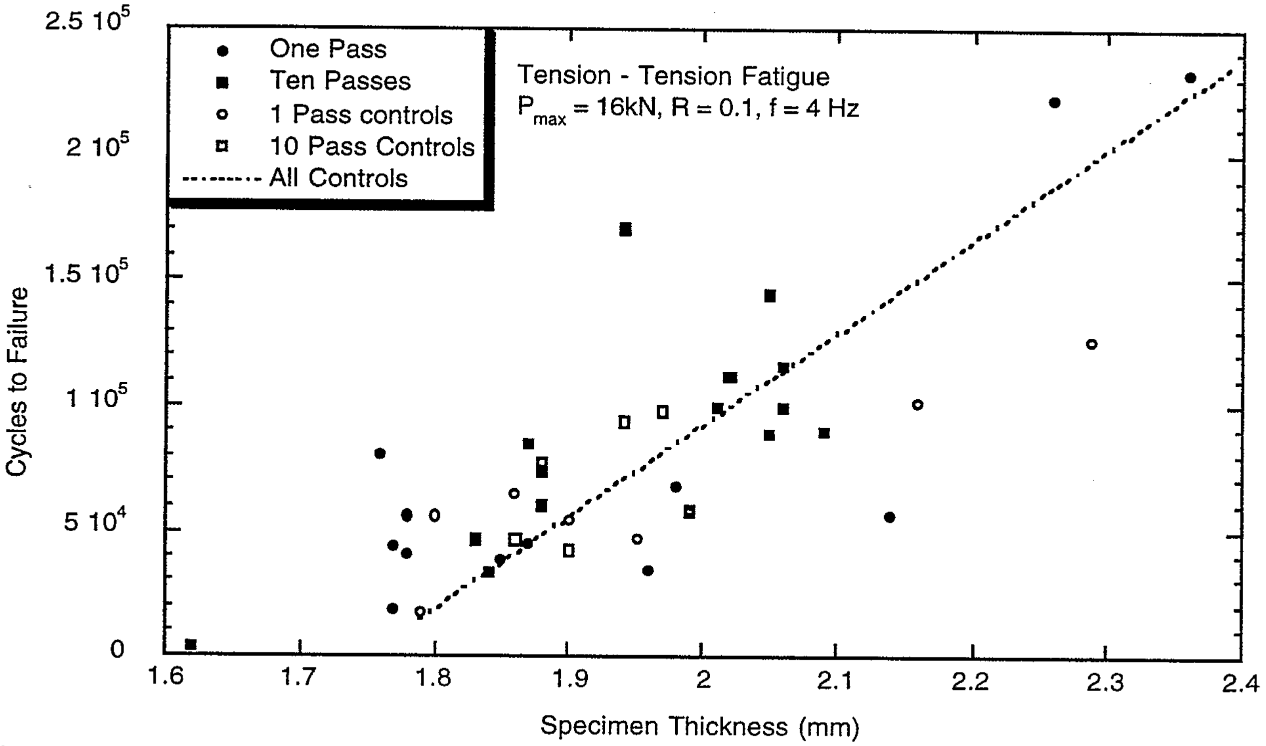

Figure 5. Tension-tension fatigue - data set 2 as a function of thickness.

same manner, Figure 6, displayed a similar thickness effect and, furthermore, the differences between panels could clearly be attributed to differences in thickness rather than to any beneficial effect of the wheat starch blasting. It is worthwhile noting that these thickness effects on the fatigue life are not due to a difference in cyclic strain between specimens. Although strain was not measured, thickness variations in poorly made panels are generally due to differences in the amount of resin bled from the laminate during cure rather than because of differences in fibre areal weight. Consequently, thicker specimens have lower moduli and when loaded to the same loads have strain values similar to those of thinner specimens. Rather, the effect of thickness on fatigue life is caused by the lower interlaminar stresses at the edges of the thicker specimens. Failure in these matrix dominated specimens begins as delamination of the free edges and is therefore very sensitive to the magnitude of the free edge stresses. Unfortunately, there is no reliable means of compensating for thickness variations when running these types of tests.

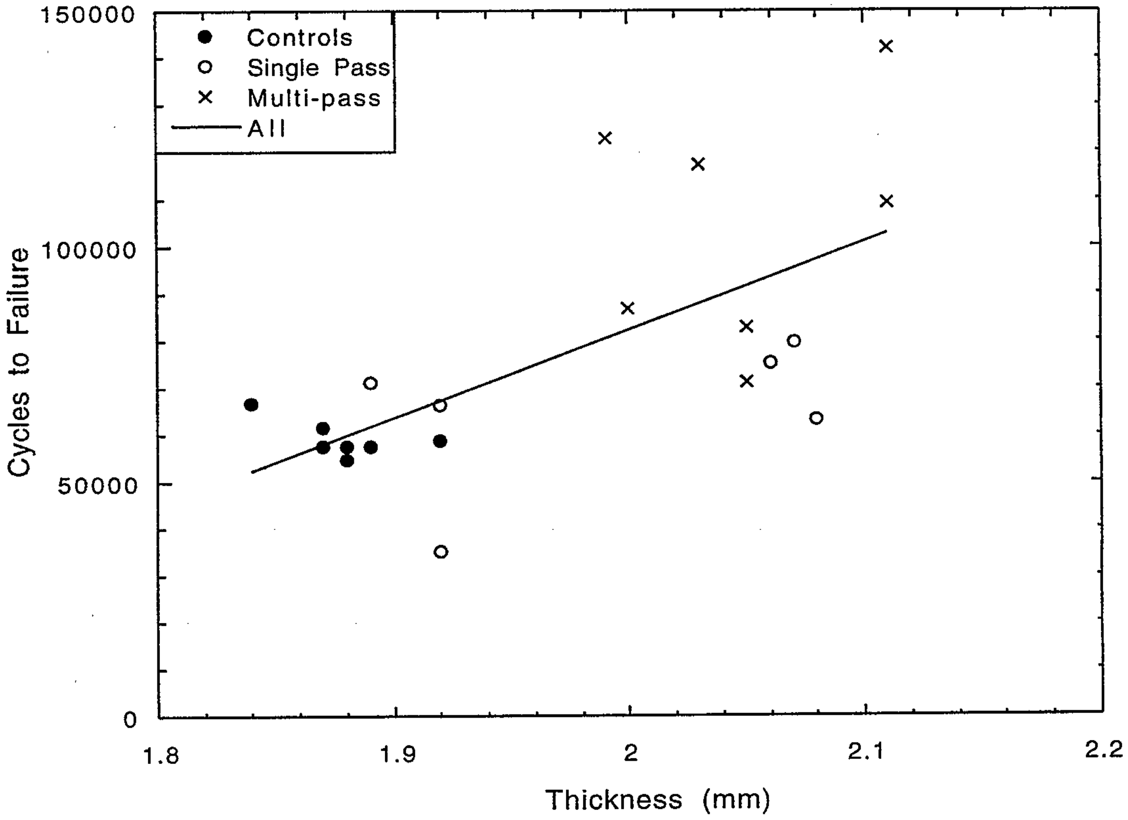

Figure 6. Original tension - tension fatigue data as a function of thickness.

TESTS ON HONEYCOMB SANDWICH PANELS

Flexural Beam Tests

The (14 x 22 inches) panels for the flexural beam specimens were comprised of one 3 mm (0.125 inch) thick 6-Al-4V-Titanium alloy face sheet and one 0.75 mm thick angle ply laminate adhesively bonded to the opposite face of a 38 mm (1.5 inches) thick sheet of aluminum honeycomb. A total of nine test panels were used for these tests and the specific blasting conditions used for each panel are indicated in Table 6. McDonnell Douglas Process Specification 213320 describes the procedure for loading (1 inch x 22 inch) beam specimens in four point bending with the titanium on either the compression side (to force the carbon/epoxy to fail in tension) or on the tension side (to obtain the compressive strength of the composite material). Two separate problems were encountered while attempting these tests. The first difficulty lay in cutting through all three layers (titanium, carbon/epoxy and aluminum honeycomb) at the same time. In PS 213320 this problem is avoided by pre-cutting the materials and fabricating each specimen individually, but for the purpose of the present tests that approach would not have permitted the coating removal from a representative area and would have exposed the edges of the carbon/epoxy to the blasting. After some experimentation, water-jet cutting was chosen as the best available option, although the water tended to channel through the honeycomb cells and punch out the back surface material leaving a serrated edge. By placing the titanium at the back, a relatively straight cut was obtained in the carbon/epoxy.

Table 6. Blasting Conditions Employed on Honeycomb Sandwich Panels

Panel ID	# of Passes	Angle	Pressure (psi)	Travel Rate (inch/sec)
AD-1	1	45	30	1.2
AD-2	Controls			
AD-3	1	90	30	1.2
AD-4	10	90	30	1.2
AD-5	1	45	40	1.6
AD-6	10	45	40	1.6
AD-7	10	45	30	1.2
AD-8	1	90	40	1.6
AD-9	10	90	40	1.6

The second problem encountered with the flexural beam tests was that failure tended to occur by shear somewhere between the inner and outer loading pins, with debonding taking place in a vertical plane between the core nodes and horizontally between the core and the face sheets. There appeared to be two factors contributing to this. First, the honeycomb was oriented with the ribbon direction perpendicular to the 22 inch length of the specimens instead of parallel to it in accordance with PS 213320. Secondly, the ribbon to ribbon core node bonds were unusually weak as indicated by the ease with which they could be pulled apart by hand. It is possible that vibrations from the water jet cutting could have contributed to this but further investigation would be required to establish this. In order to increase the probability of producing tension / compression failures, tests were run with an inner span of 44 mm instead of the specified 100 mm (4 inches). This significantly reduced the number of shear failures while still providing an adequately long region of uniform strain in the middle of the specimens on which to mount a 25 mm gage length extensometer. Table 7 shows the results of the tests carried out with the carbon/epoxy loaded in tension. Of the 27 specimens tested, 23 failed in tension with all but 7 of these failures occurring in the high strain region between the inner load points. With the exception of the specimens from test panel AD-7 there was no significant loss in strength following blasting. All three of the panel AD-7 specimens failed outside of the inner load points thus preventing a valid comparison with the AD-2 control specimens.

Table 7.Sandwich Beam Tension Test Results

	Strain in carbon/epoxy at failure (%)			
Panel ID	1	2	3	Avg
AD-1	1.087	1.202	1.256	1.181
AD-2	1.257	SF	1.119	1.188
AD-3	1.261	SF	1.033*	1.147
AD-4	1.047	1.287*	1.046	1.127
AD-5	1.038	SF	1.233*	1.136
AD-6	1.059	1.067	1.144	1.090
AD-7	0.945*	0.990*	1.060*	-
AD-8	1.320	1.116*	0.986	1.141
AD-9	SF	1.289	1.211	1.250

SF = shear failure. * indicates tension failure between inner and outer load points.

With the beam specimens oriented so that the carbon/epoxy was loaded in compression there was insufficient space between the specimen and the fixture to mount an extensometer. Failure stresses were therefore calculated from the failure loads using standard beam bending formulas, measured specimen widths and a constant skin thickness of 0.75 mm. The values shown in Table 8 display about the same amount of scatter as do the tensile strain data in Table 7. Only two specimens failed in shear, while 8 of the compression failures took place beneath the inner loading blocks. No significant reduction in strength following blasting is evident from these results.

Table 8. Sandwich Beam Compression Test Results

	Stress in carbon/epoxy at failure (MPa)			
Panel ID	Test #1	Test #2	Test #3	Avg.
AD-1	SF	1117.8	1099.1	1108.5
AD-2	1134.7	1109.7	1062.7*	1102.4
AD-3	1177.2	1078.3	1067.2	1107.6
AD-4	1023.5*	1150.2*	1072.1	1081.9
AD-5	1105.4	1055.8*	1034.7*	1065.3
AD-6	1148.7	1136.0	1166.5	1150.4
AD-7	1118.5	1102.1*	1136.1	1118.9
AD-8	1090.5	1103.2*	1105.5	1099.7
AD-9	1067.3*	1157.5	SF	1112.4

SF = shear failure. * indicates compression failure under inner load points.

FLATWISE TENSION TESTS

The sandwich panels for the flatwise tension tests were comprised of two 0.5 mm thick carbon/epoxy face sheets adhesively bonded to aluminum honeycomb core with FM-300 adhesive. Specimen preparation and tensile testing was carried out under contract at the University of British Columbia. Table 9 shows the different blasting parameters selected for each of the test panels. Cylindrical test specimens were cut from the panels using a 50.8 mm diameter core drill and water as the coolant / lubricant. Loading plates were adhesively bonded to both faces of the cylindrical specimens using AF-126 which is a 121°C curing epoxy film adhesive. Uniform loading was achieved through careful alignment during bonding as well as the use of a test fixture capable of accommodating rotation at both specimen ends about two orthogonal horizontal axes.

Table 10 shows the failure stresses of each of the three valid tests carried out on specimens from each panel. (Some tests failed at the bondline between the face sheet and the grip and were discounted). Most failures involved delamination of the carbon/epoxy (20% to 100% of the cross sectional area) and tensile failure of the core (up to as much as 75% of the cross sectional area). A small amount of debonding of the AF-126 adhesive from the core was also observed on some specimens. It is likely that some of the rather low values were caused by failures initiating at the large voids in the face sheets.

Table 9. Test Panels for Flatwise Tension Tests

Panel ID	Blasting Condition	# of Passes	Angle	Pressure (psi)	Travel Rate (inch/sec)	
242B1-1	1	1	90	40	1.6	control with paint
242C3	2	1	45	40	1.6	
242B4	3	10	45	30	1.2	control w/o paint
242B3	4	10	45	40	1.6	control w/o paint
242C1	5	1	90	30	1.2	
242B1-10	6	10	90	40	1.6	
242A4	7	1	45	30	1.2	
242A3	8	10	90	30	1.2	

Table 10. Failure Stresses of Flatwise Tension Specimens

Panel ID	Blast Condition	Failure Stress (MPa)			
		Test 1	Test 2	Test 3	Avg.
242B1-1	1	6.06	6.07	6.63	6.25
242C3	2	6.04	6.34	6.25	6.21
242B4	3	6.16	6.10	6.13	6.13
242B3	4	5.43	6.13	6.10	5.89
242C1	5	6.04	6.25	6.00	6.10
242B1-10	6	6.09	5.99	6.22	6.10
242A4	7	5.95	5.96	6.16	6.02
242A3	8	6.39	6.19	6.36	6.31
	Controls	5.94, 6.02	6.03, 6.11	5.80, 6.29	6.03

CONCLUSIONS

1. None of the test results reported above indicate that wheat starch blasting, performed under the conditions described in this investigation, has any deleterious effect on the mechanical properties of the AS4/3501-6 carbon/epoxy laminates and honeycomb sandwich structure used on the CF-188 aircraft.

2. A number of deficiencies in the test laminates made the evaluation of the effects of wheat starch blasting significantly more problematical than it otherwise would have been. These deficiencies included large variations in the thicknesses of the fatigue specimens, pre-mature core debonding in the flexural beam tests, voids in the flatwise tension specimens and control specimens that were not always truly representative of the unpainted/unblasted test laminates.

REFERENCES

1. "Test Plan for Evaluation of Plastic Media Blasting", working document provided by Mary Beth Fennel, USN, Cherry Point, March 1994.

2. Douchant, Alain, Trip Report to CAE Envirostrip, 5-7 December 1994.

UNCLASSIFIED
SECURITY CLASSIFICATION OF FORM
(highest classification of Title. Abstract, Keywords)

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document.. Organizations for whom the document was prepared, e.g. Establishment sponsoring a contractor's report. or tasking agency, are entered in section 8.) Defence Research Establishment Atlantic PO Box 1012, Dartmouth, NS Canada B2Y 3Z7	2. SECURITY CLASSIFICATION (overall security classification of the document including special warning terms if applicable). UNCLASSIFIED

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S.C.R or U) in parentheses after the title).

Composites Testing for Qualifying Wheat Starch as an Alternative Blast Media

4. AUTHORS (Last name, first name, middle initial. If military, show rank, e.g. Doe, Maj. John E.)

Russell, Alan J.

5. DATE OF PUBLICATION (month and year of publication of document) November 1997	6a. NO .OF PAGES (total containing information Include Annexes, Appendices, etc). 19	6b. NO. OF REFS (total cited in document) 2

7. DESCRIPTIVE NOTES (the category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered).

DREA Technical Memorandum

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include address).

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant). Project 1gh	9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written).
10a ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity. This number must be unique to this document.) DREA TM/97/256	10b OTHER DOCUMENT NOs. (Any other numbers which may be assigned this document either by the originator or by the sponsor.)

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification)

(X) Unlimited distribution
(   ) Defence departments and defence contractors; further distribution only as approved
(   ) Defence departments and Canadian defence contractors; further distribution only as approved
(   ) Government departments and agencies; further distribution only as approved
(   ) Defence departments; further distribution only as approved
(   ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11) is possible, a wider announcement audience may be selected).

UNCLASSIFIED
SECURITY CLASSIFICATION OF FORM

13. ABSTRACT (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), (R), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual).

The results of mechanical testing carried out in order to qualify wheat starch blast media for removing paint coatings from the carbon/ epoxy components on the CF-188 aircraft are reported. Wheat starch has potential advantages over currently used plastic blast media in as far as it comes from a renewable resource and is bio-degradable. In this investigation, coatings to CF-188 aircraft specifications, were applied to both monolithic and honeycomb sandwich test panels and then completely removed by blasting with wheat starch media. Several different blasting conditions were evaluated by carefully controlling parameters such as pressure, angle of attack and travel rate. Tension, compression, flexure and fatigue tests were then carried out in order to evaluate any loss of strength or stiffness. While deficiencies in the manufacture of some of the test panels reduced the sensitivity of some of these tests, no deleterious effects of wheat starch blasting were evident in any of the test results.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus-identified. If it not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title).

Coatings
Paint
Stripping
Blasting Media
Wheat Starch
Composite Materials
Carbon/Epoxy
Aircraft
Mechanical Properties

D
R
E
A

C
R
D
A

#509570