

White paper

Thermal Printing Cuts Cost and Adds Value for DSD

An important part of the value of automating direct store delivery (DSD) operations comes from having the ability to give customers delivery receipts, order forms and invoices on the spot. Printing documentation at the time of the visit helps ensure accuracy, reduces paperwork and clerical labor in the back office, and accelerates the cash cycle. In some countries, it is a legal requirement that DSD companies to provide and maintain a printed record of each transaction. The actual value companies can attain by mobile printing depends on the printer itself. For example, the media used in thermal printers typically costs 45 to 50 percent less than multi-part forms used in dot matrix printers¹, and the total cost of ownership (TCO) for ruggedized mobile printers is 58 percent lower than for non-ruggedized models.

Media cost, reliability, ease of use and compatibility with mobile computers and DSD applications give businesses a lot to think about when selecting a printer to support their operations. The decision is also made challenging because there are more technology and product options than ever. For companies that already use mobile printing in their DSD operations, product choices may have changed considerably since the last replacement cycle. Many first generation DSD automations included a vehicle-mounted dot matrix printer. Today DSD printers can be worn, carried or remain mounted in the vehicle, and thermal print technology is selected for the majority of new and replacement rollouts.

Dot matrix and direct thermal technology account for nearly all the printers used in DSD operations worldwide. This white paper will compare the two technologies and explain how they differ in the areas that are important to direct store delivery operations, including ease of use, reliability, media support and TCO.

Key Requirements for DSD Printers

What makes the perfect printer for DSD operations? It needs to be:

- Durable enough for reliable, long-term use in the work environment, where drops, bumps and exposure to the elements are common;
- Convenient for operators to use, transport and perform basic maintenance, such as changing media;

- Capable of high print quality, including easy-to-read text to prevent confusion and errors, plus including all the fonts, logos, bar codes and other graphics needed to present a professional image on documents;
- Compatible with quality media that will produce invoices, order forms, receipts and documents – and preserve their quality and legibility for as long as the printed material needs to be archived.

Ruggedness

Ruggedness and durability are what separate true DSD printers from general-purpose models that are adapted for mobile use. Whether it is permanently mounted in the vehicle or carried by the user, a DSD printer can be expected to be exposed to vibration, drops and temperature extremes. Devices that are used outside the vehicle will also be exposed to wind (which can blow particles into the device), rain and snow. These conditions can quickly end the effective life of non-ruggedized printers, which have an average annual failure rate of 17 percent in DSD operations, nearly three times higher than ruggedized models.²

There are both objective and subjective measures of mobile printer ruggedness. IP ratings are objective and are one of the best measures of a devices ruggedness and ability to withstand conditions common to enterprise operations. Ratings are typically expressed by the letters “IP” followed by two numbers. The first digit, which ranges from 0 to 6, indicates the level the device is protected against particles, and the second digit, which ranges from 0 to 8, is the protection against water. For example a mobile printer rated IP42 has level four particle protection, which means it can be penetrated by dirt or other objects up to 1mm wide, and level two water protection, which means the device can function after exposed to dripping water at a 15° angle to the seal. The higher the number, the greater the protection. DSD printers should have an IP rating of at least 54, which is considered dust protected and able to withstand splashing water regardless of orientation. Figure 1 below provides a guide to IP code designation.

Figure 1: IP Rating Designations

1st Digit – Particle Protection Level		2nd Digit – Moisture Protection Level	
0	Not protected	0	Not protected
1	Protected against penetration by objects larger than 50 mm	1	Protected against dripping water
2	Protected against objects greater than 12mm	2	Protected against dripping water when tilted up to 15N
3	Protected against objects greater than 2.5mm	3	Protected against spraying water
4	Protected against objects greater than 1.0mm	4	Protected against splashing water
5	Dust protected	5	Protected against water jets
6	Dust tight	6	Protected against heavy seas
		7	Protected against the effects of immersion
		8	Protected against submersion

Source: Underwriters Laboratories

¹ “Mobile Printing Requirements for Direct Store Delivery (DSD) Applications,” David Krebs, VDC Research. Accessed April 18, 2010 from <http://www.barcodesinc.com/news/?p=3069>.

² “Mobile Printing Requirements for Direct Store Delivery (DSD) Applications,” David Krebs, VDC Research. Accessed April 18, 2010 from <http://www.barcodesinc.com/news/?p=3069>.

Drop ratings are very useful measures for determining a device's ability to keep functioning and whether the seal will maintain integrity after the device is dropped – providing the drop testing is appropriate and objective. It is important to read product spec sheets carefully, because some manufacturers rate their products to drop to a carpeted or vinyl floor or plywood, while others set a higher standard and measure drops to concrete. Also note if the device is rated to withstand a drop when landing on any side or a corner. Corners and seams are most vulnerable to impact. Some tests are conducted so the device falls flat and/or only lands on reinforced areas.

Tumble ratings are another useful measurement of a device's durability. Tumble testing simulates the additional random bouncing that occurs after the initial impact from dropping the device. Some manufactures will report the number of tumbles – usually several hundred times – at specified height.

The most common failure points for mobile computers include cables and connections, paper feeders and batteries that do not last the length of the shift. Consider how various printers differ in these key areas, and how there different features could impact operations. For example, Bluetooth connectivity adds marginal cost to the printer, but eliminates the chance of failure from broken cables (and cable replacement costs). A straight paper path reduces the chances the printer will jam. Full shift or better battery life is best validated through field testing.

Reliability is the foundation for ease of use. If printers aren't working, DSD staff are not working efficiently. They will need to write receipts, invoices and orders by hand, which could easily put workers behind schedule. One major study found DSD workers lose between 35 and 40 minutes of productivity each time their mobile printers fail³, which adds hidden cost to operations. That's more than enough time to cause missed delivery windows and irritated customers.

Convenience & Ease of Use

Reliability aside, printers should be as convenient as possible for normal use. DSD drivers often have tight schedules, so anything that saves time or prevents delays is valued. Features that add convenience include easy media loading, an LCD screen to display prompts, alerts and error messages, intuitive menus and controls, and ergonomics so the printer can be used (and carried or worn if not vehicle mounted) comfortably and without interfering with unloading, stocking or other normal activity.

Print speed is the convenience factor that users and customers will notice most. DSD printers are productivity tools, so models that keep users and customers waiting for their paperwork to print are unacceptable. Printer spec sheets present the print speed in inches per second (ips), but in real world use ips is not a reliable indicator of performance because there are many variables to actual output speed, including the amount of graphics and bar codes on the printed document, printer memory, the amount of variable data to be included (price adjustments, notes, etc.), whether acceptance signatures will be digitized and printed, application software and the mobile computer used. The best way to evaluate this performance is to test different printers with the actual documents that are printed on the route.

Speed Impacts Operations

“Our route managers didn't print invoices unless they absolutely had to because our old printers really slowed them down. The results were incomplete records and an increased workload for support personnel. We wanted a very fast, very reliable printer.”

Ron Ruud
Vice President of Operations
Schwan's Home Service

One of the overlooked aspects of convenience is the printer-computer interface. Simply having the right cable connections or mutual Bluetooth connectivity is not enough to optimize performance. The software interface between the printer and computer is a major variable on output speed – using the same printer, a print job may take 20 seconds or longer to complete with one mobile computer compared to another. Once again, testing printers with the actual computers and software used on the route is the best way to identify performance differences.

Print Quality & Media Support

DSD processes are automated to improve productivity and eliminate errors. The printer needs to support that by producing clear, legible documents and (when applicable) bar codes that will read reliably to support automated data entry. The invoice or receipt the DSD driver leaves behind also represents the company image to the customer, so overall quality and crisp logos and graphics are important to support a quality brand image. Print technology and media are the main variables to print quality. One of the reasons dot matrix printers are falling out of favor is the inconsistent or weak print quality they produce on multi-part forms.

Even top-quality mobile printers can be undermined by low-quality media. The paper or other media used with the printer not only impacts initial print quality, but how long the document will remain readable. Print quality and media type are important considerations when invoices or other documents need to be retained for several years.

When considering media, DSD operators need to assess whether what has been done traditionally is optimal or necessary. Support for 8½ by 11-inch or A4 media is much less of a printer requirement than it was a few years ago. Today most customers accept smaller documents, which results in less paper being consumed and significant cost savings.

Media support, print quality, ease of use and reliability are essential criteria for DSD printers, regardless of whether dot matrix or thermal technology is used. There are many differences between the technologies on these criteria, and each printer type has advantages over the other for specific usage situations. The following sections provide an overview of dot matrix and thermal print technologies as they relate to DSD requirements.

³ Ibid.

Print Technology Overview – Dot Matrix

Dot matrix is an impact technology that features a pin striking ribbon to produce an image on the media. Dot matrix printers support full page media used in DSD, including 8½ by 11-inch and A4 sheets. As such, most dot matrix printers are not especially compact, so for DSD applications they are typically mounted in the vehicle, rather than carried for use at the stop. Portable models are available, but they don't lend themselves to convenient, one-hand operation. In-vehicle printing use does not maximize productivity because drivers often have to make an extra trip to the vehicle to retrieve the printed material after meeting with the customer (for example to get a delivery signature, order adjustment, etc.), though this productivity limitation is not unique to dot matrix printers.

Besides supporting full-size sheets, dot matrix printers can produce documents on multi-part forms, which is a major reason they were the early choice for DSD automation. Print quality is considered average, and there are visible quality differences between the top and bottom copies of multi-part forms. Because quality tends to degrade on copies, and when ribbons near their end of life, dot matrix is not a good option when bar code printing is required, because bar code readers require consistent, precise images. To get around dot matrix quality limitations, sometimes companies purchase forms with their logo preprinted, but this drives up the supply cost.

Dot matrix printers are advantageous for DSD when full page and multi-part forms are required by customers or local legislation. In fact, dot matrix remains the only option for multi-part form printing. Full-sheet printing can be a plus because it enables the use of larger type and a lot of information can be included on a page. Dot matrix disadvantages include portability and ease of use, media cost (it costs less to print two copies on thermal paper than a single multi-part form and an additional full page is required for any partial pages, including one line of print), and limited bar code and graphics output capabilities. Reliance on ribbons is also a drawback, because drivers need to keep spare ribbons stocked in the truck and to spend time changing ribbons in the field.

Print Technology Overview – Thermal

Thermal printers work by applying heat to create an image onto the media. For direct thermal printing, which is typically used in DSD and is the most widely used thermal print technology overall, the printhead applies heat to coated thermal media, which turns dark where the heat was applied. There is no ink or toner – the only supply needed for direct thermal printers is the paper or label stock itself. DSD drivers will not ever have to spend time changing ribbons or ink cartridges. The other form of thermal printing is thermal-transfer, in which the printhead heats a ribbon, which transfers ink to the media. Thermal transfer is mostly used for specialty label printing. Both direct thermal and thermal transfer produce price, crisp imaging, which is why the thermal category is the most-used technology for bar code printing. The excellent quality is also a plus for logo and graphics printing.

Thermal printers have advantages and disadvantages when it comes to media. The biggest drawback is that thermal printers can only support media up to 8 inches wide, so they can't be used for full-page printing. Multipart forms are not supported, but that is not necessarily a disadvantage because thermal paper is much less expensive. It is more cost effective for a DSD driver to print two copies if necessary (one for the customer, one to retain) on thermal paper than it is to print a single two-part form.

Many thermal printers are designed specifically for mobile use, and models are available that can be worn on a belt or shoulder strap, carried and used with one hand, mounted on a workboard with a mobile computer, or mounted in a vehicle. Handheld and wearable models can be extremely rugged, with IP and drop test ratings that support four or more years of use in demanding DSD environments.

Direct thermal printers designed for DSD use have many advantages: a variety of convenient form factors, ruggedness and reliability, excellent print quality, low-cost media, efficient use of media, fast time to print, no need for ribbons and the lowest total cost of ownership. The primary limitations are the inability to support full-size or multi-part forms.

Thermal Printer Value for DSD

Carlsberg's experience brings the differences between dot matrix and thermal print technology to life. The Danish-based brewer switched from dot matrix to thermal printers when it refreshed the technology for drivers who serve pubs, restaurants and retailers in Denmark. Because Carlsberg had already automated its DSD operations and its applications and processes did not change, its switch emphasizes the importance of print technology. The result: Carlsberg reported annual savings of \$100,000 in media cost and \$15,000 in printer service by switching from full-page dot matrix printers to thermal models that use 4-inch media.

The following sections provide more detail about the value thermal print technology offers for DSD operations.

Cost

Thermal printers cost less to operate and maintain than dot matrix models, and also usually cost less to purchase. The TCO advantage comes from lower supply costs (the ability to use lower-cost paper plus eliminating the ribbon expense) and because of the superior ruggedness of thermal printers, which enables a longer service life plus less productivity loss from breakdowns. The five-year TCO for ruggedized mobile printers is 50.6 percent lower than for consumer/commercial grade models according to industry analyst firm VDC Research Group⁵. While there are some ruggedized dot matrix models, there are more rugged options for thermal print technology.

Media

The media advantages alone make it cost effective for many businesses to switch from dot matrix to direct thermal printing. Thermal media also provides convenience benefits, reduces waste and often represents a quality upgrade because it is long lasting, resists smudges and is not dependent on ribbon quality to print clearly. Thermal media is available in a variety of sizes, thicknesses and quality levels, including paper that will remain readable for years to satisfy document retention requirements.

⁵ "Total Cost of Ownership Models For Mobile Computing and Communications Platform presentation" David Krebs, VDC Research Group, 2010.

Thermal media helps DSD operations reduce costs in two major ways: it enables businesses to use less paper, and the paper itself costs less. Thermal printing also saves money by reducing waste and eliminating the need for ribbons or toner. These benefits are good for the environment and the bottom line.

Basic savings on materials can be significant depending on the type of materials that are printed. For example, businesses that use multi-part forms can reduce their paper costs by 45 to 50 percent, according to the previously noted independent analysis. Even if multi-part forms are not used, supply costs for direct thermal printers are lower than for dot matrix because paper costs are comparable and there is no ribbon expense (and no labor cost for the time spent changing ribbons and disposing of used ones).

Thermal printers also provide an opportunity to use less paper. In Carlsberg's case, the company redesigned its A4-size invoices and delivery notes to fit on 4-inch wide media (since thermal printers use roll-fed paper, the printed form can be as long or as short as necessary). Carlsberg did not have to exclude any information from the documents, because the high print quality from the thermal printers made the text clear and legible. Redesigning the forms enabled Carlsberg to reduce its DSD printing output by 2 million pages per year.

"This is a great deal for us as there will be large savings," says Claus Jensen, development consultant at Carlsberg Denmark. "We will save 25,000 rolls of paper per year, which will give a return on investment in only two years. In addition to that, it will save our drivers much time and effort in their delivery operations."

Another Intermec customer, Mission Foods, calculated it would save \$30,000 annually by switching to thermal printers for DSD. The company previously printed two copies of each invoice, one for the customer and another that was dropped off at a Mission Foods distribution center for processing. Automating the invoice process with mobile computers, which transmit transaction data wirelessly, eliminated the need for Mission's copy of the invoice, and the thermal printers further reduced supply costs. See the complete Mission Foods case study at www.intermec.com/public-files/case-studies/en/MissionFoods_cs_web.pdf.

Print Quality

Thermal printing enables businesses to save money without sacrificing quality. In fact, thermal often provides a quality upgrade for DSD documents, because the image quality is consistent on every page (unlike multi-part forms, where top copies tend to smudge and bottom copies are often faint).

Thermal printers are favored for their quality and consistency. Some thermal printer manufacturers warranty the printhead for 1 million inches, which is more than 15½ miles of output. Because there is no ink or toner, direct thermal print quality doesn't depend on the ink supply. For printers, graphics are relatively easy to print compared to bar codes, which must be produced to exact tolerances. Since thermal printers excel at bar code printing, they can easily produce company and customer logos and other graphics on demand, saving the expense of using preprinted media.

Reliability & Ease of Use

Thermal printers provide many operational advantages for DSD, not only financial ones. The variety of convenient form factors that are offered, built-in Bluetooth or Wi-Fi

wireless connectivity, integrated credit card payment capture options, easy paper loading, ribbon-free operation and the extreme ruggedness that is available all have real value in the field. Many of these attributes and advantages have been documented throughout this white paper. To recap:

- There is a wide choice of mobile thermal printers that were designed specifically to meet the needs of DSD workers. These offer flexible vehicle mounting and carrying options, one-hand operation, wireless connectivity to mobile computers and other time-saving features.
- Thermal printers have fewer moving parts and are generally more reliable than dot matrix models used in mobile operations. Mobile thermal printers are available that meet the demanding, independent standards for environmental and drop resistance.
- Failure rates are extremely low for ruggedized mobile thermal printers.
- Thermal printers are fast, which saves time for drivers and customers.
- Paper is easy to load and ribbons do not need to be changed.

Industry analyst firm VDC Research Group summed up these advantages in its aforementioned report, which states: "Mobile printer technology preferences continue to shift from non-thermal to thermal due to the technology's comparatively lower maintenance costs, ease of use and reliability."

Conclusion

Thermal printing has clear performance, cost and convenience advantages over dot matrix for DSD operations. The most compelling reason to use dot matrix printers is for full-page printing. When full pages are not a requirement, thermal printing is the more practical choice. Businesses will save money on media, improve reliability and reduce service costs, and improve user convenience – all without sacrificing speed or quality. These assertions are well proven by Carlsberg, Mission Foods and hundreds of other DSD organizations that have deployed mobile thermal printers on their routes.

Intermec's own DSD experience also affirms the value of thermal printing. Intermec has been providing DSD automation solutions for more than 30 years, and manufactures both thermal and dot matrix printers for route operations. Intermec can provide the mobile computers, wireless options and mobile printers to meet different customer requirements and preferences. Increasingly, our customers prefer thermal printers for their DSD operations. Visit the DSD solutions section of our website or contact us today to learn more about how our experience, products and partners can help improve your direct store delivery processes.

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