Optical Quality **and V-Gard® Visors**

MSA
The Safety Company

Introduction

MSA V-Gard Visors, regardless of size, are engineered to eliminate distortion and improve impact resistance. V-Gard molded Visors are manufactured with hand-polished molds for superior optical quality. They are among the finest available in the market today, exceeding the optical requirements for many global standards, including ANSI/ISEA Z87.1-2010, CSA Z94.3 and EN 166.

Lens Quality is Important

The risk created by poorly performing lenses could be dangerous and costly. Studies have shown that visual strain causes health issues, such as debilitating headaches and a higher prevalence of musculoskeletal disorders. Other studies have concluded that workplace eye strain and eye injuries are not only common, but also cost billions in lost productivity each year[1]. Additionally, if a protective device impairs vision, workers tend to wear it incorrectly to compensate, or remove it altogether[2] — strongly increasing the risk of serious injury, workers' compensation claims, and other costs.

Eliminating offending causes of visual discomfort can reduce health issues and improve productivity.[3]

Measuring Lens Quality

Safety standards provide guidance as to the requirements and test methods[4] needed to assure that face protection products meet the applicable optical requirements. Under ANSI/ISEA Z87.1-2010 (the "Standard"), faceshield protectors must:

- Be free of visible defects;
- Have a luminous transmittance level > 85% (if the lens is clear);
- Not exhibit > 3% haze; and
- Be within acceptable tolerance levels (as defined in the Standard) for resolving power, prism, and prism imbalance[5].

Tests to certify our products meet applicable Standards requirements are conducted within our own research facilities, and are also verified by third-party test facilities.

This paper details what the optical quality requirements are, how MSA V-Gard Visors meet them, and how our products compare to competitors for these measures.

Test Method

To test optical quality, V-Gard molded Visors and "comparable" competitor visors were assessed according to the "Optical Requirements" test method outlined in ANSI/ISEA Z87.1-2010.

V-Gard Visors (molded, clear) and each of three competing manufacturers' visors were checked for optical distortion using measures of luminous transmittance, haze, prismatic power/imbalance and resolving powers. Though not a requirement for faceshields, each was also checked for refractive power and astigmatism. All testing was done with visors mounted onto the applicable manufacturers' frames.

Luminous Transmittance (LT)

Luminous transmittance is an optical property that indicates the amount of light passing through a lens. A clear lens should have a transmission value > 85%; the higher the transmission value, the more pristine the lens.

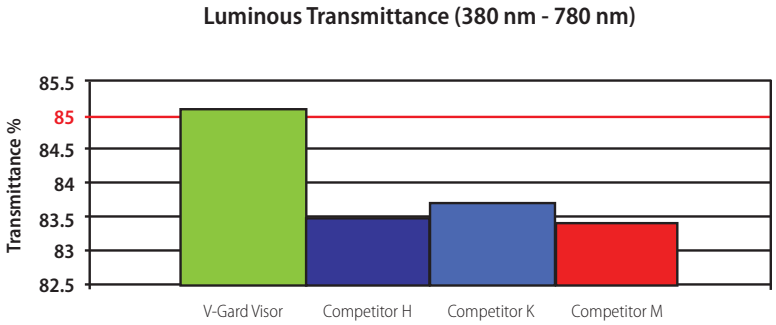


Figure 1.1: MSA V-Gard Visor passes LT ANSI/ISEA Z87.1-2010 requirements for clear, molded PC visors in this sample set.

Haze

Haze is the result of light "scattering" as it passes through an object, rather than being transmitted straight through. As haze percentage increases, clarity decreases, details are lost, and vision becomes obscured. Only clear lenses are tested for haze; products must have a haze value < 3 % to pass ANSI/ISEA Z87.1-2010.

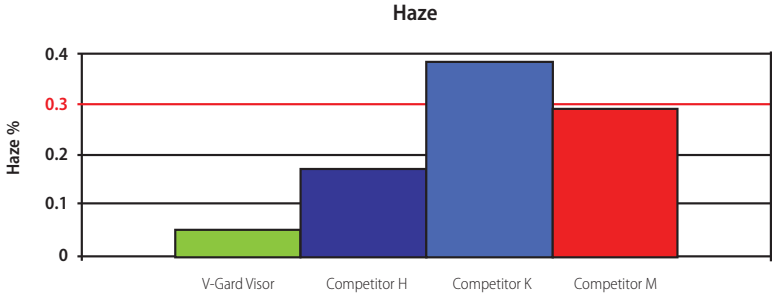


Figure 1.2: The lower the haze, the clearer the visor; all visors meet the haze requirements in ANSI/ISEA Z87.1-2010.

Prismatic Power and Imbalance

Prismatic power is the deviation of a ray of when passing through an optical center.* Prism in a visor can be produced when the front surface is not parallel to the back surface (i.e., surfaces are tilted relative to each other). Prism beyond accepted industry tolerance (< .37 diopters for faceshield protectors, per ANSI/ISEA Z87.1-2010) could cause discomfort to the wearer. When light passes through the prism, the object viewed appears to be displaced. Imbalance occurs when the wearer sees differing prismatic effects side-to-side, or above-to-below, the optical center.

Visor	Prism		V Imbalance	H Imbalance (out)
	R (.37 max)	L (.37 max)	.125 max	.75 max
MSA V-GARD	0.028	0.034	0.004	0.006
COMPETITOR H	0.072	0.087	0.001	0.155
COMPETITOR K	0.153	0.054	0.004	0.172
COMPETITOR M	0.030	0.081	0.030	0.070

Figure 1.3: Seeing things clearly: the closer the R and L prism, the less imbalanced the lens. The V-Gard Visor shows both the vertical (V) and horizontal (H) imbalance consistent and minimal, meaning the visor offers an undistorted view, regardless of whether the wearer is looking up/down or side-to-side. All visors are within tolerance.

**The optical center is the point where light passes through the lens and travels straight.*

Resolving Power

Resolving power, also known as "resolution," is the ability of the visor to allow the wearer to see fine details and sharp, separate images when objects are placed close together. The more detail able to be resolved under specified proximity conditions, the higher the resolving power of the visor. See Figure 1.4 for a picture of the NBS-1952 Resolution Test Chart.

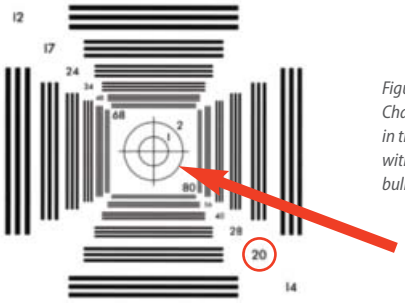
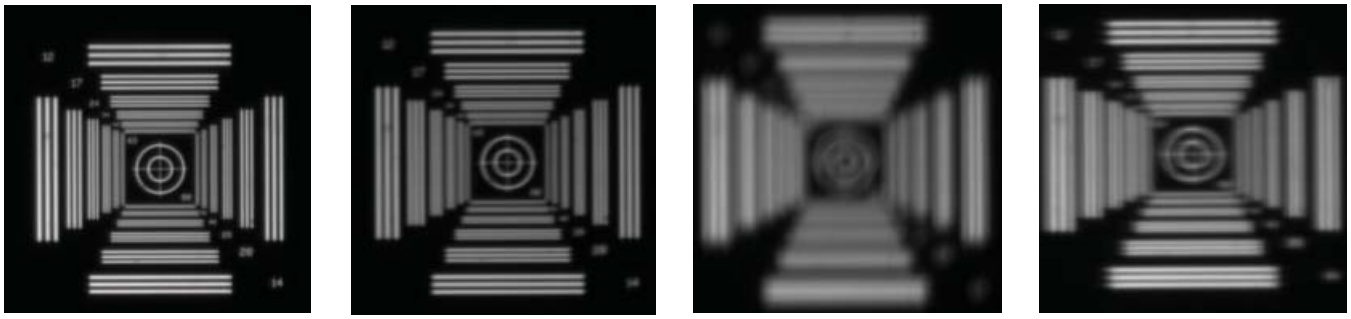


Figure 1.4: The NBS-1952 Resolution Test Chart. A pattern 20 is the minimum allowable in the Standard. Resolving power increases with readable, clear patterns closer to the bull's-eye at the back of the figure.

The photos below show the MSA V-Gard molded Visor resolving power results vs. competitors'. ANSI/ISEA Z87.1-2010 requires at least a pattern 20 reading; however, the resolving power is greater if the bars closer to the target are crisp and distinct.



MSA Molded V-Gard Visor | Competitor H | Competitor K | Competitor M

Figure 1.5a: Right eye NBS resolution readings. The MSA visor is clear and distinct to a pattern 40 (see Figure 1.4).

Visor	Resolving Power	
	R (20)	L (20)
MSA V-GARD	48	40
COMPETITOR H	34	34
COMPETITOR K	10	12
COMPETITOR M	20	24

Figure 1.5b: Competitor K does not reach a pattern 20; all others offer varying patterns of resolving power. V-Gard Visors offer the best resolving power of those tested.

Other Considerations for Reducing Eye Strain

To ensure that visual discomfort is minimized, there are a few more considerations when selecting a visor. These considerations include: anti-fog and anti-scratch (AF/AS) coatings, refractive power and astigmatism, ultraviolet (UV) protection and V-Gard assembly "fitness."

Anti-Fog and Anti-Scratch (AF/AS) Coatings

AF/AS coatings improve vision under tough conditions by preventing fogging and scratching that happen during the work day. These coatings can extend the life and use of the visor, reducing replacement costs. ANSI/ISEAZ87.1-2010 and CSA Z94.3 do not specify either a test method or marking for AF/AS, so when manufacturers claim their products offer "the best" AF/AS performance under either of these standards there's no accurate basis for comparison. EN 166 has performance criteria for AF/AS that is difficult to pass:

- To secure an "N" marking for AF performance, four (4) water, air and relative humidity-conditioned visor samples are subjected to water vapor (steam). The time required for the light transmission levels to drop to 80% of the unfogged baseline is measured, and visors must remain fog-free for a minimum of 8 seconds.
- To secure a "K" marking for AS performance, two (2) clean visor samples are rotated on a plate while 6.6 lbs (+ 0.11 lb) of natural quartz sand is dropped from a nearly 5 ft tall gravity-fed tube. Once the test is complete, the samples are cleaned and the measured light transmission must remain within tolerance.

MSA offers several molded V-Gard polycarbonate Visors coated with AF/AS that offer "N" and "K" markings.

Refractive Power and Astigmatism

Irregularly shaped visors with a lack of optical symmetry cause light to bend improperly creating astigmatism (i.e., refractive error that causes objects to appear blurry). Refractive power (measured in diopters) is the ability of the lens to focus light properly, keeping images crisp. There are no astigmatism and refractive power requirements for faceshields in ANSI/ISEA Z87.1-2010. These measures were reviewed, however, because they can help assess the consistency of lens curvature and its effect on eye strain.

Visor	Refractive Power		Astigmatism
	R (.06 max)	L (.06 max)	.06 max
MSA V-GARD	0.001	0.001	0
COMPETITOR H	0.012	0.011	0.001
COMPETITOR K	0.070	0.054	0.016
COMPETITOR M	0.039	0.041	0.002

Figure 1.6: The V-Gard Visor offers the lowest, most consistent measure of R/L refractive power, and the lowest astigmatism measured (among those sampled).

Ultraviolet (UV) Protection

According to the Environmental Protection Agency (EPA), UV radiation increases the likelihood of cataracts, tissue growth that blocks vision, skin cancer, and degeneration of the macula. All of these problems can be decreased through the use of eye protection that filters 99%-100% of UV rays.[6] All clear and green tint polycarbonate , as well as green tint propionate V-Gard Visors offer maximum UV protection. All are marked as "U6" – the highest level of UV filtering measured in ANSI/ISEA Z87.1-2010.

V-Gard Assembly "Fitness"

V-Gard Visors offer geometries that extend peripheral view and provide additional coverage required for EN certification. V-Gard Visors are designed to work exclusively with V-Gard Frames. The "hand-glove" compatibility between a V-Gard Visor and Frame decreases stress on the visor and eliminates horizontal prism often introduced when a visor is flexed when attached and in use.

Conclusion

V-Gard Visors exceed ANSI/ISEA Z87.1-2010 requirements by offering pristine optics, impact ratings, and measured performance on AF/AS coatings and UV protection (where offered). V-Gard molded Visors are designed to exceed customer expectations. They set a new level of performance for the market.

1 *American Optometric Association's American Eye-Q® survey (2010).*
2 *Banerjee A. Effectiveness of eye protection in the metal working industry. BMJ7 1990;301:645-6. (20 September.)*
3 *Hemphälä H, Eklund J., A visual ergonomics intervention in mail sorting facilities: effects on eyes, muscles and productivity. Appl Ergon. 2012 Jan;43(1):217-29. Epub 2011 Jul 2. PubMed PMID: 21726852.*
4 *ANSI/ISEA Z87.1-2010, sections 5.1 and 9.1-9.4, respectively.*
5 *The ANSI/ISEA Z87.1-2010 standard does not provide a requirement for refractive power or astigmatism for faceshields.*
6 *http://www.epa.gov/sunwise/uvandhealth.html#cataracts.*

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