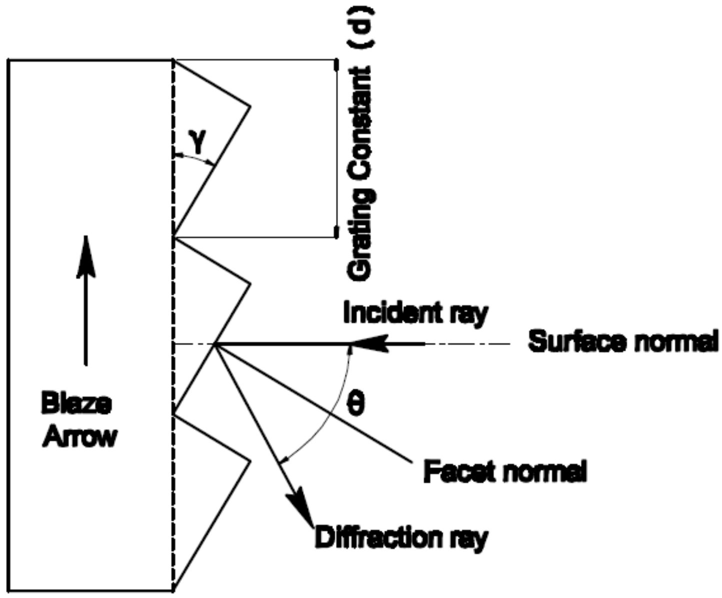
GCG-Plane Diffraction Grating

Grating is a common optical dispersion component. It is an object or device that has a spatial periodic distribution within a certain spatial range and can amplitude modulation or (and) position phase modulation of electromagnetic waves according to certain laws. According to the usage, the grating can be divided into transmission gratings and reflection gratings, and reflective gratings can be divided into plane reflection gratings, concave reflective gratings, echelle gratings, etc.

GCG series grating is one of the plane reflective gratings, which is characterized by the maximum diffraction light intensity-level glare falling outside the zero-stage spectrum, so it is called the blazed grating. For serrated grooves, the direction with the greatest light intensity is the direction of the groove surface determined by the law of reflection.

Daheng Optics provides a blazed grating with a lithography of 300-1200 lines within a range of 360nm-1250nm. At the blazed wavelength, the grating diffraction efficiency can reach 60% to 80%. It has two dimensions of 12.5mmx12.5mm and 25mmx25mm. The back of the grating is polished, and the side is marked with an arrow indicating the direction of the grating, as shown in the schematic diagram below. The damage threshold of this series of gratings is typically tested at 532nm, about 150mJ/cm2 (532nm, 10ns, 10Hz). Please note not to exceed the laser threshold during use.



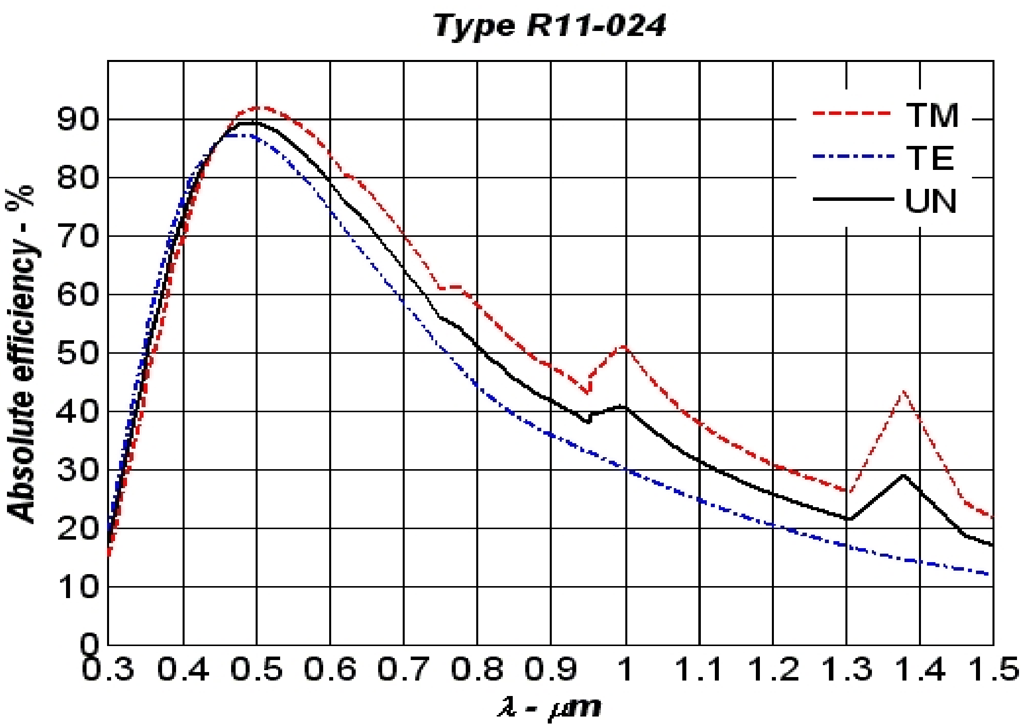
The surface of the grating is engraved with precision grooves, which is very vulnerable to damage. Please place it in a clean and dry environment. Don't touch or wipe the surface of the grating when using it. When cleaning, only clean and dry air can be used.

For detailed indicators of this series of gratings, please see Schedule 1.

Mode	Line	Blazed wavelength(um)	Blazed angle	Dimension	Tolerance	Thickness	Tolerance	Surface quality on back	Damage Threshold (532nm，10ns，10Hz)
GCG-300-0.5-12.5	300	0.5	4.3°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-300-0.5-25	300	0.5	4.3°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-300-1.0-12.5	300	1	8.6°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-300-1.0-25	300	1	8.6°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-600-0.36-12.5	600	0.36	6.2°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-0.5-12.5	600	0.5	8.6°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-0.5-25	600	0.5	8.6°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-600-0.72-12.5	600	0.72	12.5°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-0.72-25	600	0.72	12.5°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.0-12.5	600	1	17.5°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.0-25	600	1	17.5°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.25-12.5	600	1.25	22.0°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.25-25	600	1.25	22.0°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.6-12.5	600	1.6	28.7°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-600-1.6-25	600	1.6	28.7°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-1200-0.36-12.5	1200	0.36	12.5°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-1200-0.5-12.5	1200	0.5	17.5°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-1200-0.5-25	1200	0.5	17.5°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-1200-0.72-12.5	1200	0.72	25.6°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-1200-0.72-25	1200	0.72	25.6°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2
GCG-1200-1.0-12.5	1200	1	36.9°	12.5x12.5	0,-0.05	4	0,-0.05	Polished	150mJ/cm^2
GCG-1200-1.0-25	1200	1	36.9°	25x25	0,-0.05	6	0,-0.05	Polished	150mJ/cm^2

Schedule1

The efficiency curve of this series of gratings is shown in Schedule 2. The diffraction efficiency is measured under the Littrow structure at m=1



Schedule2

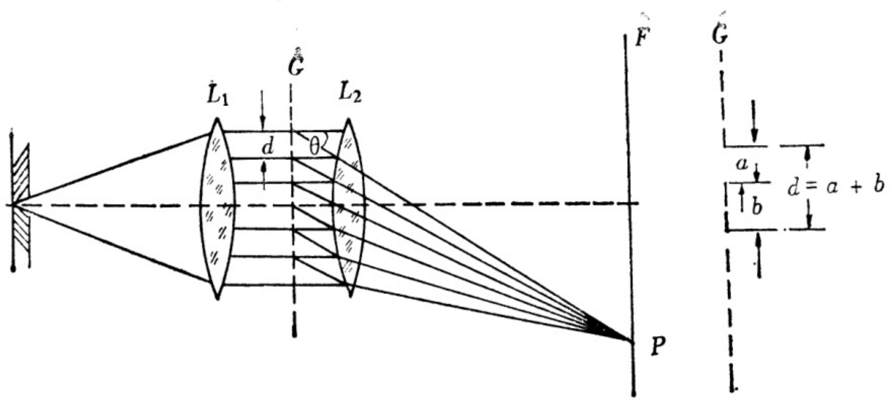
The following is a brief introduction to its basic principle and grating equation.

1. Basic characteristics of grating

Due to the spatial periodicity of the grating structure, there are a large number of equal width, equal spacing and parallel slits (or notches), so the diffraction fringes of the grating are the total effect of multi slit interference and single slit diffraction, and the diffraction pattern of the grating is the result of the intensity distribution of multi slit interference being emphasized by the single slit diffraction light.

In Figure 1, S is a sewing light source, which is on the focal plane of lens L1. If the spindle of L1 passes through the center line of the slit and parallels with each other, the sewing light source outputs parallel light after passing through L1. G is a grating, which has a transmission seam with numberous width of "a", and a width of b for the non-permeable part of the adjacent slits. The parallel light ejected from L1 shone vertically on part of the adjacent slits. The parallel light ejected from L1 shone vertically on the grating G, and the lens L2 will focus at the P of the L2 focal plane F at anθangle in the direction of the grating normal. The conditions for producing bright stripes at P are:

$$d\sin\theta=k\lambda \quad (1)$$



This is what we usually call the grating equation. In the equation, θ is the diffraction angle, λ is the wavelength of the light source used, k is the order of the spectrum (k=0, ±1, ±2,.....), d=a+b, and is the grating constant.

When the diffraction angle is θ=0, the order k=0, and any wavelength satisfies the great conditions there, so the center bright stripes appear at θ=0. For other values of k, the symbol "±" represents two sets of spectra, which are symmetrically distributed from the center bright stripe to left and right.

If the parallel light ejected from L1 is not perpendicular to the surface of the grating, the grating equation shall be written as:

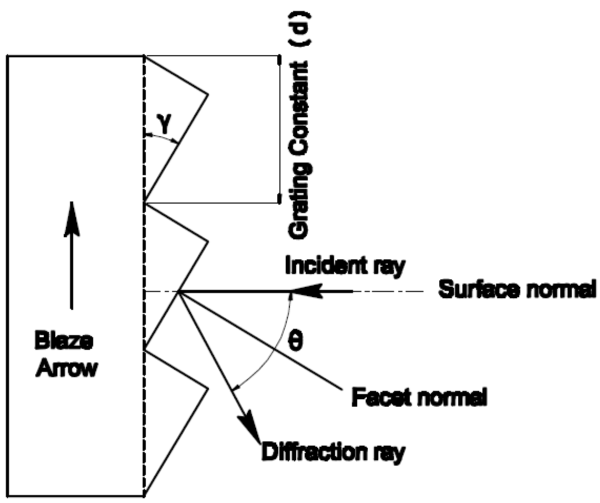
$$d(\sin\theta-\sin i)=k\lambda(2)$$

Type i is the angle between incident light and grating normal. When using formula (1), be sure to ensure vertical incident of parallel light, otherwise formula (2) must be used.

2. Blazed grating

Blazed grating is a reflection grating whose structure is shown in Figure 2. It is made of a series of parallel serrated grooves on the substrate material, and then coated with a high reflective film on its surface.

Figure 2:



The general equation of the blazed grating is:

$$\mathbf{d\,(\sin i + \sin\theta) = m\lambda} \qquad (3)$$

$$\mathbf{m\lambda_B = 2d\sin\gamma\cos(\gamma - i)} \qquad (4)$$

The main structural parameters are:

Grating constant "d": the length of the groove periodic interval, as shown in the figure above.

Engraving number "N": refers to the number of lines in the 1mm groove, which is related to the grating constant d.

Shining angle "γ": the angle between the grating plane and the groove surface, as shown in the figure above.

Entry angle "I": the angle between incident light and raster normal.

Diffraction angle "θ": the angle between diffraction light and the grating normal, as shown in the figure above.

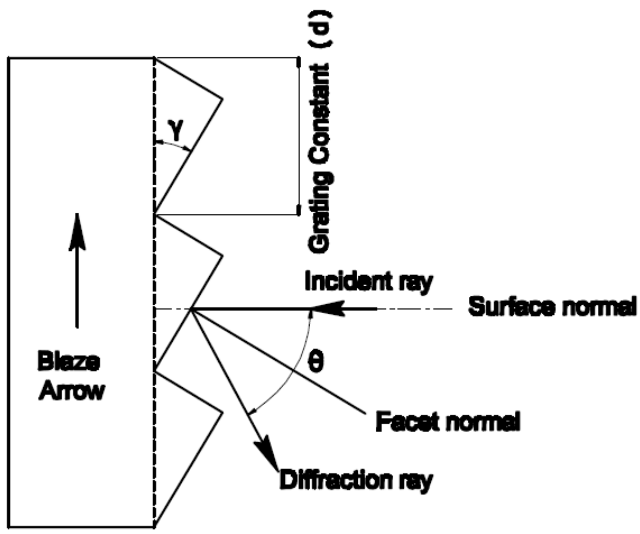
Shining wavelength "λ_B": when the grating constant "d", the glare angle"γ", and the incident angle" I" are determined, at a diffraction level "m", only one wavelength can satisfy the above equation (4), which is called the blazed wavelength under this level.

Blazed gratings usually use m=1 and m=2 spectra. When taking m=1, there are two special light paths.

The beam is perpendicular to the surface of the grating, and the incident angle i=0, as shown in Figure 3, can get:

$$\mathbf{d\sin\theta = \lambda_B} \qquad \mathbf{\theta = 2\gamma}$$

Figure 3:



When the beam is incident at a blazed angle, that is, perpendicular to the groove plane, it is the LITTROW structure shown in Figure 4. LITTROW structure is widely used in spectrometers, laser resonators and other devices, which are characterised by simple and stable structure and high diffraction efficiency, so that the equipment can obtain higher output power. At this point, the incident angle "I" is equal to the diffraction angle "γ", and you can get:

$$2d\sin\gamma = \lambda_B$$

Figure 4: