Quality Control of Mineral Oil and Scintillator
(WBS 2.2.1.6 & 2.2.4.3.4)

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Chuck Bower

Scintillator QC Introduction

- Performance of the NOvA detectors depends upon the light yield of the scintillator
- There are two controlling factors in the scintillator's light yield
  - Amount of light generated by a traversing charged particle
  - Attenuation of scintillator photons while meandering their way to the wavelength shifting fiber
- Ensuring the attenuation length of the mineral oil and controlling the quality and quantity of components prior to and during mixing lead to the required scintillator performance

Scintillator QC steps

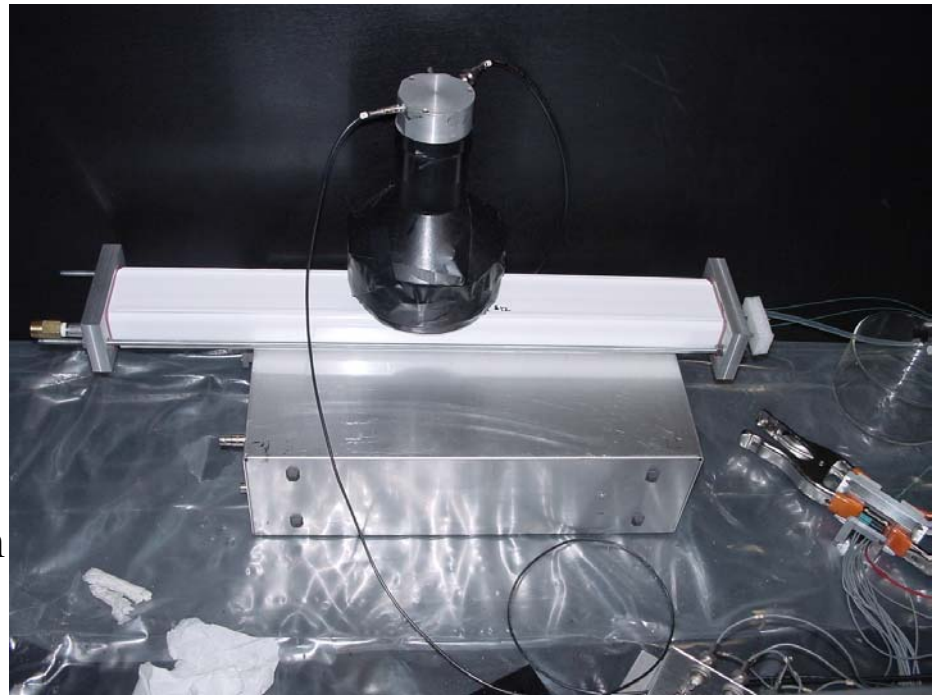
- Component testing
  - Pseudocumene: mass spectrometry
  - WLS Fluors: (see Anna's talk this session)
  - Mineral oil: measure attenuation length (at refinery and blending site)
- Composite testing
  - "Concentrate" (fluors+PS): light yield test
  - Finished Scintillator (at blending site and detector sites)
    - Light output test
    - Attenuation length measurement
    - Electrical conductivity measurement

How we know what is good enough

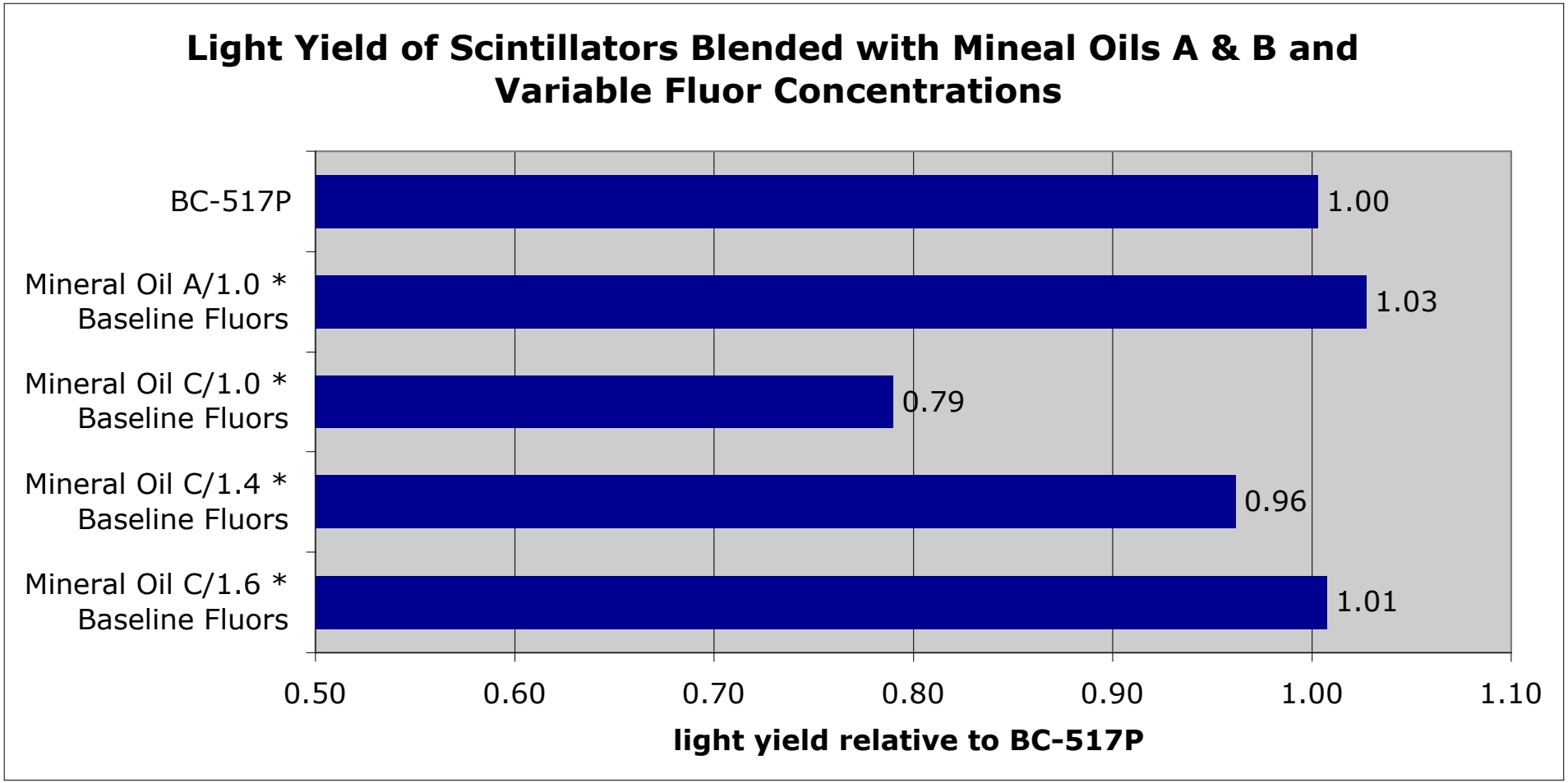
1. Monte Carlo simulation has determined absolute light yield requirements
2. Full length prototype tests at U. of MN and CIT with actual NOvA components have determined what combination satisfies (MC) requirement
3. Relative light yields in NOvA test cell at Indiana U. determined scintillator performance vs. scintillator components
4. Two types of QC measurements at Indiana U. bootstrap light yield performance to simple testing procedures to be carried out at refinery, blender site and detector sites

Msmt of light yield w/ NOvAcell

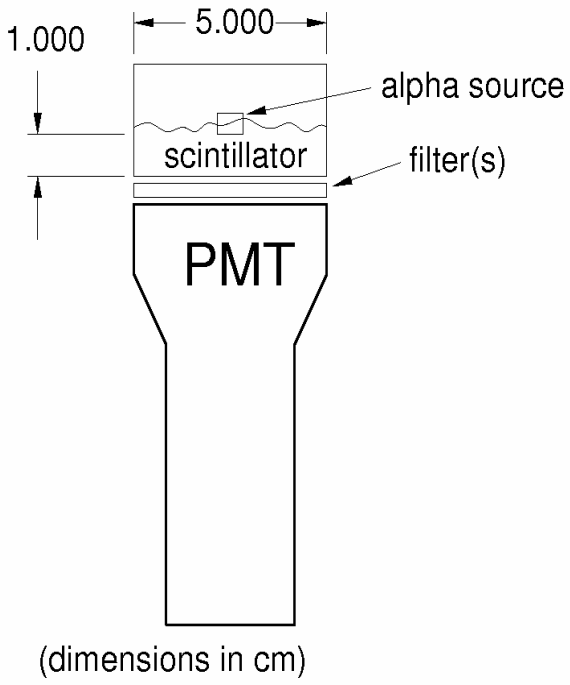
- Short version of NOvA detector single (1/16) cell
  - Same cross section
  - 60 cm length
  - Trigger on muons at center
  - 2x 1.2 m long, 0.8 mm diameter WLS fibers
    - No loop; far ends rough cut
  - MINOS M16 PMT
    - 12% < QE < 15% @520 nm
- Relative measurements mean differences between true NOvA cells and this test cell are irrelevant

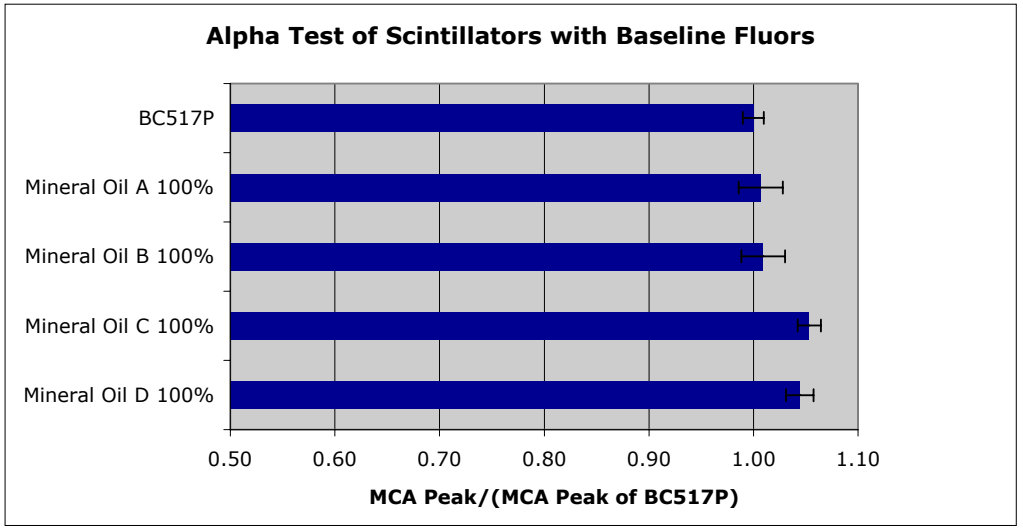


Light Yield of Scintillators



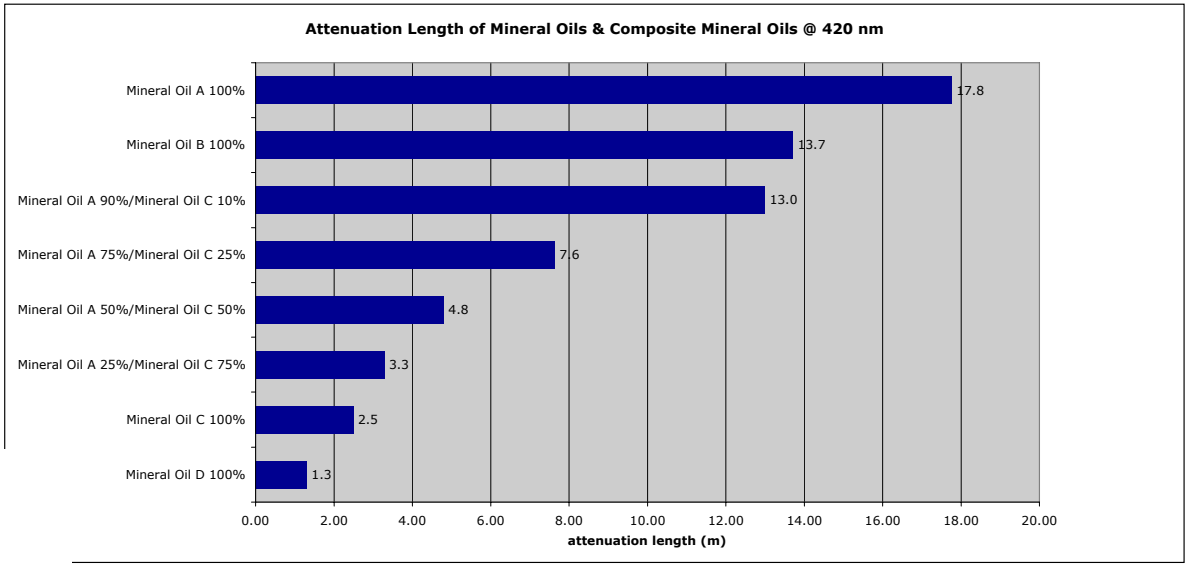
QC: Light output of mixed Scint.

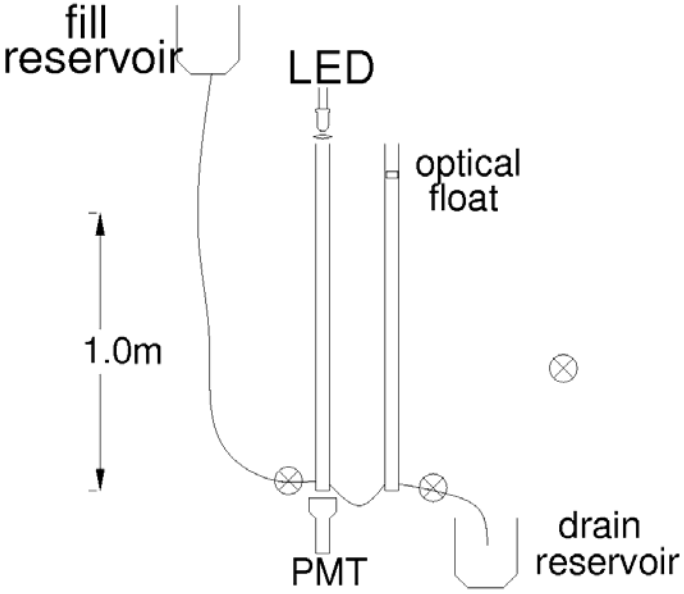




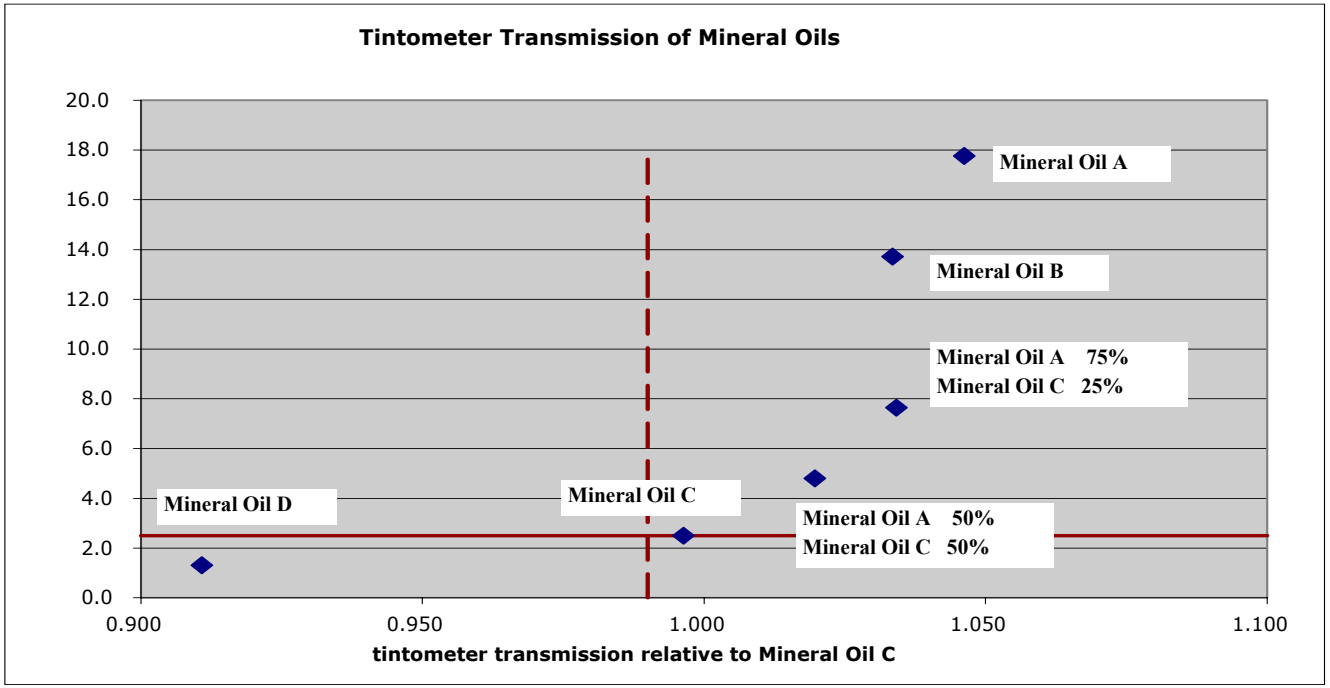
- 3% accuracy is achievable with four measurements (verified)
- 2% accuracy is achievable with ten measurements (verified)

QC: Attenuation length of mineral oil

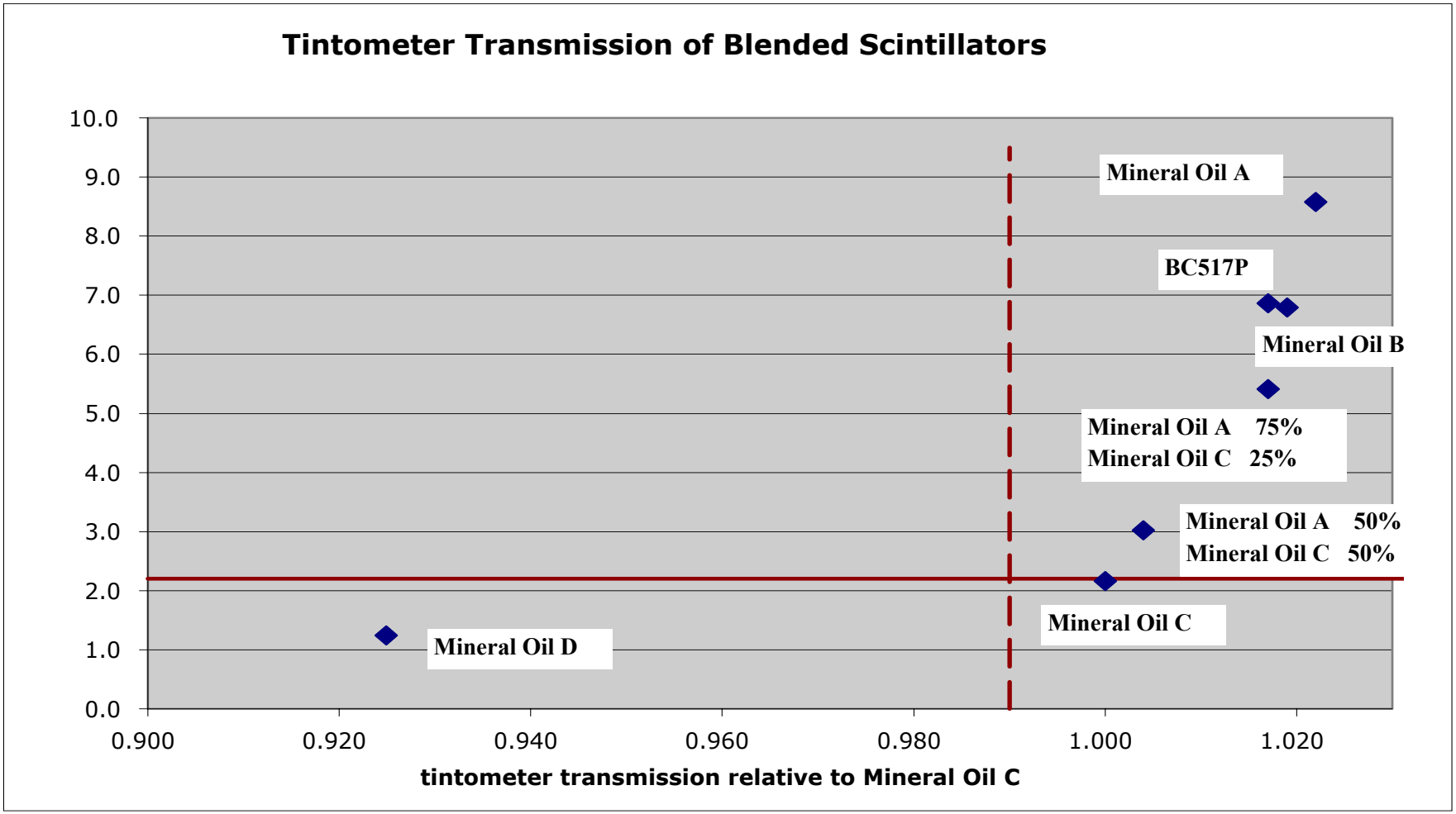




Easy Attenuation Length Msmt: Lovibond Tintometer



QC: Attenuation Lengths of Scintillators



Scintillator QC Summary

- Detector performance vs. scintillator QC tests have been established
- QC devices and (fast) procedures have been developed
- Component QC testing minimizes wasted mixing time and resources(=$)
- Testing of finished mix ensures good scintillator is installed in the detectors