

# Energy Star Lighting Partners Meeting Lighting Technology Updates

## Metal Halide: The “Other” White Light

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*On behalf of the NEMA Lamp Section*

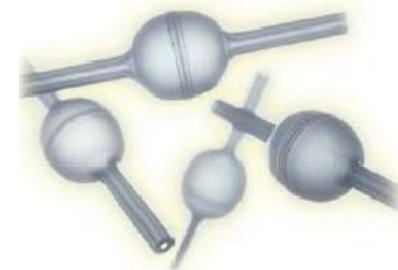
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## Metal Halide Lamps

- Invented over 50 years ago (first U.S. patent, 1961)
- Since then, MH lamps have evolved into the most energy efficient white light sources available in the market today, due to advances in
  - Physics
  - Chemistry
  - Materials Science
  - Electronics
  - Engineering

## What Is It?

- MH lamps have either a quartz or ceramic (polycrystalline alumina) arc tube
  - Ceramic arc tubes allow higher operating temperatures and still achieve high efficacy, lumen maintenance and color stability
  - Quartz arc tubes used widely based on cost



## Main Advantages: Summary

- High efficacy
- Long lifetimes
- High maintained light levels
- Color temperatures and CRI
- Broad operating temperature range
- High luminance, optical efficiency
- Ballast compatibility
- Dimmable

## High Efficacy

- MH lamps are the most efficient way to make white light commercially available today
- Recent technology advances with medium wattage ceramic MH enable
  - > 20,000 hrs rated life
  - CRI  $\geq$  90
  - Luminous efficacies of 120 LPW

## Long Lifetimes

- Proven lifetimes in excess of 20,000 hours
- Latest generation of electrodeless HID systems claim lifetimes in excess of 30,000 hours

## High Maintained Light Levels

- Lumen maintenance was once a weak point of MH systems, but no longer
- Lumen maintenance now approaches 90% with pulse start lamps and electronic ballasts



# Color Temperatures and Color Rendering

- MH systems available in wide range of
  - CCTs (1800 to 10,000 K)
  - Lumen packages (1200 to 200,000 lm)
  - Color rendering indices (up to 98)
    - Red rendering index (R9) available with values >50 in latest ceramic lamps



# Operating Temperature Range

## Operating characteristics of MH lamps

- Independent of ambient temperature
- Robust to extreme temperatures (contrast with fluorescent and LED)
- Allow for numerous applications
  - Outdoor and street
  - Studio and stage
  - Architectural
  - Office, hospitality and retail
  - High-bay
  - Sports



## Luminance & Optical Efficiency

Source	Approx. luminance (cd/m <sup>2</sup> )
Sun	10 <sup>9</sup>
HID (e.g. MH)	10 <sup>6</sup> to 10 <sup>9</sup>
High brightness LED	10 <sup>7</sup>
60W incandescent	10 <sup>5</sup>
T8 fluorescent	10 <sup>4</sup>
OLED	10 <sup>2</sup>

# Luminance & Optical Efficiency

- Where high lumens required, MH lamps are smaller and lighter than current SSL systems
- Ceramic MH arc lengths up to 5x shorter than HPS and 2-3X shorter than quartz MH
  - Can drive more efficient fixture designs with better beam control, cut-off, dark sky capability and less glare
- MH lamps suitable for luminaires that collect and direct visible light for illumination at a distance, more of a point source than an array
  - From one meter to hundreds of meters

## Ballast Compatibility & Dimmability

- 💡 MH lamps operate on wide range of commercially available magnetic and electronic ballast systems
  - Electronic ballasts up to 95% efficiency
  - Magnetic ballasts range from 75% to 92% efficiency



- 💡 Magnetic and electronic ballasts dim most MH lamps by as much as 50% of rated lamp power in all operating positions

## Summary Characteristics

	Quartz Metal Halide	Ceramic Metal Halide
Typical Wattage Range	20-2,000	15-400
Efficacy (LPW)	68-120	80-120
CCT (degrees K)	2,700-10,000	2,700-5,500
Lifetime (hours)	6,000-20,000	12,000-30,000
Lumens	1,600-200,000	1,200- 48,000
CRI	60-95	60-98

## Focus Areas of MH R&D

- 💡 Efficiency
- 💡 Life
- 💡 Maintenance
- 💡 Controls
- 💡 Drivers
- 💡 Integrated lamp-ballast systems
- 💡 Miniaturization
- 💡 Environmental sustainability
- 💡 Electrodeless

*Greatest advances will be achieved when a systems approach is used – lamps, ballasts, controls, and luminaires developed and optimized together*



## Conclusions

- 💡 Good now and better soon (over next 5 years)
  - $\geq 150$  LPW (with 90% lumen maintenance and 30,000+ hr rated lifetimes) commercially available in wide wattage range, from  $< 20$  W to  $> 1000$  W
- 💡 Most HID lamps are researched, developed and manufactured in the U.S.
- 💡 Government support for lighting R&D should be technology neutral.
  - MH and LEDs both have great potential
  - Both MH and LEDs will reduce US energy consumption and minimize lighting environmental impacts
- 💡 Energy Star eligibility