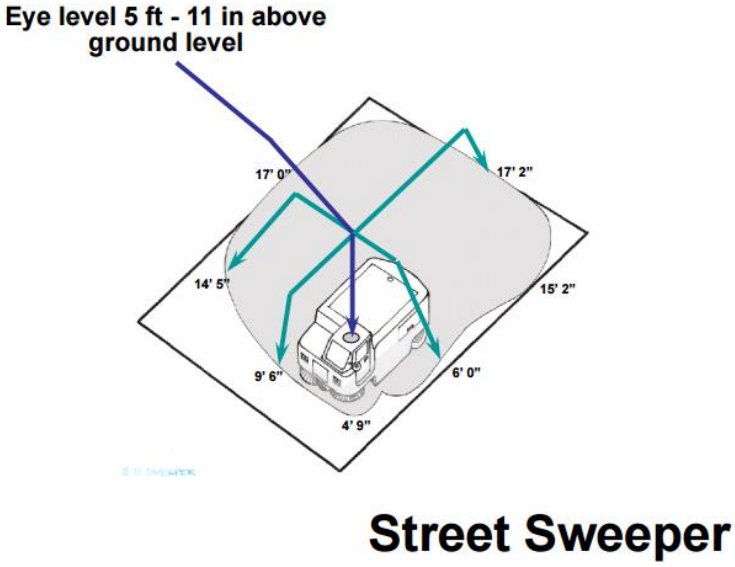
BLIND SPOTS AND THE STREET SWEEPER

The street sweeper is a difficult vehicle to analyze regarding the issue of blind spots because there is such a variety of configurations and each have their own set of blind spot problems.
Some generalizations can be made that would apply to all of these vehicles, and they would include:

1. The operator must tend to the operation of the vehicle.
2. Short range vision is required for smooth operation around parked vehicles in the roadway, debris in the roadway that could cause sweeper damage, brush location to curb and brush operation. Location of any vulnerable road user on sidewalk.
3. Long range vision is required for upcoming objects and what action will be required.
4. Generally operator is seated on the curb-side of the vehicle and must pull out into traffic lanes.
5. Backing may sometimes be required.

A generalized illustration of the blind spots existing on the street sweeper is illustrated in Massachusetts Occupation and Health Division "No-See Zones" paper:



Street Sweeper

The shaded areas are blind spots in the operators' vision of the proximity area of the vehicle and must be considered by any blind spot solution.

BLIND SPOT SOLUTION

Any proposed solution should take into account the fact that necessary information must be provided to the operator as quickly and as clearly as possible. The information should be attainable with just a glance so the operator can maintain vision to the front of the vehicle.

PROPOSED SOLUTIONS

Many manufacturers have proposed certain design changes in the equipment such as totally glass doors and placing the operator in the middle of the vehicle but such changes do not preclude the necessity of vision aids such as mirrors and cameras as supplemental aides.

EXTERIOR MIRRORS

Two considerations for exterior mirror systems are field of view and clarity of view. Does the view provided cover the area and is the view provided with clear images that do not require the operator to take time to make mental judgements.

Currently mirror manufacturers provide two types of mirrors: Flat Glass Mirrors that provide a clear view but one that does not provide a wide field of view, and Convex mirrors to supplement the flat glass mirror by providing a wider field of view.

The wide angle mirror technology used in the Convex mirrors is a single rate of curvature mirror. Flat glass is curved at a constant rate to make the convex mirror, which widens the field of view but introduces into the mirror two physical characteristics that will always be present. These are

1. the field of view starts at the face of the mirror and widens as distance from the mirror face to the rear of the vehicle is introduced until somewhere near the rear of the vehicle the

envelope has opened up enough to show the ground. This generally is described as the "Cone Theory of View".

2. as the glass is bent the size of images produced by the mirror are reduced so they appear smaller than they are in the flat glass. This generally described as "Distortion" and the more the glass is bent the more the distortion factor is increased.

An example of the Cone Theory can be illustrated by the following photo:

This photo is taken of a vehicle where the door has been completely replaced by glass to provide the operator a better view of the area on the side of vehicle which is an aid, but here it should be noted that while the operator has the head turned to view the proximity area of the vehicle and specifically, the area of the brushes, the eyes are not on the road ahead and obstacles that may be in the path of the sweeper. This has led to many times placing a larger convex mirror that is directed at the area to be seen. Distortion is still present and again the operator is not concentrating on the road ahead while looking at the mirror.

THE M-C NORTH AMERICA INC. SOLUTION

We broke the solution down into attaining 3 goals:

1. develop a mirror technology that can provide a wider view without the distortion prevalent in the current convex mirrors being used.
2. develop a solution to the problem of the cone field of view provided by current mirror systems

3. develop a proper location of the mirrors on the vehicle to maximize the aid the mirrors provide for operator.

The primary problem with the single rate of curvature is the "minimication" of images presented to the operator. The objects appear smaller than if viewed in a flat glass, and to the eye this presents a distortion element, which requires the operator to determine where the object actually is before the necessary reaction can be executed. If the operator takes action before a careful consideration is made the result can be accident. The time taken, varies for each individual, but no matter how much time taken the eyes are not on the road ahead. Our solution here was the creation of a new wide angle mirror technology (US Patent No. 8,172,411) which is a multi-radius approach that allows us have better control over the size of the images so the distortion factor is eliminated allowing the operator to use the information presented without taking time to determine where the object actually is instead of guessing where it is with current cnvex mirror technology.

1. Eliminating the effect of the cone theory of view provided by current mirrors. Other mirror manufacturers working with the single rate of curvature mirror do not have the ability to join various rates of curvature into one piece of glass because of the distortion factor. Removing the distortion factor on the wide angle mirror glass means we can join together in one mirror different rates of curvature, so we can join a flatter portion for backing, a more convex portion on the side to see out from the vehicle for lane changes and turning maneuvers, and a more convex portion on the bottom of the mirror to see the ground closer to the placement of the mirror on the vehicle. The blind spot from the mirrors location on the vehicle to the rear of the vehicle created by the Cone theory is eliminated.

2. Historically exterior mirrors have been placed on the door or frame of the door. This placement requires the operator to turn the head to view the passenger side mirror and takes the eyes off the road ahead, and also the mirror itself creates a blind spot in the operators' view. A proper placement of the mirrors should be to the front of the windshield,18 inches out and at eye level, so that the main eye contact is to the front of the vehicle for

oncoming traffic, and allows the operator to see all that is necessary along the sides of the vehicle with just a glance of the eyes. This can only be accomplished by removing the distortion in the wide angle glass, and allows the full field of view of the mirrors to be available for the operator, and can in such a situation offer some aid to the view of the front of the vehicle

For the immediate front of the vehicle we recommend cross-over mirrors (not the type of cross-over mirrors presently being used because the rate of curvature is so great that the distortion factor makes them useless) but mirrors that clearly show the operator the necessary information (presently under development with our mirror technolgy) or cameras as needed and for the rear of the vehicle the camera is the only solution. As is shown by the fact that many manufactures are offering the rear view camera as a standard.

At M-C North America Inc. we do not just sell mirrors and cameras, we sell solution that solve a problem.

Norm Smith
President
M-C North America Inc.
Web site www.m-cna.com