

The Intertek logo consists of the word "Intertek" in a white, sans-serif font, centered within a dark blue rounded rectangular background.

October 9, 2014

Jae Woo Kim  
KOA TECH Co Ltd  
173 Bonghyun-Ro  
Jinjub-Eup, Namyangju-Si  
Gyounggii-DO, - 472-865  
South Korea

**Intertek PTL # P20143793**

Dear Jae Woo Kim:

Enclosed you will find the results of the testing you requested.

If you have any questions regarding the data, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Kevin E. Schuman", written in a cursive style.

Kevin E. Schuman  
Quality Manager

KES/mm

Enclosures

Intertek Plastics Technology Laboratories reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from reports or use of the Intertek Plastics Technology Laboratories name is permitted except as expressly authorized in writing. Letters and reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities identical or similar materials, products or processes. The liability of Intertek Plastics Technology Laboratories with respect to services rendered shall be limited to the amount of consideration paid for such services and not include any consequential damages.

50 Pearl Street, Pittsfield, MA 01201  
Phone: (413) 499-0983 Fax: 499-2339  
<http://www.ptli.com>



Testing : **Determining The Izod Pendulum Impact Resistance Of Plastics**  
 Test Method : ASTM D256-10 (Method A)  
 Project Number : P20143793  
 Customer : KOA TECH Co Ltd  
 Attention : Jae Woo Kim  
 Analyst : J. Storie  
 Date : October 6, 2014



Material : **KOA TECH ACRYLIC**  
 Sample Preparation : Machined and notched by Intertek PTL  
 Sample Type : Notched  
 Pendulum Capacity : 2 ft•lb.  
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 10% RH  
 Test Conditions : 23°C ± 2°C / 50% ± 10% RH

Test Number	Width (in)	Depth Under Notch (in)	Impact Strength (ft•lb)	Impact Strength (ft•lb/in)	Break Type
1	0.501	0.399	0.214	0.43	Complete
2	0.501	0.399	0.184	0.37	Complete
3	0.501	0.399	0.216	0.43	Complete
4	0.501	0.401	0.200	0.40	Complete
5	0.501	0.400	0.194	0.39	Complete
Average	0.501	0.400		<b>0.40</b>	
Std. Dev.				0.03	
C.O.V. (%)				7	

Intertek Plastics Technology Laboratories reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from reports or use of the Intertek Plastics Technology Laboratories name is permitted except as expressly authorized in writing. Letters and reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities identical or similar materials, products or processes. The liability of Intertek Plastics Technology Laboratories with respect to services rendered shall be limited to the amount of consideration paid for such services and not include any consequential damages.

Testing	:	<b>Index Of Refraction Of Transparent Organic Plastics</b>
Test Method	:	ASTM D542-14
Project Number	:	P20143793
Customer	:	KOA TECH Co Ltd
Attention	:	Jae Woo Kim
Analyst	:	T. Keith
Date	:	October 8, 2014




Material	:	<b>KOA TECH ACRYLIC</b>
Optical	:	Dual amici prism compensator @ 589nm (Sodium D Line) illumination
Thickness	:	0.5"
Test Conditions	:	23°C ± 2°C / 50% ± 10% RH
Specification	:	Not Provided

	Index Of Refraction ( N <sub>D</sub> )
First Reading	1.4944
Second Reading	1.4943
Third Reading	1.4945
<b>Average</b>	<b>1.4944</b>



Testing	: <b>Water Absorption - 24 Hour Method</b>
Test Method	: ASTM D 570-98 (Reapproved 2010) <sup>e1</sup>
Project Number	: P20143793
Customer	: KOA TECH Co Ltd
Attention	: Jae Woo Kim
Analyst	: J. Goodrich
Date	: October 8, 2014



**ACCREDITED**  
Cert. No. 0619.01  
TESTING LABORATORY

Sample Preparation	: Machined by Intertek PTL
Sample Conditioning	: Dried for 24 hours @ 50°C in an air-circulating oven
Immersion Type	: Deionized Water at 23°C
Immersion Length	: 24 hours
Significance	: ASTM D570 specifies that weights be measured to 0.001g and change be calculated to the nearest 0.01%

Sample Name	Specimen Number	Length (in)	Width (in)	Thickness (in)	Initial Weight (g)	Final Weight (g)	Change (g)	Change (%)
<b>KOA TECH ACRYLIC</b>	1	2.960	0.986	0.124	6.994	7.018	0.024	0.34
	2	2.958	0.986	0.125	7.023	7.047	0.024	0.34
	3	2.957	0.986	0.125	7.038	7.061	0.023	0.33
Average							0.024	<b>0.34</b>

$$\% \text{ Change} = [ ( \text{Final Weight} - \text{Initial Weight} ) / \text{Initial Weight} ] \times 100$$

Intertek Plastics Technology Laboratories reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from reports or use of the Intertek Plastics Technology Laboratories name is permitted except as expressly authorized in writing. Letters and reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities identical or similar materials, products or processes. The liability of Intertek Plastics Technology Laboratories with respect to services rendered shall be limited to the amount of consideration paid for such services and not include any consequential damages.



Testing	: <b>Tensile Properties</b>	
Test Method	: ASTM D638-10	
Project Number	: P20143793	
Customer	: KOA TECH Co Ltd	
Attention	: Jae Woo Kim	Attachments: 1 Graph
Analyst	: J. Storie	
Date	: October 6, 2014	

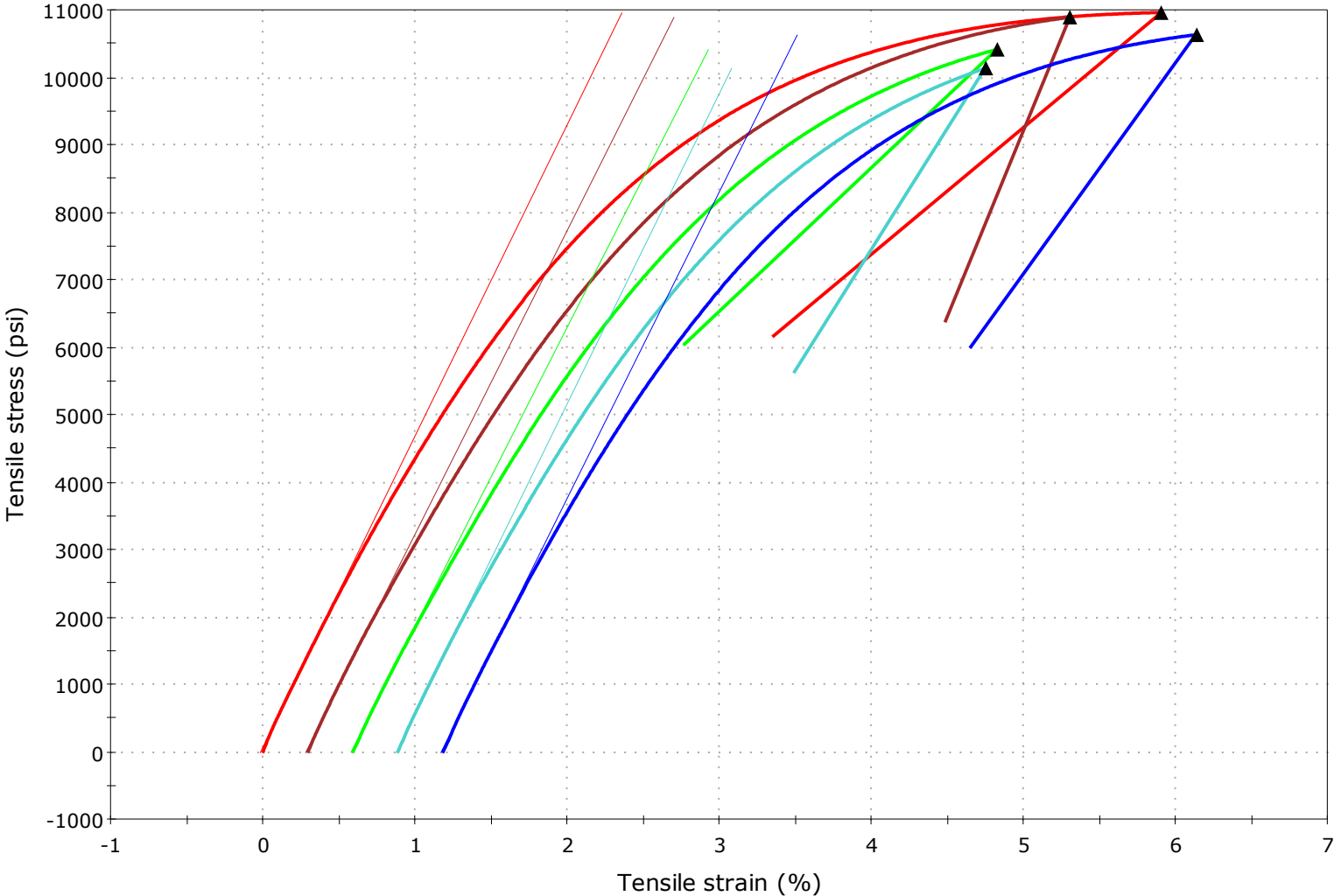
Material	: <b>KOA TECH ACRYLIC</b>
Sample Preparation	: Machined by Intertek PTL
Sample Type	: ASTM Type I Tensile Bar
Sample Dimensions	: 0.752" x 0.501" (Avg)
Cross-Head Speed	: 0.2 in/min
Extensometer	: 10% based on 50mm gage length. Meets minimum requirements for Practice E 83: Modulus (Class B-2) / Elongation (Class C).
Conditioning	: 40+ Hours At 23°C ± 2°C / 50% ± 10% RH
Test Conditions	: 23°C ± 2°C / 50% ± 10% RH
Significance	: ASTM D 638 specifies that strength and modulus be reported to 3 significant figures, elongation and standard deviation be reported to 2 significant figures.



Test Number	Tensile Strength At Break (PSI)	Elongation At Break (%)	Modulus Of Elasticity (PSI)
1	11000	5.9	461000
2	10900	5.0	450000
3	10400	4.2	444000
4	10100	3.9	460000
5	10600	5.0	454000
Average	<b>10600</b>	<b>4.8</b>	<b>454000</b>
Std. Dev.	370	0.78	7100

Note: Specimens 2 and 4 broke inside the gripped area.

P20143793 D638 Tensile - KOA TECH ACRYLIC





Testing : **Compressive Properties of Rigid Plastics**  
 Test Method : ASTM D695-10  
 Project Number : P20143793  
 Customer : KOA TECH Co Ltd  
 Attention : Jae Woo Kim  
 Analyst : D. Midgette  
 Date : October 7, 2014



Specimen Type : Rectangular Prism (0.5" x 0.5" x 1.6" nominal)  
 Cross-Head Speed : 0.05 in/min  
 Compressometer : 20% based on 25mm gage length. Meets minimum requirements for Practice E 83: Modulus (Class B-2) / Elongation (Class C).  
 Specimen Preparation : Machined by Intertek PTL  
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 10% RH  
 Test Conditions : 23°C ± 2°C / 50% ± 10% RH  
 Significance : ASTM D 695 specifies that strength and modulus be reported to 3 significant figures, and standard deviation be reported to 2 significant figures.

Sample Name	Test Number	Width (in)	Thickness (in)	Compressive Yield Strength (psi)	Compressive Modulus (psi)
<b>KOA Tech Acrylic</b>	1	0.500	0.501	15900	506000
	2	0.500	0.501	15700	478000
	3	0.500	0.501	15600	525000
	4	0.500	0.501	15500	522000
	5	0.500	0.501	15300	500000
			Average	<b>15600</b>	<b>506000</b>
			Std. Dev.	220	19000

Intertek Plastics Technology Laboratories reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from reports or use of the Intertek Plastics Technology Laboratories name is permitted except as expressly authorized in writing. Letters and reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities identical or similar materials, products or processes. The liability of Intertek Plastics Technology Laboratories with respect to services rendered shall be limited to the amount of consideration paid for such services and not include any consequential damages.

Testing : **Shear Strength Of Plastics By Punch Tool**  
 Test Method : ASTM D732-10  
 Project Number : P20143793  
 Customer : KOA TECH Co Ltd  
 Attention : Jae Woo Kim  
 Analyst : D. Midgette  
 Date : October 7, 2014



Diameter Of Punch (in) : 1.0  
 Specimen Size : 2.0 Inch Square  
 Cross-Head Speed : 0.05 in/min  
 Sample Conditioning : 40+ Hours at 23°C ± 2°C / 50% ± 10% RH  
 Sample Preparation : Specimens and center hole machined by Intertek PTL  
 Test Conditions : 23°C ± 2°C / 50% ± 10% RH

Sample Name	Test Number	Thickness (in)	Yield Force (lbf)	Yield Shear Stress (PSI)	Maximum Shear Force (lbf)	Maximum Shear Strength (PSI)
<b>KOA TECH ACRYLIC</b>	1	0.127	3530	8850	4020	10100
	2	0.126	3550	8900	4260	10700
	3	0.127	3650	9150	4520	11300
	4	0.128	3610	9050	4710	11800
	5	0.127	3630	9100	5170	13000
	Average		<b>3590</b>	<b>9010</b>	<b>4540</b>	<b>11400</b>
	Std. Dev		52	129	440	1110





Testing : **Rockwell Hardness Of Plastics and Electrical Insulating Materials**  
 Test Method : ASTM D785-08 Procedure A  
 Project Number : P20143793  
 Customer : KOA TECH Co Ltd  
 Attention : Jae Woo Kim  
 Analyst : Frank Foy  
 Date : October 6, 2014



Filler ID : None  
 Surface Condition : Machined  
 Tested Thickness : 0.498"  
 Plied, Number of Plies : No  
 Sample Type : 1.5" x 5" x 0.5" block  
 Sample Preparation : Machined by Intertek PTL  
 Testing Direction : Perpendicular to molding  
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 10% RH  
 Test Conditions : 23°C ± 2°C / 50% ± 10% RH  
 Scale : **M**  
 Significance : ASTM D 785 specifies that readings be taken to the nearest whole number.  
 : Rockwell Hardness values over 115 are not considered satisfactory and should  
 : not be reported except when requested by the customer for comparison purposes.

**KOA TECH ACRYLIC**

Test Number	Hardness Reading
1	103
2	103
3	103
4	103
5	102
Average	<b>103</b>
Std. Dev.	0

Intertek Plastics Technology Laboratories reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from reports or use of the Intertek Plastics Technology Laboratories name is permitted except as expressly authorized in writing. Letters and reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities identical or similar materials, products or processes. The liability of Intertek Plastics Technology Laboratories with respect to services rendered shall be limited to the amount of consideration paid for such services and not include any consequential damages.

Testing : **Flexural Properties Of Plastics**  
 Test Method : ASTM D790-10 Procedure A  
 Project Number : P20143793  
 Customer : KOA TECH Co Ltd  
 Attention : Jae Woo Kim  
 Analyst : J. Storie  
 Date : October 6, 2014



Material : **KOA TECH ACRYLIC**  
 Sample Preparation : Machined by Intertek PTL  
 Sample Dimensions : 0.500" x 0.250" x 5" (Average)  
 Sample Type : ASTM Flex Bar  
 Span Length (in) : 4.0  
 Cross-Head Speed (in/min) : 0.107  
 Span-To- Depth Ratio : 16±1:1  
 Radius Of Supports (in) : 0.197  
 Radius Of Loading Nose (in) : 0.197  
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 10% RH  
 Test Conditions : 23°C ± 2°C / 50% ± 10% RH  
 Significance : ASTM D790 specifies all data to be reported to 3 significant figures and standard deviation be reported to 2 significant figures.

Test Number	Flexural Stress At 5% Strain (PSI)	Flexural Strength (PSI)	Flexural Strain at Break (%)	Flexural Modulus (tangent * ) (PSI)
1	15400	----	----	426000
2	----	13100	3.71	420000
3	15200	----	----	420000
4	14700	----	----	408000
5	15400	----	----	425000
Average	<b>15200</b>			<b>420000</b>
Std. Dev.	330			7200

\* = computer generated curve fit

# POLYHEDRON LABORATORIES<sup>®</sup>, INC.

PLASTICS, POLYMERS and RUBBER TESTING

10626 KINGHURST ST. HOUSTON, TX 77099

281-879-8600 • FAX: 281-879-8666

e-mail techsales@polyhedronlab.com

January 30, 2015

Koa Tech Co. Kr.  
1173 Borghyun-Ro  
Namyangju-St Guounggi-Do  
Korea

Attn: Mr. Jae Woo Kim

## Analytical Report

### Methyl Methacrylate and Ethyl Acrylate by ASME PVHO-1-2007

<u>Sample</u>	<u>Methyl Methacrylate (ppm)</u>	<u>Ethyl Acrylate (ppm)</u>
Acrylic Blocks	3996.6	ND
Detection Limit		< 17 ppm

ND = Not detected.



Howard Kaye, Ph.D., FAIC  
Director

HK/dr

All samples will be discarded within two months.