

Development of the AeroDR® Series of DR Panels

Abstract

In recent years radiography has shifted from Computed Radiography (CR) to Digital Radiography (DR). Konica Minolta's first 14" x 17" cassette size DR system, the AeroDR has received high marks from users for both excellent image quality and immediate image access.

The lightweight AeroDR offers durability and a wireless configuration that has improved user workflow. It also employs AeroSync, an automatic X-ray detection technology that enables the AeroDR panel to be used with most existing X-ray generators, much like CR.

Konica Minolta has developed a series of panels in sizes suitable for various radiography sites, and AeroDR panels are now in widespread use from radiography rooms to patient rooms to the patient side. In addition to the 14" x 17" size, the lineup includes the AeroDR 17" x 17" panel, which can be used in a standing bucky imaging environment where radiography of a large body area is required, and the AeroDR 10" x 12", for use with infants and children and in orthopedic clinics and hospitals. These AeroDR panels enable a complete shift from CR to DR.

1. Introduction

In 2011, Konica Minolta commercialized its AeroDR system, a lightweight and robust wireless Digital Radiography panel. Its operability and inherent workability are equivalent to that of Computed Radiography, however newer functions favor DR technology, including real-time imagery, improved image quality, reduced radiation exposure and the ability to acquire multiple Images with one DR panel, replacing multiple CR cassettes and accelerating the digitization of conventional analog portable X-ray devices. Additionally, with AeroDR's portable imaging environment, an automatic X-ray detection technology known as AeroSync, the physical connection to the generator has been eliminated further simplifying the process to upgrade X-ray rooms and portable X-ray devices.

AeroDR (14"x17") is a wireless panel-type DR system for use in conventional bucky imaging platforms, while the AeroDR (10"x12") is used in bucky imaging platforms that utilize small-sized panels for infants and children. Similar technology is now used in both systems.

2. The Development of the AeroDR Series

2.1 AeroDR System Panel Lineup

Konica Minolta has now released three different panel sizes: the 14"x17", 10"x12" and the 17"x17" panel.

During the heyday of CR, a large variety of cassette sizes were available. (14"x17", 11"x14", 10"x12", 8"x10", 24x30 cm, 18x24 cm, and 15x30 cm), and the appropriate one had to be selected for each use. With the change to DR, which offers the ability



Fig.1 Three-panel lineup: 10"x12", 14"x17", and 17"x17".

to reveal images in a few seconds, regardless of the size of the anatomy being imaged, the 14" x 17" panel enables numerous anatomical parts to be imaged, achieving comparatively more added value than with CR. There are now fewer situations in which multiple panels are needed.

In large hospitals, a variety of cassettes are still used in radiography rooms to accommodate specialty applications and the array of anatomical parts that require X-ray imaging. When more than one panel is required, an increasing number of requests are often made for small-sized DR panels that accommodate parts of the body that traditionally were imaged using small-sized cassettes.

Most notably, panels used to image children or infant incubators must measure 10"x12" or less. Additionally, despite the high imaging versatility of portable panels, conventional CR or DR exclusive machines with a large 17"x17" imaging area for large anatomies may not benefit from replacement with 14" x 17" panels. Considering these issues, Konica Minolta has spearheaded the development of a series of small and large-sized cassettes that enable conventional cassette-type CR and exclusive machines to be replaced by DR.



Technical White Paper

2.2 Technological Development on the Basis of the AeroDR 14"x17" panel

Konica Minolta has developed a series of cassettes that offer special features inherent in the AeroDR system, such as high-quality images and minimal weight, faster and easier workflow enabled by operator-friendly consoles. Leveraging the fact that the control mechanism does not change with detector size, common concept designs such as scintillation, which affects image quality, a TFT Panel, and a Read IC are also common. Additionally, each panel is equipped with a lithium-ion capacitor, enabling users to recharge without worrying about long term deterioration of power and while operating under a bucky platform can be provided with optional power wiring. We have developed a series of different sized cassettes using the same basic design concepts.

2.3 Docking Station for Panels

With this cassette series, Konica Minolta has developed a docking station suitable for all cassette sizes. The newly commercialized "AeroDR Docking Station 2" can be used with all panel sizes and greatly reduces the surface area needed compared with conventional docking stations.

The Docking Station is designed for stability, even when a large panel is inserted.



Fig. 2 Newly developed Docking Station for charging accepts any of the three sized panels. It is easy to use and securely holds the panel.

3. AeroDR (17"x17" panel)

The AeroDR, a 17"x17" DR panel, offers the following advantages:

- 1) The 17"x17" full-sized wireless DR panel is the world's lightest in its class, weighing only 7.92 lbs. Although full sized, it can be used for portable imaging.
- 2) The cassette's external size complies with ISO4090, permitting installation on a conventional bucky imaging platform. It can also be used on imaging platforms and machines used for large anatomy screening.

3.1 The Value of Portable Imaging on a 17"x17" Panel

There are many occasions when patients either cannot move or cannot maintain the requested position to perform the

imaging technique. In that event, some must be rescanned using a 17"x17" cassette. In emergency situations, the entire body must be scanned, creating a need to be imaged in a larger area. AeroDR 17"x17" is a lightweight cassette-type DR system with wireless features and functions that can meet those potential needs.

3.2 Improved Function with the AeroDR Exclusive Imaging Platform

With the AeroDR exclusive imaging platform, the following three functions are characteristic of the system (Fig.3):



Fig. 3 The AeroDR 17"x17" radiographic stand has two functions. When a cassette is inserted, the cassette's lithium ion capacitor is automatically charged and wireless communication automatically changes over to wired communication.

1) Cabled Autoloader

The AeroDR exclusive cable is automatically inserted into the cassette by simply sliding the AeroDR into the imaging platform (no manual operation is required to set the cable). When inserting, communication is automatically changed from a wireless to a wired connection, improving the cycle time function.

2) Auto-Charge (Constant Recharging)

When AeroDR is inserted into the imaging platform, panels may be used "as-is" at the bucky platform, as the panel always receives power through a cable connection (recharging function). Due to constant recharging, the high-quality lithium-ion capacitor makes expansion and life shortening unlikely, increasing usable life.

3) When combining it with CS-7 Control Station, the cassette's auto-tracking function, location can be automatically reflected onto the console display through the auto-track and auto-focus functions.

4. AeroDR (10"x12" panel)

AeroDR, Konica Minolta's 10"x12" DR cassette, offers the following three advantages:

- 1) The 10"x12" wireless DR cassette is the lightest in its class, weighing only 3.7 lbs.
- 2) The 10"x12" external size, ISO4090-based cassette can be used for small-size trays, such as child buckys and incubators.

3) Considering small-sized cassette imagery, DQE is improved to help expose for the shortest period necessary to ensure reliable infant imaging.

4.1 Technological Development and Size Reduction

The 10"x12" cassettes have approximately half the surface area of 14"x17" cassettes. Therefore, motherboards and capacitors measure half the surface area in order to accommodate the DR function. In essence, to fit the same amount of function and performance into a smaller cassette size, smaller cassettes using smaller motherboards have been developed without sacrificing function and performance. This is achieved through review of the inter-substrate wiring, which shortens the distance between motherboards.



Fig. 5 The AeroDR 10"x12" detector.

When patients are likely to hold a panel, the risk of dropping increases; thus, this technology has been adopted for the small-sized, 10"x12" panel.

4.3 Short-time Exposure for Infant Imagery

When infants are imaged, the reduction of radiation exposure and the limiting of bodily movement are essential, thus a short exposure time is desired. Most infant imaging occurs in incubation beds within an NICU. Due to the many requests to image infants with portables, imaging is completed using the AeroSync function or automatic detection technology.

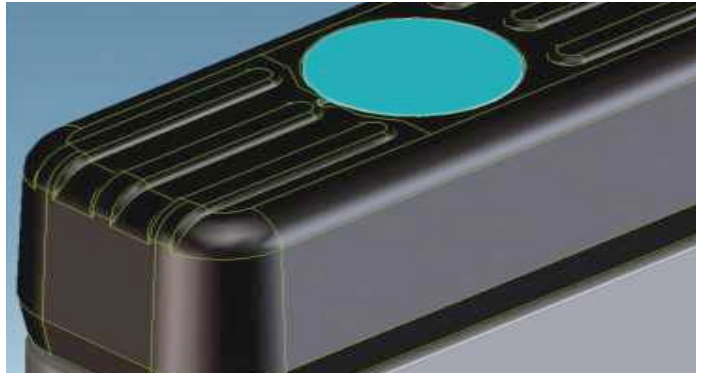


Fig. 6 The conventional corner shape or the protection cover for the 14"x17" panel.

4.2 Development to Strengthen Drop Resistance

To enable skyline imaging used in orthopedics, patients may hold the smaller, 10"x12" panels themselves. Unlike their larger counterparts, smaller-sized panels are lighter and easier to handle, enhancing ease of use; however, the risk of dropping a panel during use remains present. We have tested scenarios in which a panel might be robustly equipped without issue, and have investigated such outcomes in an effort to strengthen drop resistance.

If a panel is dropped from a height of 75 cm, the shock on a 14"x17" cassette is about 500-1000 G. To cushion shocks within the internal structure, specialized cushioning materials and a pressurized surface are optimized to absorb shock within the internal structure.

Exterior damage would most likely be caused by angular falls on the corner of a panel. The exterior of the AeroDR panel has a tubular structure comprised of carbon, with a resin protection cover capped on the longest side. After examining the structure that absorbs shock, we reformed the resin protection cover without transmitting shock to the panel itself. By setting the form for the 10"x12" panel (Fig. 7) and comparing it with the angular protection cover on a conventional 14"x17" cassette (Fig. 6), the item was redesigned to avoid damage of its protective cover and exposure of the inner contents when stimulating the shock absorption from a fall (Fig. 8).

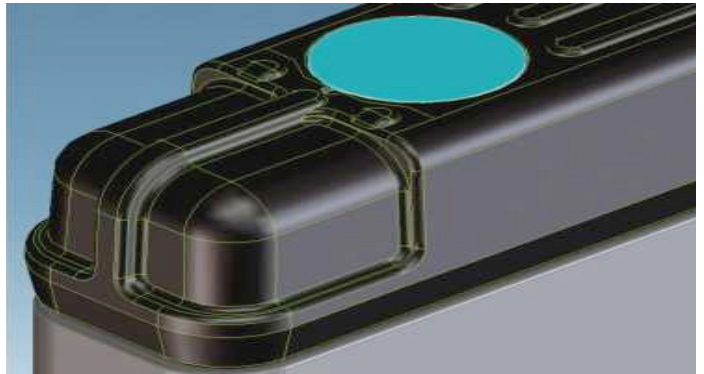


Fig. 7 The new corner shape of the protection cover for the 10"x12" panel.

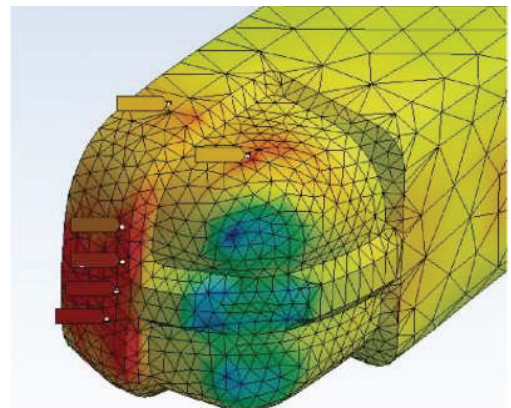


Fig. 8 The newly designed protection cover for the 10"x12" panel. Dropping a panel on its corner can cause great damage. Based on simulation of such a drop, the choice of resin and of an optimal protection cover shape and design allows absorption of the shock of a fall.

When using the AeroSync function, the minimum time needed to detect the X-ray was originally more than 5 ms. For example, when imaging with a tube current of 200 mA, the 5 ms restriction equates to approximately 1 mAs of radiation. (The value of mAs means “mAs=X-ray tube current (mA) x time (s)”).

The typical exposure of infants to radiation ranges from 50kV to 60 kV, or 1-2 mAs. However, many portable X-rays, unlike common X-ray devices, do not permit the tube current or radiation time to be set—only the mAs. For high-power systems, a tube current of 300-400 mA can be established. In the case of a 400 mA tube current, 1 mAs of radiation exposure is maintained for 2.5 ms, and the original automatic exposure detection functions do not work.

We were successful at reviewing and improving the detection algorithm, shortening the AeroSync minimum detection time by more than half. That can also be used for high power-type portables, contributing to a reduction in radiation exposure during imaging.

5. Conclusion

Konica Minolta has created a series of three panels, including the 14”x17” size, the 17”x17”, and the 10”x12”. This series enables users to select the most appropriate size unit to suit their imaging needs.

Our easily maneuverable panels are suitable for widespread use in all radiography clinics, from general clinical X-rays to standing position bucky imaging tables, where wider imaging is required, and for smaller imaging for children and orthopediatrics. For infants and children in particular, the AeroSync function with its ability to automatically detect X-rays has been improved to reduce radiation exposure.

In the future, Konica Minolta plans to continue pursuing improved usability and flexibility, developing valuable products for radiography clinics in an effort to further benefit the healthcare industry and patient care.

