



Polymer Bonded Explosives XTX 8004 (80 wt% PETN-20 wt% PDMS)

Mechanical Characterization of Mock Energetic Composite Experimental Procedure

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AOE 3054 Experimental Methods



The ADMET eXpert 7600 Universal Testing Machine and MTESTQuattro Software

You will be using the ADMET eXpert 7600 Universal Testing Machine for this experiment.

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- It is controlled via a computer running the MTESTQuattro software (it should already be running when you come to the lab, if not ask your TA to open it for you).
- The following slides will be a walkthrough for using the frame to conduct the tension, compacttension and compression tests



80 wt% particulate (sugar) -20 wt% PDMS





Make sure the power knob is in the on position and the emergency stop (red button) is in the extended position as shown in these pictures.

Pre-Check



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- Make sure 100 lbf Force Transducer is connected to MTEST Quattro Unit as shown.
- Make sure all group members are wearing safety glasses.





100 lbf Force Transducer Setup





Compact Tension Clevis Setup





Mount lower adapter to load transducer and tighten

Mount top clevis to lower adapter



Mount bottom clevis to bottom adapter



Need to adjust distance between the clevises



Compact Tension Test Procedure

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	Q *AOE3054_COMPACT	T-TENSION_2017					□ [
	Specimen Report Setup	Acquisition Analysis XY Graph Chan	nels Servo Control				
Double click on <u>AOE 3054</u> <u>COMPACT TENSION 2017 under</u> <u>test procedures</u>	Sampling Options Logging Threshold Threshold Channel: Threshold Value (mn I Zero Displacemen Logging Cutoff	Position n): 0.0 nts at Threshold	Sa V (ve Options Autosave Test Data Prefix Specimen Id User Prefix Prefix: AOE3054_LA	AB_CT		
Make sure Autosave Test Data is checked under Acquisition Tab	Stop at End of Pro Stop at Sample Br Sample Break Crite Break Threshold (N Drop Interval (% of	ofile eak ria 1): 0.0 Peak): 10.0		est Results Name: CTte Autoadd Analysis Calo Reset Results Frequen Ask Before AutoSaving	est1 culations to cy: Never g Data/Resu	Test Results Its	~
	Overwrite Oldest Da	ata When Buffer Full -TENSION_2017					- E
Make sure Transducer selected	Specimen Report Setup Channel	Acquisition Analysis XY Graph Channels Transducer	Servo Control	Units		Rate Units	Active
is 100lbf_TENSION under Channels Tab	Load Stress	100lbf_TENSION	Ŷ	N MPa	* *	min	 ✓ ✓ ✓ ✓ ✓
Keep units for the load [Newton] and the position [mm]	Position AxialStrain TransverseStrain Auxiliary	EXT-Lng	÷	mm mm mm	> >	min min min min	 ✓ ✓ ✓ ✓ ✓ ✓ ✓
	Q Default Workspace ∑	3 DMPACT-TENSION_2017					



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Adjustment of the distance between the clevises

- Initially use 200 mm/min jog rate to move the clevises close to each other
- Then, reduce the jog rate to 20 mm/min and click crossbar up and down for fine adjustments
- Zero all input channels

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Mount rigid compact tension on the bottom clevis first, then on the top clevis



eneral Gains Profile							
Preload Setup Preload (N):	0.0	Position Limits		Contro	l Panel		
Preload Rate (mm/min):	0.0	Positive Direction Limit (mm):		11			
Jog Setup Jog Rate (mm/min): 200	.0	Negative Direction Limit (mm End-of-Test Action	*	Set	₽	4	
Home Setup Home Position (mm):	0.0	Go to Home at End-of-Test Stop at End-of-Test	a	0	Û	Ŷ	
Offset from Zero Offset from Upper Lim Offset from Lower Lim	it	Jog/Home Overload Overload Range (N): 0.0	_	Ze	ero all inp	ut channels	5.
Home Rate (mm/min):	508.0						







Pre-Check for Compact Tension Test

👰 *AOE3054_COMPACT-TENSION_2017				🙋 Channels 🛿				
Specimen Report Setup Acquisition Analysis XY Graph	h Channels Servo Control					Peak	Rate	
General Gains Profile				Load (N)	2.01	-Infinit	-0.44	/min 🙆
Selected Segment		1		Stress (IVIF a)	0.007	-infinity	-0.002	/min 🛛
Waveform	Control	Limit		Position (mm)	0.00	-Infinity	0.00	/min 🛛
Ramp Sawtooth	Channel: Position 🗸	Channel:	Position 🗸	AxialStrain (mm)	N/A	-Infinity	0.0	/min 🛛
O Sinusoid	Rate (mm/min): 10.0	Value (mm):	100.0	TransverseStrain (mr	n) <mark>N/A</mark>	-Infinity	0.0	/min Ø
Sampling Units: sec 🗸 🗸		Increment (mm):	0.1	Auxiliary ()	N/A	-Infinity	0.0	/min 🛛
Samples/sec: 50				Control Out (V)	0.001		Low Gear	
Recording time is 2600 sec at 50 samples/sec								
Segments								
Position adjusted 10.00 mm/min until Position is 100.	.00 mm sampling at 50 samples/sec - Adjust Position	limit by 0.10 mm/cy	cle					
				Make acting	g on th	o note fi ie specir	ne preio men	aa
Insert Segment	Remove Segment	F	Replace Segment	Do no	ot zero	the load		
Options Cycles: 1 Log Every: 1 Cycles	Stepped Profile			Position you c change	o <mark>n nee</mark> licked nels be	ds to she zero all efore	ow ZERC input) as
				Finally	y, Start	the TEST		
 Make sure your cross If not, click on Repla 	s head displacement r ce Segment after adju	ate is 10 Isting rate	mm/min e as 10 mm/min			Control		
					22	Set Set		9









- Use the camera provided to take images of fracture surface on your specimen, measure the <u>specimen thickness</u> at last
- Make sure to measure and record the particulate sedimentation with a ruler from top (1), middle(2) and bottom (3) for each side as shown and provide the averaged value



Data Saving for Compact Tension Test

- Make sure your test data is saved automatically
- Go to Test Data .

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- Find your test data, always the last data under Test Data
- To be sure it is your data, check the date and time
 - If not, save manually as below





Default Workspace 🖾
Test Procedures Test Data
efault Workspace 🖾
 AI2 AOE3054_LAB-2017-03-10-16-32-40 AOE3054_LAB-20wtsugar_50mmpermin AOE3054_LAB-30wtsugar5point3mmpermin_buckles AOE3054_LAB-30wtsugar_6mmpermin AOE3054_LAB-40wtsugar_6mmperminDIC AOE3054_LAB-50wtsugar6mmperminDIC AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-80wtsugarpoint6mmperminDIC AOE3054_LAB-80wtsugar_5mmpermin AOE3054_LAB-8tazillian20wt%sugar AOE3054_LAB-Brazillian20wt%sugar AOE3054_LAB-Brazillian20wtsugar19mmpermin AOE3054_LAB-Brazillian30wtsugar19mmpermin AOE3054_LAB-Brazillian40wtsugar19mmpermin AOE3054_LAB-Comp80wtsugarpoint53mmpermin AOE3054_LAB-Compression-2017-03-24-11-19-22 AOE3054_LAB-CT85wtsugar2point64mmpermin AOE3054_LAB-CT_20wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_20wtsugar10mmpermin

Right click and export your data AOE3054_LAB-50wtsugar6mmperminDIC AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-80wtsugarpoint6mmperminDIC AOE3054_LAB-85wtsugar_5mmpermin AOE3054_LAB-Brazillian20wt%sugar AOE3054_LAB-brazillian20wtsugar AOE3054_LAB-Brazillian20wtsugar19mmpermin AOE3054 LAB-Brazillian30wtsugar19mmpe New AOE3054_LAB-Brazillian40wtsugar19mmpe AOE3054 LAB-Comp80wtsugarpoint53mm Cut AOE3054 LAB-Compression-2017-03-24-1 Copy AOE3054_LAB-compres_50wtsugar26point Paste AOE3054 LAB-CT80wtsugarpoin6mmperm 🥅 AOE3054_LAB-CT85wtsugar2point64mmp 👷 Delete AOE3054_LAB-CT_20wtsugar10mmpermin Rename.. AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_40wtsugar_6mmpermin Export... AOE3054_LAB-CT_80wtsugar10mmpermin Change Workspace... AOE3054_LAB_CT-2017-20wt-Sugar-PDMS

Will be exported to specific folder on desktop

Q	Export Resource	x
Resource: AOE3	054_LAB_CT-2017-20wt-Sugar-PDMS	
Export to:		
C:\Users\asml	\Desktop\AOE 3054 2017\AOE3054_LAB_CT Brow	se
Export Format	:	_
Comma Se	parated Values	
O Fixed Widt	n Values	
	OK Cancel	





Pneumatic Grip Setup for Tensile Testing







Tension Test Procedure

AOE3054_TENSION_2017

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	AOE3054_TENSION_20	17				
	Specimen Report Setup	Acquisition Analysis XY Graph Channels Servo Con	trol			
Double click on <u>AOE 3054</u> <u>TENSION 2017 under test</u> <u>procedures</u>	Sampling Options Logging Threshold Threshold Channel: Threshold Value (mm) I Zero Displacement	Position V 0.0 s at Threshold	Save Op Auto Prefix Spe O Use Prefi	tions save Test Data crimen Id rr Prefix fix: AOE3054_LAB-Tension		
	 Stop at End of Prof 	ile	Test Res	ults Name: Tension_test1		
	O Stop at Sample Bre	ak	✓ Auto	add Analysis Calculations to Test	Results	
Make sure Autosave Test Data is checked under Acquisition Tab	Break Threshold (N): Drop Interval (% of F	a : 0.0 Peak): 10.0	Rese	t Results Frequency: Never Before AutoSaving Data/Results		~
	Overwrite Oldest Dat	a When Buffer Full				
	Q AOE3054_TENSION_20	117				
	Specimen Report Setup	Acquisition Analysis XY Graph Channels Servo Con	trol			
Make sure Transducer selected	Channel	Transducer		Units	Rate Units	Active
is 100lbf TENSION under	Ctrors		*		min	
Channels Tab	Position			mm H	min	
	AvialStrain	FXT-Lpg	6	mm v	min	
	TransverseStrain	Extens		mm	min	
	Auxiliary				min	
<u>Keep units for the load</u> [Newton] and the position [mm]	 Test Procedures AOE3054_COI AOE3054_COI 	MPACT-TENSION_2017 MPRESSION_2017			1400022	



Pre-Check for Tension Test

Q AOE3054_TENSION_2017				
Specimen Report Setup Acquisition Analysis XY Graph	Channels Servo Control		-	
Selected Segment Selected Segment Samp Sawtooth Sinusoid Sampling Units: sec Samples/sec: 50 Recording time is 2600 sec at 50 samples/sec	Control Channel: Position 🗸 Rate (mm/min): 6.0	Limit Channel: Position Value (mm): 100.0 Increment (mm): 0.1		
Segments Position adjusted 6.00 mm/min until Position is 100.00 If not, click on Replac Insert Segment	mm sampling at 50 samples/sec - Adjust Position I e Segment after adjus Remove Segment	imit by 0.10 mm/cycle sting rate as specified Replace Segment		Double Check whether you have the correct displacement rate for your specimen
Options Cycles: 1 Log Every: 1 Cycles	Stepped Profile			
 Make sure your cross 6 mm/min for sam 0.6 mm/min for sa 	nead displacement ro ples with particulate mples with particulate	ate is wt%≤ 50 e wt%>50		



Adjustment of the distance between the pneumatic grips

- Initially use 200 mm/min jog rate to move the clevises close to each other
- Then, reduce the jog rate to 20 mm/min for fine adjustments (crossbar up/down)
- Mark each side of dogbone specimens 25 mm from the end



AOE3054_TENSION_2017								
pecimen Report Setup Ac	quisition Analysis XY Graph	Channels Servo Control						
General Gains Profile								
Preload Setup		Positio	on Limits					_
Preload (N):	0.0	Po	sition Limits		Contro	l Panel		
Preload Rate (mm/min):	0.0	Positiv	ve Direction Limit (mm):				1	
Jog Setup		Negat	ive Direction Limit (mm):					
Jog Rate (mm/min): 20.	0	- End-o	f-Test Action	蒸	Set	ţ	1	
Home Setup		() Go	to Home at End-of-Test			↔ ·		
Home Position (mm):	0.0	0 310	p at End-of-Test	1	0	û	÷	
Offset from Zero		-Jog/H	ome Overload					
Offset from Upper Lim	nit	Overio	bad Range (N): 0.0		Ze	ro all inp	ut channe	ls.
Offset from Lower Lim	nit		•					
Home Rate (mm/min):	508.0							

- Measure the specimen thickness and particulate sedimentation within gauge section (top, middle and bottom) and average them (FRAGILE SPECIMENS!)
- Zero all input channels
- Distance between the grips should be
 115 mm







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 Use the camera provided to take images of fracture surface on your specimen, measure the <u>specimen thickness</u> at last

Again, make sure to measure and record the particulate sedimentation within gauge section from top (1), middle(2) and bottom (3) and provide the averaged value after the test and compare with your initial measurements before testing



Data Saving for Tension Test

- Make sure your test data is saved automatically
- Go to Test Data .

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- Find your test data, always the last data under Test Data
- To be sure it is your data, check the date and time
 - If not, save manually as below









Right click and export your data

AOE3054_LAB-50wtsugar6mmperminDIC	
AOE3054_LAB-50wtsugar6mmperminDIC2	
AOE3054_LAB-80wtsugarpoint6mmperminDIC	
AOE3054_LAB-85wtsugar_5mmpermin	
AOE3054_LAB-Brazillian20wt%sugar	
AOE3054_LAB-brazillian20wtsugar	
AOE3054_LAB-Brazillian20wtsugar19mmpermir	1
AOE3054_LAB-Brazillian30wtsugar19mmpe	
AOE3054_LAB-Brazillian40wtsugar19mmpe	New 🕨
🗖 AOE3054_LAB-Comp80wtsugarpoint53mm 🦟	Cut
AOE3054_LAB-Compression-2017-03-24-1	Conv
🗖 AOE3054_LAB-compres_50wtsugar26point	сору
AOE3054_LAB-CT80wtsugarpoin6mmperm	Paste
🗖 AOE3054_LAB-CT85wtsugar2point64mmp	Delete
AOE3054_LAB-CT_20wtsugar10mmpermin	Panama
AOE3054_LAB-CT_30wtsugar10mmpermin	Kename
🗖 AOE3054_LAB-CT_40wtsugar_6mmpermin 🔛	Export
AOE3054_LAB-CT_80wtsugar10mmpermin	Change Workspace
AOE3054 LAB CT-2017-20wt-Sugar-PDMS	p



Compression Platens Setup





CompressionTest Procedure

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	Q *AOE3054_COMPRESSIO	N_2017					- 0
	Specimen Report Setup Ad	quisition Analysis XY Graph Channels Se	vo Control				
Double click on <u>AOE 3054</u> <u>COMPRESSION 2017 under test</u> <u>procedures</u>	Sampling Options Logging Threshold Threshold Channel: Threshold Value (mm): Zero Displacements a	Position 0.0 It Threshold	Save O Aut Prefix Sp U U P	options cosave Test Data x pecimen Id ser Prefix refix: AOE3054_LAB-C	ompression		
	Logging Cutoff Stop at End of Profile Stop at Sample Break		Test Re Aut	esults Name: Compres coadd Analysis Calculati	ssion_test1 ons to Test R	esults	
Make sure Autosave Test Data is checked under Acquisition Tab	Sample Break Criteria Break Threshold (N): Drop Interval (% of Pea	0.0 ak): 10.0 When Buffer Full	Res	et Results Frequency:	Never a/Results		~
	Freeze Strain Channels	at Yield N_2017					- 8
Make sure Transducer selected	Specimen Report Setup Ad	quisition Analysis XY Graph Channels Se	vo Control				
is 100lbf Compression under	Channel	Transducer		Units		Rate Units	Active
Champele Tark	Load	100lbf_Compression	~	N	¥	min	✓ ✓
Channels Tab	Stress			MPa	¥	min	✓ ✓
	Position	-		mm	¥	min	✓ ✓
	AxialStrain	EXT-Lng	~	mm	¥	min	
Keen units for the load	TransverseStrain		~	mm	¥	min	× Ц
[Newton] and the position [mm]	Auxiliary		·			min	<u> </u>
	 Test Procedures AOE3054_COMF AOE3054_COMF AOE3054_COMF AOE3054_TENSI 	PACT-TENSION_2017 PRESSION_2017 ON 2017					



Pre-Check for Compression Test

Q *AOE3054_COMPRESSION_2017	
Specimen Report Setup Acquisition Analysis XY Graph Channels Servo Control	
General Gains Profile	
Selected Segment Waveform Ramp Sawtooth Sinusoid Sampling Units: Samples/sec: 50	 Do not change the load limit It is set as 200 N
Recording time is 2600 sec at 50 samples/sec Segments Position adjusted 5.30 mm/min until Load is 200.00 N sampling at 50 samples/sec - Adjust Load limit by 0.10 N/cycle If not, click on Replace Segment after adjusting rate as specified Insert Segment Remove Segment Replace Segment Replace Segment	Double Check whether you have the correct displacement rate for your specimen
Options Stepped Profile Cycles: 1 Log Every: 1 Cycles	
 Make sure your cross head displacement rate is 5.3 mm/min for samples with particulate wt% ≤ 50 	



Adjustment of the distance between the compression platens

- Initially use 200 mm/min jog rate to move the clevises close to each other
- Then, reduce the jog rate to 20 mm/min for fine adjustments
- No need to measure dimensions of the compression samples (cylinder height and diameter is fixed as 44 mm and 19 mm, respectively
- Zero all input channels
- Place the compression cylinder between compression platens as vertical as possible
- Apply some preload no more than 2-3 N
- Do not zero the preload but set the position zero

	Live	Peak	Rate	
oad (N)	2.01	-Infinity	-0.44	/min 🛛
tress (MPa)	0.007	-Infinity	-0.002	/min 🛛
sition (mm)	0.00	Infinity	0.00	/min 🛛
xialStrain (mm)	N/A	-Infinity	0.0	/min 🛛
ansverseStrain (mm)	N/A	-Infinity	0.0	/min Ø
xiliary ()	N/A	-Infinity	0.0	/min Ø

AOE3054_TENSION_2017								
Specimen Report Setup Ac	quisition Analysis XY Graph Channels Servo	Control						
General Gains Profile								
Preload Setup		Position Limits	Position Limits					
Preload (N):	0.0	Position Limits	l Panel					
Preload Rate (mm/min):	0.0	Positive Direction Limit (mm):				1.00		
Jog Setup		Negative Direction Limit (mm):						
Jog Rate (mm/min): 20.0		End-of-Test Action	*	Set	 ‡	4		
Home Setup		Go to Home at End-of-Test			→			
Home Position (mm): 0.0			1	0	û	÷		
Offset from Zero		Overload Range (N): 0.0	Range (N): 0.0 Zero all input channels.					
Offset from Upper Limit		ovenoud hange (N).						
Offset from Lower Lim	it 	-						
Home Rate (mm/min):	508.0							

Weight concentrations above 60 wt% particulate are FRAGILE SPECIMENS!



Finally, READY TO START THE TEST



Compression Testing



Unmount Compression Platens



use your fingers to untighten



- Measure the shear band degree if the specimen fails
- Specimens with wt% < 50 may not fail at a set maximum compressive load of 200 N
- Specimens with wt% < 50 may also buckle if they are not placed vertically within the platens



Data Saving for Compression Test

- Make sure your test data is saved automatically
- Go to Test Data

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- Find your test data, **always the last** data under Test Data
- To be sure it is your data, check **the** date and time
 - If not, save manually as below





00 Default Workspace 🕴						
 ▷ Cest Procedures ▲ Cest Data 						
👰 Default Workspace 🛛						
 AI2 AOE3054_LAB-2017-03-10-16-32-40 AOE3054_LAB-30wtsugar_50mmpermin AOE3054_LAB-30wtsugar5point3mmpermin_buckles AOE3054_LAB-30wtsugar_5mmpermin AOE3054_LAB-40wtsugar_6mmperminDIC AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-80wtsugarpoint6mmperminDIC AOE3054_LAB-80wtsugar_5mmpermin AOE3054_LAB-80wtsugar_5mmperminDIC AOE3054_LAB-80wtsugar_5mmpermin AOE3054_LAB-80wtsugarpoint6mmperminDIC AOE3054_LAB-81wtsugar_5mmpermin AOE3054_LAB-8razillian20wt%sugar AOE3054_LAB-Brazillian20wtsugar19mmpermin AOE3054_LAB-Brazillian30wtsugar19mmpermin AOE3054_LAB-Brazillian40wtsugar19mmpermin AOE3054_LAB-Comp80wtsugarpoint53mmpermin AOE3054_LAB-Compression-2017-03-24-11-19-22 AOE3054_LAB-CT30wtsugar20point64mmpermin AOE3054_LAB-CT30wtsugar10mmpermin AOE3054_LAB-CT30wtsugar10mmpermin AOE3054_LAB-CT30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_30wtsugar10mmpermin AOE3054_LAB-CT_40wtsugar_6mmpermin 						
AOE3054_LAB_CT-2017-03-24-10-37-32						

AOE3054 LAB-Compression Prefix Prefix automatically will change to AOE3054_LAB-Compression under test data instead AOE3054 LAB-CT or AOE3054 LAB-Tension Right click and export your data AOE3054 LAB-50wtsugar6mmperminDIC AOE3054_LAB-50wtsugar6mmperminDIC2 AOE3054_LAB-80wtsugarpoint6mmperminDIC AOE3054_LAB-85wtsugar_5mmpermin AOE3054_LAB-Brazillian20wt%sugar AOE3054_LAB-brazillian20wtsugar AOE3054_LAB-Brazillian20wtsugar19mmpermin AOE3054 LAB-Brazillian30wtsugar19mmpe New AOE3054 LAB-Brazillian40wtsugar19mmpe 🗖 AOE3054_LAB-Comp80wtsugarpoint53mm 🚽 Cut AOE3054 LAB-Compression-2017-03-24-1 Copy AOE3054_LAB-compres_50wtsugar26point Paste AOE3054_LAB-CT80wtsugarpoin6mmperm 🗖 AOE3054_LAB-CT85wtsugar2point64mmp 👷 Delete AOE3054_LAB-CT_20wtsugar10mmpermin Rename.. AOE3054_LAB-CT_30wtsugar10mmpermin Export... 🗖 AOE3054_LAB-CT_40wtsugar_6mmpermin AOE3054_LAB-CT_80wtsugar10mmpermin Change Workspace...

AOE3054 LAB CT-2017-20wt-Sugar-PDMS



