WOLF COMPOSITE SOLUTIONS

SSV SYSTEM MANUAL 2017

3991 Fondorf Drive // wolfcomposites.com // 614.219.6990 // inquiry@wolfcomposites.com

NHTSA SURROGATE STRIKE VEHICLE (SSV)

INTRODUCTION

PROJECT PURPOSE

The U.S. National Highway Traffic Safety Administration (NHTSA) has created a new test system called the Strikeable Surrogate Vehicle (SSV) to test Autonomous Emergency Braking (AEB) systems in the U.S.

The SSV consists of a carbon target, which mimics the rear end of a car. During the test, the SSV simulates a vehicle ahead of it, which is registered by the test specimen's assist system and triggers a braking or evasion maneuver.

The US NCAP (New Car Assessment Program) has adopted the AEB as a recommended safety technology in the assessment criteria for all new vehicles. All major automakers are using AEB presently, along with other tech, to boost overall passenger safety. Currently, German crash test facility manufacturer MESSRING is using the SSV and it has already become a standard in Europe and Asia.

LEARN MORE ABOUT THE SSV:
wolfcomposites.com/resources/ssv

DISCLAIMER

The SSV is a compliance tool. The SSV is the last line of testing after extensive prior validation has been performed. The SSV is not meant to be impacted repetitively. It should only be used when you are confident that you are NOT going to hit any target, and even then, start at the LOWEST impact speed.

Wolf Composite Solutions is not liable for any damages resulting from misuse, abuse, testing or handling the target outside the parameters of NHTSA test procedures and guidelines included within this manual.

Wolf Composite Solutions reserves the right to evaluate damages supposedly resulting from craftsmanship or material failure, on a case by case basis, using photographic and video evidence.

OVERVIEW // DETAILS
TABLE OF CONTENTS

IDENTIFICATION // COMPANY 0.0

MANUFACTURER: Wolf Composite Solutions
ADDRESS: 3991 Fondorf Drive
CITY: Columbus, Ohio 43228
PHONE: 614-219-6990
EMAIL: inquiry@wolfcomposites.com
WEB: www.wolfcomposites.com
PRODUCT: USNCAP Surrogate Strike Vehicle

MANUAL VERSION: 1.2 - 10/23/17

FOR ORDERS AND PURCHASE INQUIRIES
PLEASE SEE OUR CATALOG OF CURRENT SYSTEMS AND SPARE PART OFFERINGS.
wolfcomposites.com/resources/ssv

1.0 OPERATING INSTRUCTIONS

1.1 PURPOSE OF THIS DOCUMENT

This manual contains important instructions ensuring the safe, correct, and efficient operation of the system. Adherence to these instructions will help reduce risks, decrease costly repairs and down-time, and increase the reliability and service life of the system.

Any individual tasked with working on this system should read and comply with this manual. All personnel involved in the handling of the system must read this manual before using this test system. This applies in particular to any person who might handle the system only occasionally, e.g. for maintenance and repair work.

This manual must be easily accessible at all times. A copy of this manual must be present near the system at all times. In addition to the manual, any mandatory accident prevention measures or personal protective equipment applicable in the country of use should be utilized. The regulations for safe and professional work at the specific site where the system is used should be complied with as well.

1.2 TARGET GROUPS

The Operator, as the superordinate legal entity, is responsible for the intended use of the system and for the training and deployment of authorized personnel. The operator shall define the responsibilities and authority of the authorized personnel within their organization. The operator shall be intimately familiar with this document as well as NHTSA test procedures.

Qualified Staff shall be defined as any person whose qualifications, knowledge and experience enable that person to assess any task conveyed to them and to recognize any potential risks. Qualified staff must be familiar with applicable rules and regulations. This applies only to technically trained and qualified staff or to people selected as suitable by the operator.

Trained/Instructed Staff shall be defined as any person who has been briefed on the tasks conveyed to him/her, potential risks that may result from inappropriate handling, and who has been trained where necessary. Such person has also been informed about the required safety equipment and safety measures. Any staff to be coached, instructed, briefed, or being generally trained may handle/work with the system only under constant supervision of experienced staff. Competencies must be clearly outlined and defined. All personnel must have the legally required minimum age.

1.3 LIABILITY

The information provided herein is based on our experience and knowledge and is given in good faith.

Aspects of this manual were prepared in German. They were then translated into the relevant national/contractual language by a qualified translation agency.

Utmost care was used in drafting this manual. Should you notice any omissions and/or errors nevertheless, please let us know in writing. Your suggestions can make this manual even more user-friendly. For any suggestions or additions, please contact: **inquiry@wolfcomposites.com**

Wolf Composites is not liable for any loss, cost, expense, inconvenience or damage that may result from use or inability to use the system. Under no circumstances shall Wolf Composites be liable for any loss, cost, expense, inconvenience or damage exceeding the purchase price of the testing system.

1.4 REPRINTS & COPYRIGHT

2.0 GENERAL SAFETY

2.1 GENERAL SAFETY INSTRUCTIONS

Please familiarize yourself with the basic safety instructions to ensure safe handling and trouble-free operation of this system.

Do not use the system for any purpose other than that specified by the designer and/or manufacturer.

Any faults, errors, malfunctions or hazards found by any member of staff must be reported immediately to the operator or the operator's authorized representative.

Work on the system by several different people requires good cooperation and precise coordination.

During normal operation of the system, never remove, bypass, or deactivate any of the safety devices or safety features.

Any safety devices disassembled for repair or maintenance must be re-assembled upon completion of repair or maintenance work and then tested.

Only suitably qualified staff shall be allowed to work on technical equipment.

Use cleaning agents only in accordance with the safety regulations applicable to the product.

2.2 SAFETY NOTICES & SIGNS

The knowledge of and adherence to each individual locations safety notices and signs is important during the assembly and operation of this equipment.

Disregarding them may result in severe health damage or even cause life-threatening injuries!

2.3 PERSONAL PROTECTIVE EQUIPMENT

The operator must provide the legally required personal protective equipment to all qualified and trained staff working with the test system.

Depending on the task at hand, the use of personal protective equipment may be mandatory. This will be explicitly pointed out by the operator or the operator's authorized representative. Examples include but are not limited to:

1. Protective Footwear
2. Protective Gloves
3. Protective Eyewear
4. Helmets etc.

2.4 SAFETY & DEVICES

While the system is state of the art and complies with established safety rules and regulations, dangerous situations may still arise. All safety and protection devices must be kept in proper working order.

Use the system only if it is in proper working order and only for its specified purpose. Be safety-minded and aware of the hazards, and comply with this manual. Immediately remove, or have someone remove, any hazards and/or replace malfunctioning parts that may pose a safety risk. Cease any operation while parts are being replaced and/or hazards are being removed. Any dismounted protection devices must be mounted again in their protective position before resuming operation.

2.5 SPECIAL HAZARD WARNINGS

Before operating the system, ensure that the system's operation will not pose a risk to anyone.

Please refer to the safety data sheets for cleaning agents.

2.6 ORGANISATIONAL MEASURES

Keep this manual readily accessible near the system at all times. Comply with and ensure other people's compliance with the generally applicable, legal, and other mandatory rules and regulations concerning accident prevention and protection of the environment.

All staff instructed to carry out work on the system must read this manual, in particular the safety instructions, before starting to work. Take note of all safety and hazard warnings on the system and ensure that they remain legible.

Do not modify the system without the manufacturer's prior consent; unauthorized modifications may compromise the system's safety. Only use spare parts from the manufacturer. Observe the deadlines for recurrent examinations and/or inspections.

3.0 SYSTEM DESCRIPTION

3.1 INTENDED USE

Strictly comply with the safety instructions in the manuals for the components used in/with the system. The system is intended for use in restricted outside areas.

The USNCAP test procedure states:
“Unless specified otherwise, the road test surface shall be dry (without visible moisture on the surface), straight, and flat, with a consistent slope between level and one percent. The road surface shall be constructed from asphalt or concrete and shall be free of irregularities, undulations, and/or cracks that could cause the SSV to pitch excessively. The road test surface must produce a peak friction coefficient (PFC) of at least 0.9 when measured using an American Society for Testing and Materials (ASTM) E1136 standard reference test tire, in accordance with ASTM Method E 1337-90, at a speed of 64.4 km/h (40 mph), without water delivery. The test track PFC shall be documented.”

Refer to 7.3.1 on slider puck wear and replacement.

Operating temperature: 45°F – 104°F (7°C – 40°C)

Maximum humidity: 60%

The system may be used only by qualified personnel instructed by the operator and may not be used for purposes other than AEBS testing.

Use of the system on public roads is prohibited. Any other use shall be regarded as non-compliant.

The system may be used only for its intended purpose as described in this manual. Any other use shall be regarded as non-compliant. The manufacturer shall not be held liable for any damage resulting from such non-compliant use.

The system’s design is state of the art and its operation is safe if operated in accordance with the manual and the specifications indicated. Nevertheless, its use may result in a risk for the life and limb of the user or of a third party, or may have an effect on the system and on other material assets.

Use the system only if it is in proper working order and only for its specified purpose, be safety-minded and aware of the hazards, and comply with this manual. Immediately remove or have someone remove any hazards or malfunctioning part that may pose a safety risk.

THE FOLLOWING MUST ABSOLUTELY BE AVOIDED:
1. Non-compliance or lax compliance with the information provided in this manual.

2. The use of spare parts or components not supplied by the manufacturer.

3. Incorrect operation, removal, manipulation or non-use of protection devices.

4. Unauthorized modifications to the system or modification of the system's functions.

5. Non-compliant use or non-compliant maintenance work.

3.2 FORESEEABLE MISUSE

Hazards may arise from incorrect or non-compliant use of the system. The manual must be available throughout the time of operation of the system. Please keep a copy of this manual near the system and keep it within easy reach during any maintenance and repair work.

The only way to ensure safe operation of the system as delivered is to use it for its intended purpose in accordance with our documents. Compliance with the manual is essential. The manufacturer shall not assume any liability nor extend any warranty for non-compliant use of the system.

The system is not designed for indoor use. Use of the system on public roads is prohibited. Hazardous materials must be disposed of while avoiding any personal or environmental risk. Leakage of hazardous materials may also threaten the environment. All applicable legal provisions must be complied with.

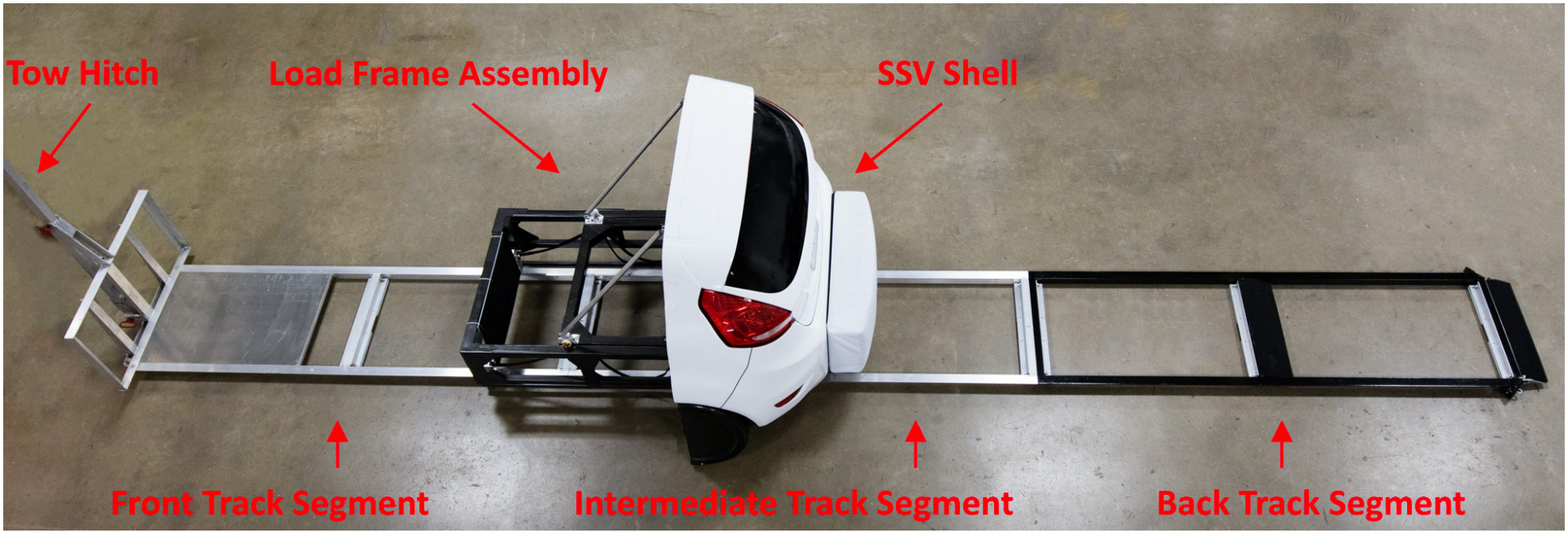
3.3 FUNCTIONAL DESCRIPTION

The system was designed for AEBS testing. This manual does not cover the tow vehicle. The operator is responsible for compliance with safety regulations in selecting and using the tow or subject vehicle used with the system. Moreover, the operator is responsible for ensuring that any additional instruments, tools, or other materials and vehicles used for testing comply with applicable safety regulations, including national provisions. The operator is responsible for the users' appropriate and safety- minded handling of the system. The operator must supervise the use of the system to ensure its users comply with the applicable safety regulations and to prevent its non-compliant use.

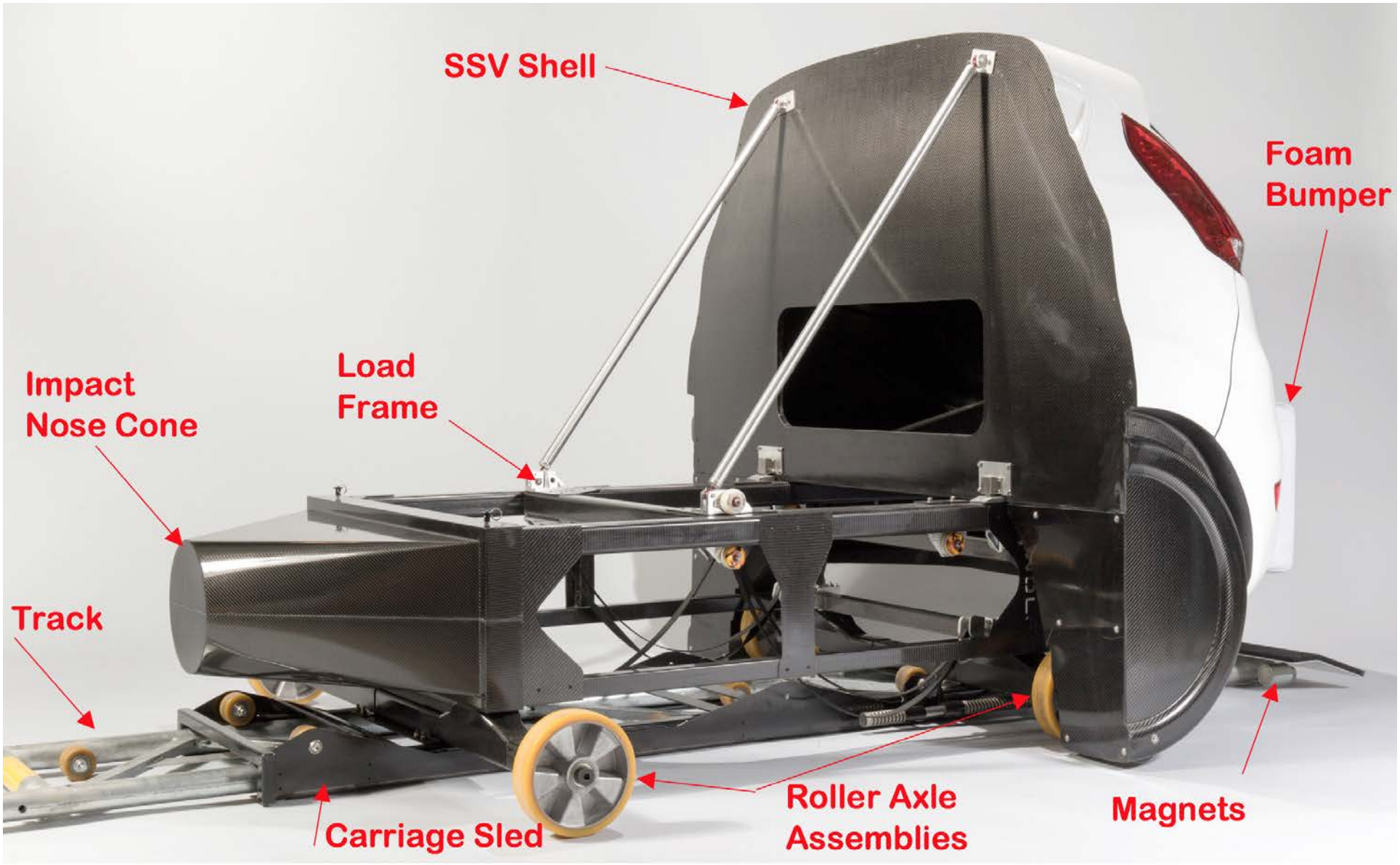
3.4 CONSTRUCTION & COMPONENTS

The SSV system is available in two versions, the NHTSA version utilizing an aluminum track assembly, and a hybrid ADAC version utilizing the steel ADAC track assembly and a modified attachment system. The former will be depicted in the following images.

3.4.1 NHTSA VERSION



3.4.2 ADAC HYBRID VERSION



3.5 NHTSA TECH. SPECS.

Total length without tow vehicle (max.): 78 feet, 10 ¾ inches as measured from the center of the hitch to the end of the towed rail (without the SSV installed on it).

DIMENSIONS	LENGTH (in.)	WIDTH (in.)	HEIGHT (in.)	WEIGHT (lb.)
SSV SHELL ASSEMBLY	36	67	57	54
LOAD FRAME ASSEMBLY	64	36	18	45
SSV FOAM BUMPER	9	34	14	8
FRONT TRACK	102	38	37	71
INTERMEDIATE TRACK	96	28	2.75	24
REAR TRACK	102	31	2.75	84
TRACK FOAM BUMPERS	18	38	21	16
MIDDLE SKID	4.5	23.25	2.5	5
CONNECTOR SKID	6	23.25	2.5	6
TOW HITCH ARM	81	4.25	7.5	16
CRATED SSV ASY	72	42	82	478
CRATED TRACK ASSY	110	42	48	816

3.6 ADAC HYBRID TECH. SPECS.

Total length without tow vehicle (max.): 70 feet, 2 ½ inches as measured from the center of the hitch to the end of the towed rail (without the SSV installed on it).

DIMENSIONS	LENGTH (in.)	WIDTH (in.)	HEIGHT (in.)	WEIGHT (lb.)
SSV SHELL ASSEMBLY	36	67	57	54
LOAD FRAME ASSEMBLY	64	36	18	45
SSV FOAM BUMPER	9	34	14	8
SLED WITH ROLLERS	65	20.5	5	60
FRONT AXLE WITH ROLLERS	58	8	8	12
REAR AXLE WITH ROLLERS	46	8	8	12
NOSE CONE	18	36.5	12.5	5.5
FRONT TRACK SEGMENT	150	25	18	194
INTERMEDIATE TRACK SEGMENT	123	17.5	2.5	75
REAR TRACK SEGMENT	120	24	2.5	79
TRACK SYSTEM FOAM BUMPERS	18	38	21	16
CRATED SSV ASSY	72	60	62	512
CRATED TRACK ASSY	110	42	48	816

4.0 ASSEMBLY,OPERATION

4.1 ASSEMBLY, OPERATION, TRANSPORT

The system is not designed for indoor use. Use of the system on public roads is prohibited. The system may be used only on closed-off and monitored roadways.

The assembly and operation of the system shall be carried out only by qualified staff instructed by the operator. The transport of the system shall be carried out only by trained and/or instructed staff.

Please strictly comply with the safety instructions in the manuals for the components used in/with the system. The manufacturer shall not be liable for damage to the tow vehicle or the tested vehicle.

Do not stand on the tracks or any other parts of the system.

Always secure the SSV load frame and track segments against any un-required movement.

4.2 SYSTEM ASSEMBLY, OPERATION

The system must be placed on a suitable, stable, and level surface and used in a manner preventing any inadvertent movement of the system.

The operator is responsible for compliance with safety regulations in selecting and using the tow or test vehicle used with the system. Moreover, the operator is responsible for ensuring that any additional instruments, tools, or other means and vehicles used for testing comply with applicable safety regulations, including national provisions.

The operator is responsible for the users' correct and safety-minded handling of the system. The operator must supervise the use of the system to ensure its users comply with the applicable safety regulations and to prevent its non-compliant use.

50-meter (164 feet) radius around the system, the tow vehicle, and the tested vehicle must be kept clear of people and objects over the entire length of the test run. Prevent entry to the danger zone.

4.2.1 NHTSA SYSTEM ASSEMBLY & OPERATION

The following describe the procedure of assembling the SSV system with the NHTSA track system.

Tools Required for SSV Assembly:

1. Impact Gun or Drill
2. 9/16" Nut Drivers
3. #2 Phillips Head Driver Bit
4. Rubber Mallet
5. 7/16" wrenches
6. 9/16" wrenches
7. 1/4" Drive Ratchets
8. 7/16" Long Sockets for 1/4" drive
9. 5/32", 7/32"and 3/16" Hex key
10. Torque wrench
11. Blanket to lay shell on
12. Step ladder to reach Top of SSV Shell crate
13. Pallet Jack

4.2.1A NHTSA RAIL ASSEMBLY

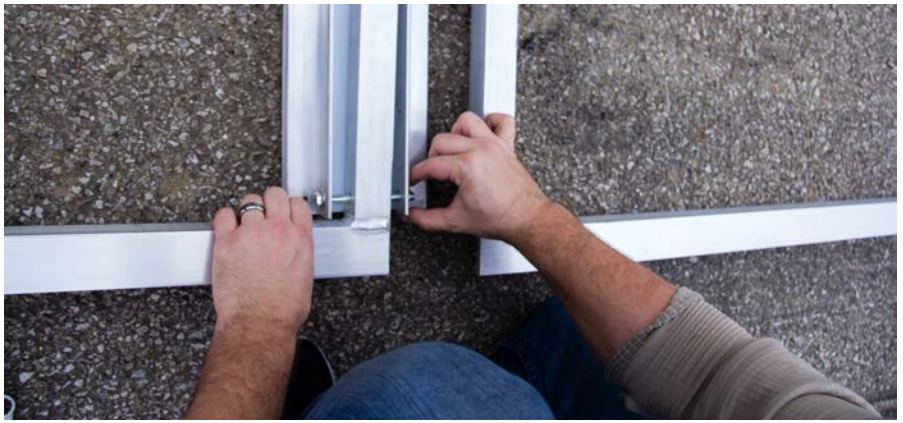
1. Remove the Top and Front of the crate to gain access to the track system.

2. Release the tie down straps securing the tracks to the crate. Remove foam bumpers, tow hitch, and all the middle track segments from the crate. The black steel track segments should be on the bottom.

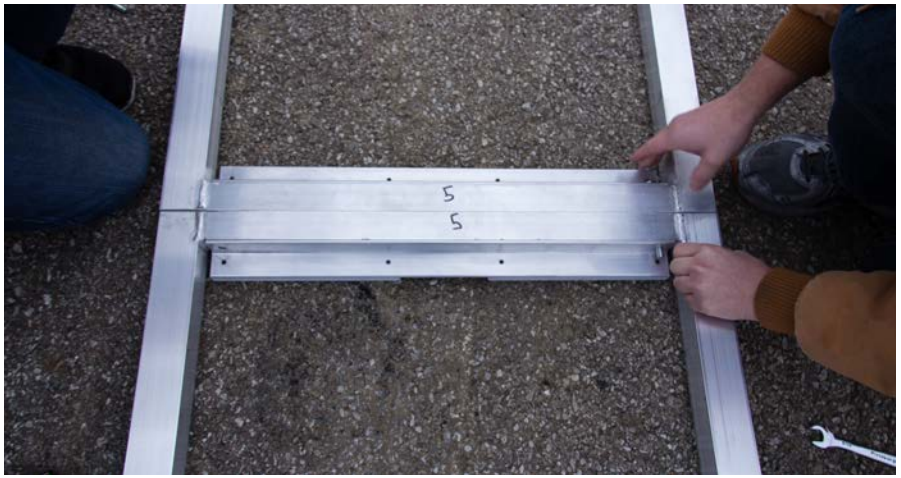
3. Lay out the track segments in the following order with the plastic pucks facing the ground.

1. Black Steel Back Track Segment
2. Aluminum Intermediate Tracks (Sections 2-8)
3. Front Aluminum Track (tow hitch)
4. Attach Foam Block #1 to the front track by feeding Velcro straps through slots in the corners of the track end and pulling it around and back to the foam block.
5. Attach Foam Block #2 using the Velcro straps on its side to the side of Foam Block #2

4. The numbered track segments should butt together and connect with the track connector. The plastic puck on the bottom of the track connector should be on the ground and the aluminum angles should be up and go around both ends of the two track segments.



5. Assemble the track together using the provided 3/8”-16x5” bolts. Place a washer on the bolt, slide it through the holes of the track connector and both track segments, place another washer on the bolt and then tighten the 3/8” nut on the bolt using a 9/16” socket and wrench to 34-38 N•m (25-28 lb-ft) of torque. You may need to align the track connector and track ends together with a rubber mallet to allow passage of the bolt through all the holes.



6. Connect all aluminum track segments together using this method. Do not attach the steel track segment to the completed aluminum assembly until the SSV Shell and Load Frame have been assembled and placed on the steel track.

7. The tow hitch is connected to the track system via a hitch pin on the front track segment. It can be secured in a vertical position with another hitch pin during repositioning or when not in use.

8. The tow hitch accepts a US standard 2” hitch ball and the tow arm can accommodate a variety hitch ball heights. While the 2” (50.8 mm) tow hitch coupler is known to have been used with the European standard 50 mm ball, it is at the operator’s discretion whether or not to implement its use. Operator assumes all liability for this action.

NOTE: WOLF COMPOSITE SOLUTIONS ASSUMES NO LIABILITY FOR ANY DAMAGE TO TRACK SYSTEM OR TOW VEHICLE IN THE EVENT OF A DISCONNECTION UNDER THESE CIRCUMSTANCES.

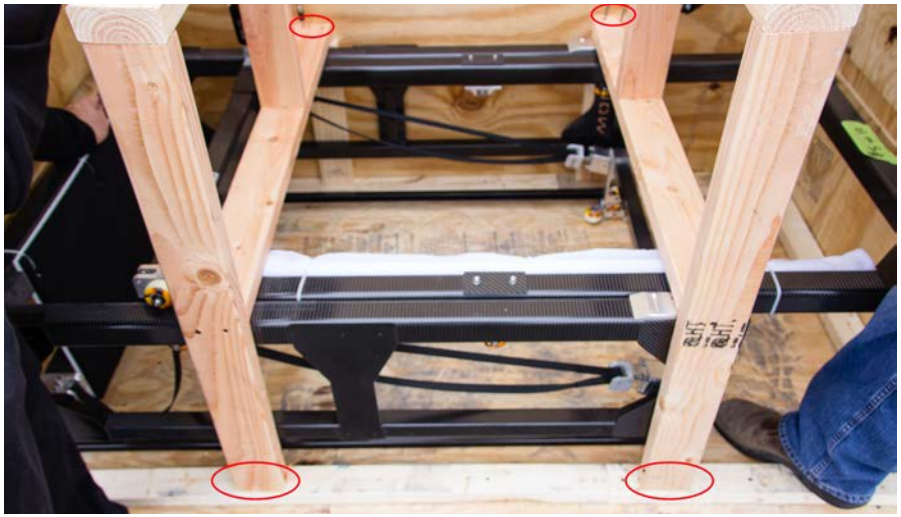
4.2.1B ASSEMBLY OF SSV & LOAD FRAME

1. Remove the top of the crate followed by the front of the crate to gain access to the SSV bulkhead opening.

2. Remove the 4 Philips head screws inside the rectangular hole of the SSV bulkhead that are securing the SSV Shell to the wood carrier frame in the crate.

3. Remove SSV Shell from the crate and set it aside.

4. Remove the 8 Philips head screws in the SSV shell carrier frame, they secure the Load Frame to the crate.

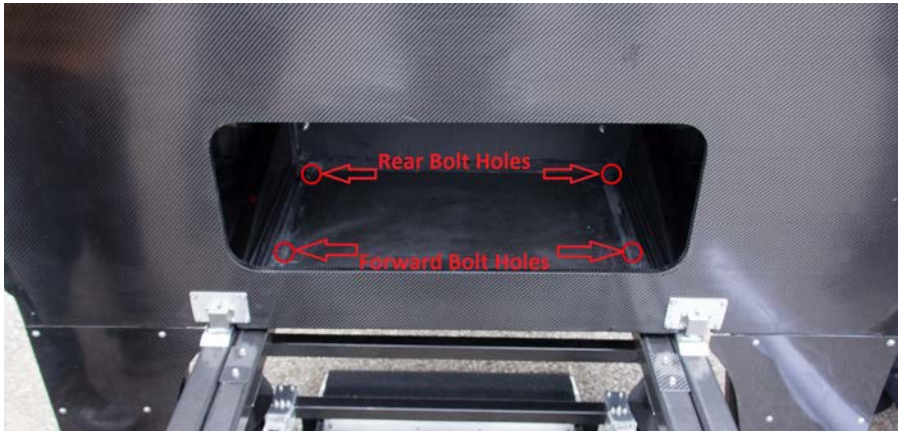


6. Carefully position the SSV Shell over the load frame assembly, and align the 4 bolt holes of the slide frame with the same 4 bolt holes inside the SSV shell used to secure it to the crate. The black polyurethane wheels inside the Carbon wheel housings should roll gently on the pavement supporting very little weight.

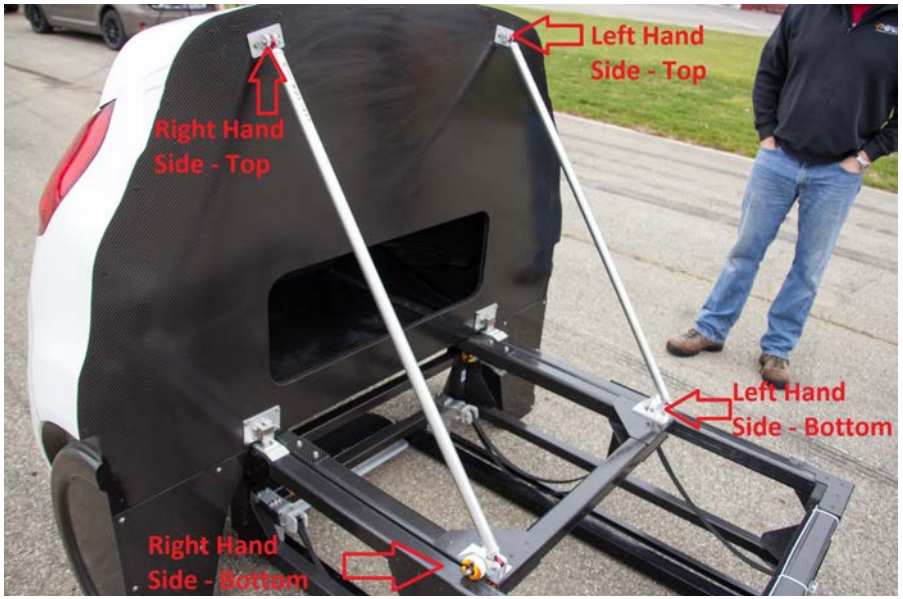
7. Join the SSV Shell and Load Frame using the four 1/4”-20 bolts provided. Place washers on the two 3-1/4” long bolts and slide them through the rearward most holes of the SSV Shell and slide frame, apply another washer and then the 1/4” Nylock nut.

8. Place washers on the two 3” long bolts and slide them through the forward most holes of the SSV Shell and slide frame, apply another washer and then the 1/4” Nylock nut.

9. Tighten the bolts using a 7/16” socket and 7/16” wrench to 24.5-30 N•m (18-22 lb-ft) of torque. **DO NOT OVER TIGHTEN.** Over tightening risks cracking the carbon tubing, compromising its ability to function. This damage is not covered under warranty.

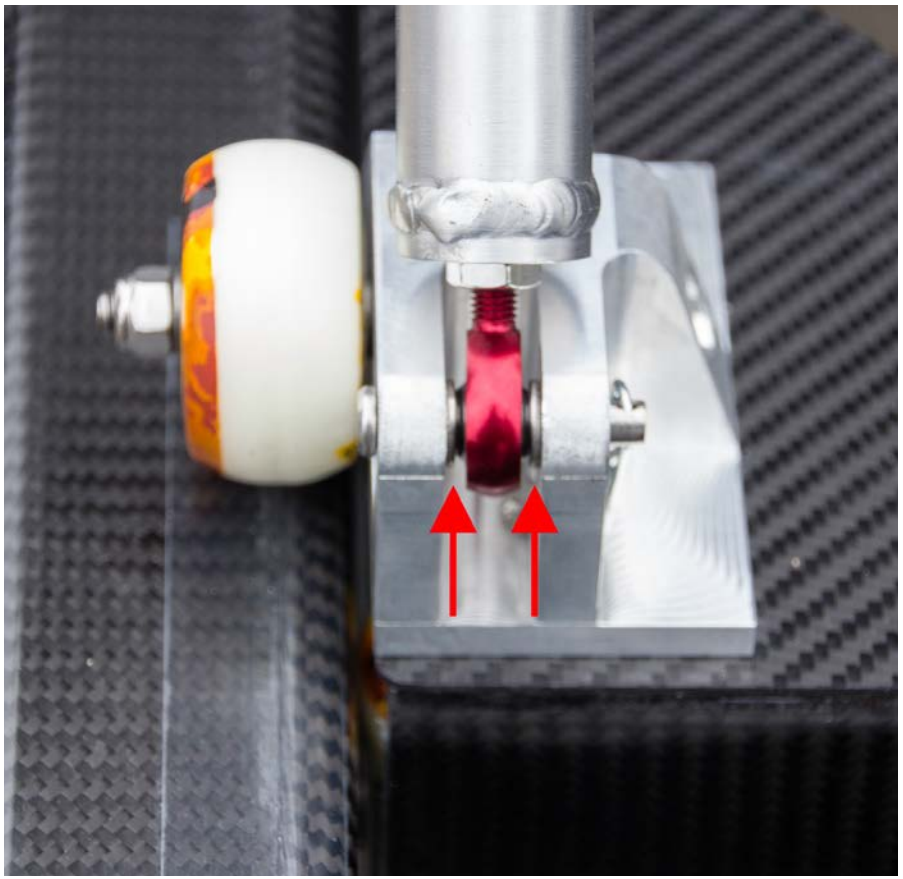


10. The support struts can be assembled, attaching the top Shell and the rear of the Slide Frame. Each strut should be labeled either (L) / (R) and have a top and bottom designation. Remove the hair pins from the ball joints and loosely place them in the correct orientation.



11. Connect the top of each strut to the top of the SSV Shell by sliding the hitch pins through the holes, noting there are no washers, and secure them with the hairpins.

12. Connect the bottom of each strut to the slide frame by sliding the hitch pins through the hole, a washer, then through the ball, another washer and then out the other side. Finally, secure the bottom hitch pin with the hairpins.



4.2.1C COUPLING NHTSA TRACK TO SSV

1. The SSV Shell and Load Frame Assembly are now ready to be placed on the track system. The rear end or bumper side of the SSV assembly should be loaded onto the front of the black steel track segment first and then rolled completely on the track.

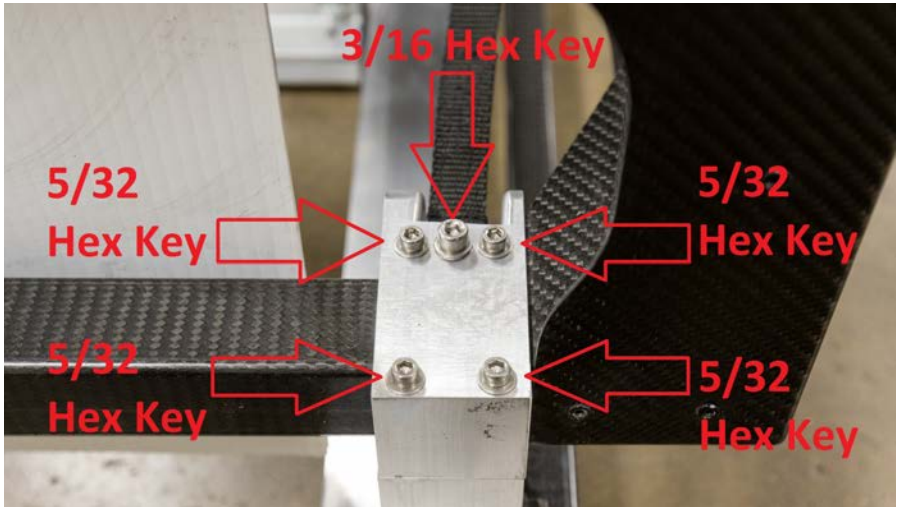
2. Now the steel rear track segment can be secured to the rest of the completed track system using the same 3/8”-16 x 5” bolts and process as the other track connectors.

4.2.1D REQUIRED PARAMETERS FOR TESTING

1. The SSV Assembly should roll freely from the front track all the way to the rear track. Manually push the SSV over the entire length of track to the bumpers to assure there are no misaligned tracks that could bind or negatively affect the travel of the SSV system in the event of an impact during AEBS testing.

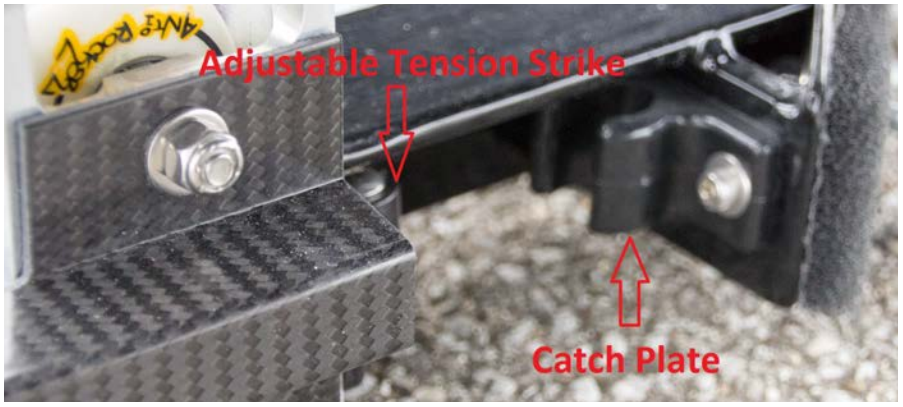
2. Adjust any tracks that are misaligned, and recheck the movement of the SSV prior to setting it in its initial testing position.

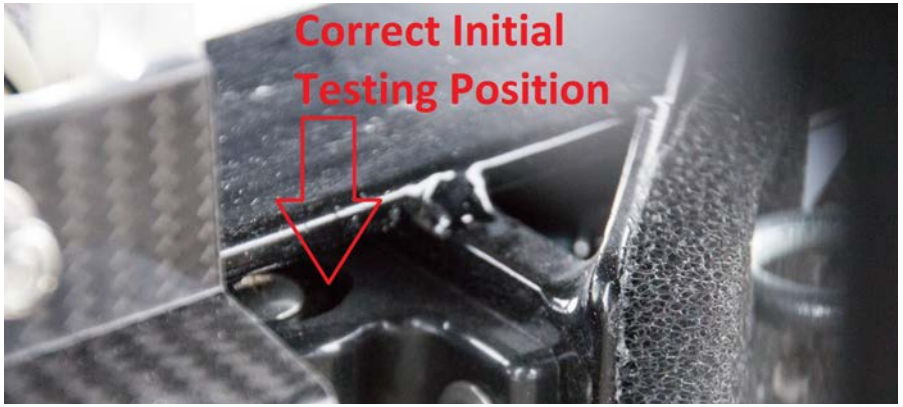
3. Check the lateral movement of the Load Frame on the track by pushing the SSV left and right. If there are more than a few millimeters of side to side movement, adjustments can be made to the left and right rear carriage assembly rollers.



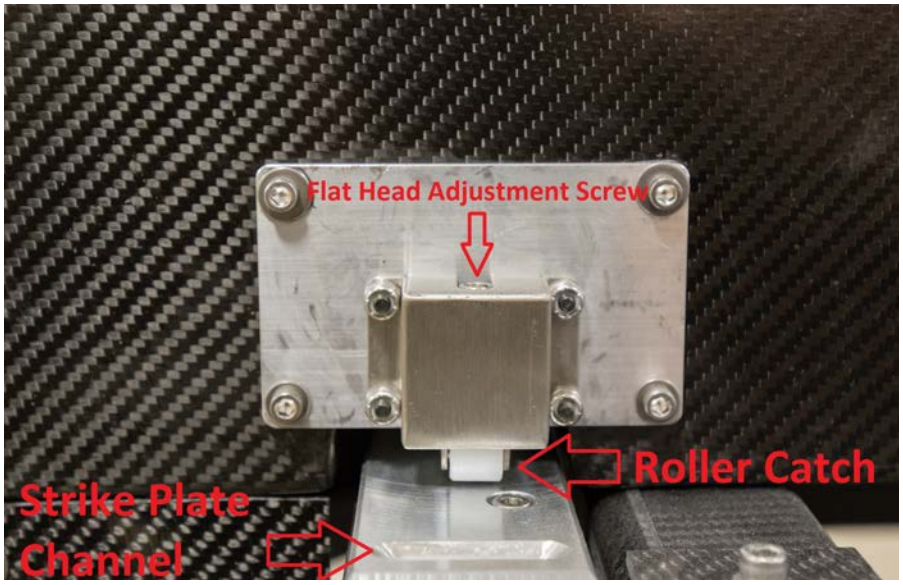
4. To adjust the carriage assembly rollers, loosen all 5 of the bolts from the top using both a 5/32” and 3/16” Hex key. Gently slide the assembly inward until the lateral movement is reduced to a satisfactory level.

5. With the SSV lateral movement set, roll the load frame to the back track and push it until the adjustable catch grabs and holds the strike, securing the SSV in testing position.





6. With the Load Frame secure, move the SSV Slide frame into position by assuring that the roller catch is inside the strike plate channel. If needed, the height of the roller can be adjusted vertically by a flathead screwdriver up to 3/8” to assure proper seating.



7. The SSV System is now ready to begin AEBS testing. For static or stationary tests, make sure the tow arm is secured in the vertical position by the hitch pin. For dynamic or moving tests, make sure the tow hitch is securely attached to the ball on the tow vehicle.

4.2.2 ADAC SYSTEM ASSEMBLY & OPERATION

The following describe the procedure of assembling the HYBRID SSV system with the ADAC track system.

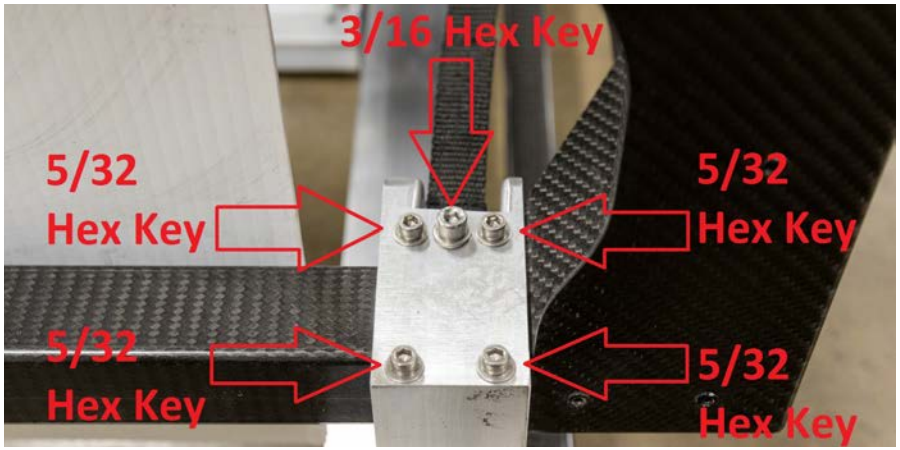
Tools Required for SSV Assembly:

1. Impact Gun or Drill
2. 9/16” Nut Drivers
3. #2 Phillips Head Driver Bit
4. Rubber Mallet
5. 7/16” wrenches
6. 9/16” wrenches
7. 1/4” Drive Ratchets
8. 7/16” Long Sockets for 1/4” drive
9. 5/32”, 7/32”and 3/16” Hex key
10. Torque wrench
11. Blanket to lay shell on
12. Step ladder to reach Top of SSV Shell crate
13. Pallet Jack

4.2.2A CONVERSION - NHTSA TO ADAC TRACK

1. Take SSV Shell and Load frame assembly off the track.

2. Using both a 5/32” and 3/16” Hex key, loosen all 5 of the bolts from the top of each of the 4 Carriage assembly attachment clamps to release the SSV Load Frame from the carriage stiffener assembly and retain the hardware.



4.2.2B ASSEMBLY OF RAIL SYSTEM

1. Put the front rail segment and the first intermediate rail segment on the ground.

2. Check the correct positioning of the rail segment. Its rollers must touch the ground. All rollers must be in place.

3. Use the connecting elements to join the rail segments. Initially fit the screws, the special washers, and the spring washers only on one rail segment and tighten them just a little bit. There is no need to fully disassemble the connecting elements after initial assembly. Just make sure to loosen the screws a little for easier handling.

4. Check the correct positioning of the washers and then tighten all screws (4 per joint), applying a torque of 90 N•m (66 lb-ft) with a suitable tool.

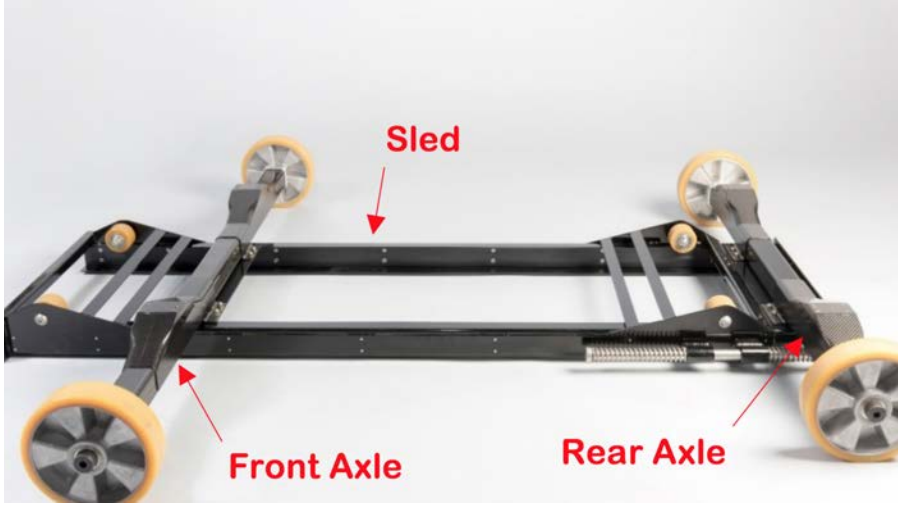
5. Repeat steps 1 to 4 up to the last intermediate rail segment of the assembly.

4.2.2C ASSEMBLY OF LOAD FRAME ON SLED

1. Securely place steel sled in work area.

2. Attach the wider Carbon Axle assembly to the front of the steel sled using the supplied hardware (8 1/4”-28 100 degree screws, washers and nylon lock nuts).
Tighten screws to 24.5-30 N•m (18-22 lb-ft) of torque.

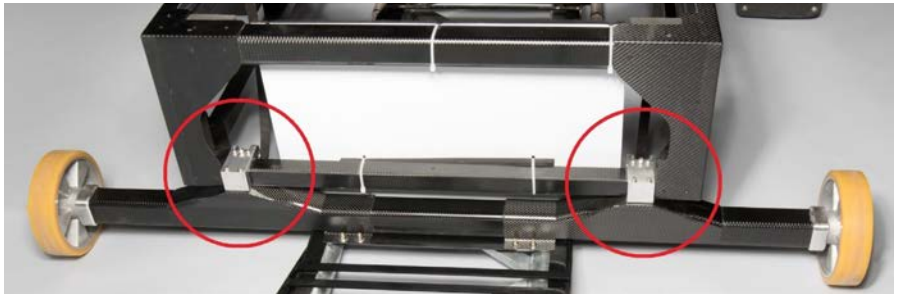
3. Attach the narrow Carbon Axle assembly to rear of the steel sled using the supplied hardware (8 1/4”-28 100 degree screws, washers and nylon lock nuts).
Tighten screws to 24.5-30 N•m (18-22 lb-ft) of torque.



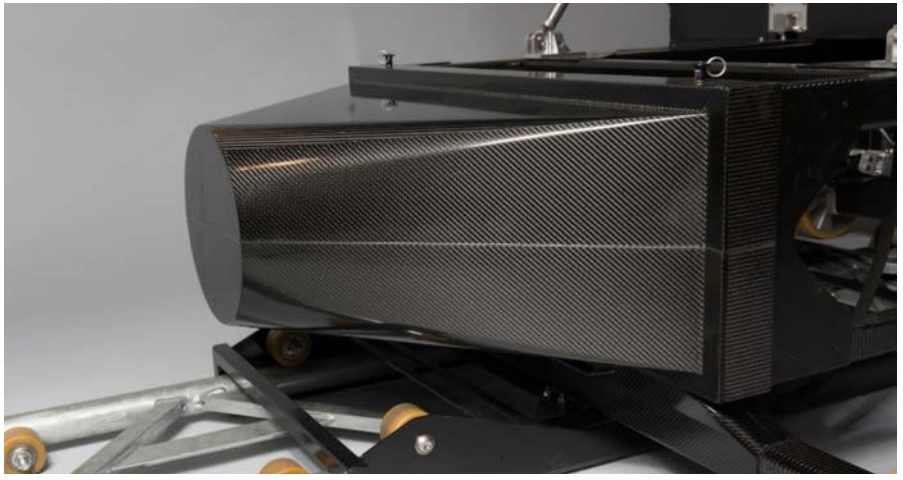
4. Follow the instructions in section 4.2.1.b for assembly of the SSV shell and the load frame.

5. Carefully place the SSV load frame assembly on top of the four mounting areas of the carbon axle assemblies in the correct orientation.

6. Using the four 5/32” Hex bolts and the 3/16” Hex bolt, line up the holes of the carriage assembly clamps and the carbon axles, and tighten to 24.5-30 N•m (18-22 lb-ft) of torque.



7. Place the Carbon Nose cone onto the front of the SSV load frame with the two cutaways on the bottom, otherwise the nose cone will hit the carriage assembly clamps.



8. Secure the nose cone to the load frame using the supplied quick release pins by placing them through the holes on each side of the load frame.

4.2.2D COUPLING THE SSV TO TRACK

1. Place the Hybrid End Ramp Assembly on to the rear of the ADAC rail system assuring its placement covers the two magnets.

2. Unscrew the bottom half of the clamp from the rest of the assembly using a 3/16” Hex key, place it around the rail segment and tighten to 34-38 N•m (25-28 lb-ft) of torque.

3. With the last section of the rail system disconnected from the rest of the rails, roll the sled onto the ADAC rail and connect the rail segments as described in steps 3-4 in section 5.2.2.b.

4.2.2E COUPLING RAIL SYSTEM TO VEHICLE

1. Position the towbar at the level of the tow hitch. Make absolutely sure the towbar is horizontal. The towbar is very heavy and must be lifted by 2 people!

2. The mandatory distance between the wheel surface and the ground with the ball acceptor engaged (tow vehicle fully prepared): 50 to 70mm (2 to 3 in).

3. Engage the ball acceptor on the ball of the tow hitch. The safety cable must surround the tow hitch.

4. Make sure both locking elements are in their correct positions.

5. Screw-connect the coarse and fine toothing in both locations on the tow bar, tighten the assembly, and insert the safety pin.

6. For uncoupling, carry out the above steps in reverse order. Repeat as needed throughout testing.

4.2.2F PARAMETERS FOR AEBS TESTING

1. Before any testing is performed, roll the SSV Hybrid assembly along the entire length of the ADAC rail system to assure proper fitment.

2. Adjust any rail segments that rub the steel sled excessively to avoid any jarring or catching that could damage the SSV hybrid or the rail system.

4.2.3 DAMAGE ASSESSMENT OF SYSTEM

1. After each impact between the SSV and the subject vehicle, the SSV shell, load frame assembly, foam bumpers, and track system should be thoroughly inspected for any damage.

2. Pay special attention for cracks in the SSV shell and in the joints of the load frame assembly. Assure that all rivets are in place. Check for stress fractures in the carbon tubing of the load and slider frame. Check the bolts and carbon supports inside the SSV shell bulkhead for damage. If any cracks in the carbon are found or if any joints are damaged, impact testing must be discontinued immediately and the manufacturer must be notified.

3. Check all the rolling gear, all the wheels on the load frame and the two black wheels in the carbon wheel housings, for proper alignment, wear, and excessive abrasion. Also examine UHMW tape on the carbon tubing under the wheels for abrasion or tears.

4. Check the fabric and all the stitched seams on the two large foam bumpers attached to the front track segment and the smaller foam bumper on the back of the SSV for rips, tears or broken threads (Fig. 42). If any foam is exposed due to fabric tears or broken seams, impact testing must be discontinued and the manufacturer must be notified.

5. Inspect all the nylon straps for fraying and check their cross stitching to assure they are not coming unsecured. Also inspect the shoulder bolts attaching the straps to the frame for any bending. It is recommended that several sets of extra straps be on hand at all times.

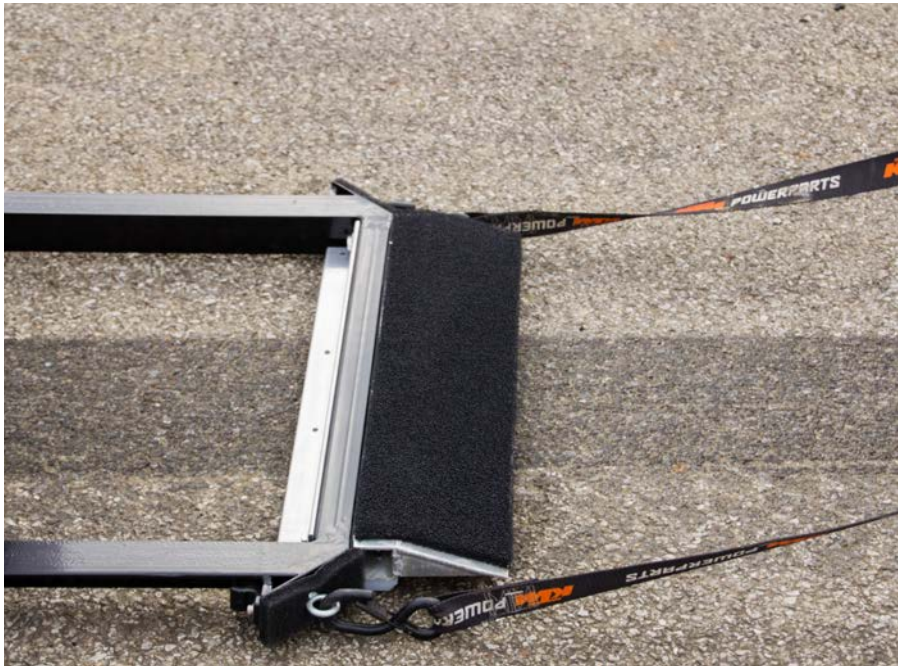
6. **For further instructions on assessing damage or replacing a damaged part, please see Chapter 6.**

7. If after an impact occurs and a damage assessment is concluded with the operator deeming the system to be in proper working order, the track system can be repositioned for further testing.

4.2.4 REPOSITIONING THE SSV

1. Before moving the track system, disconnect the tow hitch from the tow vehicle and secure it in the vertical position.

2. The tie down straps used for securing the track segments to the crate are also used for repositioning of the fully assembled track system after testing by clipping the straps to the eye bolts on the end steel track to the vehicle designated for repositioning.



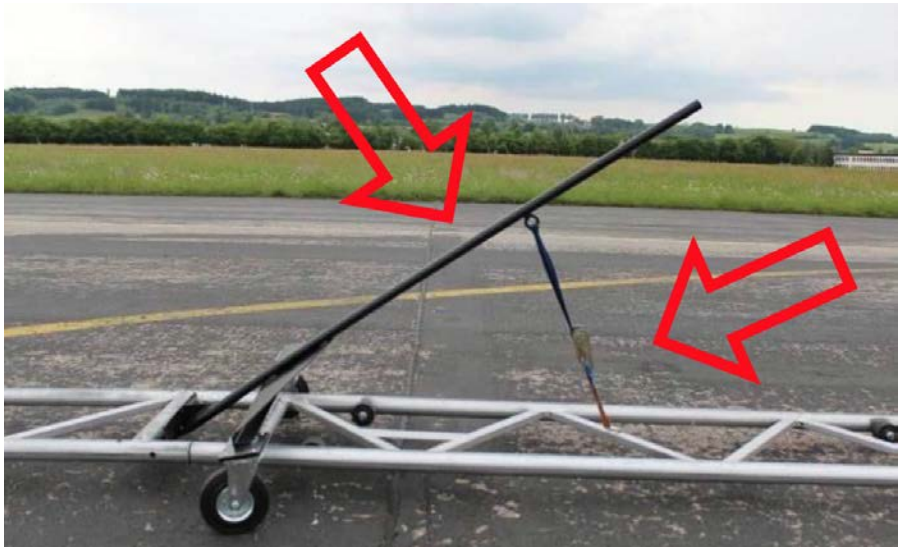
3. Pull the system straight back to the initial position, and begin testing again.

4.2.4B REVERSING THE ADAC SYSTEM

1. The reversing assembly must be used to reposition the SSV system with the ADAC track system.

2. Position two reversing assemblies at the joints between two intermediate rail segments.

3. Push the bar of the reversing assembly down and attach the tension belt to the rail linkage using the hook as shown. The rollers of the intermediate rail segments must no longer touch the ground.



4. Maneuver slowly; reposition the system in its initial position and begin testing again. Avoid jamming the carriage.

5.0 OPERATION & CONTROL

5.1 OPERATION & CONTROL

1. Strictly comply with the safety instructions in the manuals for the components used in/with the system. The manufacturer shall not assume any liability for damage to the tow vehicle or the subject vehicle. The system may be used only by qualified personnel instructed by the operator.

2. Set up and use the system on suitable, stable, and level surfaces without holes to prevent inadvertent movement of the system. Keep the test track clear of any objects, loose chippings, or other debris. Make sure there is no salt on the test track so as to avoid corrosion.

3. The operator is responsible for compliance with safety regulations in selecting and using the tow or subject vehicle used with the system. Moreover, the operator is responsible for ensuring that any additional instruments, tools, or other means and vehicles used for testing comply with applicable safety regulations, including national provisions. The operator is responsible for the users' correct and safety-minded handling of the system. The operator must supervise the use of the system to ensure its users comply with the applicable safety regulations and to prevent its non-compliant use.

4. Both the NHTSA track system and ADAC hybrid track system follow the same operation and test procedures once assembled.

5.2 SAFETY BEFORE / DURING OPERATION

1. Avoid standing on the track system or any other parts of the system. Make sure the tow hitch arm is correctly positioned and the ball acceptor securely engages when mounting the track system to the tow hitch.

2. Check the tightening torque **(34-38 N·m (25-28 lb-ft))** of the screws at the track connectors. Make sure all the plastic pucks are in place and in proper working condition.

3. Check the cleanliness of the track system, making sure itis free of debris as that can negatively affect the movement of the SSV down the track.

4. Make sure the SSV and load frame are correctly positioned on the track and securely fastened.

5. Only straight and zero-offset collisions with the target/rail system are allowed. Avoid running curves, large bumps and pot holes. Avoid collisions with the target when the system is swerving.

6. Manually decelerate the subject vehicle to a standstill immediately after collision with the target. If possible, avoid full braking with tow vehicle (maximum recommended deceleration: 0.3 g (6.5 mph/s or 3 m/s2)). Decelerating at this slow rate mitigates or prevents the collision of the SSV Load frame with the foam bumpers.

5.3 SECURING THE DANGER ZONE

1. A 50-meter (164 feet) radius around the system, the tow vehicle and the tested vehicle must be kept clear of people and objects over the entire length of the test run.

2. No entry into the danger zone.

5.4 SPEED LIMITS

Please adhere to all speed limit guidelines in this document. Wolf composites is not responsible or liable for damages incurred due to testing over the approved speedlimits.

5.4.1 TESTS WHILE STATIONARY

1. The SSV system must be used with the NHTSA track system in its entire length for stationary impacts. NEVER use the SSV load frame as a standalone system.

2. While performing a stationary test, the towing system must not be attached to a tow vehicle. Stow the hitch arm in the vertical position as shown in 4.2.1.a.

3. **Maximum collision speed must not exceed 25 mph.**

5.4.2 TESTS WHILE MOVING

1. The SSV system must be used with the suitable track system in its entire length for impacts. NEVER use the SSV load frame as a standalone system. This applies for both the NHTSA and ADAC track systems.

2. The maximum speed for the tow vehicle while it is pulling the SSV track and assembly must not exceed 35 mph.

3. **The maximum speed difference between the tow vehicle and the tested vehicle must not exceed 25 mph.**

5.5 TEST PROCEDURES

Please adhere to all procedure guidelines in this document. Wolf composites is not responsible or liable for damages incurred due to testing outside of the approved guidelines.

5.5.1 TESTS WITH STATIONARY TARGET

1. When testing the SSV with in the stationary setup, lock the hitch arm in the vertical position.

2. Place the subject vehicle and the SSV system in the starting position for testing.

3. Calibrate the measurement equipment in the subject vehicle.

4. Accelerate the subject vehicle to the specified speed.

5. Collide with the SSV at the specified speed, straight and with zero offset.

6. Manually decelerate the subject vehicle to a standstill immediately upon collision with the target.

7. Perform the required damage assessments and evaluate the readiness of the system for further testing.

8. If the operator deems the system undamaged, reposition the SSV system and continue test procedures.

9. If the operator deems the system unfit for further testing due to repairable damage, perform repairs according to the proper manuals, notify the manufacturer, and continue testing.

10. If the operator deems the system unfit for further testing due to irreparable damage, stop testing immediately and notify the manufacturer.

5.5.2 TEST WITH MOVING TARGET

1. Place the subject vehicle and the tow vehicle with the SSV system attached in the initial testing position for testing. (Assure proper connection of the tow hitch as described in section 4.2.1.a. and 4.2.2.e.)

2. Calibrate the measurement equipment in the tow vehicle and the subject vehicle.

3. Accelerate the tow vehicle to the specified speed. (Caution: the SSV must be in its starting position and maintain it until impact).

4. Allow sufficient time for tow vehicle to reach its specified speed before accelerating the subject vehicle.

5. Collide with the SSV at each test's specified speed, straight, and with zero offset.

6. Manually decelerate the subject vehicle to standstill immediately upon collision with the target.

7. Immediately upon collision, the tow vehicle with the test system must decelerate slowly (at no more than 0.3 g (6.5 mph/s or 3 m/s2)). Decelerating at this slow rate mitigates or prevents the collision of the load frame with the foam bumpers.

8. When both vehicles are stationary, perform the required damage assessments and evaluate the readiness of the system for further testing.

9. If the operator deems the system undamaged, reposition the track system, set the SSV system to its initial testing position and continue test procedures.

10. If the operator deems the system unfit for further testing due to reparable damage, perform repairs according to the proper manuals, notify the manufacturer and continue testing.

11. If the operator deems the system unfit for further testing due to irreparable damage, stop testing immediately and notify the manufacturer.

6.0 REPAIR & MAINTENANCE

6.1 REPAIR & MAINTENANCE

1. Prior to any repair and maintenance work, the system must be uncoupled from the tow in a secured location.

2. Strictly comply with the safety instructions in the manuals for the components used in/with the system.

3. Maintenance work is to be carried out only by trained and/or instructed staff.

4. Servicing (repair) is to be carried out only by the operator's skilled staff.

5. Regular maintenance and inspection of the systems is essential in preventing malfunctions and increasing operational safety.

6. Any safety devices disassembled for repair or maintenance must be reassembled upon completion of repair or maintenance work and then tested.

7. Use only manufacturer supplied equipment or parts.

6.2 CLEANING THE SYSTEM

1. Clean the SSV Shell and Load Frame Assembly only with water and a wet microfiber towel.

2. Remove dirt and debris from the track system with a dry brush or a microfiber towel and water.

6.3 MAINTENANCE SCHEDULE

COMPONENT	CHECK	OPERATION	FREQUENCY	COMMENT
General Condition	Visual Check for Damage, discoloration, cracks	Examine	Daily / Weekly	Inspect cracked or bent components, replace when needed
Track Segments	Check for tight fit, visual check for damage	Examine / Tighten	Each Run	
SSV / Load Frame	Ease of pushing the SSV	Examine / Adjust	Each Run	
Plastic Slider Pucks (NHTSA)	Visual check for completeness, damage	Examine / Replace	Daily	Look for peeling, or shredding, see section 6.3.1
Rebound and Restraint Straps	Visual check for damage of webbing and threads	Examine / Replace	Each Run	Immediately replace damaged straps, see 6.3.2
Roller Catch on Load Frame	Check for damage and proper alignment	Examine / Adjust / Clean	Each Run	Adjust height as needed, see section 4.2.4
Plastic Load Frame Wheels	Check for wear, damage and alignment	Examine / Adjust / Replace	Each Run	Replace damaged or worn wheels, see section 6.3.3
Sorbothane Washers	Visual check for damage and wear	Examine / Replace	Every 10 Impacts	Replace damaged or worn washers, see section 6.3.4
Magnets (ADAC)	Visual check for soiling and damage	Examine / Clean	Each Run	Remove any dirt or debris
Track Rollers (ADAC)	Check for completeness, abrasions	Examine / Replace	Each Run	Immediately replace

6.3.1 UHMW PLASTIC SLIDER PUCKS

NOTICE: The higher the friction coefficient (PFC), the faster the pucks will wear down. Please take care when choosing your test site to choose a surface that meets the required .9 PFC, but is not so rough that testing will cause the slider pucks to wear prematurely.

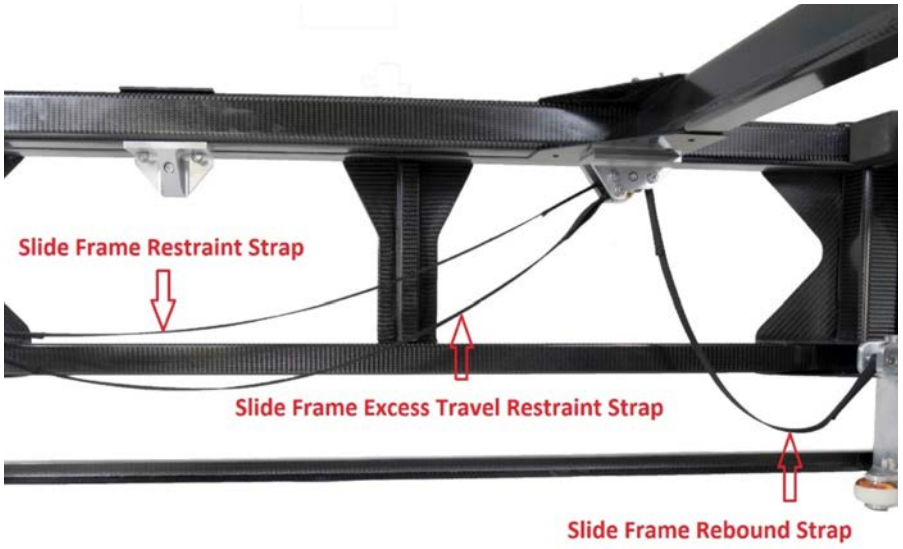
1. The 1" thick pucks are machined with a 45° chamfer that is approximately 3/8" high. Abrasive wear of the puck should not go below this chamfer line. If the puck is worn below 5/8" thick, you risk the pavement damaging the track and grinding the heads off of the screws, making replacement very difficult.

2. Pucks showing signs of excessive abrasion or uneven wear must be replaced. If movement of the track becomes difficult or if any metal is making contact with the pavement, excessive wear has occurred and the slider pucks need to be replaced.

3. To replace worn slider pucks, unscrew the four 1/4"-28x3/4" Philips head screws holding the puck to the track segment or track connector. Next, place new puck in correct position, chamfer facing out, add medium strength thread locker, Loctite 242, to the screws and tighten to 3-4 N•m (2-3 lb-ft) of torque.

6.3.2 WEAR / REPLACEMENT - NYLON STRAPS

1. There are three nylon straps, each of different length, that aid in the energy absorption process or protect the slide frame from damage during an impact.



2. The Slide Frame Restraint Strap is the first strap designed to absorb impact energy. It is designed to keep the slide frame from impacting the front of the load frame and should absorb most of the initial energy. Therefore, the strap should be scrutinized most for fraying, chaffing, or broken threads during the post impact damage assessment.

3. The Slide Frame Excess Travel Strap is the next stage of energy absorption. It works in conjunction with the restraint strap and will prevent the slide frame from hitting the load frame should the restraint strap fail.

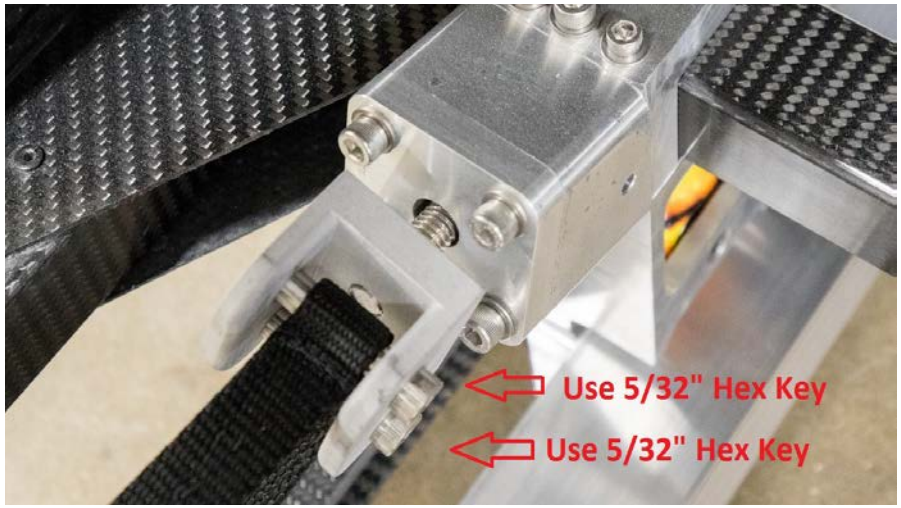
4. The Slide Frame Rebound Strap is the final strap used to dissipate impact energy and works in the same axis but opposite direction of the first two straps. It is designed to keep the slide frame from impacting the rear of the load frame after the load frame begins travelling down the track after an impact.

5. The webbing of the strap is designed to stretch on impact, dissipating some of the force imparted from the test vehicle onto the SSV. Due to this repeated elongating stress, there is a fatigue life for the webbing and/or stitching.

6. After every 10 impacts of the SSV, all the nylon straps should be removed to have their lengths checked for excessive stretching. If the lengths of straps have permanently stretched due to impacts more than 20% of their original length, they need to be replaced.

7. The maximum allowable length for the:
- Slide Frame Excess Travel Restraint Strap is ~37".
- Slide Frame Restraint Strap is ~34".
- Frame Rebound Strap is ~24".

8. Replacing a broken strap entails unscrewing the corresponding 5/16" x 1-1/4" shoulder bolt with a 5/32" hex key, replacing the damaged strap with the correct length new original equipment strap. Next, slide the steel shoulder bolt through the eyelet of the strap into the aluminum assembly and tighten to 20-24 N•m (15-18 lb-ft) of torque. In the event of a strap failure with no replacements, impact testing must be discontinued immediately and the manufacturer must be notified.



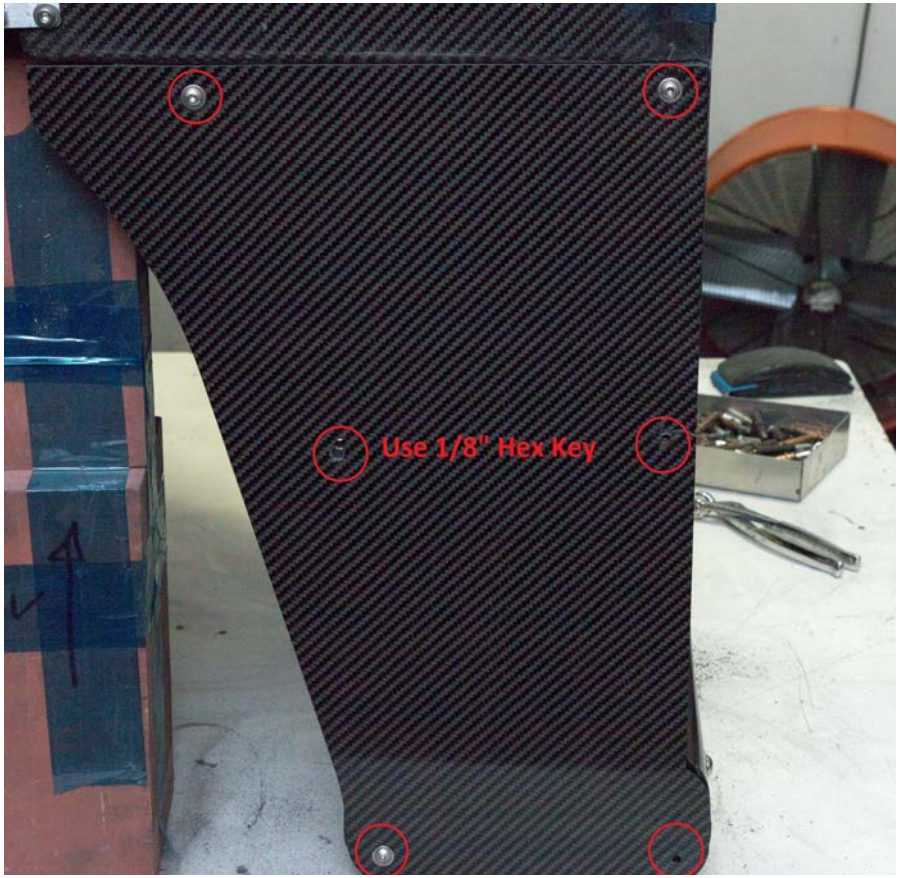
6.3.3 WEAR / REPLACEMENT - PLASTIC WHEELS

1. The UHMW tape on the carbon tubes, plastic wheels, and sealed bearings are designed to minimize friction on the load frame and to allow smooth travel along the tracks. However, the wheels and surfaces that the load frame and slide frame roll on can experience wear or damage with repeated impacts of the SSV. A visual inspection of all 24 (NHTSA) or 10 (ADAC) of the 47.4mm wheels and both of the 100mm wheels that roll on the ground in the carbon wheel housings should be performed after every impact with the SSV. If any of the carbon tubes or joints are cracked or damaged or if any of the machined aluminum assemblies are damaged or bent immediately discontinue impact testing and notify the manufacturer.

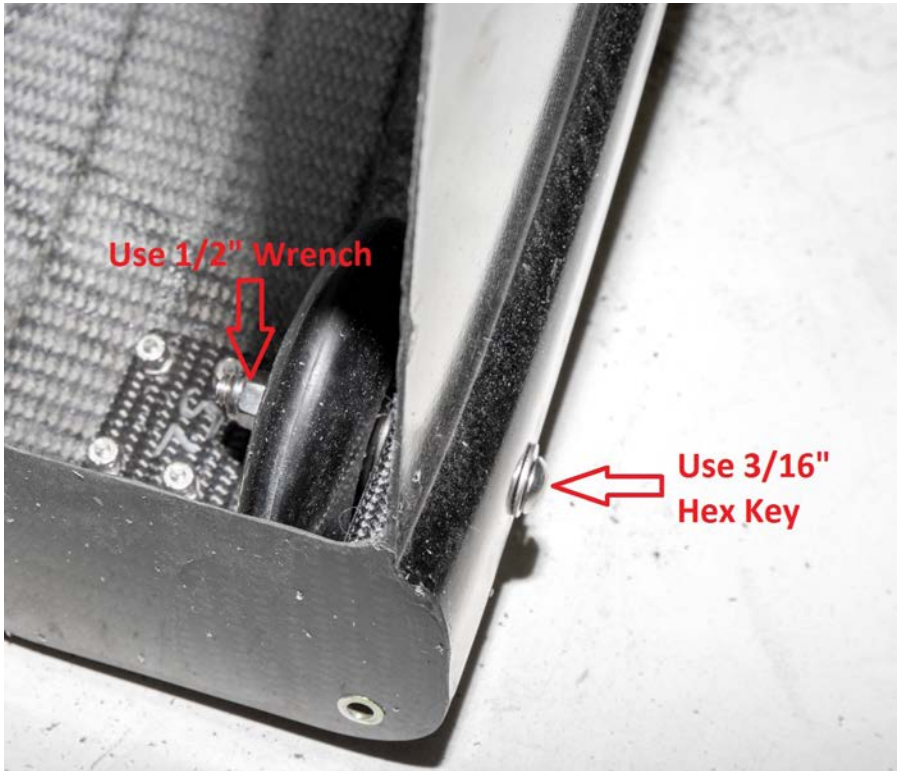
2. Replacement of any of the 47.4 mm wheels is performed by removing the M6-1 x 55 or M6-1 x 40 bolts from the carriage. Untighten the bolt using a 3/16” Hex key and use 7/16” wrench on the M6-1 nylon locknut Replace the wheel using only manufacturer supplied spares. Slide the bolt and bearing through the carriage, then the bearing and thread on the nylon locknut to 20-24 N•m (15-18 lb-ft) of torque.

3. The 100mm wheels in the carbon wheel housings are designed to allow the SSV shell to roll smoothly on the pavement during towing and impact. As the slider pucks wear down with repeated use, so too will these wheels. The minimum allowable diameter for the wheels is 80mm, but care should be given to assure that the bottom of the carbon wheel housings do not scrape on the ground. If the wheel housings touch the pavement with acceptable wheels check to assure that the testing surface is sufficiently flat. Next check that the SSV Shell and load frame were assembled properly. Finally, check the track system for any damaged or misaligned track segments.

4. Replacement of the 100mm wheels in the carbon wheel housings entails first removing the carbon wheel cover to gain access to the hardware holding the wheel in place. Unscrew the six 10-32 bolts holding the wheel cover in place using a 1/8” hex key.



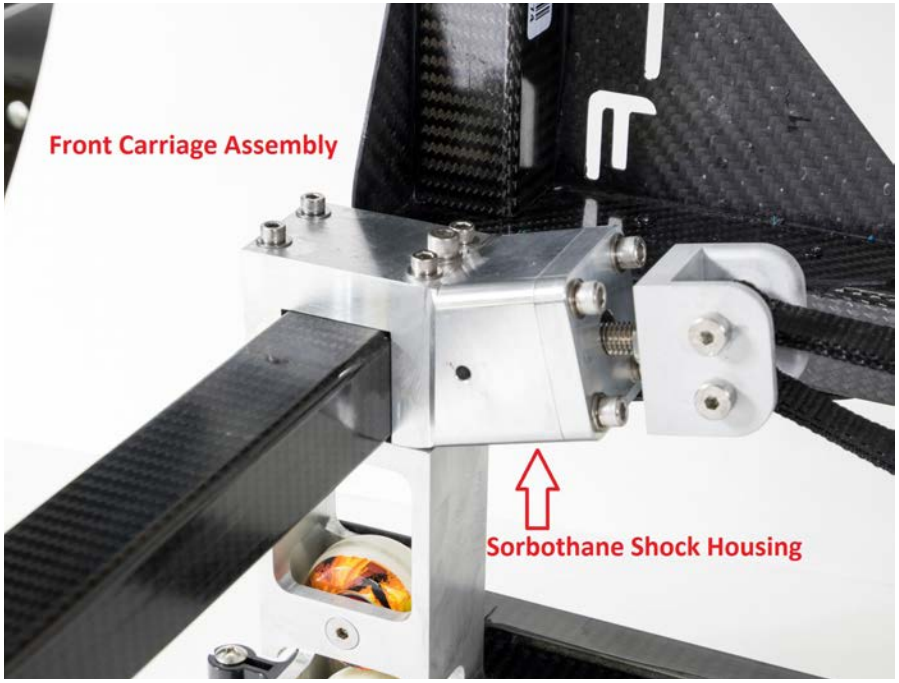
5. Once the 100mm wheel is exposed, use a 3/16” hex key to unscrew the bolt and a 1/2” wrench to hold the nylon lock nut (Fig 54). Replace the wheel using only manufacturer supplied spares. Slide the bolt through the carbon housing, then the bearing inside the wheel and thread on the nylon locknut to 3-4 N•m (2-3 lb-ft) of torque. Assure that the bolts are not overtightened as this could pinch the bearing, increasing the rolling resistance of the wheels and negatively affecting the performance of the SSV.



6. With the new wheel in place, the wheel cover can be put back on the wheel housing by lining up the six 10/32 bolts with the correct rivnuts and tightening them to 3-4 N•m (2-3 lb-ft) of torque with the 1/8” hex key.

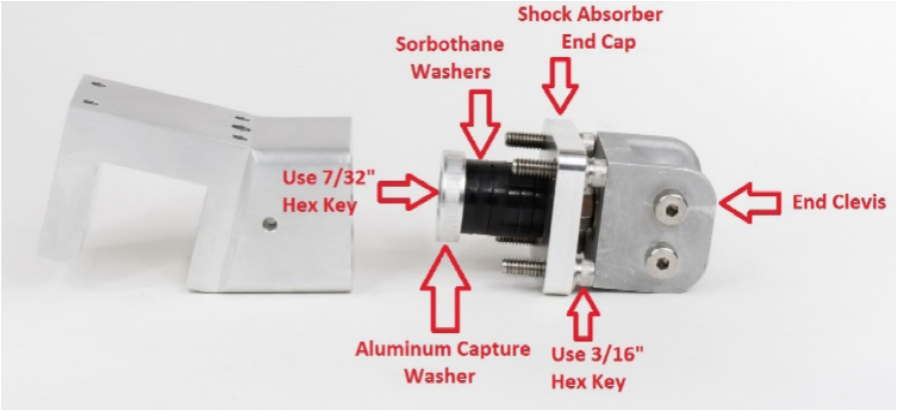
6.3.4 REPLACEMENT - SORBOTHANE WASHERS

1. Sorbothane is a viscoelastic urethane polymer designed to absorb shock and vibrations. The left and right rear carriage assemblies both contain a 3/8”-16x2-1/2” bolt with six sorbothane washers on it that work in conjunction with the nylon straps to help absorb the shock and energy of an impact with the SSV. Due to the stress of repeated compressions, there is a fatigue life for the shock absorbing properties of the washers.



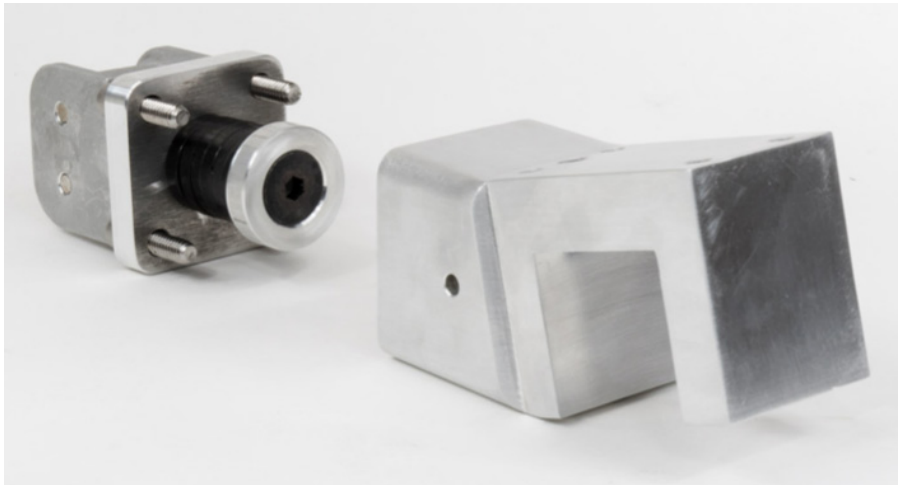
2. As with the nylon straps, after every 10 impacts of the SSV, all the sorbothane washers should be removed and examined for shearing and cracking. Damaged washers should be discarded and replaced with manufacturer supplied parts only.

3. To gain access to the sorbothane washers, the four 1/4”-20x1” bolts need to be removed from both the left and right front carriage assemblies using a 3/16” hex key.

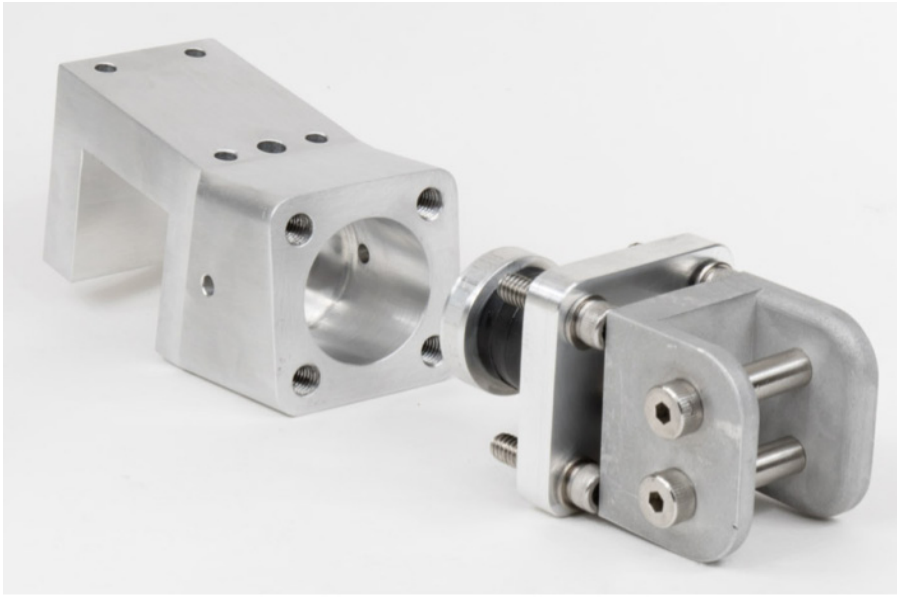


4. Next, use a 7/32” hex key to free the 3/8”-16 x 2-1/2” bolt with the aluminum washer capturing the sorbothane washers from the end clevis where the straps attach. Then remove the 3/8”-16 hex nut and washer to allow access to the damaged sorbothane washers and replace.

5. To reassemble start by sliding the end 3/8”-16 x 2-1/2” bolt with the aluminum and new sorbothane washers through the hole in the shock end cap, thread the 3/8”-16 hex nut onto the bolt and then the washer and then thread the bolt onto the end clevis until it is flush. Next, tighten the hex nut to prevent the bolt from coming out of the clevis.



6. Finally, insert the washer assembly back into the carriage assembly and tighten the four 1/4”-20x1” bolts to 38-40.5 N-m (28-30 lb•ft).



6.3.5 WEAR / REPLACEMENT - ROLLERS

1. The track rollers (Fig. 61) must have a minimum diameter of 55mm to ensure the smooth running of the rails, and keep a minimum ground clearance of 10mm.

2. The carriage rollers must have a minimum diameter of 190 mm to ensure the sled rolls smoothly on the track and does not bind.

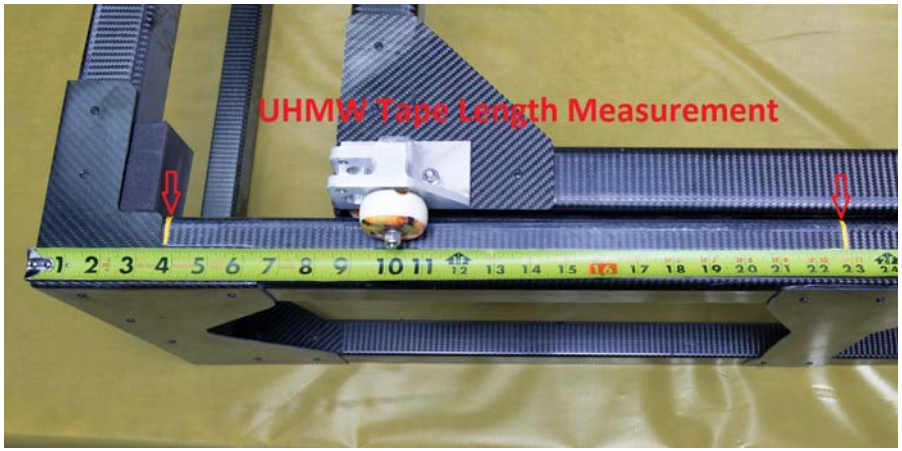
3. Rollers showing signs of oblique abrasion or wear (look out especially for rubber crumbling and porosity) must be replaced.

4. Replacing a roller consists of removing the nut holding it on, removing the worn out roller, replacing it with a new one, and replacing the nut. Replace the roller using only manufacturer supplied spares.

6.3.6 - UHMW TAPE REPLACEMENT

1. The wear-resistant, slippery UHMW tape is designed to provide a nonstick, low-friction surface with high abrasion and impact resistance. Increased wear and abrasion of the clear UHMW plastic tape used to protect the carbon tubes can occur over the course of multiple impacts. If excessive abrasion, tearing or delamination of the UHMW tape occur that exposes the carbon tubes to direct contact with the wheels, immediately discontinue impact testing to replace the tape using only manufacturer supplied replacements.

2. The entire length of damaged tape should be measured and its location on the tubing marked with indelible ink before it is peeled. Next, wipe the carbon tube down lightly with acetone to provide the best bonding surface for adhesion. Make sure not to wipe off the marks used to place the tape in the proper location. Cut the tape from the roll to the proper length and adhere it to the carbon tube using the locating marks as a guide to its placement.



6.4 SPARE PARTS

All spare parts must comply with our technical specifications, and original spare parts always do. We shall issue no warranty for any parts other than the original spare parts delivered by us.

The installation and/or use of spare parts not delivered by us may adversely affect engineering parameters and thus compromise active and/or passive safety.

We shall assume no liability nor give any warranty for damage resulting from the use of any spare parts and accessories other than those from the original manufacturers.

Please address any spare parts orders to our customer service. For smooth and quick processing of your spare parts order, please provide the following information:

1. Customer Address
2. Identification data of the system
3. Designation of the spare parts
4. Desired quantity
5. Desired shipping mode

See Chapter 0.0 for our address and phone number. Please provide all the details indicated above to ensure correct processing of your order.

7.0 DISASSEMBLY, STORAGE, DISPOSAL

7.1 DISASSEMBLY, STORAGE, DISPOSAL

Disassembly, storage and disposal of the system are to be carried out only by trained/instructed staff qualified for such operations. Make sure to follow all applicable regulations regarding personal protective equipment including but not limited to protective footwear and protective gloves.

7.2 DISASSEMBLY

1. Various parts of the system must be handled with care. Therefore, please read the following instructions. Please bear in mind to take extreme care when disassembling parts subject to mechanical stress as the mechanical energy stored in these parts may cause injury.

2. Care should be taken when handling disassembled parts to avoid unnecessary impacts, crushing, or twisting when fitting components back into their respective storage/ transport crates.

3. Repackaging the SSV Shell and Load Frame entails placing the load frame on the floor of the crate and securing it with the SSV shell carrier, then screwing the SSV Shell on the carrier frame.

4. Repackaging the Track System starts by placing the front track segment on the floor of the crate followed by the black steel track segment, the middle track segments, the foam bumpers and the tow hitch.

7.3 STORAGE

Certain conditions should be observed in order to properly store the SSV System. These conditions include protecting all parts susceptible to corrosion (bare metal) by storing the system in a clean, dry place. The system should be stored in an area without any risk of damage. Make sure to store the complete system with all its individual parts to avoid any essential parts missing when putting the system back into operation.

7.4 DISPOSAL

1. Only wear items should be disposed of at the discretion of the operator or other trained/qualified staff.

2. The manufacturer should be contacted and provide written consent before disposal of any non-wear items as repairs can be possible.

3. To properly dispose of items, remove and destroy the type label to avoid identification. Ensure the complete disposal or recycling of components. Ensure safe and ecological disposal of the materials used. Comply with applicable national provisions.

8.0 QUANTITIES, SHIPPING LISTS

8.1 SYSTEM SHIPPING LIST

The following tables describe the included materials for each COMPLETE system. Each system shared a common shell, however the rest of the assembly is largely different for each system. Please consult the table that corresponds to the system you are currently using.

8.1.1 NHTSA SYSTEM SHIPPING LIST

PART	PART #	QTY
Surrogate Shell	SSV-1005	1
Shared Frame Assembly	SSV-1010	1
NHTSA Base Kit	SSV-1100	1
Hitch Assembly	CA197-3045	1
Hitch Pins	91594A310	2
Tow / Guide Frame	CA197-3040/3012	1
Guide Rail Frame	CA197-3010	7
Guide Rail Tail	CA197-3015	1
Foam Blocks	CA197-3070	2

8.1.2 ADAC SYSTEM SHIPPING LIST

PART	PART #	QTY
Surrogate Shell	SSV-1005	1
Shared Frame Assembly	SSV-1010	1
Hybrid Base Kit	WH-5000	1
Front Axle	inc. in WH-5000	1
Rear Axle	inc. in WH_5000	1
Nose Cone	inc. in WH-5000	1
Straps Set	inc. in SSV-1010	1
Front Rail Segment	20222212	1
Intermediate rail Segment	20222215	5
Rear Rail Segment	1739A22	1
Foam Blocks	CA197-3070	2
Manuevering Assemblies	N/A	2

LIMITED WARRANTY & LIABILITY

This limited warranty extends only to the original purchaser.

Wolf Composite Solutions warrants this product and its parts against defects in materials or workmanship for 1 years from the original ship date. During this period, Wolf Composites will repair or replace defective parts with new or reconditioned parts at Wolf's option, without charge to you. Any after-market additions or modifications will not be warranted unless completed by Wolf Composites. The owner is responsible for the payment, at current rates, for any service or repair outside the scope of this limited warranty.

Wolf Composites makes no other warranty, either express or implied, other than as set forth below. Wolf Composites makes no warranty or representation, either express or implied, with respect to any other manufacturer's product. Except as provided below, Wolf Composites is not liable for any loss, cost, expense, inconvenience or damage that may result from use or inability to use the system. Under no circumstances shall Wolf Composites be liable for any loss, cost, expense, inconvenience or damage exceeding the purchase price of the testing system.

The warranty and remedies set forth below are exclusive and in lieu of all others, oral or written, expressed or implied. No reseller, agent or employee is authorized to make any modification, extension or addition to this warranty.

WARRANTY CONDITIONS

The above Limited Warranty is subject to the following conditions:

•This warranty extends only to products distributed and sold by Wolf Composites.

•The warranty does not cover any replacement or repair of parts due to normal use i.e wear and tear, on any part of the system. Wear and tear items are the sole responsibility of the buyer/user.

•This warranty covers only normal use of the testing system. Wolf Composites shall not be liable under this warranty if any damage or defect results from (i) misuse, abuse, neglect, improper shipping or installation, this includes using the system at speeds over recommended values as noted in the manual, or (ii) service or alteration by anyone other than an authorized Wolf Composites tech.

•No warranty extension will be granted for any replacement part(s) furnished to the purchaser in fulfillment of this warranty.

•Any warranty claims must be accompanied with documentation to show that the issue arose during accepted use, as defined in the manual.

Please contact Wolf Composites directly to submit any warranty repairs.
inquiry@wolfcomposites.com

NOTES

3991 Fondorf Drive // wolfcomposites.com // 614.219.6990 // inquiry@wolfcomposites.com

THANK YOU.