UNITED STATES ARMY
ENVIRONMENTAL HYGIENE
AGENCY
ABERDEEN PROVING GROUND, MD 21010

NONIONIZING RADIATION PROTECTION SPECIAL STUDY NO. 25-42-0340-83
DYNATRON MODEL DT-820 HELIUM-NEON (HeNe) LASER
APRIL 1983

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NONIONIZING RADIATION PROTECTION SPECIAL STUDY NO. 25-42-0340-83, DYNATRON MODEL DT-820 HeNe LASER, APRIL 1983

A Nonionizing Radiation Protection Special Study of the Dynatron Model DT-820 HeNe Laser was performed by this Agency at Walter Reed Army Medical Center. It was determined that the Dynatron Model DT-820 laser was a Class 2 laser system and the laser radiation emitted from the Dynatron did not present a hazard to the skin.
SUBJECT:  Nonionizing Radiation Protection Special Study No. 25-42-0340-83, Dynatron Model DT-820 HeNe Laser, April 1983

EXECUTIVE SUMMARY

The purpose, essential findings, and major recommendations of the inclosed report follow:

a. Purpose. The purpose of this report is to determine if the laser radiation emitted by the Dynatron Model DT-820 Helium-Neon laser exceeds current exposure limits and to make recommendations to eliminate exposure of personnel to potentially hazardous laser radiation.

b. Essential Findings. The Dynatron Model DT-820 laser is a Class 2 laser system and the laser radiation emitted from the Dynatron does not present a hazard to the skin. However, personnel should not attempt to stare directly into the beam.

c. Major Recommendations. Do not point the Dynatron Model DT-820 laser into the eyes of patients.

FOR THE COMMANDER:

JOSEPH T. WHITLAW, JR
Colonel, MSC
Director, Radiation and Environmental Sciences

CF:
HQDA (DASG-PSP) wo incl
Cdr, WRAMC (HSHL-MAA-VI-Col Graziano)
Cdr, WRAMC (PVNTMED Actv) (2 cy)
Cdr, WRAMC (HSHL-HP) (2 cy)
Comdt, AHS (HSHA-IPM)

7 JUN 1983
1. AUTHORITY. Letter, HSHL-HP, Walter Reed Army Medical Center, 26 October 1982, subject: Evaluation of Laser Acupuncture Investigational Medical Device, and indorsement thereto.

2. REFERENCES. See Appendix A for a listing of references.

3. PURPOSE. To evaluate possible optical radiation hazards associated with the Dynatron Model DT-820 Helium-Neon (HeNe) laser and to make recommendations necessary to eliminate exposure of personnel to potentially hazardous optical radiation from this device.

4. GENERAL.
   a. Background. The Dynatron Model DT-820 HeNe Laser was obtained by the Pain Control Clinic, Walter Reed Army Medical Center (WRAMC), from Dynatronics Research Corporation, Salt Lake City, Utah 84104, for consideration for possible use as a laser "biostimulator." An extensive literature on "laser biostimulation" has accumulated in recent years (Appendix B). Many claims have been made in these reports to the effect that low power coherent light has certain properties to stimulate wound healing, pain relief, etc., at levels below thermal heating. In the United States, most of these reports have been met with great skepticism. However, there has been a need to conduct an unbiased study of these effects. The WRAMC Pain Control Clinic planned to use this device to test by objective means these claims found in the literature.
   
   b. Description. The Dynatron Model DT-820 is a HeNe laser operating at 632.8 nm. The laser radiation is delivered through a flexible fiber optic light guide to a hand-held stylus. The system may be operated in the pulsed mode from 2.5 Hz to 200 Hz. In the pulsed mode, the beam is mechanically chopped with 50 percent duty cycle. The system is portable and is operated from 120 V AC. The Figure shows an illustration of the Dynatron laser.
   
   c. Inventory. One Dynatron Model DT-820 laser [Serial Number (SN) EXP .2] was on hand at the Pain Control Clinic, WRAMC, Room 6344, Ward 63.
   
   d. Instrumentation.
      (1) United Detector Technology Inc. (UDT) Model 40X Optometer (SN 45101).
      
     (2) Tektronix Model 214 Storage Oscilloscope (SN B111999).
      
   e. Radiometric Terms and Units. Radiometric terms and units are listed in Appendix C.
Figure 1. The Dynatron Model DT-820 HeNe Laser.
5. FINDINGS.

a. Radiometric Measurements. Radiometric measurements were made on the Dynatron Model DT-820, SN EXP 2, at the Pain Control Clinic, WRAMC, on 31 March 1983. The results of these measurements are as follows:

(1) Continuous Wave Mode.

Radiant Power: 0.89 mW
Beam Divergence: 27° at 1/e points

(2) Pulsed Mode. The Table provides values of the measured frequency and the average power for various frequency settings. An indicated frequency of 29 Hz gave the maximum average power of 0.67 mW.

TABLE. LASER OUTPUT MEASUREMENTS

<table>
<thead>
<tr>
<th>Indicated Frequency</th>
<th>Measured Frequency</th>
<th>Average Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hz</td>
<td>Hz</td>
<td>mW</td>
</tr>
<tr>
<td>Low Mode</td>
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<td></td>
</tr>
<tr>
<td>2.5</td>
<td>2.9</td>
<td>0.41</td>
</tr>
<tr>
<td>10</td>
<td>26.3</td>
<td>0.39</td>
</tr>
<tr>
<td>20</td>
<td>28.6</td>
<td>0.42</td>
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<tr>
<td>25</td>
<td>34.5</td>
<td>0.52</td>
</tr>
<tr>
<td>High Mode</td>
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<tr>
<td>25</td>
<td>28.6</td>
<td>0.48</td>
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<td>160</td>
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<td>0.40</td>
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<tr>
<td>200</td>
<td>200</td>
<td>0.40</td>
</tr>
</tbody>
</table>

b. Manufacturer's Measured Parameters.

(1) Continuous Wave Mode.

Radiant Power: 0.95 mW
Beam Divergence: 30°

(2) Pulsed Mode. Average Power at 80 Hz: 0.45 mW
c. Federal Performance Standard. The appropriate warnings were permanently attached to the device housing and other system safety features were present as prescribed in 21 CFR 1040.

d. Investigational Device Exemption (IDE). At the time of the study the WRAMC Pain Control Clinic was preparing an IDE for submission to their Human Use Committee.

6. DISCUSSION.

a. Laser Hazard Classification. The maximum radiant power of the Dynatron Model DT-820 HeNe laser is 0.89 mW. This is greater than the Class 1 emission limit for visible lasers of 0.4 \( \mu \)W and less than the Class 2 emission limit for visible lasers of 1 mW. Therefore, this laser is classified from a hazard standpoint as a Class 2, low power laser. The potential hazard from this laser is limited to the eye, and it does not pose a skin or fire hazard. A retinal injury could result if an individual were to stare within the direct laser beam or a specularly reflected beam. However, an individual’s natural aversion response (blink reflex) to the extremely bright light from this laser would limit the exposure to a level below current protection standards; therefore, this laser does not pose a significant hazard to the eye.

b. Exposure Limit. The exposure limit for staring directly into the beam of the Dynatron Model DT-820 laser was calculated to be 10 s at a distance of 2 cm and 8 hr at a distance of 70 cm.

7. CONCLUSION. The Dynatron Model DT-820 laser does not present a hazard during normal use. However, personnel should not attempt to stare directly into the beam.

8. RECOMMENDATION. Do not point the Dynatron Model DT-820 laser into the eyes of patients [para 5-38b(5), AR 40-5].

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APPENDIX A

REFERENCES


2. AR 40-46, Control of Health Hazards from Lasers and Other High Intensity Optical Sources, 6 February 1974, with Change 1, 15 November 1978.

3. TB MED 279, Control of Hazards to Health from Laser Radiation, 30 May 1975.


APPENDIX B

BIBLIOGRAPHY


### APPENDIX C

**USEFUL CIE RADIOMETRIC AND PHOTOMETRIC TERMS AND UNITS**

<table>
<thead>
<tr>
<th>Term</th>
<th>Symbol</th>
<th>Defining Equation</th>
<th>SI Unit and Abbreviation</th>
<th>Term</th>
<th>Symbol</th>
<th>Defining Equation</th>
<th>SI Units and Abbreviation</th>
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</thead>
<tbody>
<tr>
<td>Radiant Energy</td>
<td>$E_r$</td>
<td>$\frac{dE_r}{dt}$</td>
<td>Joulie (J)</td>
<td>Luminous Energy</td>
<td>$L_r$</td>
<td>$\frac{dE_r}{dt}$</td>
<td>lumen-second (lm-s)</td>
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<td>Radiant Energy Density</td>
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<td>$\frac{dE_r}{dt}$</td>
<td>Joulie per cubic meter (J-m$^{-3}$)</td>
<td>Luminous Energy Density</td>
<td>$E_{rd}$</td>
<td>$\frac{dE_r}{dt}$</td>
<td>lumen-second per square meter (lm-s-m$^{-2}$)</td>
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<tr>
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<td>$\frac{dE_r}{dt}$</td>
<td>Watt (W)</td>
<td>Luminous Flux</td>
<td>$E_{F}$</td>
<td>$\int \cos \theta d\omega E_r d\omega$</td>
<td>lumen (lm)</td>
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<td>Luminous Intensity</td>
<td>$I_r$</td>
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<td>Luminous Flux Density</td>
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<td>$\frac{dE_r}{dt}$</td>
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<td>$\frac{dE_r}{dt}$</td>
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<td>Luminous Intensity (candela)</td>
<td>$I_r$</td>
<td>$\frac{dE_r}{dt}$</td>
<td>lumen per steradian (lm-sr) or candela (cd)</td>
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<td>Luminous Intensity (candela)</td>
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<td>Joulie per square meter (J-m$^{-2}$)</td>
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<td>Luminous Efficiency (of a source)</td>
<td>$\eta_r$</td>
<td>$\frac{dE_r}{dt}$</td>
<td>lumen per watt (lm-w$^{-1}$)</td>
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<td>$\frac{dE_r}{dt}$</td>
<td>lumen per watt (lm-w$^{-1}$)</td>
</tr>
</tbody>
</table>

1. The units may be altered to refer to narrow spectral bands in which case the term is preceded by the word spectral, and the unit is then per wavelength interval, and the symbol has a subscript A. For example, spectral luminance $L_A$ has units of W-m$^{-2}$-nm$^{-1}$ or more often, W⋅cm$^{-2}$-nm$^{-1}$.

2. Optical density $\eta_o$ is the ratio of the electrical input power of a source to its input power, expressed in decibels.

3. Luminous efficiency $\eta_l$ is the ratio of the luminous output power to its input power, expressed in decibels.

4. At the source $I = \frac{dI}{dt}$ and at a detector $I = \frac{dI}{dt}$.

5. $P_1$ is electrical input power in watts.