PPI TR-2/2021

PPI PVC Range Composition
Listing of Qualified Ingredients

Plastics Pipe Institute
The Voice of an Industry.

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FOREWARD

This technical report was developed and published with the technical help of the members of the (Plastics Pipe Institute, Inc.) Hydrostatic Stress Board (PPI HSB). The members have shown their interest in quality products by assisting independent standards-making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

PPI's PVC range composition and all applicable policies are included in this technical report. This technical report lists of each of the ingredients that have been accepted by the Hydrostatic Stress Board (HSB) by its commercial designation as qualified for use in PPI's PVC Range Composition. Requirements for acceptance are covered by applicable PPI policy or, in cases for which there is no applicable policy, the HSB may determine these requirements through a "Special Case" consideration. The listings included in this report also show allowable use levels for each ingredient and any other applicable limitation.

This report was prepared by the PPI HSB as a service to the industry. The information in this report is offered in good faith and believed to be accurate at the time of its preparation but is offered "as is" without any express or implied warranty, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Each product manufacturer that lists compositions with the PPI HSB does so voluntarily and with the express agreement that PPI assumes no liability in regard to the lists, and that it will hold PPI harmless from any claims or liability in connection with its listed pipe compositions.

Additional information may be needed in some areas, especially with regard to unusual or special applications. Consult the manufacturer or material supplier for more detailed information. PPI does not endorse the proprietary products or processes of any manufacturer, and assumes no responsibility for compliance with applicable laws and regulations.

Questions, comments, and problems of interpretation should be referred to the PPI HSB Chair, Plastics Pipe Institute, 105 Decker Court, Suite 825, Irving, TX 75062. Copies of this report, as well as other publications, are available from the PPI website: www.plasticpipe.org.

This report was updated June 11, 2021.

SUMMARY OF CHANGES

TR-2/2014 to TR-2/2016	
Part B.2	Includes requirements when testing liquid dispersed colorants.
2017	
All policy language in the document	All policy language moved into PPI TR3 which converted PPI TR2 into a listing document such as PPI TR4.
2018	
Part D (new)	Part D – Requirements for Obtaining a Dependent Listing Under the PPI PVC Range Composition
2020	
Foreword	Editorial revision from "…technical help and financial support of the members of the PPI (Plastics Pipe Institute)." to "…technical help of the members of the (Plastics Pipe Institute, Inc.) Hydrostatic Stress Board (PPI HSB)."
Document	Editorial revision of "Chairman of the HSB" to "PPI HSB Chair".
Table of Contents	Editorial revision of Appendix A and Appendix D noting that the dependent listing request template and manufacturer contact information are now available online.
Section I Definitions	Editorial revision to reference the correct policy sections for Prequalified and Functional Equivalent Ingredients, Part A and Part B respectively.
Part A Table 1	Editorial revision from "Compliance to B.2 and Listing by PPI." to "Compliance to Part B.2 and Listing with the PPI HSB."
Part A.2 Ash	Editorial revision adding unit of measure (%).
Part A.4 Acid Number	Editorial revision adding reference to comment "(1)".
TABLE 1 – PVC Resin	Editorial revision to reference the correct policy section for PVC Resin, Part B.1.
TABLE 6B – TITANIUM DIOXIDE FUNCTIONAL EQUIVALENTY – LIQUID DISPERSED	Editorial revision to the notes to reflect the name changes in the products.
2021	
Part B.1, Part B.2	HSBTG25-0219: Revisions to reflect new definition, commercially produced pipe.
Table 1	PVCTG14-0818: New NOTE 2 explaining that some allowable use levels were determined via an HSB Special Case and to reference the colorant tables for the levels.

I. Definitions Specific to TR-2

Vinyl Plastics — Compositions of polymers and ingredients that are based on polymers of vinyl chloride, or copolymers of vinyl chloride with other monomers, the vinyl chloride being in the greatest amount by mass. Within the context of TR-2 the term vinyl is limited to compositions of polyvinyl chloride (PVC).

Ingredient — Any chemical, mineral, polymer or other ingredient that has been added to a vinyl composition for the purpose of imparting certain desired processing or product performance properties.

Pre-qualified Ingredient— Any chemical, mineral, polymer, etc. having properties meeting the applicable requirements as set forth in Section III Part A.

Functionally Equivalent Ingredient— Any chemical, mineral, polymer, etc. not having properties meeting the applicable requirements as set forth in Section III Part B and shown to function in an equivalent manner through testing.

Combination Ingredient Package- A set ratio of a pre-blended combination of prequalified ingredients. As a service to formulators of PVC pipe compounders, some suppliers of ingredients make available "packages" of pre-blended combinations of Prequalified Ingredients provided: 1) each of its individual ingredients is qualified for such use; and 2) the net amount of each individual ingredient that is introduced into the composition, both through the "package" and by direct addition, is in compliance with the composition requirements for that ingredient. It is the responsibility of the formulator to make sure that the PPI PVC range composition is always prepared in accordance with the currently listed composition.

Functional Equivalent Ingredient Package- A set ratio of a pre-blended combination of ingredients containing an ingredient/ingredients that is not pre-qualified. This package will be accepted for listing upon completion of testing demonstrating that its use in PPI's PVC Range Composition continues to yield a PVC compound that complies with the minimum property requirements for cell class 12454, in accordance with ASTM D1784, and that qualifies for a 4,000 psi HDB, for water, for 73.4°F, in accordance with ASTM D2837. There is no standard protocol, or policy for effecting this demonstration. Minimum data requirements are established by the HSB for each case, depending on the nature of the ingredients, and the information already available. Those seeking to qualify these kinds of combinations of ingredients should make a "Special Case" request of the PPI HSB Chair.

PPI PVC Range Composition - A PVC composition, classified as PVC 1120, Class 12454 in accordance with applicable ASTM requirements, that carries a PPI recommended hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa) for water for 73.4°F (23°C), with such basis having been established in accordance with requirements stated in PPI Technical Reports TR-2 and TR-3. This composition is maintained by the HSB of PPI and is made available for use by the general public.

Privately held PVC Composition - A privately held PVC composition that carries a PPI recommended hydrostatic design basis (HDB) that has been established based on the requirements of PPI Technical Reports TR-2 and TR-3. This private composition is maintained by a specific company or organization and is not made available by PPI to the general public.

Standard Grade (S) - A PPI HSB recommended rating that is valid for a five-year period, given to those materials that comply with the full data requirements of TR-2 and TR-3.

Experimental Grade (E) - A PPI HSB recommended rating that is valid for a limited duration, given to those materials covered by data that do not yet comply with the full requirements of the Standard Grade, but satisfy the applicable minimum preliminary data requirements that are detailed in TR-2 and TR-3. The owner of an experimental listing must understand there is a potential risk in commercial sale of an experimental ingredient in case it does not meet all theTR-2 requirements.

II. INTRODUCTION

It was recognized early in the evolution of the thermoplastics pipe industry that in consequence of its viscoelastic nature, the fracture strength of a thermoplastic polymer is significantly influenced — for any given set of conditions of temperature and environment — by duration of loading. The longer a load is sustained; the lower is the fracture strength. It was also recognized that the long-term strength of a thermoplastics composition is not only determined by the primary ingredient, the base polymer, but can also be profoundly influenced by the nature and quantity of ingredients — such as property modifiers, processing aids, stabilizers, and colorants — that are used to enhance performance and facilitate processing, and to give product identification. But in those early days there existed no standard method by which reliable design stresses could be established for thermoplastic compositions intended for pressure pipe. All too often, design stresses were based on results of relatively short-term loading with ***safety factors*** that — based on experience, educated guess, limited experience, or other rationale — were said to adequately compensate for the reduction in long-term strength that characteristically occurs with all plastics when subjected to prolonged loading. Unfortunately, this approach was not only inconsistent from material to material, but oftentimes it was unreliable. The long-term strength of some materials was overestimated, while that of others was underestimated.

To remedy this situation, the Thermoplastics Pipe Division (subsequently named the Plastics Pipe Institute) of the Society of the Plastics Industry established in November 1958 the Working Stress Subcommittee, the predecessor to the Hydrostatic Stress Board (HSB), consisting of technical persons well versed in the state-of-the-art of the evaluation and forecast of the long-term strength of plastics. Two and half years later, in April 1961, this group agreed on a uniform Tentative Method for Estimating Long-Term Hydrostatic Strength and Hydrostatic Design Stress of Thermoplastic Pipe; and in July 1963, it issued its first hydrostatic design stress recommendations for compositions for which data had been submitted in accordance with this method.

A frequent challenge to the HSB was the evolutionary nature of the industry, particularly in the case of PVC pipe compositions. At first, each PVC composition was a fixed and very specific composition, with the use level and identity of each ingredient spelled out. The ingredient identification would often consist of a manufacturer's trade designation. In search of more effective and less costly sources of ingredients, companies holding listings for PVC compositions would often qualify alternative sources of a certain ingredient. To demonstrate qualification a company had to submit to the HSB extensive long-term data that showed the proposed change would not compromise a listed composition's long-term strength. From the knowledge learned by this work, policies were developed whereby a newly proposed ingredient, for example, a calcium carbonate — can qualify for that purpose provided it is demonstrated that its physical and chemical properties comply to requirements that have been established for that class of ingredient based on results of industry wide testing. These policies provided for prequalification of ingredients that greatly facilitated the process of determining equivalence.

Later on, during the seventies, the concept of "PVC range compositions" was introduced. As new and improved extrusion technology began to be used, it was discovered that fine-tuning the quantity of certain ingredients — particularly, so called "internal" and "external" lubricants — would greatly benefit production rate and product quality. To avoid the impracticality of having to qualify each composition variation, industry expanded their fixed content recipes into range compositions,

whereby the allowable content of certain ingredients was defined not by a fixed amount but rather, by a minimum/maximum range. The acceptable ranges of ingredient content had also to be established by long-term data documentation.

To make it possible to use resins and other ingredients from different suppliers, extruders of PVC pipe had to qualify a number of "different" range PVC compositions — each provided by a different resin supplier — which in fact were often times quite the same except for source of resin, or some other key ingredient. For a manufacturer of a new ingredient, or of an alternative to an existing ingredient, having to qualify his product for inclusion in the many private PVC range compositions that then abounded was a costly and time-consuming process. In recognition of this situation, the HSB proposed in 1983 to establish a single, generic and public PVC range composition which then included all PVC resins and ingredients which had been qualified in privately held compositions of the same kind. To accomplish this required the cooperation of all major holders of PVC compositions, including their willingness to share with the HSB their confidential recipes. This cooperation was obtained, the compositions of the many stress-rated compositions were compared, and a single, generic, state-of-the-art composition was established which allowed a wide choice in PVC resins and in ingredients.

The HSB next worked on defining the policies and procedures for qualifying new ingredients. In 1985 the PPI PVC range composition and related policies were agreed upon and are published in this report. Since that time many new alternate ingredients have been qualified for use in this composition.

The policies and procedures in this Technical Report are intended to cover ingredient listings for most PVC piping applications. PPI recognizes there may be unusual cases, issues or circumstances that are not covered in TR-2, and that may justify an exception to the standard policies. To allow manufacturers an opportunity to have their ingredient(s) listed by PPI when this occurs, the HSB has provided a "Special Case" system. The manufacturer may present its "Case" to the HSB at one of their two annual meetings, usually in February and August, using the approved "Special Case" form in TR-3. All information provided to HSB in these special cases will be made available for review only by HSB members and PPI staff, and will be held by them in strict confidence, in accordance with PPI's written confidentiality procedures (available from the PPI HSB Chair). There is a PPI fee for each special case. You must contact the PPI HSB Chair well in advance of each meeting to arrange for your special case. A completed HSB submission form ***must*** be received at least two (2) weeks prior to the HSB meeting to permit HSB consideration at that meeting.

III. PPI PVC Range Composition

The PPI PVC Range Composition in PPI TR-2 Section III Table 1 is divided into categories which are detailed in Section I Definitions Specific to PPI TR-2.

Qualified ingredients are listed in accordance with the above categories.

Because the PPI PVC Range Composition has been established from a matrix of PPI listed range compositions – each of which has a 4,000-psi hydrostatic design basis at 73.4°F that has been established through extensive stress-rupture testing – a company may obtain a dependent listing under this composition by meeting the requirements set forth in Part D of TR-2.

Part A. Pre-qualified Ingredients Exempted from Stress-Rupture Testing

An individual or combination ingredient that meets the allowable content range in Table 1 and the physical property requirements of Part A is a pre-qualified ingredient and is exempt from stress rupture testing for qualification. An ingredient manufacturer may still elect to publish this prequalified ingredient in the appropriate table in TR-2.

A PVC composition that complies with the minimum property requirements of cell class 12454 according to ASTM D 1784 and that satisfies the limitations of the PVC range formulation given in Table I, qualifies for a recommended hydrostatic design basis (HDB) of 4,000 psi at 73°F (23°C) without the need to submit the stress-rupture data. A manufacturer wishing to register this PVC range composition for use in his plant should apply to the PPI HSB Chair and identify the manufacturer's commercial designation for this composition. These PVC compositions are dependent on the PPI PVC range composition and are published in PPI TR-4.

Table 1
PPI PVC Range Composition for Listing at 73°F (23°C)

Ingredient	**Qualification Requirements**	**Allowable Content Range** (in parts per hundred parts of resin)
PVC Resin	Compliance to B.1 and Listing with the PPI HSB	100
Heat Stabilizer	Compliance to B.2 and Listing with the PPI HSB	0.3 – 1.0
Calcium Stearate	Compliance to A.2	0.4 – 1.5
Paraffin Wax	Compliance to A.3	0.6 – 1.5
Polyethylene Wax	Compliance to A.4	0.0 – 0.3
Titanium Dioxide	Compliance to A.5	0.5 – 3.0
Calcium Carbonate	Compliance to A.6	0.0 – 5.0
Process Aid	Compliance to B.2 and Listing with the PPI HSB	0.0 – 2.0
Colorant	Compliance to B.2 and Listing with the PI HSB, or compliance to TR-3 Part D.1 Listing with PPI HSB	See listings in PPI TR-2 of qualified colorants

NOTE 1: See TR-2, Section IV for listing of Prequalified and Functionally Equivalent Ingredients

NOTE 2: Ingredient tables should be referenced for specific approved ranges. PHR levels outside of the general ranges shown are the result of HSB Special Case approvals. For more information on the HSB Special Case process, contact the PPI HSB Chair.

The pipe manufacturer is encouraged to perform some stress-rupture testing on any combination of ingredients that is new to him to ensure that the anticipated strength is realized under the selected processing conditions. One of the best means to check for proper processing is by use of either the Accelerated Regression Test (ASTM D 2241) or other long-term stress-rupture data generated in accordance with ASTM D 1598 and analyzed by the method of least squares as described in ASTM D 2837.

Part A.1 PVC Resin

This policy only applies to mass and suspension grades of PVC resins.

There are no pre-qualified PVC resins for the PPI PVC Generic Range Formulation. All PVC resins must be qualified according to Part B.

PVC Resin made in a new plant — For equivalent PVC resin that is currently listed in TR-2 that is made in a new plant, a provisional listing will be granted based on manufacturer's data supporting equality of the resin through chemical and physical property analysis. E-2 level hydrostatic data is required for a standard grade listing.

Part A.2 Calcium Stearate

The following guidelines are not to be considered as specifications or standards to indicate the requirements for calcium stearates, nor is it intended that they describe all the commercial calcium stearates that are suitable for use in polyvinyl chloride (PVC) plastic pipe compounds. The intent is only to give guidelines for alternative use of members of a group of commercial calcium stearates that are apparently chemically identical and that have been found by physio- chemical analysis, by engineering pipe testing, and by use of pipe in the field to be sufficiently similar in nature to produce pipe and fittings that are basically the same in properties and performance. Consideration has been given to physio-chemical analysis of the calcium stearates, long-term hydrostatic pressure testing of pipe, and requirements of the applicable pipe standards.

Commercial calcium stearates may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term pipe testing provided (1) the substitution is for the same amount, (2) the substitution in the compound is 1.5 parts or less per hundred parts of resin and (3) the properties fall within the ranges given below:

Property (see Note1)	**Units**	**Test Methods**	**Requirements**
Melting Point	°F (°C)	see NOTE 1	293 -329 (145 – 165)
Chlorides, as chloride ion	% max		0.3
Free fatty acid,	% max		1
Acid number			200 +/- 15 (see NOTE 2)
Iodine value	max		5 (see NOTE 2)
Volatile content, at 221°F (105°C)	% max		3.5
Ash (as CaO) at 1832°F (1000°C)	%		9.0 – 12.0
Iron	ppm max		100
Color			White to off-white
Particle Size			At least 95% through U.S. Standard 20 mesh

NOTE 1: The test methods shall be those commonly used in the calcium stearate industry.
NOTE 2: Acid number and iodine value apply to the stearic acid raw material.

Calcium stearates not meeting these guidelines may be evaluated as a functional equivalent in accordance with the policies and procedures in Part B of TR-2. When sufficient data, background, and successful usage, both in production and service, have been developed with other calcium stearates, they may be considered for inclusion in a new group under these guidelines.

Part A.3 Paraffinic Hydrocarbon Wax

The following guidelines are not to be considered as specifications or standards to indicate the requirements for hydrocarbon waxes, nor is it intended that they describe all the commercial hydrocarbon waxes that are suitable for use in polyvinyl chloride plastic (PVC) pipe compounds. The intent is only to give guidelines for the alternate use of members of a group of commercial paraffinic hydrocarbon waxes that have been found by physio-chemical analysis, by engineering pipe testing, and by use of pipe in the field to be sufficiently similar in properties and performance. Consideration has been given to physio-chemical analysis of the hydrocarbon waxes, long-term hydrostatic pressure testing of pipe, and requirements of the applicable standards (See Note 1).

Commercial paraffinic hydrocarbon waxes may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term pipe testing provided (1) the substitution is for the same amount, (2) the substitution in the compound is 1.5 parts or less per hundred parts of resin, (3) the particle size is approximately the same and (4) the properties fall within the ranges given below:

Property	Units	Test Method	Requirements
Chemical Type		See NOTE 1	Hydrocarbon wax*
Congealing Point, °F (°C)	°F (°C)	ASTM D938	149 – 169 (65 – 76)
Viscosity at 210°F	cSt	ASTM D445	5.5 – 7.5
Kinematic Carbon Number Distribution of Normal Hydrocarbon	%	ASTM D5442	Min 80% C26 – C50
			<20% C26 and below
			<10% above C50
			Zero above C85
Non-normal paraffin	% content	ASTM D5442	10 – 50
Needle Penetration (77°F)		ASTM D1321	10 – 18
Oil Content	% max	ASTM D721	1%
Flash point	°F (°C)	ASTM D92	449 (230)
Color (Saybolt)	min	ASTM D156	+10
Acid Number	max	ASTM D1386	0.5
Density	g/cm3	ASTM D792	0.915 – 0.940
Physical Appearance			Small uniform flake Prill or powder**

*Hydrocarbon waxes containing linear and branched chains with carbon numbers from C20 to C60.
**This requirement is not applicable when the wax is added as a liquid.

NOTE 1: Hydrocarbon waxes not meeting these guidelines may be evaluated as a functional equivalent in accordance with the policies and procedures in Part B of TR-2. When sufficient data, background, and successful usage, both in production and service, have been developed with other hydrocarbon waxes, they may be considered for inclusion in a new group under these guidelines.

NOTE 2: The test methods not prescribed shall be those currently used in the industry.

Part A.4 Polyethylene Wax

The following guidelines are not to be considered as specifications or standards to indicate the requirements for polyethylene waxes, nor is it intended that they describe all the commercial polyethylene waxes that are suitable for use in polyvinyl chloride (PVC) plastic pipe compounds. The intent is only to give guidelines for alternative use of members of a group of commercial polyethylene waxes that are apparently identical and that have been found by physio-chemical analysis, by engineering pipe testing, and by the use of pipe in the field to be sufficiently similar in nature to produce pipe and fittings that are basically the same in properties and performance. Consideration has been given to physio-chemical analysis of the polyethylene waxes, long-term hydrostatic pressure testing of pipe, and requirements of the applicable standards (See Note 1).

Commercial polyethylene waxes may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term pipe testing provided (1) the substitution is for the same amount, (2) the substitution in the compound is 0.3 parts or less per hundred parts of resin and (3) the properties fall within the ranges given below:

Property	**Units**	**Test Method**	**Requirements**
Gardner Color (Molten Wax)	max	D1544	4
Flash point	min °F (°C)	D92	500 (260) open cup
			425 (218) closed cup
Ring and Ball Softening Point Or Mettler Drop Point Test	°F (°C) °F (°C)	E28 D3954	210 - 225 (99 - 107) 203 - 221 (95 - 105)
Thermosel Viscosity @ 283°F		D3236	70 – 400
Penetration Hardness		D5	3 – 6
Acid Number, mg KOH/g	(1)		10 – 18

(1) The test method may be any that is commonly used by the industry such as Allied Chemical W-305-TW-1 or Eastman Chemical ECD 27-102.

NOTE 1: Polyethylene waxes not meeting these guidelines may be evaluated as a functional equivalent in accordance with the policies and procedures in Part B of TR-2. When sufficient data, background, and successful usage, both in production and service, have been developed with other polyethylene waxes, they may be considered for inclusion in a new group under these guidelines.

Part A.5 Titanium Dioxide

The following guidelines are not to be considered as specifications or standards to indicate the requirements for titanium dioxides, nor is it intended that they describe all the commercial titanium dioxides that are suitable for use in polyvinyl chloride (PVC) plastic pipe compounds. The intent is only to give guidelines for alternative use of members of a group of commercial titanium dioxides that are apparently chemically identical and that have been found by physiochemical analysis, by engineering pipe testing, and by use of pipe in the field, to be sufficiently similar in nature to produce pipe and fittings that are basically the same in properties and performance. Consideration has been given to physiochemical analysis of the titanium dioxides, long-term hydrostatic pressure testing of pipe, and requirements of the applicable pipe standards. (See Note 1)

Commercial titanium dioxides may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term pipe testing provided (1) the substitution is for the same amount, (2) the substitution in the compound is three parts or less per hundred parts of resin, and (3) they meet the following requirements:

Property	**Units**	**Test Methods**	**Requirement**
Crystal structure		see NOTE 1	Rutile
Particle size	Average microns		0.10 - 0.35
Retained on 325 mesh screen	% max		0.2
Titanium dioxide content	% min		92
Chemical modification			alumina and/or silica
Carbon content, at 1652°F (900°C) - burn and measure carbon dioxide	% max		0.3
Volatile content loss at 221°F (105°C)	% max		0.7
Specific gravity			4.0 - 4.3

NOTE 1: Titanium dioxides not meeting these guidelines may be evaluated as a functional equivalent in accordance with the policies and procedures in Part B of TR-2. When sufficient data, background and successful usage, both in production and service, have been developed with other titanium dioxides, they may be considered for inclusion in a new group under these guidelines.

NOTE 2: The test methods shall be those described in ASTM D 476, "Standard Specification for Titanium Dioxide Pigments."

Part A.6 Calcium Carbonate

The following guidelines are not to be considered as specifications or standards to indicate the requirements for calcium carbonate, nor is it intended that they describe all the commercial calcium carbonates that are suitable for use in polyvinyl chloride (PVC) plastic pipe and fitting compounds. The intent is only to give guidelines for the alternative use of members of two groups of commercial calcium carbonates that are apparently chemically identical (within each group) and that have been found by physio-chemical analysis, by engineering pipe testing, and by use of pipe in the field to be sufficiently similar (within each group) in nature to produce pipe and fittings that are basically the same in properties and performance. Consideration has been given to physio-chemical analysis of the calcium carbonates, long-term hydrostatic pressure testing of pipe, and requirements of the applicable pipe standards.

These guidelines cover two separate groups of calcium carbonates, Group A in which the particles are not coated with another material and Group B in which the particles are coated with commercial calcium stearate and/or stearic acid. Substitutions may be made within a group but not from one group to the other (See Note 1).

Group A (uncoated particles)
Uncoated commercial calcium carbonates may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term testing provided (1) the substitution is for the same amount, (2) the amount used in the compound is five parts or less per hundred parts of resin, and (3) the properties fall within the ranges given below:

Property	Units	Test Methods	Requirements
General Description	Calcium Carbonate (uncoated particles)		
Chemical Analysis			
Calcium carbonate analysis	% min	(PMD Test Methods – See Appendix B)	94.00%
Iron, as ferric oxide	% max		0.25%
Silica, SiO_2	% max		1.25%
Weight loss at 221°F (105°C)	% max		0.50%
Particle Properties			
Type		(PMD Test Methods – See Appendix B)	Microcrystalline
Size, range	micron		0.02 – 15.00
Size, mean	micron		0.05 – 3.50
Other Properties			
Density	g/cm^3	(PMD Test Methods – See Appendix B)	2.65 – 2.71

Group B (Stearate coated)

Stearate coated commercial calcium carbonates may be substituted one for another in polyvinyl chloride (PVC) plastic pipe and fitting compounds without additional long-term pipe testing provided (1) the substitution is for the same amount, (2) the amount used in the compound is five parts or less per hundred of resin, and (3) the properties fall within the ranges given below:

Property	Units	Test Methods	Requirements
General Description	Calcium Carbonate coated with calcium stearate (See NOTE 1)		
Chemical Analysis			
Calcium carbonate analysis	% min	(PMD Test Methods – See Appendix B)	93.00%
Iron, as ferric oxide	% max		0.25%
Silica, SiO_2	% max		1.25%
Weight loss at 221°F (105°C)	% max		0.50%
Fatty acids - as stearic acid			0.75 - 2.00
Particle Properties			
Type		(PMD Test Methods – See Appendix B)	Microcrystalline
Size, range	micron		0.02 – 15.00
Size, mean	micron		0.05 – 3.50
Other Properties			
Density	g/cm3	(PMD Test Methods – See Appendix B)	2.65 – 2.71

(a) This group covers commercial calcium carbonates in which the particles are coated with commercial grades of calcium stearate and/or stearic acid. The fatty acid mixtures in these stearates are over 50 percent by weight stearic acid (C18) with other fatty acids, mainly palmitic (C16) and a small amount of myristic (C14).

NOTE 1: Calcium carbonates not meeting either of these two groups of guidelines may be evaluated as a functional equivalent in accordance the policies and procedures in Part B of TR-2. When sufficient data, background, and successful usage both in production and service have been developed with other calcium carbonates, they may be considered for inclusion in a new group under these guidelines.

Part B. PVC Resin, Functionally Equivalent and Other Ingredients Not Exempted from Stress-Rupture Testing - Data Requirements for Listing at 73ºF (23ºC)

An individual or combination ingredient that does not meet the allowable content range in Table 1 or the physical property requirements of Part A is a functionally equivalent ingredient and is not exempt from stress rupture testing. All functionally equivalent ingredients are published in the appropriate tables in TR-2.

The principal consideration in the establishment of policies and rulings regarding the determination of equivalence of a commercially offered ingredient for its use in PPI's PVC Range Composition is the potential adverse effect that the subject ingredient can have on the short-term and the long-term properties of the resultant composition. This composition must always be formulated so that it is in compliance with the ASTM requirements for PVC 1120 materials, Class 12454 as per ASTM D 1784. A particular concern of the HSB is that the longterm hydrostatic strength of this composition should always satisfy the ASTM requirements for a hydrostatic design basis (HDB) of 4,000 psi (27.58 MPa) for water at 73.4°F (23°C). It is not the HSB's role to consider the effect of the use of an alternate ingredient on the quality of the fluid that may be transported by the piping made from PPI's PVC Range Composition. This consideration is left to others. In the case of the transport of potable water the most commonly referenced standards that address this issue are NSF/ANSI Standard 14, "Plastics Piping Systems components and Related Materials", and NSF/ANSI Standard 61, "Drinking Water System Components — Health Effects". Agencies, such as NSF International, have established programs by which plastic piping compositions, including each of the composition's ingredients, are evaluated in accordance with these standards and listed when found acceptable. Because of their additional health effects criteria, some of the ingredients listed in this report may not be included in listing issued by these certifying agencies. Agencies certifying compliance to the above listed NSF/ANSI standards should be contacted for the specifics relating their listing programs.

This policy is intended only to apply to the PPI Range Composition, with alternative formulation components that have been determined to be satisfactory for the commercial production of PVC pressure pipe yielding a 4,000-psi HDB for water at 73ºF (23ºC). The requirements given herein are not to be considered as specifications or standards that describe the only PVC range formulation and components suitable for production of PVC 1120 or PVC 1220 pipe.

Part B.1 PVC Resin

This policy only applies to suspension and mass grades of PVC resins.

1. The PVC resin must meet the property requirements given below:

Property	Units	Test Method	Requirements
Type of Material			PVC Homopolymer
Inherent Viscosity		ASTM D1243	0.88 - 0.96
Heat Loss (water)	wt%	1 Hr @ 221˚F (105˚C)	0.5 max
Apparent Bulk Density	gm/cc	ASTM D1895	0.46 - 0.62
Compacted Bulk Density	gm/cc		0.54 - 0.72
RVCM			10 ppm max

2. Stress-rupture data obtained on commercially produced pipe from a PVC composition with components falling within the ranges given in Part A, except for liquid stabilizer and calcium carbonate which must be at the maximum levels, confirm that the use of the alternate PVC resin yields the anticipated HDB of 4,000 psi for water for 73ºF (23ºC). The data must be obtained in accordance with TR-3 and evaluated according to ASTM D 2837.
   a. Experimental listing of a new PVC resin shall be available upon the presentation of acceptable E-2 or higher-grade data for one lot of pipe. The experimental listing expires one year following the effective date. The owner of an experimental listing must understand there is a potential risk in commercial sale of an experimental ingredient in case it does not meet all theTR-2 requirements.
   b. Standard listing, with no expiration date, shall be available upon the presentation of acceptable E-10, or higher-grade data for one lot and E-2, or higher-grade data on two other lots.

Part B.2 Heat Stabilizer, Process Aid, Colorant and other Components Not Complying to Part A

Any heat stabilizer, process aid, or colorant and any calcium stearate, paraffin wax, polyethylene wax, titanium dioxide or other ingredient not meeting the guidelines given in Part A will be accepted for listing when the appropriate stress-rupture data confirm the anticipated HDB of 4,000 psi for water at 73°F (23°C) when evaluated according to ASTM D 2837. The data shall be obtained on commercially produced pipe and from a composition that falls within the ranges listed in Part A except for the subject component that shall be at the maximum proposed use level. In cases where the minimum proposed use level is greater than zero, the composition shall be formulated in two lots with the subject component at the maximum proposed use level and with the subject component at the minimum proposed use level. The data must be obtained in accordance with TR-3 and evaluated according to ASTM D 2837.

a. Experimental listing of the component shall be available upon the presentation of acceptable E-2 or higher-level data for one lot of pipe that has been formulated with the subject component at the maximum proposed use level (for approval of a liquid colorant, this lot of pipe also has to be made with maximum amount of paraffin wax). The experimental listing expires one year following its effective date. The owner of an experimental listing must understand there is a potential risk in commercial sale of an experimental ingredient in case it does not meet all the TR-2 requirements.

b. Standard listing, with no expiration date, shall be available upon the presentation of acceptable E-10 or higher-grade data for one lot and E-2 or higher-grade level data for two other lots. One of these lots of pipe shall include the subject component at the minimum proposed use level as required per the above paragraph. Each of these three lots shall be formulated with different qualified PVC resin.

Part C. Standard Industry Practice of High Intensity Mixing of PVC Pipe Compounds

It is recognized that the method of mixing affects dispersion of ingredients in compounds and potentially the quality of pipe. Therefore, when qualifying new chemically equivalent ingredients to the current ***PPI Range Formula*** the method of mixing is to be described.
Part E.1 of TR-3 describes the standard industry practice of high intensity mixing of PVC pipe compounds.

Part D – Requirements for Obtaining a Dependent Listing Under the PPI PVC Range Composition

Part D.1 – Initial Data Requirements

This policy details the information and data requirements for obtaining an initial dependent listing of a PPI PVC Range Composition. The intended owner of the dependent listing shall provide the PPI HSB Chair, on a confidential basis, with the following information in writing by completion of a request letter. An example request letter, in an electronic template format, is available on the PPI HSB web section.

1. The identification by which the resultant dependent listing is to be listed
2. Stress rupture data generated per ASTM D1598 at 73°F obtained on pipe made from the subject formulation, with data point distribution per PPI TR-3, Part A.1.2.1, Experimental Grade level E2.
3. Complete details of the formulation used to generate the submitted stress rupture data.
4. The cell classification, when determined in accordance with ASTM D1784, of the formulation that was used to generate the submitted stress rupture data.

An example request letter, in an electronic template format, is available on the PPI HSB web section.

IV. Listing of Pre-qualified and Functionally Equivalent Ingredients

TABLE 1 – PVC RESIN

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
PVC Resin	Listing by PPI or compliance 100.0 to Section III Part A.1	100.0

PVC Resin

Manufacturer	Product	Limitations	Range, phr
Braskem S.A.	NORVIC SP 767RA PROCESSA+		100.00
Finolex Industries Limited	FS-6701*		100.00
Formosa Plastics Corporation, U.S.A.	Formolon 622		100.00
Formosa Plastics Corporation, U.S.A.	Formolon 622F		100.00
Formosa Plastics Corporation, U.S.A.	Formolon 622S		100.00
Formosa Plastics Corporation, U.S.A.	Formolon S-65		100.00
Oxy Vinyls, LP	OxyVinyls 225		100.00
Oxy Vinyls, LP	OxyVinyls 225 G		100.00
Oxy Vinyls, LP	OxyVinyls 225 P		100.00
Shintech, Inc.	SE1100		100.00
Shintech, Inc.	SE-950		100.00
Shintech, Inc.	SE-950EG		100.00
Shintech, Inc.	SE-950W		100.00
Westlake Chemical Corporation	Georgia Gulf 1091		100.00
Westlake Chemical Corporation	Georgia Gulf 5385		100.00
Westlake Chemical Corporation	Westlake 1230P_K		100.00

* Denotes experimental or provisional listing

TABLE 2 – HEAT STABILIZER

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Heat Stabilizer	Listing by PPI	0.3 - 1.0 (unless otherwise stated)

Heat Stabilizer

Manufacturer	Product	Limitations	Range, phr
Galata Chemicals	Mark 1925		0.30 - 1.00
Galata Chemicals	Mark 1930		0.30 - 1.00
Galata Chemicals	Mark 1939		0.30 - 1.00
Galata Chemicals	Mark 1942*		0.30 - 1.00
Galata Chemicals	Mark 1971		0.30 - 1.00
Galata Chemicals	Mark 1971L		0.30 - 1.00
Galata Chemicals	Mark 2903		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-181FS		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-283SP		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-3412		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-691		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-694		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-694-OM		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-696		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-697		0.20 - 1.00
PMC Organometallix, Inc.	Advastab TM-697-OM		0.20 - 1.00
PMC Organometallix, Inc.	Advastab TM-698		0.30 - 1.00
PMC Organometallix, Inc.	Advastab TM-900F		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 121		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 130		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 135		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 140		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 150		0.30 - 0.40
PMC Organometallix, Inc.	Thermolite 161		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 170		0.30 - 0.50
PMC Organometallix, Inc.	Thermolite 176		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 176C		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 178		0.30 - 1.00
PMC Organometallix, Inc.	Thermolite 197		0.30 - 1.00
Reagens USA	REA TIN OR RT 6610		0.30 - 1.00
Reagens USA	REA TIN OR RT 6610 M		0.30 - 1.00
Reagens USA	REA TIN OR RT 6611		0.30 - 1.00
Reagens USA	REA TIN OR RT 6611 A		0.30 - 1.00
Reagens USA	REA TIN OR RT 6611 S		0.30 - 1.00
Reagens USA	REA TIN OR RT 6612		0.30 - 1.00
Reagens USA	REA TIN OR RT 6631		0.30 - 1.00
Reagens USA	REA TIN OR RT 6634		0.30 - 1.00
Reagens USA	REA TIN OR RT 6638		0.30 - 1.00
Reagens USA	REA TIN OR RT 6640		0.30 - 1.00
Reagens USA	REA TIN OR RT 6650		0.30 - 1.00
Reagens USA	REA TIN OR RT 6676		0.30 - 1.00

* Denotes experimental or provisional listing

Manufacturer	Product	Limitations	Range, phr
Reagens USA	REA TIN OR RT 6676 S		0.30 - 1.00
Valtris Specialty Chemicals	Akcrostab T-5277		0.30 - 1.00
Valtris Specialty Chemicals	Akcrostab T-5311P		0.30 - 1.00

* Denotes experimental or provisional listing

TABLE 3A – CALCIUM STEARATE

Note – Tables of Prequalified Ingredients contain products commonly used by industry. Calcium stearates in compliance with Section III Part A.2 need not appear on this table to be used in the PPI Range Composition.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Calcium Stearate	Compliance to Section III Part A.2	0.4 - 1.5

Calcium Stearate

Manufacturer	Product	Limitations	Range, phr
Dover Chemical Corporation	Doverlube CA-20		0.40 - 1.50
Dover Chemical Corporation	Doverlube CA-21		0.40 - 1.50
Valtris Specialty Chemicals	Synpro Calcium Stearate 12B		0.40 - 1.50
Valtris Specialty Chemicals	Synpro Calcium Stearate 15F		0.40 - 1.50

* Denotes experimental or provisional listing

TABLE 3B – CALCIUM STEARATE FUNCTIONAL EQUIVALENT

Note – Cannot be used with other functional equivalents.

Calcium Stearate Functional Equivalent

Manufacturer	Product	Limitations	Range, phr

* Denotes experimental or provisional listing

TABLE 4A – PARAFFIN WAX

Note – Tables of Prequalified Ingredients contain products commonly used by industry. Paraffin waxes in compliance with Section III Part A.3 need not appear on this table to be used in the PPI Range Composition.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Paraffin Wax	Compliance to Section III Part A.3	0.6 - 1.5

Paraffin Wax

Manufacturer	Product	Limitations	Range, phr
Honeywell Inc.	RL 165		0.60 - 1.50
Honeywell Inc.	RL 250		0.60 - 1.50
International Group	INTERFLO 66		0.60 - 1.50
International Group	INTERFLO L-6530B		0.60 - 1.50
Masterank Wax, Inc	MR7073		0.60 - 1.50
Masterank Wax, Inc	MR7173		0.60 - 1.50
Reagens USA	Realube RW 70		0.60 - 1.50
Reagens USA	Realube RW 73		0.60 - 1.50
Rheogistics LLC	Synertive Rx-165		0.60 - 1.50
Rheogistics LLC	Synertive Rx-170		0.60 - 1.50
Valtris Specialty Chemicals	PETRAC 165		0.60 - 1.50
Valtris Specialty Chemicals	PETRAC 200		0.60 - 1.50

* Denotes experimental or provisional listing

TABLE 4B – PARAFFIN WAX FUNCTIONAL EQUIVALENT

Note – Cannot be used with other functional equivalents.

Paraffin Wax Functional Equivalent

Manufacturer	Product	Limitations	Range, phr
International Group	INTERFLO 39		0.60 - 1.50
Norac Additives	Norac XL-65A		0.70 - 1.60
Petro-Canada Lubricants, Inc	Puretol PSO 550		1.00 - 2.00
Reagens USA	RW 1600		0.60 - 1.50
Sasol Chemicals (USA) LLC	Sasolwax B52		0.60 - 1.10
Sasol Chemicals (USA) LLC	Sasolwax L6600		0.60 - 1.50
Sasol Chemicals (USA) LLC	Sasolwax L6800		0.60 - 1.00
Sasol Chemicals (USA) LLC	SASOLWAX P100		0.60 - 1.00
Sasol Chemicals (USA) LLC	SASOLWAX P200		0.60 - 1.00
Sonneborn, Inc.	HYDROBRITE PVC OIL		1.00 - 2.00

* Denotes experimental or provisional listing

TABLE 5A – POLYETHYLENE WAX

Note – Tables of Prequalified Ingredients contain products commonly used by industry. Polyethylene waxes in compliance with Section III Part A.4 need not appear on this table to be used in the PPI Range Composition.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Polyethylene Wax	Compliance to Section III Part A.4	0.0 – 0.3 (unless otherwise stated)

Polyethylene Wax

Manufacturer	Product	Limitations	Range, phr
Honeywell Inc.	A-C 629		0.00 - 0.50
Honeywell Inc.	A-C 629A		0.00 - 0.50
Rheogistics LLC	Synertive Rx-215		0.00 - 0.30
Rheogistics LLC	Synertive RX-729		0.00 - 0.30
Valtris Specialty Chemicals	PETRAC 215		0.00 - 0.30
Westlake Polymers	EPOLENE E-14		0.00 - 0.30
Westlake Polymers	EPOLENE E-14P		0.00 - 0.30

* Denotes experimental or provisional listing

TABLE 5B – POLYETHYLENE WAX FUNCTIONAL EQUIVALENT

Note – Cannot be used with other functional equivalents.

Polyethylene Wax Functional Equivalent

Manufacturer	Product	Limitations	Range, phr
Honeywell Inc.	A-C 307		0.00 - 0.50
Honeywell Inc.	A-C 307A		0.00 - 0.50
Honeywell Inc.	A-C 316		0.00 - 0.50
Honeywell Inc.	A-C 316 A		0.00 - 0.50
Sasol Chemicals (USA) LLC	Sasolwax A28		0.00 - 0.30

* Denotes experimental or provisional listing

TABLE 6A – TITANIUM DIOXIDE

Note – Tables of Prequalified Ingredients contain products commonly used by industry. Titanium Dioxides in compliance with Section III Part A.5 need not appear on this table to be used in the PPI Range Composition.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Titanium Dioxide	Compliance to Section III Part A.5	0.5 - 3.0

Titanium Dioxide

Manufacturer	Product	Limitations	Range, phr

* Denotes experimental or provisional listing

TABLE 6B – TITANIUM DIOXIDE FUNCTIONAL EQUIVALENT -- LIQUID DISPERSED

Note: PPI Range Composition requires 0.5-phr minimum titanium dioxide content meeting the requirements of Section III Part A.5. Functional equivalents must demonstrate equivalent weathering performance when formulated at their minimum use level.

Titanium Dioxide Functional Equivalent - Liquid Dispersed

Manufacturer	Product	Limitations	Range, phr
ColorMatrix Corp.	CC10201254, White	Note 1	0.60 - 2.00
ColorMatrix Corp.	CC10201255, White	Note 1	0.70 - 1.00
ColorMatrix Corp.	CC10201265, Blue	Note 1	0.70 - 1.10
ColorMatrix Corp.	CC10201269, White	Note 1	0.60 - 1.40
ColorMatrix Corp.	CC10201270, White	Note 1	0.60 - 1.40
ColorMatrix Corp.	CC10201414, Blue	Note 1	0.70 - 1.30
ColorMatrix Corp.	CC10201418, Bright White	Note 1	0.70 - 1.00
KibbeChem, Inc	KC-TI75 Blue	Note 2	0.67 - 1.35
KibbeChem, Inc	KC-TI75 Gray	Note 2	0.67 - 1.35
KibbeChem, Inc	KC-TI75 Green	Note 2	0.67 - 1.35
KibbeChem, Inc	KC-TI75 Purple	Note 2	0.67 - 1.35
KibbeChem, Inc	KC-TI75 White	Note 2	0.67 - 1.35
KibbeChem, Inc	KC-TI80 White	Note 2	0.63 - 1.35
KibbeChem, Inc	KC-TI85 White	Note 2	0.59 - 1.35
New Tech Color and Additives	WBM-00428V6 Blue White	Note 4	0.70 - 1.10
New Tech Color and Additives	WHM-00275V6 White	Note 4	0.60 - 1.40

* Denotes experimental or provisional listing

NOTE 1: When using any of the ColorMatrix liquid titanium dioxide dispersions, additional titanium dioxide may be added but it must be in dry form, comply with Section III Part A.5, and cannot exceed the following amounts:

Dispersion	Maximum additional TiO2 (phr)
CC10201414ES, Blue	2.0
CC10201265TT, Blue	1.75
CC10201255PP, White	2.1
CC10201418ES, Bright White	2.3
CC10201269TT, White	1.9
CC10201270TT, White	1.9
CC10201254TT, White	1.3

NOTE 2: When using any of the KibbeChem liquid titanium dioxide dispersions, additional titanium dioxide may be added, but it must be in dry form, comply with Section III Part A.5, and cannot exceed the following amounts.

Consult the manufacturer on requirements to add KC-TI175 Blue ingredients separately such that the level of the diluent does not exceed that set by KC-TI175 Blue.

Dispersion	Maximum additional TiO2 (phr)
KC-TI75 Blue	2.0
KC-TI75 Gray	2.0
KC-TI75 Green	2.0
KC-TI75 Purple	2.0
KC-TI75 White	2.0
KC-TI80 White	1.92
KC-TI85 White	1.85

NOTE 3: When using any of the Ferro Corporation liquid titanium dioxide dispersions, additional titanium dioxide may be added, but it must be in dry form, comply with Section III Part A.5, and cannot exceed the following amounts:

Dispersion	Maximum additional TiO2 (phr)
Spectraflo 98-105040	2.0

NOTE 4: When using any of the New Tech ColorÂ liquid titanium dioxide dispersions, additional titanium dioxide may be added, but it must be in dry form, comply with Section III Part A.5, and cannot exceed the following amounts:

Dispersion	Maximum additional TiO2 (phr)
WBM-00428V6 Blue White	2.23
WHM-00275V6 White	1.88

TABLE 6C – TITANIUM DIOXIDE FUNCTIONAL EQUIVALENT -- DRY POWDERS

Note – PPI Range Composition requires 0.5 phr minimum titanium dioxide content meeting the requirements of Section III Part A.5. Functional equivalents must demonstrate equivalent weathering performance when formulated at their minimum use level.

Titanium Dioxide Functional Equivalent - Dry Powders

Manufacturer	Product	Limitations	Range, phr
FP Pigments	FP 510*	Note 1	0.00 - 1.50
TOR Minerals	Hitox TiO2		0.50 - 3.00

* Denotes experimental or provisional listing

Note1 - When using FP-510 at the max. use level additional TiO2 will need to be added to meet the minimum level as required by the PPI PVC range formula. When using FP-530 additional TiO2 may also be needed. Additional TiO2 and CaCO3 may also be added up to the permitted maximum levels. When adding additional TiO2, it must be in dry form and meet the requirements of PPI TR-2 Part A.5. Additional CaCO3 must meet the requirements of PPI TR-2 Part A.6.

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TABLE 7A- CALCIUM CARBONATE

Note – Tables of Prequalified Ingredients contain products commonly used by industry. Calcium carbonates in compliance with Section III Part A.6 need not appear on this table to be used in the PPI Range Composition.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Calcium Carbonate	Compliance to Section III Part A.6	0.0 - 5.0

Calcium Carbonate

Manufacturer	Product	Limitations	Range, phr
	Hubercarb Q3T		0.00 - 5.00
Huber Carbonates	Hubercarb G2		0.00 - 5.00
Huber Carbonates	Hubercarb G2T		0.00 - 5.00
Huber Carbonates	Hubercarb G3		0.00 - 5.00
Huber Carbonates	Hubercarb G35		0.00 - 5.00
Huber Carbonates	Hubercarb G35T		0.00 - 5.00
Huber Carbonates	Hubercarb G3T		0.00 - 5.00
Huber Carbonates	Hubercarb Q2		0.00 - 5.00
Huber Carbonates	Hubercarb Q2T		0.00 - 5.00
Huber Carbonates	Hubercarb Q3		0.00 - 5.00
Huber Carbonates	Hubercarb Q3T		0.00 - 5.00
Huber Carbonates	Hubercarb W3N		0.00 - 5.00
Huber Carbonates	Optifil		0.00 - 5.00
Huber Carbonates	Optifil T		0.00 - 5.00
TechnoBrick S.A.DE C.V	TECHNOCARB-1T		0.00 - 5.00

* Denotes experimental or provisional listing

TABLE 7B- CALCIUM CARBONATE FUNCTIONAL EQUIVALENT

Note – Cannot be used with other functional equivalents.

Calcium Carbonate Functional Equivalent

Manufacturer	Product	Limitations	Range, phr
Huber Carbonates	Hubercarb M3		0.00 - 5.00
Huber Carbonates	Hubercarb M3T		0.00 - 5.00
Omya, Inc	PULPROWHITE 3 - SA		0.00 - 5.00
Specialty Minerals Incorporated	Ultra-Pflex		0.00 - 5.00

* Denotes experimental or provisional listing

TABLE 8 – PROCESSING AID

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Processing Aid	Listing by PPI	0.0 - 2.0 (unless otherwise stated)

Processing Aid

Manufacturer	Product	Limitations	Range, phr
Arkema, Inc.	PLASTICSTRENGTH 770		0.00 - 2.00
Arkema, Inc.	PLASTISTRENGTH 530		0.00 - 3.00
Arkema, Inc.	PLASTISTRENGTH 550		0.00 - 3.00
Arkema, Inc.	PLASTISTRENGTH 551		0.00 - 3.00
Dow Chemical Co.	Paraloid K-120 ND		0.00 - 2.00
Dow Chemical Co.	Paraloid K-175		0.00 - 1.00
Dow Chemical Co.	Paraloid KM-334		0.00 - 3.00
Dow Chemical Co.	Paraloid KM-390		0.00 - 3.00
Galata Chemicals	Blendex SA101		0.00 - 2.00
Galata Chemicals	Blendex SA106		0.00 - 2.00
Galata Chemicals	Blendex SA211		0.00 - 2.00
Galata Chemicals	Blendex SS311		0.00 - 2.00
Kaneka North America LLC	Kane Ace PA-10		0.00 - 2.00
Kaneka North America LLC	Kane Ace PA-20		0.00 - 2.00

* Denotes experimental or provisional listing

TABLE 9A – COLORANT – DRY POWDER

Note: – In accordance with Part D.1 of PPI TR-3, the amount of dry colorant may be changed (decreased, or increased) from the amount specified by as much as 0.5 phr without the need to submit confirmatory stress-rupture data. Thus, it is permissible to mix different dry colorants to achieve a desired color, so long as the resultant mixture meets the requirements of TR-3 Part D.1.

Ingredient Class	Qualification Requirement	Allowable Use Level (Phr)
Colorant	Listing by PPI	Product Specific

Colorant - Dry Powder

Manufacturer	Product	Limitations	Range, phr
Birla Carbon	Raven 410		0.00 - 0.20
Birla Carbon	Raven 520		0.00 - 0.20
Cabot Corporation	BLACK PEARLS 880		0.00 - 0.14
Cabot Corporation	MONARCH 700		0.00 - 0.20
Cabot Corporation	REGAL 660		0.00 - 0.20
Cabot Corporation	REGAL 660R		0.00 - 0.20
Holland Colours, Inc.	Holcobatch C Black 938996		0.00 - 1.00
Holland Colours, Inc.	Holcobatch C Blue 93108 F		0.00 - 0.50
Holland Colours, Inc.	Holcobatch C Blue 934884 F		0.00 - 1.00
Holland Colours, Inc.	Holcobatch C Green 93427 F		0.00 - 0.50
Holland Colours, Inc.	Holcobatch C Violet 934690		0.00 - 0.50
Holland Colours, Inc.	Holcobatch C Yellow 93055 F		0.00 - 0.50
KibbeChem, Inc	KC-MP Black		0.00 - 0.50
KibbeChem, Inc	KC-MP Blue		0.00 - 0.50
KibbeChem, Inc	KC-MP Green		0.00 - 0.50
KibbeChem, Inc	KC-MP Purple		0.00 - 0.50
KibbeChem, Inc	KC-MP Tan		0.00 - 0.50
KibbeChem, Inc	KC-MP Yellow		0.00 - 0.50
KibbeChem, Inc	KC-MP Yellow Green		0.00 - 0.50
Tri-Tex Co. Inc	Tricolith Blue GLS		0.00 - 0.10

* Denotes experimental or provisional listing

TABLE 9B – COLORANT – LIQUID DISPERSED

Note – Liquid dispersed colorant may not be combined with other liquid dispersed colorants

Colorant - Liquid Dispersed

Manufacturer	Product	Limitations	Range, phr
ColorMatrix Corp.	CC10201262, Violet		0.00 - 0.10
ColorMatrix Corp.	CC10201264, Blue		0.00 - 0.40
ColorMatrix Corp.	CC10201271, Purple		0.00 - 0.50
ColorMatrix Corp.	CC10201272, Brown		0.00 - 0.30
ColorMatrix Corp.	CC10201273, Black		0.00 - 0.50
ColorMatrix Corp.	CC10201274, Yellow		0.00 - 0.40
ColorMatrix Corp.	CC10201275, Violet		0.00 - 0.50
ColorMatrix Corp.	CC10201283, Blue		0.00 - 0.40
ColorMatrix Corp.	CC10201284, Brown		0.00 - 0.40
ColorMatrix Corp.	CC10201285, Gray		0.00 - 0.90
ColorMatrix Corp.	CC10201288, Black		0.00 - 0.43
ColorMatrix Corp.	CC10201415, Blue		0.00 - 1.20
ColorMatrix Corp.	CC10201416, Blue		0.00 - 0.45
ColorMatrix Corp.	CC10201417, Blue		0.00 - 0.41
ColorMatrix Corp.	CC10201419, Dark Gray		0.00 - 0.85
ColorMatrix Corp.	CC10201420, Black		0.00 - 0.34
ColorMatrix Corp.	CC10201421, Brown		0.00 - 0.40
ColorMatrix Corp.	CC10256367, Green		0.00 - 0.40
KibbeChem, Inc	KC-LD Black		0.00 - 0.50
KibbeChem, Inc	KC-LD Blue		0.00 - 0.50
KibbeChem, Inc	KC-LD Green		0.00 - 0.50
KibbeChem, Inc	KC-LD Purple		0.00 - 0.50
KibbeChem, Inc	KC-LD Tan		0.00 - 0.50
KibbeChem, Inc	KC-LD Yellow		0.00 - 0.50
KibbeChem, Inc	KC-LD-Yellow Green		0.00 - 0.50
New Tech Color and Additives	BLM-00429V6 Blue		0.00 - 0.40
New Tech Color and Additives	TKM-00714V6 Black		0.00 - 0.50

* Denotes experimental or provisional listing

TABLE 10 – COMBINATION INGREDIENT PACKAGE

A set ratio of a pre-blended combination of pre-qualified ingredients under TR-2 policies. This table lists the percentage of the maximumallowable usage under the PPI generic range formulation (see Table I) that each ingredient contributes when used at its maximum use range. Additional amounts of other qualified ingredients can be added, but the total combined percentage can not exceed 100% of the allowable. See the example following this table.

Combination Ingredient Package

Manufacturer	Product	Range, phr		Heat Stabilizer	Calcium Stearate	Paraffin Wax	Polyethylene Wax	Titanium Dioxide	Calcium Carbonate	Processing Aid
		min	max							
Galata Chemicals	Mark 2910	1.32	1.97	47%		100%				
Honeywell Inc.	RL 315	0.70	1.50			89%	55%			
Honeywell Inc.	RL 410	0.70	1.65			99%	55%			
Honeywell Inc.	RL 415	0.70	1.75			99%	88%			
Honeywell Inc.	RL 420	0.70	1.50			80%	100%			
International Group	INTERFLO L-355	0.60	1.50			89%	55%			
International Group	INTERFLO L-4853A	0.75	1.50			80%	100%			
International Group	INTERFLO L8688A	0.70	1.67		56%	56%				
International Group	INTERFLO L8688B	1.20	3.00		100%	80%	100%			
International Group	INTERFLO L8688C	1.20	2.30		46%	100%	38%			
KibbeChem, Inc	KC-TI80 WC	0.63	3.75			50%		100%		
Masterank Wax, Inc	MR7010	0.67	1.50			90%	50%			
Masterank Wax, Inc	MR7577	0.80	1.67		56%	56%				
PMC Biogenix	ADVAPAK LS-203R	1.95	2.77	43%	39%	99%	62%		1%	
PMC Biogenix	ADVAPAK S-1201R	2.08	2.60	37%	37%	100%	41%		1%	
PMC Biogenix	ADVAPAK S-1203R	2.40	2.52	32%	38%	100%	27%		1%	
Reagens USA	Realube RW 9310	0.54	1.66			100%	55%			
Reagens USA	Realube RW 9310-3	0.54	1.66			100%	55%			
Reagens USA	RW 7030	1.33	2.14		43%	100%				
Reagens USA	SL 25	1.68	2.58	27%	41%	100%	65%			
Rheogistics LLC	Synertive Rx-2675	1.50	2.25		40%	99%	56%			

Manufacturer	Product	Range, phr		Heat Stabilizer	Calcium Stearate	Paraffin Wax	Polyethylene Wax	Titanium Dioxide	Calcium Carbonate	Processing Aid
		min	max							
Rheogistics LLC	Synertive Rx-3075	1.50	2.40		48%	100%	60%			
Rheogistics LLC	Synertive Rx-310	0.54	1.66			100%	55%			
Rheogistics LLC	Synertive RX-313	0.80	1.73			100%	77%			
Rheogistics LLC	Synertive Rx-315-S	0.70	1.76			100%	88%			
Rheogistics LLC	Synertive Rx-320	0.74	1.60			87%	100%			
Rheogistics LLC	Synertive Rx-320-S	0.75	1.50			80%	100%			
Rheogistics LLC	Synertive Rx-3370	1.50	2.50		56%	100%	58%			
Rheogistics LLC	Synertive Rx-5050	0.80	2.00		67%	67%				

Note 1 - Intercoastal ISM Brite White 1000 - contains dry pigment and cannot be combined with additional pigments when utilized.

Using Table 10

Percentages shown in Table 10 are the percentages each Pre-qualified Ingredient present, in the Combination Package, contributes toward the maximum allowed in the PPI Range Formula when that package is used at the maximum phr of its range.

Example:

Manufacturer	Product	Range [phr]		Heat Stabilizer	Calcium Stearate	Paraffin Wax	Polyethylene Wax	Titanium Dioxide	Calcium Carbonate	Processing Aid
Rheogistics LLC	Synertive Rx-3370	1.50 2.50			56%	100%	58%			

When the above package is used at 2.5 phr (PVC resin) it contributes the following phr of each ingredient to the blended compound:

Product	Ingredient	Contribution	PPI Maximum	Contribution to blend
Synertive Rx-3370	Heat Stabilizer	0%	1.0 phr	0.00 phr
	Calcium Stearate	56%	1.5 phr	0.84 phr
	Paraffin Wax	100%	1.5 phr	1.5 phr
	Polyethylene Wax	58%	0.3 phr	0.174 phr
	Titanium Dioxide	0%	3.0 phr	0.00 phr
	Calcium Carbonate	0%	5.0 phr	0.00 phr
	Processing Aid	0%	2.0 phr	0.00 phr

TABLE 11 – FUNCTIONALLY EQUIVALENT INGREDIENT PACKAGE

A set ratio of a pre-blended combination of ingredients containing one or more ingredients that is not pre-qualified under thepolicies of TR-2. This table lists the percentage of the maximum allowable usage under the PPI generic range formulation(see Table I) that each ingredient contributes when used at its maximum use range. Additional amounts of other qualified ingredients can be added, but the total combined percentage can not exceed 100% of the allowable. **The addition of other Functional Equivalent Ingredients is not allowed.** See the example following this table.

Functionally Equivalent Ingredient Package

Manufacturer	Product	Range, phr		Heat Stabilizer	Calcium Stearate	Paraffin Wax	Polyethylene Wax	Titanium Dioxide	Calcium Carbonate	Processing Aid
		min	max							
Honeywell Inc.	HPL-6875	0.60	1.50			100%				
Honeywell Inc.	RL 1800	0.65	1.15		54%	23%				
Honeywell Inc.	TLP-2020	1.60	2.38		47%	100%	59%			
Honeywell Inc.	TLP-2030	1.60	2.45		54%	97%	61%			
Honeywell Inc.	TLP-2620	1.65	2.48		46%	99%	100%			
KibbeChem, Inc	KC-TI75S White (Note 1)	0.66	1.50	15%				45%		
Norac Additives	Norac XL-207	0.70	1.80			106%	72%			
PMC Biogenix	ADVALUBE B-3020	1.20	2.53		56%	100%	63%			
PMC Biogenix	ADVAPAK LS-203NHS	1.95	2.77	43%	39%	99%	62%		1%	
PMC Biogenix	ADVAPAK S-1201	2.08	2.60	37%	37%	100%	41%		1%	
PMC Biogenix	ADVAPAK S-1203	2.40	2.52	32%	38%	100%	27%		1%	
Reagens USA	RLS 5000	0.00	2.25		42%	98%	53%			
Reagens USA	RW 4545	0.89	2.20		66%	66%	73%			
Reagens USA	RW 5050	0.00	2.00		67%	67%				
Reagens USA	RW 9010	0.67	1.60			96%	53%			
Rheogistics LLC	Synertive Rx-2977	1.50	2.24		40%	100%	46%			
Rheogistics LLC	Synertive Rx-2990	1.60	1.85		32%	78%	68%			
Rheogistics LLC	Synertive Rx-4252	1.20	2.81		79%	100%	46%			

Using Table 11

Percentages shown in Table 11 are the percentages the package contributes in terms of functionality toward the maximums allowed in the PPI Range Formula when that package is used at the maximum phr of its range.

Example:

Manufacturer	Product	Range [phr]		Heat Stabilizer	Calcium Stearate	Paraffin Wax	Polyethylene Wax	Titanium Dioxide	Calcium Carbonate	Processing Aid
Reagens USA	RLS 5000	0.00 2.25			42%	98%	53%			

When the above package is used at 2.25 phr (PVC resin) it contributes the following phr of each ingredient to the blended compound:

Product	Ingredient	Contribution	PPI Maximum	Contribution to blend
Synertive Rx-3370	Heat Stabilizer	0%	1.0 phr	0.00 phr
	Calcium Stearate	42%	1.5 phr	0.63 phr
	Paraffin Wax	98%	1.5 phr	1.47 phr
	Polyethylene Wax	53%	0.3 phr	0.16 phr
	Titanium Dioxide	0%	3.0 phr	0.00 phr
	Calcium Carbonate	0%	5.0 phr	0.00 phr
	Processing Aid	0%	2.0 phr	0.00 phr

The addition of supplemental **pre-qualified ingredients** is allowed up to the PPI Maximum. **The addition of Functional Equivalent Ingredients is not allowed.** In those instances where the use level of the package contributes less than the minimum use level specified in the PPI Range Formulation, the addition of supplemental pre-qualified ingredients is required.

APPENDIX A – Example Letter for Requesting a Dependent Listing for the PPI PVC Generic Range Formulation

**The request template is available on the PPI HSB web page.

APPENDIX B

PMD Test Procedures & References for the Evaluation of Calcium Carbonate

PMD-1: Calcium Carbonate Analysis**:** Acceptable data is generated when using EDTA titration procedures as per ASTM-C25 or equivalent, or as listed in the assay procedures of the current edition of Food Chemicals Codex for Limestone, Ground.

PMD-2: Iron, as Ferric Oxide: Acceptable data is generated when using wet chemical analysis as per ASTM-C25 or equivalent, or when using firmly established Atomic Absorption methods.

PMD-3: Silica, SiO2: Acceptable data is generated when using wet chemical analysis as per ASTM-C25 or equivalent, or using firmly established X-ray diffraction methodology.

PMD-4: Weight Loss at 221 deg. F.: Acceptable data is generated when using an oven method as described in ASTM-C25 or equivalent.

PMD-5: Fatty acids as stearic acid: Acceptable data is generated when using a heated weight loss procedure as described in Appendix A as published by the PMD or by using firmly established thermo gravimetric analysis (TGA) methods.

PMD-6: Particle type: Visual inspection via optical or SEM microscopy.

PMD-7: Particle Size, range & mean: Acceptable data is generated when using a Sedigraph* and following procedures as described in ASTM-D1199 or equivalent.

PMD-8: Density: Acceptable data is generated when following procedures as described in ASTM-D153 and C188 or their equivalents.
Sedigraph: Micromeritics, One Micromeritics Drive, Norcross, Ga. 30093-1877
Procedure for the determination of the organic treatment found on Stearate Treated Ground Limestone (Weight Difference Method).

Scope: This method of test is intended for the determination of stearate treated ground limestone products using a weight difference method.

Method: Weight loss is carefully determined when a ground limestone sample that has been stearate treated is heated to a temperature of 400 deg. C.

Apparatus:

a) Crucibles, porcelain, 30 ml. Capacity with cover.
b) Muffle Furnace, capable of maintaining 400 deg. C. + or - 10 deg. C.
c) Analytical balance accurate to 0.1 mg.
d) Dessicator

Procedure:

a) Dry approximately 5 grams of the stearate treated limestone product and approximately 5 grams of the limestone product prior to treatment with stearate, at 105 deg. C. for 2 hours. Cool in a dessicator.
b) Transfer the crucibles containing the limestone samples, treated and untreated, to a separate, previously ignited, weighed porcelain crucible and cover. The crucible and cover should have been cooled in a dessicator after ignition and weighed to 0.1 mg.
c) Weigh the crucibles containing the limestone samples, and the covers to 0.1 mg.
d) Remove the cover and place it and the crucibles containing the limestone samples in the muffle furnace. Heat the samples to 400 deg. C. for 1.5 hours.
e) Replace the covers, cool in dessicator and weigh to 0.1mg. To assure that constant weight has been achieved, heat the samples again for 30 minutes at 400 deg. C., cool and weigh.
f) Determine the percent weight loss in each crucible.

$L_W = [SC_B - SC_A \times 100] / [SC_B - C_T]$

Where:

L_W = % Loss of Weight

C_T = Tare Weight of Crucible and Cover

SC_B = Weight of Sample, Crucible and Cover before heating

SC_A = Weight of Sample, Crucible and Cover after heating

Reporting: The amount of stearate treatment in percent should be reported. The following calculation can be used to determine the amount of stearate treatment in percent.

$P_T = L_WT - L_WU$

Where:

P_T = Amount of Treatment in Percent

L_WT = % Loss of Weight of the Treated Sample

L_WU = % Loss of Weight off the Untreated Sample

Precision: Duplicate determinations should agree within plus or minus 0.1%.

APPENDIX C

CALCULATION EXAMPLE TO CONVERT PVC COMPOUND FORMULATIONS FROM PHR TO WEIGHT PERCENT

GIVEN: A typical PVC pressure pipe compound formulation is expressed in PHR, or parts of a specific ingredient per 100 parts resin used. This makes batching calculations easier. PHR is not the same as weight percent, but the conversion from one basis to the other is fairly straight forward.

An example of such a formulation is given in the Table below.

Ingredient Type	**PHR**	**Weight Percent** (%)
Resin	100.00	92.57
Heat Stabilizer	0.70	0.65
Paraffin	1.20	1.11
PE Wax	0.15	0.14
Calcium Carbonate	5.00	4.63
Titanium Dioxide	0.50	0.46
Pigment	0.03	0.03
Calcium Stearate	0.45	0.42
TOTAL	**108.03**	**100.00**

DETERMINE: What is the weight percent for each individual ingredient?

1. Write down the PVC compound ingredients expressed as parts by weight for every ingedient in the formulation.(see column headed "PHR")

2. Add the PHR column of individual ingredients to obtain a total number of parts utilized (i.e. - pounds / one hundred lbs. of PVC resin) (e.g. 100+0.7+ 1.2+0.15+5.0+0.5+0.03+0.45 = 108.03
3. To calculate the corresponding weight percent for each ingredient, divide the PHR for each ingredient by the total number of parts utilized. Then multiply by 100 (e.g. (1.20 / 108.03) x 100 = 1.11%).
4. Record these results in the column labeled "weight percent".
5. Check - If the calculation was performed correctly, the total weight percent must equal 100 percent.

APPENDIX D – List of Manufacturer Contacts

**See the PPI HSB Search Listing feature, on the PPI HSB web page.