Substrate materials - tests and outcomes

The substrate is the base form upon which the skin of copper is electro-deposited. Each of the substrate materials were tested for the following characteristics:

Characteristic to be trialled	Additional Notes
Ease of production	It was important that the production of the base forms was not overly time consuming or difficult as one advantage of using the electroforming process to produce underlying forms is the freedom to experiment with the enamelled surface that comes from not having invested a large amount of time and energy in the production of the base form
Cost	For similar reasons as those outlined above it was important that the ability to experiment and to risk taking associated with experimentation was not hampered by the high cost of production
Ease of replication	Again the fact that the base form had the ability to be easily replicated was desirable so that experimentation would not be hampered by the worry about damaging a one-off object. Also for the production of a standardized sample object by which to test the variables of the electroforming process was important
Ease of alteration	The ability to easily alter a standardized form would allow a greater range of pieces to be created
Surface characteristics	The final electroform tends to mimic and exaggerate the underlying surface characteristics so it was important that the test take this into account
Interaction with electro-conductive coatings	A range of electro-conductive materials were trialled and the ease of application and their ability to adhere to the substrate surface was an issue
Ability to withstand immersion in the electroforming solution	The electroforming solution contains sulphuric acid and therefore some materials are unsuitable to immersion in the bath because the acid will cause them to break down
Ease of removal post production	Because, for the purposes of this research, the final electroformed object were to be enamelled it was important that the material used for the production of the base forms could be removed prior to enamelling

Substrate Material test results

Material	Ease of production	Cost	Ease of Replication	Ease of alteration	Surface characteristics	Interaction with electro-conductive coatings	Ability to withstand immersion in the electroforming solution	Ease of removal post production	Additional comments
Hand carved Blue Carving wax	Poor (depending on the nature of the form to be produced)	Low	Poor *	Good	A variety of surface texture can easily be achieved	Good	Good	Good	Good for one-off pieces
Moulded Blue casting wax	Good	Low	Good	Good	Difficult to achieve a smooth surface	Good	Good	Good	Some problems with wax shrinking inside moulds
Moulded Microcrystalline wax	Good	Low	Good	Good	A variety of surface texture can reasonably easily be achieved	Good	Good	Good	Some problems with wax shrinking inside moulds The white nature of the wax creates a visual difficulty when carving that can be solved by the addition of a colouring agents such as wax crayon
Z-corp 3D printed forms impregnated with wax	Poor Needs specialized equipment	High	Excellent	Poor **	Satisfactory Needs sanding to achieve a smooth surface	Satisfactory	Poor Breaks down on immersion	N/A	
Z-corp 3D printed forms impregnated with sealant	Poor Needs specialized equipment	High	Excellent	Poor **	Satisfactory Needs sanding to achieve a smooth surface	Satisfactory	Good	Poor/Satisfactory	It is possible to remove the base form but this requires repeated soaking and/or steaming
Found materials – plastics	Good	Low	Poor *	Poor	Variable	Variable	Good	Poor/ Satisfactory	Material can be removed by burning but this produces toxic fumes so must be done in a well ventilated area
Found materials - Organic sealed with several layers of varnish	Good	Low	Poor *	Poor	Good dependant on application method of sealant	Satisfactory	Good but only if completely sealed with layer of varnish	Satisfactory	Material can be removed by burning but this produces smoke so must be done in a well ventilated area
Copper wire/ mesh	Good	Low/ medium	Poor *	Satisfactory	Good	N/A No conductive coating required	Good	N/A Does not need to be removed prior to enamelling	

* Poor but mould can be taken from finished object if replication is an issue
** Poor in terms of the printed form but easily achieved at the CAD stage