

Short Research Article

A Comparative Study of Air Flow Value over the Infant Radiant Warmer Bed

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Abstract

Radiant warmers are widely used in hospital neonatal care departments. Particular requirements for the basic safety and essential performance of infant radiant warmers are regulated by EN 60601-2-21:2009 + A1:2016. This standard doesn't include the maximal air flow value over the infant bed while the standard 60601-2-19:2009 describes the maximal air flow values for incubators. This study shows fluctuation of the air flow over the infant bed and it leads to think, that a more preventive care of infants ambient is needed in the system. Authors have investigated the impact of air barriers on direct air flow value. Studies show that barriers can significantly decrease air flow over infant's bed and potentially lower infant's heat losses by convection on infant bed.

Keywords

heat loss, thermal stress, neutral thermal environment

1. Introduction

There have been various studies of convective and radiative heat transfer relevance in infant ambient environment. Those studies show that the temperature and air flow are major factors of heat loss by convection (Soll, 2008).

1.1 Current Regulations for Ambient Environment

Standard EN60601-2-21:2009+A1:2016 determines radiant warmer working condition in maximum ambient air flow is 0.3m/s, and temperature cannot fluctuate more than delta 1 °C in one hour time frame to maintain stability.

1.2 Action Program

Since hospitals have provided HVAC systems, authors assume that in baby care room air ventilation systems are laminar flows from room's ceiling to bottom. The main impact is unexpected air flow sources from windows, from door movement, for example, air drafts. The authors have studied how to reduce the level of air flow in a baby's warmer bed by installing barriers around the baby's bed to reduce the air flow, for example, from open windows, open doors movement.

2. Materials and Methods

Tests were carried out at Armgate Ltd laboratory. Measurements have made no harm to human health, in process flow measurements were simulated with and without obstacles. Test has been carried out according to EN60601-2-21:2009+A1:2016, which regulates ambient conditions around radiant warmer bed.

2.1 Simulated Designs

Air flow measurements were simulated in real life conditions where small amount of people movement happened. People movement are counted in measurement process in 2 m radius from measurement point. The measurement point is located in the middle and 23 cm above the baby's mattress. Simulated air flow source is located directly from the middle point of mattress in a 120 cm distance. Laminar flow is simulated as flow from door to window, and goes directly to the right side of the bed. The air ventilation system of the building was not taken into account.

Two designs were compared:

- (1) Flow measurement without any obstacles;
- (2) Flow measurement with two side barriers in size 75 x 33 cm. Barriers are located along the outer left and right long side of the radiant warmer bed, mounted on the level of the bed. Barriers cover full bed length. Barriers are made from light transparent polycarbonate 4mm flat sheet.

2.2 Data Management and Process Instruments

All tests were done with Testo multifunctional instrument Testo 480. Data were processed by software EasyClimate 3.4 and MS Excel program. Laminar flow was simulated with ventilator KC4-EU-CBA1731A Dyson. The measurement equipment was calibrated before tests.

2.3 Method Type

Authors chose experimental laboratory method, which is simulating real life ambient conditions around radiant warmer bed.

3. Results and Discussions

First, measurements took 63.25 min time, tested without barriers. As Figure 1 shows, the air flow fluctuations (blue line) and average trendline (red dotted line) is increasing.

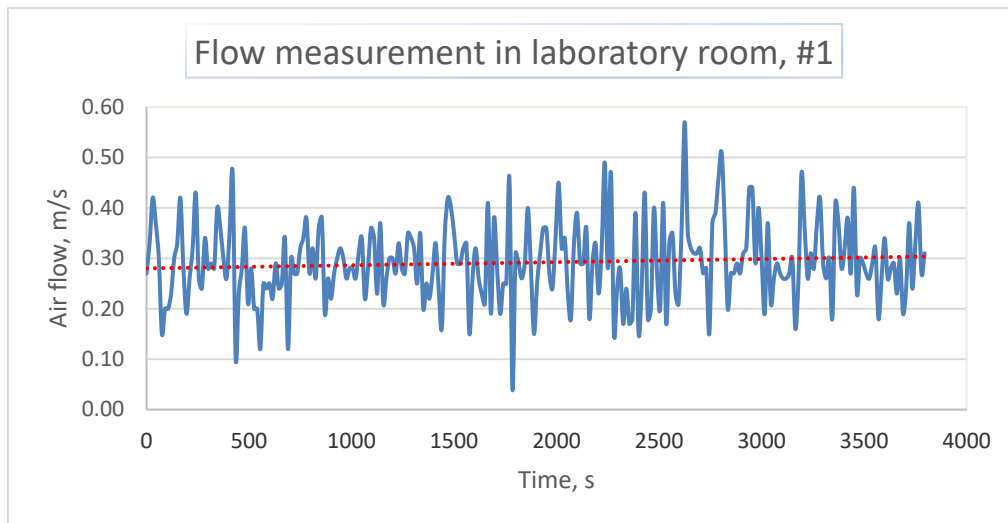


Figure 1. Air Flow in Laboratory Room, around Infant Bed

During tests no people movement was allowed in a 2m radius. Average flow value during the first measurement is 0.29 m/s and it fluctuates between 0.04 to 0.57 m/s air flow.

The second measurement of the air flow over the infant bed is provided in the same ambient conditions with the same level of forced air flow.

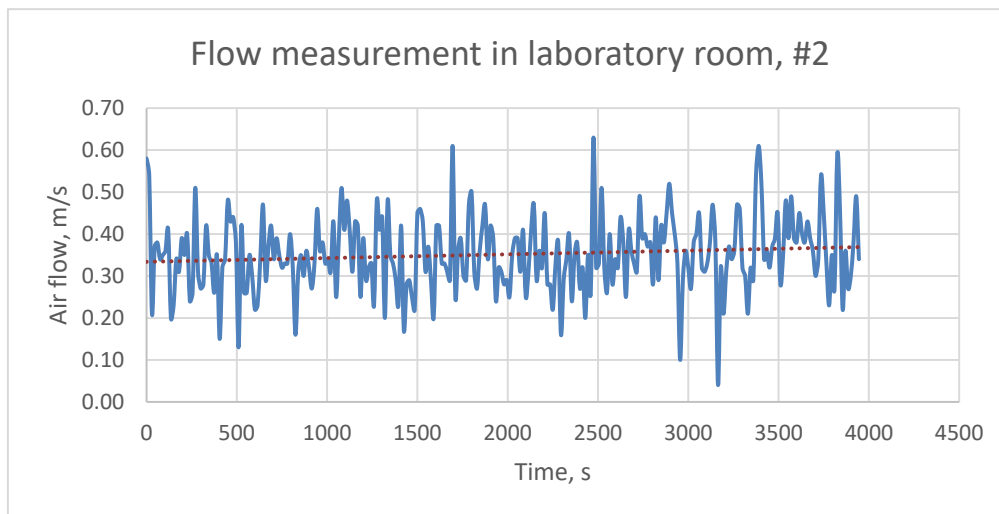


Figure 2. Air Flow in Laboratory Room, around Infant Bed, Second Measurement

Figure 2 shows that air fluctuations are high as in previous measurement. Average flow value during the second measurement is 0.46 m/s and it fluctuates between 0.04 to 0.58 m/s air flow.

The measurement of the air flow over the infant bed with the two polycarbonate sheet barriers are provided in the same ambient conditions with the same level of forced air flow during first 2500 seconds. In 2819s, 3134s and 4484s people movement occurred in the front side of the bed in a 0.5 m radius to simulate caregivers movement.

In Figure 3, the blue line shows air flow over the bed, when barriers are fixed to both long sides of the bed.

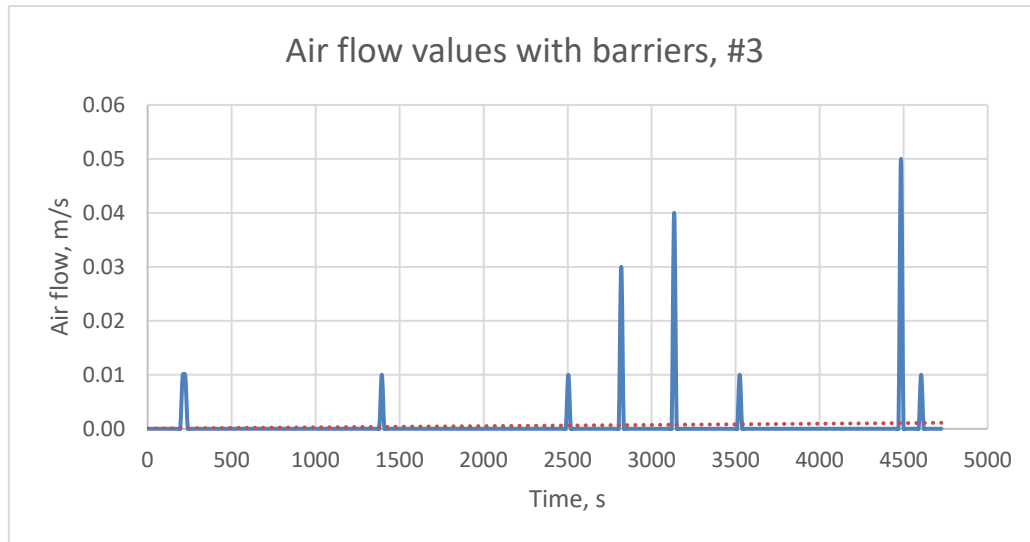


Figure 3. Air Flow Values with Barriers

Figure 3 shows that barriers significantly reduce the air flow over the radiant warmer bed. Still, there are some small fluctuations, the air flow does not exceed 0.05 m/s threshold. Three peaks in 2819s, 3134s and 4484s appear during people movement.

Figure 4 shows the same air flow over the radiant warmer bed, the same conditions as Figure 3.

In 164s, 959s and 2099s people movement is showed in the front side of the bed in a 0.5 m radius to simulate caregivers movement.

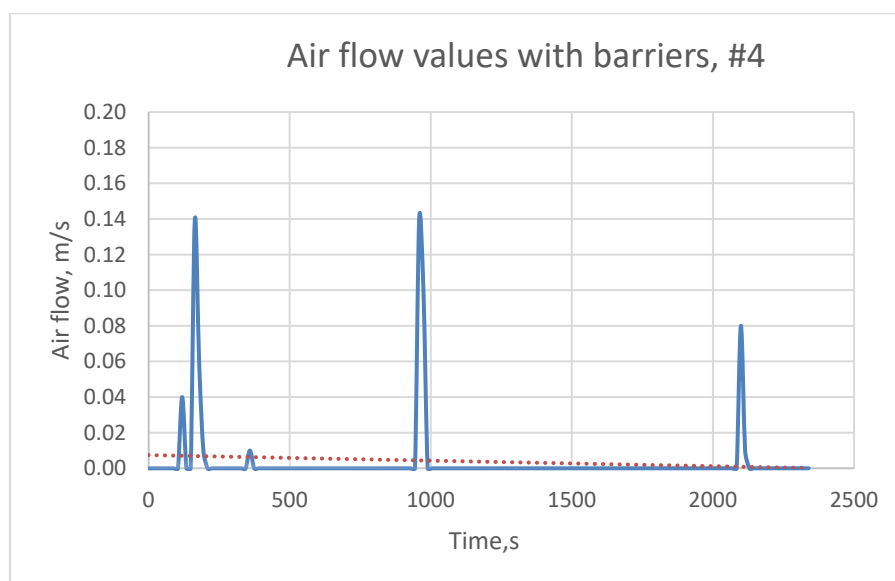


Figure 4. Air Flow Values with Barriers, Second Measurement

4. Conclusions

Authors have come to the following conclusions:

- (1) With two polycarbonate sheet barriers it is possible to achieve airflow level without person movement around radiant warmer bed below 0.02 m/s value, when in the meantime the airflow in the room is fluctuating from 0,04 to 0,58m/s value.
- (2) With two polycarbonate sheet barriers it is possible to achieve airflow level with person movement around radiant warmer bed below 0.15 m/s value, when in the meantime the airflow in the room is fluctuating from 0,04 to 0,58m/s value.
- (3) Taking into account a typical temperature level from 22 °C to 26 °C in an infant nursing room, air barriers potentially can decrease thermal convection heat losses in a newborn on the infant warmer bed.
- (4) Polycarbonate barrier do not reduce visibility of the infant warmer bed.
- (5) Further investigation is needed for optimization of design and mechanical properties of the barrier.

Acknowledgments

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Reference

Soll, R. F. (2008). Heat loss prevention in neonates. *Journal of Perinatology*, 28, S57-S59.