Industrial Lighting
A Primer

All through history people have sought better ways to illuminate their work. Even the cavemen needed torches to allow them to draw on the walls of their underground caverns. Fire brought both light and heat for thousands of years before crude lamps of animal fat gave way to the candle for general indoor illumination used around the world.

Roman Grease Lamp

An offshoot of the common candlestick became what we now call the Lacemakers Globe. This quite possibly could qualify as the world's first industrial light source! It was observed that when a candle flame was aligned behind a rounded glass bottle filled with water, a magnifying and focusing effect was produced, in addition to simply lighting up a small area. This was high technology of the first order! No longer did the lacemaker have to pack it in when the sun went down, for soon the new Lacemaker's Globe became fairly common in European Cottage Industry, enabling the production of lace at a greater rate than ever before. It is also not too much of a stretch to conclude that the repetitive patterns of the lacemaker could be looked upon as a forerunner to the theory of mass production, along with the pin makers who toiled away in the 'second tier' of the feeble light pool cast by the globe, hammering heads onto straightened bits of wire in order to make the common pin. This was mighty slim pickings by today's standards to be sure, but just a few hundred years ago it represented a revolutionary increase in handiwork production after the sun went down, for the very first time in history.

Lacemakers Globe

Whale oil, paraffin, and kerosene lamps all had their day in history but it was not until Edison's first electric lightbulb shattered the darkness in 1880 that industrialized nations began applying a multitude of electric lighting solutions to the problems unique to manufacturing in an effort to improve quality and increase productivity.

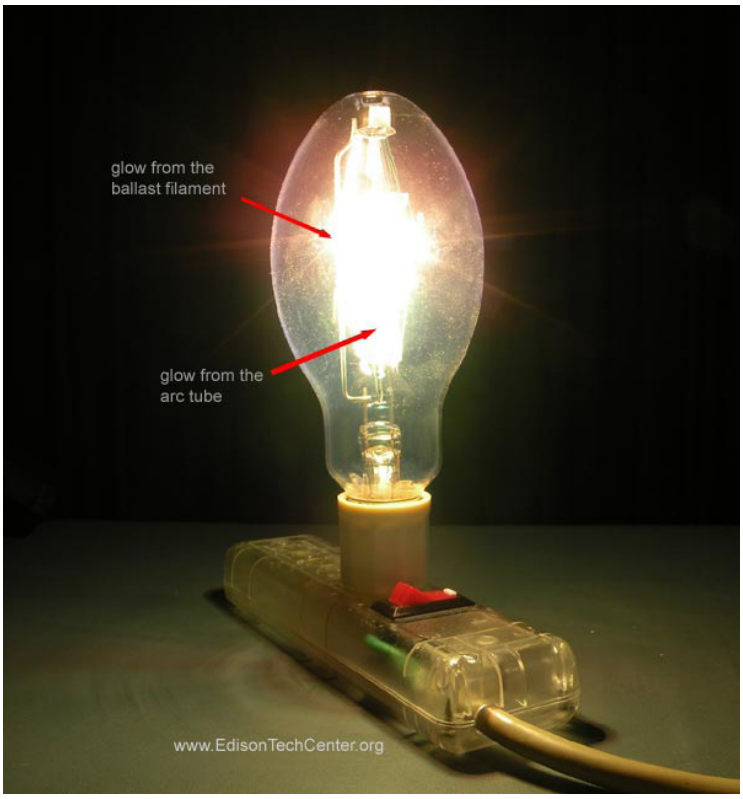
Miners' Carbide Lantern

Oil Lamp

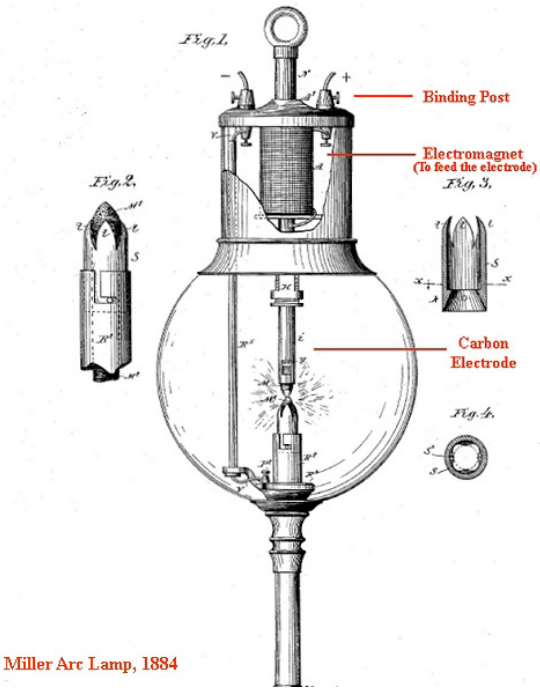
Edison Lamp

The electric lamp began the quest for modern task lighting as well as general interior illumination. From the reading lamp to the mess hall, electric light was here to stay.

By the end of the nineteenth century, electric lighting was fast becoming the standard against which all artificial lights were measured. Carbon arc street lights became operational in Paris in 1881, and shortly thereafter, debuted on the stage at the Moulin Rouge. They were bright and



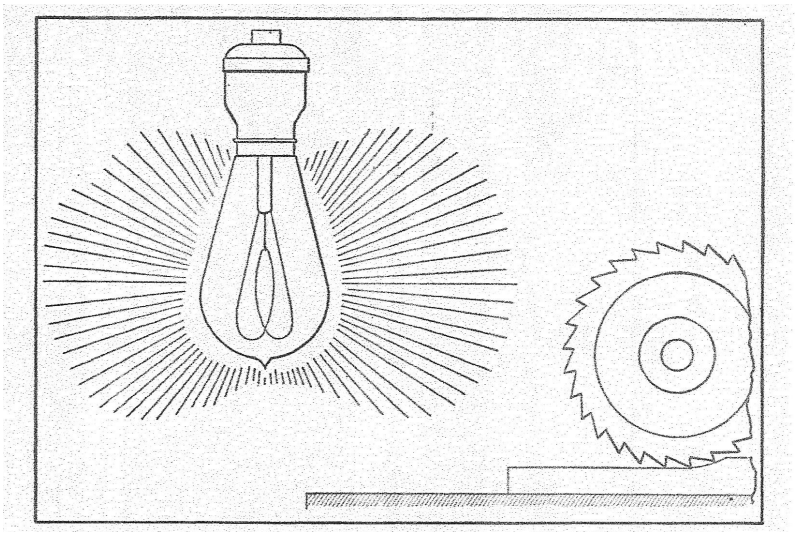
Edison Arc Lamp



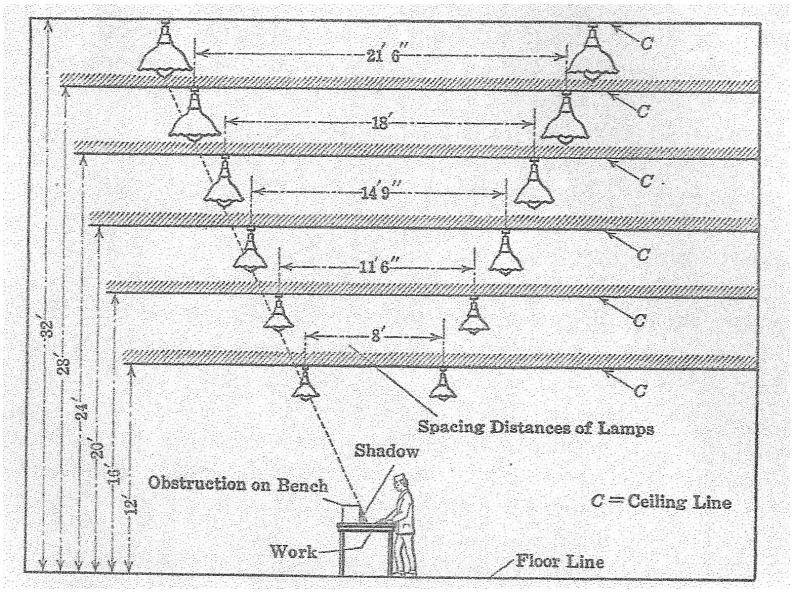
Carbon Street Lamp

they could be directional, but they ran hot and gave off a heavy blue-green tint. We have the early arc lights' glare to thank for Toulouse Lautrecs singularly peculiar facial color characteristics found on many of his theatrical posters of the day.

In 1903, it was the newfangled Cooper Hewitt mercury vapor arc lamp that became the forerunner to today's fluorescent tubes. It was widely used for general illumination, so much so that by 1913 the arc light and the incandescent lamp had become so widespread that American industry relied heavily upon a plethora of published tables and manuals which outlined many standardized guidelines for factory illumination. These early works set the precedent for ambient lighting requirements that helped early industry throughout World War I. Oddly enough, there are industrial concerns which still adhere to those old tables and statistics, even today! It was the massive demands of World War II, however, which put a

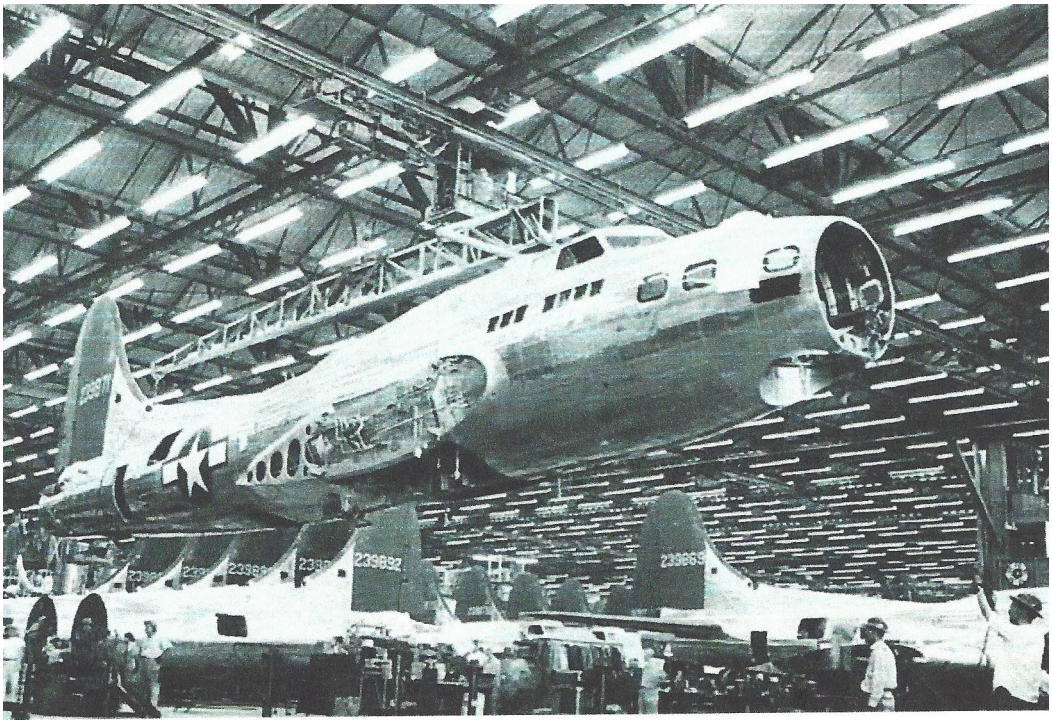


From 1913 Lighting Handbook



From 1913 Lighting Handbook

tremendous strain on war materials production. This demand was made even worse by the military's thirst for fuel, creating the first modern energy crisis. This was met primarily by the rapid adoption of literally miles upon miles of fluorescent lamps, which burned about one third the energy of the incandescents of the era.



By 1960, though, widespread installation of metal halide and high pressure sodium lamps successfully challenged fluorescents as the high bay and ambient light source of choice, right up to the next energy crisis of 1973. Once again, inventors and engineers rose to the challenge and by 1976, General Electric came out with a rather pricy, but small, curly cued compact fluorescent light (CFL) to address the growing cost of energy.

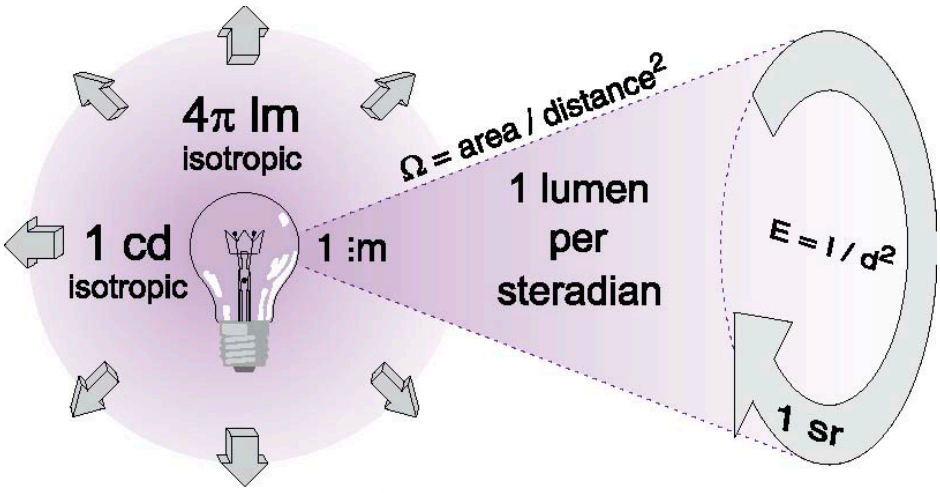
Compact fluorescent light (CFL) development plodded along, but by the early 2000's they were a commercially viable option using 70% less energy than the screw-in incandescent bulbs they were designed to replace. Costs dropped as well, to the point where affordability became a large part of the energy saving equation, particularly for use in the home.

For industrial task and machine lighting though the CFL was and is totally outshined by the fluorescent, halogen and LED lamps. All of these fixtures lend themselves better to the concentration of light onto a single area, depending upon application, rather than just general ambient room illumination alone. This is also more in keeping with the original candle-powered Lacemaker's Globe; that of specifically concentrating light onto the work piece in order to inspect or perform work on it.

This brings us to the era of the light emitting diode—the LED. Today's LED is truly a light generating innovation. Since its beginnings years ago as a lowly red 'indicator lamp,' up through yellow, green, blue, and finally white iterations, today's LED's are at the top of the heap, where low power consumption , superb color rendering, long lifespan, and impressive light output are simply the best that ever was! LED's truly are a major technological marvel and, like other new technologies, are subject to a great deal of new nomenclature, information and misinformation.

New technology is often encumbered by a barrage of needlessly complicated explanations and arcane formulae that, while quite accurate in and of itself, is rather beyond the realm of 'necessary' knowledge for decision makers and end users. Case in point is the term **Luminous Efficacy**—this is nothing more than a term used to describe how many lumens (emitted light) the source puts out divided by the watts (power draw) it takes to do it. Until recently, the wattage was simply stamped onto the top of a common light bulb, and the public had a very good idea of how much light output could be expected to come from it—be it 60, 75 or 100 watts, et cetera.

Let us look at another example of LED technospeak: the **Candela**—this is shorthand for very precise measurement of luminous intensity. What is meant by shorthand? Well, one candela equals one lumen per steradian—and of course we all know that a steradian is the common unit used to measure a solid angle equal to a unit area cut in the surface of the unit sphere.



Since the surface area of the unit sphere is 4π, the maximum solid angle is 4π steradians. Got

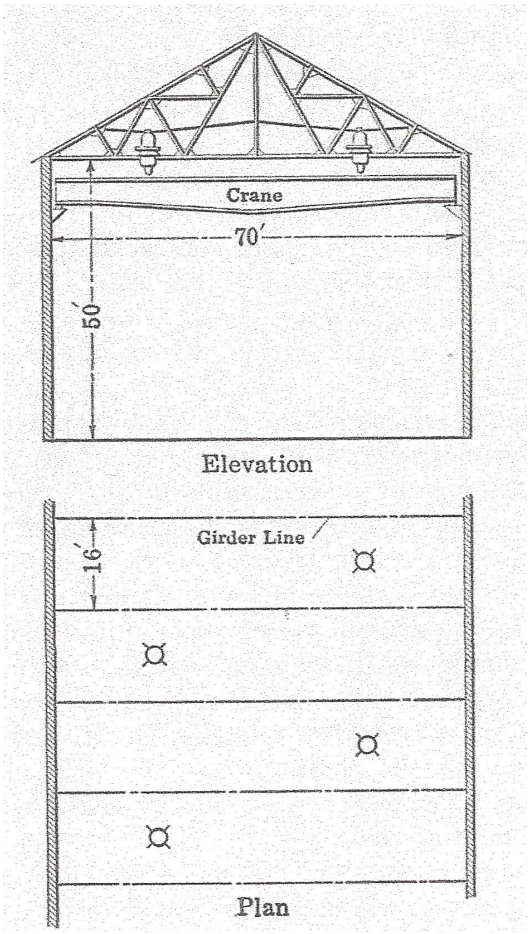
it? No? Then look at it this way. The Sun shines on the Earth at any given time, but it is brighter and hotter at the equator than at the poles because it is a tad closer and the rays shine in a touch straighter angle. It is just that 'tads' and 'touches' are not very specific, are they? Particularly when you are just trying to light up your shop in a cost effective manner.

But, getting back to luminous efficacy and what a machine tool or production or maintenance decision maker needs to know—efficacy is a measurement of light output versus the power that it takes to illuminate. Typically, a 75 watt incandescent bulb will have an efficacy of 15 lumens per watt (15 lm/w). A similar CFL has an efficacy of about 69 lumens per watt (69 lm/w). Impressive, but the luminous efficacy of LED lighting designed specifically for industrial applications is far in excess of the household style unit. It is all about using the right lamp for the job, and part of that equation is knowing how efficient the lamp is in converting electricity into light output.

The simple fact is that today's LED's are often smaller than a matchhead and capable of putting out 10 times the light for any given wattage. They are very new, very small, very powerful, and they do not have a convenient place to stamp the wattage! Even if they did, the public's expectations of how much light can be expected per watt consumed is still governed by one hundred year old Edison-style thinking, hence the avalanche of LED technospeak…why? Because in 2010 the U.S. Department of Energy estimated that there were over 971 million 60 watt bulbs still in use throughout America. Furthermore, this did not count the millions of 15-30-75-100 watt bulbs that were also in common use.

Most of the fanfare over LED technology has been geared to the general public and the homeowner because this is where the government wants to see the largest reduction in energy consumption. Industrial applications are somewhat different. For one thing, the luminous efficacy of fixtures (luminaires) designed specifically for industry is frequently far in excess of what can be achieved by simply retrofitting a new "bulb" into the Edison style socket found in the home. Industrial and machine lighting is all about using the correct light for the job at hand, remember, in addition to how efficient that fixture is at converting electricity into light output.

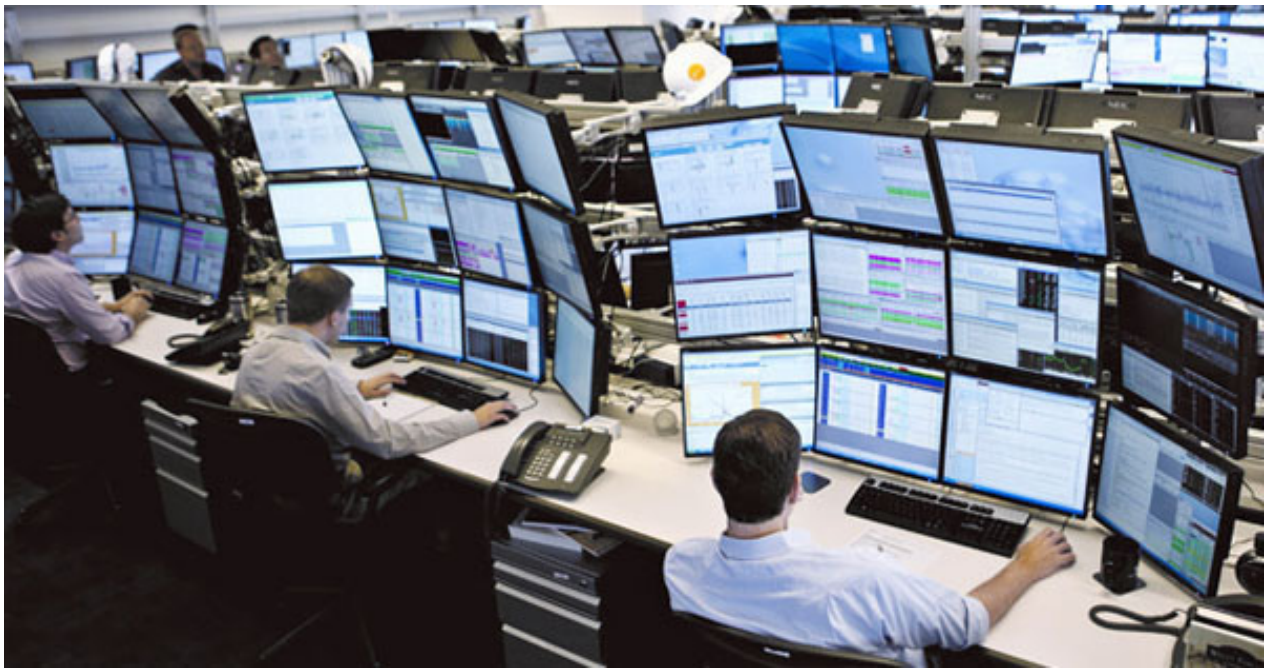
Today's industrial and machine lighting systems are not constrained like home systems. In the home, the problem is how to upgrade the lamps found in existing fixtures and applications that go back to Thomas Edison. On the production floor, the problem is to get with the program and think beyond the formula books published back in 1913. Decision makers should remember that no machine operator ever said they had too much light on their workpieces!



From 1913 Lighting Handbook

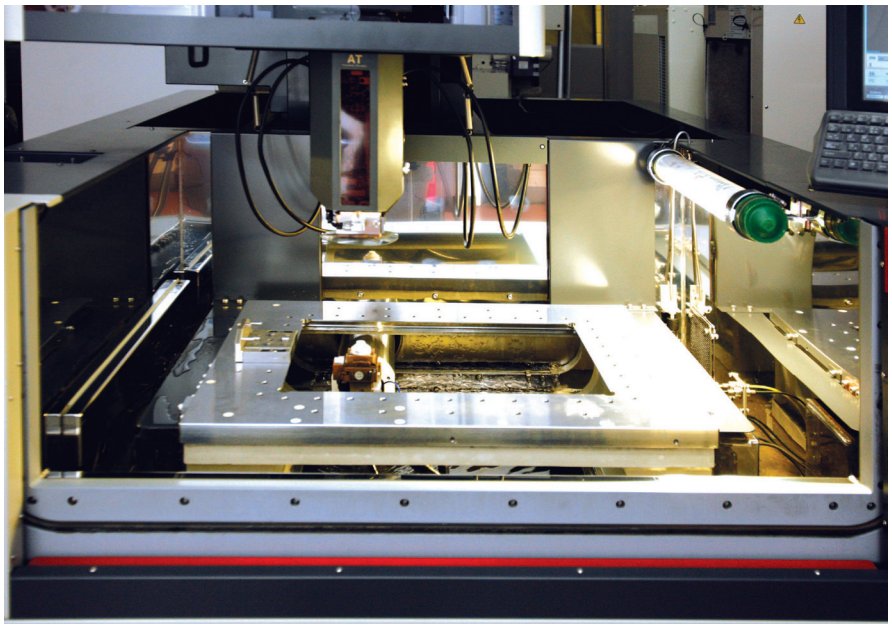
Manufacturing, Maintenance, and Production managers today are faced with plant lighting needs that cannot be lumped together with the way they were in pre-World War II days. General plant illumination can be a puzzler—how best to provide just the right amount of ambient light throughout the facility? These needs can differ widely, from office to warehouse to shop floor and work station, et cetera. Task lighting is the next critical lighting area to consider: What is the right choice for general assembly? What about an EDM operator? What about the machinist in maintenance? What about the shipping dock? Many different needs require many different solutions and can encompass halogen, incandescent, fluorescent, and LED types. As usual, it all depends on the individual circumstances. Finally, there is Quality Control (QC) and inspection lighting. This is where the smart manager understands that today's tolerances and workpiece materials and dimensions are worlds away from what was acceptable in World War II. Today's materials were undreamed of in 1943. Modern paint and coatings, for instance, can easily demand several thousand lux—just for the operator to see what he or she is spraying.

Here is an ambient lighting example: generally speaking, more light across the board is usually a very good thing, but there are some interesting exceptions. The most common is found in today's office environment. Thirty years ago, typical ambient office lighting was actually brighter than what is called for today. The reason is quite simple. Back then the office floor was often 'bullpen' style, dotted with typewriters and an occasional word processor. Today's office is awash with computer screens of every size, type, and description, furnishing the employee with his or her own personal background lighting and thus reducing dependence on brighter ambient lighting. According to the Illuminating Engineering Society of America (IESNA), the old office standards were around 750—1,000 lux, while today's office lighting varies between 300 and 500 lux. We have come a long way since 1913.



Informed lighting choices have to be made in today's industrial competitive business environment, and any good Industrial Engineer will tell you that just staying abreast of today's needs is not good enough. Serious consideration must also be given to the production needs of tomorrow, to the best of everyone's abilities. While no one can predict the future, everyone agrees that it will indeed be different from today. Tolerances will be tighter and materials will be more exotic. Energy will be more costly. Labor will be more expensive, and customers will be more difficult to please!

Just building and marketing a good machine tool or work center will not be good enough. It will have to be better than the competition in as many ways as possible and one of the most painless and least costly is to deliver it with the best machine lighting in the business as standard equipment. As you no doubt already know, there is industrial lighting, and then there is industrial lighting…For all sorts of applications. We cannot tell you which type is the 'best' for your particular application, but we can tell you that we concern ourselves only with the toughest, brightest, and most durable machine lighting solutions of them all. We offer the finest and widest choice of top quality machine lighting in North and South America, for use worldwide. Halogen, fluorescent, or LED—Halogen Lighting Products Corporation has the right light for your job. The right light for your machine system.



So, when the decision is made to invest in new production machinery, insist that it be delivered with the finest machine lighting in America, pre-installed as standard equipment, and furnished by Halogen Lighting Products Corporation.

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