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TECHNICAL REPORT

TESTS OF PLASTIC PLANO SAFETY SPECTACLES

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

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ABSTRACT

This report describes tests of industrial safety spectacles with plastic lenses advertised as meeting the requirements of the ANSI Z87.1 standard. A general description of each test is included along with a presentation of the test results. Seventeen individual models were tested and found to be in general compliance with the ANSI standard.

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INTRODUCTION

The Testing and Certification Branch of the National Institute for Occupational Safety and Health is developing a body of technical information about personal protective devices currently available to the industrial worker. These devices include safety helmets, safety-toe shoes, linemen's rubber gloves, and eye and face protective devices. This report is one of a series concerning such devices.

Industrial safety spectacles are by far the most frequently used safety device for eye protection in the occupational environment. The Occupational Safety and Health Act of 1970[1] requires that these spectacles comply with the American National Standards Institute (ANSI) standard Z87.1-1968.[2] This report describes a testing program to determine the extent to which industrial safety spectacles currently available in this country comply with this standard.

Frames of industrial safety spectacles can be either plastic or metal. Lenses can be either glass or plastic, each having advantages and disadvantages. It is generally recognized that the glass lenses provide superior scratch resistance, while plastic lenses are lighter in weight and more impact resistant. Plastic lenses in plastic frames are considered in this testing program.

NIOSH recently tested glass lens safety spectacles. The results are published in "Tests of Glass Plano Safety Spectacles," HEW (NIOSH) Publication No. 77-136.[3]

SELECTION OF DEVICES

The program described in this report was implemented to survey the quality of plastic plano safety spectacles available in the United States and advertised as being in compliance with the ANSI Z87.1 standard.

Unlike street-wear spectacles, the shapes of industrial spectacles are standardized. As a result, the same basic lens is typically used in all the various frame styles available from a particular manufacturer, and because lens quality is the most important determinant in user safety, no attempt was made to test all of the numerous frame styles available. Instead, one model, randomly selected from all available models, was tested for each manufacturer.

Models from 17 manufacturers were purchased for testing. To standardize the testing program, all spectacles were ordered with a 48 mm lens size, 22 mm bridge size, 6 diopter base curve, plastic frame, cable temples, clear plastic lenses, and sideshields.

TESTING PROGRAM

Twelve specimens from each of 17 spectacle models were tested as outlined in the flow-chart on page 13. The tests and requirements are those of the ANSI Z87.1 standard. Except for the addition of the penetration and haze tests required for plastic lenses, the tests are the same as those described in "Tests of Glass Plano Safety Spectacles." A review of the detailed tests procedures is, therefore, not necessary for those familiar with the earlier report. However, the reader may wish to read the new sections describing the haze and penetration tests. A brief explanation of each test follows.

Lens Impact Test

The lens impact test consisted of dropping a 1-inch steel ball weighing 66.7 grams, onto the center of the outer surface of the lens. The lenses were mounted on a 1/8-inch thick neoprene gasket (Shore A durometer reading of 40 $\pm$ 5) glued to the test block specified in the ANSI standard.[4] The tests were conducted at increasing "energy steps" until fracture occurred or until the maximum energy was achieved. The initial step, in which the steel ball was dropped from a height of 50 inches as required in the ANSI standard, was used as a basis for pass/fail. Higher energy impacts, each 20 percent greater than the previous one, were used for comparison purposes only. A total of 16 lenses were impact tested for each model. A single failure at the 50-inch height was considered sufficient cause to fail the model.

Frame Impact and Penetration Tests

Spectacles were frame impacted to test the strength of the lens-frame combination and subjected to the penetration test to determine their resistance to flying projectiles with sharp points. Both tests were performed by mounting the spectacles on an anthropomorphic headform such that the outer surfaces of the lenses faced upward. The test fixture used for the frame impact testing of glass lens spectacles was not used for these tests because of the difficulty encountered in securing the temples to the fixture and the fact that clamping the temples is not a realistic way to conduct the test, since temples are free to move when spectacles are worn.

A drop height of 50 inches was used in both tests. A steel ball weighing 66.7 grams was employed in the frame impact test, and a Singer #25 needle attached to a 43.4 gram mass was used in the penetration test. Eight lenses of each model were subjected to both tests. Four lenses were frame impacted prior to the penetration test, and the other four lenses were subjected to the penetration test prior to being frame impacted. Survivors were retested using a 100 inch drop height for comparison purposes. Only the 50 inch drop height was used as a basis for pass/fail. Failure of a single lens resulted in failure of the model.

Luminous Transmittance and Haze Tests

Lenses were tested for luminous transmittance and haze using a Gardner model UX-10 hazemeter with a model PG-5500 digital display. Testing was performed with the CIE type A standard light source according to procedure A of the ASTM test method D1003-61T.[5]

Clear plastic spectacle lenses are required to transmit at least 89% of the incident luminous light and exhibit not more than 6% haze. Eight lenses of each model were tested, and each model's averages were recorded. An average of less than 89% transmittance or more than 6% haze resulted in failure of the model.

Luminous transmittance is a measurement of the darkness of the lens. The percent luminous transmittance is simply the percentage of visible light transmitted through the lens. A 10% reduction in transmittance would be nearly unnoticeable to the wearer. Haze is the percentage of light scattered or diffused by minute optical defects in the lens material. It tends to disrupt visual acuity especially when the object being viewed is near a bright source of illumination. This is the same optical effect that occurs when driving into the sun with a dirty windshield.

Flammability Test

Frame-fronts, temples, and sideshields were tested for flammability. Frame-fronts were tested whole with lenses and temples removed. They were mounted in the position in which they are worn, held by the left side, and ignited on the extreme right edge where the temple was attached. The time required for the flame to burn to a line inscribed on the center of the bridge was recorded.

Temples and sideshields were similarly tested by mounting them in a horizontal position and recording the time required for the flame to burn a measured distance. To eliminate their natural curvature, all sideshields were straightened prior to testing. Temples were tested as received; nothing was removed. All samples were tested as outlined in the ANSI Z87.1 standard, and the ASTM test method D635-72 was consulted to provide some of the details not covered by the ANSI standard.[6] It should be pointed out that the flammability requirements of the ANSI Z87.1 standard are very subjective and very briefly described. The details of the test are a matter of conjecture. Therefore, NIOSH developed a test method using the ANSI Z87.1 standard as a basic guideline. The objective of the test was to develop easily reproducible procedures consistent with the intent of the ANSI standard. The test was designed to be realistic; flammability samples were placed in the "as worn" position during testing.

Samples which burned the entire measured distance were classified as "burning," and a burn rate was computed. If the sample would not ignite or if the flame went out before burning the entire distance, the sample was classified as "self-extinguishing." Testing continued until 5 samples were given the same classification. This classification was recorded for the component. If the component was classified as "burning," an average burn rate was calculated to determine failure or compliance with the maximum allowable burn rate of 1.06 mm/sec. In addition a statistical test based on the student's t distribution was used to determine the level of confidence.[7] If there were not at least 90 percent confidence that the component passed or failed, the result was considered inconclusive. Components classified "self-extinguishing" were considered passing.

Refractive Power Test

The refractive power test is actually four individual tests which measure the optical qualities of prism, sphere, cylinder, and definition. These tests were conducted using NBS Special Publication 374 as a guide.[8] Sixteen lenses were tested for prism and ten for each of the remaining tests. At a distance of 35 feet, a target was observed through each lens using a Gaertner model M522 11 power telescope having a 19 mm objective aperture. Each lens was viewed perpendicularly through its geometric center unless a localized defect was present near the center, in which case the target was viewed through the defect.

The prismatic power test measures the extent to which an object being viewed is displaced by the lens under test. Prism in spectacle lenses becomes a problem when two lenses exhibit significant amounts in opposite directions, causing the eyes of the wearer to look in slightly different directions to focus on an object. This causes eye fatigue. For this reason spectacle lenses should be bought and tested in pairs. To prevent this prismatic imbalance, which is significantly more important than pure prism, the ANSI standard requires each lens to exhibit not more than 1/16 diopter of prism, thus setting the maximum difference between any two lenses at 1/8 diopter, an amount easily accommodated by most people.

The prism of an individual lens is meaningful only when the optical axis of the lens is specified. Because the ANSI standard does not specify the location of the design optical axis, the prism of individual lenses cannot be measured unless an arbitrary point of reference is selected. It is, however, possible to measure directly the prismatic imbalance between the left and right lens without knowing the location of the optical axis. In this test series, prismatic imbalance was measured. Imbalance greater than 1/8 diopter between a left and right lens resulted in failure of the model. While this procedure readily identifies those cases in which prismatic imbalance in specific pairs of spectacles is a problem, it does not represent the only possible interpretation of the ANSI standard. Because manufacturers do not generally pair lenses before insertion into frames, it might be more realistic to consider the total group of lenses of each model and to determine whether the maximum difference between any two lenses in the group is greater than 1/8 diopter. While such a test would have been more severe than that adopted in this testing series, the standard is broad enough to accommodate it.

Spherical power refers to the maximum refractive power in any meridian, and cylindrical power refers to the maximum difference in refracting power between any two meridians. The ANSI standard sets a maximum of $\pm$ 1/16 diopter for both. These two quantities were measured by observing a target composed of radial lines, eliminating parallax between the crosshairs in the telescope and the target, and recording the two refractive power readings 90° apart. The larger of the two is the spherical power and the difference is the cylindrical power. If an axis of cylinder was observed, one of the crosshairs in the telescope was aligned parallel to the axis prior to taking the reading to eliminate focusing error.

The definition test is a measure of the extent to which the visual acuity of the wearer is affected. This is a "catch-all" because it is sensitive to almost any type of optical defect. In order for a lens to pass, each of the 3 lines on the number 20 pattern of the NBS circular C533 must be distinguishable.

Flat and Edge Transverse Tests

The flat and edge transverse tests evaluate the mechanical integrity of the frame. Both tests are conducted with temples removed and lenses in place.

In the flat transverse test, the left half of the frame-front and bridge was secured in a holder such that the outer surface of the lenses faced downward. A 16 ounce weight was attached to the right temple hinge and allowed to stabilize.

In the edge transverse test, the right half of the frame-front and bridge was grasped by the hand and held in a normal wearing position. The left half was then pressed downward against one of the platforms of an equal-arm balance while the other platform contained a five-pound weight. Sufficient downward force was applied to balance the system.

In both tests, the forces were removed as soon as the system stabilized, and the devices were immediately examined. Any permanent deformation was cause for failure. Three specimens were subjected to each test.

Corrosion and Disinfection Tests

The corrosion and disinfection tests require spectacles to demonstrate a minimum level of durability. The corrosion test determines the effects of exposing the device to a salt spray (fog) under controlled conditions. The disinfection test evaluates the extent to which spectacles can withstand routine disinfection without deterioration.

Spectacles were tested for corrosion resistance in a Singleton model SCCH-21 test cabinet according to ASTM test method B117-64.[9] After being exposed to the fog for 48 hours, the devices were rinsed with distilled water, air dried, and inspected. In order to pass, the spectacles must have been totally usable.

In the disinfection test the spectacles were washed in a soap solution, thoroughly rinsed, and then immersed in a hypochlorite solution for 10 minutes at room temperature. Upon completion of the test, the devices were air dried and inspected. Any significant deterioration or discoloration was cause for failure. This procedure was repeated using a phenol solution. Both disinfecting solutions were used at the strengths recommended on their respective labels.

Water Absorption Test

This test measures the tendency of the frames and lenses to absorb moisture. Plastic materials used in the construction of the safety spectacles must not absorb more than 5 percent water when tested in the following manner.

Two sections of the frame-front were cut from a specimen and tested according to Federal Test Method Standard, Number 406, Method 7031.[10] Samples were conditioned according to paragraph 4.1.1, and tested as outlined in procedure A. In addition, if the temple material was different from the frame-front, a sample was similarly cut from each of two temples and tested. Lenses were tested whole. Sideshields were not tested.

The samples were placed in an oven at 50° C for 24 hours, cooled, and weighed. After immersion in distilled water for 24 hours at 23° C, the samples were reweighed. The percent of water absorbed was calculated from the two weights. This percent was corrected for any water soluble material present.

The percent water absorbed for the component was determined by averaging the results for two samples. If the average was less than or equal to 3 percent, the component passed; otherwise, two additional samples were tested and a new average was computed using all four samples. The new average was then used to determine failure or compliance with the 5 percent requirement.

Design Requirements

The ANSI standard lists several design requirements for safety spectacles. These include such items as manufacturer's markings, lens thickness, and the elimination of eye exposure. At least one specimen from each model was examined for compliance with the design requirements.

TEST RESULTS

Lens Impact Test Results

The results of the lens impact test are presented in Table A-1. The lenses performed very well in both the standard and higher energy tests. Their performance was clearly better than the glass lenses at higher energies.

All seventeen models passed the standard test. Sixteen of the models also survived impacts at the five higher energy levels. Poor performance at higher impacts was observed only in the American Optical Corporation model: While two lenses survived all five higher energy impacts, three lenses fractured at each of the first three higher energy steps, four fractured at step 4, and one at step 5.

The difference in performance between the American Optical Corporation model and the other models is apparently due to the fact that the American Optical Corporation lenses are made of CR-39 plastic while the other lenses appear to be made of polycarbonate. At the time of this writing, we have been informed that American Optical Corporation will be introducing a polycarbonate lens in the near future. Therefore, these test results will not be representative of their future models which are not constructed of CR-39.

Frame Impact and Penetration Test Results

As was the case in the glass lens spectacles testing program, all models passed the standard frame impact test. All models also passed the standard penetration test, which is not required for glass lenses. All models also passed both tests at increased energy steps. When the drop height was increased from 50" to 100", all lenses survived.

We are not aware of why glass lenses are not required to pass the penetration test. Our experience has been that if the glass lenses were subjected to this test, they would have a considerably higher failure rate.

Throughout the impact and penetration testing, the headform worked very well. In addition to eliminating the problems encountered with the test fixture used in the glass lens testing program, this headform provides for a more realistic test because the spectacles are supported only at those points at which they are supported when worn. Another significant feature of this test fixture is that it can be used with any eye protection device: spectacles, flexible fitting goggles, face shields or eyecup goggles.

Luminous Transmittance Test Results

All lenses passed the luminous transmittance test. The values were from 90.3%

to 92.8%, inclusive, a range in which transmittance differences would probably not be detected by the wearer. The variance between models of plastic lenses is greater than that for glass lenses, which ranged from only 92.1% to 92.4%. The minimum allowable transmittance is 89%.

The American Optical Corporation model had the only transmittance exceeding 92%. This is apparently because it was constructed from CR-39 plastic instead of polycarbonate.

Haze Test Results

All models passed the haze test. The values ranged from 0.17% to 0.85% haze, well below the allowable 6%. The amount of haze measured in this testing program is probably undetectable to the wearer.

Flammability Test Results

Seven of seventeen models passed the flammability test; seven failed and three were judged "inconclusive." Sideshields were responsible for the ten models which did not pass. All fronts and temples passed. Burn rates for fronts ranged from 0.48 to 0.70 mm/sec. Three fronts were self-extinguishing. Burn rates for temples ranged from 0.52 to 0.72 mm/sec. with one temple being self-extinguishing. The range for sideshields was 0.73 to 1.37 mm/sec. One sideshield was self-extinguishing. These burn rates are similar to those obtained in the glass lens spectacles testing program, in which four models also failed because of excessive sideshield burn rates.

Refractive Power Test Results

Sixteen of the seventeen models tested passed all four parts of the refractive power tests. There were no failures due to prism or cylinder. Two lenses in the American Optical Corporation model failed the spherical power test, and one lens in the Glendale Optical Company model was marked questionable on definition. It should be pointed out that although both the glass and plastic lenses, as separate groups, exceeded the requirements of the refractive power test, the glass lenses were of noticeably higher optical quality.

Flat and Edge Transverse Test Results

There were no failures in either the flat or edge transverse tests. As was the case with the glass lens spectacles, the frames deformed slightly under load but returned to their original shape when the load was removed.

Corrosion and Disinfection Test Results

Two of the sixteen models tested failed the corrosion test. One model had no metal parts and was not included. As in glass lens spectacles, the wire-screen sideshield was the only problem area. The American Industrial Safety Equipment Company and Jackson Products models rusted to the extent that 50% of their screens were clogged. The Fendall Company model was the only one with wire-screen sideshields which did not rust or discolor. The other six models with wire-screen sideshields discolored and/or rusted, but there was no clogging and, therefore, no effect on ventilation or peripheral vision. Other metal parts discolored, but there was no effect on the usability of the device.

All seventeen models passed the disinfection test. Three models with wire-screen sideshields had some rust, but there was no clogging of the screen.

Water Absorption Test Results

All components easily passed the water absorption test. The range for frame-fronts was 1.5% to 3.0% absorption. Four models had temples that appeared to be made of different material than the frames. The range for these temples was 1.9% to 3.9% absorption. These figures are comparable to those obtained in the glass lens spectacles testing program. Plastic lenses were also tested, and none absorbed more than 0.3% water.

The relationship between water absorption and the degree of protection provided the user is not clear. We are not aware of how a water absorption rate in excess of 5% would lessen protection.

Design Requirement Results

Table A-2 lists the results of the more significant design requirements. All models except the Comasec Products model passed the requirement that the manufacturer's marking appear on the frame-front. All models except the Glendale Optical Company model passed a similar requirement for the temples. Along with the Sellstrom Manufacturing Company model, the Glendale Optical Company model also failed to have the temple length marked. The Comasec Products model also lacked temple length markings, but it was considered passing because the temple was adjustable. This point is discussed further in the glass lens spectacles report.

There were no failures in providing adequate eye protection, temple interchangeability, or lens thickness. Eleven models had universal bridges. The other six models all passed the requirement that the actual bridge size be within one millimeter of the size marked on the frame-front. All eight models with perforated plastic sideshields passed the requirement that the perforations exclude a 1.5 millimeter diameter particle.

Additional design irregularities were noticeable in the Comasec Products model. Its lenses differed in size and shape from the lenses of other models and it did not comply with the requirement that the eye size be marked on the frame. In addition, although all sideshields were found to be "securely attached," the mechanism for attachment on the Comasec Products model was clearly not as rugged as those found on the other sixteen models.

The results of the design requirements for plastic lens spectacles are quite similar to those obtained for glass lens spectacles. Overall, both groups generally complied with the design requirements.

CONCLUSIONS AND RECOMMENDATIONS

The spectacles tested in this program were found to comply with the primary requirements of the ANSI Z87.1 Standard. There were no failures in the standard lens and frame impact tests. All models met the important design requirement that eye exposure be eliminated.

Where failures occurred, they were minor; that is, they were not directly related to the user's safety. The burn rates of failures in the flammability test were not sufficiently higher than the maximum allowable burn rate to be a hazard. The excessive rusting of the sideshields on two models in the corrosion test is not likely to be a significant problem. Because the deterioration normally would take place over a considerable period of time, the wearer would have ample opportunity to clean or replace the spectacles. None of the design requirement failures would affect the user's safety.

Comparing the ANSI test results of glass lens spectacles with those of plastic lens spectacles does not provide all the information a buyer needs to determine which spectacles are better for particular work environments. The requirements in the ANSI Z87.1 Standard do not make evident, for example, the fact that plastic lenses are more susceptible to abrasion than glass lenses. In industrial applications where abrasion is a significant consideration, it would be necessary to replace plastic lenses more frequently than glass. Failure to do so could lead to eye fatigue and accidents. Also, the drop ball test in the current ANSI standard does not adequately demonstrate that polycarbonate lenses offer considerably more impact resistance than glass lenses.

To summarize, we found that plastic lens spectacles were in general compliance with the standard, just as the glass lens spectacles were. As one might assume, glass lens spectacles are more appropriate where abrasion resistance is the primary consideration. Plastic lenses, preferably of the polycarbonate type, should be used when impact resistance is the primary consideration. In addition, the selection of adequate sideshields, as discussed in "Tests of Glass Plano Safety Spectacles," is very important.

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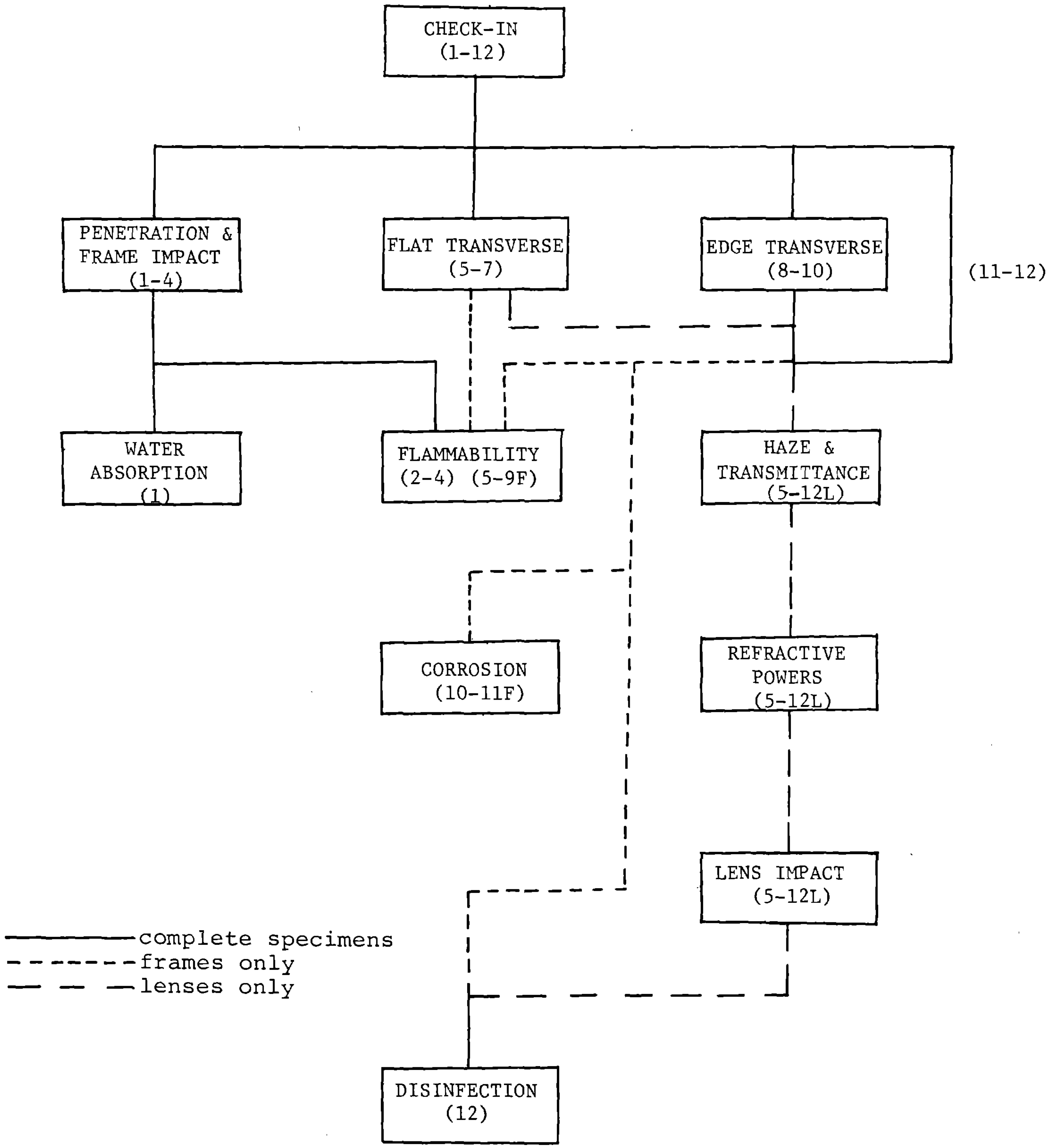
FLOWCHART: PLASTIC LENS SAFETY SPECTACLES



The ()'s indicate the specimen numbers
that are available for each test.

Table A-1 Performance Test Results***

Manufacturer Model	Lens+ Impact	Frame** Impact	Trans-mittance (min=89%)	Haze (max=6%)	Flammability++ (max=1.06 mm/sec) Front	Temple	Sideshield	Prism**	Refractive Powers Definition*	Sphere*	Cylinder*
Aden S-4328-22		8	90.8	0.7	0.57	0.65	0.96	8	10	10	10
American Ind 475-SMSP		8	91.4	0.4	0.58	0.65	1.32F	8	10	10	10
American Opt F9849-SM	1	8	92.8	0.2	SE	0.66	0.90I	8	10	8	10
American Saf 2348-516-SMO		8	91.2	0.5	0.54	0.60	1.17F	8	10	10	10
Bausch & Lomb 5Z197S01		8	91.5	0.5	SE	0.54	1.37F	8	10	10	10
Bouton 5949 U		8	90.4	0.8	0.55	0.69	0.73	8	10	10	10
Cesco 318CST28X		8	91.1	0.7	0.62	0.72	0.74	8	10	10	10
Comasec		8	91.8	0.3	SE	SE	SE	8	10	10	10

* Number passing out of ten tested.

** Number passing out of eight tested.

*** All failures are indicated by F; I = inclusive results.

\+ The number shown is the impact step at which fracture occurred. The impact energy, E, is given by $E=E_o [1.20]^m$, where m is the impact step and E_o is the ANSI pass/fail energy corresponding to a 1" steel ball dropped from 50" (m=0 the ANSI pass/fail test.) Absence of a number indicates no fractures occurred.

++ SE = Self-extinguishing.

Table A-1 (continued)***

Manufacturer Model	Lens+ Impact	Frame** Impact	Trans-mittance (min=89%)	Haze (max=6%)	Flammability++ (max=1.06 mm/sec) Front	Temple	Sideshield	Prism**	Refractive Powers Definition*	Sphere*	Cylinder*
Eastern Saf BS-WC		8	90.9	0.7	0.55	0.57	0.95	8	10	10	10
Fendall 1458		8	91.5	0.5	0.48	0.52	0.93	8	10	10	10
Glendale C7048-1		8	90.3	0.3	0.54	0.68	0.91I	8	9	9	10
Jackson S7048-CCPW		8	91.1	0.5	0.70	0.63	1.28F	8	10	10	10
Morse 335-WSP		8	91.3	0.9	0.65	0.65	1.23F	8	10	10	10
Norton 2449		8	91.4	0.7	0.63	0.55	1.01I	8	10	10	10
Sellstrom C 700S		8	91.0	0.4	0.66	0.60	1.19F	8	10	10	10
Wilkie Opt WO-62S		8	91.2	0.5	0.58	0.62	1.11F	8	10	10	10
Willson MCS 48		8	90.7	0.5	0.54	0.68	0.89	8	10	10	10

* Number passing out of ten tested.

** Number passing out of eight tested.

*** All failures are indicated by F; I= inconclusive results.

\+ The number shown is the impact step at which fracture occurred. The impact energy, E, is given by $E=E_o [1.20]^m$, where m is the impact step and E_o is the ANSI pass/fail energy corresponding to a 1-inch steel ball dropped from 50" (m=0 the ANSI pass/fail test.) Absence of a number indicates no fractures occurred.

++ SE = Self-extinguishing.

Table A-2 Design Requirements***

Manufacturer Model	Frame-Front: Manufacturer Marking	Frame-Front: 1 mm Bridge Tolerance*	Temples: Markings: Manufacturer	Temples: Length	Temples: Inter-Changeable	Sideshields: Eyes Protected	Sideshields: 1.5 mm Hole Tolerance**	Lens Thickness (3.0-3.8 mm)
Aden S-4328-22	P	P	P	P	P	P	P	P
American Ind 475-SMSP	P		P	P	P	P		P
American Opt F9849-SM	P	P	P	P	P	P	P	P
American Saf 2348-516-SMO	P		P	P	P	P		P
Bausch & Lomb 5Z197S01	P		P	P	P	P		P
Bouton 5949 U	P		P	P	P	P	P	P
Cesco 318CST28X	P		P	P	P	P	P	P
Comasec	F		P	P	P	P	P	P
Eastern BS-WC	P		P	P	P	P		P

P = Pass
F = Fail
* Not applicable to universal bridge.
** Applies to perforated plastic sideshields only.
*** All failures are indicated by F.

Table A-2 (continued)***

Manufacturer Model	Frame-Front: Manufacturer Marking	Frame-Front: 1 mm Bridge Tolerance*	Temples: Markings Manufacturer	Temples: Markings Length	Temples: Inter-Changeable	Sideshields: Eyes Protected	Sideshields: 1.5 mm Hole Tolerance**	Lens Thickness (3.0-3.8 mm)
Fendall 1458	P	P	P	P	P	P		P
Glendale C7048-1	P	P	F	F	P	P	P	P
Jackson S7048-CCPW	P		P	P	P	P		P
Morse 335-WSP	P		P	P	P	P		P
Norton 2449	P	P	P	P	P	P		P
Sellstrom C 700S	P	P	P	F	P	P	P	P
Wilkie Opt WO-62S	P		P	P	P	P	P	P
Willson MCS 48	P		P	P	P	P		P

P = Pass
F = Fail
* Not applicable to universal bridge.
** Applies to perforated plastic sideshields only.
*** All failures are indicated by F.

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2.

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TESTS OF PLASTIC PLANO SAFETY SPECTACLES

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16. Abstracts

This report describes tests of industrial safety spectacles with plastic lenses advertised as meeting the requirements of the ANSI Z-87.1 standard. A general description of each test is included along with a presentation of the test results. Seventeen individual models were tested and found to be in general compliance with the ANSI standard.

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