

# SURGICAL LIGHT



BRINGING

**VISION**

TO THE OPERATING ROOM

4,300°K

$$\phi = \int_0^{2\pi} \int_0^R I(r) r dr d\theta$$

V( $\lambda$ ) function

TECHNOLOGY  
BEHIND  
THE LIGHT

## The Requirements of a Surgical Light.

Work in the operating room is by its very nature life critical, and the constant, accurate processing of visual information is essential to success.

The requirements for lighting the surgical sight are strict and varied. The light must be exceptionally bright, however, it must also be very cool, so as not to damage tissue, or heat the head of the surgeon. It must not distort the color of the tissue. The pattern of light should generally be circular with an edge that is defined, but not too severe. The interior of the light pattern should be free from dark rings, spots, or other irregularities.

*It is difficult to imagine any task more demanding than*

EACH LAMP HEAD CARRIES TWO BULBS. IF ONE FAILS, THE SECOND ONE ILLUMINATES SEAMLESSLY.

COMPACT 25" LENS TOLERATES UP TO 70% BLOCKAGE OF LIGHT—MORE THAN LIGHT HEADS 50% LARGER.

LIGHT INTENSITY, PATTERN, POSITION, AND ON/OFF CAN BE ADJUSTED FROM THE STERILE HANDLE.



NUVO

ALL JOINTS OF THE NUVO SURGICAL LIGHT ARE FREE TO ROTATE CONTINUOUSLY, WITHOUT RIGID STOPS, TO PROVIDE MAXIMUM POSITIONING FLEXIBILITY.

AT 4,500K, COLOR TEMPERATURE OF THE LIGHT IS BALANCED TO PROVIDE ACCURATE VISUAL ASSESSMENT OF THE PATIENT.

*one facing the surgical team during a typical procedure.*

As the working area for the surgical procedure may vary significantly in size, the light must offer an adjustable pattern. The area above the surgical site must be resistant to shadowing when an object, such as the surgeon's head, is placed directly in the beam. When procedures require the opening of deep cavities, the light must be capable of penetrating such a cavity without being refocused.

Total failure of the light is unacceptable. Even though surgical lights are generally used in pairs, a single light should have a redundant light source capable of producing adequate performance for the duration of the case.

To cap this ambitious list, the light must perform uniformly well through a range of distances — and it is strongly preferred that the light not require adjustment as a case proceeds.

With such an array of critical requirements, there are virtually an infinite number of possible combinations to consider, and it's not surprising that several of them are in direct opposition to one another. NUVO approached this complex problem by using its custom computer-modeling program to compute practically all possible permutations and be able to eliminate nonviable combinations. In conclusion, we arrived at a solution that optimized all aspects of a light's performance — the NUVO Surgical Light.

## The Reflector.

Highly polished reflector technology has enabled NUVO to achieve an exceptionally uniform and versatile light pattern for its NUVO Surgical Light. It can be adjusted in diameter from 5.5 inches up to 10 inches, has a soft feathered edge, and will tolerate as much as 70% of the light field being blocked without a significant reduction in light intensity occurring. To achieve this level of performance, the reflector utilizes three patented technologies.

### **Two geometric shapes are combined.**

A parabola, defining the perimeter of the emitted light pattern, transforms into an ellipse to achieve shadow reduction, depth of field, and cavity penetration.

### **2000 optical facets are burnished into the surface of the reflector.**

A typical facet was about 65% efficient and required a considerable increase in bulb output and related heat output to achieve intensity requirements. NUVO, with the aid of its specially-designed, computer-modeling program, developed facets that increased the efficiency to almost 95%.

*With patented shaping and positioning, 2,000 facets are*

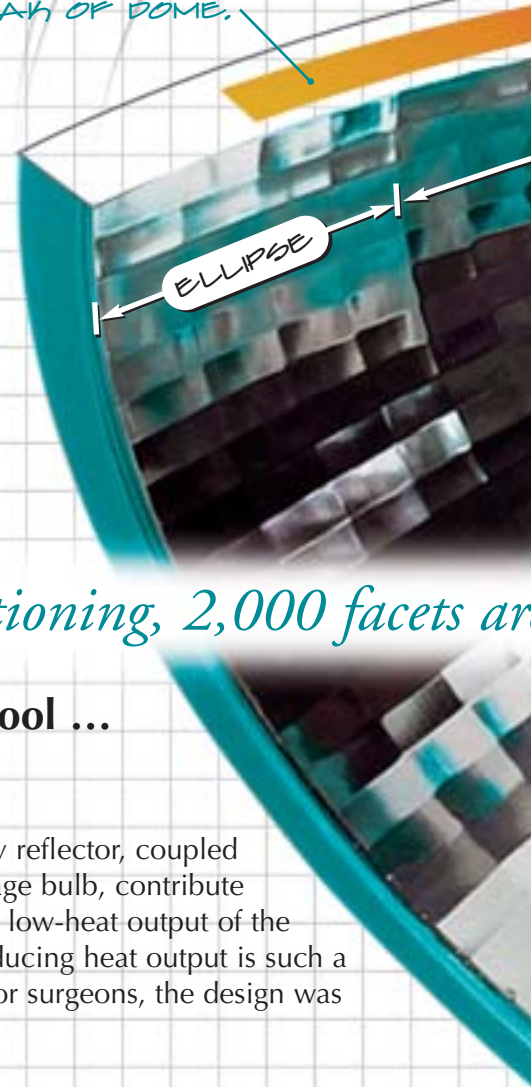
### **Shadows are virtually eliminated.**

The specific angled position of each facet permits light from 30 different positions on the reflector surface to focus onto the same 1.5 cm<sup>2</sup> of the operating surface. This redundancy means that light from only 7-8 of the 30 facets in each grouping is needed to deliver the required level of intensity. When all 30 groupings are mapped together, they create a uniform pattern, which will tolerate 70% blockage (22-23 facets of each 30) before a noticeable decrease in light intensity is witnessed.



SPECIAL SHAPED FACETS ARE ALMOST 95% EFFICIENT.

HOT AIR RISES BETWEEN REFLECTOR WALLS TO PEAK OF DOME.



## Keeping It Cool ... Naturally.

The high-efficiency reflector, coupled with the low-wattage bulb, contribute significantly to the low-heat output of the light. But since reducing heat output is such a significant factor for surgeons, the design was further enhanced.

Special filter-glass panels block 99% of the infrared heat emitted from the bulb, and are positioned to create a labyrinth which naturally funnels hot air upward. This convection process within the light head, as well as hot air rising inside the reflector walls, draws all the hot air up to the peak of the light dome. At this point, the heat is radiantly transferred through a special non-metallic cap and out above the light head. The net result is a light that delivers the lowest heat-to-light ratio in its class at 3.6μW/cm<sup>2</sup>/fc.



## A New Shape With a Purpose.

A parabolic reflector can be used to capture light from a small source and create a beam with a diameter equal to that of the reflector. An elliptical reflector can gather the source's light and focus it at a more distant point. Given the requirements for light to illuminate deep into a cavity, illuminate the cavity walls, as well as maintain a constant quality of pattern through the field of light — a blended shape, somewhere between a parabola and an ellipse — is most appropriate. In fact, the NUVO Surgical Light, with its distant focal point lying somewhat beyond the focal plane at which a pattern is materialized, meets this requirement precisely.



*Shadow-free, color-correct illumination deeply penetrates*



3,000°K

4,300°K

4,500°K

## The Right Color for Accurate Decision Making.

The goal of a surgical light is to deliver high-intensity light that is capable of illuminating the most demanding surgical site. All artificial light sources, capable of achieving this task, will distort an object's color if not carefully adjusted. The NUVO Surgical Light utilizes IR filters that have been specially formulated to correct the color of light it emits.

Imagine for a moment walking through a park early on a sunny morning. What you observe is the rich color of the trees, the lushness of the grass, and the luster of the roses. The reason everything appears so rich in color is due to the color temperature being about 3,000°K, which adds a great deal of red to objects. Conversely, as the day comes to a close, the color temperature rises to 5,000°K and beyond. Objects then appear more aged and much more blue. Mid-day, when the color temperature is 4,200°K-4,300°K, is the best time to view items for well-balanced color. It is no coincidence that surgeons have long claimed that a color temperature





N U V O, I N C.

NUVO Surgical Light  
... nothing short of optical excellence.



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