



Fraunhofer

**TESTED[®]
DEVICE**

LS Cable & System Ltd.
ROFHV(FX)-SB 9X2SQ_PVC/B
Report No. LS 1405-706

DUPLICATE

Statement of
Qualification

Particle Emission

Statement of Qualification

Customer: LS Cable & System Ltd.
238, 3Gongdan-2ro
730-735 Gumi-si, Gyeongbuk
Korea

Component tested

Category: Energy Supply

Subcategory: Cable Systems

Product name: ROFHV(FX)-SB 9X2SQ_PVC/B (manufacturing date: 03/21/2014; color: black)

Test result / Classification:
(in acc. with ISO 14644-1)

The cable system ROFHV(FX)-SB 9X2SQ_PVC/B is suitable for use in cleanrooms fulfilling the specifications of the following air cleanliness classes:

| Parameter | Air Cleanliness Class |
|--|-----------------------|
| $v_1 = 0.5 \text{ m/s}; a_1 = 1.0 \text{ m/s}^2$ | 1 |
| $v_2 = 1.0 \text{ m/s}; a_2 = 2.0 \text{ m/s}^2$ | 1 |
| $v_3 = 2.0 \text{ m/s}; a_3 = 4.0 \text{ m/s}^2$ | 1 |
| Overall result | 1 |

Random sampling of particle emissions (airborne) at representative sites

Standards/Guidelines: VDI 2083-9.1; ISO 14644-1
The norms stated refer to the relevant editions applicable at the time of the tests.

Test devices: Optical particle counter:
LasAir II 110 with measuring ranges $\geq 0.1 \mu\text{m}$, $\geq 0.2 \mu\text{m}$, $\geq 0.3 \mu\text{m}$,
 $\geq 0.5 \mu\text{m}$, $\geq 1.0 \mu\text{m}$ und $\geq 5.0 \mu\text{m}$

Test environment parameters:

- Cleanroom Air Cleanliness Class (according to ISO 14644-1):..... ISO 1
- Airflow velocity:..... 0.45 m/s
- Airflow pattern:..... Vertical laminar flow
- Temperature:..... $22^\circ\text{C} \pm 0.5^\circ\text{C}$
- Relative humidity:..... $45\% \pm 5\%$

Test procedure parameters:

- Energy chain:.....igus E61.29.50.075.0
- Chain bending radius:..... $r = 75 \text{ mm}$
- Stroke length:..... $s = 820 \text{ mm}$
- Cable length:..... $l = 850 \text{ mm}$
- Parameter set 1:..... $v_1 = 0.5 \text{ m/s}; a_1 = 1.0 \text{ m/s}^2$
- Parameter set 2:..... $v_2 = 1.0 \text{ m/s}; a_2 = 2.0 \text{ m/s}^2$
- Parameter set 3:..... $v_3 = 2.0 \text{ m/s}; a_3 = 4.0 \text{ m/s}^2$

The measuring devices used for the qualification tests are calibrated at regular intervals; their results can be traced back to national and international standards. In cases where no national standards exist, the test procedure implemented complies with the technical regulations and norms applicable at the time of the test. The relevant documentation can be viewed on request at any time.

For further information about the test environment and parameters, please refer to the Fraunhofer IPA test report.

Fraunhofer Institute for
Manufacturing Engineering and Automation IPA

Stuttgart, May 16, 2014

Place, date of first document issued

Department of Ultraclean Technology
and Micromanufacturing

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Place, current date

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