Theory of Operation

Apple Color StyleWriter Pro

Introduction

This document describes Color StyleWriter Pro printer operations. It covers:

- Ink jet technology
- Paper feed system
- Print cycle

Ink Jet Technology

The Color StyleWriter Pro printer uses a printing technology called ink jet, or bubble jet, printing. The Color StyleWriter Pro uses four ink cartridges (one each for Cyan, Magenta, Yellow, and Black) and a replaceable print head with four 64-nozzle bubble jet heads, one for each color.

The Ink Cartridges

Each ink cartridge contains about 8 grams of one color of water-soluble ink. Each cartridge is expected to last for approximately 315 pages, assuming a 5% coverage of each page with that color of ink. The user replaces the ink cartridges as necessary.

Caution: Although the ink is water-soluble, it does stain. It is also electrically conductive. If the ink spills inside the printer, it can cause electrical damage unless the spill is thoroughly cleaned up before power is turned on.

Cartridge shelf life is approximately 6 months once you open the cartridge and install it in the printer, and 18 months while in the package.

Caution: Be sure to install each cartridge in the proper slot. Installing the wrong color cartridge can damage the print head.

Print Head

The user-replaceable printhead contains a printed circuit board and four bubble jet head units, one for each color of ink.

Printed Circuit Board

The print head receives printing signals from the controller board through the contact points on the printed circuit board.

Caution: To prevent ESD damage to the controller board and/or dirt on the contacts, never touch the contact points.

Nozzles

Each bubble jet head unit contains a single line of 64 print nozzles that eject ink onto the paper. The nozzles are cleaned and protected by automatic maintenance functions (priming, purging, wiping, and capping) described later in this module.

Filters

The print head also contains mesh filters to purify incoming ink.

Caution: Never touch the filters. If you must set the print head down, do not rest it on the filters.

Print Head Handling

Follow these precautions:

- Do not touch any part of the print head except its black plastic sides.
- If you must set the print head down, rest it only on its black plastic sides, never on its printed circuit board, printing nozzles, or mesh filters.
- Do not leave a used print head uncapped (out of the printer) for more than 12 hours, or any ink in the print head will dry and clog the nozzles.

Alignment

Whenever the print head is removed from the printer, even for a moment, its alignment is affected. If the print head has been removed and reinstalled, the Macintosh may prompt you to initiate the alignment procedure. The user or

servicer can select the “Check alignment before printing” option in the Utilities section of the Print dialog box of any Macintosh application to initiate the alignment procedure.

Print Head Components

The following table describes the functions of print head components.

Component	Function
Filters	Remove dust and particles from the ink before it flows to the nozzles.
Joint pipes	Carry the filtered ink to the nozzles of the bubble-jet head units.
Nozzles	Contain the filtered ink from the joint pipe. Built into each nozzle is a heater plate.
Bubble-jet head unit	The print head contains four bubble-jet head units, one for each color of ink. Each bubble-jet head unit contains 64 nozzles. The bubble-jet head unit receives printing signals that control ink placement and applies heater voltages to the nozzle heaters.
Nozzle heaters	Plates that receive the head drive current through resistive heating elements. The ink heats to a boil, creating bubbles.
Head cover	Protects the bubble-jet head units.

Note: The nozzle heaters and their electrical connections within the print head are formed on a silicon substrate using semiconductor technology.

Ink Jet Printing in Action

The ink jet system prints characters and graphics by firing ink drops at the paper from thin nozzles. Before printing begins, the print head receives the print signals, and the nozzles are primed (filled with ink). Ink feeding takes place as follows: Negative air pressure vacuum inside the print head draws the ink from each ink cartridge through a mesh filter, which removes dust and particles from the ink, and into the joint pipe, which directs the ink to the bubble-jet nozzles.

When the nozzles are filled, the following steps take place:

1 Heat is generated by applying currents through a resistive heating element (the nozzle heater) built into each nozzle. The ink boils and vaporizes. The vapor produces bubbles.

2 The smaller bubbles quickly accumulate into a large bubble.

3 The bubble creates a pressure wave. The pressure wave ejects an ink drop from the nozzle at about 9.5 meters per second.

4 As the current ends and the ink ejects, the bubble contracts and produces a vacuum.

5 The vacuum draws fresh ink from the ink cartridge. Ink flows from the cartridge through a filter to the joint pipe.

The Purge Unit

The purge unit, driven by its own motor, maintains the print quality of the ink jet nozzles in the print head. The purge unit performs the following routine maintenance procedures to protect the print head.

Priming

The priming process cleans and unplugs the nozzles by quickly ejecting a small amount of ink and refilling the nozzles with fresh ink. (Priming occurs when power is switched on and when wiping is done. See “Wiping.”)

Cleaning

The cleaning process completely ejects ink from all the nozzles and refills them with ink several times to prevent clogging. This process ensures optimum print quality.

A longer version of cleaning, “super cleaning,” is performed automatically when the printer is switched on for the first time. This thorough cleaning may take up to 5 minutes or more.

Cleaning and super cleaning can be initiated by the user, using the Macintosh print dialog Utilities options. See *Color StyleWriter Pro User’s Guide*, Chapter 4, for more information.

Wiping

The wiping process wipes dust and ink off the nozzles with a rubber head wiper. (Wiping is done automatically when the power is switched on or off, after paper is fed, when the nozzle cap is opened or closed, and every 60 seconds during printing.)

Capping

The capping process covers the nozzles to prevent them from drying, leaking, or collecting dust.

During printing, if no data has been received for 60 seconds, the purge unit wipes and caps the print head. When the printer has been idle for 60 seconds, or when you use the power on/off button to turn off the printer, the print head is capped.

On the Color StyleWriter Pro, the purge unit is located in the base of the printer, under the carriage unit's home position.

The Paper Feed System

Here's how paper is fed through the printer during a print cycle:

1 When printing starts, the cut sheet feeder presses the paper forward against the pickup rollers.

2 The pickup rollers rotate, sending the top piece of paper (if present) to the paper feed section. At the same time, a flag on the pickup roller shaft trips the pickup rollers sensor to indicate that the rollers have moved.

3 Meanwhile, the paper entering the paper feed section moves a second flag, which trips the paper sensor.

If the paper sensor is not tripped, it sends a message to the controller board, which informs the Macintosh computer that the printer is out of paper. Print Monitor displays that message for the user.

If the paper is detected for at least two seconds, printing starts. The feeder roller picks up the paper and moves it forward, and the carriage unit moves across the paper, ejecting ink. The feeder roller continues advancing the paper until the page is printed.

4 The eject rollers make sure that the printed page exits the printer completely.

The Print Cycle

The print cycle consists of the following sequence of steps:

1 The computer sends a printer initialize signal (INIT) to the printer.

2 The printer checks for Ready status and sends appropriate signals to the computer.

3 The ink cartridge is primed before printing begins, and primed and wiped during printing.

4 The computer sends a high-resolution image of each page through the serial connection to the printer logic board, where each page is reconstructed and sent to the print head by way of the logic board ribbon cable.

5 The paper sensor checks for paper.

6 The paper feed motor rotates the feeder roller to advance the paper one line at a time.

7 The carriage motor moves the print head across the paper, transferring ink to the paper to reproduce the page.

8 When the printing signals stop, the carriage motor takes the ink cartridge to the home position and activates the purge unit, which wipes and caps the nozzles on the print head and locks the carriage into place.