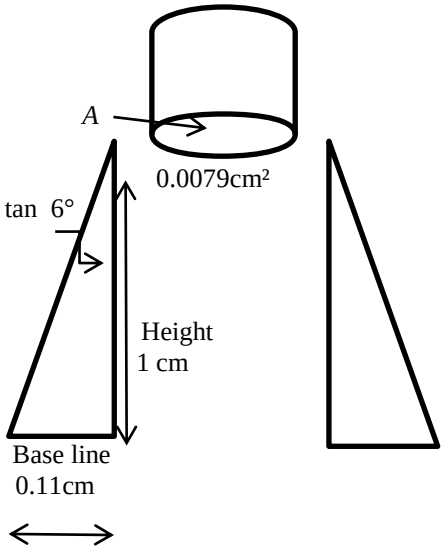
i. Calculations

1. Calculation of Fluence. (Energy Density)

Tip size = MZ10 (1 mm tip size)
Diameter = 0.5 mm
Surface $A = \pi r^2$ (3.14 x 0.5mm ²)
= 0, 79 mm²
= 0,0079cm²



Divergence of 6° both sides of tip
Base line = tan 6°
= 0.11cm
Triangle surface = ½ x base x height
= ½ x 0.11cm x 1 cm
= 0.055cm²
Total Surface at = (0.055cm² x 2) + 0.0079cm²
at 90° = 0.1179cm²

But: Handpiece is tilted at 45°

Effective focal spot area = Total surface at 90° / Cosin 45°
= 0.1179 cm² ÷ 0.707 (Cosine 45°)
= 0.17 cm²

LASER: P(avg) = 0.5 W, 30 Hz.

Fluence: = Laser pulse energy (J) / Effective focal spot area (cm²)

= 0.01667 J / 0.17 cm²

= 0.098 J/cm² (98.1 mJ)

E(pulse) = P(avg) ÷ Frequency
= 0.5 J.s ÷ 30 pps
= 0.01667 J (16.67 mJ)

2. Dose (Joules/cm^2) = Power (watts) x Time (sec) / Area (cm^2)
= P(avg) x sec ÷ 0.17cm²
= 0.5J.s x 30 s ÷ 0.17cm²
= 88.23 J/cm²

or = (add all pulse's energy) x sec÷0.17cm²
= (16.67 mJ x 30 (1/sec) x 30 s ÷ 0.17cm²
= 88 252 mJ/cm²
= 88.23 J/cm²

3. Dosage = (Joules /cm²) Total energy of irradiation for 3 visits
= 88.23J/cm² x 3 visits
= 264.69 J/cm²

3. Peak Power = Rate of energy flow in every pulse

= E(pulse) ÷ pulse duration (t)
= 16.67 mJ ÷ 0.06ms (60 µs)
= 277.8 J.s
= 277.8 W

or P(avg) ÷Duty Cycl
= 0.5 J.s ÷ 0.0018 (0.18%)
= 277.8 J.s
= 277.8 W

4. Power Density: = Power density is the amount of power (time rate of energy transfer) per unit volume (also known as irradiance)

= P(peak) ÷ Effective focal spot area (cm^2)
= 277.8J.s ÷ 0.17 cm^2
= 1634.1 W/cm^2

5. Duty Cycle : = Fractional amount of time the laser is "on" during any given period.

= Δt ÷ T **or** P (avg) ÷P (peak)
T = 1÷ 30 pps = 0.5W ÷ 277.8W
= 0.033 s = 0.0018
= 33 ms = 0.18%
Δt = pulse width
= 0.060 ms (60μs)

= Δt (0.060 ms) ÷ T (33 ms)
= 0.0018
= 0.18%