

## Robustness Assessment of Safety Devices for Prefilled Syringes

### INTRODUCTION

Prefilled syringes are becoming a preferred way of administration with a market growth over 10% per year <sup>(1)</sup>. Preferences of pharmaceutical companies and healthcare workers can be explained by several advantages over traditional packaging in vials such as ease of use and better dose accuracy <sup>(2)</sup>. Prefilled syringes also respond to the growth in drug self-administration allowing patients to self-inject prescribed medications at home reducing therefore the healthcare costs.

Needle stick injuries remain however a main concern for parenteral injections.

Legislations in several countries nowadays mandate the use of sharps safety devices to reduce needles exposure during a medical procedure (The USA was the first country - in 2001, followed by Europe and recently Canada). Safety devices market is showing a far greater growth rate than for the mainstream prefilled syringes market.

Rexam has developed a platform of **passive safety devices, Safe'n'Sound**, which does not require any extra gesture from the user to activate safety features <sup>(3)</sup>. The device can be attached by simple clip-on to standard prefilled syringes sold on the market.



### STUDY OBJECTIVE

Prefilled syringes are subject to numerous shocks from the filling lines, throughout transportation until the final administration to the patient. In this study, the ability of safety devices of resisting to shocks when already assembled onto prefilled syringes was compared with several drop tests protocols. In addition, robustness prior to syringe assembly was tested to simulate industrial processes. We have compared Rexam's Safe'n'Sound with two other safety devices (named A and B) from different manufacturers (manufacturers A and B).

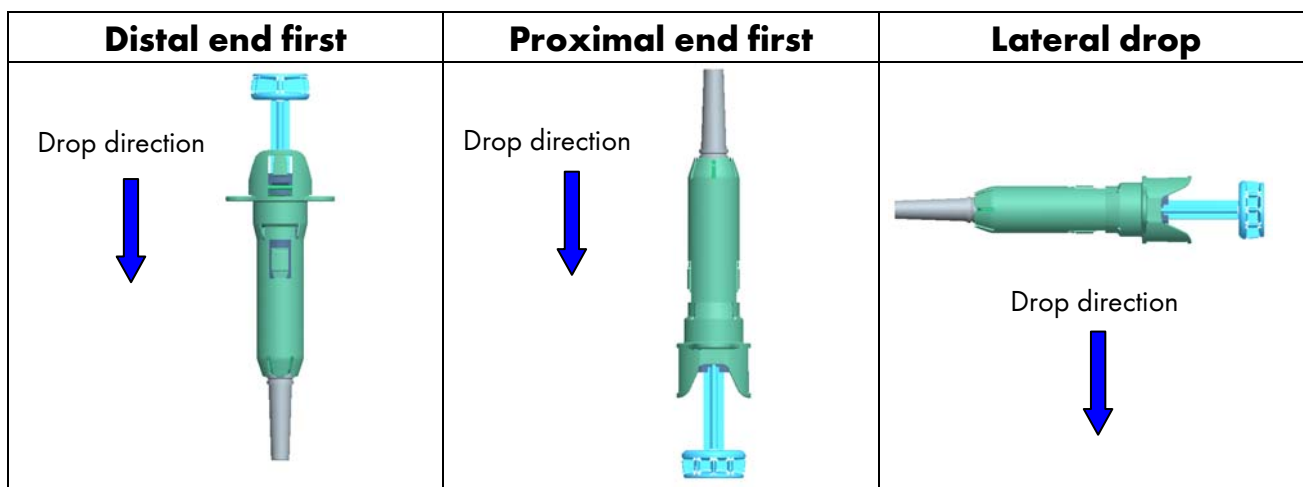
### METHODS and RESULTS

#### SAFE'N'SOUND DROP TEST VALIDATION

##### Tests description

Drop tests were performed in 3 different drop directions with Rexam Safe'n'Sound Safety devices as shown in Figure 1. Tests were following Rexam internal protocols P039-01 <sup>(4)</sup>, P040-01 <sup>(5)</sup> and P042-01 <sup>(6)</sup> on 40 Safe'n'Sound without syringe and 40 Safe'n'Sound with 1ml long staked needle prefilled syringes, filled with 1ml water before and after use.

Figure 1: Three directions of drop test for prefilled syringe equipped with a safety device. The drop direction "distal end first" is the most severe test condition.



The drop tests were performed on the devices at room temperature before and after accelerated ageing (material: Memmert UFE500 oven). Ageing was tested under two different conditions described as following:

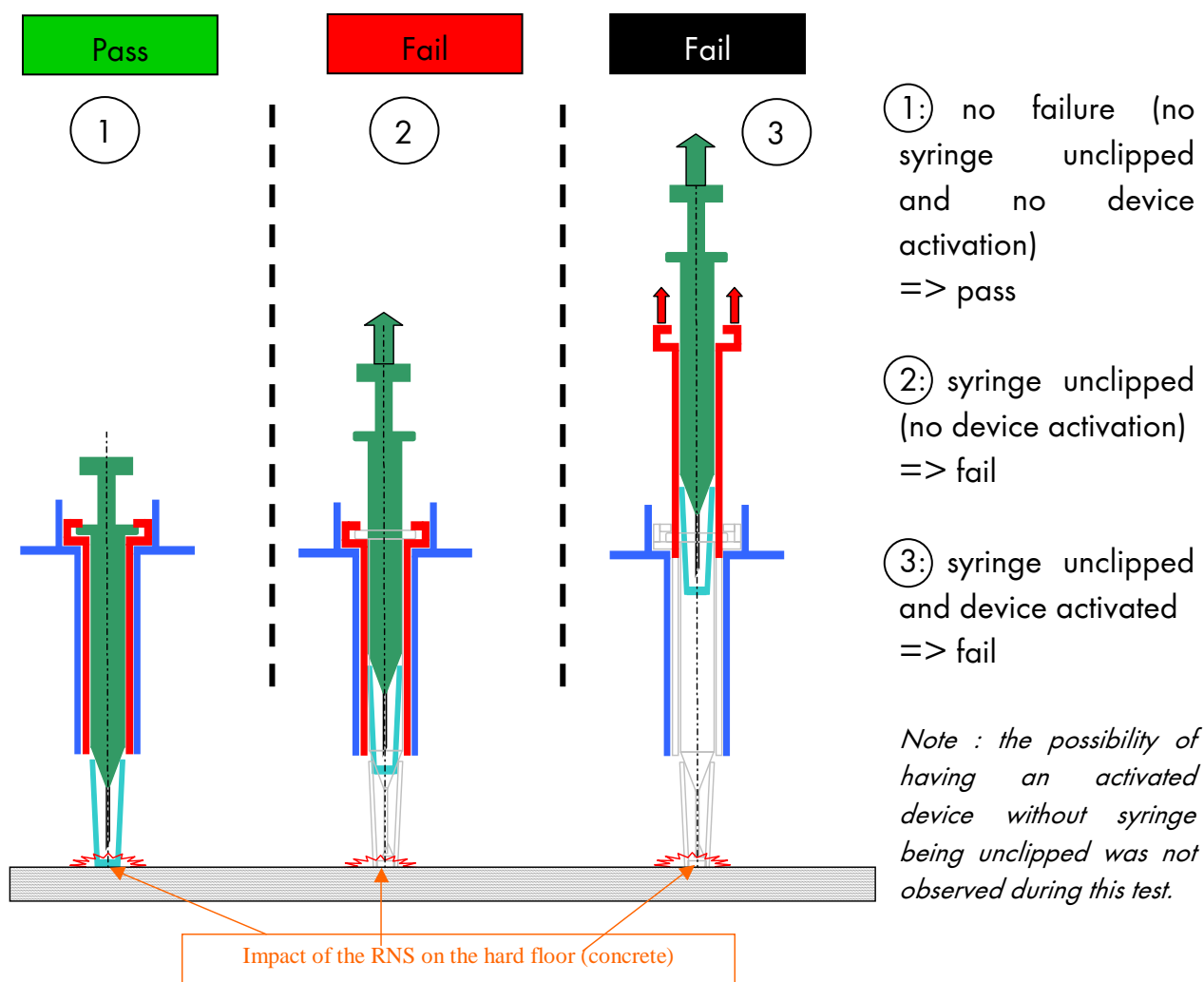
- ❑ 1 week at 60°C before syringe device assembly
- ❑ 1 week at 60°C after syringe device assembly

The devices were left to cool down to room temperature (20°C) before being tested.

##### Acceptance criteria

After the drop test, the visual inspection of the devices allowed a classification according to the acceptance criteria shown in Figure 2.

Figure 2: Acceptance criteria for prefilled syringes equipped with safety systems after drop test protocol.



### Results

The prefilled syringes equipped with Safe'n'Sound devices, before and after ageing, presented neither activation nor syringe unclipping in the 3 directions of the drop test protocols. 100% of Safe'n'Sound devices passed the test under the combination of the 9 testing conditions.

## SAFE'N'SOUND IN FEEDING BOWL TEST

### Test description

A feeding bowl test was performed following Rexam internal protocol P030-02 <sup>(7)</sup>. In this test 40 Safe'n'Sound (version for 1 ml long staked needle syringes) were tested without being assembled to a glass syringe. To simulate conditions of delivery to assembly lines, 40 devices were originally packed in bulk in a bag, then dropped in

an assembly line feeding bowl RNA (Rhein-Nadel-Automation), type SRC-N400-2R, operating at 100 Hz frequency, and kept in the functioning bowl during 4 hours.

### **Acceptance criteria**

Acceptance criteria after the feeding bowl test were the same as previously described in Figure 2 (cases 1 and 3 only were observed without syringe). The devices must show no activation to pass.

### **Results**

We observed no activation of the 40 Safe'n'Sound devices after 4 hours of test. 100% of Safe'n'Sound passed the test in feeding bowl.

## **DROP TEST COMPARISON BETWEEN 3 SAFETY DEVICES**

### **Test description**

3 different Safety Devices for prefilled syringes were tested following internal Rexam protocol P040-01 <sup>(5)</sup>, based on the standard protocol EN60068-2-32 <sup>(8)</sup>. According to this protocol, prefilled syringes equipped with safety devices were dropped from 1-meter height to hard surface (concrete) with the RNS (Rigid Needle Shield) orientated downwards (see Figure 1 "distal end first"). The syringes were filled with water.

The three different combination tested were the following:

- ❑ Safe'n'Sound safety device was assembled with 1 ml long staked needle syringe, cut flange, filled with 1 ml of water, with RNS.
- ❑ Device A: safety device from manufacturer A was assembled with 0.5 ml long staked needle syringe, cut flange, filled with 0.5 ml of water, with RNS.
- ❑ Device B: safety device from manufacturer B was assembled with 1 ml long staked needle syringe, cut flange, filled with 1 ml of water, with RNS.

### **Acceptance criteria**

The acceptance criteria after the drop test in distal end first were the same as previously described in Figure 2.

### Results

The test for 20 devices from each manufacturer demonstrated clear differences in the drop test results. Individual results tests were classified in the table below.

Table 1: Differences observed under drop test conditions of Safety Devices

	No failure <b>1</b>	Syringe unclipped <b>2</b>	Syringe unclipped & device activated <b>3</b>	<i>Total</i>
<b>Rexam Safe'n'Sound</b>	20	0	0	20
<b>Device A</b>	5	15	0	20
<b>Device B</b>	1	4	15	20

Figure 3: Results of drop tests of 3 different Safety Devices for prefilled syringes.

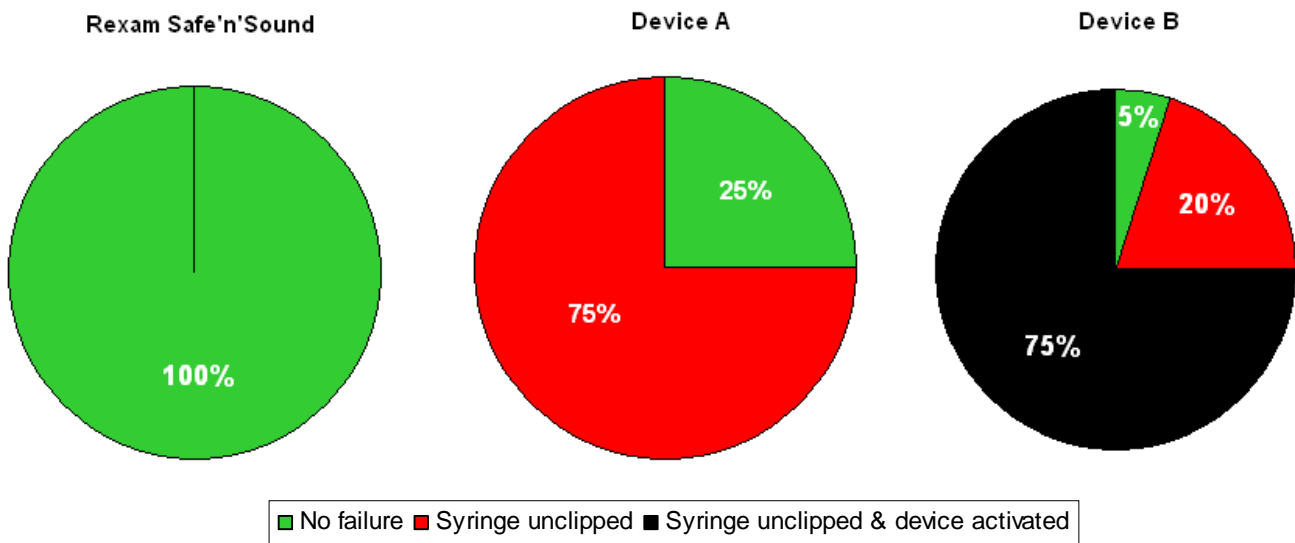


Figure 3 showed clear differences in results:

- Safe'n'Sound presented 100 % pass with neither syringe unclipped from the safety device nor activation observed.
- Device A showed 75 % syringes unclipped from the device after dropping without any activation; only 25 % of devices A passed the drop test.
- Device B presented only 5 % pass with syringes assembled in safety device after the drop test; 75 % of the devices were activated with a syringe unclipped, and 20 % of the devices presented a syringe unclipped without any activation. In total, 95 % of Safety System B failed with syringes unclipped from the safety device.

## DISCUSSION

To have a representative comparison with the Safe'n'Sound, Rexam's passive safety device for prefilled syringes, the other two safety devices from Manufacturer A and B were selected as they also present passive characteristics.

The Safe'n'Sound very good drop test results, showing no activation will be repeated with a larger number of devices to claim 100 % reliability under drop test conditions <sup>(9)</sup>.

However, this study clearly showed significant differences of safety devices for prefilled syringes tested.

Resistance to accidental shocks is key to cost reductions. Indeed, it allows bulk packing of the devices and a more efficient process on the assembly line for higher productivity. In addition, once assembled, it eliminates the potential loss of expensive drugs through accidental activation.

Last but not least, patient safety is improved by avoiding dangerous disassembly of the device. In addition, in a critical emergency situation, the accidental activation of the device before injection could delay a life-saving injection.

From this study, we can conclude that devices A and B don't guarantee the safety of the user in case of accidental drop. The main three risks for the user are: injury with the glass components if the syringe breaks on the floor after being unclipped, injury with the needle if the drop happens without cap and the syringe is unclipped, and also non functionality of the device.

The Safe'n'Sound design guarantees a much better syringe protection in case of drop compared to other tested safety devices.

These drop tests results are also part of a feasibility test for the Safe'n'Sound bulk transportation. The Safe'n'Sound was also shown to be suitable for distribution into feeding bowls due to its resistance to shocks. These characteristics allows Safe'n'Sound safety device to be well adapted to high volume production.

**REFERENCES**

- (1) Freedonia. July 2007. *World Pharmaceutical Packaging*
- (2) Frost & Sullivan. November 2005. *European Prefilled Syringes Markets*
- (3) PMPS. Drug Delivery and Dosage Forms. 2007, p.86-87. *Safe'n'Sound*
- (4) Rexam internal protocol P039-01: *Safe'n'Sound 1 ml long: Drop test without syringe, without packaging*
- (5) Rexam internal protocol P040-01: *Safe'n'Sound 1 ml long: Drop test with syringe 1.0 ml long, before use, without packaging*
- (6) Rexam internal protocol P042-01: *Safe'n'Sound 1 ml long: Drop test with syringe 1.0 ml long, after use*
- (7) Rexam internal protocol P030-02: *Safe'n'Sound 1 ml long: Resistance to the vibrations*
- (8) Standard *EN60068-2-32: Environmental testing. Test methods. Test Ed. Free fall*
- (9) Guidance for Industry and FDA Medical staff. Aug 2005. *Medical devices with sharps injury. prevention features (part 10)*