The need for a reliable photometric system in the mesopic range results from discrepancies between current photometry, which is solely based on daylight vision, and visual perception under dim light conditions. A luminance based mesopic photometric system to evaluate light distributions is particularly relevant for safety related applications like automotive, street, and emergency lighting. In order to describe rod and cone contributions to mesopic vision and to determine a measure of mesopic luminance several methods were used: minimally distinct border settings, minimum motion settings, threshold contrasts for the detection of flashes, motion discrimination thresholds, and the detection of a counterphasing stimulus. While minimally distinct borders and minimum motion settings were expected to favor the achromatic luminance channel, detection threshold contrasts and detection thresholds for a counterphasing stimulus incorporate both the achromatic and the chromatic pathways of the visual system. In all studies the emphasis lies on extrafoveal perception under adaptation conditions ranging from photopic to scotopic. Results show a decrease of cone contribution with decreasing adaptation luminance which can be described with a sigmoid function. Foveal and near foveal vision is dominated by cones also at mesopic light levels, whereas far peripheral vision is rod dominated at high mesopic and low photopic adaptation conditions. An increase in S/P ratio of the adaptation background and spatial frequency of the object leads to a decreased effectiveness of rods relative to cone stimulation at mesopic levels. Mechanistically inspired models are suggested to provide an account of these trends.