Arizona Department of Transportation
Flexible Delineator/Channelizer/Marker (Surface and Ground Mounted) Prequalification Process
based on
American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP)

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A. INTRODUCTION

The process detailed herein was originally approved by ADOT's Traffic Control Product Evaluation Committee (TCPEC) in December, 1996. It was modified per the March, 1997 TCPEC meeting to divide the Approved Products List (APL) per ADOT Maintenance (Procurement only) and Construction (C&S projects only) uses. The division of the APL was necessary to account for ADOT's variation of direct maintenance needs as opposed to what is necessary for construction projects. Refinements to this process are still under consideration and development.

(NOTE: The two part list was later dropped because ADOT C&S rejected the standard specification change which was submitted to them.)

This prequalification process represents a major change for ADOT's approach to flexible delineators/channelizers/markers. Prior practice had been to utilize an ADOT conducted field performance/laboratory testing specification. ADOT's new approach/specification is primary based on the AASHTO NTPEP data. However, many of the ADOT based laboratroy tests have been retained and of course actual/observed field performance will always supersede all prior field/lab test requirements. Nevertheless, the primary requirement for ADOT's consideration to use any surface or ground mount flexible delineator/channelizer/marker is that it has to have been tested per AASHTO NTPEP. Additionally, the tested product has to perform within certain ADOT determined parameters based on this NTPEP's recorded/published test data (e.g. number of hits survied, allowable percent lost, etc.).

The following reasons are why ADOT is utilizing NTPEP test data:

- An evaluation of published NTPEP test results from 1991 to 1997 has revealed that the results appear to give a fair and reasonable portrayal of the products available in the flexible delineator/channelizer/marker market and the relative performance differences between those products. Additionally, the tests appear to be performed in a consistently fair and objective manner that is in accordance to the set procedures. The Tennessee Department of Transportation, the NTPEP testing agency since 1991, has done a very professional job of conducting these tests.

- ADOT is a member of AASHTO's NTPEP. Using these NTPEP test results represents one of the advantages of ADOT participating in this program. The information and savings that ADOT obtains from the NTPEP "cooped" (or pooled) test approach compared to what it would cost ADOT to conduct a similar testing program is enormous. To not utilize this data would be a waste of valuable and limited resources.

- The NTPEP test is done on a yearly basis, if products are submitted for testing. Thus, the latest test results on the flexible delineator/channelizer/marker market are only a year and a half away from consideration by ADOT. It takes NTPEP a little over a year to conduct, compile, review, and publish test results. It would be extremely difficult for ADOT to conduct a more timely test program. Also, the NTPEP test procedures have been developed and are updated via a national committee that is made up of governmental and industry representatives. Thus, the results derived from these tests represent a recognized consistency with national approach.

The development of ADOT's new flexible delineator/channelizer/marker specification spurred the development of this process and terminology presented herein. It also has resulted in an entirely reorganized APL. All the products listed represent what products have been determined by ADOT to meet the new specification. There are two versions of the new specification. One is for construction projects and will be utilized by private contractors to furnish and install flexible DCMs. The other specification is for a statewide purchasing contract for ADOT to purchase flexible DCMs directly for maintenance use. The new construction project specification (special provision currently) is available from ADOT Contacts and Specifications (contact Joe Roman). The new statewide purchase contract maintenance specifications will be available shortly from ADOT Procurement. The new APL is available from ADOT's Arizona Transportation Research Center (ATRC). New standard installation drawings for flexible delineator/channelizer/markers should be issued sometime in early 1998.

B. TERMINOLOGY

The development of ADOT's new approach to flexible delineator/channelizer/marker products has necessitated a complete reevaluation of the current practice to these devices. ADOT's past practices were very limited in terms of the solutions and products that were offered for flexible delineator/channelizer/marker applications. Almost all ADOT Standard Specifications and Drawings are/were geared to the metal post version of these devices. Additionally, even these specifications/drawings were lacking in terms of how effectively they address ADOT's needs. Therefore, a significant amount of effort was necessary to develop an approach that better addressed ADOT needs and conformed to the applicable regulations. To this regard many new definitions/terms had to be developed. The following is a listing of those terms and the definition and justification which apply to them:

1. *Flexible delineator/channelizer/marker (DCM)* - The MUTCD has a number of very specific definitions on the application of delineator, channelizer, and marker devices. How each of these devices is used if left to the judgement and experience of the designer and field personnel based on the MUTCD and ADOT Standards. Therefore, it has been judged inappropriate to only use the term "flexible delineators" with regards to ADOT's use of these devices. The general category term *flexible delineator/channelizer/marker (DCM)* has been developed to recognize the diversity of applications these devices can be used for.

2. *DCM device product classifications* - It is helpful to divide flexible DCM devices (or products) into a number of different categories (or divisions). Each of these divisions is based primarily on how the device is best applied. Additionally, the divisions are intended to allow for fair competition based on product features that appear to offer advantages in performance and/or application.

3. *Surface and ground mount flexible DCM devices* - The first division is between surface and ground mount device applications. The surface mounts are intended to be placed on paved surfaces via an adhesive and are typically applied as channelizers (as per the MUTCD definition). The ground mounts are typically applied to roadway side slope areas and are primarily used as delineators and markers. The ground mounts are secured in place either by driving a portion of the device into the ground, or attaching them to an anchor which is driven into the ground.

All surface mounts will always consist of two basic pieces, the base and the body. As already mentioned, the base is typically designed to be glued to a paved surface. The body in turn is mounted into the base and secured with some sort of locking device and/or pin(s).

4. *Ground mounted DCMs - single and two-piece devices* - Ground mounted DCM devices are further divided based on their product designs. There are two basic types of designs, single and two-piece products. The single piece delineators consist of a single monolith piece which is driven approximately 18 inches into the ground. Typically, a single piece device is equipped with an anchor barb which helps prevent the device from working its way out of the ground (via flexing in the wind) after it has been installed. A two-piece device consists of a body and an anchor piece. The anchor piece (plastic or metal) is driven in the ground and the above ground piece (body) is attached in some fashion to the anchor (prior to its installation or after).

   The type to be used depends mostly on where the device is applied and/or what the soil conditions are. If the soil has lots of fines and is fairly well compacted, single piece devices with a soil anchor barb attached should perform well. If the soil is rocky, un-compacted, or consists mostly of cinders or aggregate without fines, then a two-piece device may do better. Additionally, there are those who claim that two-piece devices can be installed successfully as quick or quicker than single piece devices. ADOT's field experience is limited to this regard. Thus, it will take time for ADOT to accumulate enough experience to be able to determine the pros and cons of the two different device types.

NOTE: ADOT maintenance has almost completely rejected the notion of using flexible ground mount delineators because of the difficulties they have had with installing them and the perception they bend over during heavy snow conditions and shoulder maintenance crews rip them out when they grade or mow the side slopes. However, there are some 5 to 6 year old installations on SR 87 north of Strawberry which indicate otherwise. So, instead they have been using metal posts because they can be easily pounded into the ground and they represent a harden installation. I believe the resulting negative issues of using more metal posts vs. flexible has not been fully explored (e.g. metal posts are typically only good for one hit, they present more of a hazard – per the first vehicle hit and when they bend over at an angle) or balanced with regards to the potential risks they present road users. FHWA does not regard a metal post as much of a hazard since it is only in the ground 18 inches (see discussion in Roadside Guide, NCHRP-250 and 350 reports on this). The assumption is the post will come out of the ground when it is hit by a vehicle, thus it is not regarded as a "fixed object." Field inspections have revealed that this assumption is not always correct, that the post often bend over totally or at an angle. The resulting bent metal post often represents a hazard that makes it inconsistent with 250/350 assumptions.

5. *Bi-directional and multi-directional DCM devices* - Flexible DCM devices have many different cross-sectional configurations. Which section is used is a very proprietary area which may often involve a patent. ADOT has no preference as to the configuration of the cross-section except when there is an application reason that is based on the needed viewing directions of the device. The needed viewing direction of the device is an especially important consideration on curving sections of roadway, intersections, and hazard markers. To account for this needed "viewable directionality" the following product classes have been developed:

(a) *Bi-directional* - A bi-directional device typically has two sides (front and back) from which it can be viewed from. The bi-directional device cross-section can be of any shape (e.g. oval, round, flat, curved, or any combination thereof). The bi-directional devices are normally used on tangent sections of roadways or when it is desirable to only delineate/mark a feature in either one or two directions. A reflective element (or reflector tab) of prismatic sheeting is either applied to one side or both sides.

(b) *Multi-directional* - A multi-directional device can be viewed from any direction (360°) or multi-directional. Multi-directional devices shall have a round cross section or a tubular T –sections that have a wide projection when viewed from all sides. Multi-directional devices are normally used for highly curved sections of roadway and curb returns at intersections. A reflective element (or reflector tab) of prismatic sheeting is applied to the entire circumference or parameter of a mutli-directional device.

A device that is classified as a multi-directional device can also be used as a bi-directional device, but a bi-directional device may not be classified as a multi-directional device. The configuration, size, and color of the reflective tabs depend on other application considerations defined later in this document.

Reflector tabs/material - ADOT's research and field demonstrations have indicated that the optimal reflector tabs for DCM devices are long and relatively narrow, and made of high potential brightness prismatic retroreflective sheetings that are specifically designed as a delineator (ASTM D 4956 Type V) and/or vehicle conspicuity tape. The sheeting material needs to have abrasion resistant characteristics (as indicated by Penn DOT field research) such as a hard acrylic clear film or equivalent. The sheeting shall also have self sealing edges or and edge seal to prevent moisture and/or dirt invasion. Examples of products that appear to conform to these requirements are 3M's Scotchlite™ Diamond Grade™ Conspicuity Sheeting (Series 980), Stimsonite Series 4500 Conspicuity Sheeting, and Reflexite AR-1000 sheeting. Currently, only the Reflexite sheeting has the needed flexibility which enables it to be used for both bi- and multi-directional devices. The typical Simsonite (or Avery) and 3M prismatic sheetings are limited to bi-directional devices only (flat or mostly flat) because the have a tendency to break their bond and try to go flat again. However, it is believed that the likelihood of this can be greatly reduced if the 3M or Avery material is wrapped around the body and overlapped by an inch or so. This type of treatment acts like a belt buckle which locks the sheeting around the body. More work is needed to determine if this is a long term effective solution. Both 3M and Avery have been working on developing more flexible versions of their prismatic sheetings.

Reflector tab sizes and position - In 1988, a study entitled "Optimization of Post Delineator Placement from a Visibility Point of View" was published in the *Transportation Research Record* 1172. This study indicated that delineators with long and narrow (18" x 1") prismatic sheeting reflector tabs spaced every 350 to 400 feet at a lateral offset of 10 to 14 feet at a mounting height of 42 inches provides the optimal roadway delineation. Subjective research conducted by Potters Industries (maker of glass beads) in the 1980's also had similar findings. ADOT's own field demonstrations of the longer and narrower reflector tabs enable the delineator to reflect light back more effectively, almost at any distance. Additionally, the longer pattern is believed to present a better indication of the edge of the roadway than the standard 4 inch by 4 inch "spots in space" delineator reflector tab approach (e.g. the long and narrow reflector codes to the driver that this is the edge of the roadway, not something else). The long and narrow reflector assures that the reflector is always in a good position to catch headlight light, even at real close distances that may be important during nighttime dust, rain or snow storms when visibility is limited and vehicles are (or should be) driving more slowly (or less fast). Work is continuing to develop the exact size of the reflector tabs, however, generally all tabs will be longer. Drawings have been developed that show the various reflector tabs under consideration

Reflector tab colors and patterns - Over the years ADOT has developed the following practice with regards to pattern/color used for DCM devices:

(a) *Single yellows* - are typically used to delineate the left edge of one-way roadways.

(b) *Single whites* - are typically used to delineate the right edge of roadways.

(c) *Single greens* - are used as snow markers. The single green is used to mark the start of a longitudinal roadway feature such as the start of curb, guardrail, or other item which could interfere with snow plow operation.

(d) *360° single whites or yellows* - are typically used to delineate the radius returns at intersections. The 360° reflector tabs are also used on sharp curves.

(e) *Single reds* - are used to delineate the edges of truck escape ramps.

(f) *Double whites* - are typically used on freeway exit and entrance ramps to delineate the tapers involved with the ramps. Typical use is limited between the mainline taper point to the front or back of the ramp gore.

(g) *Double yellows* - are typically used to mark/delineate divided highway crossovers.

(h) *Double greens* - are used as snow markers. The double greens are used on conjunction with the single greens to mark the end of a longitudinal roadway feature such as the start of curb, guardrail, or other item which could interfere with snow plow operation.

(i) *Triple vertical yellows* - are typically used to mark hazards such as culverts and other fixed objects.

C. PREQUALIFICATION PROCESS

There are a number of other important requirements and features that are necessary to define a flexible DCM device. However, often these requirements become difficult to properly and fairly define because of the wide variety of product designs and materials currently used by the seven or eight manufacturers of flexible DCM devices. Often a favorable and/or desirable feature is protected by a patent. Specifying this feature could make the specification too restrictive and/or favor one manufacturer. Additionally, the manufacturers of DCM products often claim how durable their product is, however it is next to impossible to verify these claims without field testing. Laboratory testing can give some indication of the validity of these claims, but they do not necessarily correlate with actual field performance. It has become a popular practice in the United States to test a flexible DCM product based on how it performs in a "field crash test." The problems in the past with the test were how they were conducted and the repeatability and fairness of the test procedures. The tests were often dominated by one vendor's approach that would sometimes unnecessarily and/or unfairly skew the results in their favor. Tests were also time consuming and costly to run. These are some of the main reasons that led to a national cooperative testing program for flexible DCM products.

The American Association of State Highway and Transportation Officials (AASHTO) via either their Southern AASHTO (SAASHTO) or now the National Transportation Product Evaluation Program (NTPEP) have been conducting a comprehensive testing program of flexible DCM devices since the late 1980's. The current testing agency is Tennessee Department of Transportation (TDOT) Materials and Testing Division. TDOT has been doing the NTPEP version of this test since 1991.

The current NTPEP test procedure requires a flexible DCM manufacturer to submit then samples of their product. Eight of the ten devices are subjected to a sequential two season (winter/summer or summer/winter) crash test (or vehicle impact test). The other two samples are artificially ultraviolet (UV) resistance weather tested.

The vehicle impact tests are conducted using a typical passenger sedan (e.g. 1991 Dodge Dynasty). The samples are impacted up to five times (if they survive) during each season with either the bumper or the wheel of the test vehicle. Five impacts are performed on four samples by the bumper, and five impacts are performed on the remaining four samples by the bumper and wheel. Thus, there are four groups of four sample impacts (or hits), two per season. These groups can be summarized as follows:

1. Summer vehicle bumper hits (4 samples x 5 hits per sample = 20 total possible hits)
2. Summer vehicle wheel hits (4 samples x 5 hits per sample = 20 total possible hits)
3. Winter vehicle bumper hits (4 samples x 5 hits per sample = 20 total possible hits)
4. Winter vehicle wheel hits (4 samples x 5 hits per sample = 20 total possible hits)

Any one sample on the NTPEP test can be hit a total of 20 times, if it survives. This equates to eighty possible hits for the entire test set.

TDOT makes written observations/measurements of each test sample after every impact. The test result parameters include: front/back deflection (or list), side deflection (or list), visible signs of distress, failures, and reflective sheeting loss. Additionally, TDOT photographs the set of test samples after each impact. The results of the NTPEP testing are then published in a final report.

NTPEP does not interpret test results. The objective of NTPEP is to test products and then present the compiled test results. The interpretation of the data for product approval and/or specification development is left to the user of that data.

In preparing for this prequalification process, ADOT has utilized test results from seven NTPEP tests (91/92, 92/93, 93/94, 94/95, 95/96, 1996, and 96/97). All seven of these tests were conducted by TDOT. Using the NTPEP test results ADOT has developed an experimental procedure to interpret and classify flexible DCM products into three expected field performance levels. The expected performance levels are:

LEVEL I - The anticipated field performance of these products should be more than adequate.

LEVEL II - the anticipated field performance of these products should be adequate.

LEVEL III - The anticipated field performance of these products should be marginal. ADOT should not use these products.

These levels are based on the number of hits the entire set (8 total) of test samples was able to withstand, the maximum allowable averaged side deflection (or list) of any of four impact test groups, maximum allowable averaged front/back deflection (or list) of any of the four impact test groups, maximum allowable averaged percent list of any of the four impact test groups, maximum allowable overall averaged (all 8 samples) percent sheeting loss, the overall number of noted physical distress observations, and a subjective overall photograph visual rating of the final condition of all the remaining test samples after the twenty vehicle impacts. The visual rating system is important in considering the meaning of the other requirements.

To compile, derive, and evaluate all of the NTPEP test results, to determine what expected performance level a product falls under, does take some time. The following is a step-by-step process on how this is to be done.

STEP ONE

Obtain the latest NTPEP final report on flexible delineator test results. The last flexible delineator test results to be evaluated by ADOT was for the summer 1996/winter 1997 (96-97).

NOTE: ADOT ATRC conducted an evaluation of Impact Recovery Systems (per PRIDE application 00060 in May 2001 using this process and NTPEP results from Report 151 98-99).

STEP TWO

A series of data compilation and evaluation tables have been developed. The first table to be filled out is entitled *Table A - Impact Test Summary*. An impact test summary table is filled out for each type tested, ground or surface mount. Here the product is identified by manufacturer, model number an NTPEP sample number. Then each group of impact tests is summarized for the summer and winter tests by impact type (wheel (w) or bumper (b)). All information necessary to fill out *Table A* is given on a series of impact test data tables contained within the NTPEP test report. The following is the process for *Table A*:

(a) Determine which products are surface mounts or ground mounts per the detailed sample identification description. Also, try to determine from this information if the product is a bi- or multi-directional DCM. If the device is a ground mount also determine if it is either a single or two-piece device. Note this information on the NTPEP impact test data tables.

(b) Contact all of the manufacturers noted and request detailed information, specifications, and samples on the NTPEP tested products.

(c) Fill out *Table A* for each of the tested products per the following description and example:

Table A has rows labeled *W* for wheel hits and *B* for bumper hits. There are five columns for each of the hits in that season’s test group. Record the number of test samples that survive each hit. If NTPEP has failed to record a “Deg List” and a “% List” this signifies that the sample has failed. The number of surviving samples (0 to 4) should then be recorded in the appropriate row. The final “Degree List”, “side”, “front”, and “% list” is averaged based on all the surviving samples within the test group (wheel impact and bumper impacts). The following is an example of how *Table A* is to be filled out:

	Year: 7/17/96 **Location: Davidsion County, Tennessee** **Season: Summer @ 85°F** **Test Vehicle: 1991 Dodge Dynasty**									
		1	**2**	**3**	**4**	**5**	**Ave. Side**	**Ave. Front**	**Ave. % List**	**Comments**
Flexstake 754 TTC-965-4	W	4	4	4	4	4	3.25	2.75	3.05	no observed product distress (0)
	B	4	4	4	4	4	3.25	1.75	1.90	no observed product distress (0)

Sample calculations for averaged values:

For the summer portion of the test, all four wheel impact samples and bumper impact samples survived. Therefore, the average list values are calculated from the NTPEP report tables from the five impact columns as follows:

<u>Wheel Impacts</u>

$$\text{Average side list} = \frac{2 + 3 + 4 + 4}{4} = 3.25$$

$$\text{Average front list} = \frac{0 + (-3) + (-6) + (-2)}{4} = 2.75$$

$$\text{Average \% list} = \frac{0 + 3.3 + 6.7 + 2.2}{4} = 3.05$$

<u>Bumper Impacts</u>

$$\text{Average side list} = \frac{4 + 3 + 3 + 3}{4} = 3.25$$

$$\text{Average front list} = \frac{(-1) + (-1) + (-2) + (-3)}{4} = 1.75$$

$$\text{Average \% list} = \frac{2.2 + 1.1 + 2.2 + 2.2}{4} = 1.9$$

NOTE: All values are to be additive regardless if they are negative or positive. The object is to evaluate the averaged entire list one way or another; it does not matter in what direction (front, back, or either side). If a sample fails before the fifth impact, then only the surviving sample values are to be used. In addition to requiring certain maximum values for list the new flexible DCM specification also requires the device to survive a certain number of hits. Thus, it is thought that these requirements will work in concert to account for any loss in sample size during the NTPEP test. The average is only to be used on the number of samples surviving.

SPECIAL NOTE: The averaged values need to be judged as to their meaning and fairness. For example, if a set of samples survive most (60 or more) or all of their impacts, and the averaged list values are unduly influenced (or skewed) by the poor performance of one sample, it may be advisable to fail that poor performing sample and recalculate the average based on the other surviving samples. The objective of this procedure is to prequalify DCM products based on a field test that produces a model of how these products may perform. Thus, the poor performance of one or two samples on test does not necessarily mean the product will perform poorly. This procedure is not a "cookbook," some judgment is still required at times.

(d) The next item to be evaluated on the test samples is the type of retroreflective sheeting and the average sheeting loss per impact type and the entire averaged sheeting loss is to be calculated per *Table B - Sheeting Loss/Damage Summary*. The shape of the sample and the direction the sample was placed with regards to the shape is also to be summarized in this table. The manufacturer of the tested sample may need to be contacted regarding the shape.

The sheeting loss/damage summary is an important aspect of a DCM device to investigate. The main advantage of a flexible DCM is its ability to be struck repeatedly and still function. However, the device is of no use if the reflector tab made of reflective sheeting does not survive the vehicle strikes. Thus, the samples tested need to show that they will be able to retain a reasonable amount of its reflector tab sheeting which enables it to function at night.

Fill out *Table B* using the sample identification description found in the NTPEP report to find the type of sheeting on the samples.

(f) The next item to be evaluated is the visual appearance of the test samples after each of the test sets of vehicle impacts. This is done by reviewing the photographs of each impact (±) in the back of the NTPEP final report and applying *Table C - Visual Evaluation of Crash Test Results*. The visual evaluation helps to illustrate the results derived from *Table A*.

The visual evaluation is subjective. Six judgement levels have been established to evaluate the NTPEP photographs. These levels are based on the overall average appearance of the test samples. Thus, the poor performance of one or two samples should not weigh too heavily. All of the photographs are to be reviewed, however the rating given should be heavily weighted to the last photograph after the tenth impact set of all eight samples.

The following is the criteria to be used to judge the photographs:

<u>Level 1</u> - Excellent; all of the test samples are straight and true and are still serviceable (e.g. will function as intended).

<u>Level 2</u> - Good; at least seven of the test samples appear to be fairly straight and true and are still serviceable (e.g. will function as intended). The other sample is either missing or is hardly serviceable.

<u>Level 3</u> - OK, at least five to six of the test samples appear to be fairly straight and true and are still serviceable (e.g. will function as intended). The other two or three samples are either missing or are hardly serviceable or better.

<u>Level 4</u> - Fair, at least half of the remaining test samples appear to be fairly serviceable or better. The samples from the other half are either missing or are hardly serviceable or better.

<u>Level 5</u> - Poor, at least two of the remaining test samples appear to be fairly serviceable or better. The other six of the samples are either missing or are hardly serviceable or better.

<u>Level 6</u> - Bad, all of the remaining test samples are either missing or appear to be hardly serviceable.

NOTE: *Serviceable* means that the sample is standing fairly straight and all the pieces of the body are still in place. *Fairly serviceable* means the sample is standing up (45° angle or greater) and the body is pretty much in one piece. *Hardly serviceable* means that the body is really bent over and there are pieces missing.

SPECIAL NOTE: It is important to review each photograph in sequence. This gives clues of how the samples are performing and what or how they are failing. Does the device pull out of the ground, if it is a ground mount? Does the base pull off the surface, if it is a surface mount? If these tow failure conditions apply, this does not necessarily signify a problem with the sample, it may be an abnormality in the installation of the sample. If these two failure conditions do occur it is allowable to make exceptions to the evaluation criteria, especially if the device appears to be performing well other than this pull our or pull off problem. However, if a piece of the anchor or lower portion of the sample is still there, or the base is still there, then this signifies a failure in the sample and all the stated criteria applies.

A checkmark is to be placed in the rating level that best describes the overall appearance. The comment box can be used to clarify the rating given. The same *Table C* can be used for both ground and surface mount samples.

Again, as already stated, the evaluator can also make allowances in the criteria based on how the samples do as the crash test progresses as recorded by the NTPEP photographs. If all the samples are performing better than fair up to the seventh, eighth or ninth impacts, then allowances can be made to the stated criteria. If allowances are made, a brief statement should be made in the comment box as to why.

(g) The next step in this procedure is to summarize the results derived from *Tables A, B, and C. Table D - Flexible DCM Evaluation Summary* is to be used for this purpose. This table summarizes:

(1) The total number of hits the samples survived (80 possible) (*From Table A*).
(2) The maximum averaged side list (*From Table A*).
(3) The maximum averaged front/back list (*From Table A*).
(4) The maximum averaged percent list (*From Table A*).
(5) The overall averaged sheeting loss (*From Table B*).
(6) The total number of observed areas of sample distress (*From Table A*).
(7) Visual rating (*From Table C*).

(h) The next step is to compare the results of *Table D* to *Table E - Expected Performance Ranking (EPR)* to determine if the evaluated samples conform to any of the expected performance levels. There is a *Table E* for each type of DCM device, ground or surface mount, and for Levels I and II.

The specifications for the various EPR levels are as follows:

No.	`	EPR Level	No. of Hits Survived	Ave. Max Side List	Ave. Max. Front/Back List	Ave. Max. Percent List	Ave. Max. Overall Sheeting Loss	Total No. of Noted Signs of Distress	Visual Rating
1	Surface Mount	I	60*	5.5	5.5	6.5	14%	4 or less	Good or better
2	Surface Mount	II	60	8.5	12.5	14.0	25%	5 or less	Fair or better
3	Ground Mount Two-Piece	I	80	4.75	5.5	4.0	3.5%	3 or less	OK or better
4	Ground Mount Single Piece	I	80	7.0	7.0	7.0	8%	2 or less	Good or better
5	Ground Mount Two-Piece	II	80	7.0	6.5	10.0	13%	4 or less	Fair or better
6	Ground Mount Single Piece	II	65	7.0	8.0	8.0	25%	7 or less	Fair or better

NOTES: * - 60 hits without any body or base failure
Max - means maximum allowable value for that test value
+ - the maximum allowable sheeting loss can be waived for Level II if the performance of the sample or the remaining requirements
are met