

# *Fabric Printing Techniques*

## TEXTILE PRINTING

APPLICATION OF COLOR TO A FABRIC IN A  
DESIGN OR PATTERN

### OBJECTIVES

1. GOOD REGISTRATION
2. GOOD CLARITY
3. GOOD DEFINITION
4. GOOD PENETRATION
5. GOOD FASTNESS
6. LOW PERCENTAGE SECONDS

## TYPES OF PRINTING PROCESSES

### I. AUTOMATIC FLAT SCREEN PRINTING

A. APPROXIMATELY 17% OF PRINTED GOODS

B. ADVANTAGES

(1) LARGE REPEATS

(2) MULTIPLE STROKES FOR PILE FABRICS

C. DISADVANTAGES

(1) SLOW

(2) NO CONTINUOUS PATTERNS

## II. ROTARY SCREEN PRINTING

A. APPROXIMATELY ~~60~~% OF PRINTED GOODS

B. ADVANTAGES

(1) FAST

(2) QUICK CHANGEOVER OF PATTERNS

(3) CONTINUOUS PATTERNS

C. DISADVANTAGES

(1) DESIGN LIMITATIONS

(2) SMALL REPEATS

III. ENGRAVED ROLLER PRINTING

A. APPROXIMATELY 26% OF PRINTED GOODS

B. ADVANTAGES

(1) HIGH DESIGN CAPABILITY

A. FINE DETAIL

B. MULTIPLE TONES

C. DISADVANTAGES

(1) COPPER CYLINDERS VERY EXPENSIVE

(2) NOT ECONOMICAL FOR SHORT RUNS

(3) REQUIRES HIGHLY SKILLED WORKERS

IV. HEAT TRANSFER PRINTING

A. APPROXIMATELY 7% OF PRINTED GOODS

B. ADVANTAGES

(1) HIGH QUALITY PRINTS

(2) FEWER SECONDS

(3) ECONOMICAL FOR SHORT RUNS

(4) PRACTICALLY POLLUTION FREE

C. DISADVANTAGES

(1) SLOW

(2) PRIMARILY ONLY FOR POLYESTER

## STEPS IN PRINTING PROCESS

1. PREPARATION OF PRINT PASTE
2. PRINTING OF FABRIC
3. DRYING
4. FIXATION OF DYESTUFF
5. WASHING-OFF

## Preparation of Printing Pastes

Type of specific formulation used depends on the fiber, the colorant system used and, to some extent, the type of printing machine.

Typical ingredients used include:

- dyes or pigments
- thickeners
- binders, cross-linking agents
- sequestrants
- dispersing agents - surfactants
- water-retaining agents (humectants)
- adhesion promoters
- defoamers
- catalysts
- hand modifiers



## Thickeners

Viscosity - the resistance of a fluid to flow - (ie. the thickness of the fluid)

- one of the most important variables in a print paste formulation

- can be controlled by choosing from a wide range of possible thickener products, modified by changes in temperature, pH, and electrolyte concentration

Thickener systems -

Natural gums

Synthetic polymers

Emulsions - (oil-in-water, water-in-oil)

Foam

## Dynamics of Print Pastes

Viscosity - Laminar flow (fluids)

Turbulent flow

Important factors for print paste;

Shear stress

Shear rate

Newtonian Fluids - those fluids which possess a constant viscosity over a broad shear rate (stress) range at a given temperature.

Non-Newtonian Fluids - those fluids which exhibit a changing viscosity with a changing shear rate (stress)

- Pseudoplastic
- Plastic
- Thixotropic

Effect of Electrolytes

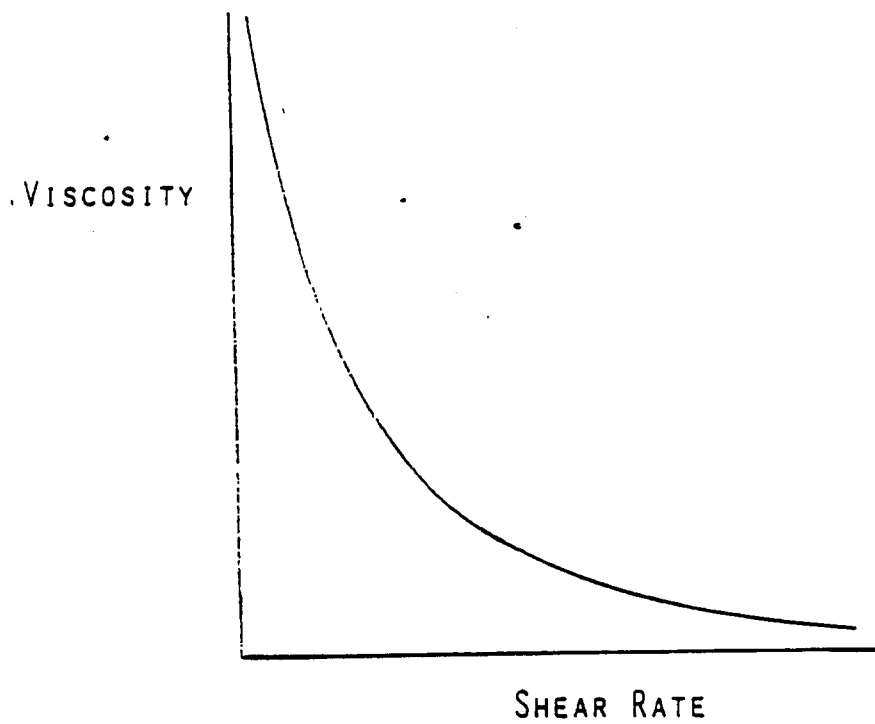
Effect of Concentration

## THICKENING AGENTS

MUST HAVE PSEUDOPLASTIC FLOW BEHAVIOR

LOW SHEAR = HIGH VISCOSITY

HIGH SHEAR = LOW VISCOSITY



PSEUDOPLASTIC BEHAVIOR

## THICKENING MEDIA

### SOLUTIONS OF POLYSACCHARIDES

- GUM ARABIC
- GUM TRAGACANTH
  
- LOCUST BEAN GUM
- GUAR GUM
- SODIUM ALGINATE

### EMULSIONS

- OIL-IN-WATER
  - WATER-IN-OIL
- OIL IS USUALLY VARSOL

### SYNTHETIC (ALL-AQUEOUS)

- POLYACRYLIC ACID
  - EMA RESIN
- ELECTROLYTE SENSITIVE

### FOAMS

- AIR DISPERSED IN WATER

## Binders

A product of high molecular weight which is capable of forming a three-dimensional film used to hold the pigment particles in place on the surface of a textile substrate

- not necessary when using dyes
- very important in determining fastness properties

Normally synthetic (latex) compounds

Acrylics

Vinyl Acetates

Butadienes

Self-crosslinking agents

Methylolacrylamide

Methylolmethacrylamide

## Sequestering Agents

These are compounds which react with metallic ions in such a way that the metal becomes part of a complex

EDTA - most popular to use with dyes

Calgon - often used to soften water

Dispersing agents

Surfactats - used to disperse solid particles, promote paste stability, and increase paste penetration into the fiber.

Similar in use are protective colloids - increasing paste stability.

Surfactants can be

Anionic	S-	(acidic)
Cationic	S+	(basic)
Nonionic	S	(neutral)

## Humectants

Materials added to print paste formulations to prevent water evaporation from the paste - preventing "skin-over" and paste instability

### Typical Humectants

Ammonia

Triethanolamine

Polyalcohols

Ethylene glycol

Glycerine

Urea



## Adhesion Promoters

Increase adhesion of binder system to substrate

i.e. Pigment printing of fiberglass is enhanced  
by using aminosilane

## Defoamers

Added to print pastes to minimize formation of foam (before foam printing).

Often silicone surfactants have been used - however any compound which decreases bubble formation in the print paste and exhibits no adverse effects can be used.

## Hand Modifiers

Normally softeners - because binders tend to stiffen the fabric.

## Catalysts

A chemical added to a formulation to increase the speed of a chemical reaction.

May be included in print paste formulation for the binder or for reactive, sulfur, or vat dyes.

May be acidic or basic.

## AUXILIARY CHEMICALS

THOSE NECESSARY FOR FIXATION OF DYE ONTO FIBER

REACTIVES - ALKALI

VATS - REDUCING AGENT

ACIDS - ACID

CATIONIC - ACID

DISPERSE - CARRIER

DO NOT INCORPORATE STRONG ACID, BASES, OXIDIZING AND REDUCING AGENTS IN PRINT PASTE.

ACID AGER

LATENT REDUCING AGENTS

(SODIUM SULFOXYLATE FORMALDEHYDE)

## SCREEN ENGRAVING PROCESS

1. PREPARATION OF POSITIVE FILM
  - A. COLOR SEPARATION
  - B. STEP AND REPEAT
  - C. REGISTRATION AND ACCURACY
  
2. TRANSFER TO SCREEN
  - A. LACQUER METHOD
  - B. GALVANO METHOD

## LACQUER METHOD

### PERFORATED SCREEN PREFORMED

- A. HEAT
- B. DEGREASE AND CLEAN
- C. COAT WITH LIGHT - SENSITIVE EMULSION
- D. DRY
- E. FILM PLACED IN CONTACT WITH  
SCREEN
- F. EXPOSE TO LIGHT
- G. WASH
- H. INSPECT
- I. CURE
- J. INSTALL END RING

## FLAT-BED SCREEN PRINTING

MECHANIZATION OF HAND SCREEN PROCESS

FABRIC GLUED TO BLANKET

SCREENS RISE AND FALL

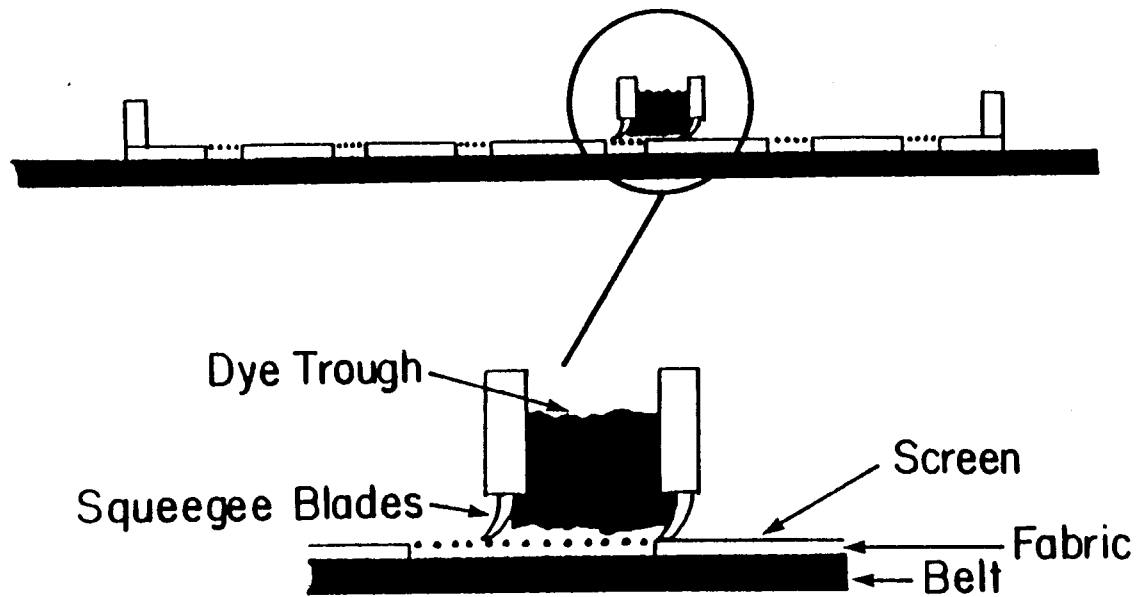
PRINTING DONE WHILE SCREEN IN DOWN  
POSITION

ROD OR BLADE SQUEEGEE SYSTEM

UP TO FOUR STROKES POSSIBLE

SLOW PROCESS

# FLAT BED PRINTING AND SQUEEGEE UNIT





## ROTARY SCREEN PRINTING

CONTINUOUS SCREEN PRINTING PROCESS

FABRIC GLUED TO BLANKET

FABRIC MOVES UNDER ROTATING SCREENS

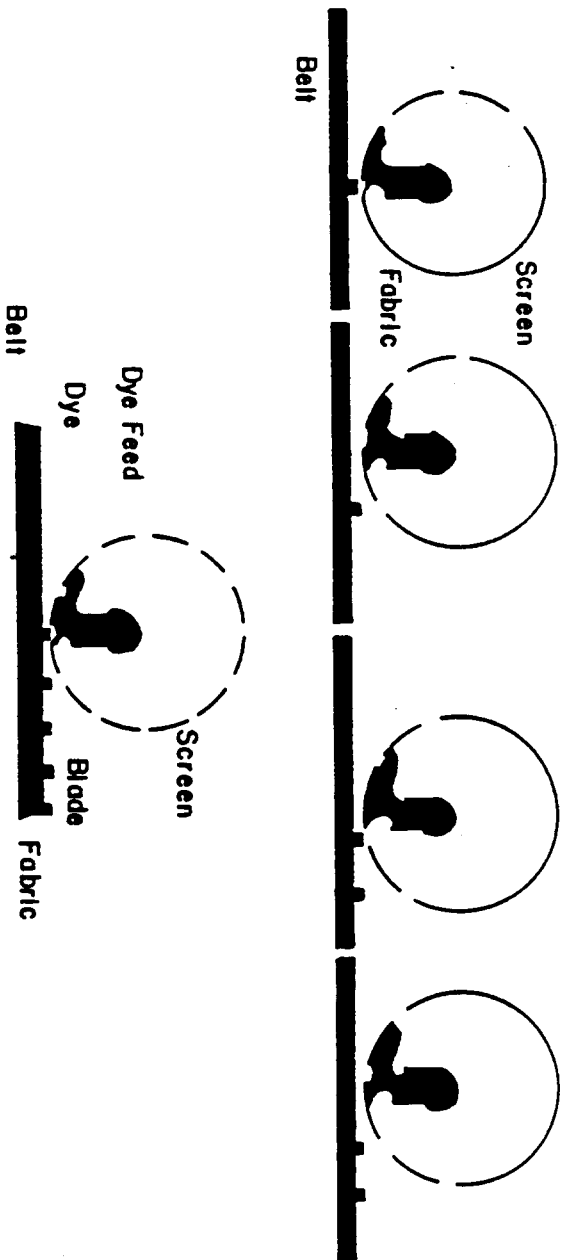
ROD OR BLADE SQUEEGEE SYSTEM

FINE ADJUSTMENTS EASILY MADE

SPEEDS UP TO 100 YD./MIN.

# ROTARY SCREEN PRINTING

## SQUEEGEE PRINCIPLE



## FIXATION METHODS

### 1. ATMOSPHERIC STEAM

- TREATMENT AT 212 DEGREES F WITH SATURATED STEAM
- USED WITH
  - DIRECT DYES
  - VAT DYES
  - NAPHTHOL DYES
  - ACID DYES
  - CATIONIC DYES
  - REACTIVE DYES
- FESTOON STEAMER MOST COMMON EQUIPMENT
  - ACID AGER FOR ACID DYES

### 2. PRESSURE STEAM

- TREATMENT AT 230 DEGREES F UNDER LOW PRESSURE
- USED WITH DISPERSE DYES
- TURBO-AUTOCLOAVE MOST COMMON EQUIPMENT

### 3. HIGH TEMPERATURE STEAM

- TREATMENT WITH SUPERHEATED STEAM AT TEMPERATURE UP TO 420 DEGREES F
- USED WITH  
DISPERSE DYES  
PIGMENTS
- CAN ALSO BE USED AS AN ATMOSPHERIC STEAMER

### 4. DRY HEAT

- TREATMENT WITH DRY HEAT AT TEMPERATURES UP TO 420 DEGREES
- USED WITH  
DISPERSE DYES  
REACTIVE DYES  
PIGMENTS

## REASONS FOR SCOURING

REMOVE THE THICKENING AGENT

REMOVE AUXILIARIES

REMOVE EXCESS DYESTUFF

IMPROVE BRILLIANCE OF PRINT

IMPROVE FASTNESS PROPERTIES OF  
PRINT

PROBLEM-

BACK STAINING OF UNDYED AREAS

## PIGMENT PRINTING

70% OF ALL PRINTED FABRICS IN U.S. ARE PRINTED WITH PIGMENTS

### COMPOSITION OF PRINT PASTE

PIGMENT

THICKENER (EMULSION OR ALL AQUEOUS)

BINDER (ACRYLIC POLYMER)

LOW CROCK BINDER

SOFTENER

### PROCESS

1. PRINT

2. DRY

3. CARE

### ADVANTAGES

- ALL FIBERS AND FIBER BLENDS
- NO AFTERWASH

### DISADVANTAGES

- POOR CROCK FASTENESS
- HARSH HARD

## Typical Pigment Print Formulation

	% Dry Weight
Pigment	10%
Dispersing Agent	3%
Soap and/or Oleic acid/Ammonia	2%
Defoamer	1/10%
Latex (Binder)	5-10%
Casein	1%
Bacteriocide	1/10%
Carbopol	1/2%
Solvent	2%
Water	77%

# DEFECTS IN SCREEN PRINTING

OUT OF REGISTRATION

LINT AND THREAD MARKS

GLUE STREAK

COLOR SMEAR

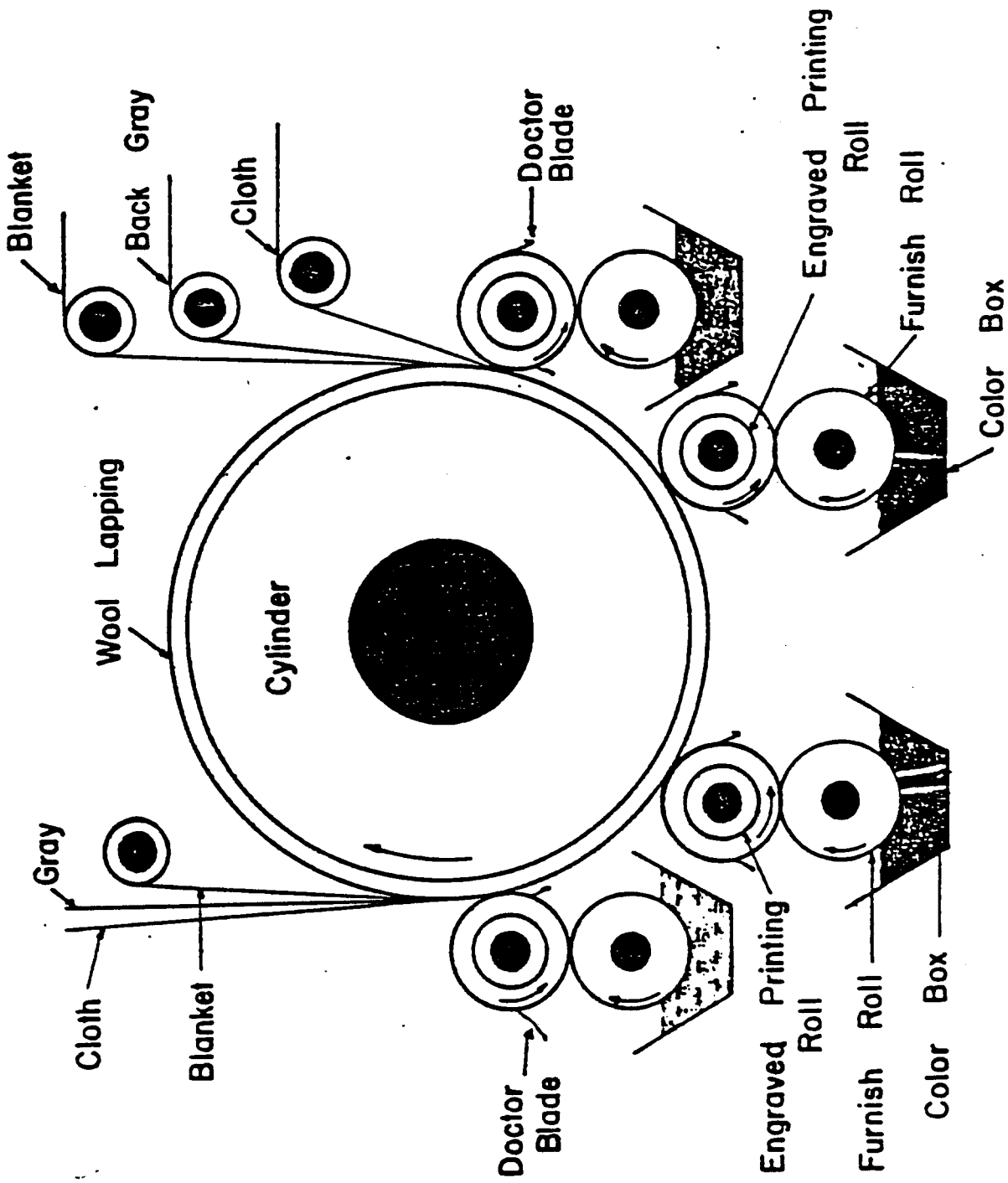
COLOR OUT

CREASED FABRIC

PINHOLE

DAMAGED SCREEN





DIAGRAMMATIC VIEW OF A ROLLER-PRINTING SYSTEM

## RESIST PRINTING

Fabric is first printed with a resisting agent, then dyed.

Produces similar effects to discharge printing.

Can use white or colored resists.

Can use dyes of much higher stability than those used in discharge printing and, therefore, much higher fastness can be obtained.

## DISCHARGE PRINTING

Discharge printing is a method where a "dyed" fabric is printed with discharging agents which selectively destroy the dye. A white discharge is produced.

An alternative method is to print along with discharging agents, nondischargeable dye which gives a colored discharge surrounded by a "ground" color.

### Advantages

- 1) Large areas of ground color possible
- 2) Delicate colors and intricate patterns possible on deep ground color - excellent depth and clarity possible
- 3) Higher production costs but long lasting, unique styles

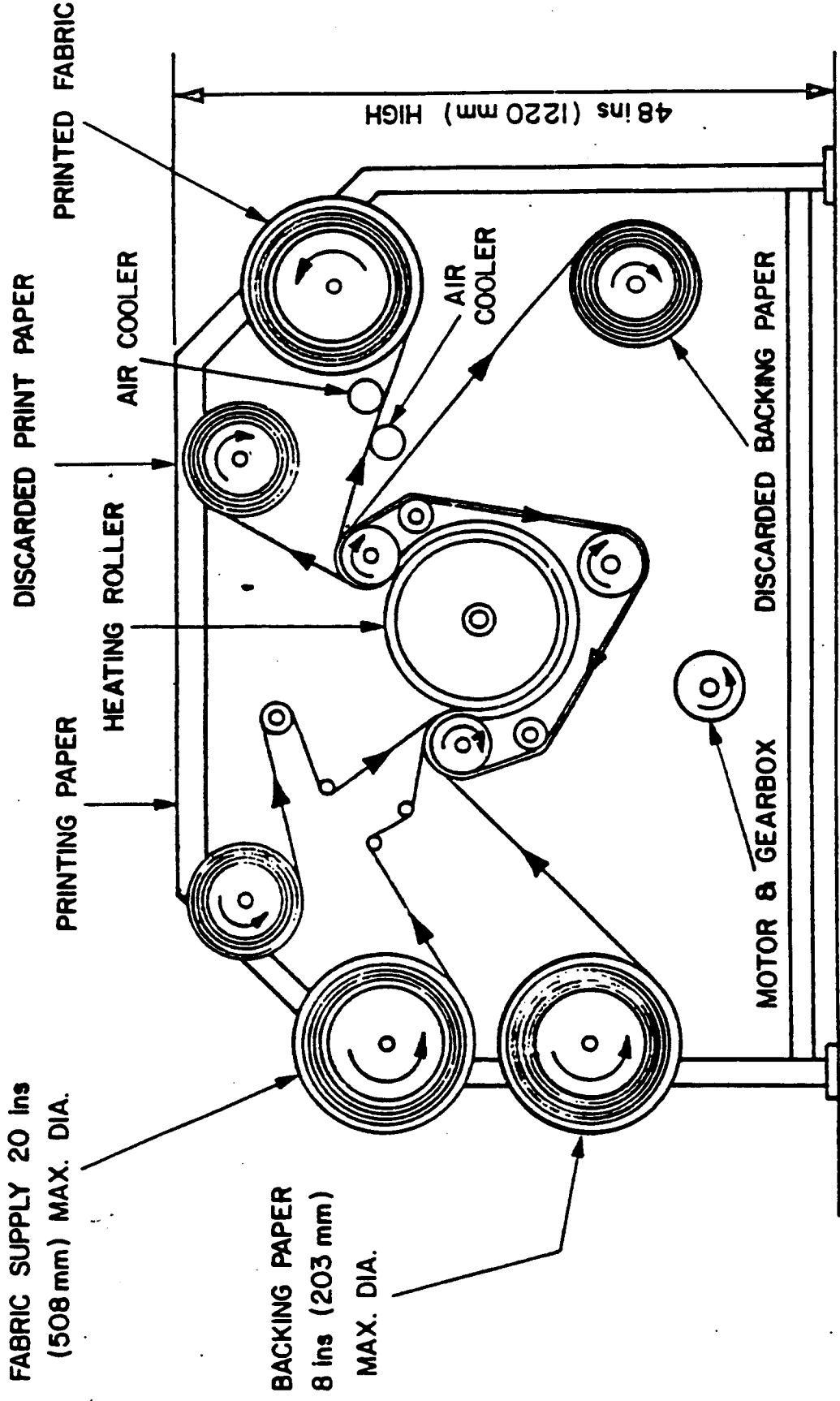
## HEAT TRANSFER PRINTING

### Advantages

1. Easier handling of units
2. Easier training of operators
3. Better registration and clarity
4. Fewer Seconds (2% vs. 10%)
5. Inventory in paper
6. Pollution - free

### Disadvantages

1. Slow
2. Limited to synthetic fibers  
mainly polyester



# HEAT TRANSFER PRINTING UNIT

## PRESENT USES OF HEAT TRANSFER PRINTS

Knitted Apparel

Woven Apparel

Drapery Fabric

Upholstery Fabric

Automobile Interiors

Carpet Tiles

## RECENT INNOVATIONS IN HEAT TRANSFER PRINTING

Deep Penetrating Dyes for Pile Fabrics

Cationic Dyes for Printing Acrylics -

Processes for Printing Polyester/Cotton Blends

1. Coating Cotton Fiber with Polyester Resin.
2. Resin Fixing Dyes on Cotton.

Wet Heat Transfer Printing