

JOB NUMBER: 30160 07-86165R2
PAGE: 1 of 6
DATE: July 2, 2007

662 Cromwell Avenue
Saint Paul, MN 55114
USA

Telephone : (651) 645-3601
Toll Free : (888) 645-TEST
Telefax : (651) 659-7348
Website : www.storktct.com

Investigative Chemistry
Non Destructive Testing
Metallurgical Analysis

Geotechnical
Failure Analysis
Materials Testing

Construction Materials
Product Evaluation
Welder Qualification

**TESTING
OF
ABS PLASTIC**

**Prepared for:
Protomold Co. Inc.
Attn: Mr. Kevin Crystal
1757 Halgren Rd
Maple Plain, MN 55359**

Prepared By:



**Bob DiProspero
Testing Technician
Product Evaluation Department**

Reviewed By:



**William Stegeman
Project Manager
Product Evaluation Department
Phone: 651-659-7230**

The test results contained in this report pertain only to the samples submitted for testing and not necessarily to all similar products.

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

Stork Twin City Testing Corporation is an operating unit of Stork Materials Technology B.V., Amsterdam, The Netherlands, which is a member of the Stork Group

JOB NUMBER: 30160 07-86165R2

PAGE:

2 of 6

DATE:

July 2, 2007

TESTING OF ABS PLASTIC

INTRODUCTION:

This report presents the results of tensile and flexural tests conducted on samples of ABS plastic. The testing was authorized by Mr. Kevin Crystal of Protomold Co. Inc. on June 1, 2007. The testing and data analysis were completed on June 7, 2007.

The scope of our work was limited to conducting tensile and, flexural tests on the samples submitted and reporting the results.

SUMMARY OF RESULTS:

ASTM D790, Flexural Properties of Plastics

Sample	Average Peak Load, lbf	Average Flexural Strength, ksi
Machined, First Cut	20.4	9.3
Molded, 2 End Gates	24.5	9.3
Molded, Center Gate	25.5	9.6
Molded, 1 End Gate	24	9.2
FDM, X axis	15.7	4.9
FDM, Z axis	10.4	3.6

ASTM D638, Tensile Properties of Plastics

Sample	Average Peak Load, lbf	Average Peak Stress, psi	Average Strain at Break, %	Average Break Stress, psi
Machined, First Cut	110	5456	16.2	4562
Molded, 2 End Gates	104	5117	2.0	5117
Molded, Center Gate	103	5118	2.2	5118
Molded, 1 End Gate	125	6194	14.5	5399
FDM, X axis	54	2563	1.6	2563
FDM, X-Y axis	53	2529	1.5	2529
FDM, Z axis	43	2088	1.5	2088

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

JOB NUMBER: 30160 07-86165R2

PAGE:

3 of 6

DATE:

July 2, 2007

SAMPLE IDENTIFICATION:

The table below lists the particular samples received (marked with "R") and identified as ABS plastic. Two types were provided: black ABS plastic, identified and labeled by the customer as "Molded" and "Machined", and white ABS plastic, identified and labeled by the customer as "FDM". Five to ten specimens of each sample type were machined by the customer to conform to the dimensions specified by the tensile and flexural test methods.

Material	FDM ABS			Protomold injection molded ABS			
Location	X	XY	Z	First Cut	Center Gate	1 End gate	2 End Gate
Tensile	R	R	R	R	R	R	R
Flexural	R		R	R	R	R	R

TEST METHODS:

The samples were allowed to condition at standard laboratory conditions of 72 ± 4°F and 50 ± 5% relative humidity for at least 40 hours prior to testing. Standards used are detailed below, with notes of deviations.

Test Method	Test Method Title	Deviations or Comments
ASTM D638	Standard Test Method for Tensile Properties of Plastics, Specimen Type V	0.05 in/min test speed; 1.0 inch grip separation
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials	0.05 in/min test speed; 2.0 inch span

CALIBRATED TEST EQUIPMENT:

MTS Universal Testing machine, model Qtest/50LP, System No. 1532, Stork TCT asset # MM210-009, calibrated 5/07

Mitutoyo Calipers, model CD-8C, S# 0006565, ID MM160-068, calibrated 11/06

UNCALIBRATED TEST EQUIPMENT:

Holding grips, fixtures and clamps

JOB NUMBER: 30160 07-86165R2

PAGE:

4 of 6

DATE:

July 2, 2007

TEST DATA:

ASTM D790 Flexural Properties

Sample	Specimen	Width, in	Thickness, in	Peak Load, lbf	Ultimate Flexural Strength, ksi	Modulus, ksi	Strain at Break, %
Machined First Cut	1	0.502	0.127	25.1	9.3	328	no break
	2	0.503	0.108	17.9	9.2	359	no break
	3	0.501	0.111	19.3	9.4	358	no break
	4	0.503	0.117	21.3	9.3	344	no break
	5	0.502	0.110	18.5	9.1	371	no break
	Average			20.4	9.3	352	
	Standard Deviation			2.9	0.1	16	
Molded 2 End Gates	1	0.499	0.126	24.6	9.4	347	no break
	2	0.499	0.126	24.5	9.3	358	no break
	3	0.500	0.125	24.5	9.4	359	no break
	4	0.500	0.126	24.4	9.3	355	no break
	5	0.499	0.126	24.3	9.3	357	no break
	Average			24.5	9.3	355	
	Standard Deviation			0.1	0.1	5	
Molded Center Gate	1	0.499	0.126	25.1	9.5	348	no break
	2	0.499	0.126	25.2	9.5	353	no break
	3	0.499	0.127	25.7	9.6	352	no break
	4	0.499	0.126	25.9	9.7	352	no break
	5	0.499	0.127	25.6	9.6	348	no break
	Average			25.5	9.6	351	
	Standard Deviation			0.3	0.1	3	
Molded 1 End Gate	1	0.500	0.125	24.1	9.3	340	no break
	2	0.499	0.126	23.9	9.1	331	no break
	3	0.499	0.125	24.2	9.3	350	no break
	4	0.500	0.125	23.9	9.2	332	no break
	5	0.499	0.126	23.9	9.1	332	no break
	Average			24.0	9.2	337	
	Standard Deviation			0.1	0.1	8	
FDM X axis	1	0.498	0.139	15.9	5.0	219	5.9
	2	0.498	0.139	15.6	4.9	222	5.8
	3	0.498	0.139	15.8	5.0	207	5.7
	4	0.499	0.139	15.5	4.8	219	5.4
	5	0.500	0.138	15.9	5.0	222	6.0
	Average			15.7	4.9	218	5.8
	Standard Deviation			0.2	0.1	6	0.2
FDM Z axis	1	0.502	0.130	10.4	3.6	186	3.0
	2	0.502	0.132	10.4	3.6	178	3.1
	3	0.502	0.130	10.3	3.6	187	3.0
	4	0.502	0.130	10.5	3.7	174	3.2
	5	0.502	0.132	10.4	3.6	178	2.9
	Average			10.4	3.6	181	3.0
	Standard Deviation			0.1	0.0	6	0.1

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

JOB NUMBER: 30160 07-86165R2

PAGE:

5 of 6

DATE:

July 2, 2007

TEST DATA, continued:

ASTM D638, Tensile Properties of Plastics

Sample	Specimen	Width, in	Thickness, in	Peak Load, lbf	Peak Stress, psi	Strain at Break, %	Break Stress, psi
Machined First Cut	1	0.126	0.156	109	5527	16.4	4579
	2	0.127	0.166	105	4983	11.0	4394
	3	0.127	0.162	115	5591	24.2	4716
	4	0.127	0.154	110	5632	18.6	4558
	5	0.127	0.156	110	5547	10.8	4563
	Average			110	5456	16.2	4562
	Standard Deviation			4	267	5.6	114
Molded 2 End Gates	1	0.126	0.16	104	5135	1.9	5135
	2	0.127	0.16	104	5121	2.0	5121
	3	0.128	0.16	103	5047	2.0	5047
	4	0.126	0.162	104	5128	2.0	5128
	5	0.127	0.161	105	5156	2.1	5156
	Average			104	5117	2.0	5117
	Standard Deviation			1	41	0.0	41
Molded Center Gate	1	0.126	0.159	102	5076	2.3	5076
	2	0.126	0.16	96	4794	2.1	4794
	3	0.127	0.16	106	5253	2.3	5253
	4	0.126	0.16	104	5198	2.1	5198
	5	0.126	0.159	106	5271	2.4	5271
	Average			103	5118	2.2	5118
	Standard Deviation			4	197	0.1	197
Molded 1 End Gate	1	0.126	0.16	125	6205	16.2	5178
	2	0.128	0.16	126	6130	6.8	5301
	3	0.126	0.159	125	6253	25.3	5140
	4	0.126	0.16	125	6214	2.7	6214
	5	0.126	0.159	124	6170	21.5	5160
	Average			125	6194	14.5	5399
	Standard Deviation			1	47	9.6	460

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

JOB NUMBER: 30160 07-86165R2

PAGE:

6 of 6

DATE:

July 2, 2007

TEST DATA, continued:

ASTM D638, Tensile Properties of Plastics

Sample	Specimen	Width, in	Thickness, in	Peak Load, lbf	Peak Stress, psi	Strain at Break, %	Break Stress, psi	
FDM X axis	1	0.126	0.166	54	2598	1.6	2598	
	2	0.125	0.167	54	2572	1.6	2572	
	3	0.126	0.167	53	2519	1.6	2519	
	4	0.126	0.166	54	2554	1.6	2554	
	5	0.126	0.166	54	2570	1.5	2570	
	Average				54	2563	1.6	2563
	Standard Deviation				0	29	0.0	29
FDM X-Y axis	1	0.126	0.166	52	2472	1.5	2472	
	2	0.126	0.166	54	2576	1.5	2576	
	3	0.126	0.166	51	2452	1.5	2452	
	4	0.126	0.166	54	2588	1.5	2588	
	5	0.126	0.166	53	2556	1.5	2556	
	Average				53	2529	1.5	2529
	Standard Deviation				1	62	0.0	62
FDM Z axis	1	0.127	0.165	44	2117	1.6	2117	
	2	0.128	0.162	43	2050	1.5	2050	
	3	0.128	0.160	41	2005	1.5	2005	
	4	0.127	0.160	42	2066	1.4	2066	
	5	0.128	0.160	45	2202	1.6	2202	
	Average				43	2088	1.5	2088
	Standard Deviation				2	75	0.1	75

REMARKS:

The test materials not consumed in testing will be retained for 14 days from the date of this report and then discarded unless we receive written notification requesting otherwise.

F:\Product\MMFILES\WES\2007 Completed Pjts\86165 PRO249 Protomold\86165 Protomold Rpt R2.doc