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Results of exposure of Festo PUN-H 8mm (Blue) Plastic Tube to Novec 649

This document summarises the discovered degradation of the Festo PUN-H Blue Plastic Tube after exposure to Novec.

TRACEABILITY

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Introduction

- A ~1m long piece of 8 mm Festo PUN-H (Blue) Tube was used as a bypass for the Novec 649 circuit during LHCb Baby Demo commissioning that lasted five weeks and later to fill the Novec to the station occasionally.
- The tube was used since June 2018 till April 2019. It is estimated that it has been filled with liquid Novec only for approximately six weeks during this time.
- The tube was used in contact with Novec continuously only at the beginning of its use. The remaining time it was empty and disconnected from the system (atmospheric air in contact with both internal and external surface) and used very sporadically.
- The tube has never been in contact with solvents, hydrocarbons or other chemicals except Novec 649.

The tube being used during commissioning of LHCb Baby Demo in summer 2018



The tubes
in use on
the LHCb
Baby Demo

Findings

It became apparent that the tube mechanical properties are deteriorating:

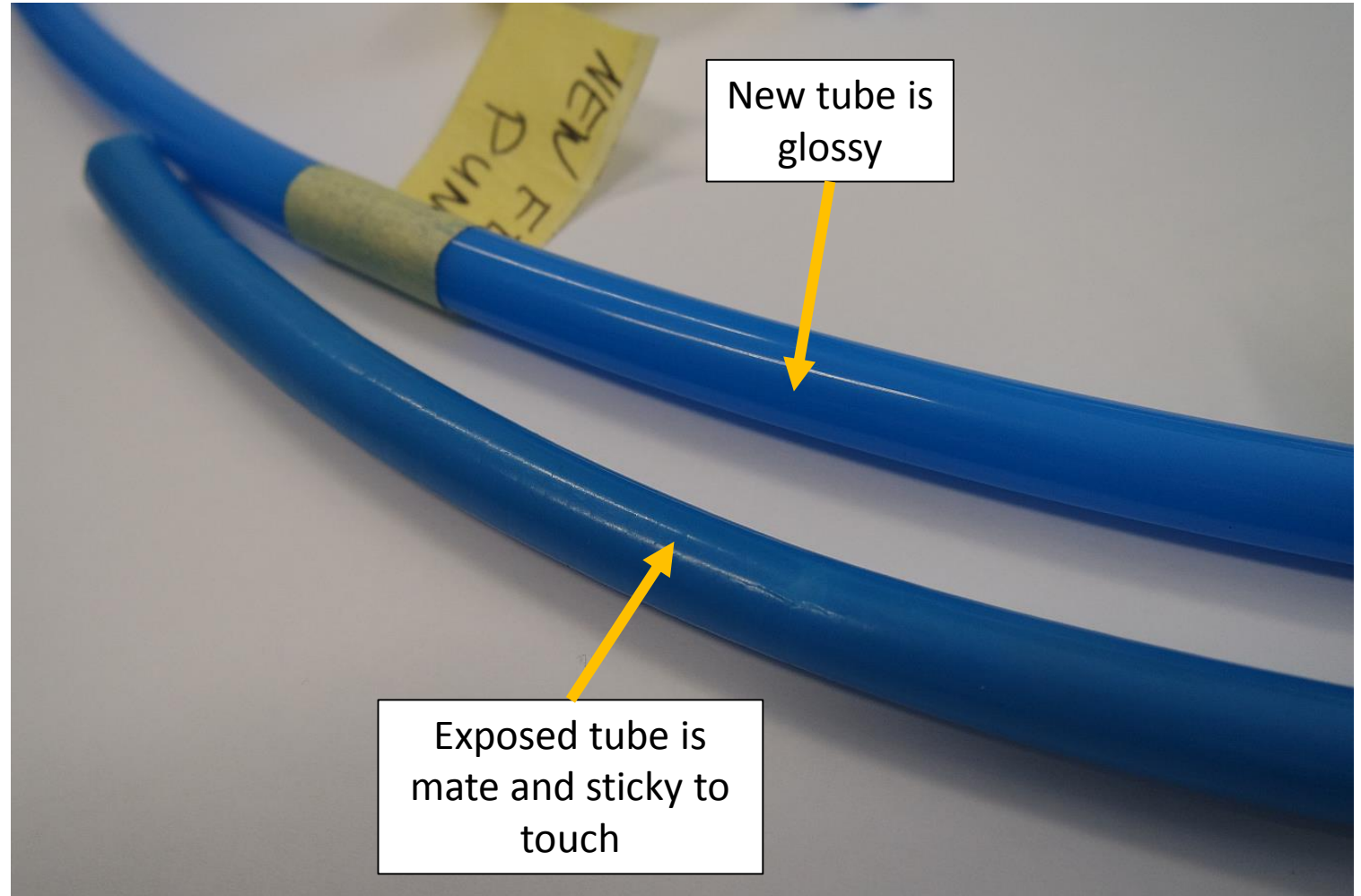
- The tube is matte (it used to be smooth, shiny and glossy)
- The tube is sticky to touch
- The tube is easy to break when bended/folded excessively (new tube does not break even though it gets damaged when bended/folded excessively)
- The tube cracks when squished (new tube gets damaged but it does not crack)

The changes developed in time, relatively long after continuous exposure to the Novec!

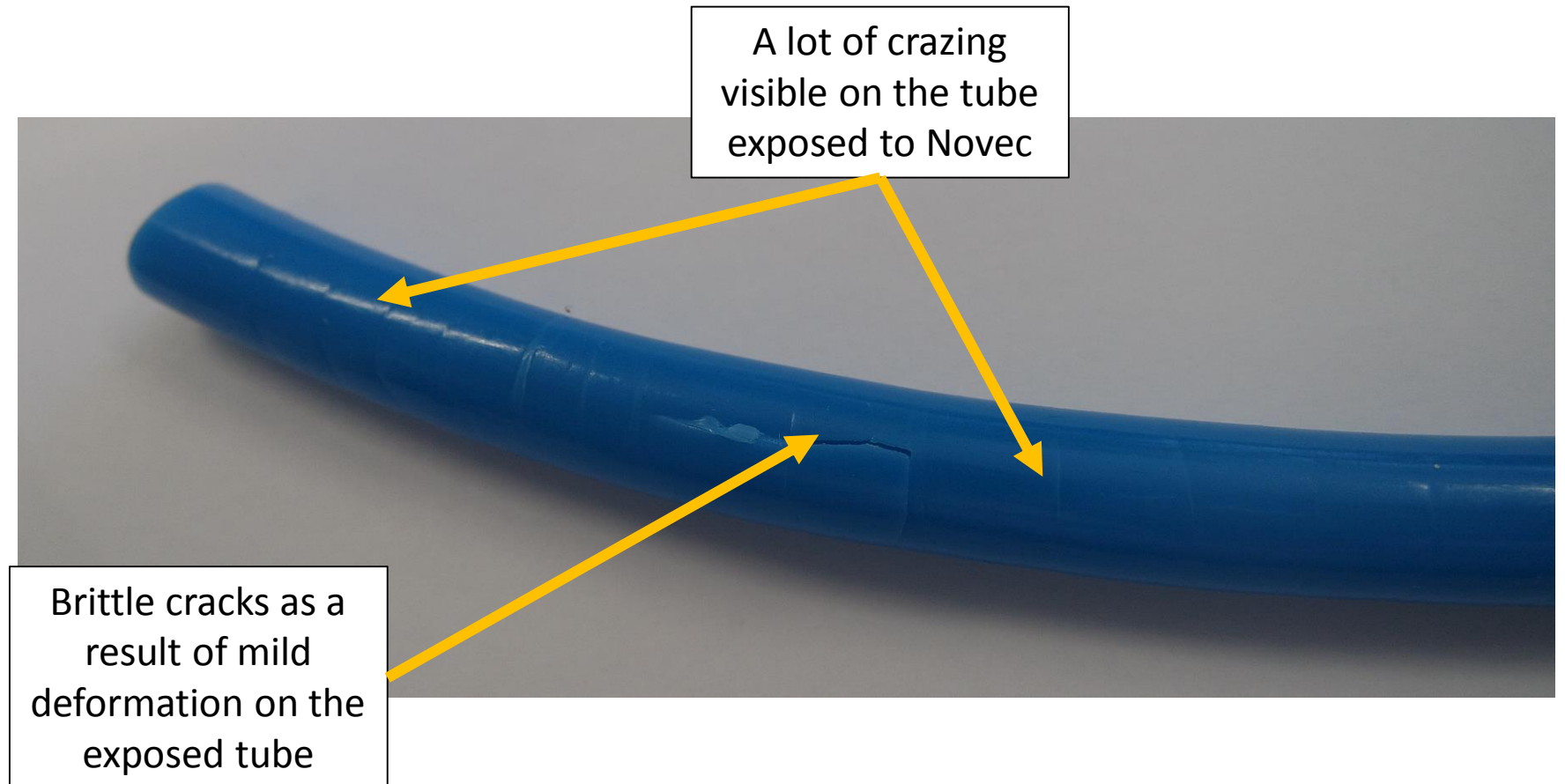
The changes were not apparent immediately after contact with Novec, it took several months for the tube to exhibit obvious changes.

Exposure to air humidity after the contact with the Novec might or might not be an important factor.

Tube surface



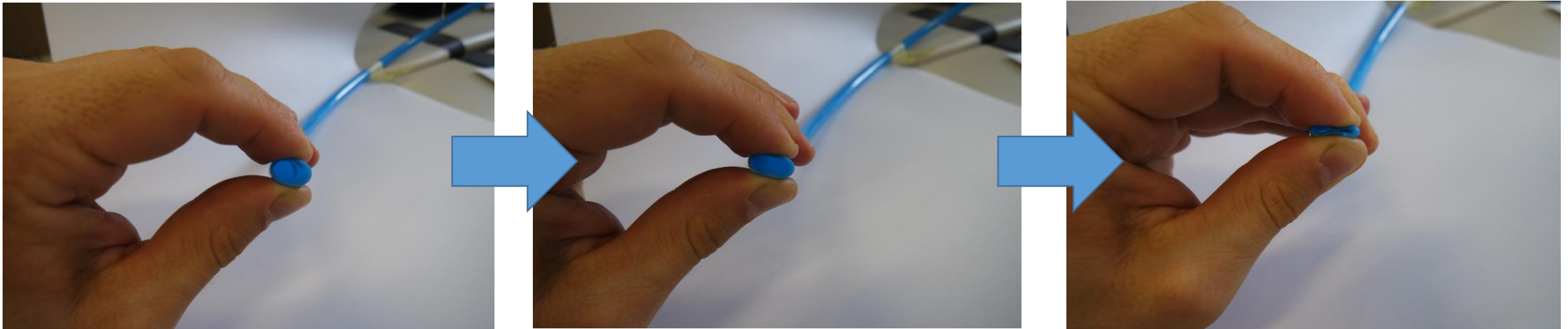
Developed cracks



Squish test

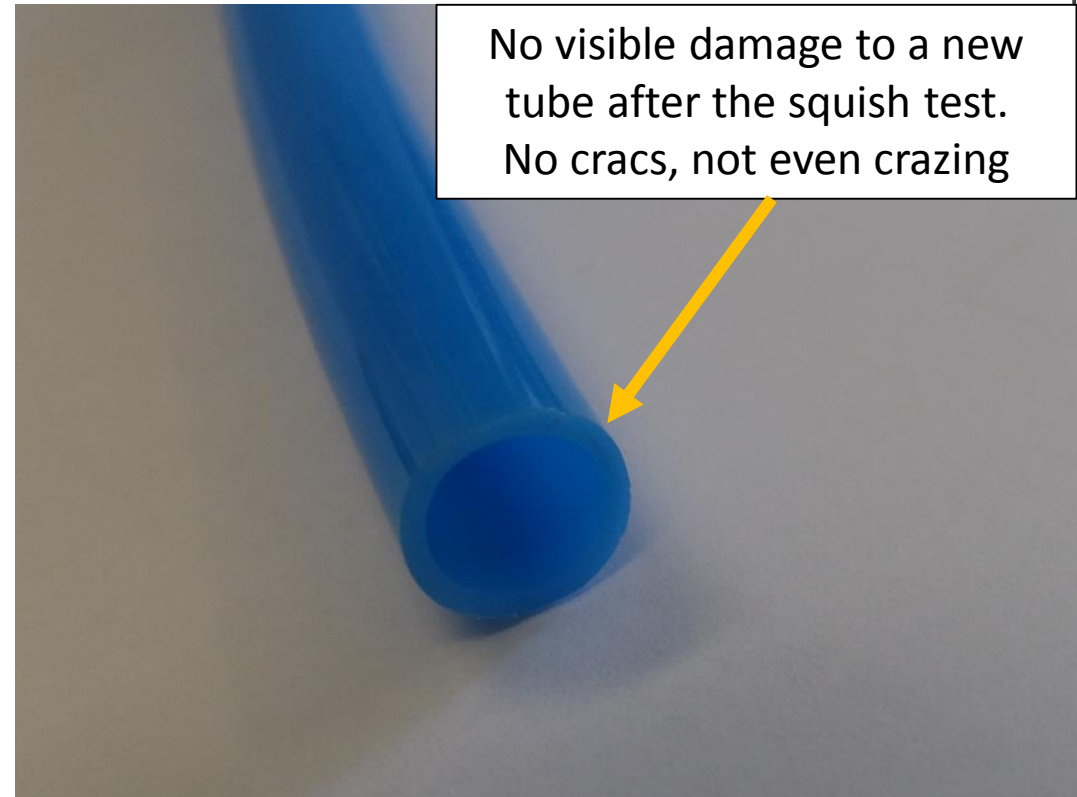
Fully Squishing the tube between fingers

See next slides for results



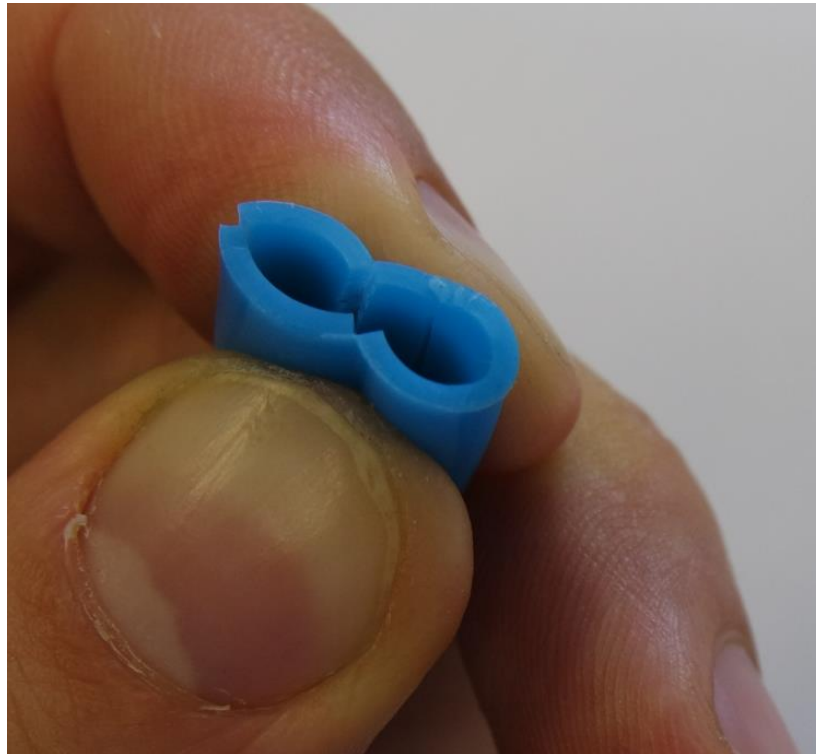
Squish test

Fully Squishing the tube between fingers



Squish test

Fully Squishing the tube between fingers



Many cracks developed on the tube exposed to the Novec after the squish test

