



Fraunhofer

**TESTED[®]
DEVICE**

igus GmbH
chainflex CF9

Report No. IG 2405-1526

DUPLICATE

Statement of
Qualification

Product series
Particle Emission
in Dry-Cleanroom

Customer

igus GmbH
Spicher Strasse 1a
51147 Cologne
Germany

Component tested

Category: Energy Supply

Subcategory: Cable Systems

Product name: chainflex control cable CF9
Tested Products:

- CF9.02.02 (manufacturing date: third quarter of 2021)
- CF9.03.16.07.03.INI (manufacturing date: first quarter of 2023)
- CF9.05.36 (manufacturing date: second quarter of 2022)
- CF9.15.36 (manufacturing date: first quarter of 2023)
- CF9.25.25 (manufacturing date: third quarter of 2022)
- CF9.160.04 (manufacturing date: second quarter of 2020)

Random sampling of particle emissions (airborne) at representative sites in dry-cleanroom

Standards/Guidelines: ISO 14644-1, -14
The norms stated generally refer to the version valid at the time of the tests.

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

Test environment parameters:

- Dry-Cleanroom Air Cleanliness Class (according to ISO 14644-1): ISO 3
- Airflow velocity: $0.1\text{ m/s} \pm 0.05\text{ m/s}$
- Airflow pattern: displacement flow
- Temperature: $22\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$
- Relative humidity/dew point: $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$

Test procedure parameters:

- Energy chain: igus E61.29.02.75 or igus E61.29.02.150
- Chain bending radius: $r = 75\text{ or }150\text{ mm}$
- Stroke length: $s = 820\text{ mm}$
- 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: $v_3 = 2.0\text{ m/s}$; $a_3 = 4.0\text{ m/s}^2$

Test result / Classification

When operated under the specified test conditions, the series chainflex control cable CF9 is suitable for use in Dry-Cleanrooms (with a room temperature of $22\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ and dew point of $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) fulfilling the specifications of the following Air Cleanliness Classes according to ISO 14644-1:

Test parameter(s)	Air Cleanlines Class
$v_1 = 0.5\text{ m/s}$; $a_1 = 1.0\text{ m/s}^2$	4
$v_2 = 1.0\text{ m/s}$; $a_2 = 2.0\text{ m/s}^2$	4
$v_3 = 2.0\text{ m/s}$; $a_3 = 4.0\text{ m/s}^2$	4
Overall result	4

Please note: Transport damages, incorrect installation, aging behavior, etc. can influence the test result.

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.

Detailed information and parameters of the test environment can be found in the Fraunhofer IPA test report.

Fraunhofer Institute for Manufacturing Engineering and Automation IPA

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Department of Ultraclean Technology and Micromanufacturing

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on behalf of
Dr.-Ing. Frank Bürger, Project Manager Fraunhofer IPA

