1. OBJECT OF EXTERIOR MIRRORS ON VEHICLES

Provide the operator a view of the areas around the vehicle that cannot be seen by the eyes while sitting in the seat.

The mirrors must provide a view of the proximity area of the vehicle while at the same time allow the operator to maintain a view of the road ahead to avoid oncoming traffic.

To provide the required view the mirrors must have Clarity of View i.e. images must be clearly recognizable so operator does not have to take time to make mental calculations as to where the object shown is in relation to the vehicle being operated.

To provide the required view the mirrors must have Field of View i.e. view provided by the mirrors must cover all areas surrounding the vehicle.

To provide the required view the mirrors must be properly located on the vehicle. i.e. preferably placed in front of the windshield so they can be viewed with just a glance of the eyes.

2. CLARITY OF VIEW

Flat glass provides the maximum clarity of view. i.e. images image presented are as they would appear if directly viewed by the eyes.

When a wider view is required, flat glass is curved at a prescribed uniform rate of curvature. i.e. the convex mirror.
Curving of the glass introduces the concept of “minification” of objects. i.e. images shown in the glass are smaller in size than they would be if seen in a flat glass, often described as ‘distortion’.

An illustration of the difference between the flat glass and the convex glass can be illustrated by looking at the typical case type mirror offered by manufacturers:

A wider field of view with the single rate of curvature convex mirror can only be obtained by curving the glass at a more severe curve until it reaches a point where the distortion factor makes it unusable as a driving mirror. An illustration of such a glass can be illustrated as follows:
3. FIELD OF VIEW

The field of view produced by the combination of a flat glass (7 inch by 7 inch flat glass required by FMVSS 111 on all vehicles at time vehicle is provided by the manufacturer to the buyer in the US) with a convex glass in a single case or as two separate mirrors, always starts at the face of the mirror and opens up as distance from the face of the mirror to the rear of the vehicle is introduced. i.e. field of view produced is described as a cone theory field of view.

This field of view will always be the same and can be illustrated in the following photos:

The trash truck:

![The trash truck](image)

The dump truck:

![The dump truck](image)
The fire truck

The school bus

The transit bus

(c) Driver side view

(d) Passenger side view
4. SOLUTION

A solution to the problem of eliminating the blind spot along the side of the vehicle involves:

1. Expanding the field of view, and
2. Expanding that field of view with clarity.

Expanding the field of view with the use of the technology currently being used by mirror manufacturers can only be obtained by using such a severe rate of curvature that clarity of view is lost, as illustrated by the discussion in paragraph 2 of this paper. The distortion factor makes the mirrors unusable when the vehicle is in motion.

The M-C North America Inc. solution was to first develop a technology that allows us to control the size of images when making a wide angle mirror. This was accomplished using a multi-radius glass, where the glass is composed of varying rates of curvature to create the overall radius of curvature desired. (US Patent No. 8,172,411).

This approach allows us to have more control over the size of the images presented so distortion is eliminated.

Elimination of the distortion factor in the wide angle mirror allows us to fuse flatter glass with convex glass into a single mirror. For instance we can have a mirror that contains various
rates of curvature into one mirror with no distinction as to where the rates of curvature meet.

An illustration of such a mirror is shown by the following print:

A flatter portion the R1750mm is used for backing and showing a view to the rear of the vehicle and a convex portion of R400mm is placed on the bottom to show a view down to the ground, and on the outside of the mirror to provide a view out from the side of the vehicle. (needed for lane changes and turning maneuvers).

The following illustration shows what field of view, and clarity of view that can be developed using this technology:
We examine the requirements for a particular vehicle, decide what cut of glass will accomplish the required view and provide the solution in a single mirror that can provide the necessary view and still be used as a driving mirror. In the US where a flat glass mirror must be placed on the vehicle we simply provide the necessary flat glass in one mirror and for the supplement mirror use our technology to create in this supplemental mirror the solution to the blind spot problem.

Our solution can be presented in a case type mirror or in a two mirror configuration.

5. LOCATION OF THE MIRROR ON THE VEHICLE

Exterior mirrors on vehicles have historically been placed on the door area of the vehicle, which requires the operator to turn the head to look at the mirrors. Placing the mirrors in such a position loses a portion of the field of view, requires the operator to turn the head instead of just a glance, and can provide a blind spot behind the mirror. All of these problems can mitigated by placing the mirrors to the front of the windshield (our position is 18 inches to the front at a 45 degree angle) at eye level of the operator. In such a position the operator can receive all the information on the side of the vehicle with just a glance while maintaining the main focus the eyes to the front of the vehicle for oncoming traffic, and/or pedestrian travel when the vehicle is making a turning maneuver.

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