

APPLICATION OF HEAT TRANSFER VINYL MATERIALS IN DESIGN PRACTICE

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Abstract Heat transfer printing, a versatile technique employed extensively across diverse industries, stands out for its ability to yield high-quality and long-lasting printed outputs. This method covers the intricate process of transferring images from a heat transfer film onto an array of surfaces, encompassing paper, fabric, plastic, and an assortment of materials. The widespread adoption of heat transfer printing can be attributed to its efficacy in achieving intricate designs and colors while ensuring durability and resilience against wear and tear. This article explores the multifaceted applications of heat transfer vinyl materials in design practice, provided information on its significance and impact within the creative and industrial realms.

Keywords: Heat transfer vinyl; transfer materials; design; application method.

1. INTRODUCTION

Heat transfer vinyl is an advanced technology in design practice [1-6]. Heat transfer vinyl is a specialized material used for creating transfers or inscriptions through heat transfer printing. This material possesses unique characteristics and advantages suitable for various applications. Operating similarly to conventional heat transfer printing, heat transfer vinyl utilizes heat to transfer images or text from specially treated vinyl onto the surface of another material, such as fabric, plastic, or paper. Available in various colors and textures, this material offers a wide range of design possibilities, including matte, glossy, metallic, or even fluorescent vinyl. Particularly suitable for textile materials like t-shirts, hats, bags, etc., it creates a resilient and durable print resistant to washing and wear [7-9].

Heat transfer vinyl is easily cut using a special cutting plotter. Following the cutting process, the motif is applied to the surface and transferred using a heat transfer press. This material provides customization opportunities, enabling the creation of unique designs and personal messages on different items. Commonly used in the production of promotional materials, branded products, and clothing with a corporate logo, this type of vinyl is typically resistant to external factors such as water, UV rays, and atmospheric conditions, making it suitable for outdoor use. Heat transfer vinyl represents an effective means of personalizing various items and materials, offering flexibility and creative expression in a wide range of applications [10-12].

2. APPLICATION OF HEAT TRANSFER VINYL

Heat transfer vinyl finds widespread application in the textile industry due to its unique characteristics and customization possibilities. Here are some areas where heat transfer vinyl is used on textiles:

- T-shirt and Clothing Design - Widely used to attach various decorations, designs, logos, and texts to t-shirts, blouses, shirts, sportswear, and other clothing items. This method allows for quick and easy personalization of clothing [13];
- Sports and Work Uniforms [14] - Vinyl is exceptionally suitable for making sports kits and work uniforms. Names, numbers, logos, or other identification elements can be added to textile surfaces;
- Children's Clothing and Accessories [15] - Heat transfer vinyl is popular for personalizing children's clothing, baby clothes, diapers, blankets, and other textile products for children;
- Hobbies and Handcrafts [16] - Individuals engaged in hobbies and crafts use heat transfer vinyl to create personalized gifts, such as towels, cushions, blankets, etc. This method provides an opportunity for creative expression and personalized gifts;
- Accessories and Labels [17] - Textile accessories such as bags, caps, hats, and socks can be branded with heat transfer vinyl. Additionally, vinyl is used to create labels containing care information, brand logos, or other details;
- Fashion Accents [18] - This material offers the opportunity to create fashion accents on textiles, such as stylish inscriptions, emblems, or applications that complement clothing and make it individual;
- Promotional and Branded Products [19] - Businesses use heat transfer vinyl to brand textile promotional products such as hats, t-shirts, backpacks, and others, providing a quick and effective method for promoting their brands.

Figure 1 shows example of logo application on textile with heat transfer vinyl.



Figure 1. Example of logo application on textile with heat transfer vinyl.

Heat transfer vinyl offers flexibility and the opportunity for creative expression in the textile industry, used for both individual and professional purposes.

3. PARAMETERS AND SPECIFICATIONS OF HEAT TRANSFER VINYL

Heat transfer vinyl is available in various brands and models, and parameters and specifications may vary depending on the specific product (Table 1 [20]). Common parameters and characteristics frequently found in heat transfer vinyl include:

- Material Type: PU (Polyurethane) - a flexible and thin material with excellent elasticity, or PVC (Polyvinyl Chloride) - a harder and more economical material.
- Vinyl Thickness: Usually measured in millimeters (mm), with different applications requiring different vinyl thicknesses.
- Roll Width: The width of the heat transfer vinyl roll can vary from 12 inches (30 cm) to larger sizes. Wider rolls are suitable for larger projects.

- Adhesive Type: Standard adhesive for regular applications or easily removable adhesive, allowing easier removal of excess material after cutting.
- Abrasion Resistance: Indicates how resistant the vinyl is to everyday use and washing.
- Colors and Finishes: Different colors and finishes such as matte, glossy, glitter, reflective, and others are available for design variety.
- Compatibility with Cutting Plotters: Heat transfer vinyl must be compatible with the cutting plotters used. Cutting files are prepared according to the cutter's specifications.
- Fixation Temperature Range: Indicates the temperature range within which the vinyl must be fixed onto the fabric.
- Fixation Time: The time required for successful fixation of heat transfer vinyl using a heat press.

Storage and Shelf Life: Information on optimal storage conditions and the product's shelf life.

Table 1. Specifications of heat PVC vinyl "Brick" [20].

APPLIES ON	SUGGESTED CUTTING SETTINGS			TRANSFER SETTINGS			Peel
	Blade	Pressure	Speed	Time	Temperature	Pressure	
Cotton, polyester, poly/cotton blends (not suited for treated and dye sublimated textiles)	60°	150 gf	10 cm/sec	25 seconds	155°C (311°F)	Medium/High (4 bar)	cold

4. APPLICATION METHOD. TYPES OF HEAT TRANSFER VINYL

The production of products from heat transfer vinyl involves several basic steps, including material selection, design of the motif, vinyl cutting, application to textiles, and heat fixation.

4.1. Selection of Heat Transfer Vinyl

Choosing suitable heat transfer vinyl for a specific project, considering colors, textures, and sizes. Heat transfer vinyl comes in various types, each intended for different applications and materials [20]. Here are some basic types:

- PU (Polyurethane) Vinyl:
 - o Extremely thin and flexible material.
 - o Suitable for clothing and textile materials.
 - o Excellent elasticity and abrasion resistance.
- PVC (Polyvinyl Chloride) Vinyl:
 - o Harder compared to PU vinyl.
 - o Suitable for textiles and other materials.
 - o Economical option in terms of price.
- Flock Vinyl:
 - o Used to create a fluffy effect.
 - o Suitable for t-shirts, hats, and other textile surfaces.
 - o Provides a suede or cotton-like feel.

- Reflective Vinyl:
 - o Contains reflective particles that reflect light.
 - o Used for signaling and workwear, sports equipment, etc.
- Glitter Vinyl:
 - o Contains small sparkling particles.
 - o Suitable for adding a sparkling effect to textiles and accessories.
- Metallic Vinyl:
 - o Imitates a metallic appearance.
 - o Used for creating striking designs on clothing and accessories.
- Fluorescent Vinyl:
 - o Bright and vibrant color.
 - o Suitable for creating vivid and remarkable designs.
- Production Vinyls (e.g., Heat-Resistant Vinyl):
 - o Withstands high temperatures and thermal processes.
 - o Suitable for industrial applications such as making work uniforms and equipment.
- Sublimation Vinyl:
 - o Allows sublimation printing on the vinyl.
 - o Used for creating personalized sublimation products.
- Special Effect Vinyl (Chameleon, Holographic, etc.):
 - o Offers various effects such as color-changing or holographic reflections.

Figure 2 shows catalogue for example types of heat transfer vinyl.



Figure 2. Catalogue for example types of heat transfer vinyl.

Heat transfer vinyl offers flexibility and the opportunity for creative expression in the textile industry, used for both individual and professional purposes.

4.2. Motif Design

Preparation and selection of a design to be transferred onto the fabric. It may include text, logos, images, or a combination of them. The file needs to be vector-based, and software like Adobe Illustrator or CorelDRAW can be used for this purpose. These software tools allow the creation of vector files that can be used for working with a cutting plotter.

4.3. File Preparation for Cutting

When using a cutting plotter, a file with the appropriate dimensions and format is prepared.

- SVG (Scalable Vector Graphics): A vector format used by many plotters for cutting. It allows the preservation of vector information.
- EPS (Encapsulated PostScript): Another vector format used for storing vector images and supporting transparency.
- AI (Adobe Illustrator): Files created in Adobe Illustrator containing vector information and suitable for cutting.

4.4. Vinyl Cutting

Submitting the file to the cutting plotter in the specified format and size. Applying preferred cutting settings in specialized software, allowing additional editing of the file before cutting. These settings may include adjusting the knife pressure, mirror cutting the contour, media size for printing, etc. The specialized software needs to be compatible with the model of the cutting plotter, usually provided by the manufacturer along with the plotter. Machine model Jaguar IV was used for example (Figure 3).

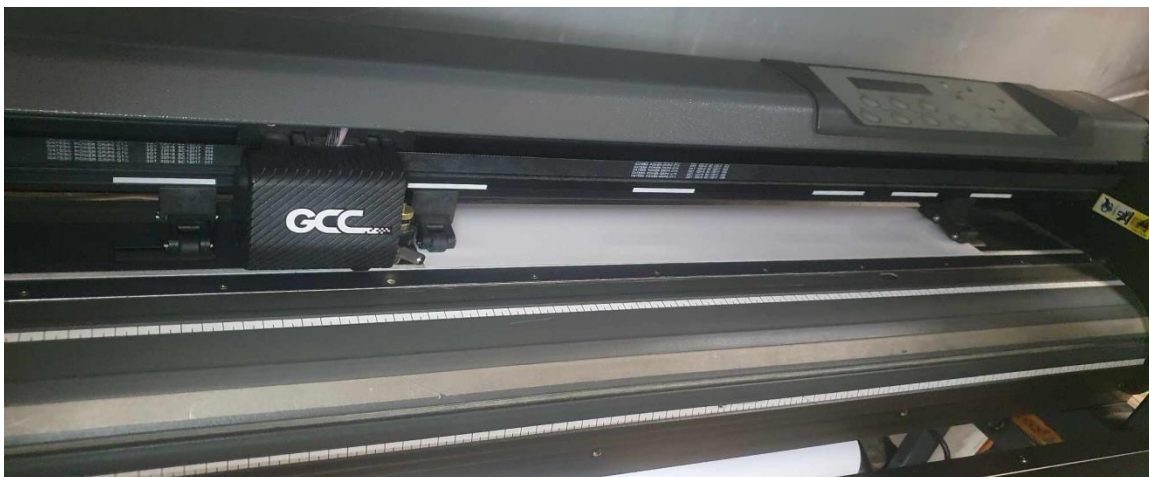


Figure 3. Cutting plotter model Jaguar IV (<https://www.youtube.com/watch?v=ll7YXdVQOMI>).

4.5. Weeding

Using a specialized tool to remove excess vinyl. This tool often has a blade used for cutting the vinyl in areas that need to be removed. Some models may have a spatula or cutting edge used for delicately separating excess material from the design. This tool helps avoid damaging the design during the weeding process. Weeding tools have a comfortable and ergonomic handle, making them

easy to use and providing greater control over the process. There are weeding tools in various sizes, chosen depending on the design size and cutting complexity. The blade can be made of materials such as stainless steel, ensuring durability. The weeding tool is usually lightweight and convenient to use, making the weeding process more comfortable and efficient.

4.6. Application on Textile

Positioning the heat transfer vinyl on the textile in the desired position. Templates can be used to position the design at specific intervals or a fixed position. These templates allow applying the vinyl in the same position for a series of transfers.

Heat Fixation through a heat press to apply heat to the vinyl. For heat transfer of heat transfer vinyl, heat presses are used, providing both heat and pressure on the material. Follow the manufacturer's instructions for temperature, time, and pressure, applied through the control panel of the press. Here are a few types of heat presses that can be used for this process:

- Flat Heat Press: Used for transferring vinyl onto flat surfaces such as t-shirts, blouses, hats, and other textiles. This type of press provides uniform heat and pressure across the entire material.
- Cap Heat Press: A specialized type of heat press designed for transferring vinyl onto caps. This press has a smaller working surface, suitable for the shape of caps.
- Small Item Heat Press: This type of press is designed for transferring vinyl onto small items such as keychains, puzzles, cups, and others. This press can be interchangeable with different frames for various shapes and sizes of items.
- Large Format Heat Press: This type of press is intended for transferring vinyl onto larger textile surfaces, such as banners, flags, or large t-shirts. This press typically has a large working surface.
- Removal of the Carrier Film from the Vinyl after Heat Fixation - Depending on the specifications of the chosen material provided by the manufacturer, the carrier film may be removed immediately after heating while the material is still hot. For some types of vinyl, it may be necessary to wait until complete cooling before removing the carrier film.
- After completing these steps, the result is a personalized product with heat transfer vinyl. It is important to follow the manufacturer's instructions and conduct tests before mass production to ensure the desired outcome

3. CONCLUSIONS

The article introduces heat transfer vinyl as a highly advantageous tool for personalizing textiles, accessories, and surfaces. Its user-friendly transfer process accommodates individuals with diverse crafting experience, offering design flexibility through a rich array of colors, textures, and styles. Notably wear and wash-resistant, it proves suitable for everyday items and allows for swift and efficient production of personalized goods, catering to small batches and individual orders in a cost-effective manner. Compatible with diverse materials like cotton, polyester, lycra, and leather, heat transfer vinyl's cutting capability facilitates precise designs that can be stored and replicated for repetitive production. The availability of various vinyl types, such as glitter, reflective, and metallic, enhances its appeal for creating unique and innovative designs.

The article underscores how heat transfer vinyl emerges as an exceptionally attractive and efficient solution for individuals seeking a quick and innovative approach to personalize a wide range of surfaces.

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References

- [1] Su, Y., Fan, Y., Liu, G., Tian, M., and Li, J., 2023, A Review on Sustainable Method to Evaluate Heat and Moisture Transfer in Clothing Material, *Sustainability*, Vol. 15, 2747.
- [2] Silhouette101, 2018, Heat Transfer Essentials, <https://www.silhouette101.com/wp-content/uploads/2018/09/ebook-heat-transfer-essentials.pdf> (visited November 2023).
- [3] Calvyn, 2023, The ultimate guide to heat transfer vinyl (HTV), YoPrint, <https://www.yoprint.com/the-ultimate-guide-to-heat-transfer-vinyl-htv/> (visited November 2023).
- [4] Coastal Crew, Heat Transfer Vinyl 101: An Introduction to HTV, <https://www.coastalbusiness.com/blog/heat-transfer-vinyl/heat-transfer-vinyl-101.html> (visited November 2023).
- [5] Xiaom, Y.-Q., and Kan, C.-W., 2022, Review on Development and Application of 3D-Printing Technology in Textile and Fashion Design, *Coatings*, Vol. 12, 267.
- [6] Jeong, S., Kim, G., Bae, H., Kim, H., Seo, E., Choi, S., Jeong, J., Jung, H., Lee, S., Cheong, I., et al., 2023, Reactive Disperse Dyes Bearing Various Blocked Isocyanate Groups for Digital Textile Printing Ink, *Molecules*, Vol. 28, 3812.
- [7] Júnior, H. L. O., Neves, R. M., Monticeli, F. M., and Dall Agnol, L., 2022, Smart Fabric Textiles: Recent Advances and Challenges, *Textiles*, Vol. 2, pp. 582-605.
- [8] Stempien, Z., Khalid, M., Kozanecki, M., Filipczak, P., Wrzesińska, A., Korzeniewska, E., and Szaśiadek, E., 2021, Inkjet Printing of Polypyrrole Electroconductive Layers Based on Direct Inks Freezing and Their Use in Textile Solid-State Supercapacitors, *Materials*, Vol. 14, 3577.
- [9] Xiao, Y.-Q., and Kan, C.-W., 2022, Review on Development and Application of 3D-Printing Technology in Textile and Fashion Design, *Coatings*, Vol. 12, 267.
- [10] VinylTechnology, 2023, Textile & Polymer Manufacturer. About Vinyl Technology, <https://www.vinyltechnology.com/about> (visited November 2023).
- [11] Vertisol, 2023, Vinyl Fabric - Vertisol, technical vinyl fabric manufacturer, <https://www.vertisol.com> (visited November 2023).
- [12] Fullspeed100, 2023, Heat Transfer Vinyl Applications, <https://www.fullspeed100.com/branding-applications/heat-transfer-vinyl> (visited November 2023).
- [13] Customoneonline, 2023, Heat transfers printing. High quality & affordable custom vinyl T-shirt printing, <https://customoneonline.com/pages/heat-transfers-printing-vinyl> (visited November 2023).
- [14] A4apparel, 2023, Transfer printing is ideal for short print runs with no set up costs, <https://www.a4apparel.co.uk/heat-transfer-printing.html> (visited November 2023).
- [15] PolyesterClothing, 2023, Heat Transfer Vinyl (HTV) Safety: Decorating Children's Apparel, <https://www.polyesterclothing.com/blog/heat-transfer-vinyl-safety-decorating-childrens-apparel> (visited November 2023).
- [16] Abeautifulmess, 2023, Dress Your Tech with Printed Vinyl, <https://abeautifulmess.com/dress-your-tech-with-printed-vinyl> (visited November 2023).
- [17] Apprintable, 2023, Different Types of Clothing Labels and Their Purpose, <https://www.apprintable.com/types-of-clothing-labels.html> (visited November 2023).
- [18] Notjessfashion, 2023, How to wear vinyl like a street style star, <https://www.notjessfashion.com/how-to-wear-vinyl> (visited November 2023).
- [19] VinylClothingCo, 2023, Designs printed on top quality t-shirts, sweatshirts, hoodies, <https://vinylclothingco.com> (visited November 2023).
- [20] Siser, 2023, Heat transfer vinyl, <https://www.siser.com> (visited November 2023).

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[21] GCCWorld, 2023, Innovation with a Human Touch, <https://www.gccworld.com> (visited November 2023).