

LIGHTING AND THE VDT SCREEN

A summary of the study conducted by researchers of the University of Colorado at Boulder and Lighting Technologies, Inc. for Peerless Lighting and presented to the Illuminating Engineering Society in August, 1984

A summary of
**The University
of Colorado Study**

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The need for the study

In recent years, the following events have occurred:

- Verbatim, a Silicon Valley diskette manufacturer, found that 79% of VDT users want better lighting.
- District 925 of the Service Employees International Union reported 600 complaints of neck and back pain, headaches, eyestrain and exhaustion by VDT users in a six-month period.
- Unions and white-collar organizations like "9 to 5" are pushing VDT-related legislation in California, New York, Illinois and nine other states.
- The National Institute for Occupational Safety reports a 24.4% difference in productivity between an ergonomic (best case) and a typical work station (worst case).
- A computer industry analysis reports that a VDT is installed in an American work space every three minutes of every working day.
- A building industry magazine survey tells us that major companies rearrange at least part of their VDT work spaces every 18 months.

Peerless Lighting felt the need for specific research to determine how workers really perceive VDT lighting. The University of Colorado study measures subjective reactions and isolates lighting from the other environmental issues.

The test room The study was conducted in a 20' x 20' mocked-up office at the University of Colorado in Boulder. It had a standard office acoustical ceiling, light-colored walls and carpets and four desks with IBM Personal Computers. Each computer had a monochrome monitor placed on top of the disk unit, providing eye-level display for most subjects. Two of the monitors had their screens parallel to the light fixtures' axes and two were perpendicular. The room layout and equipment remained constant throughout the test. The only environmental modification over three test sessions was a change of light fixtures.

The fixtures The experiment compared three of the highest-quality commercially-available fluorescent fixtures.

1. A three-lamp deep-cell parabolic louvered recessed system. The system chosen was the type most frequently installed in demanding computer applications.
2. A two-lamp linear indirect system developed by Peerless Lighting. This fixture has a prismatic lens over its upper half and provides some light source visibility.
3. A one-lamp version of the Peerless system. All three installations were energy-efficient (below 1.5 watts per square foot) and provided similar light levels on the task areas (about 40 foot candles).

The subjects To establish a statistically-sound base, the researchers selected 48 subjects from 70 applicants, all members of the University community. Some of the subjects wore glasses or contact lenses.

The test procedure The subjects were divided into groups of four and presented the lighting systems in a different order. At each of the three sessions, each subject spent 55 minutes at one of the desks doing difficult hard copy and VDT tasks—comparison of printouts of random numbers against a similar readout on the VDT—then 20 minutes answering a questionnaire. The questionnaire asked for an evaluation of each of ten environmental aspects using fourteen different semantic scales. Then the researchers applied sophisticated evaluation techniques including Factor Analysis and Analysis of Variance.



A VDT in the parabolic room as the operator sees it. The hot spot obliterates readout.



A VDT under the two-lamp indirect (Peerless) system. No hot spot, all text legible.



The one-lamp Peerless system. The fixtures reflect in the screen, but it's no longer a problem.

The results The questionnaire responses showed remarkable differences between the systems. The conclusion of the report said:

"Of the ten environmental aspects judged by the operators, the judgement of seven of them varied as the lighting systems changed. These were:

- | | |
|------------------------------|------------------------------------|
| Glare on the computer screen | Fine light distribution (modeling) |
| Glare from lights | Type of light fixture |
| Glare from surfaces | General impressions |
| Overall light distributions | |

“For all seven aspects, the lensed uplight (Peerless) luminaires evoked the highest rating...When there was any preference at all, it was for the environment lighted with the (Peerless) luminaires.”

The charts on the right display these preferences as determined by the study.

Not only did the test subjects express preference for the Peerless systems in these seven major areas of lighting performance, they also perceived themselves to be “more productive” by a wide margin in the Peerless-equipped test rooms.

In that this test was not designed as an objective measurement of the subjects’ long term productivity, no hard conclusion can be drawn. Nonetheless, the fact that the subjects “perceived” themselves to be more productive with the Peerless systems is an important fact. When people feel more productive, they generally have a more positive attitude about their work. As a result, they often become more productive.



The University of Colorado test room lit with parabolic fixtures. Note the glare on the screen of the VDT on the right.

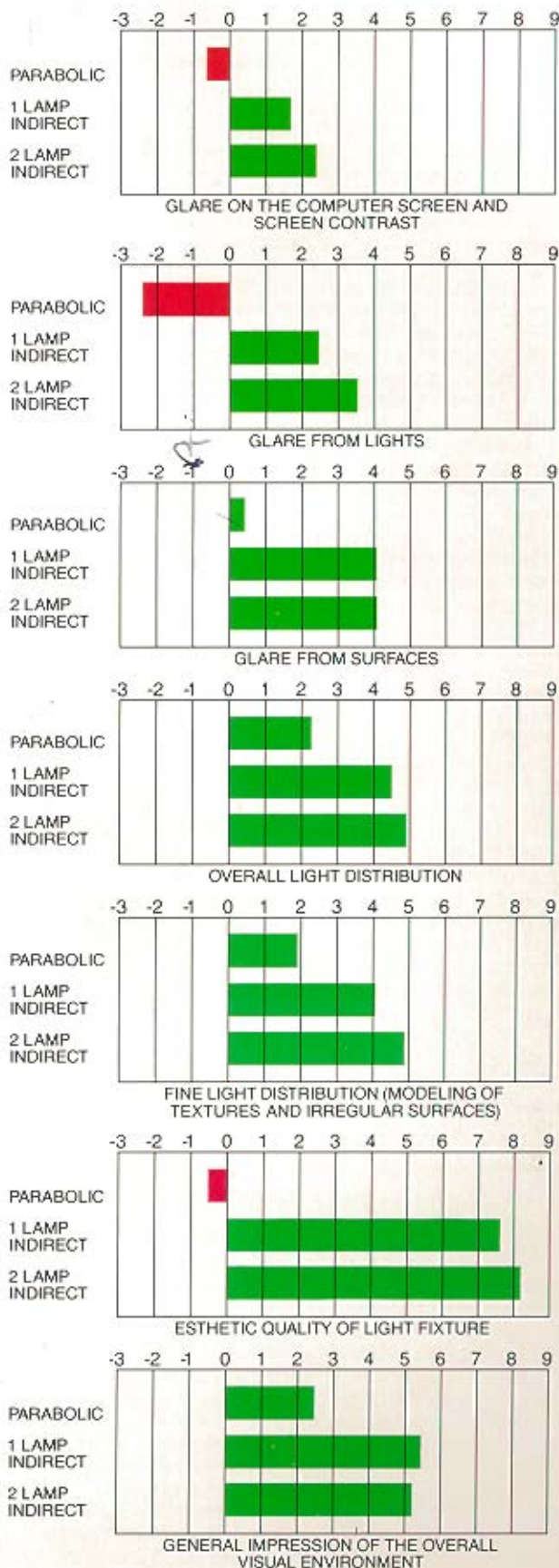


The same room lit with a Peerless system. The even wall and ceiling illumination takes the hot spots off the screens.

An additional discovery The four VDTs in the test room were supposedly identical, but after the study the researchers found a subtle difference in one of the monitors. It was manufactured at a different location from the other three and had a slightly more diffuse front glass. The report’s conclusion stated: “In addition, it was found that slight differences in the VDT screens caused differences in the fidelity of the reflected images. In the presence of the parabolic louvered luminaires this caused significantly lower ratings to be given to the environment at certain work stations in the room. In the presence of the (Peerless) luminaires these lower ratings were not seen. Presumably, the (Peerless) luminaires reduce the dependency of the quality of some environmental factors on the characteristics of the VDT screens.”

Judged overall quality of each lighting system in the University of Colorado test.

The basis for these charts, referred to in the study as “mean goodness factor,” was achieved through factor analysis of all data for each environmental aspect.



Softshine Indirect Lighting: a new approach to lighting the VDT screen

The computer screen reflects whatever it's facing. Some VDTs have polarizing or non-glare screens which help, some can swivel or tilt away from the problem source. But many don't, and swiveling or tilting the screen can force the user into strained back and neck positions.

Only two things can really help: keeping window glare off the screen (either by shading the windows or reorienting the VDTs) and improving the lighting.

To improve the lighting, Peerless devised a system that reduces the room's overall contrast—contrast between ceiling and walls and between fixture and ceiling—thereby minimizing reflections.

The Peerless Very Wide Spread Indirect system radically alters the distribution of an indirect up light. Instead of sending the light upwards, it diverts it dramatically to the sides. It's effective under ceilings as low as 8'6".

At a normal seating or standing height, these fixtures reveal a low-brightness strip of lens, as comfortable to look at as a parabolic fixture at its best viewing angle. The optics even out the light over the whole ceiling and throw far more light on the upper walls than any other system. No hot spots, no deep shadows, and, because exceptional efficiency is a feature of the optical design, a high overall light level in the room.

A second Peerless Softshine Indirect system, the High Efficiency system, is designed to provide similar results under ceilings 9'6" or higher. Both systems have already been used in major installations across the country.



CIGNA Corporation, Bloomfield CT

Over 8½ miles of Peerless High Efficiency lighting systems appear in the 500,000 sq. ft. facility owned by one of America's largest insurance companies.

This project is the first of its type in which movable, full-height partitions are interfaced with the lighting systems.

The Peerless Softshine system used on the CIGNA project utilizes the most efficient optical system available for indirect applications, and features a narrow strip of lens on either side which provides a hint of low brightness, visible light source to occupants within the space. This system provides a higher perceived light level than totally indirect systems.

VDTs are located throughout the workspaces. The lighting systems minimize veiling reflections on the screens, making for a comfortable VDT workspace.



South Carolina Electric & Gas Co., Columbia SC

This 19-story headquarters tower for a major regional utility company is equipped with almost three miles of Peerless Softshine Lighting systems.

Since VDTs were to be used extensively throughout the installation, indirect lighting was the preferred method of illumination. Without the energy-saving benefits of Peerless Softshine Indirect systems however, indirect lighting would have been impractical. Here, these fixtures have an efficiency comparable to direct down lights, delivering an average of 50 footcandles at 14 watts per square foot with 2-lamp systems on 10-foot centers.

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Copies of the complete research study and product literature on the lighting systems discussed available on request.