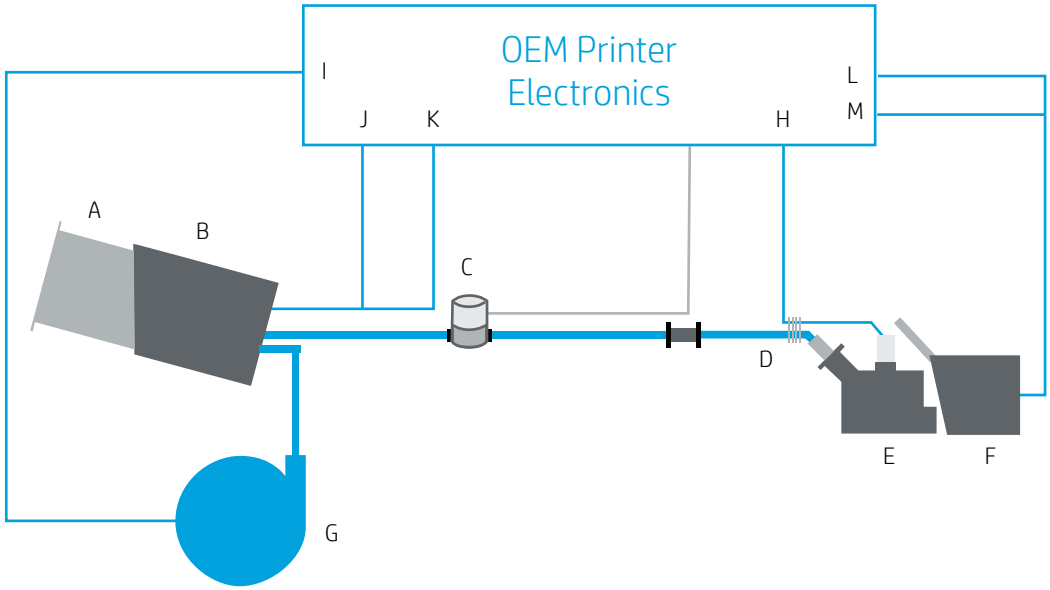
Technical white paper

HP Bulk Solvent Ink System Overview

Reliable, versatile, cost-effective, enclosed system solution

The HP Bulk Solvent Ink System, with its associated enablers, development kit, reference configuration designs, and documentation, supports the development of enclosed bulk printing solutions that are reliable, cost effective, and versatile.



A – Ink Cartridge

B – Ink Cartridge Stall

C – Regulator Valve Assembly

D – Pigtail Assembly (optional) with valve

E – Print Cartridge with protector connector

F – Print Cartridge Stall

G – Pressurized Air Supply Source (optional)

H – Bulk System Control

I – Air Pressure Management Control (Optional)

J – Ink Cartridge Control

K – Ink Cartridge Security (Smart Card) Control

L – Print Cartridge Security (Smart Card) Control

M – Printer Writing System Control

Bulk solution

The HP Bulk Solvent Ink System is part of HP's portfolio of products, enablers, and systems. It is supported by a collection of components and documentation to enable the design and building of complete bulk ink delivery solutions. The system incorporates key HP components, including:

- Print cartridge stalls
- Ink cartridge stalls
- Tubing (2 types)
- Pen driver boards
- Print cartridge connector protectors
- Print cartridge valves

The system includes reference fluidic valves, optional pressurized air supply source, and optional pigtail assemblies. The printer electronics provide control of the bulk system, air pressure management (optional), ink cartridge, printer security, and printer writing system. Ink regulation functionality is demonstrated through control routines offered via source and object code. The system supports high-quality printing through security-enabled ink cartridges and print cartridges with inks offered by both HP and partners.

Enclosed system

The HP Bulk Solvent Ink System and its suite of enablers and reference components support the development of an enclosed printing system. This enclosed system isolates the ink from negative environmental interaction, and optimizes performance. It ensures system integrity by blocking outside contaminants and air from entering the fluidic system, and by eliminating the free escape of liquids and volatiles from the system. The design eliminates all openings. Enablers and reference components provide tight seals at all interfaces, and cartridge and enabler materials minimize air and vapor transmission. The solution allows tight control of the printing system and its environment, ensuring long, consistent, reliable printing performance while maintaining a safe work environment.

Reliable system

System reliability is a critical attribute of any printing solution, and the HP Bulk Solvent Ink System provides a reliable, field-proven ink regulation solution for confident and consistent, ink delivery.

- **A simple control system** manages print cartridge ink re-fill using a dependable, accurate sensor integrated into each print cartridge for ink level feedback, and a simple, fail-safe fluidic regulation valve to allow ink to flow from the ink cartridge to the print cartridge. The HP Development Kit includes a reference system design and the associated software source and object code for a proven control routine.
- **The 45sci Print Cartridge** is an extension of the HP 45si cartridge, refined to optimize ink fill-level feedback. The HP 45si cartridge provides a solid, robust design, proven across a range of HP and partner solvent inks.
- **The print cartridge sensor**, located within the 45sci Print Cartridge, uses Texas Instruments' LDC technology to provide accurate, un-intrusive, ink level feedback. Texas Instruments' inductive sensing is a non-contact, magnet-free sensing technology that provides a high resolution, precision measure of the ink bag position without interfering with backpressure control or print cartridge operation.
- **The regulator valve** is a simple fluidic valve that allows the flow of ink from the ink cartridge to the print cartridge, based upon the sensor's ink level feedback. The HP Bulk Solvent Ink System allows freedom of valve choice. Consistent ink flow control can be achieved through a wide range of commercially available options. HP has tested several types of valves and found tradeoffs between cost, performance, and reliability. The simple designs of these valves reduce the risk of mechanical malfunction, and simplify cleaning and air purging. Stainless steel bodies with minimal moving parts support lower wear and longer life. Solvent-compatible seal options support applications with a wide range of solvent ink options. The sealed design and robust materials ensure the integrity of the enclosed system by containing the ink and vapor while blocking air entry.
- **The ink cartridge** provides an ink bag within a larger, rigid, secondary container. The large-capacity (400 ml), multi-layer, collapsible bag provides solvent resistance and air-barrier properties to maintain the integrity of the system. A leak detection circuit is an additional safeguard to monitor bag integrity. The ink cartridges are designed to interface with the HP stall assembly (Q2308-60015), which provides air, ink, and electrical interfaces to properly engage the ink cartridge. The ink cartridge is equipped with two independent sets of physical lock-out features to ensure that only the proper ink cartridge is inserted into the appropriate ink cartridge stall.
- **The Smart Card** solution includes both print cartridge and ink cartridge ICs, and host Smart Card chips that together enable the required authentication, store manufacturing information, and record product performance and usage parameters. The host Smart Card chips provide the ability to communicate with the Smart Card ICs to access or change information fields. The Smartcard ICs and the host Smart Card chips together allow the system to optimize print

performance while providing the required supplies authentication and ink match validation that avoids performance and safety issues due to unintentional mixing of mismatched supplies.
- **HP tubing** allows ink to flow to the print cartridge. It is offered in two sizes to provide a custom fit to both the HP ink cartridge stall and the HP print cartridge valve. Both tubing types are engineered, multi-layer composites that provide both excellent solvent resistance and superior air-barrier properties. Both tubing types ensure the integrity of the enclosed system by containing the ink and vapor while blocking air entry.

Economical system

System cost is an important consideration for any printing system, and the HP Bulk Solvent Ink System reduces development cost and enables economical solutions.

- **The Development Kit** provides a thoroughly documented, functional bulk-solvent solution as a reference for timely system demonstration and exploration, thereby reducing the initial investigation and product development investment.
- **Regulation control source and object code** significantly decreases the required software development effort.
- **Printed circuit assembly (PCA) board** and its available schematics simplify integration into printing system electronics.
- **Enablers and reference components** eliminate design and sourcing effort, while speeding time to market.
- **Regulator valves** offer simple, economical, commercially available control options that enable cost, performance, and reliability trade-off choices.
- **Ink cartridge stalls** provide a proven, easily integrated interface to the ink cartridge and its Smart Card interface.
- **System versatility** allows further performance – cost trade-offs to be considered as part of the solution design or configuration.

By leveraging HP's reference system, a solid bulk-solvent solution can be developed that supports solid business financials.

Versatile system

System versatility is critical to addressing the needs of the range of potential applications, and the HP Bulk Solvent Ink System provides the versatility to expand or optimize to the needs of each application.

- Fixed-head designs for typical manufacturing line applications or scanning-head designs for more demanding applications are supported.
- Multiple horizontally or vertically fired print cartridges, each at the same height or at different heights, can be controlled with dedicated valves for each cartridge, or the system may be simplified by sharing a single valve controlled by the sensor from a single print cartridge.
- Dual horizontally and vertically fired banks of print cartridges can be configured to support simultaneous printing of top and bottom sides from a single system.
- Pressurization or gravity can be used to flow ink from the ink cartridge. The pressurized ink cartridge provides location freedom (height flexibility) for the ink cartridge. It also ensures more complete ink delivery, and thus less ink waste. A gravity-fed system is also possible as a simpler option.
- The ink cartridge and associated stall offer orientation (installation angle) flexibility, with 15 degree (pressurized) or 90 degree (gravity) orientations being typical.
- Ink-line pigtail assemblies with quick disconnect fittings can be included to simplify component swap-out or other interactions.
- Tube lengths can vary to meet the specific application needs, with pressurized systems supporting longer lengths.
- HP 45sci Print Cartridges are compatible with the same stalls and drive electronics as single-use HP 45ai and HP 45si Print Cartridges, thereby offering flexibility to introduce single-use cartridges for ink assessment or short-run needs.
- Ink level detection algorithms (available via reference source and object code) ensure sufficient time to swap out empty ink cartridges, while maintaining uninterrupted printing from print cartridge reserves.
- Accurate ink cartridge out-of-ink detection is included as part of the regulation control (available via reference source and object code).
- With multiple ink cartridge stalls, the system can be designed with auto-switch capability, allowing extended operation without concern for ink depletion.
- Dual in-line valve redundancy can be added, to provide fail-safe operation.

Portfolio offering

The HP Bulk Solvent Ink System complements HP's existing portfolio of products, enablers, and systems by adding a second bulk system offering with a unique set of features and benefits.

The HP Bulk Solvent Ink System delivers the features and capabilities to support the development of enclosed bulk printing solutions that are reliable, cost effective, and versatile. Optimal system and print performance is achieved through the use of these specified enablers, alignment with reference configuration designs, and adherence to HP documentation.

Feature	HP Bulk Solvent Ink System	HP Bulk Ink Delivery System
Solvent compatible	Yes	No
Aqueous compatible	In development	Yes
Ink cartridge capacity	400 cc	350 cc
Regulation technology	Electronic valve control with dynamic fill level sensor feedback.	Mechanical
Development Kit	Available	Not available
Security	Smart Card authentication with customized OEM memory space.	Smart Chip (no authentication)
PCA	• Available as a reference design for integration into printer PCA. • Standalone sample included in development kit.	Only available as an HP offered enabler
Software and Firmware	• Available as reference source and object code. • Fully functional and fully documented.	Not available
Ink match validation (ink cartridge and print cartridge)	Supported	Not supported
Out of ink detection	• Available as reference source and object code. Extension of regulation functionality. • Fully functional and fully documented.	Coil-based sensor
Architecture	Compatible with simple embedded systems and fully demonstrated on Raspberry Pi single-board computer.	Dependent upon Windows PC and RS-232 port

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