

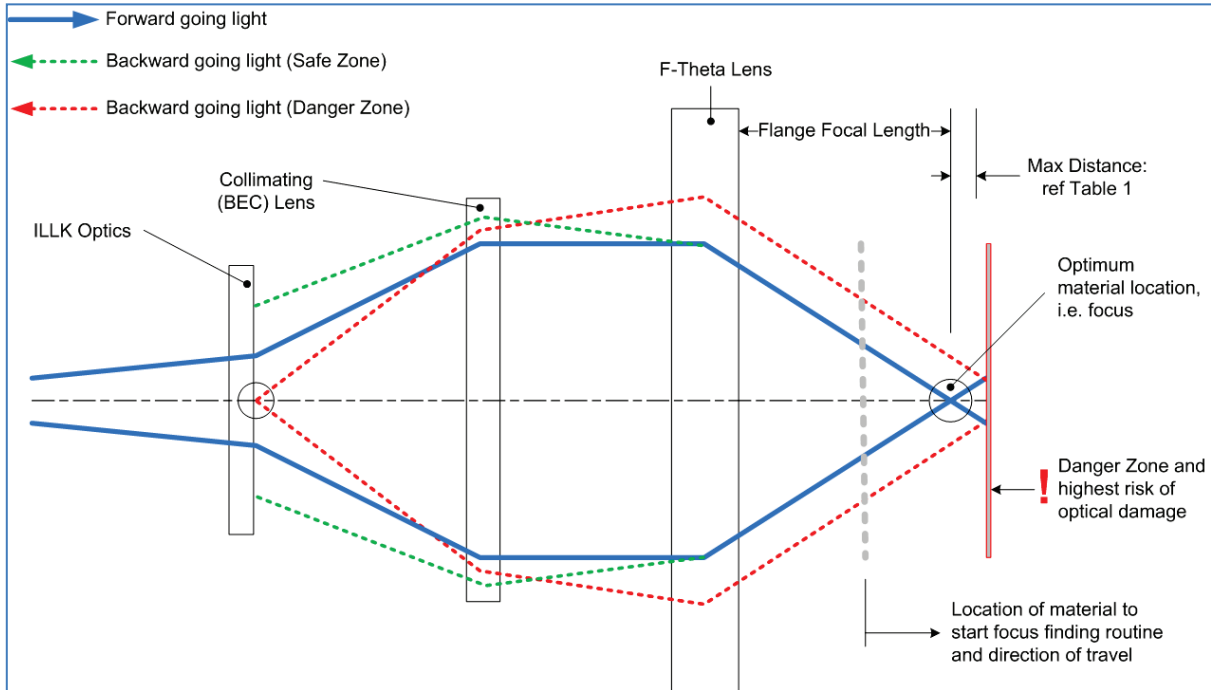
## Technical Note

### G4 ILLK – Safe De-Focus Operating Limits

- ✔ The G4 “ILLK” beam delivery provides extremely robust protection to the G4 Laser, ensuring that back reflected light is isolated and removed before it has an opportunity to interact with the laser cavity. However care must be taken when processing highly reflective materials heavily out of focus (e.g. silver, copper, gold, brass).
- ✔ In extreme cases, de-focused back reflected light interacts with optical surfaces within the “ILLK” which can result in energy densities that may exceed the rated Laser Induced Damage Threshold (LIDT) of the optical surface and/or coatings. The likelihood of this occurring is very low due to the scattered nature of back reflected light and the sensitivity to angular deviation from normal incidence.
- ✔ Highest risk is present when long focal length Beam Expanding Collimators (BECs) are used in conjunction with short focal length F-Theta lenses. For the processing of highly reflective materials, an FL100 (BEC) and FL100 (F-Theta) combination is not recommended.
- ✔ To avoid this situation and the risk of damaging optical components within the ILLK beam delivery, it is additionally required that the following method of focus finding be followed:
  - Use a non-highly reflective material such as stainless steel for initial set-up and focus finding.
  - Ensure that the substitute material is the same thickness as the material to be processed. If this is not possible, the offset must be applied when switching materials. Note that this will not be necessary if the focus is located on the material top surface.
  - Use reduced power (e.g. <50%) for initial set-up and focus finding.
  - When starting a focus finding routine, locate the material towards the F-Theta lens, i.e. *inside* of the expected focus location (*negative* de-focus) as detailed in Fig 1. This can be determined by the “Flange Focal Length” dimension provided by the F-Theta manufacturer. This is the “Safe Zone”.
  - Move the material slowly towards focus in small steps (<0.5mm) until focus is found. Highest risk of optical damage is beyond focus at a distance dependent on BEC and F-Theta lens combination.
  - Once focus is found using the steps detailed above, fine tuning of focus can be conducted using desired power and material. If focus location needs tuning, always move the material back towards the F-Theta lens and move out towards focus, again in small steps (<0.5mm).
  - Highest risk of optical damage is beyond focus and is dependent on BEF and F-Theta lens combination. Once focus is found, do not go beyond focus by the values listed in Table 1 (*positive* de-focus limits). This is the “Danger Zone”.

# Technical Note

## G4 ILLK – Safe De-Focus Operating Limits



**Fig 1: Focus Finding Method**

		F-Theta Focal Length / mm				
		100	163	254	300	410
BEC Focal Length / mm	30	15	40	97	135	252
	50	5	14	35	49	91
	75	2	6	16	22	40
	100	-	4	9	12	22

**Table 1: Positive De-Focus Limits (mm)**