

Production of Tangible Graphic Displays

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The earliest reported method of producing embossed material was in 1517 by Francesco Lucas who engraved alphanumeric characters in wooden blocks. The first single-copy tactile maps were probably made by Weissenbourg in the early 18th century by sewing beads and threads on linen. In 1785 Valentin Haüy successfully embossed raised images in paper, but it was not until the last decade that embossed maps and diagrams have become widely available to the blind population.

Table 1 Methods of Production (A - very high, B - high, C - medium, D - low).

	Method of Duplicating	Base Material	Cost						Quality			
			Capable of operation by a blind person	Needs accurate visual master	Time to make master	Capital cost of equipment	Cost of materials for master	Cost of materials for copies	Maximum elevation	No. of different elevations	Accuracy	Durability
1. Raised line drawing kit		thin plastic	X		C	D	D	D	D	D	D	D
2. Metal foil	vacuum forming	plastic			C	B	D	C	C	C	C	B
3. String master	vacuum forming	plastic			B	B	D	C	C	B	C	B
4. Wire master	vacuum forming	plastic			B	B	D	C	C	B	B	B
5. Solid dot	screen printing	paper		X	B	D	D	D	D	D	C	D
6. Sewing machine	vacuum forming	plastic	X		C	B	C	C	C	C	C	B
7. Embossed zinc plates	press	paper			C	B	C	D	C	C	C	D
8. Sintered bronze	vacuum forming	plastic		X	A	B	A	C	C	B	A	B
9. Metal and epoxy	vacuum forming	plastic			B	C	C	C	C	A	A	B
10. Virkotype	deposition	paper		X	C	B	B	C	C	D	D	C
11. Polyvinyl	deposition	PVC		X	C	B	B	A	C	C	C	B
12. Photoetching	press	paper		X	C	B	B	C	C	B	A	B
13. Photolathe	press	paper		X	C	B	C	C	C	C	D	B
14. Drum embosser		paper		X	C	C	D	C	C	C	D	C
15. Relief printer		paper	X		D	B	D	C	C	C	D	D
16. Sensory quill	vacuum forming	plastic or metal foil	X		D	B	D	C	C	C	D	C
17. Line embosser	paper	paper	X		C	A	D	D	D	D	D	D
18. Manual engraver	vacuum forming	plastic			C	C	C	C	C	B	B	B
19. Numerically-controlled machine tool	vacuum forming	plastic			D	A	C	C	C	B	A	A

The main characteristics of systems for producing tactual maps are summarised in Table 1. The choice of method will depend on the ultimate use of the map and on financial considerations. Traditionally the copies are made on manila paper but this material imposes physical limitations on the design; there is a limited range of discriminable symbols, relatively low height of embossing, and paper is not suitable for outdoor use. Many of the systems developed in recent years have employed the vacuum forming of plastic sheets which are more durable and capable of better symbol definition. Wiedel (1971) and Gill (1973) have studied the suitability of various commercially-available thermoplastics, and found calendered polyvinyl chloride gave the best results.

It has been found desirable to use more than one height of embossing but many production systems are limited to a single elevation. The optimum elevation of symbols will depend on whether the copies are monolithic, the map is for outdoor use, and on the tactile sensitivity of the user. If the production system requires an accurate visual master for each elevation of embossing, then the maps will be very expensive when only a few copies are required.

1. Raised line drawing kit

These kits have been designed for drawing by the blind or by teachers who need to produce a map or diagram quickly. The most usual method is to use a ballpoint pen on Mylar or Melinex which puckers under the pressure of the pen. This system can only produce one type of line and braille cannot be added easily.

2. Metal foil

A master for vacuum forming is made by embossing a sheet of aluminium foil (Schiff, 1966; Craven 1972). The map has to be drawn in mirror image on the back of the foil, which is then placed on a rubber mat and the lines embossed with a spur wheel. Textured areas can be produced by glueing sandpaper to the front surface of the foil.

3. String master

A method called string master involves building up a master on

transparent cellulose. Various thicknesses of string are used for line symbols; sandpapers, linoleum and fabrics are used for textures.

4. Wire master

The wire master method is very similar to the previous method except that solder wire is used in place of string (Fletcher, 1970; Armstrong, 1978). Solder can be rolled to give solid, dotted or dashed lines with a triangular cross-section. This system is superior to the string method since the solder is easier to manipulate and the lines have sharper crests.

5. Solid dot

Nippon Lighthouse in Japan have developed a technique called solid dot for screen printing embossed maps. The system requires no special equipment and can produce multi-coloured maps. Disadvantages include low elevation of embossing and poor control over dot profile. Since the visual quality is good but the tactual quality relatively poor, the main application is for people with some useful vision who use both visual and tactual senses to read a map.

6. Sewing machine

A master for vacuum forming is made by machine sewing a fibrous material with thick thread. Areal and point symbols can be glued to the top surface of the master.

7. Embossed zinc plates

A system based on the traditional method for printing braille books involves embossing a pair of zinc plates on a special machine. The plates are used in a press for making copies on manila paper. This system is usually limited to producing maps in a punctate form with only one elevation of embossing.

