Approval for Laser Materials

SLQ Wiki Fabrication Lab 2024/04/20 03:19

Approval for Laser Materials

All materials need to be tested to make sure they are safe to use in The Edge's Laser Cutter. Different materials can cause damage to the equipment and can be hazardous to the health and safety of the operator and other people in the Fabrication Lab.

All participants completing a Laser induction are informed of the Edge's policy that all new materials need to be approved before use in the Laser.

Users of the Laser can apply 14 days in advance to use a new material and are asked to provide a sample of the material and MSDS sheets pertaining to the material and any other treatments applied to the material.

The Latest version of the Guidelines for Laser Material Testing is always available on the wiki and is included below, along with the list of materials that Trotec recommend, and a list of compounds that are filtered readily by the extractor.

One of the compounds of concern is Formaldehyde which is found in a range of building materials (e.g. plywood, MDF) . The document below gives a good explanation of this issue and is provided on the website of our ply supplier.

http://revolutionwoodpanels.com.au/products/plywood/product/20/cd-pine-plywood.html

http://www.ewp.asn.au/library/downloads/ewpaa_formaldehyde_emmisions.pdf

[1)]

Tested materials

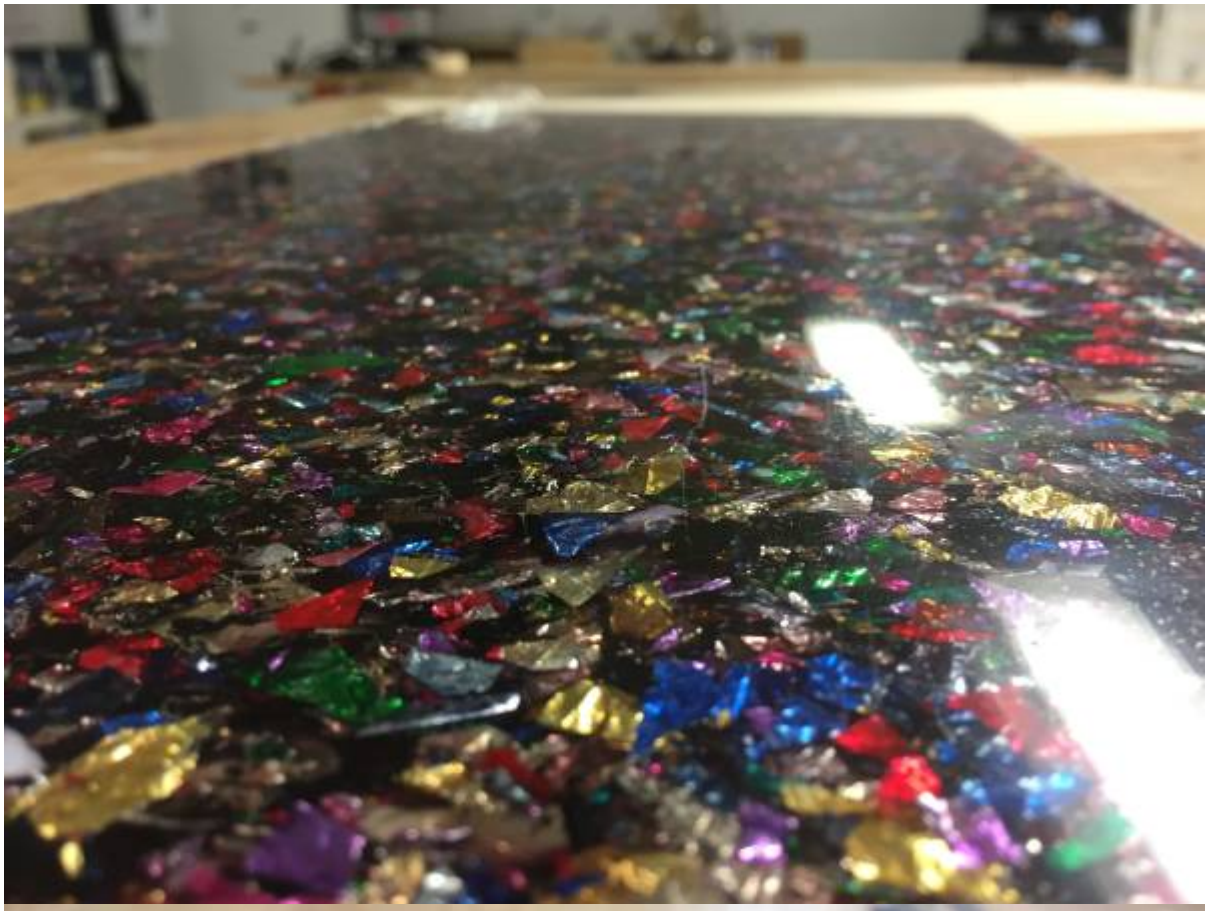
Premium Glitter Flake Acrylic

(Kaleidoscope Glitter Sheet)

- Test Date: 08/11/2017
- Test Completed by Mick Byrne / Phil Gullberg
- Supplier: Acrylics Online
- 3mm

Technical Data

Glitter acrylic can be cut, drilled, routed, laser cut, glued, formed, hot stamped, and silk screened like any other standard acrylic sheet. It is also ideal in applications that require other acrylic products to be used in combination with the Glitter without the need for mechanical fasteners or complex adhesives.



Suede

Test Date 13 Aug 2016 Test Completed By Mick Byrne.

Suede is a material recommended by Trotech so approved the app to use this completed tests on the laser.

The first test (Far Right) was etched at the same settings as Balsa 40% power 95% speed- this was too much (sooty and could not see the gradation in the contrast bar. 2nd test (Far left) was 20% power 95% speed 3rd test (top) was 27% power 95% speed - I'd recomend somewhere between these last 2 settings

Plybrace F27 hardwood structural ply

-

Test Date 15 Aug 2016 Test Completed By Mick Byrne. A bunnings product name was provided by applicant and from there an MSDS was sourced for this material. This product is also certified as low Formaldehyde.

http://www.dashwoodtimber.co.nz/downloads/Structural_Plywood_Properties_&_Applications_Manual_March_2008.pdf[2)]

http://www.ewp.asn.au/library/downloads/ewpaa_formaldehyde_emmisions.pdf[3)]

Slate

Test Date 28 Feb 2019 Test Completed By P. Gullberg.

This material can only be engraved ,not cut using the Rayjet. Settings come directly from Trotec's website.

The bitmap gradient and title test were engraved using error diffusion. The Rayjet struggles with the deeper engravings which end up looking like the more shallow engravings. The Engrave settings text is engraved using the Trotec recommended settings. Smoke levels were average.

Engraving: 60% power 100% Speed

Japanese Polyester

Test Date Aug 2016

PETG

Copper wire test passed and OK'd for laser

Peter Musk Nov 2017

Acrylic Felt

Sourced from Spotlight. Tested (copper wire) on 15/11/17
Smoky but passed for laser cutting.

Peter Musk

Silicone Rubber 0.5mm Test Date 22 Aug 2017 Test Completed By Mick Byrne. Silicon Rubber is a material recommended for cutting on the Trotec Website. After a few cuts we arrived at the following settings

Etching 20% Power 4% Speed

Cutting 40% Power 4% Speed

Laser Cutter New Materials Testing Guide

Content

1: Aim

The aim of this document is to provide a guideline for the testing of the cutting and etching of new materials in the Edge's Trotec 100w CO2 Laser Cutter.

Most of the tools in The Edge Fabrication Lab have been acquired with the intention of making these available to the public so members of our community can experiment with a range of fabrication technologies.

There is also an acknowledgement that members of the public and staff will want to experiment using different materials in equipment like The Edge's Laser Cutter.

This section outlines a process to manage the risks of health hazards and damage to equipment that could occur from cutting/ etching different materials in the Laser cutter. These are guideline only and as such, do not cover all eventualities.

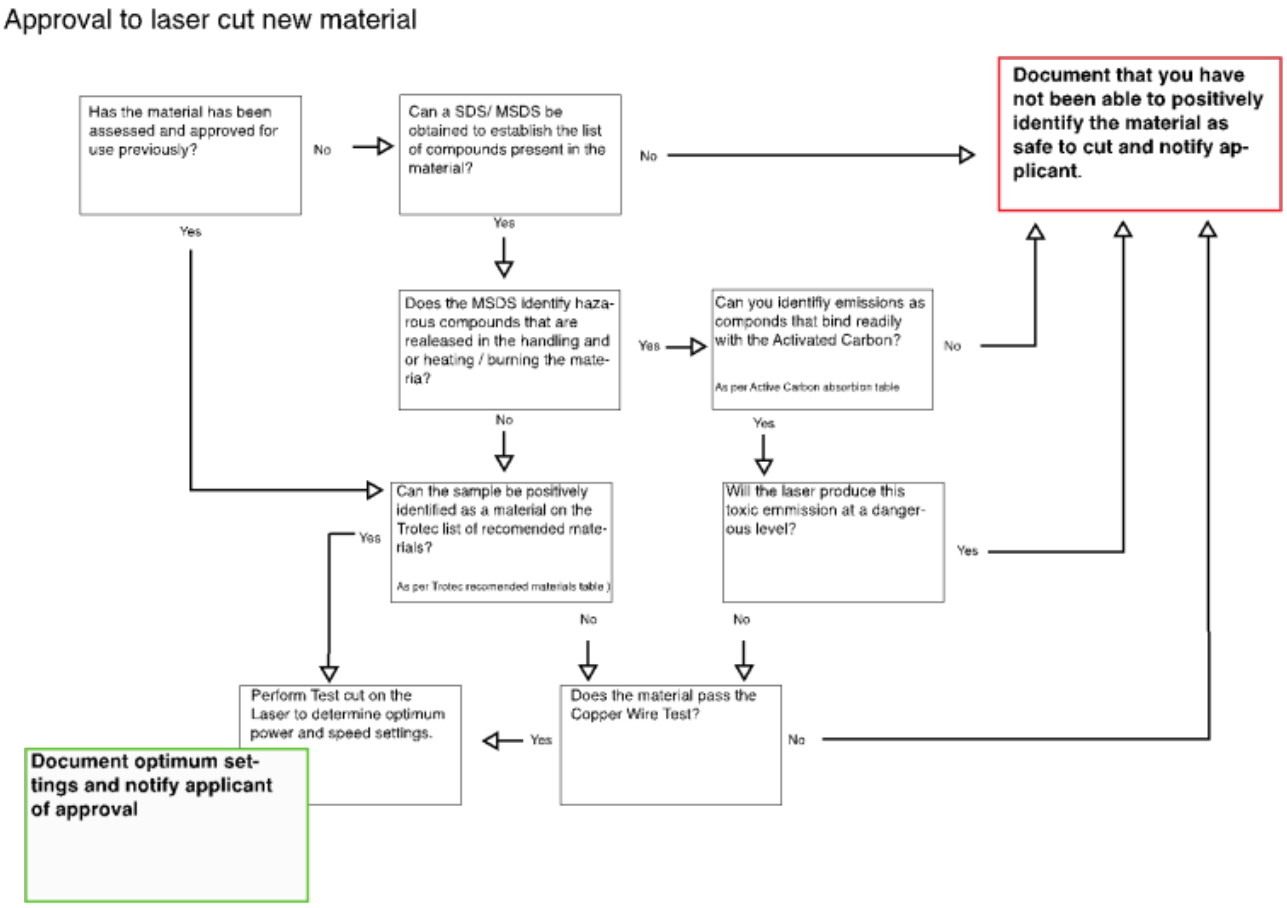
When testing new materials using the laser cutter extreme caution should be used.

Management of The Edge also reserves the right to the ban the cutting / etching of certain materials found to reduce the efficiency of the machine.

2. Method

The following Flowchart describes the process an authorized supervisor can undertake to assess a new material for approval to be cut/ etched on the Edge's Laser cutter.

A: Approval to cut flow chart



B: Notes to the Flowchart

- Material Safety Data Sheet (MSDS/SDS) for the material. MSDS sheets can be obtained through Google searches or from http://www.msds.com. Examine the MSDS for *'Hazards'* and *'Hazard Identification'* sections, particularly hazards related to heating the material. For example from the Medium Density Fiberboard (MDF) MSDS:

Section 2: Hazards Identification

Overall Statement of Hazardous Nature:
In its intact state, this product is classified as not hazardous according to the criteria of Worksafe Australia. Dust from the product is hazardous according to the criteria of Worksafe Australia.

Health Hazard Information:
In its intact state this product is not classified as a hazardous substance by Worksafe Australia. Formaldehyde gas may be released under some conditions, particularly when product is heated. However, in well ventilated storage areas and workplaces, the concentration of formaldehyde is unlikely to exceed the World Health Organisation standard of 0.1 ppm for the general environment and will be well below the National Occupational Health and Safety Commission (NOHSC) Occupational Exposure Standard of 1.0ppm.

- While the laser cutter is equipped with a HEPA air filter, ALL gas release may be hazardous, so any unapproved materials releasing toxic fumes may not be used without express exception permission from senior management of The Edge
- If unsure of a material or the data contained within the MSDS, contact the manufacturer and

enquire about laser cutting of the material

THE FOLLOWING MATERIALS ARE KNOWN TO BE HAZARDOUS AND CANNONT BE CUT

- Polyvinylchloride (PVC) based materials
- Materials containing melamine resins
- Plastics containing Nylon
- High Density Foam or other materials containing polyurethane
- MDF or Plywood or other materials containing either urea- or phenol-formaldehyde
- Foam-core board or other materials containing Polystyrene or Styrene
    1. If you are unsure of the type of plastic you are dealing with refer to http://www.chymist.com/polymers.html or to the charts below
    2. If the material is a reflective material such as a glass or mirror surface, it is recommended to cut from the non-reflective side if available

C: Copper Wire Test

1. Use appropriate PPE (personal respirator, eye protection)
2. If you haven't performed this test before, use PVC sample in the kit to establish a positive result
3. Obtain a piece of copper wire about 5 cm long. Push one end of the wire into a small cork. (The cork is used as a handle so you are not touching a hot wire)
4. Place one plastic pellet or sample near your Bunsen burner. This is the sample you will be testing
5. Hold the free end of the copper wire in the burner flame until it is red hot and the flame no longer has a green color
6. Remove the wire from the flame and touch the hot wire to the plastic pellet or sample you will be testing. A small amount of the plastic should melt onto the wire. If the wire sticks to the plastic sample, use a pair of tongs to remove it. (You do not want to burn a large piece of plastic). Place the end of the wire, with the small amount of plastic on it, into the flame. You should see a slight flash of a luminous flame (a yellow-orange color). If the flame turns green in color, then the sample contains chlorine

- Needs sentence here about whether test is passed when chlorine is or is not present

D: Test Cut Procedure

1. **If the material is found to be suitable for cutting, set up the material and focus the laser as per standard Edge Laser Cutter Induction procedure**
2. I**n CorelDraw, create a small 20mm x 20mm square set to RED Hairline**
3. **For low density materials or materials LESS than 2mm thick:**
    - In the Rayjet print preferences, set the RED CUTTING setting Power to 5% and Speed to 5% with a single pass
    - Select skip in the BLACK ENGRAVING option
    - Set 'Move job to Laser' in the laser print spooler
    - Perform this cut
    - Move laser to top left corner away from material
    - Remove material and examine cut. Mark the Power and Speed settings in the format

POWER/SPEED next to the cut. i.e. 5/5
- If the cut did not penetrate the material completely, perform the procedure again from Step 8 using an increment of 5% in Power
- It is important to make successive cuts next to each other in an ordered pattern and note the power/speed for each cut
- Repeat the procedure increasing the power until a complete cut is made. At this point, fine tune the settings using 1-2% increments or decrements, taking notes on the test material for each cut

4. **For high density materials or materials more than 2mm thick:**
   - In the Rayjet print preferences, set the RED CUTTING setting Power to 5% and Speed to 5% with TWO passes
   - Select skip in the BLACK ENGRAVING option
   - Set 'Move job to Laser' in the laser print spooler
   - Perform this cut
   - Remove material and examine cut. Mark the Power and Speed settings in the format POWER/SPEED next to the cut. i.e. 5/5
   - If the cut did not penetrate the material completely, perform the procedure again from Step 8 using an increment of 5% in Power
   - It is important to make successive cuts next to each other in an ordered pattern and note the power/speed for each cut
   - Repeat the procedure increasing the power until a complete cut is made. At this point, fine-tune the settings using 1-2% increments or decrements, taking notes on the test material for each cut
   - Once successful cuts have been made, examine the cut edges. If these are smooth and straight note down the cut settings for use. If the edges are melted or beveled / rounded, you may need to increase the passes, in which case, perform the procedure from the 5/5 % setting start again
5. **Once settings have been found for cutting, test for engraving as follows:**
   - In CorelDraw, create a small 20mm x 20mm square set to filled with BLACK
   - In the Rayjet print preferences, set the BLACK ENGRAVING setting Power to 5% and Speed to 50%.
   - Select skip in the RED CUTTING option
   - Set 'Move job to Laser' in the laser print spooler
   - Perform this engrave
   - Move laser to top left corner away from material
   - Remove material and examine engraving. Mark the Power and Speed settings in the format POWER/SPEED next to the engrave. i.e. 5/50
   - If you are not happy with the engraving, perform the procedure again from Step 8 using an increment of 5% in Power
   - It is important to make successive engraves next to each other in an ordered pattern and note the power/speed for each engrave
   - Repeat the procedure increasing the power until a good deep engrave is performed. At this point, fine tune the settings using 1-2% increments or decrements, taking note on the test material for each engrave
   - If 100% power is reached and with 50% speed and the engrave is not sufficient, set power to 90% and reduce the speed until desire engraving depth is reached

Sections 3, 4 and 5 above all say 'perform the test again from Step 8, but there is no Step 8 - re-write needed

As with normal operation, the laser cutter must always be monitored during operation in case of smoke, fire or flare up

3: References

Harvard Fab Lab, n.d. Laser Training Checklist, Retrieved 27 May 2015 from http://isites.harvard.edu/fs/docs/icb.topic1198394.files/training_checklist_LASER.pdf

David A. Katz, Identification of Polymers ©1998 Retrived 31 Aug 2015 http://www.chymist.com/polymers.html

Active Carbon Absorption of Chemicals

The Atmos 500 uses a three stage process to remove airborne contaminants. The first stage filters large particles, the second and activated carbon bed, the third is a HEPA filter (small particles).

Of the three the activated carbon stage is the most important for removing smells and potentially toxic out-gasses caused by the laser cutting process, and is most critical to the operation of the fabrication lab.

While most organic compounds will adsorb on activated carbon to some degree, the adsorption process is most effective on higher molecular weight and high boiling point compounds. Compounds having a molecular weight over 50 and a boiling point greater than 50 degrees centigrade are good candidates for adsorption [4)]

These charts are adapted from More information about the Regeneration of Active Carbon - Lenntech

Chemicals with very high probability of being adsorbed by active carbon

<datatables>

2,4-D	Deisopropyltatrazine	Linuron
Alachlor	Desethylatrazine	Malathion
Aldrin	Demeton-O	MCPA
Anthracene	Di-n-butylphthalate	Mecoprop
Atrazine	1,2-Dichlorobenzene	Metazachlor
Azinphos-ethyl	1,3-Dichlorobenzene	2-Methyl benzenamine
Bentazone	1,4-Dichlorobenzene	Methyl naphthalene
Biphenil	2,4-Dichlorocresol	2-Methylbutane
2,2-Bipyridine	2,5-Dichlorophenol	Monuron
Bis(2-Ethylhexyl)Phthalate	3,6-Dichlorophenol	Napthalene
Bromacil	2,4-Dichlorophenoxy	Nitrobenzene

Bromodichloromethane	Dieldrin	m-Nitrophenol
p-Bromophenol	Diethylphthalate	o-Nitrophenol
Butylbenzene	2,4-Dinitrocresol	p-Nitrophenol
Calcium Hypochloryte	2,4-Dinitrotoluene	Ozone
Carbofuran	2,6-Dinitrotoluene	Parathion
Chlorine	Diuron	Pentachlorophenol
Chlorine dioxide	Endosulfan	Propazine
Chlorobenzene	Endrin	Simazine
4-Chloro-2-nitrotoluene	Ethylbenzene	Terbutryn
2-Chlorophenol	Hezachlorobenzene	Tetrachloroethylene
Chlorotoluene	Hezachlorobutadiene	Triclopyr
Chrysene	Hexane	1,3,5-Trimethylbenzene
m-Cresol	Isodrin	m-Xylene
Cyanazine	Isooctane	o-Xylene
Cyclohexane	Isoproturon	p-Xylene
DDT	Lindane	2,4-Xylenol

</datatables>

Chemicals with high probability of being adsorbed by active carbon

Aniline	Dibromo-3-chloropropane	1-Pentanol
Benzene	Dibromochloromethane	Phenol
Benzyl alcohol	1,1-Dichloroethylene	Phenylalanine
Benzoic acid	cis-1,2- Dichloroethylene	o-Phthalic acid
Bis(2-chloroethyl) ether	trans-1,2- Dichloroethylene	Styrene
Bromodichloromethane	1,2-Dichloropropane	1,1,2,2-Tetrachloroethane
Bromoform	Ethylene	Toluene
Carbon tetrachloride	Hydroquinone	1,1,1-Trichloroethane
1-Chloropropane	Methyl Isobutyl Ketone	Trichloroethylene
Chlorotoluron	4-Methylbenzenamine	Vinyl acetate

Chemicals with moderate probability of being adsorbed by active carbon

For these chemicals active carbon is only effective in certain cases.

Acetic acid	Dimethoate	Methionine
Acrylamide	Ethyl acetate	Methyl-tert-butyl ether
Chloroethane	Ethyl ether	Methyl ethyl ketone
Chloroform	Freon 11	Pyridine
1,1-Dichloroethane	Freon 113	1,1,2-Trichloroethane
1,2-Dichloroethane	Freon 12	Vinyl chloride
1,3-Dichloropropene	Glyphosate	
Dikegulac	Imazypur	

Chemicals for which adsorption with active carbon is unlikely to be effective

However it may be viable in certain cases such as for low flow or concentrations.

Acetone	Methylene chloride
Acetonitrile	1-Propanol
Acrylonitrile	Propionitrile
Dimethylformaldehyde	Propylene
1,4-Dioxane	Tetrahydrofuran
Isopropyl alcohol	Urea
Methyl chloride	

Factors that influence the performance of active carbon in air

- Type of compound to be removed: In general compounds with a high molecular weight, lower vapor pressure/higher boiling point and high refractive index are better adsorbed.
- Concentration: The higher the concentration, the higher the carbon consumption.
- Temperature: The lower the temperature, the better the adsorption capacity.
- Pressure: The higher the pressure, the better the adsorption capacity.
- Humidity: The lower the humidity, the better the adsorption capacity.

1) source: Wastewater Engineering; Metcalf & Eddy; third edition; 1991; page 317|

Read more: http://www.lenntech.com/library/adsorption/adsorption.htm#ixzz4880i9cJh

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