

**Alfred University Senior Design Project**

**RFL (Robot Fighting League) Arena**

**by**

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## **PURPOSE**

This document will act as a Machine Specification document for the Alfred University Mechanical Engineering Departments' Robot Fighting League Arena.

The Arena was designed and built to enable Alfred University Mechanical Engineering Department to acquire sanctioning by the Robot Fighting League, and host tournaments. The Arena was also intended to function as part of the "Science On Wheels" program, which will introduce young men and women to the field of science and engineering.

## RFL SANCTIONING

The Alfred Robot Fighting League Arena was built under the guidelines as provided by the Robot Fighting League. Following those strict guidelines enables the Alfred Arena to qualify as a Class “B” Enclosure.

The Mission Statement from the Robot Fighting League (<http://botleague.net/>) is excerpted below:

*The Robot Fighting League (RFL) organizes and promotes combat robot competitions and other robotic sports. The RFL was created in November 2002 out of an ongoing discussion among many of the combat robot competition organizers. The RFL mission is to promote the sport of fighting robots, provide consistency among events and support builders and event organizers.*

### Steps in obtaining RFL membership:

1. Contact a local organizer and ask them to sponsor your membership. Send them a proposal that outlines your plans in as much detail as possible. Include arena specs, people involved, dates for events, rules, etc.
2. You will need to be voted in by 2/3's of the membership.
3. As a new member you will be "provisional" until you have held your first event, at which time you can request full membership. After a satisfactory review of your event you will become a general member with all the rights and privileges accorded general members.



### Contact information at the RFL:

### Next Steps for Alfred Sanctioning:

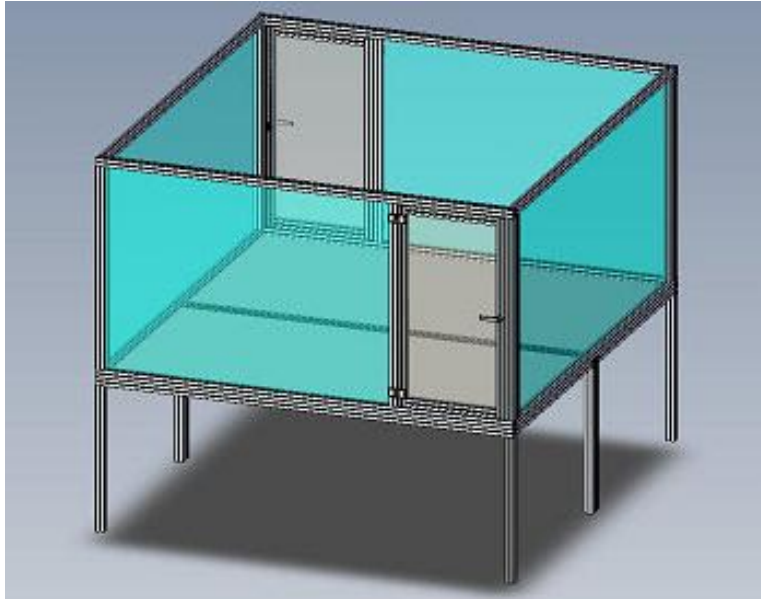
1. Conduct an RFL Event, coordinated with the RFL contact above
2. After the successful completion of the first RFL event, Alfred University will prepare and present a detailed event report to the RFL for approval
3. Once complete, the “provisional” status will be removed, and Alfred University will be a sanctioned entity, under the RFL guidelines.

## **EQUIPMENT DESIGN**

The Arena design was completed using Solidworks software. The design criteria for the Arena was to make it portable, while also modular in design. To make it portable, it was designed to be the size of a sheet of plywood (4'x8' sheets). This size limitation would allow the equipment to be transported in a pickup truck or a commercial van with little trouble. The Arena was also designed in "panels", for ease of transportation. By having a panel design, it would allow the arena to be easily carried, assembled and disassembled by a small group (2-3 people). Secondly, having panels, it allowed the arena to be made modular.

## APPARATUS

The Arena design was completed using Solidworks 2008 software. The Solidworks design of the Arena is illustrated in Figure 1 below. Figure 2 below shows a completed arena.



**Figure 1– Solidworks Illustration of the Arena**



**Figure 2– Photograph of the Completed Arena**

## EQUIPMENT LIST

Equipment Name	Man. Part #	Qty Used
<b>Arena Main Assy</b>		
Table Frame Assy		2
Window Panel Assy		2
Door Panel Assy (includes Door Sub-Assy)		2
Roof Panel Assy		2
Joining Plates	50.05.0053	18
<b>Table Frame Assy</b>		
Profile, 40mm x 80mm LIGHT x 95-5/8" lg	54.41.0001	1
Profile, 40mm x 40mm LIGHT x 95-5/8" lg	54.40.0001	1
Profile, 40mm x 80mm LIGHT x 44-3/8" lg	54.41.0001	2
Profile, 40mm x 40mm LIGHT x 32" lg	54.40.0001	4
Profile, 40mm x 40mm LIGHT x 44-3/8" lg	54.40.0001	2
Swivel Bracket, #B25	46.01.0225	4
End Cap for 4040 Profile	MK2507	6
End Cap for 4080 Profile	MK2508	2
Angle Bracket	82.40.0742	8
Aluminum (Omegabond) Flooring 47-1/2" w x 92-3/4"lg		2
<b>Window Panel Assy:</b>		
Profile, 40mm x 40mm LIGHT x 97-7/8" lg	54.40.0001	2
Profile, 40mm x 40mm LIGHT x 47"lg	54.40.0001	2
¼" Lexan, 48" x 95-5/8" lg		1
Panel Seal Strip, 40 series	MK3011	
<b>Door Panel Assy:</b>		
Profile, 40mm x 40mm LIGHT x 92-13/16"lg (top & bottom)	54.40.0001	2
Profile, 40mm x 40mm LIGHT x 47"lg (sides)	54.40.0001	2
¼" Lexan, 48" x 65-1/8" lg		1
Panel Seal Strip, 40 series	MK3011	
<b>Door Sub-Assy:</b>		
Profile, 40mm x 40mm LIGHT x 46-5/8" lg (vertical door)	54.40.0001	2
Profile, 40mm x 40mm LIGHT x 20-1/16"lg (hor door)	54.40.0001	2
¼" Lexan, 21-1/16" x 44.38" lg		1
Door Handle	K110000010	1
Screw, SHCS, M8x20	DO912820	2
Nut, Hex Finish, M8	DO9348	2
Door Catch		1
Door Hinge	B46.01.010	2
Nut, 40mm Profile, M8	34.01.0001	2
Panel Seal Strip, 40 series	MK3011	
<b>Roof Panel Assy:</b>		
Profile, 40mm x 40mm LIGHT x 46"lg	54.40.0001	2
Profile, 40mm x 40mm LIGHT x 95-5/8"lg	54.40.0001	2
¼" Lexan, 47" x 93.38" lg		1
Panel Seal Strip, 40 series	MK3011	

**Figure 3 - EQUIPMENT LIST (BOM)**

## SPONSORS

The Arena was made possible by several donations, from the following companies:



### Ø Cross Brothers

Cross Brothers is a Material Handling Company located in Henrietta, NY. Cross Brothers is an official representative of MK Automation Inc, an Aluminum Extrusion company. **Cross Brothers donated the Aluminum Extrusion profiles, and the labor required for the assembly of the arena.**

Cross Brothers Corporate Office:  
3353 Brighton-Henrietta Town Line Road  
Rochester, NY 14623  
(585) 427-7850

[www.crossbros.com](http://www.crossbros.com)

Contact: Bob Frost, Vice President

MK Automation, Inc [www.mkprofiles.com](http://www.mkprofiles.com)

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## CORNING

### Ø Corning Incorporated

Corning Incorporated is a Fortune 500 Company with many business units. **Corning assisted by providing a monetary donation used to procure Arena materials.**

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### Rimco Plastics

Rimco Plastics Corporation is a family owned and operated business in Elmira, NY. Rimco specializes in foam molding/cutting, vacuum forming, thermal forming and machining from solid material. **Rimco Plastics assisted in supplying the Polycarbonate sheets used for the walls and roof of the arena.**

Rimco Plastics Corporation  
316 Colonial Drive  
Horseheads, NY 14845  
Phone: (607) 739-3864  
Fax: (607) 739-3577

<http://rimcoplastics.com>

Contact: Les Reimsnyder III, Owner

[Reimsnl3@rimcoplastics.com](mailto:Reimsnl3@rimcoplastics.com)



## ARENA ASSEMBLY PROCEDURE

The Arena Assembly Procedures will be outlined in the following sections.

**TOOLS REQUIRED:** 6mm Allen Wrench, T-Handle preferred (but not required).

1. Start the Assembly of the Arena by obtaining the two (2) sections of the Table Frame Assembly. Align the tables so that the Aluminum Sheeting (OmegaBond) tabletop is joined in the center. Doing so will leave a “dead space” on the perimeter, where the walls will be installed in subsequent steps. See Figures 4 & 5 below.



Figure 4 - Table Frame Assembly

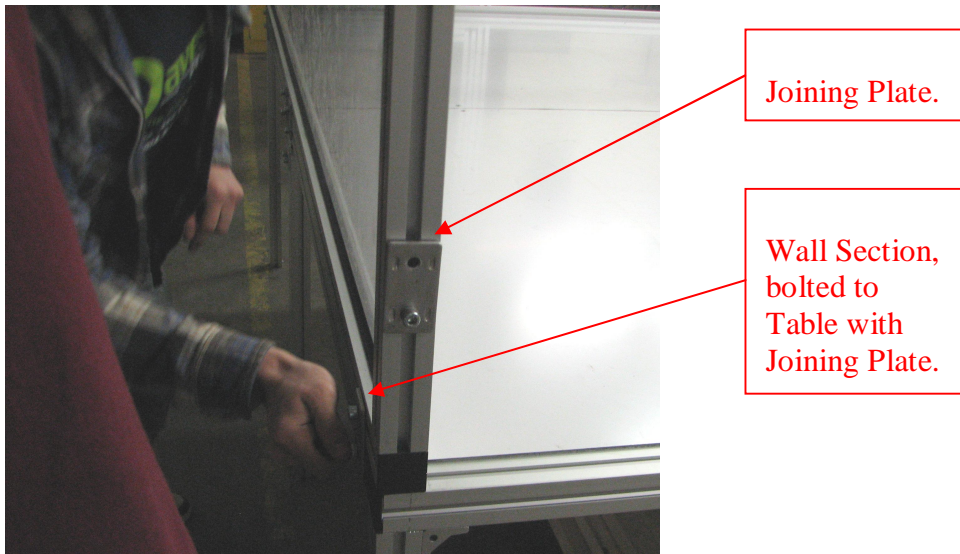
2. Secure the Tables together by fastening the Joining plates underneath the Table Top surface. See Figure 5 below.



Figure 5 - Attaching Joining Plates on Bottom side of Table Assy

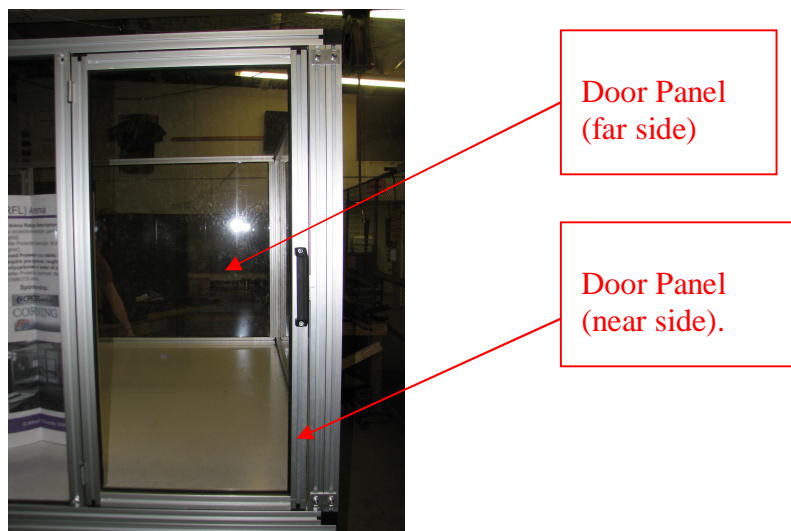
*Arena Assembly Procedure, continued*

3. Start the assembly of the walls. Install adjacent walls, while holding upright. Attach the Joining Plates to the Table and adjacent walls. See Figure 6 below.



**Figure 6 - Joining Wall Panel to Table & Joining Plates**

4. Continue with the assembly of the walls, until all four walls are installed.
  - a. NOTE: The Door Panels are on opposite sides, for robot loading. Ensure that the Door Panels are installed on opposite sides on the Table Frame (opposing each other). See Figure 7 below.



**Figure 7 - Joining Wall Panel to Table & Joining Plates**

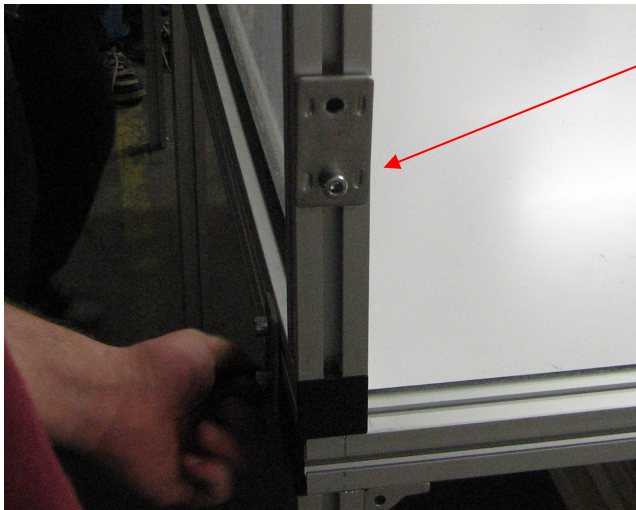
5. When all four (4) walls are installed, and all joining plates attached, install the Roof Panels, and secure with remaining Joining Plates.

## ARENA DIS-ASSEMBLY PROCEDURE

The Arena Dis-Assembly Procedures will be outlined in the following section.

To start the Dis-Assembly of the Arena, ensure that enough help is available! Proceed with caution when removing the Roof Panels from the top of the Arena.

1. Start the Dis-Assembly of the Arena by removing the Roof Panels. The Joining Plates will have to be loosened using the 6mm Allen wrench.
  - a. **NOTE:** It may be advantageous to leave the Joining Plates in place, by only removing one set of screws (and leaving one set in place). Then, lightly (by hand) secure the screws to the extrusion. This will ensure that the plates stay put, and will not be misplaced. See Figure 8 below for an example.



Joining Plate rotated 90° to aid in Dis-Assembly, and then Re-Assembly at a later time.

Rotate 90° and hand-tighten one side (top side in this case) to keep in place on the same piece of extrusion.

Figure 8 - Positioning of Joining Plates for Disassembly

2. Continue removing all wall panels, and securing the Joining Plates.
3. To disassemble the Table Assembly, loosen the Joining Plates underneath. Refer to Figure 5 for location.

*Arena Disassembly Procedure, continued*

4. Once the Table tops have been separated flip each Table up on its side.
5. The legs on the table can be folded up for storage into the Storage Rack, located in the Thermal Sciences Lab (First Floor of Engineering Offices, Seidlin Annex).

## **APPENDIX “A”- RFL By-Laws**

### **RFL By-laws**

Version 1.07, adopted December 18, 2006

#### **1. Goals:**

1. To Promote safety at every level of the sport of robotic combat.
2. To Promote the sport of robotic combat and help build its audience.
3. To Provide consistency between events.
4. To Support event organizers and builders.

**2.RFL Membership:** RFL Memberships are made up of Organizations (Member Organizations, referred to as MOs). There are five types of members :

1. **Provisional Members:** A new MO voted in by the general membership. These MOs have a voice but no vote.
2. **General Members:** These members have a vote in all RFL issues.

**2.2a Associate Member:** Associate Members are organizations sponsored by a General Member for the purpose of holding league sanctioned events. The sponsoring General Member vouches for the conduct of the Associate Member event. Associate Members' events are subject to the same rules and requirements as General Members' events. Associate members do not receive a vote and cannot participate directly in discussions - the General Member is the representative for the Associate Member(s) whom the General Member sponsors.

3. **Dormant Members:** MOs that may have placed their operations on hold. These members have no vote and may or may not be a part of discussions as decided by the Commissioner or a majority vote.
4. **Suspended Members:** MOs facing possible punitive action pending a decision on a disputed action. These members have a vote and may be a part of discussions.

3. A MO has a single representative who places the MO's official vote. The MO may have supporting staff or members that also participate in discussions at the discretion of the rest of the membership or Commissioner. The MO is accountable for the actions of all people seen to be members or staff of their organization.

4. Any robotic combat event organizer or event organizing body that adheres to the RFL rules and guidelines is eligible to become a general member of the RFL.

5. Potential MOs must be sponsored by a current RFL voting member. Member sponsors are responsible for gathering information on the potential member and relaying it to the general membership for their review. In agreement with the RFL Commissioner, a membership vote is then called requiring a 2/3 majority within the voting period of 10 days.

6. Newly voted members are Provisional (non-voting) MOs.

## ***APPENDIX "A"- RFL By-Laws, continued***

### **7. To become a full member:**

1. A provisional MO must hold an event in a public venue\* within one year of their initial vote under RFL guidelines.
2. The event must be witnessed and or documented in a way satisfactory to the Sponsor and

Commissioner. With their recommendation (and providing there are no member objections) the provisional member becomes a full member. If there are objections that cannot be resolved through discussion, a vote may be requested by the Provisional member which requires 2/3 majority within the voting period of 10 days.

8. A MO's status may be changed to Dormant at the request of that member or if they have not held an event in a public venue\* within the last 12 months of membership. To qualify, the event must be organized and hosted (or co-hosted) directly by the member; events held by associate members sponsored by the voting member do not count. RFL Membership may be terminated or suspended through member resignation or a 2/3-majority vote by the membership.

\*A Public Venue is defined as property, or venue open and easily accessible to the general public not zoned as residential.

9. The Commissioner may suspend a member for a serious infraction, (flaunting the by-laws, acting against an RFL decision, etc.) The Commissioner's suspension of a member must be upheld by a 2/3-majority vote within 7 days or the suspension will be automatically lifted. The Commissioner may exercise this right on only one member at a time.

10. Sale of Events: an MO may elect to sell their event, e.g. the event name and associated intellectual property, while that event is a member of the league. In the event of such a sale or transfer the membership status of the event shall be transferred according to the following provisions:

1. If the new owner is already an RFL member and keeps the acquired event as a separate and distinct entity then RFL membership is transferred with the event and there is no change in membership status. If the transferred event was a general member, the new owner or owner's designee casts the event's vote.
2. If the new owner is already an RFL member and merges the acquired event with another event, the transferred event ceases to exist as a separate entity within the league and no longer has a vote.
3. If the new owner is NOT a member of the league but wishes to become a member, the transferred event becomes a "Provisional" member.

### **11. Governing Method**

1. Any changes or additions to these bylaws requires a valid simple-majority vote by the membership within a voting period of 10 days.

## ***APPENDIX “A”- RFL By-Laws, CONTINUED***

### **2. Officers**

1. The RFL will elect a slate of officers once per calendar year on or about the 15th of October. Officer’s terms are one year and begin on November 1st at midnight. Only voting members may make nominations. Nominations will begin on or about Sept 1st. Nominations will be closed and the voting will begin on or about the 1st of October. Voting will be closed

on or about October 15th and the new officers will be announced at that time. The phrase “On or about” is understood to mean the first business day inclusively after the named date.

All dates will be listed at least one week prior to the opening of nominations. Officers do not need to be voting members to serve, but serving as an officer does not, in itself, furnish a vote.

### **2. Commissioner**

1. The Commissioner is the general RFL spokesman (or can designate a spokesman on their behalf).

2. The Commissioner calls general votes and performs all duties as outlined in these bylaws.

3. The Commissioner may appoint committees or people to work on certain tasks.

### **3. Lieutenant Commissioner**

1. The Lieutenant Commissioner's duties are to act in place of the Commissioner person when he or she is absent or incapacitated.

### **4. Secretary**

1. The Secretary’s duties are to maintain a record of the actions authorized by the League and notify the members of meetings and other activities.

### **6. Treasurer**

1. The Treasurer’s duties are to receive and deposit all monies received by the League, to be the League’s contact with the bank(s) selected by the League for the League’s accounts, to disburse funds to cover expenses as authorized by the members, to maintain the financial records of the League, and to prepare the League’s quarterly and annual financial statements and any other necessary financial data and reports.

### **3. Voting**

1. For a vote to be valid, a quorum of 50% of the general membership must be either present or vote by proxy, email or forum.

2. Vote percentages are tallied based on the members voting on the issue. (Non-voters and abstaining votes do not count in the yes vs. no percentage)

## ***APPENDIX "A"- RFL By-Laws, continued***

3. Simple majority decides all votes unless otherwise noted.
4. All votes must have a voting period set by the Commissioner or the member calling the vote not to exceed 14 days.
5. Any vote which does not get votes from 50% of the membership within the voting period may be extended at the Commissioner's discretion or held for a re-vote in the future.
6. Votes, discussions and meetings may be held in person, by phone, or email and/or forums on the Internet.
7. Small issues may be decided upon by the Commissioner on behalf of the RFL and should be reported as necessary to the membership. Any member has the right to lodge an objection to a Commissioner decision and call for a majority vote to override the decision.
8. General votes may also be called by any member with a second supporting the call to vote.

### **12. General**

1. All RFL events must be held under RFL Building Guidelines and all events must make their results easily available and free to the rest of the RFL membership. (Some event results may need to be held from the public however if its for TV or other later release, all RFL members should honor this.)
2. Any RFL member may make event-specific changes to the RFL guidelines in the interest of safety, parity, insurance requirements, fire marshal requests, etc. as required to hold their event. These changes should not undermine the spirit of the RFL standard rules and must be reported to the membership and when possible published in advance.
3. RFL Building Guidelines or other event related guideline changes should be accumulated and voted on at least once per year. The vote should take place in the last quarter of the calendar year (ideally after the last event of that year.) Specific rules may be modified or changed by vote at any time during the year as necessary.
4. RFL MO's are required to update their rules with new versions no later than 30 days after those revisions are voted on and released.
5. All RFL Members (and their supporting members or staff as seen to be a part of their organization) should conduct themselves professionally and courteously to other RFL members and the public at large.
6. Conflict Management: All disputes that cannot be worked out directly between two RFL MO's should be brought to the Commissioner first. If there is still no resolution each party to the conflict should present their case to the RFL membership for a vote. Conflicts between MO's should never be made public.



***APPENDIX “A”- RFL By-Laws, continued***

7. RFL MOs are required to disclose any conflicts, overlaps, discussions, negotiations or situations that may cause competition to another MO or event. These conflicts should be disclosed to the conflicting member first, if the conflict cannot be resolved please refer to 'Conflict Management'.

8. No RFL member should use the RFL brand, logo, or image that in any way conflicts with any contracts held by the RFL or in any way that is perceived by the RFL membership as damaging the RFL's reputation and/or interests.

## APPENDIX “B”- POLYCARBONATE CLEANING PROCEDURES

The cleaning procedure for the polycarbononate panels is shown below. The procedures were provided by the polycarbononate panel manufacturer, Sabic Innovative Plastics,

<http://www.sabic-ip.com/gep/en/Home/Home/home.html>.

<http://www.arcata.com/sd/clients/geplasti.html?coid=32709>



<http://www.arcata.com/sd/clients/geplasti.html?coid=32709>

### SECTION 08841

#### POLYCARBONATE SHEET

##### 1.1 CLEANING

- A. Immediately after completing construction activities relating to installation of polycarbonate sheet materials, remove remainder of strippable masking from surfaces of polycarbonate sheet glazing; do not expose masking to sunlight for an extended period of time.
- B. Immediately after removing masking, clean glazing in accordance with polycarbonate sheet manufacturer's instructions:
  - 1. Rinse surface with lukewarm water.
  - 2. Wash surface with mild soap and lukewarm water.
  - 3. Use soft cloth or sponge gently to loosen dirt and grime; scrubbing glazing surfaces, or using squeegee on glazing surfaces, is not permitted.
  - 4. Repeat rinse as above, and wipe surface dry with soft cloth until surfaces are spotless and dry.

##### 1.2 PRECAUTIONS:

- A. DO NOT USE PAPER TOWELS TO CLEAN THE POLYCARBONATE SHEETING – THEY ARE ABRASIVE AND WILL SCRATCH THE SURFACE**
- B. LIKewise, DO NOT USE ANY TYPE OF SCRAPER OR RAZOR-BLADES ON THE POLYCARBONATE SHEETING. DOING SO WILL SCRATCH THE SURFACE**