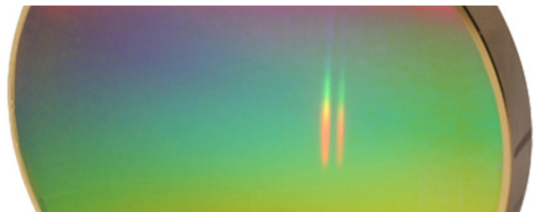
Headwall



HOLOGRAPHIC GRATINGS

CAPABILITIES OVERVIEW

Headwall produces master-quality holographic diffraction gratings for its OEM customers. These gratings precisely manage reflected light, which is a key functionality in spectrometers where very high spectral and spatial resolution within customer-defined spectral ranges is vital. Across a wide array of sizes, shapes, and groove profiles, Headwall's holographic diffraction gratings are unmatched in the industry.

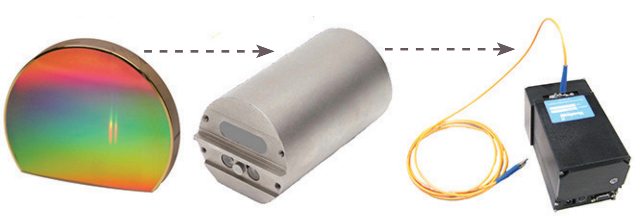
- 40+ years of grating production
- In-house optical design services
- In-house spectrometer design services
- Optical component integration
- High-volume capabilities
- Clean room production
- Customer test-bed release
- Consignment / Kanban options
- ISO 9001:2015 certified

THE HEADWALL ADVANTAGE:

FROM GRATINGS TO SPECTRAL ENGINES

- LOW STRAY LIGHT
- ABERRATION-CORRECTED
- HIGH EFFICIENCY
- HIGH SPECTRAL & SPATIAL RESOLUTION
- HIGH TEMPERATURE SURVIVABILITY
- RAPID PROTOTYPING

DIFFRACTION GRATINGS *OEM COMPONENTS* *INTEGRATED SPECTRAL ENGINES*



ORIGINAL HOLOGRAPHIC GRATINGS VERSUS:

• RULED GRATINGS

Light, in the form of a *laser interference pattern*, is the tool used to create an original master-quality holographic diffraction grating. The holographic exposure does not create any mechanical tooling marks and thus generates very low unwanted stray light that can impact application performance, especially in the visible spectral region. Minimal stray light is the key objective for any diffraction grating, which is why *holographic* technology surpasses *ruled* designs.

Ruled gratings are generated *mechanically*, leaving tool marks during the production process. These tool marks generate stray light. Ruled gratings claim high efficiency but this claim needs to be balanced against higher amounts of stray light and overall reduced application performance.

• REPLICATED GRATINGS

Replicated gratings are made by replicating the 1st generation master grating with epoxy, resulting in 2nd, 3rd, and 4th generation sub-masters. The making of copies during the replication process degrades the 1st generation master, as well as the resulting sub-masters, and incorporates the resulting scratches, digs, pits, and other surface deformation errors into the replicated copies.

This results in far more scatter coming off of the grating when illuminated, and leads to significantly high levels of stray light when employed in a spectrometer. Additionally, as the sub-master degrades to a point where it is no longer usable, a new sub-master will be used in the replication process. This results in a saw toothed variance in stray light performance, and further results in poor product uniformity over replicate grating batches. Furthermore. depending on the type of resin used, the shelf life of the replicate grating can be short and the epoxy resin can break down under a laser based applications with high power and duty cycles.

• PRISMS

Transmission through glass material results in:

- Index of refraction changes with temperature; changes the wavelength dispersion & focal path length degrades resolution and Signal to Noise Ratio.
- Inhomogeneities in refractive index introduce complex aberrations that are difficult or impossible to compensate downstream in the optical train. Prisms are especially sensitive to these effects because of the typically long path lengths travelled inside the glass.
- Scatter from defects at multiple surfaces, as well as bulk scatter, can worsen the stray light specification

HOLOGRAPHIC GRATINGS

Headwall's production and testing capabilities are focused on master-quality holographic diffraction gratings for a wide range of OEM optical applications.

Gratings are produced to exacting tolerances and specifications, yielding very high and uniform optical performance in high-volume situations. Headwall's technical collaboration results in a compressed time-to-delivery for OEMs, and rapid prototyping capabilities assure that customer specifications are met.

PRODUCTION CAPABILITIES

Original master-quality diffraction gratings	Typical Dimensions (dia.) in mm: 10-90 typical
Holgraphic designs; Rowland Circle designs	Typical Dimensions (length x height x thickness) in mm: Length 10-75; Height 6-40; Thickness 2-15
Diamond-turned aluminum grating designs	Spectral range (nm): 160 to 10,000
Geometries: Planar, Concave, Convex	Groove Frequency Range: 50 to 3600+gr/mm
Aberration-corrected concave and convex	Angle of Incidence: 0 to 85 degrees
Custom peaked or blazed wavelength	Substrate: Black glass; ULE; BK7; Fused Silica; Ohara Clear Ceram; Zerodur
Groove profile adjustments	Wavefront Accuracy: 0.25λ PV / 0.1 λRMS or better
Customized S & P polarization adjustments	Stray Light Specification: 10^{-3} to 10^{-4}** ** Stray light specification based on a spectrometer measurement
Types: Low-Loss; Littman-Metcalf; Low Polarization Dependent Loss (LPDL); Cross; Pulse Compression; High Angle of Incidence; Low Stray Light	

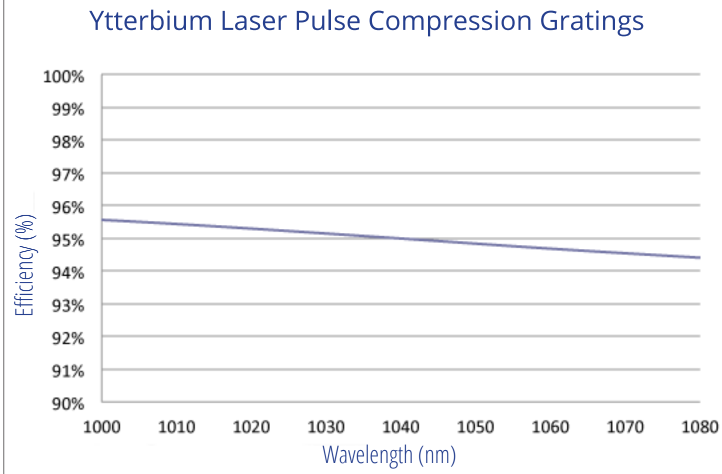
GRATING DESIGN WORKSHEET

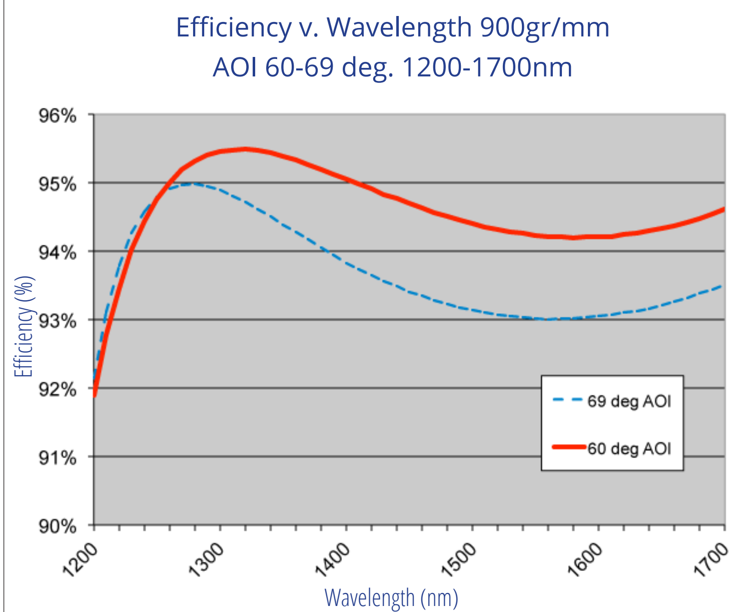
For rapid prototyping and delivery, please have these requirements defined in your specification:

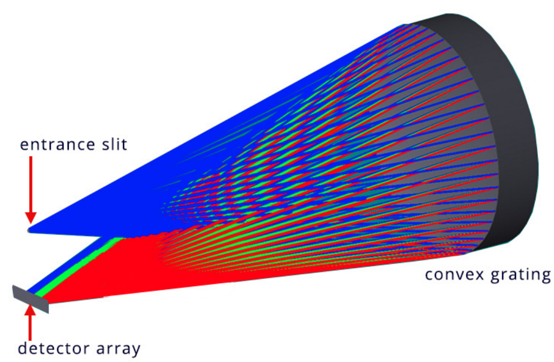
Design: Planar, Rowland Circle; Aberration-Corrected; Concave or Convex	
Application: Spectroscopy, Hyperspectral Imaging, LPDL, Low Loss, Rowland Circle, Littman Metcalf, Laser Pulse Compression, Low Stray Light	
Spectral range in nanometers (nm)	
Dimensions and tolerances	
Material of construction	
Clear aperture (yes or no)	
Peak or Blaze wavelength (nm)	
Angle of Incidence	
Efficiency requirements	

PULSE COMPRESSION GRATINGS

Headwall ptimizes grating performance for specific cavity geometries and beam requirements. Applications include fiber amplifier lasers; TiSa; Ytterbium; Yttrium; ND:Glass; and OPCPA amplified lasers.







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