

Assessment of Cheater Fittings for Compressed Nitrogen Gas in the Operating Theatres at the Health Sciences Centre Winnipeg

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ABSTRACT

Following the completion of a new operating room (OR) facility at the Health Sciences Centre Winnipeg (HSC), a cheater fitting was installed on the nitrogen gas outlets to convert the newer nitrogen Diameter Index Safety System (DISS) outlets to medical-air Schraeder (quick connect) fittings found on most existing surgical tools. These cheaters violate the CSA Z7396.1-06 *Medical Gas Pipeline Systems*¹ standard because they eliminate the gas-specificity of the outlets and thus introduce the possibility of misconnections, potentially resulting in injuries and/or damages. This assessment found that replacement of these cheater fittings is not feasible, due to the double-sheathed hoses and fittings that are used with most surgical tools. In the short term, it is recommended that the OR at HSC mitigate the present risk by installing warning signs near the existing nitrogen outlets and educate staff about the risks of the current cheaters. Following an anticipated shift in the industry, resulting from a revision of the National Fire Protection Agency (NFPA) *Standard for Healthcare Facilities*, the feasibility of eliminating the cheater fittings will need to be reconsidered.

respiration, and powering surgical tools. Depending on the facility, there can be as many as 10 different gases supplied to a particular room at varying pressures. Nitrogen gas is most often used for powering pneumatic tools such as drills, saws and reamers used in the operating room. For this reason, nitrogen is generally supplied at a higher pressure of around 150 psi.

The Health Sciences Centre Winnipeg (HSC), recently completed construction of a new, state of the art operating facility in the Ann Thomas Building. The medical gas delivery system was designed with Diameter-Index-Safety-System (DISS) terminal units for all medical gases. These fittings, as shown in Figure 1, use different diameter probes and couplers to allow only the correct probe to connect with the correct coupler.

The use of medical gases at HSC is governed by the Canadian Standards Association (CSA) Z7396.1-06 *Medical Gas Pipeline Systems*¹. This standard states that all medical gas systems must be gas-specific and non-interchangeable.

INTRODUCTION

Medical gases have been used in healthcare centers for decades for many purposes including anaesthesia delivery, patient

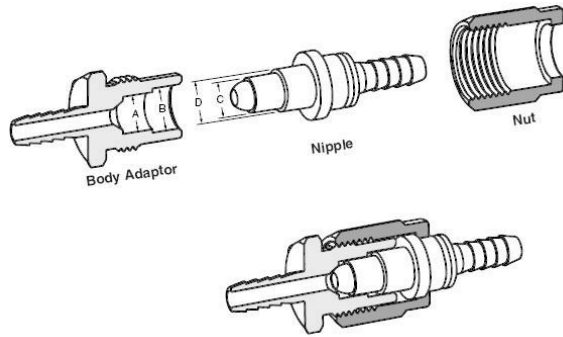


Figure 1: Cross-section of the Diameter Index Safety System fitting².

While the DISS fittings comply with Z7396.1-06, the introduction of these fittings created an issue as the majority of the existing pneumatic surgical tools are fitted with medical-air Schraeder (quick connect) fittings (Figure 2), which are incompatible with the nitrogen DISS outlets.

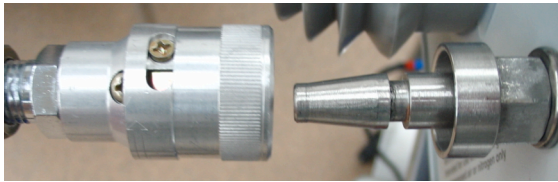


Figure 2: Medical-air Schraeder (quick connect) fitting, coupler (left), probe (right).

To enable the use of the existing surgical tools in the new OR facility, cheater fittings (Figure 3) were assembled and installed. Unfortunately, these fittings also removed the gas-specificity of the DISS nitrogen outlet.

From literature, medical gas misconnections have been the cause of numerous patient deaths^{3,4}, and even more close calls^{5,6} and injuries^{7,8}. In general, the most serious misconnections involve connection of an air or oxygen line (for patient respiration) to a nitrogen or other hypoxic gas source. To prevent such accidents, CSA standards require healthcare institutions to install gas

fittings that are physically impossible to cross-connect.



Figure 3: Cheater fitting used at HSC Winnipeg.

PURPOSE OF THE STUDY

The purpose of this study was to assess the risk inherent in the current set up and to examine the feasibility of fully enforcing the CSA standard in the Ann Thomas OR at HSC Winnipeg.

FINDINGS

Initially it was thought that cheaters were only installed in the Adult OR located in the Ann Thomas building. Upon inspection of the other operating facilities at HSC, it was found that the Children's OR also had cheaters installed on the nitrogen outlets. Both ORs require these fittings to power most of their pneumatic tools and equipment.

A tool inventory was compiled for both the Adult OR and the Children's OR. The majority of surgical tools which required cheaters were owned by and used in the Adult OR. On occasion, the two operating

locations shared some of the more specialized tools and equipment.

The cheaters are composed of three main parts; a nitrogen DISS fitting (connecting with the gas outlet), a 90° pipe elbow, and a medical-air Schraeder (quick connect) coupler (connecting with the tool hose). The components are threaded with Teflon tape to ensure minimal gas leakage or loss of pressure.

In the OR at HSC, the medical-air Schraeder fitting is very specific to those devices which require compressed nitrogen. Currently, all devices requiring medical-air, such as respirators and anaesthesia units, have medical-air specific DISS fittings and therefore cannot be connected to a cheater outlet. Therefore, a risk analysis was performed to determine whether cheaters do in fact pose a significant risk of misconnection as they are solely used with nitrogen-powered tools.

The risk analysis was performed in accordance with CSA 14971-1:1999 *Medical Device Risk Management*⁹. This analysis determined that the risks most significant to patient and staff safety are those which occur due to a system fault or failure. Such fault or failure could be caused by any type of modification to surgical tool fittings or to the cheater, as well as the introduction of new equipment with abnormal fittings. For example: The medical-air DISS fitting for a respirator is damaged and is mistakenly replaced with a spare medical-air Schraeder fitting making the respirator connectable to the cheaters on the nitrogen outlets. Accordingly, the current cheater connection was deemed an unacceptable hazard.

SOLUTIONS

The initial solution investigated was to simply exchange the medical-air Schraeder fittings on the tool hoses for nitrogen DISS fittings so that the cheaters could be removed from the outlets and a direct connection (DISS to DISS) could be made. However, the surgical tools that are used in direct contact with patients during surgery are fitted with double-layered (or double-lumen) medical-air hoses. The inner hose supplies the tool with compressed nitrogen and the outer hose removes the exhaust gas from the operating area. A special fitting vents the exhaust gas at the outlet (Figure 4). These vented Schraeder fittings cannot be replaced with regular DISS fittings (which are not designed for double-layered hoses or venting).

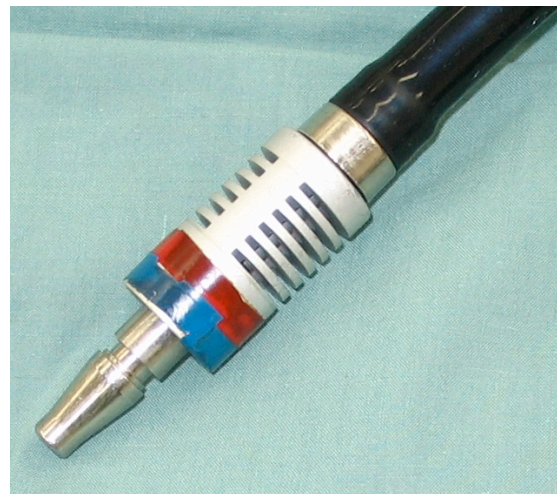


Figure 4: Double-lumen hose with vented medical-air Schraeder quick-connect fitting.

A number of medical gas-fittings manufacturers were contacted about purchasing nitrogen-specific fittings that are compatible with double-lumen hoses. None of the manufacturers could supply such fittings. However, tool manufacturers such

as Synthes, Zimmer, and ConMed-Hall/Linvatec, could supply nitrogen-specific double-lumen Schraeder fittings. Unfortunately, these fittings only come fully assembled with double-lumen hoses, specific to the tool manufacturer and cannot be supplied separately. HSC Winnipeg has around 50 surgical tools with double-lumen hoses and vented medical-air Schraeder fittings (Figure 4). Replacement of all of these tool hoses is otherwise unnecessary and would cost approximately \$50 000.

In the United States, the National Fire Protection Agency (NFPA) is the supervisory body of healthcare facility standards. In 2010 the NFPA is scheduled to release a major revision of their NFPA 99 *Standard for Healthcare Facilities* with the intention that this standard can be more easily adopted by local jurisdictions as legal code. Consequently, healthcare facilities will be required to make all medical gas connections entirely gas-specific, and thus require a solution to the use of medical-air Schraeder fittings on surgical tool hoses. Accordingly, it is anticipated that medical gas-fittings manufacturers will develop an easy and inexpensive product in response to this demand from healthcare facilities. Following this speculated shift in industry, the replacement of cheater fittings should become more feasible and less expensive.

Until this anticipated shift in industry occurs, certain measures can be taken to mitigate the current risks involved with using cheaters. Foremost, educating the staff will raise awareness of the hazards involved with the cheaters as well as the consequences of a gas misconnection. Secondly, the addition of signage close to the cheaters will warn staff to use caution when connecting nitrogen gas

lines. Finally, the addition of Loctite (a sealant glue) to the cheaters will increase their permanency as well as prevent tampering or unwarranted modifications to the cheaters.

CONCLUSION

Use of cheater fittings at HSC Winnipeg continues to pose a safety risk to patients and staff. Ideally, these fittings should be replaced with a suitable alternative that is cost effective and fulfills the gas-specificity requirements of the CSA Z7396.1-06 standard. Presently, the only immediate solution to obtain gas-specificity in the ORs is to replace all surgical tool hoses and fittings with pre-assembled packages obtained directly from the manufacturers of the tools. Such a replacement would represent a cost of approximately \$50 000 to the healthcare facility.

The anticipated revision to NFPA 99 healthcare facilities standard is predicted to compel fittings manufacturers to supply North American hospitals with a simple and inexpensive solution to cheaters. Until this time, staff education, signage, and added permanency should be put into action to mitigate the current risks.

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