



# Holographic Diffraction Grating

## Telcordia GR-1221-CORE Reliability Data Sheet

### Introduction

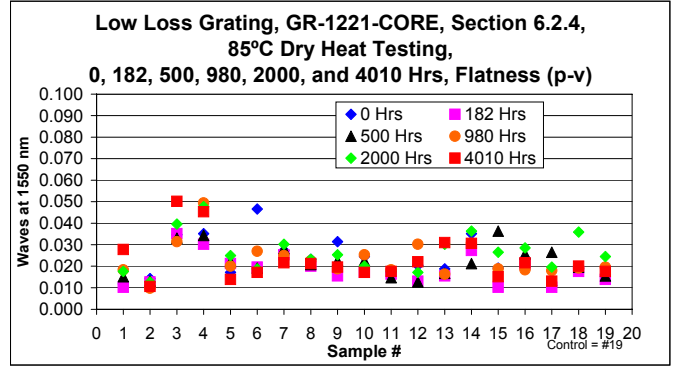
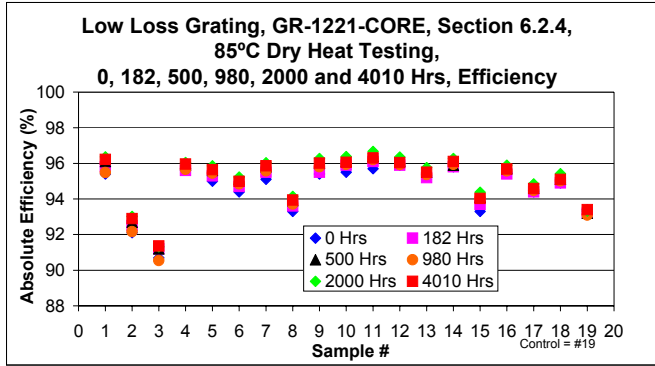
Every Headwall Photonics holographic diffraction grating is an “original” grating, similar to a master grating, and involves no epoxy replication. Our “original” process uses a very environmentally stable set of materials including Ultra Low Expansion (ULE) glass, a proprietary photo-resist, and a durable gold coating. A photolithographic process, similar to that used in semi-conductor manufacturing, exposes the photo-resist to a laser interference pattern, resulting in the surface relief structure of the grating. Once this structure is coated with gold it offers a very stable optical component. In addition to standard optical performance specifications for a diffraction grating, such as insertion loss, polarization-dependent loss (PDL), and wavefront flatness, there are also reliability specifications that must be met before an optical component can be deployed into the telecom network.

Telecom equipment is routinely deployed into harsh environments, such as underground, undersea, on telephone poles, or in sub-stations. The reliability of all sub-components, including diffraction gratings, is of the utmost importance to telecom service providers, since servicing components that fail can be difficult and expensive to repair. Telcordia Technologies (formerly BellCore) has created a set of standardized environmental specifications that must be met to qualify a component for use in the telecommunications network. One such set of specifications, known as GR-1221-CORE, Generic Reliability Assurance, Requirements for Passive Optical Components, specifies the requirements and testing protocol for components that are intended to be embedded into the network. This data sheet discusses the preliminary results of reliability testing on our “original” diffraction gratings with this testing protocol, and discusses Telcordia compliance in general.

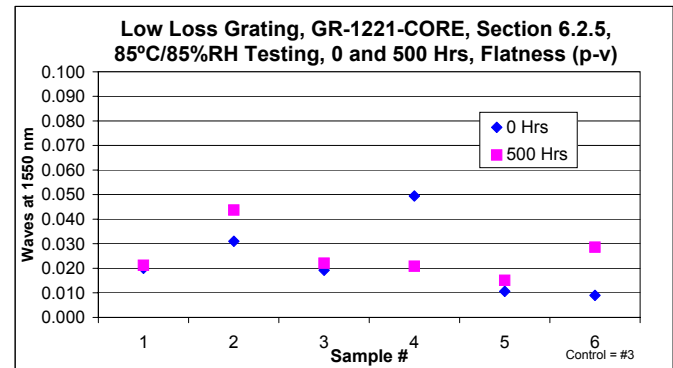
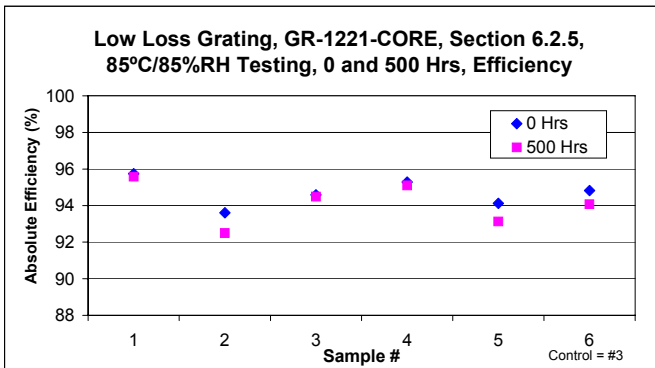
Table 1 identifies the reliability testing performed on telecommunications-grade Low Loss (High Efficiency) 1000 gr/mm planar gratings. The tests conducted in accordance with Telcordia standards are considered the most difficult required by Telcordia GR-1221-CORE. In addition to the testing in accordance with Telcordia requirements, a group of gratings was exposed to 4000+ hours at 100°C Dry Heat.

<b>Telcordia GR-1221-CORE Section</b>	<b>Test Description</b>	<b>Qty Tested</b>	<b>Pass/ Fail Criteria</b>	<b>Qty Pass</b>
6.2.4	85°C Dry Heat; 0, 168, 500, 1000, 2000, and 4000 Hrs	18	No change in efficiency > 2%; Flatness maintained to $\lambda/10$ (p-v) at 1550 nm, Visual Inspection	18
6.2.5	85°C/85%RH Damp Heat; 0, 500 Hrs	5	No change in efficiency > 2%; Flatness maintained to $\lambda/10$ (p-v) at 1550 nm, Visual Inspection	5
6.2.7	-40°C/70°C Temperature Cycling; 0, 100 and 500 Cycles	18	No change in efficiency > 2%; Flatness maintained to $\lambda/10$ (p-v) at 1550 nm, Visual Inspection	18
N/A	100°C Dry Heat; 0, 168, 500, 1000, 2000 and 4000 Hrs	18	No change in efficiency > 2%; Flatness maintained to $\lambda/10$ (p-v) at 1550 nm, Visual Inspection	18

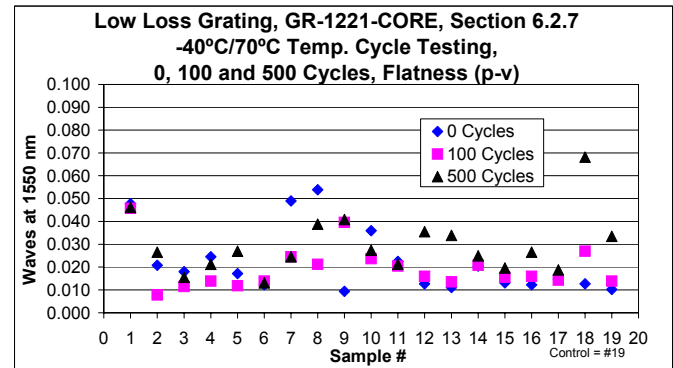
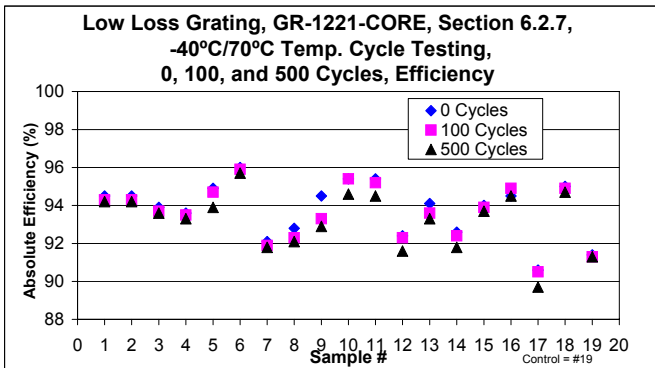
**Table 1, Environmental Testing of Low Loss (High Efficiency) Planar Grating**



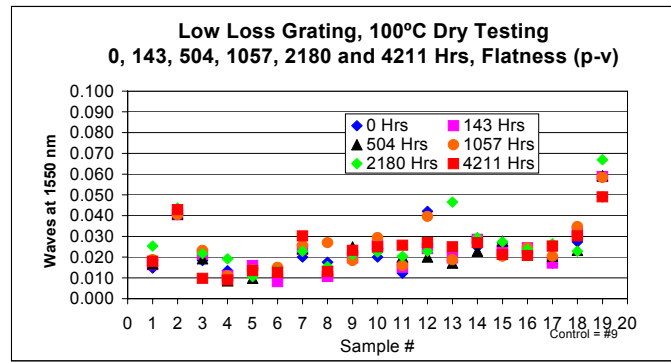
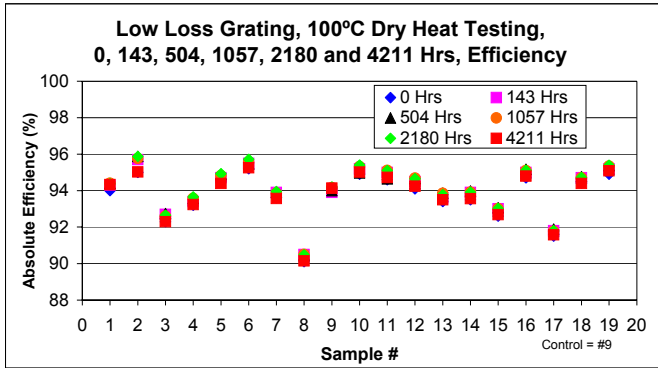
**GR-1221-CORE, Section 6.2.4, Test Results, Efficiency and Flatness**



**GR-1221-CORE, Section 6.2.5, Test Results, Efficiency and Flatness**



**GR-1221-CORE, Section 6.2.7, Test Results, Efficiency and Flatness**



## 100°C Dry Heat Testing, Test Results, Efficiency and Flatness

In addition to the reliability testing identified in Table 1, Headwall Photonics has also performed reliability tests on a DWDM aberration-corrected concave grating design. The testing performed, pass/fail criteria and results are detailed in Table 2. The key parameter for pass/fail was the maintenance of the grating polarization dependent loss (PDL).

Telcordia GR-1221-CORE Section	Test Performed	Qty Tested	Pass/ Fail Criteria	Qty Pass
6.2.4	85°C Dry Heat; 0, 168, 500, 1000 and 2000 Hrs	16	No change in Polarization Dependent Loss > 0.10 dB within wavelength range, Visual Inspection	16
6.2.6	-40°C Low Temperature Storage; 0, 24, 168, 500, 1000 and 2000 Hrs	10	No change in Polarization Dependent Loss > 0.10 dB within wavelength range, Visual Inspection	10
6.2.7	-40°C/70°C Temperature Cycling; 0, 2850 Cycles	4	No change in Polarization Dependent Loss > 0.10 dB within wavelength range, Visual Inspection	4

**Table 2**  
**Reliability Testing of Low Polarization Dependent Loss (LPDL) Concave Grating**

### Summary

The test results shown above demonstrate the reliability of the Headwall Photonics's telecommunications-grade original holographic diffraction gratings. Reliability testing was successfully performed on Low Loss (High Efficiency) planar gratings and on Low Polarization Dependent Loss (LPDL) Aberration-Corrected Concave gratings. The results show that the gratings tested pass extreme environmental testing procedures thereby demonstrating the reliability of the epoxy-free material set and allowing the use of these gratings in hermetic and non-hermetic packaging schemes.

For product information and a complete list of Headwall Photonics, Inc., please go to our website:

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