

AUTOMOTIVE HEADS UP DISPLAYS TAKE CENTER STAGE



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ABSTRACT

Automotive Heads Up Displays take center stage

Once again the automotive industry grasps new technology into its own vibrant blood stream. Heads Up Display (HUD) is one of the hottest technological inventions of recent years. Adding this dynamic optical imaging system is the next hierarchy to the “enhanced sound system” we all appreciate. Benefits of monitoring multiple activities with a smoother, less distracting (safety) operation of the vehicle.

The HUD image appears out in front of the driver, near the front end of the vehicle. This projected image is created with a custom contoured enhanced aluminum coated polymer mirror optically designed to match the windshield of the specific vehicle. Also, molded plastic light pipes create pinpoint illumination to enhance HUD’s critical information

Benefits include reduced cost, weight by using plastic optics instead of glass (~50%), and the ability to add mechanical features to the mirror help eliminate (typically metal) mounting components.



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Polymer Optics – Brief History

Polymer Optics Industry ~15 years Syntec Optics

Industry has advanced with improvements in mold manufacturing & molding techniques

- Diamond turned inserts
- Specialized advanced polymer materials
- 3D Mold Flow simulations/analysis
- High tech molding machines control flow rates & pressures precisely
- Scientific molding techniques develop repeatable process
- Can hold form on larger optics – glass quality image

In some cases polymer optics are out performing glass counterparts

- Complex surface options
- Light weight
- Mounting options



Polymer Optics – Examples

Our optical engineers design custom shaped polymer optics in geometries traditionally produced with glass.



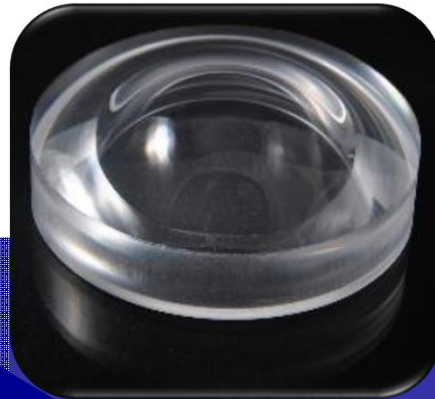
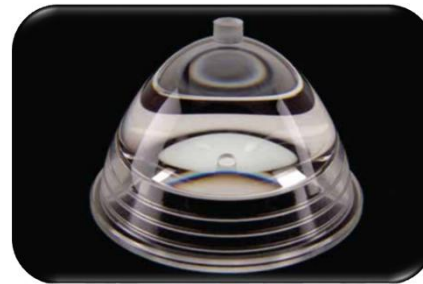
Prisms



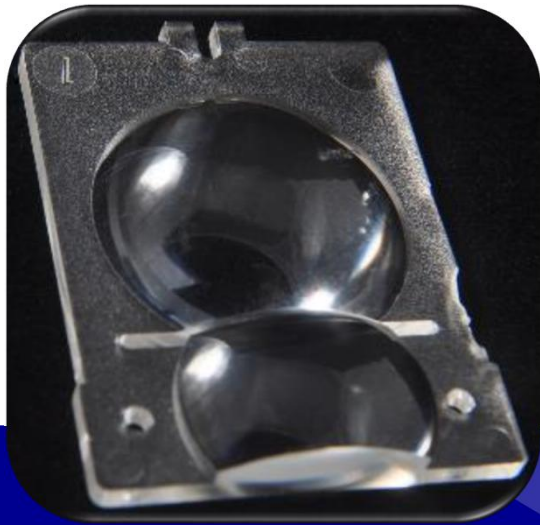
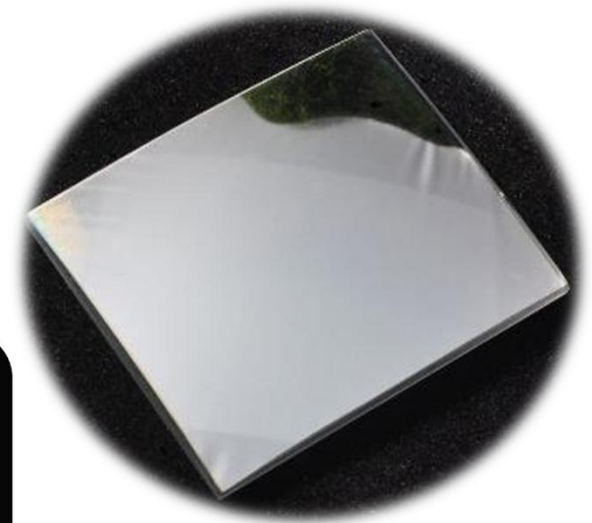
Polymer Optics – Examples

Plastic molded lenses will perform as good, if not better than glass for most applications

Lenses



Mirrors



Polymer Optics – Auto Industry

Headlight: Used in commercial applications & HumVees

Challenge:

- Needed to be Reliable, Durable, DOT compliant
- Material polycarbonate
- Reflector and shaping optic (snap together)

Solution:

- Designed Single molded piece
- Introduced high polished finish



Heads Up Display – Brief History

- Original rudimentary HUD in 1950(s) fighter jet technology – Speed and targeting systems
- General Motors introduced first Automobile HUD 1988 – Speed and tachometer (Olds Cutlass Supreme)
- Chevrolet Corvette offered first color HUD – 1998
- Today's HUD's offer GPS, Augmented Reality, Night Vision Tech, Infrared Cameras, Accident Avoidance, etc...
- Two Types – Built-in and add-on's

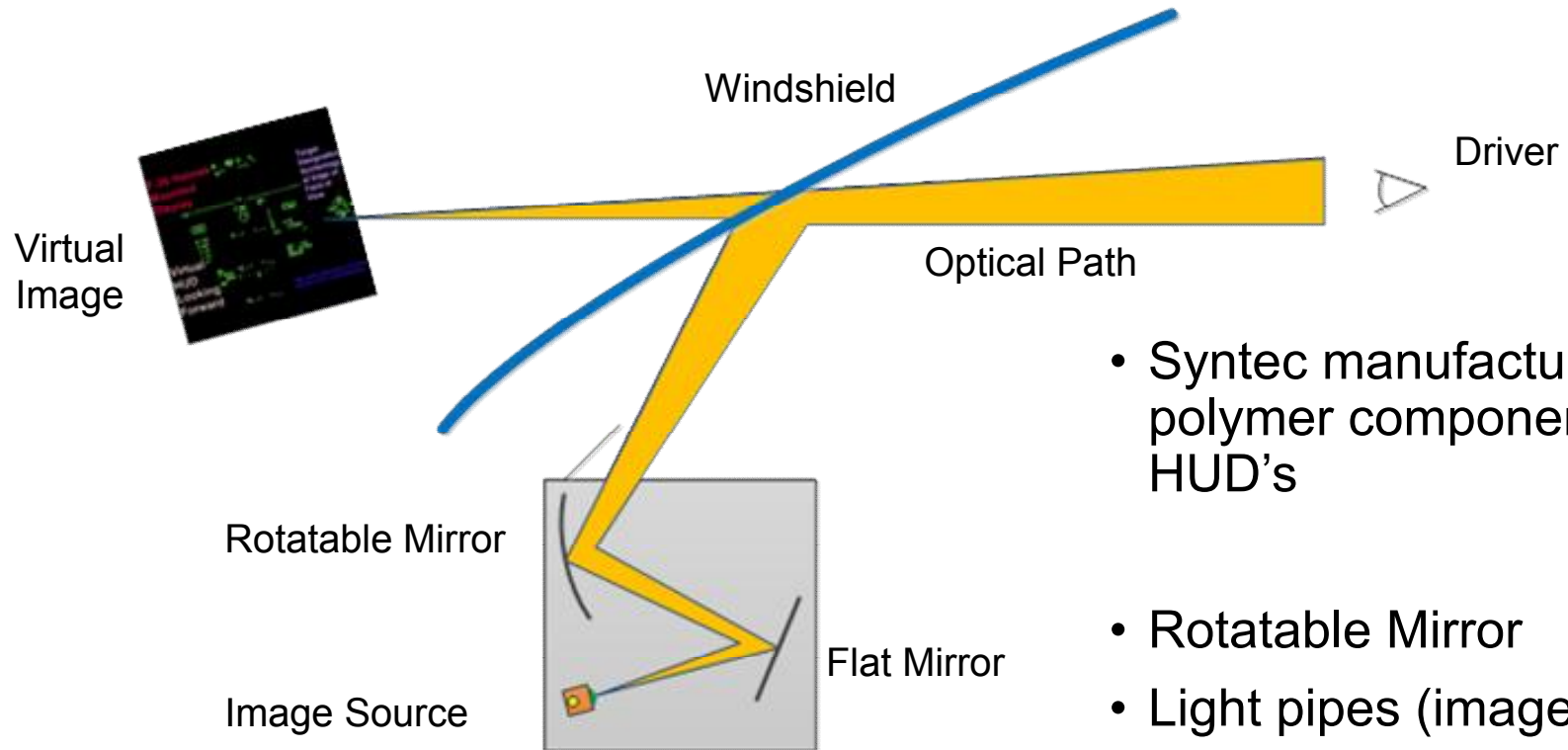


Heads Up Display – Brief History

- Why HUD?
- Safety – Drivers eyes stay on road
- Systems Display Speed, turn signal direction, radio status, outside air temperature, Lights (high beam), compass, plethora warning messages
- Driver needs to become used to system – Short learning curve
- Some find system a distraction
- Eventually replace instrument panel?



Heads Up Display – System



- Syntec manufactures two polymer components for HUD's
- Rotatable Mirror
- Light pipes (image source)



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Heads Up Display – TIR Light Pipe

- Eight Total Internal Reflection (TIR) light pipes
- Base – Plano
- Top - Asphere
- Made from Zeonex material
- Injection molded
- Optical component placed at the image source to illuminate particular areas of HUD
- Mounting points and alignment pins molded onto optical part



Heads Up Display – Rotatable Mirror

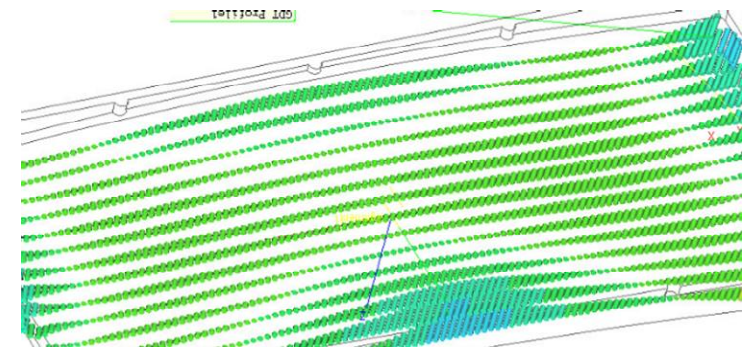
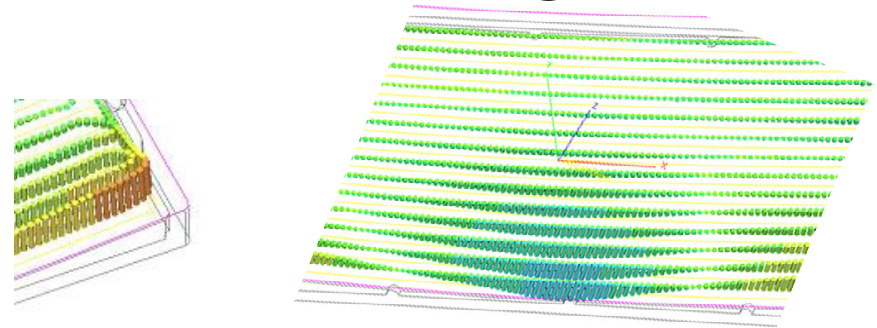
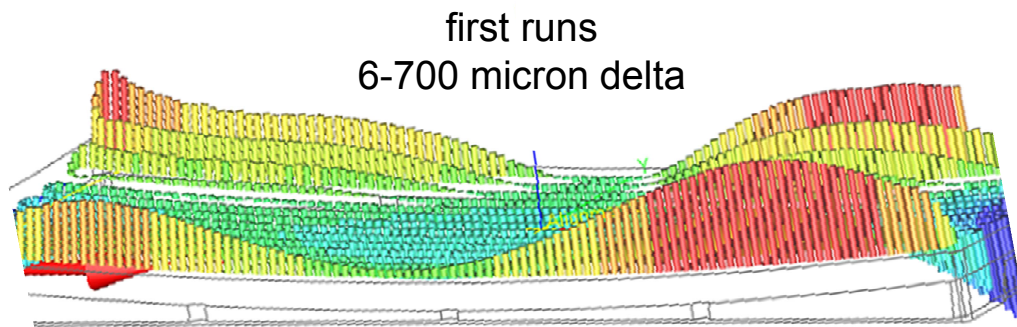
- Non-Symmetrical polynomial surface
 - Custom curve compliments windshield
 - Made from polycarbonate material
 - Injection molded – 220 ton press
 - Surface tolerance < 100 microns
 - Coated w/ enhanced protected aluminum
-
- Difficult to mold
 - Sink and shrink deformities minimized
 - Mounting hardware molded into mirror edges



~15 x 6 cm



Heads Up Display – Rotatable Mirror Testing



65 micron delta

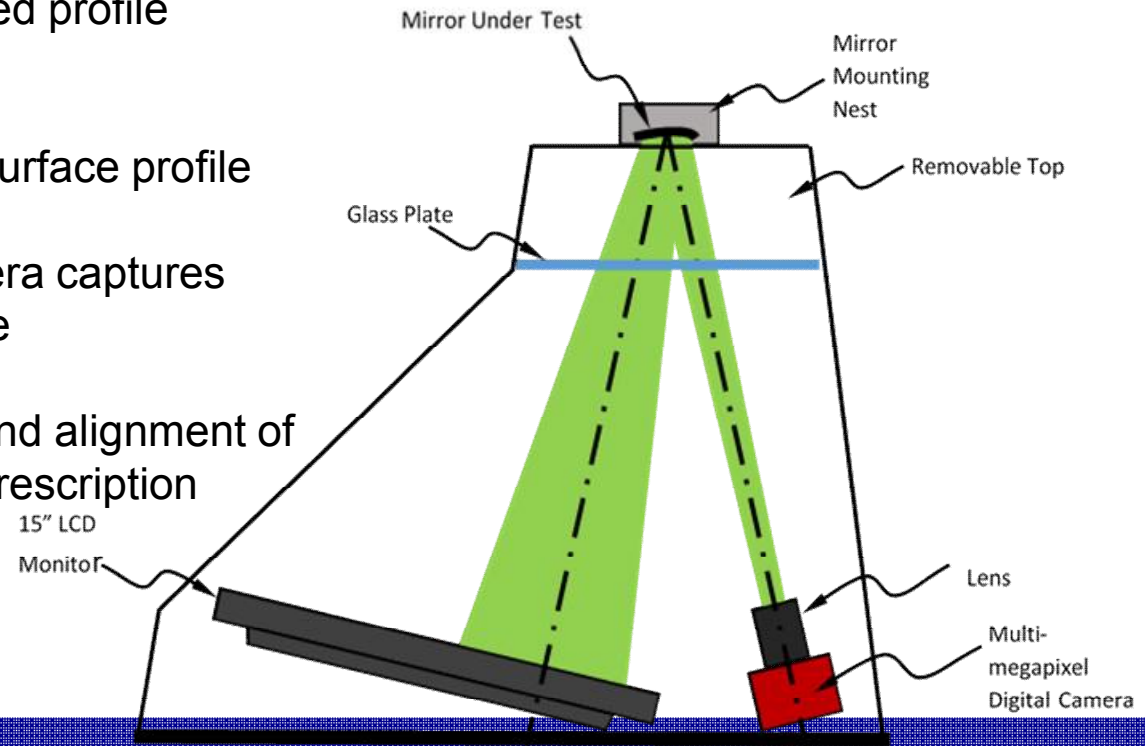
- How to test the surface?
- Contour measuring machine CMM w/ 2K points - less than 100 Micron delta
- Program >20 min to complete



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Heads Up Display – Rotatable Mirror Testing

- How to confirm your mirror surface matched profile without a HUD system and a windshield?
- Design and build custom test set to map surface profile
- LCD displays dot test pattern, digital camera captures image, computer analyzes captured image
- Calculates distance between each point and alignment of entire mirror surface compared to mirror prescription



Conclusions

- Polymer Optics are replacing traditional glass in many automotive applications
- Compressed development schedules are driving changes. Optical molding inserts can be manufactured, re-profiled quickly
- Benefits include; reduction in cost, weight, and elimination of mounting hardware



Thank You for your time

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SOURCES

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