CAN SIDERAILS SURPASS STEEL ON THE SPRINT 200?

The design of the Sprint 200 siderails elevated (left) and folded under mattress (right)

BACKGROUND

Prominently visible and one of the most important integral parts of a stretcher, siderails are there to protect the patient. The siderails prevent the patient from falling out of the stretcher. Moreover, in emergency departments, the siderails installed on stretchers are usually used as a driving element during patient transport. Also, in an emergency they protect the staff from the impact of aggressive or restless patient behavior. Due to these specific facts, the siderails used on emergency stretchers should be durable enough to withstand these extreme conditions. For that reason, siderails are covered by safety norms for medical devices globally to ensure that quality and safety is met every time. Stretcher siderails are usually made of steel. Steel is considered a robust and durable material. But it has weaknesses with its greater weight, and it is corrosive and rigid. The Sprint 200 stretcher comes with Zero Gap siderails, which can be folded under the mattress, to minimize the gap between bed and stretcher to ease patient transfers. For that reason, we needed to find a material for siderails which can be light, durable, and adjustable for a specific design shape.

CONCLUSION

Can plastic siderails surpass the strength of steel? Yes, if you have the right plastic material, such as "long glass fiber reinforced polyamide". LGRP material is a strong, light, non-corrosive, and flexible material which can replace steel in the stretcher siderails. This fiber reinforced plastic is used in various industries as a metal replacement, and it has been used for many years. The tests performed ensured that the innovative Sprint 200 siderails passed IEC norm requirements for patient safety. The tests demonstrated that the siderails can withstand more than double the required forces applied on the siderails.

New Sprint 200 Siderail Design and Materials

Long fiber glass reinforced polyamide (LGRP) replaces steel in industry.
(Review of material usage across different industries)

Linet R&D took on the challenge of how to ensure the same or higher strength of currently used siderails in hospital stretchers. We looked for materials which can provide durability while being lightweight. We found that steel is being replaced by long glass fiber reinforced polyamide (LGRP) in industry. LGRP is a plastic compound which includes glass fibers which reinforce the plastic material. LGRP can be shaped to meet desired design requirements while providing corrosion resistance and maintaining a low weight. Fiber reinforced polyamides are mostly used in the transport industries, such as automotive, rail, and aerospace. (Thomas, 2019) It has a higher strength-to-weight ratio than steel, so this material has found a place in the construction industry. (U.S., 2014) LGRP can be also seen in firearms applications. The bodies of weapons and magazines are made of LGRP because it can sustain high loads and is corrosion resistant (ČZ, 2022). Another feature of fiber reinforced plastic is its non-conductive properties, thanks to which can be used in the construction of electricity pylons, which can then be installed by air crane helicopter thanks to their low weight (Morby, 2018). For these reasons, we used LGRP to create our own unique design of siderails with additional features that are limited to steel siderails. (Table 1).

TABLE 1 | Comparison of material features: LGRP siderails vs. conventional steel siderails (DataSheet)

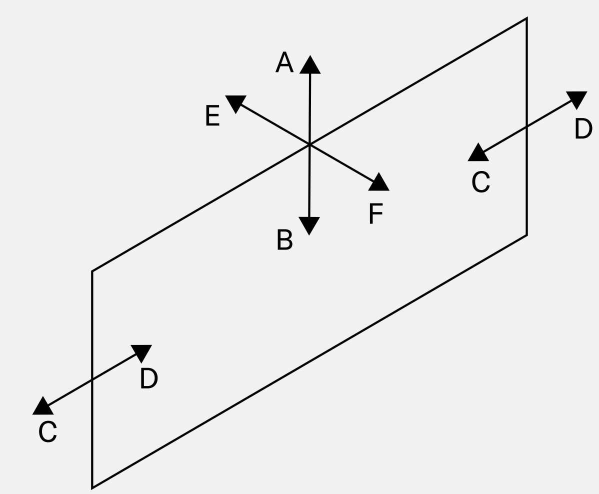
	LGRP SIDERAILS	CONVENTIONAL STEEL SIDERAILS
CORROSION RESISTANCE	**Excellent Corrosion Resistance**	**Low Corrosion Resistance** Subject to oxidation and corrosion. Require painting or galvanizing.
WEIGHT	**Light: 400 g (1 siderail bar)** Substantially lighter than steel	**Heavy: 1200 g (1 siderail bar)**
CONDUCTIVITY	**Non-Conductive**	**Conducts Electricity**
STRENGTH-TO-WEIGHT RATIO	**LGRP has 2,2 times more than conventional steel.***	
ADJUSTING TO DIFFERENT SHAPES	**Moldable**	**Limited flexibility**

** Steel with a yield strength of 235 MPa*

LGRP siderails bars offers higher strength to weight ratio then steel siderail bars.
(Table 1 material comparison)

Testing Siderail Durability

IMAGE 1 | Testing forces on the siderail to norm IEC 60601-2-52



Forces in directions A, C, D, E, F = 500 N (110 lbF)
Force in the direction B = 750 N (165 lbF)

In the Linet lab, we performed a lot of tests on siderails and siderail bars. We loaded siderails and bars with various loads and performed crash tests. We followed norm IEC 60601-2-52 on the particular requirements for the basic safety and essential performance of medical beds, which defines how much and in which direction the siderails should be loaded (Image 1). The siderails need to be locked and functional and must not endanger the patient when they are loaded (IEC60601-2-52, 2015).

The Sprint 200 siderails passed the required forces without any problems. We wanted to know how much force could be sustained in the F direction (Image 1). The F direction represents force applied on the siderail out of the stretcher. The siderails withstood an applied force of 1,100 N (242.6 lbF), which is 2.2 times more than is requested by the norm.

We performed crash tests on the siderails according to the standard IEC 60601-1, where siderails must withstand the stresses caused by careless handling and must not cause an unacceptable risk. The test was performed by driving the stretcher with its siderails impacted into a door frame with a load of 320 kg (705 lbs). The siderails withstood the impact on the door frame without losing function (IEC60601-1, 2007).

Sprint 200 siderails sustained **2.2 times higher force** than is required by the norm.
(LINET lab testing)

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