Texas A&M Transportation Institute
Proving Ground
3135 TAMU
College Station, TX 77843
979-845-6375

NTPEP
AASHTO THE VOICE OF TRANSPORTATION
NATIONAL TRANSPORTATION PRODUCT EVALUATION PROGRAM
444 North Capitol Street SW, Suite 249
Washington, DC 20001
202-624-5800

TECHNICAL MEMORANDUM

Contract No.: **1903665**
Test Report No.: **613301-01-2**
Project Name: **Impact Recovery Systems, Inc. OmegaPost™ 2 High Performance Delineator – TTCD-2019-01-001 – High Speed Applications**
Sponsor: **AASHTO National Transportation Product Evaluation Program (NTPEP)**

DATE: **2019-09-30**

TO: **Jonathan M. Sirianni**
Associate Program Manager, NTPEP

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FROM: **Nathan D. Schulz**, Associate Transportation Researcher
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FOR MORE INFORMATION:

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TASK REPORT:

This tech memo documents the testing of Impact Recovery Systems, Inc OmegaPost™ High Performance delineators installed on concrete and asphalt.

DISCLAIMER:

The contents of this report reflect the views of the authors who are solely responsible for the facts and accuracy of the data, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP), The Texas A&M University System, or Texas A&M Transportation Institute (TTI). This report does not constitute a standard, specification, or regulation. In addition, the above listed agencies assume no liability for its contents or use thereof. The names of specific products or manufacturers listed herein do not imply endorsement of those products or manufacturers. The results reported herein apply only to the article being tested. The test was performed according to TTI Proving Ground quality procedures and according to the test matrix and specifications set forth by AASHTO NTPEP TTCD 18-01 "Standard Practice for NTPEP Evaluation of Temporary Traffic Control Devices."[1]

TEST MATRIX/CONDITIONS:

TTI Proving Ground performed high speed application impact testing on the Impact Recovery Systems, Inc. OmegaPost™ High Performance delineators with the base glued on concrete and bolted to asphalt according to specifications of AASHTO National Transportation Product Evaluation Program (NTPEP). A total of 200 vehicle impacts per sample were to be performed or until all posts failed. Half of the test delineators were installed to receive bumper impacts and the other half to receive tire impacts. A tire impact consisted of the vehicle impacting the delineator with the centerline of the delineator aligned with the centerline of the vehicle tire. During a tire impact, the vehicle tire traverses over the delineator. A bumper impact consisted of the vehicle impacting the delineator with the front bumper at the ⅓-point of the vehicle. The bumper and tire impacts were performed simultaneously in a single pass of the vehicle. The vehicle was traveling at a nominal speed of 70 mph when impacting the delineators. Temperature at the time of testing was above 81°F.

TEST ARTICLE DESCRIPTION:

Drawings containing dimensions and details of the test delineators and installation layout can be found in Attachment A. Each delineator consisted of a polymer delineator, with reflective sheeting, attached to a polymer base. Half of the delineators were installed on concrete using E-bond epoxy according to manufacturer's instructions. The other half delineators were installed on asphalt using plastic inserts, grade 8 flat washers, and ½-inch × 4-inch lag screws according to manufacturer's instructions. Additional material information and specifications can also be found in Attachment A.

The test installation was made up of four OmegaPost™ High Performance delineators installed on concrete and four delineators installed on asphalt (8 total). Material specifications for the delineators can be found in Attachment A. Half of each set of test delineators were installed to receive tire impact testing (denoted as #1T and #2T on concrete, #3T and #4T on asphalt). The remaining test delineators were installed to receive bumper impact testing (denoted as #1B and #2B on concrete, #3B and #4B on asphalt). The test delineators were each spaced at 48 inches in the direction of vehicle travel. Four pairs of delineators (8 total) were installed in two parallel lines (spaced 36 inches apart) to allow them to be struck consecutively at two locations (tire and bumper) on the impacting vehicle in a single pass. The delineators were oriented parallel (#1T and #1B on concrete, #3T and #3B on asphalt) and at 25° (#2T and #2B on concrete, #4T and #4B on asphalt). The two pair of delineators attached on concrete were spaced at 48 inches apart and two pair of delineators attached on asphalt were spaced 48 inches apart, with approximately 30 ft between the concrete and asphalt installations, making total length of the installation of approximately 38 ft.

TEST VEHICLE:

A 2011 Kia Rio, shown in Attachment B, Figures B1 and B2, was used for all testing. Test inertia weight of the vehicle was 2453 lb, and its gross static weight was 2627 lb. The height to the lower edge of the vehicle front bumper was 7.75 inches, and the height to the upper edge of the front bumper was 21.5 inches. Additional dimensions and information on the vehicle are given in Attachment B, Table B1. A trained driver directed the vehicle into the installations. Safety measures were installed in the vehicle to protect the driver in the event the test vehicle became unstable during the testing, including the installation of a racecar seat with a 5-point harness and a rollbar. The installation of these safety features is standard procedure when a

driver directs the vehicle from within the vehicle and in no way reflects the safety of the product being tested.

IMPACT DURABILITY TESTING:

Description of Tests:

The testing was performed on September 23, 2019. Photographs of the delineators prior to testing are shown in Attachment B, Figures B3 and B4. Half of the test delineators were installed to receive bumper impacts and the other half to receive tire impacts. A tire impact consisted of the vehicle impacting the delineator with the centerline of the delineator aligned with the centerline of the vehicle tire. During this impact the vehicle tire traverses over the delineator. A bumper impact consisted of the vehicle impacting the delineator with the front bumper at the ⅓-point of the vehicle. The bumper and tire impacts were performed simultaneously in a single pass of the vehicle. The vehicle was traveling at a nominal speed of 70 mph. Temperature at the time of testing was above 81°F.

Test Article Damage:

A delineator is deemed to have failed when it does not rebound to within 15° of vertical within 5 minutes after impact or when it fractures. In addition, a tear of more than 50% of the delineator post cross section is considered a failure.

The delineators attached to concrete with epoxy completed 200 runs with no failure. The anchors pulled out of the asphalt for delineator #4B on run 36. Delineators #3B and #4T pulled out of the base on runs 40 and 76, respectively. The post tore horizontally halfway up the post on delineator #3T on run 79. A summary of the damage to the delineators is provided in Table 1.

Table 1. Summary of Failure Modes for the Delineator Posts.

	Delineator Post	Run Number	Failure Mode
Glue-Down on Concrete	1T	200	No failure
	1B	200	No failure
	2T	200	No failure
	2B	200	No failure
Bolt-Down on Asphalt	3T	79	Tear halfway up the post
	3B	40	Pulled out of base
	4T	76	Pulled out of base
	4B	36	Anchors pulled out of asphalt

List/lean measurements were taken before the test, after run 1, after run 10, after run 100, and after run 200. Documentation of list/lean measurements can be found in Attachment B, Table B2. Photographs were taken before the test, after run 1, after run 10, after run 50, after run 100, after run 150, and after run 200, or after failure. Photographs can be found in Attachment B, Tables B2 through B9.

Test Vehicle Damage:

Damage to vehicle hood and bumper after testing is shown in Attachment B, Figure B2.

SUMMARY OF TESTING:

The objective of the testing performed was to evaluate the durability of the Impact Recovery Systems, Inc. OmegaPost™ High Performance delineators with E-Bond epoxy attachment to concrete and bolted to asphalt with plastic inserts, grade 8 flat washers, and ½-inch × 4 inch lag screws. The tested delineators attached to concrete resisted an overall average of 200 impacts. The delineators on concrete resisted an average of 200 tire and 200 bumper impacts. The tested delineators attached to asphalt resisted an overall average of 58 impacts. The delineators on asphalt resisted an average of 78 tire and 38 bumper impacts. Table 2 presents a summary of the testing conducting for the Impact Recovery Systems, Inc. OmegaPost™ High Performance delineators attached to a concrete surface and to an asphalt surface. All testing was performed at a nominal impact speed of 70 mph.

Table 2. 613301-01-2 Impact Recovery Systems, Inc. OmegaPost™ High Performance Delineators on Concrete and Asphalt Test Summary.

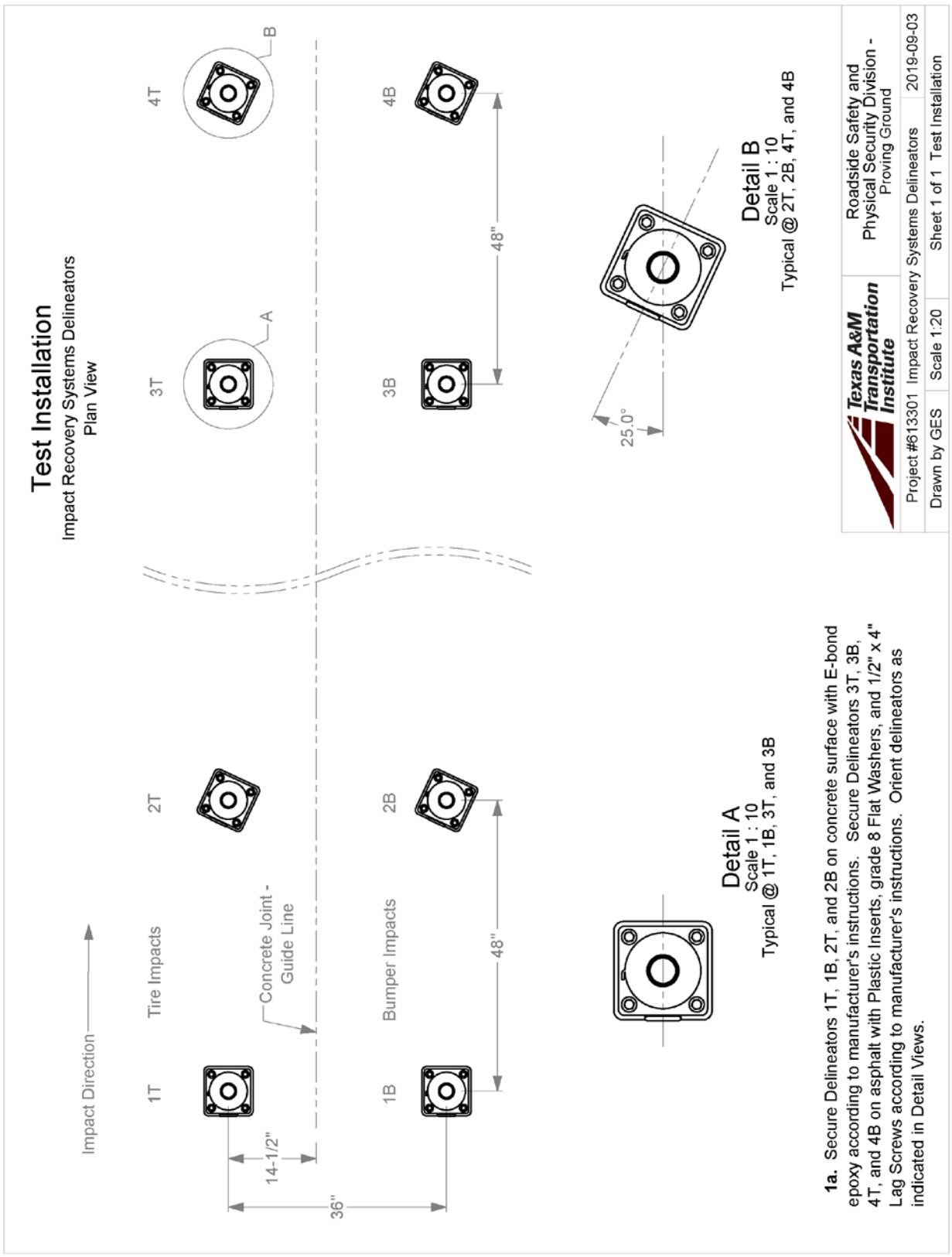
Concrete	Tire	Bumper
1	200	200
2	200	200
Average	200	200
Overall	200	

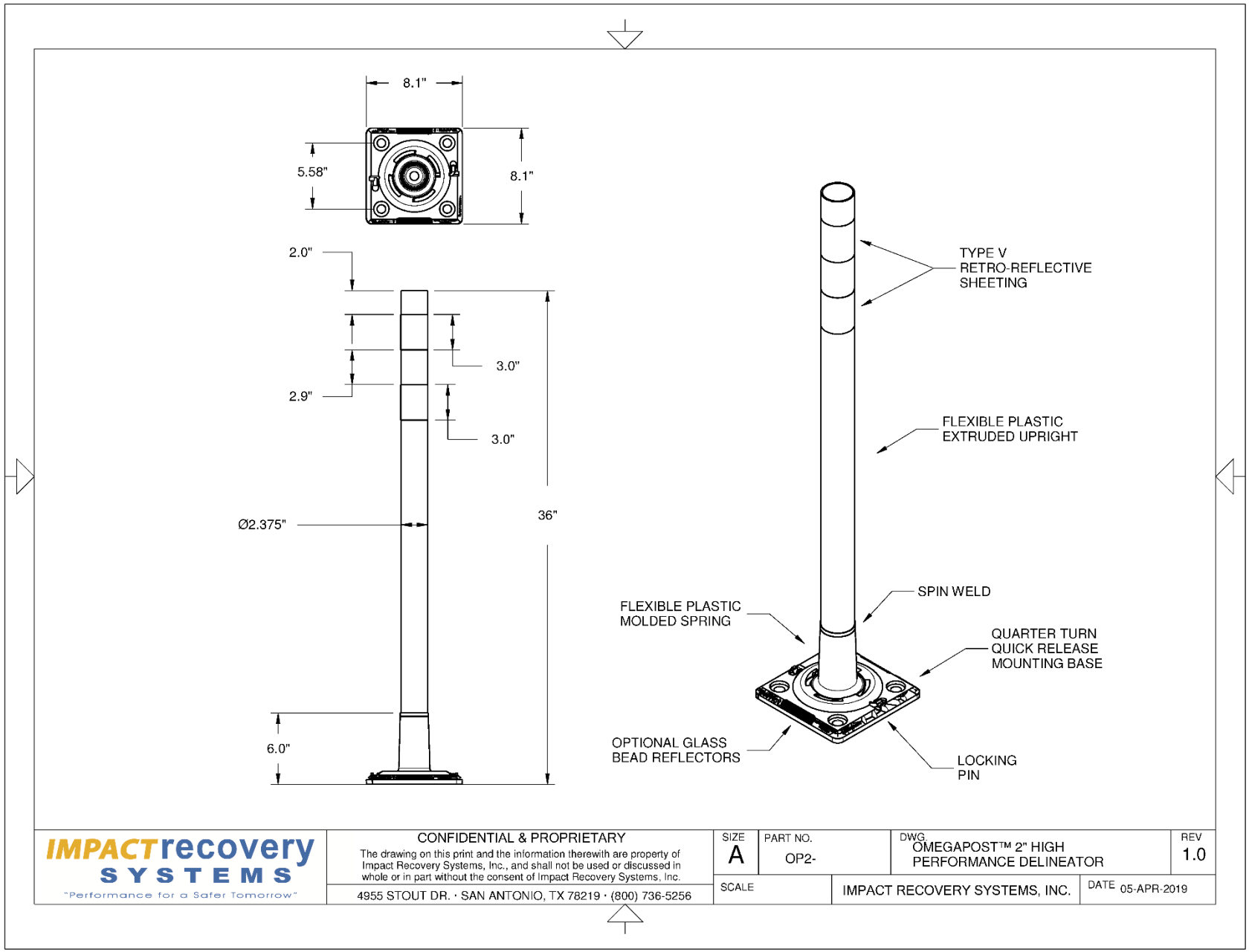
Asphalt	Tire	Bumper
3	79	40
4	76	36
Average	78	38
Overall	58	

REFERENCES:

1. AASHTO. *Standard Practice for NTPEP Evaluation of Temporary Traffic Control Devices*, AASHTO Designation TTCD 18-01. American Association of State Highway and Transportation Officials, Washington, DC, 2018.

ATTACHMENT A: TEST ARTICLE DETAILS





IMPACT recovery SYSTEMS
"Performance for a Safer Tomorrow"

4955 STOUT DR. · SAN ANTONIO, TX 78219 · (800) 736-5256

SIZE	PART NO.	DWG.	REV
A	OP2-	OMEGAPOST™ 2" HIGH PERFORMANCE DELINEATOR	1.0
SCALE	IMPACT RECOVERY SYSTEMS, INC.	DATE 05-APR-2019	

Impact Recovery Systems

Installation Instructions—#BS-SMQT Surface Mount Quarter Turn Base

It is the responsibility of the owner and installer to determine the suitability of the substrate for proper anchorage. Substrate should generally be properly installed, in good repair and crack free. Consult with owner's engineers as needed.

ANCHOR KIT (#IM-ANCHOR-KIT)

Kit contains four each: 16mm x 3" plastic sleeve, 1/2" x 4" lag screw, 1– 1/4" metal washer

Recommended Tools: Hammer drill with 5/8" bit, small hammer, 3/4" wrench or socket, 1/4" Allen wrench (fixed style only)

1. Place Base on surface and align arrows to the desired position in the direction sign face or post will face. Mark anchor holes.
2. Drill four (4) holes 3" deep using a 5/8" bit. Clean holes.
3. Using a small hammer, gently tap the plastic sleeves into the holes. Top of sleeve should be flush with surface.
4. Place the base over the anchors. Assemble washer to lag screw. Start lag screw through anchor holes into plastic sleeves. Use 3/4" wrench to tighten lag screws snug into base.

#IM-ANCHOR-KIT

EPOXY KIT

FOR BEST RESULTS CLOSELY FOLLOW THE EPOXY MANUFACTURER'S INSTALLATION RECOMMENDATIONS

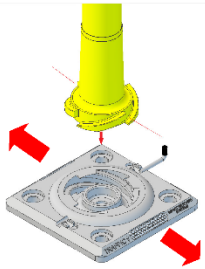
1. Pavement surface must be clean and dry.
2. Flame treat the underside of the base prior to installation. Quickly passing a cool flame over the plastic surface for proper adhesion. Take care to avoid melting plastic.
3. Mix epoxy as directed and closely follow epoxy instructions. Time, temperature, pressure, mix ratios, working life and shelf live all vary by manufacturer. Use a total of approximately 16 to 24 ounces per base (high end for high speeds).
4. Align the base with arrows facing traffic and push into epoxy. Rotate base 90 degrees and back, filling underside channels and holes in base with epoxy. Allowing epoxy to fill anchor holes will increase adhesion though mechanical bonding.
5. Epoxy should extend around sides of fixed base and through anchor holes.
6. Allow epoxy to dry 24 hours for optimum performance. Most epoxies are temperature sensitive. Take care to follow manufacturer's recommendations.

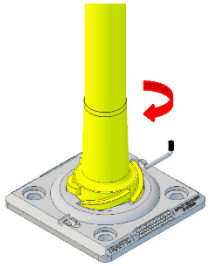
Epoxy Kit

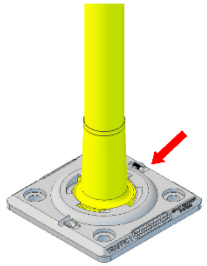
High Speed Application

Post Installation:

1. Start by inserting the threaded post into the base with holes aligned 90º to keeper pin slot. Push down to insert the post and rotate clockwise until fully seated.
2. Install L-shaped keeper pin through base and into post hole such that the pin lies flat in the retention slot on top of the base.







Marlex® 9005 Polyethylene

Version 1.6 Revision Date 2016-11-10

SECTION 1: Identification of the substance/mixture and of the company/undertaking

Product information

Product Name : Marlex® 9005 Polyethylene
Material : 1108187, 1108186, 1108185, 1108184, 1108183, 1108182, 1108181, 1108160, 1108159, 1108158, 1108155, 1108154, 1108157, 1108156, 1066247, 1066244, 1066091, 1066245, 1066246, 1066254, 1066248, 1066253, 1066249, 1066250, 1066252, 1066251

EC-No.Registration number

Chemical name	CAS-No. EC-No. Index No.	Legal Entity Registration number
Ethylene	74-85-1 200-815-3 601-010-00-3	Chevron Phillips Chemical Company LP 01-2119462827-27-0004
1-Hexene	592-41-6 209-753-1	Chevron Phillips Chemical Company LP 01-2119475505-34-0005

Company : Chevron Phillips Chemical Company LP
10001 Six Pines Drive
The Woodlands, TX 77380

Local : Chevron Phillips Chemicals International N.V.
Airport Plaza (Stockholm Building)
Leonardo Da Vincilaan 19
1831 Diegem
Belgium

SDS Requests: (800) 852-5530
Technical Information: (832) 813-4862
Responsible Party: Product Safety Group
Email:sds@cpchem.com

Emergency telephone:

Health:
866.442.9628 (North America)

1.832.813.4984 (International)
Transport:
CHEMTREC 800.424.9300 or 703.527.3887(int'l)
Asia: +800 CHEMCALL (+800 2436 2255) China:+86-21-22157316
EUROPE: BIG +32.14.584545 (phone) or +32.14583516 (telefax)
South America SOS-Cotec Inside Brazil: 0800.111.767 Outside Brazil: +55.19.3467.1600

Responsible Department	:	Product Safety and Toxicology Group
E-mail address	:	SDS@CPChem.com
Website	:	www.CPChem.com

MEDICAL APPLICATION CAUTION: Do not use this material in medical applications involving permanent implantation in the human body or permanent contact with internal body fluids or tissues fluids or tissues.

Do not use this material in medical applications involving brief or temporary implantation in the human body or contact with internal body fluids or tissues unless the material has been provided directly from Chevron Phillips Chemical Company LP or its legal affiliates under an agreement which expressly acknowledges the contemplated use.

Chevron Phillips Chemical Company LP and its legal affiliates makes no representation, promise, express warranty or implied warranty concerning the suitability of this material for use in implantation in the human body or in contact with internal body fluids or tissues.

SECTION 2: Hazards identification

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Not a hazardous substance or mixture according to Regulation (EC) No 1272/2008.

Label elements

Labeling (REGULATION (EC) No 1272/2008)

Not a hazardous substance or mixture according to Regulation (EC) No 1272/2008.

SECTION 3: Composition/information on ingredients

Mixtures

Hazardous ingredients

Chemical name	CAS-No. EC-No. Index No.	Classification (REGULATION (EC) No 1272/2008)	Concentration [wt%]
Polyethylene Hexene Copolymer	25213-02-9		95 - 100
Contains no hazardous ingredients according to GHS. :			

SECTION 4: First aid measures

If inhaled	:	Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion. If symptoms persist, call a physician.
In case of skin contact	:	If the molten material gets on skin, quickly cool in water. Seek immediate medical attention. Do not try to peel the solidified material from the skin or use solvents or thinners to dissolve it.
In case of eye contact	:	In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
If swallowed	:	Do not induce vomiting without medical advice.

SECTION 5: Firefighting measures

Flash point	:	No data available
Autoignition temperature	:	No data available
Suitable extinguishing media	:	Water. Water mist. Dry chemical. Carbon dioxide (CO2). Foam. If possible, water should be applied as a spray from a fogging nozzle since this is a surface burning material. The application of high velocity water will spread the burning surface layer. Avoid the use of straight streams that may create a dust cloud and the risk of a dust explosion. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Specific hazards during fire fighting	:	Risks of ignition followed by flame propagation or secondary explosions can be caused by the accumulation of dust, e.g. on floors and ledges.
Special protective equipment for fire-fighters	:	Use personal protective equipment. Wear self-contained breathing apparatus for firefighting if necessary.
Further information	:	This material will burn although it is not easily ignited.
Fire and explosion protection	:	Treat as a solid that can burn. Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.
Hazardous decomposition products	:	Normal combustion forms carbon dioxide, water vapor and may produce carbon monoxide, other hydrocarbons and hydrocarbon oxidation products (ketones, aldehydes, organic acids) depending on temperature and air availability. Incomplete combustion can also produce formaldehyde.

SECTION 6: Accidental release measures

Personal precautions	:	Sweep up to prevent slipping hazard. Avoid breathing dust. Avoid dust formation.

Environmental precautions	:	Do not contaminate surface water. Prevent product from entering drains.
Methods for cleaning up	:	Clean up promptly by sweeping or vacuum.
Additional advice	:	Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air).

SECTION 7: Handling and storage

Handling

Advice on safe handling	:	Use good housekeeping for safe handling of the product. Keep out of water sources and sewers. Spilled pellets and powders may create a slipping hazard. Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary, but may not by themselves be sufficient. At elevated temperatures (>350°F, >177°C), polyethylene can release vapors and gases, which are irritating to the mucous membranes of the eyes, mouth, throat, and lungs. These substances may include acetaldehyde, acetone, acetic acid, formic acid, formaldehyde and acrolein. Based on animal data and limited epidemiological evidence, formaldehyde has been listed as a carcinogen. Following all recommendations within this SDS should minimize exposure to thermal processing emissions.
Advice on protection against fire and explosion	:	Treat as a solid that can burn. Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Storage

Requirements for storage areas and containers	:	Keep in a dry place. Keep in a well-ventilated place.
Advice on common storage	:	Do not store together with oxidizing and self-igniting products.

SECTION 8: Exposure controls/personal protection

Engineering measures

Consider the potential hazards of this material (see Section 2), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

Personal protective equipment

Respiratory protection	:	No respiratory protection is normally required. If heated material generates vapor or fumes that are not adequately controlled by ventilation, wear an appropriate respirator. Use the following elements for air-purifying respirators: Organic Vapor and Formaldehyde. Use a positive pressure, air-supplying respirator if there is potential for uncontrolled release, exposure levels are not known, or other circumstances where air-purifying respirators may not provide adequate protection. Dust safety masks are recommended when the dust concentration is excessive.
Eye protection	:	Use of safety glasses with side shields for solid handling is good industrial practice. If this material is heated, wear chemical goggles or safety glasses with side shields or a face shield. If there is potential for dust, use chemical goggles.
Skin and body protection	:	At ambient temperatures use of clean and protective clothing is good industrial practice. If the material is heated or molten, wear thermally insulated, heat-resistant gloves that are able to withstand the temperature of the molten product. If this material is heated, wear insulated clothing to prevent skin contact if engineering controls or work practices are not adequate.

SECTION 9: Physical and chemical properties

Information on basic physical and chemical properties

Appearance

Form	:	Pellets
Physical state	:	Solid
Color	:	Opaque
Odor	:	Mild to no odor
Odor Threshold	:	No data available

Safety data

Flash point	:	No data available
Lower explosion limit	:	Not applicable
Upper explosion limit	:	Not applicable
Autoignition temperature	:	No data available
Thermal decomposition	:	Low molecular weight hydrocarbons, alcohols, aldehydes, acids and ketones can be formed during thermal processing.

Molecular weight	:	Not applicable
pH	:	Not applicable
Melting point/range	:	90 - 140 °C (194 - 284 °F)
Freezing point		Not applicable
Initial boiling point and boiling range	:	Not applicable
Vapor pressure	:	Not applicable
Relative density	:	Not applicable
Density	:	0,91 - 0,97 g/cm3
Water solubility	:	Negligible
Partition coefficient: n-octanol/water	:	No data available
Solubility in other solvents	:	No data available
Viscosity, dynamic	:	Not applicable
Viscosity, kinematic	:	Not applicable
Relative vapor density	:	Not applicable
Evaporation rate	:	Not applicable

SECTION 10: Stability and reactivity

Reactivity	:	This material is considered non-reactive under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Chemical stability	:	This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

Possibility of hazardous reactions

Conditions to avoid	:	Avoid prolonged storage at elevated temperature.
Materials to avoid	:	Avoid contact with strong oxidizing agents.
Thermal decomposition	:	Low molecular weight hydrocarbons, alcohols, aldehydes, acids and ketones can be formed during thermal processing.
Hazardous decomposition products	:	Normal combustion forms carbon dioxide, water vapor and may produce carbon monoxide, other hydrocarbons and hydrocarbon oxidation products (ketones, aldehydes, organic

acids) depending on temperature and air availability. Incomplete combustion can also produce formaldehyde.

Other data : No decomposition if stored and applied as directed.

SECTION 11: Toxicological information

Marlex® 9005 Polyethylene
Acute oral toxicity : Presumed Not Toxic

Marlex® 9005 Polyethylene
Acute inhalation toxicity : Presumed Not Toxic

Marlex® 9005 Polyethylene
Acute dermal toxicity : Presumed Not Toxic

Marlex® 9005 Polyethylene
Skin irritation : No skin irritation

Marlex® 9005 Polyethylene
Eye irritation : No eye irritation

Marlex® 9005 Polyethylene
Sensitization : Did not cause sensitization on laboratory animals.

Marlex® 9005 Polyethylene
Further information : This product contains POLYMERIZED OLEFINS. During thermal processing (>350°F, >177°C) polyolefins can release vapors and gases (aldehydes,ketones and organic acids) which are irritating to the mucous membranes of the eyes, mouth, throat, and lungs. Generally these irritant effects are all transitory. However, prolonged exposure to irritating off-gases can lead to pulmonary edema. Formaldehyde (an aldehyde) has been classified as a carcinogen based on animal data and limited epidemiological evidence.

SECTION 12: Ecological information

Ecotoxicity effects

Elimination information (persistence and degradability)

Bioaccumulation : Does not bioaccumulate.

Mobility : The product is insoluble and floats on water.

Biodegradability	:	This material is not expected to be readily biodegradable.

Ecotoxicology Assessment

Additional ecological information	:	This material is not expected to be harmful to aquatic organisms., Fish or birds may eat pellets which may obstruct their digestive tracts.

SECTION 13: Disposal considerations

The information in this SDS pertains only to the product as shipped.

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14: Transport information

The shipping descriptions shown here are for bulk shipments only, and may not apply to shipments in non-bulk packages (see regulatory definition).

Consult the appropriate domestic or international mode-specific and quantity-specific Dangerous Goods Regulations for additional shipping description requirements (e.g., technical name or names, etc.) Therefore, the information shown here, may not always agree with the bill of lading shipping description for the material. Flashpoints for the material may vary slightly between the SDS and the bill of lading.

US DOT (UNITED STATES DEPARTMENT OF TRANSPORTATION)
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

IMO / IMDG (INTERNATIONAL MARITIME DANGEROUS GOODS)
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

IATA (INTERNATIONAL AIR TRANSPORT ASSOCIATION)
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

ADR (AGREEMENT ON DANGEROUS GOODS BY ROAD (EUROPE))
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

RID (REGULATIONS CONCERNING THE INTERNATIONAL TRANSPORT OF DANGEROUS GOODS (EUROPE))
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

ADN (EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE

OF DANGEROUS GOODS BY INLAND WATERWAYS)
NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION BY THIS AGENCY.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

SECTION 15: Regulatory information

National legislation

Major Accident Hazard Legislation : 96/82/EC Update: 2003
Directive 96/82/EC does not apply

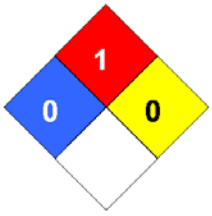
Water contaminating class (Germany) : nwg not water endangering

Notification status

Europe REACH	:	On the inventory, or in compliance with the inventory
United States of America (USA) TSCA	:	On TSCA Inventory
Canada DSL	:	All components of this product are on the Canadian DSL
Australia AICS	:	On the inventory, or in compliance with the inventory
New Zealand NZIoC	:	On the inventory, or in compliance with the inventory
Japan ENCS	:	On the inventory, or in compliance with the inventory
Korea KECI	:	On the inventory, or in compliance with the inventory
Philippines PICCS	:	On the inventory, or in compliance with the inventory
China IECSC	:	On the inventory, or in compliance with the inventory

SECTION 16: Other information

NFPA Classification : Health Hazard: 0
Fire Hazard: 1
Reactivity Hazard: 0



Further information

Legacy SDS Number : 240370

Significant changes since the last version are highlighted in the margin. This version replaces all previous versions.

The information in this SDS pertains only to the product as shipped.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Key or legend to abbreviations and acronyms used in the safety data sheet			
ACGIH	American Conference of Government Industrial Hygienists	LD50	Lethal Dose 50%
AICS	Australia, Inventory of Chemical Substances	LOAEL	Lowest Observed Adverse Effect Level
DSL	Canada, Domestic Substances List	NFPA	National Fire Protection Agency
NDSL	Canada, Non-Domestic Substances List	NIOSH	National Institute for Occupational Safety & Health
CNS	Central Nervous System	NTP	National Toxicology Program
CAS	Chemical Abstract Service	NZIoC	New Zealand Inventory of Chemicals
EC50	Effective Concentration	NOAEL	No Observable Adverse Effect Level
EC50	Effective Concentration 50%	NOEC	No Observed Effect Concentration
EGEST	EOSCA Generic Exposure Scenario Tool	OSHA	Occupational Safety & Health Administration
EOSCA	European Oilfield Specialty Chemicals Association	PEL	Permissible Exposure Limit
EINECS	European Inventory of Existing Chemical Substances	PICCS	Philippines Inventory of Commercial Chemical Substances
MAK	Germany Maximum Concentration Values	PRNT	Presumed Not Toxic
GHS	Globally Harmonized System	RCRA	Resource Conservation Recovery Act
>=	Greater Than or Equal To	STEL	Short-term Exposure Limit
IC50	Inhibition Concentration 50%	SARA	Superfund Amendments and Reauthorization Act.
IARC	International Agency for Research on Cancer	TLV	Threshold Limit Value
IECSC	Inventory of Existing Chemical Substances in China	TWA	Time Weighted Average
ENCS	Japan, Inventory of Existing and New Chemical Substances	TSCA	Toxic Substance Control Act
KECI	Korea, Existing Chemical Inventory	UVCB	Unknown or Variable Composition, Complex Reaction Products, and Biological Materials
<=	Less Than or Equal To	WHMIS	Workplace Hazardous Materials Information System
LC50	Lethal Concentration 50%		

Safety Data Sheet

Version 4.0

Issue Date	:	12/01/2018	Ref. 150000004486
Revision Date	:	10/31/2018	

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	□Thermoplastic polyester elastomer
Product Grade/Type	:	5556 NC010
Product Use	:	Polymer
Restrictions on use	:	For manufacturing and research use only
Manufacturer/Supplier	:	DuPont 974 Centre Road Wilmington, DE 19805, USA
Product Information	:	+1-800-441-7515 (outside the U.S. +1-302-774-1000)
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	+1-800-424-9300 (outside the U.S. +1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Product hazard category
Combustible dust

Label content

Pictogram	:	not required
Signal word	:	Warning
Hazardous warnings	:	If small particles are generated during further processing, handling or by other means, may form combustible dust concentrations in air.
Hazardous prevention measures	:	not required

Other hazards

Version 4.0

Issue Date	:	12/01/2018	Ref. 150000004486
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No applicable data available.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

This product does not contain any components that require disclosure according to OSHA Hazard Communication Standard 2012.

SECTION 4. FIRST AID MEASURES

General advice	:	No applicable data available.
Inhalation	:	Move to fresh air in case of accidental inhalation of fumes from overheating or combustion. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Skin contact	:	The material is not likely to be hazardous by skin contact, but cleaning the skin after use is advisable. Cool skin rapidly with cold water after contact with molten material. Do not peel polymer from the skin. Obtain medical treatment for thermal burn.
Eye contact	:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.
Ingestion	:	No specific intervention is indicated. Consult a physician if necessary.
Most important symptoms/effects, acute and delayed	:	No applicable data available.
Protection of first-aiders	:	No applicable data available.
Notes to physician	:	No applicable data available.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Water, Foam, Dry chemical, Carbon dioxide (CO2)
Unsuitable extinguishing media	:	No applicable data available.

Specific hazards	:	Combustible . Large molten masses may ignite spontaneously in air. Water quenching is good practice. Minimize the generation and accumulation of dust. Failure or malfunction of temperature control systems on processing equipment, such as extruders, may create explosion hazards. Hazardous combustion products may include: (see also section 10) Carbon monoxide, Carbon dioxide.
Special protective equipment for firefighters	:	Wear self-contained breathing apparatus and protective suit.
Further information	:	Evacuate personnel and keep upwind of fire.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Spilled material is a slipping hazard.
Environmental precautions	:	Do not discharge to streams, ponds, lakes or sewers.
Spill Cleanup	:	Spills of fine material should be cleaned using gentle sweeping or vacuuming. Cleaning methods (e.g. compressed air) which can generate potentially combustible dust clouds should not be used. Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Use only non-sparking tools.
Accidental Release Measures	:	No applicable data available.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Open container only in well-ventilated area. Wash hands thoroughly after handling. Provide appropriate exhaust ventilation at dryers, machinery and at places where dust or volatiles can be generated. Do not breathe dust. Pneumatic conveying and other mechanical handling operations can generate combustible dust. Minimize the generation and accumulation of dust. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces.

Handling (Physical Aspects)	:	No applicable data available.
Dust explosion class	:	No applicable data available.
Storage	:	Store in a cool, dry place. Keep container closed to prevent contamination. Keep in an area equipped with sprinklers.
Storage period	:	No applicable data available.
Storage temperature	:	No applicable data available.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls	:	General mechanical ventilation is normally adequate but use local exhaust where necessary to maintain exposures below acceptable limits. Use local exhaust to completely remove vapors and fumes liberated during hot processing from the work area.
Personal protective equipment		
Respiratory protection	:	Additives in this product do not present a respiration hazard unless the product is ground to a powder of respirable size and the dust is inhaled. All dusts are potentially injurious to the respiratory tract if respirable particles are generated and inhaled. A respiratory protection program that meets country requirements must be followed whenever workplace conditions warrant respirator use. Consult the respirator manufacturer to determine the appropriate type of equipment for a given application. Observe respirator use limitations specified by the manufacturer. Use a positive pressure air supplied respirator if exposure levels are not known or there are any other circumstances where air purifying respirators may not provide adequate protection. Consult the OSHA respiratory protection information located at 29CFR 1910.134.
Hand protection	:	Additional protection: Wear leather or cotton gloves when grinding, sawing, routing, drilling or sanding., When handling hot material, use heat resistant gloves.
Eye protection	:	Wear safety glasses with side shields. Wear tightly fitting chemical splash goggles and face shield when possibility exists for eye and face contact due to spattering or splashing of molten material. A full-face mask respirator provides protection from eye irritation.
Skin and body protection	:	If there is a potential for contact with hot/molten material wear heat resistant clothing and footwear.

Version 4.0

Issue Date : 12/01/2018 Ref. 150000004486
Revision Date : 10/31/2018

Exposure Guidelines
Exposure Limit Values

This product does not contain any exposure limits that require disclosure according to OSHA Hazard Communication Standard 2012.
Non-Constituent(s)

Dust (inhalable and respirable fraction)

Permissible exposure limit:	(OSHA)	5 mg/m3	8 hr. TWA Respirable fraction.
Permissible exposure limit:	(OSHA)	15 mg/m3	8 hr. TWA Total dust.
TLV	(ACGIH)	3 mg/m3	TWA Respirable particles.
TLV	(ACGIH)	10 mg/m3	TWA Inhalable particles.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance
Physical state : solid
Form : pellets
Color : natural

Odor : none

Odor threshold : Not applicable

pH : Not applicable

Melting point/freezing point : Melting point/range
> 130 °C (> 266 °F)

Boiling point/boiling range : Boiling point/boiling range
Not applicable

Flash point : Not applicable

Evaporation rate : Not applicable

Flammability (solid, gas)	:	May form combustible dust concentrations in air during processing, handling or other means.
Upper explosion limit	:	Not applicable
Lower explosion limit	:	Not applicable
Vapor pressure	:	Not applicable
Vapor density	:	Not applicable
Specific gravity (Relative density)	:	> 1
Water solubility	:	insoluble
Solubility(ies)	:	No applicable data available.
Partition coefficient: n-octanol/water	:	No applicable data available.
Auto-ignition temperature	:	Not applicable
Decomposition temperature	:	>275 °C Thermal decomposition of the resin accelerates above temperature listed. Decomposition can occur below the recommended processing temperature limit. Decomposition is a function of both processing temperature and time at that temperature.
Viscosity, kinematic	:	Not applicable
Viscosity, dynamic	:	Not applicable

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	Stable at normal ambient temperature and pressure.
Chemical stability	:	Stable at normal ambient temperature and pressure.
Possibility of hazardous reactions	:	Polymerization will not occur.
Conditions to avoid	:	Temperature > 275 °C (> 527 °F) Abnormally long processing time or high temperatures can produce irritating

and toxic fumes.
Decomposes on heating. At temperatures above the "conditions to avoid" temperature, thermal decomposition of the resin accelerates. Decomposition can occur below the recommended processing temperature limit. Decomposition is a function of both processing temperature and time at that temperature.

Incompatible materials : Strong acids Strong bases, Strong oxidizing agents

Hazardous decomposition products : Hazardous thermal decomposition products may include: Tetrahydrofuran , Carbon dioxide, Carbon monoxide, 2-Methylpropene, Acetaldehyde, Acrolein, Propionaldehyde, Acetic acid, Formic acid

SECTION 11. TOXICOLOGICAL INFORMATION

Further information : No data is available on the product itself.For additional toxicity data, write to the company address or call the non-emergency number shown in Section 1.

Carcinogenicity

The carcinogenicity classifications for this product and/or its ingredients have been determined according to HazCom 2012, Appendix A.6. The classifications may differ from those listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or those found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest edition).

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 12. ECOLOGICAL INFORMATION

Additional ecological information : No data is available on the product itself. Toxicity is expected to be low based on insolubility in water.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste disposal methods - Product : Preferred options for disposal are recycling or incineration with energy recovery. The high fuel value of this product makes incineration very

desirable for material that cannot be recycled. Treatment, storage, transportation, and disposal must be in accordance with applicable federal, state/provincial, and local regulations.

Contaminated packaging : No applicable data available.

SECTION 14. TRANSPORT INFORMATION

Not classified as dangerous in the meaning of transport regulations.

SECTION 15. REGULATORY INFORMATION

TSCA	:	In compliance with TSCA Inventory requirements for commercial purposes.
SARA 311/312 Hazard classification	:	Combustible dust
SARA 313 Regulated Chemical(s)	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
PA Right to Know Regulated Chemical(s)	:	Substances on the Pennsylvania Hazardous Substances List present at a concentration of 1% or more (0.01% for Special Hazardous Substances): None known.
NJ Right to Know Regulated Chemical(s)	:	Substances on the New Jersey Workplace Hazardous Substance List present at a concentration of 1% or more (0.1% for substances identified as carcinogens, mutagens or teratogens): None known.
California Prop. 65	:	This product does not contain any substances requiring a warning under the Safe Drinking Water and Toxic Enforcement Act.

SECTION 16. OTHER INFORMATION

Restrictions for use : Do not use DuPont materials in medical applications involving implantation

in the human body or contact with internal body fluids or tissues unless the material has been provided from DuPont under a written contract that is consistent with DuPont policy regarding medical applications and expressly acknowledges the contemplated use. For further information, please contact your DuPont representative. You may also request a copy of the DuPont POLICY Regarding Medical Applications and DuPont CAUTION Regarding Medical Applications.

Read the product information datasheet for this product or the molding guide for this resin family.
Refer to NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for safe handling.

Issue Date : 12/01/2018
Revision Date : 10/31/2018

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Warning

Hazard statements: If small particles are generated during further processing, handling or by other means, may form combustible dust concentrations in air.

Refer to Safety Data Sheet (SDS) for further information.

DuPont
974 Centre Road
Wilmington, DE 19805, USA

Product Information: +1-800-441-7515 (outside the U.S. +1-302-774-1000)
Medical Emergency: 1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency: CHEMTREC: +1-800-424-9300 (outside the U.S. +1-703-527-3887)

Version 4.0
Revision Date 10/31/2018
Issue Date 12/01/2018
Ref. 150000004486

ATTACHMENT B: TEST PHOTOGRAPHS AND OTHER INFORMATION

Figure B1. Vehicle before Testing.

Figure B2. Vehicle after Delineator Tests.

Table B1. Vehicle Properties for Test No. 613301-01-2.

Date: 2019-09-23 Test No.: 613301-01-2 VIN No.: KNADH432B6714459

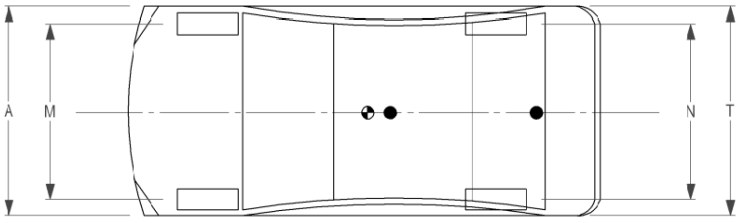
Year: 2011 Make: Kia Model: Rio

Tire Inflation Pressure: 32 PSI Odometer: 100550 Tire Size: 185/65R14

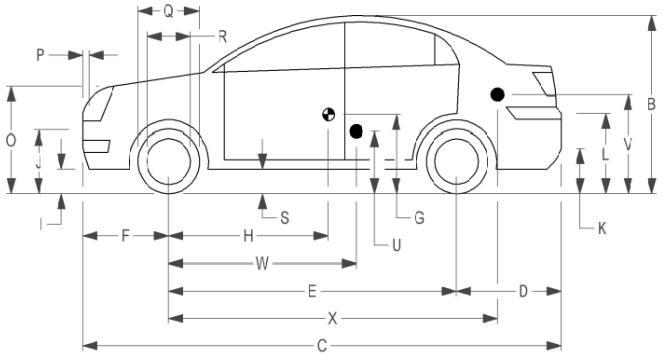
Describe any damage to the vehicle prior to test: None

● Denotes accelerometer location.

NOTES: None



Engine Type: 4 CYL
Engine CID: 1.6 L
Transmission Type:
☐ Auto or ☑ Manual
☑ FWD ☐ RWD ☐ 4WD
Optional Equipment:
None



Dummy Data:
Type: Live Driver
Mass: 174 lb
Seat Position: Driver

Geometry: inches

A	66.38	F	33.00	K	12.25	P	4.12	U	
B	51.50	G		L	25.25	Q	22.50	V	
C	165.75	H	60.02	M	57.75	R	15.50	W	
D	34.00	I	7.75	N	57.70	S	8.25	X	
E	98.75	J	21.50	O	27.00	T	66.20		

Wheel Center Ht Front 11.00 Wheel Center Ht Rear 11.00 W-H 0.00

RANGE LIMIT: A = 65 ±3 inches; C = 169 ±8 inches; E = 98 ±5 inches; F = 35 ±4 inches; H = 39 ±4 inches; O (Bottom of Hood Lip) = 24 ±4 inches
TOP OF RADIATOR SUPPORT = 28.25 inches; (M+N)/2 = 56 ±2 inches; W-H < 2 inches or use MASH Paragraph A4.3.2

GVWR Ratings:		**Mass:** lb	Curb	Test Inertial	Gross Static
Front	1718	M_{front}	1467	1558	
Back	1874	M_{rear}	876	895	
Total	3638	M_{Total}	2343	2453	0

Allowable TIM = 2420 lb ±55 lb | Allowable GSM = 2585 lb ± 55 lb

Mass Distribution:
lb LF: 801 RF: 757 LR: 412 RR: 483

Table B2. Delineator List/Lean Summary for Test No. 613301-01-2.

#	Before		Run #1		Run #10		Run #100		Run #200		Failure	Mode
	List	Lean	List	Lean	List	Lean	List	Lean	List	Lean	Run #	
1T	90	90	90	89	87.5	89	87	87	85	85		
1B	90	90	89	90	88	89.5	87.5	87.5	87.5	88		
2T	90	90	90	89	88	89	87	86	85	86.5		
2B	90	90	88	88	88	88	88	86.5	89	88		
3T	90	90	89.5	90	88	89	--	--	--	--	79	Torn horizontally halfway up
3B	90	89.5	89.5	88	88	86	--	--	--	--	40	Post pulled out of base
4T	90	90	89	89.5	88	88.5	--	--	--	--	76	Post pulled out of base
4B	90	90	90	89	89	86	--	--	--	--	36	Anchors pulled out of asphalt
Run	Notes:											

Figure B3. Delineators Attached to Concrete prior to Testing.

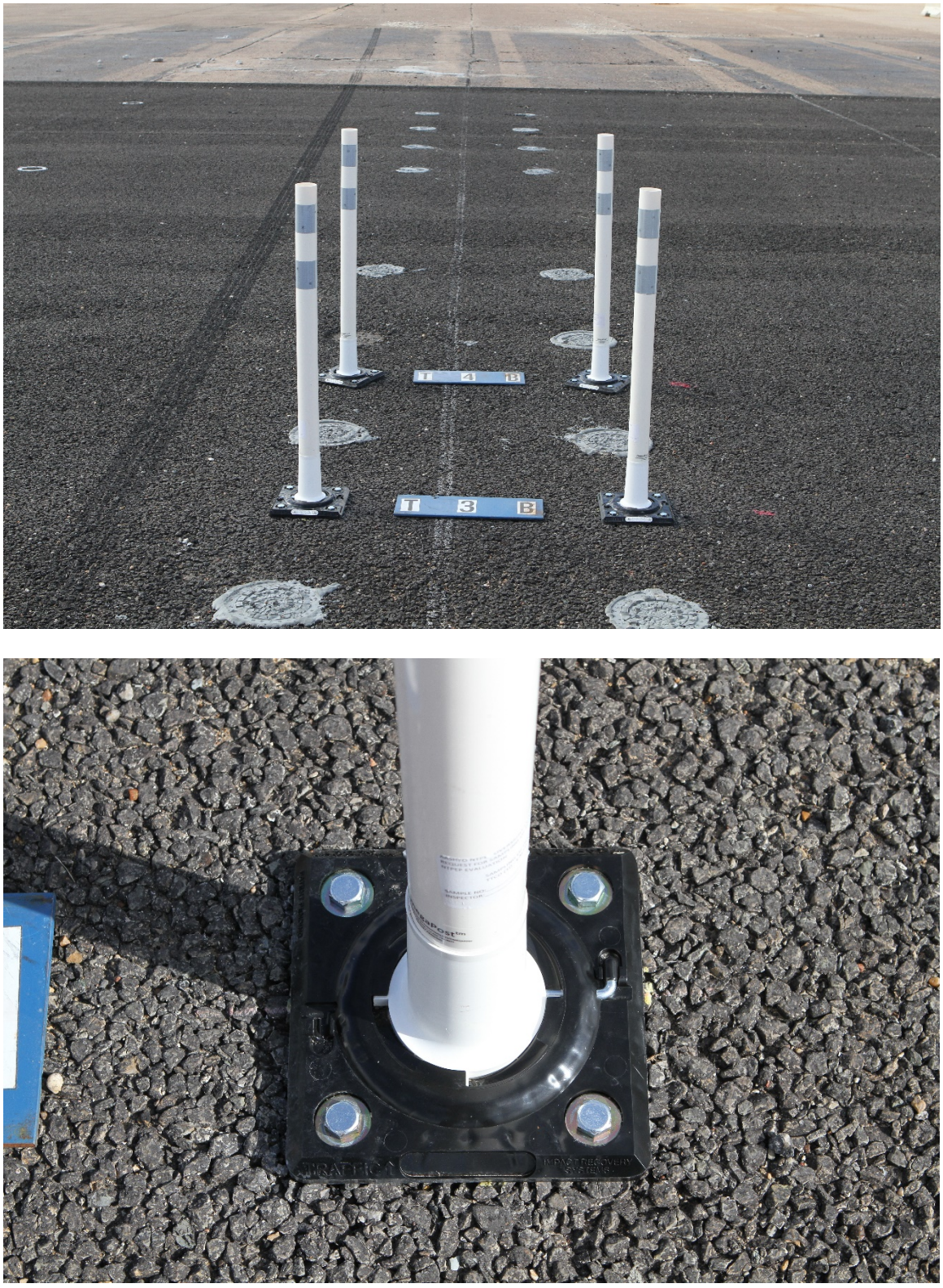


Figure B4. Delineators Attached to Asphalt prior to Testing.

Table B2. Delineator #1T after Specific Runs for Test No. 613301-01-2			
Photos – Post #1T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B2. Delineator #1T after Specific Runs for Test No. 613301-01-2			
Photos – Post #1T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Run #100			
Run #150			

Table B2. Delineator #1T after Specific Runs for Test No. 613301-01-2			
Photos – Post #1T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #200			

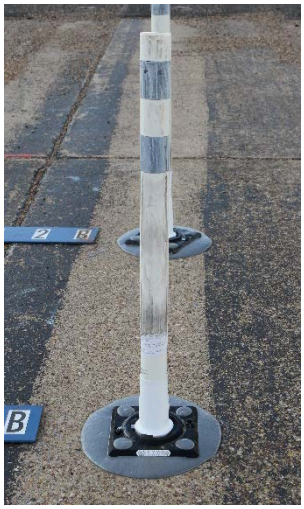
Table B3. Delineator #1B after Specific Runs for Test No. 613301-01-2			
Photos – Post #1B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B3. Delineator #1B after Specific Runs for Test No. 613301-01-2			
Photos – Post #1B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Run #100			
Run #150			

Table B3. Delineator #1B after Specific Runs for Test No. 613301-01-2			
Photos – Post #1B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #200			

Table B4. Delineator #2T after Specific Runs for Test No. 613301-01-2			
Photos – Post #2T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B4. Delineator #2T after Specific Runs for Test No. 613301-01-2			
Photos – Post #2T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Run #100			
Run #150			

Table B4. Delineator #2T after Specific Runs for Test No. 613301-01-2			
Photos – Post #2T (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #200			

Table B5. Delineator #2B after Specific Runs for Test No. 613301-01-2			
Photos – Post #2B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B5. Delineator #2B after Specific Runs for Test No. 613301-01-2			
Photos – Post #2B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Run #100			
Run #150			

Table B5. Delineator #2B after Specific Runs for Test No. 613301-01-2			
Photos – Post #2B (Concrete Glue-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #200			

Table B6. Delineator #3T after Specific Runs for Test No. 613301-01-2			
Photos – Post #3T (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B6. Delineator #3T after Specific Runs for Test No. 613301-01-2			
Photos – Post #3T (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Failure Run #79			

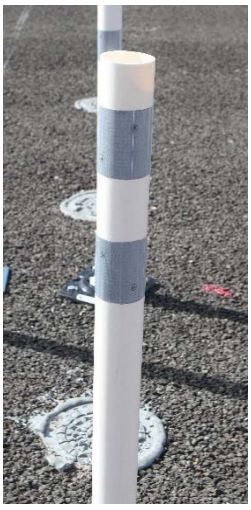
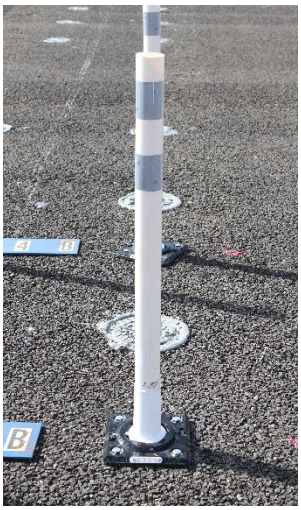
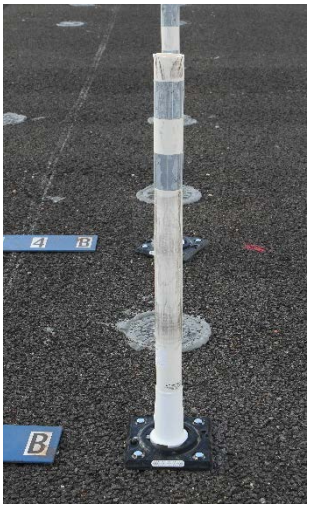
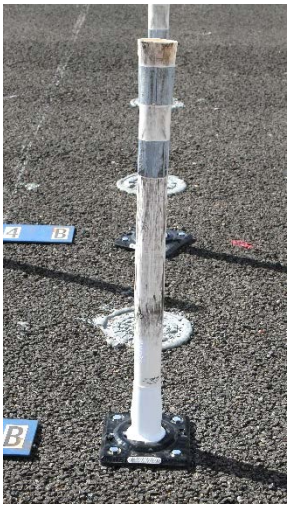
Table B7. Delineator #3B after Specific Runs for Test No. 613301-01-2			
Photos – Post #3B (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

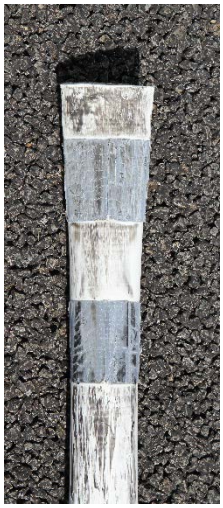
Table B7. Delineator #3B after Specific Runs for Test No. 613301-01-2			
Photos – Post #3B (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Failure Run #40			

Table B8. Delineator #4T after Specific Runs for Test No. 613301-01-2			
Photos – Post #4T (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B8. Delineator #4T after Specific Runs for Test No. 613301-01-2			
Photos – Post #4T (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Run #50			
Failure Run #76			

Table B9. Delineator #4B after Specific Runs for Test No. 613301-01-2			
Photos – Post #4B (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Before Testing			
Run #1			
Run #10			

Table B9. Delineator #4B after Specific Runs for Test No. 613301-01-2			
Photos – Post #4B (Asphalt Bolt-Down)			
Run #	Reflective Sheeting	Full Post	Base or Damage
Failure Run #36