APPENDIX T-2
2017 FSAE® IMPACT ATTENTUATOR DATA REPORT

This form must be completed and submitted by **all teams no later than the date specified in the Action Deadlines on specific event website**. The FSAE Technical Committee will review all submissions which deviate from the FSAE® rules and reply with a decision about the requested deviation. All requests will have a confirmation of receipt sent to the team. Impact Attenuator Data (IAD) and supporting calculations must be submitted electronically in Adobe Acrobat Format (*.pdf). The submissions must be named as follows: schoolname_IAD.pdf using the complete school name. **Submit the IAD report as instructed on the event website. For Michigan and Lincoln events submit through fsaeonline.com.**

*In the event that the FSAE Technical Committee requests additional information or calculations, teams have **one week from the date of the request** to submit the requested information or ask for a deadline extension.

University Name: __Polytechnique Montréal
Team Contact: __Renaud Pepin
Faculty Advisor: __Eduardo Olivera

Car Number(s) & Event(s): _11 @ Formula North_
E-mail Address: renaud.pepin@polymtl.ca
E-mail Address: eduardo.olivera@polymtl.ca

Material(s) Used	Formula SAE Standard Impact Attenuator
Description of form/shape	Pyramidal
IA to Anti-Intrusion Plate mounting method	Loctite EA E-30UT
Anti-Intrusion Plate to Front Bulkhead mounting method	Welded
Peak deceleration (<= 40 g's)	Standard Impact attenuator
Average deceleration (<= 20 g's)	Standard Impact attenuator

Confirm that the attenuator contains the minimum volume 200mm wide x 100mm high x 200mm long ☐

Standard Impact attenuator

Figure 1: Force-Displacement Curve (dynamic tests must show displacement during collision and after the point v=0 and until force becomes = 0)

ATTACH PROOF OF EQUIVALENCY
TECHNICAL COMMITTEE DECISION/COMMENTS

Approved by_____ Date_____

NOTE: THIS FORM AND THE APPROVED COPY OF THE SUBMISSION MUST BE PRESENTED AT TECHNICAL INSPECTION AT EVERY FORMULA SAE EVENT ENTERED

University Name: __Polytechnique Montréal__ Car Number(s) & Event(s): _11 @ Formula North_

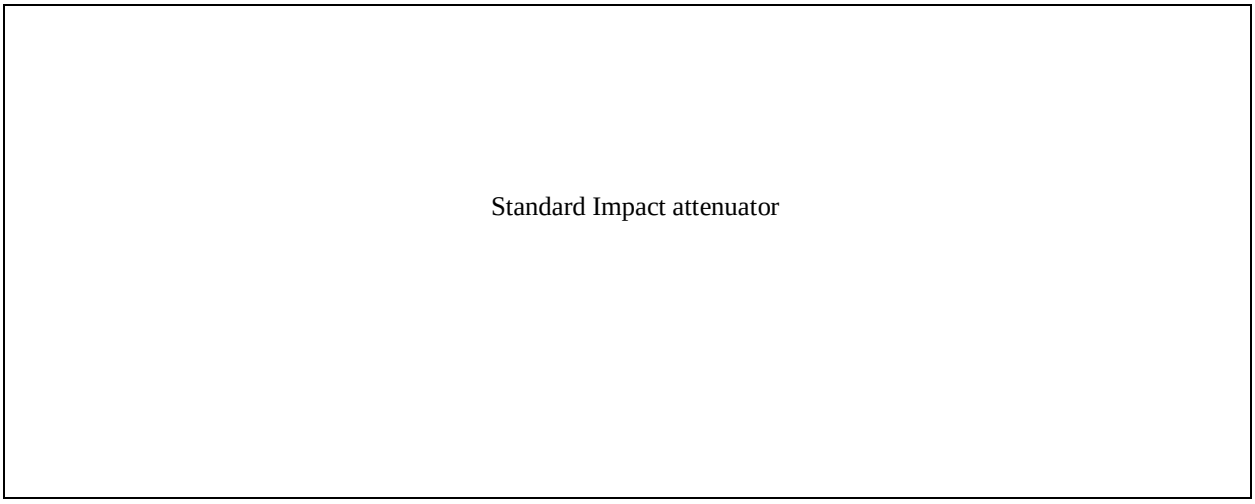


Figure 2: Energy-Displacement Curve (dynamic tests must show displacement during collision and after v=0)

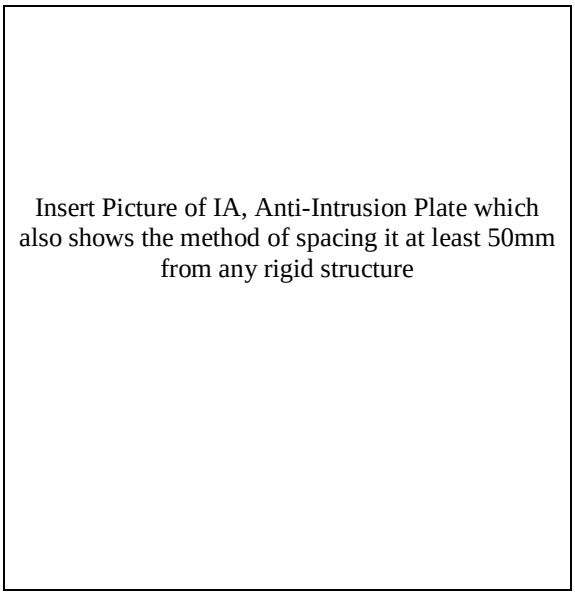


Figure 3: Attenuator as Constructed

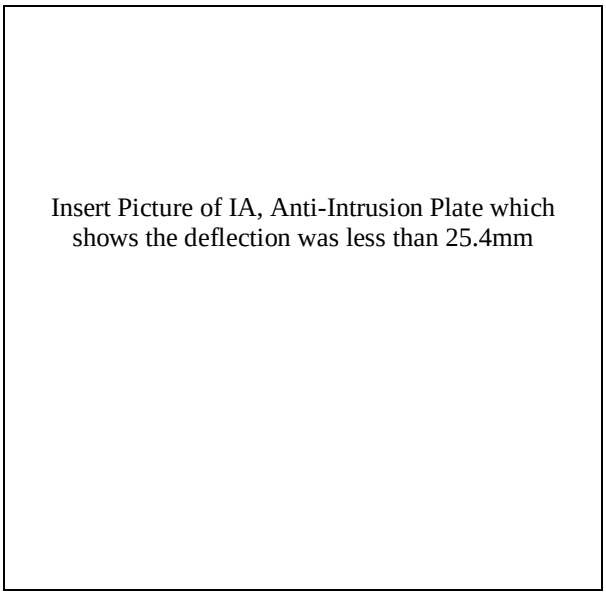
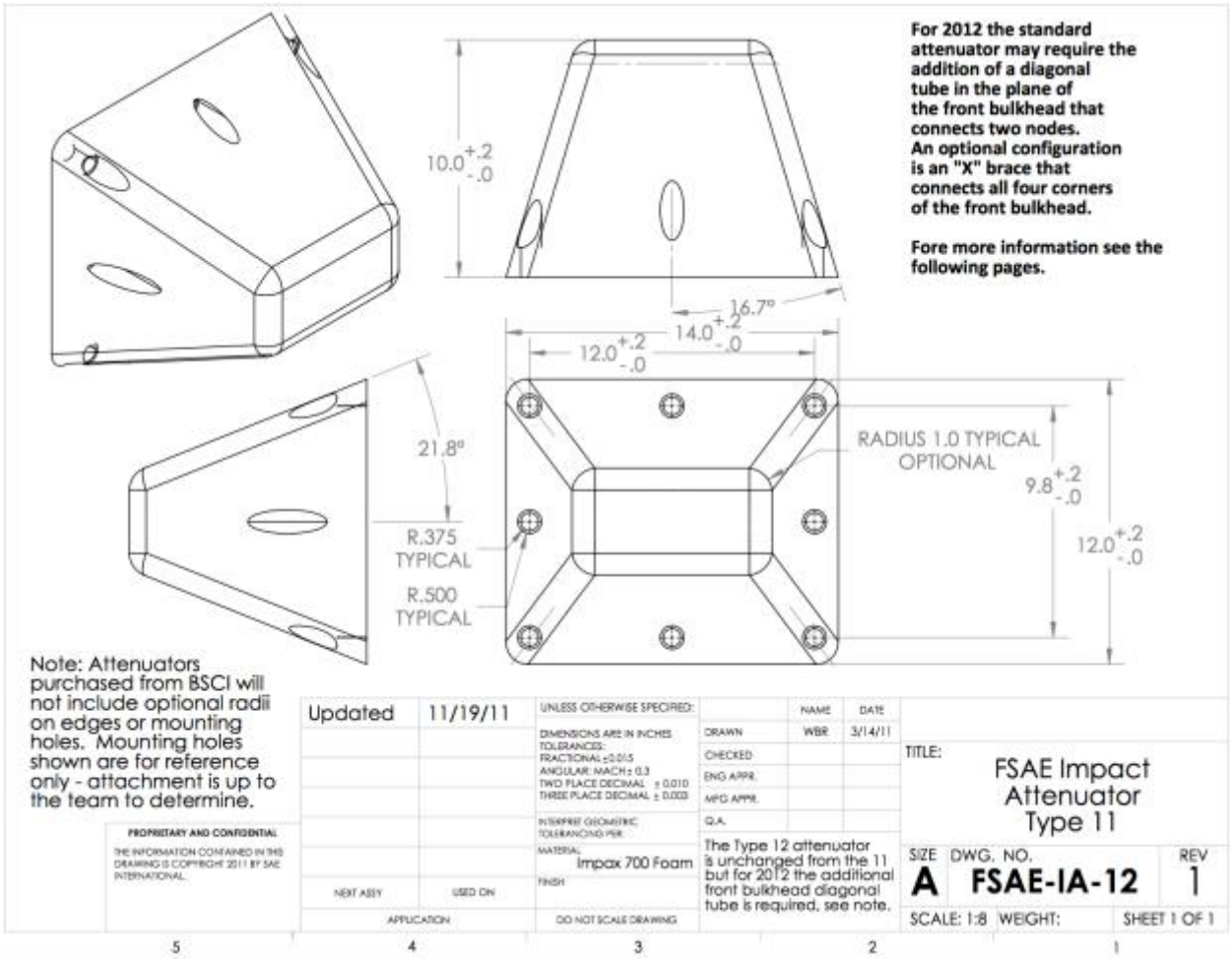


Figure 4: Attenuator after Impact

Energy Absorbed (J): Must be >= 7350 J		Vehicle includes front wing in front of front bulkhead?	No
IA Max. Crushed Displacement (mm):		Wing structure included in test?	-
IA Post Crush Displacement - demonstrating any return (mm):		Test Type: (e.g. barrier test, drop test, quasi-static crush)	
Anti-Intrusion Plate Deformation (mm)		Test Site: (must be from approved test site list on website for dynamic tests)	

University Name: __Polytechnique Montréal__ Car Number(s) & Event(s): _11 @ Formula North_



Length (fore/aft direction): 254 mm (>=200mm)
Width (lateral direction): 304.8 mm (>=200mm)
Height (vertical direction): 355.6 mm (>=100mm)
Attenuator is at least 200mm wide by 100mm high for at least 200mm: Yes
Attach additional information below this point and/or on additional sheets

Impact Attenuator Report – Polytechnique Montréal (car #11)

Introduction

This year, the team decided to use the standard impact attenuator (IA) type 12 like the past year, but to reduce the front bulkhead to the minimum dimension possible. It will be bonded to a 0.060in steel anti-intrusion plate (AIP). The use of a steel AIP allows it to be welded to the front bulkhead. No diagonal is used in the front bulkhead since the distance between the impact attenuator and the front bulkhead tubes complies with the rules.

Design of impact attenuator and positioning to the anti-intrusion plate

The standard impact attenuator type 12 bought at BSCI was chosen. The receipt from BSCI for the purchase can be found in appendix A. The orientation of the IA on the AIP is vertical as shown on Figure 1 below. The IA is fixed to the AIP with Loctite EA E-30UT.

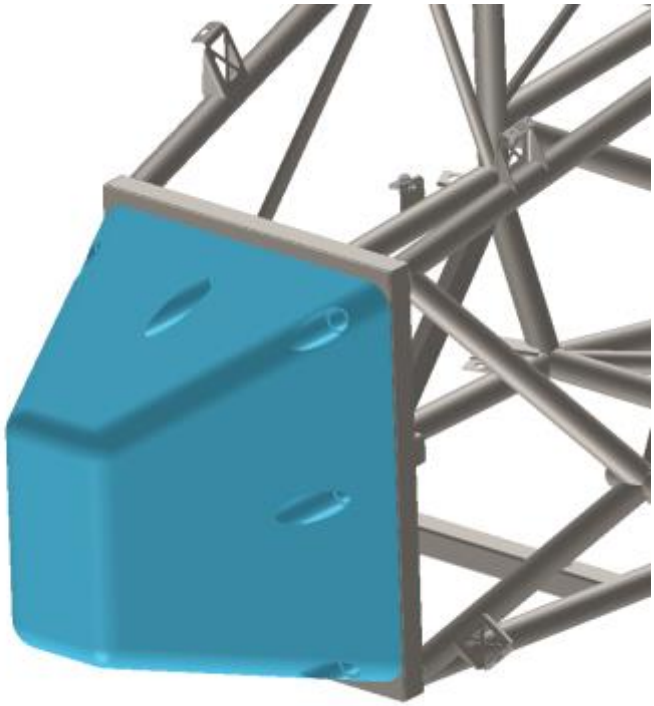


Figure 1. Orientation of the impact attenuator

Dimensions of the front bulkhead

The dimensions of the front bulkhead are shown in figure 2. As shown in figure 3, the outside profile of the anti-intrusion plate does not extend beyond the Standard impact attenuator by more than 1in (25mm), as per rule T3.20.6. Therefore, no diagonal steel tube is required in the design of the front bulkhead. The front bulkhead was designed to have the minimal dimensions required to incorporate a Standard impact attenuator in order to minimize weight. The overlap of the impact attenuator over the front bulkhead tubes is shown in figure 4.

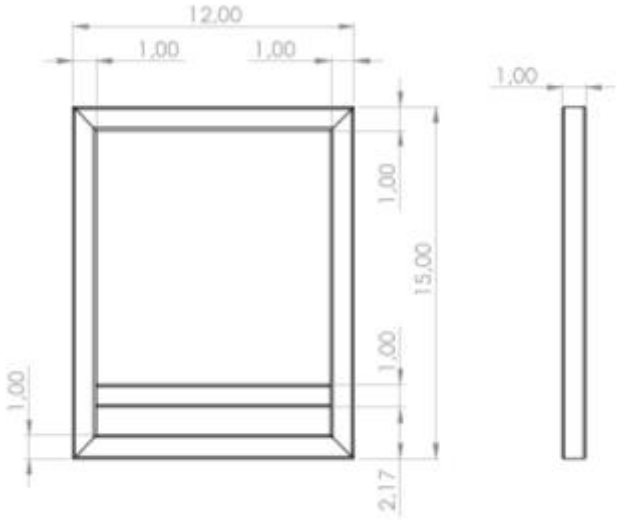


figure 2. Front bulkhead dimensions

Design of the Anti-Intrusion Plate

The welded anti-intrusion plate is made out of a 0.060in (1.5mm) solid steel plate as per rule T3.20.3. The anti-intrusion plate is 12.00in X 15.00in to match the front bulkhead size, and therefore extends past the centerline of the front bulkhead tubes on all sides as per rule T3.20.5.

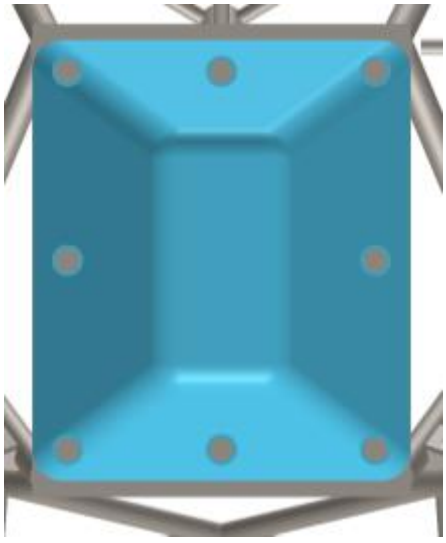


Figure 3. Outside profile of Anti-Intrusion plate

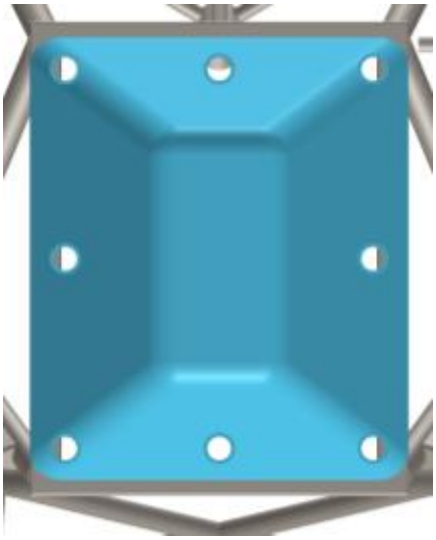


Figure 4. Outside profile of Impact Attenuator

Attachment method of the impact attenuator

The impact attenuator is bonded to the anti-intrusion plate with Loctite EA E-30UT epoxy adhesive. As such, no additional fasteners are required. This adhesive was chosen for its good shear resistance of 29MPa for steel. It also cures at ambient temperature within three hours.

Attachment method of the anti-intrusion plate

The anti-intrusion plate will be welded to the front bulkhead. The welds will be interrupted welds of at least 1in (25mm) in length with spacing of less than 1in (25mm) each, as per rule T3.20.4. Welding the anti-intrusion plate allows the bulkhead size to be smaller than when fixing it with bolts, as there is no need for the plate's exterior profile to be greater than the exterior profile of the impact attenuator. It also allows for a narrower front bodywork design.

Conclusion

This report shows that the Impact Attenuator Assembly of Polytechnique Montreal's car, including the Impact Attenuator and Anti-Intrusion plate, is in compliance with all Formula Student rules.

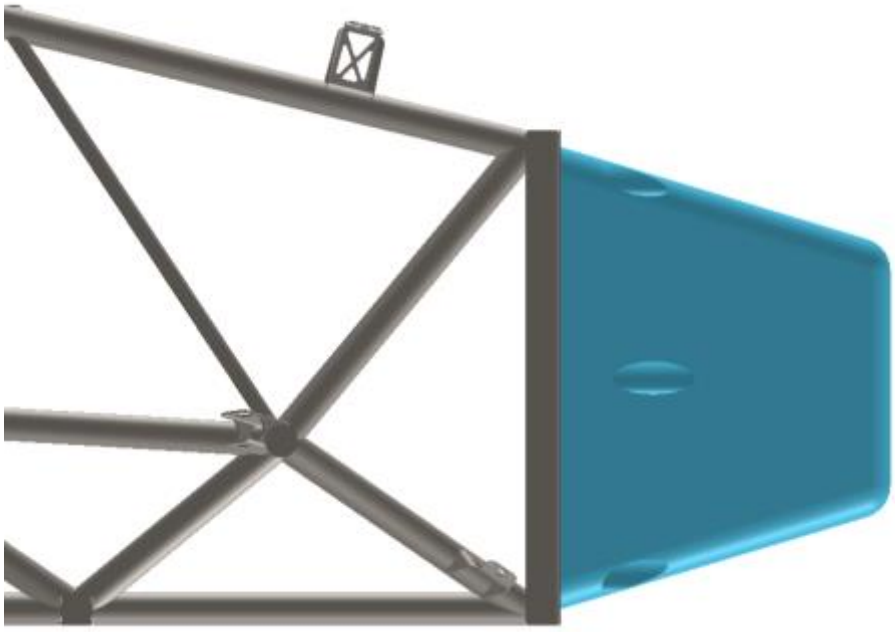


Figure 5. Side view of Impact Attenuator Assembly

APPENDIX A

Receipt from supplier (BSCI) for standard FSAE impact attenuator

Invoice

BSCI, Inc.
170 Barley Park Lane
Mooresville, NC 28115 USA

Phone: (704) 664-3005
Fax: (704) 660-1540

Date	Invoice #
2/10/2017	20528

PAID 02/08/2017

Bill To	Ship To
FORMULE POLYTECHNIQUE MONTREAL RENAUD PEPIN 3295 TRACY LAVAL, QC H7E 1M1 CANADA	RENAUD PEPIN 2500 CHEMIN DE POLYTECHNIQUE MONTREAL, QC H3T 1J4 CANADA

WO #	PO #	Terms	Rep	Ship Date	Ship Via	Tracking #
6800	ONLINE SALES	Online Credit Card Sales	MLS	2/10/2017	UPS Standard	

Item	Description	Backordered	Qty	Rate	Amount
155-60-11	BLACK FIA TYPE A ROLL BAR PADDING 1 1/8" - 1 5/8" BAR DIAMETER 36" LENGTH		1	29.99	29.99
EC-50-1.5	1.5" X 16" X 36" ENER-CORE EC 50		1	99.00	99.00
FSAE Attenuator	STANDARD IMPACT ATTENUATOR, MATERIAL DOW IMPAXX 700		1	160.00	160.00
SHIPPING	UPS STANDARD SHIPPING CHARGES		1	59.19	59.19
	Tracking#: 1Z2E75996867118045, 1Z2E75996866198256				

All orders are manufactured according to the standards of BSCI, Inc. Through issuance of a purchase order and acceptance of the order, you have validated all aforementioned product(s) for intended use. Testing is delegated and validated by the customer in its entirety.

Thank you for your business. Please pay from this invoice.

All products sold by BSCI, Inc. are sold "as is" and without warranty of any kind. Expressed and implied warranties, including without limitation implied warranties of merchantiability or fitness for a particular purpose, are expressly disclaimed by BSCI, Inc.(Seller). BSCI, Inc. WILL NOT be liable for any loss, damage, injury or death arising from the use of any products sold by BSCI, Inc. Users shall assume all liability and responsibility in connection therewith. All past due accounts will be charged 1.5% monthly, 18% APR.

Subtotal	$348.18
Sales Tax (0.0%)	$0.00
Payments/Credits	-$348.18
Balance	$0.00

www.rollbarpadding.com