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Vol. 4 No. 1 January 2003

Contents

A comparison of the suitability of xenon and halogen lights for harvesting

Abstract

FERIC evaluated the performance of xenon lights to determine their suitability as an alternative to halogen lights in harvesting operations. Although more expensive, xenon lights provide more intense and more uniform lighting, which facilitates navigation in the forest during night operations, particularly in partial cutting. The report also presents some practices to adopt with any lighting system.

Keywords:

Xenon light, Halogen light, Lighting, Harvesting.

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Introduction

Forestry machines represent a large capital investment, and to reduce their hourly operating cost, it's important to maximize their hours of use by working at night. However, questions have been raised concerning the effectiveness of lighting systems for night work and their maintenance requirements, depending on the type of operation.

The most common lighting systems in forestry use halogen lights, but these systems don't necessarily provide sufficient illumination for operations such as selection cuts in hardwood forest. In the early 1990s, the introduction of "high-intensity discharge" lights, more commonly known as "xenon lights", provided an alternative. Halogen lights produce illumination by heating a metal filament, but xenon lights have no filament, and produce illumination by the ionization of xenon gas.

The number of suppliers of xenon lights is increasing, and some equipment manufacturers now offer them as options or even as standard equipment on some machines. Discussions with researchers at SkogForsk, the Swedish institute of forestry research, indicate that all forestry machines in Sweden will be equipped with the xenon lighting systems within a year.

Xenon lights are more expensive than halogens, but according to the manufacturers, can offer better lighting, increased durability, and decreased energy consumption. To verify these claims, FERIC studied both types of light under conditions typical of harvesting operations. This report presents the results of this comparison and guidelines for obtaining the maximum performance from any lighting system.

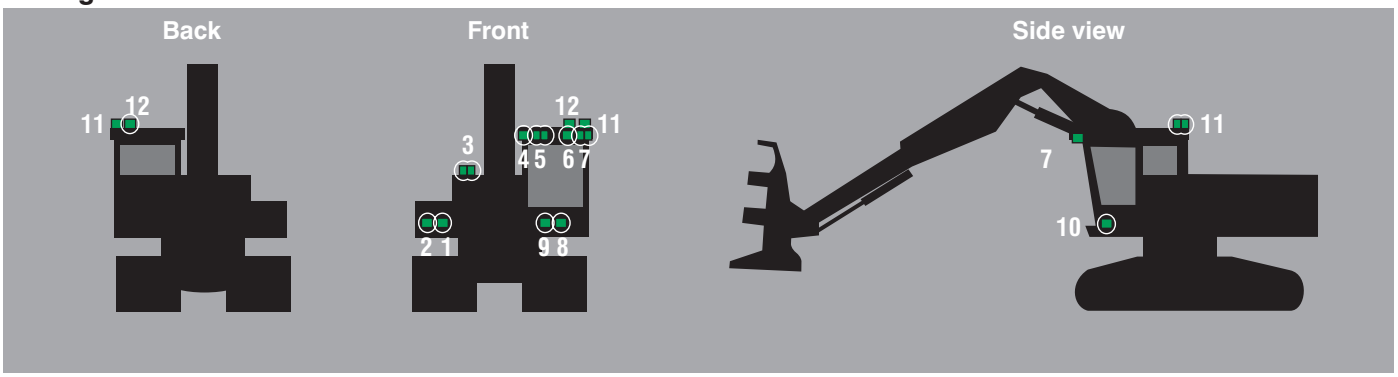
Study conditions and methods

Our study began with a survey of users of xenon lights in forestry operations; 25% of those we contacted responded to the survey. Next, FERIC compared the light provided by two different lights used in asymmetrical configurations powered by a 12 V electrical system: a 35-W xenon light manufactured by Nordic Lights and a single halogen light with 35 or 55 W bulbs (two different bulbs were used) from ABL Lights Incorporated. Comparisons of the illumination provided by the three bulbs and of the luminance differences between the two 35-W bulbs were performed using a white ash log as the reference point. This target was placed 8 m in front of the light being tested, since at this distance, illumination was equivalent for the two 35-W lights. Photographs of the target at different exposure times were taken using a camera with manual exposure control to permit an analysis of the images using the Ergovista software.

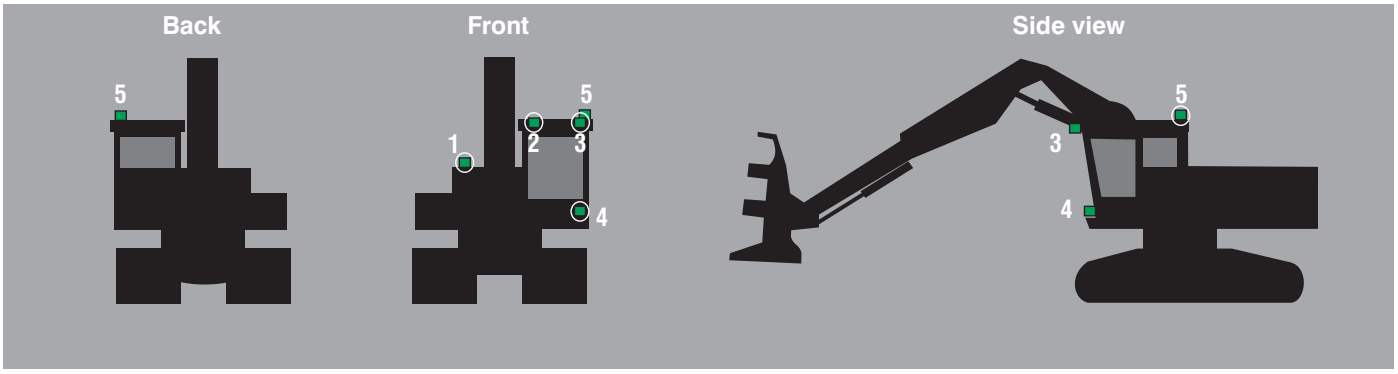
To conclude the study, illumination measurements were performed to compare two lighting configurations on a Tigercat 845 feller-buncher: the original configuration used 12 halogen lights, for a total of sixteen 55-W H3 bulbs (some lights had two bulbs), whereas the xenon configuration comprised five lights for a total of five 35-W D2S bulbs. Figure 1 presents the positions of the lights.

Figure 1. The two lighting configurations on the Tigercat 845 feller-buncher studied by FERIC.

Halogen



Xenon



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Publications mail #40008395 ISSN 1493-3381

Two types of illumination measurements were performed: the first was done at 40 cm above ground (with the sensor horizontal) to establish the distribution of the ground-level illumination provided to the operator during in-woods navigation and in the handling of stems after felling, and a second at 1.5 m above the ground (with the sensor vertical) to determine the distribution of the lighting offered to the operator for navigation and stem selection in the forest. The illumination surveys were performed using a Kleton K7020 light meter; the luminance values were determined with a Bruel & Kjaer Type 1100 luminance meter.

Results and discussion

User perceptions

Respondents to our survey worked either two or three shifts daily in mixedwood (40%) and softwood (60%) operations. All confirmed that the xenon lights facilitated their work by providing better lighting. The majority also felt that safety and productivity had improved, thanks largely to the improved ease of orienting themselves within the stand. One respondent also reported that the quality of his work had improved. In the hardwood operations, the xenon lighting permitted work during the leaf-free season (fall and winter), which had proved difficult with halogen lighting.

Comparison of single lights

Comparison of the illumination levels provided by the single lights (Figure 2) revealed that for the zone extending from the machine to the target, the 35-W xenon light provided up to six times as much illumination as the 35-W halogen light in the horizontal plane and four times as much illumination as the 55-W halogen light. With the sensor held vertically, the xenon light offered up to three times the illumination provided by the 35-W halogen light and twice the illumination of the 55-W light.

Figure 2 illustrates the differences and similarities between the two types of light:

- The contrast offered on the reference target by the two lights was similar.
- Navigation and overall visibility are improved with the xenon lights.
- Image analysis demonstrated that the surface area of the zone of high light intensity for the xenon light was around 15% greater than that of the halogen light.
- The xenon light provided more uniform lighting than the halogen light.

Based on the illumination surveys, it would be necessary to increase the power of the halogen light to 55 W to cover the same area as the xenon light; however, the xenon light would still provide nearly four times the illumination of the halogen light.

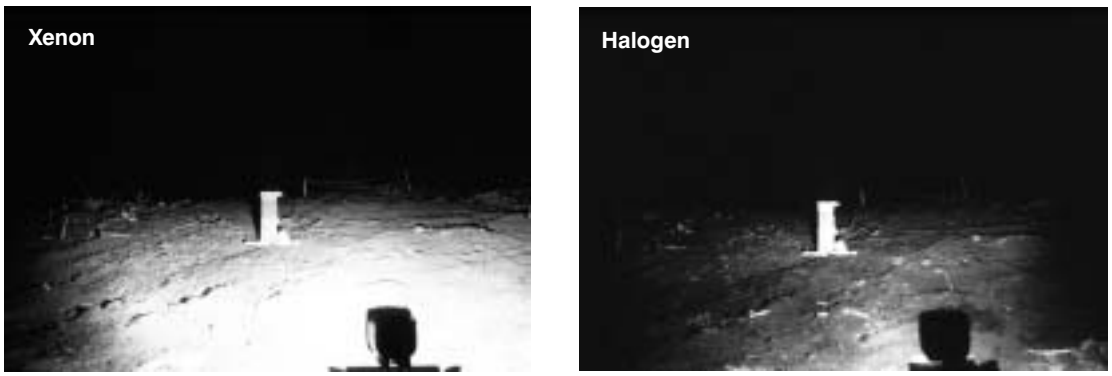

Figure 2. Illumination provided by the 35-W lights.

Lighting configurations on the feller-buncher

FERIC proposed the xenon configuration on the Tigercat 845 feller-buncher based on theoretical data provided by Bauer (1999). The luminous efficiency of a D2S xenon bulb (35 W) is nearly three times that of an H3 halogen bulb (55 W). Thus, five D2S bulbs were deemed capable of replacing the sixteen H3 halogen bulbs of the original configuration. Figure 3 illustrates the lighting provided by the xenon configuration. Illumination is improved beyond the reach of the boom; thus, the operator can see farther, and this facilitates navigation at night and handling of the boom. Within the reach of the boom, the two configurations offered comparable levels of illumination.

Based on the recommendations of Frumerie (1999), the xenon configuration is superior, but neither of the two configurations offered the recommended level of illumination inside the reach of the boom. Based on our results, the addition of one more xenon light should meet these illumination requirements, whereas three more halogen lights would be required to provide the same result.

Economics of the lighting systems

The configuration we studied with five xenon lights would cost around $2000 more than the configuration with sixteen halogen lights. However, *based on manufacturer data*, usage of the system for 10 000 hours of night work would require at most three bulb changes with the xenon configuration, versus 44 changes for the halogen configuration. FERIC was unable to confirm this information, so our comparison of the economics of the two configurations does not incorporate any potential maintenance cost savings. However, FERIC queried 15 users

Figure 3. The Tigercat 845 feller-buncher working under xenon lighting.

Table 1. Analysis of the costs associated with the individual lights and for the configurations as a whole

	Individual light		Configuration	
	Halogen	Xenon	Halogen	Xenon
Characteristics				
Number of bulbs	1	1	16	5
Total power (W)	55	43[a]	880	215
Fuel consumption (L/h)	0.025	0.020	0.400	0.100
Purchase cost ($)[b]	60.00	640.00	960.00	3200.00
Fuel cost ($)[c]	150.00	120.00	2400.00	600.00
Total ($)	210.00	760.00	3360.00	3800.00
Additional cost compared with halogen ($)	—	550.00	—	**440.00**

[a] This power requirement includes 35 W for the D2S bulb and 8 W for the ballast.
[b] Average purchase cost, since the price varies among manufacturers.
[c] Based on a cost of $0.60/L and 10 000 hours of use.

of xenon lights about their experience. Three reported problems with the lights or the bulbs and returned to using halogen lights. Among the 12 other respondents, one indicated that he had changed only one bulb in 3 years of use; the others still used the original bulbs. Table 1 presents the results of the economic comparison.

Implementation

Based on the results of our study, five xenon lights should be capable of replacing the sixteen halogen lights traditionally installed on a feller-buncher. However, during the installation, you should:

- Follow the manufacturer's instructions concerning all handling of the lights.
- Avoid mixing types of lighting because their respective colors differ (Boebel et al. 2000, Davner 2002).
- Position the lights as far as possible from the operator's line of sight (e.g., at the corners of the cab) to eliminate the glare that can be created under poor weather conditions such as fog, snow, and rain (Bullough and Rae 2001).
- Take advantage of the different lighting patterns offered by manufacturers (e.g., asymmetric vs. symmetric) so as to cover the same area with fewer lights.
- Confirm that the machine's electrical system can meet the power demands imposed by the lights, or install a control box that lets operators turn the lights on sequentially rather than all at once. Some xenon lights can require up to 20 amp at start-up, but their power demand decreases to a lower level than that required by a 55-W halogen light.
- Given their relatively high purchase costs, protect the lights well.

For maintenance:

- When changing bulbs, make sure to reposition the glass lens correctly so as to avoid altering the lighting pattern.
- Keep the lens clean to preserve the light's maximum illumination.

Disclaimer

The modification of any machine without the consent of the manufacturer can invalidate the warranty, damage the machine, or injure the operator.

Acknowledgments

The author is grateful for the assistance of the Coopérative Forestière des Hautes-Laurentides, the manufacturers (ABL Lights Incorporated, NBB Nordisk Bibelysning AB, and Nordic Lights), Rocan Forestry Services Ltd., the Université du Quebec à Trois-Rivières, SkogForsk, and the users of the xenon lights.

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