

Technical Report 27

**COMPARISON OF SECONDARY SUBSTRATE
MATERIAL AND CONSTRUCTION**

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There are several requirements that must be met in the selection of a substrate for secondary mirrors. First, the substrate must be rigid enough to hold its shape under the stress of fabrication (lapping), and to resist gravitational flexure within a given design error budget. Second, it must resist deformations due to thermal transients in the telescope environment (again within the error budget). Third, taken together with its mount, the entire secondary package should achieve isothermality with the ambient air in about the same time as an actively cooled borosilicate honeycomb primary--namely, one hour. Finally, the chosen substrate must meet these requirements at a reasonable cost.

A survey of commercially available substrate materials and construction techniques leads to a bewildering range of choices and costs. Some simple scaling techniques can be used to compare relative flexure and thermal response. These techniques are not accurate enough to provide detailed design of a substrate and mount, however they can be used to compare the relative performance of such diverse substrates as, say, a ULE meniscus and an aluminum foam-cored sandwich.

NOTATION

The notation used is similar to Mehta's¹:

b = Rib spacing
t_f = Front facesheet thickness
t_b = Equivalent bending thickness
t_w = Web thickness
A = Area of mirror surface
D = Mirror diameter
E = Young's modulus
F = Flexural rigidity
H_c = Core depth or rib height
I = Sectional moment of inertia
W = Mirror weight
η = Core or rib solidity ratio
ρ = Density
ν = Poisson's ratio

The following are also used:

c = Material specific heat
h = Heat transfer coefficient
k = Material thermal conductivity
v = Wind velocity
A_r = Area of rib walls
C = Thermal capacitance