GS-52

GREEN SEAL® STANDARD FOR
SPECIALTY CLEANING PRODUCTS FOR HOUSEHOLD USE

EDITION 2.5

April 8, 2020

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GREEN SEAL

Green Seal is a nonprofit organization whose mission is to use science-based programs to empower consumers, purchasers, and companies to create a more sustainable world. Green Seal sets leadership standards that aim to reduce, to the extent technologically and economically feasible, the environmental, health, and social impacts throughout the life-cycle of products, services, and companies. The standards may be used for conformity assessment, purchaser specifications, and public education.

Green Seal offers certification of products, services, and companies in conformance with its standards. For additional information on Green Seal or any of its programs, contact:

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FOREWORD

Edition. Edition 2.5 was issued on April 8, 2020. It replaces Edition 2.4 from September 12, 2019. Corrections and/or clarifications were last made to this edition on January 29, 2021. Information on standard revisions and corrections and clarifications can be found on Green Seal's website.[1]

General. The final issued standard was developed in an open and transparent process with stakeholder input that included producers, users, and general interests.

The requirements in the standard are based on an assessment of the environmental, health, or social impacts associated with the products, services, or organizations covered in the scope of the standard. These requirements are subject to revision, and generally cover aspects above and beyond regulatory compliance. This standard neither modifies nor supersedes laws and regulations. Any conformity assessment to this standard requires compliance with all applicable laws and regulations for the manufacturing and marketing of the products.

Provisions for safety have not been included in this standard, since they are supervised by regulatory agencies. Adequate safeguards for personnel and property should be employed for all stages of production, and for all tests that involve safety considerations.

Products, services, or organizations that are substantially similar to those covered by this standard in terms of function and life cycle considerations may be evaluated against the intent of the requirements of this standard, accounting for relevant differences between the intended scope of the Standard and the actual product, service, or organization to be evaluated.

This standard may not anticipate a feature of the product that may significantly, and undesirably, increase its impact on the environment, health, or society. In such a situation, Green Seal will ordinarily amend a standard to account for the unanticipated environmental, health, or societal impacts.

Normative references (e.g., other standards) in this standard intend to refer to the most recent edition of the normative reference. Test methods may be required for product evaluation. Unless explicitly stated that a specified method is the only acceptable one, the intent of the standard is that an equivalent test method may be accepted at Green Seal's sole discretion.

Certification to this standard shall be awarded only by Green Seal, or, with Green Seal's explicit written permission, by a third-party certification program conducting on-site audits.

Disclaimer of Liability. Green Seal, as the developer of this standard, shall not incur any obligations or liability for any loss or damages, including, without limitation, indirect, consequential, special, or incidental damages, arising out of or in connection with the interpretation or adoption of, reliance upon, or any other use of this Standard by any party. Green Seal makes no express or implied warranty of merchantability or fitness for a particular purpose, nor any other express or implied warranty with respect to this Standard.

[1] https://www.greenseal.org/green-seal-standards/standard-revisions

ACRONYMS AND ABBREVIATIONS

ACGIH. American Conference of Governmental Industrial Hygienists
AISE. Association for Soaps, Detergents and Maintenance Products
AOEC. Association of Occupational and Environmental Clinics
ASTM. ASTM International, a standard setting organization formerly known as the American Society for Testing and Materials
ATTC. American Type Culture Collection
BCF. Bioconcentration Factor
BOD. Biological Oxygen Demand
CARB. Air Resources Board for the State of California
CAS. Chemical Abstracts Service
CDC. United States Centers for Disease Control
CFC. Chlorofluorocarbon
CFU. Colony Forming Unit
CO_2. Carbon Dioxide
CFR. Code of Federal Regulations
DOC. Dissolved Organic Carbon
ECHA. European Chemicals Agency
ECVAM. European Centre for the Validation of Alternative Methods
EN. European Standard
EPA. United States Environmental Protection Agency
Ex-ECB. ex-European Chemicals Bureau
FAO. Food and Agricultural Organization of the United Nations
FDA. United States Food and Drug Administration
GHS. Globally Harmonized System of Classification and Labelling of Chemicals
GMM. Genetically Modified Microorganism
GREENGUARD. GREENGUARD Environmental Institute an industry-independent, non-profit organization (www.greenguard.org)
HCPA. Household and Commercial Products Assocation
IARC. International Agency for Research on Cancer
ICCVAM. Interagency Coordinating Committee on the Validation of Alternative Methods
ILO. International Labour Organization
INCI. International Nomenclature of Cosmetic Ingredients
IRIS. Integrated Risk Information System.
ISO. International Organization for Standardization
JECFA. Joint Food and Agricultural Organization of the United Nations/ WHO Expert Committee on Food Additives
LOAEL. Lowest-Observed Adverse Effect Level
NIH. United States Department of Health and Human Services, National Institutes of Health
NOAEL. No-Observed Adverse Effect Level
NOP. National Organic Program
NTP. National Toxicology Program
OECD. Organization for Economic Co-operation and Development
OPP. Office of Pesticide Programs of the United States Environmental Protection Agency
OSHA. Occupational Safety and Health Administration

SDS. Safety Data Sheet
ThOD. Theoretical Oxygen Demand.
TRI PBT. EPA Toxic Release Inventory Persistent, Bioaccumulative, and Toxic Chemicals
USDA. United States Department of Agriculture
VOC. Volatile Organic Compound
WHO. World Health Organization

GREEN SEAL STANDARD FOR SPECIALTY CLEANING PRODUCTSFOR HOUSEHOLD USE, GS-52

1.0 SCOPE

This standard establishes environmental, health, and social requirements for *specialty cleaning products* intended for *household use*. For the purposes of this standard, this includes, but is not limited to: *boat cleaning products*; *boat wax, polish, sealant, or glaze products*; *deck, siding, and outdoor furniture cleaning products*; *dish cleaning products (automatic and hand)*; *furniture polish products*; *graffiti remover products*; *metal cleaning products*; *motor vehicle cleaning products*; *motor vehicle wax, polish, sealant, or glaze products*; *motor vehicle dressing products; waterless motor vehicle cleaning products; tire and wheel cleaning products; motor vehicle windshield washing fluid*; *odor remover products*; *optical lens cleaning products*; *oven cleaning products*; *drain additive/cleaning products; chewing gum remover; upholstery cleaning products*; *antimicrobial pesticide products* (e.g., products covered by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)), and other household cleaning products sold for specialty uses[2]. This standard includes specialty cleaning products that contain *enzymes* or *microorganisms*. This standard does not apply to products that contain *enzymes* or *microorganisms* that are sold in *spray packaging*. This standard does not apply to products intended for industrial and institutional use, printing press cleaning products, laundry care products, *air fresheners*, or products that serve as sporicides, sterilizers, or used to sterilize *critical* and *semicritical medical devices* and equipment. See Appendix 1 for an example list of products included in this standard.

Due to the large number of possible cleaning products, processes, soil types, and cleaning requirements, the compatibility of cleaning products with surface materials is not specifically addressed in this standard. Product users should follow the manufacturer's instructions on compatibility

Words and phrases described in the standard that appear in *italics* have a corresponding definition located in the definition section of the standard, Annex A.

Criteria that include an asterisk (*) in the title are considered foundational criteria[3].

2.0 PRODUCT-SPECIFIC PERFORMANCE REQUIREMENTS

2.1 Product Performance. Each product shall clean soils and surfaces specific to the intended use of the *specialty cleaning product* effectively, at the most dilute/least concentrated

[2] Products that are sold for routine cleaning functions including *general purpose*, floor, *restroom*, toilet, glass and carpet cleaning with or without *enzymes* and *microorganisms* are covered under the Green Seal Standard for Cleaning Products for Household Use, GS-8.

[3] Foundational criteria are set-up to be the same across Green Seal's cleaning product standards, though some unique exceptions may be included for each standard. Revisions to these criteria in the future will apply to all standards that include the identified foundational criteria (excluding unique exceptions).

manufacturer-recommended dilution level for routine cleaning.[4] Products shall be diluted, as required, just prior to testing using water from the cold tap at no more than 50ºF (10ºC). Exceptions shall be made for *dish cleaning products* and *upholstery cleaning products*, which shall perform at the temperatures specified in the corresponding criteria that follow. The following criteria include test methods that are applicable to some product categories, for all other product categories follow section 2.2 Alternative Performance Requirements herein. Requirements for *antimicrobial pesticide products* are included in section 2.3 herein.

2.1.1 Deck, Siding, and Outdoor Furniture Cleaning Products. *Deck, siding, and outdoor furniture cleaning products* shall remove at least 80% of the particulate soil in ASTM International (ASTM) D4488, A5[5].

2.1.2 Boat, Motor Vehicle, Tire and Wheel, and Waterless Motor Vehicle Cleaning Products. *Boat, motor vehicle, tire and wheel, and waterless motor vehicle cleaning products* shall remove at least 80% of the particulate soil in ASTM D4488, A5.

2.1.3 Bilge Cleaning Products. B*ilge cleaning products* shall demonstrate efficacy for degreasing (emulsifying oil, grease, and fuel) and cleaning (removal of soils and mold stains) with an appropriate test method following section 2.2 Alternative Performance Requirements herein.

2.1.4 Boat Wax, Polish, Sealant, or Glaze Products. *Boat wax, polish, sealant, or glaze products* shall be tested for gloss and smear resistance with an appropriate method following section 2.2 Alternative Performance Requirements herein.

2.1.5 Motor Vehicle Wax, Polish, Sealant, or Glaze Products. *Motor vehicle wax, polish, sealant, or glaze products* shall perform equivalent to or better than the control product in ASTM D 3836 or ASTM D6625. The control product shall be a national market-leading product.

2.1.6 Dish Cleaning Products. *Dish cleaning products* are exempt from the water temperature requirement in 2.0 for performance testing, but shall follow any temperature specifications in the criteria below.

2.1.6.1 Automatic Dish Cleaning Products. *Automatic dish cleaning products* shall demonstrate soil removal efficacy with an appropriate method following section 2.2 Alternative Performance Requirements herein. The product shall be tested on the following types of soils: colored, bleachable soil; dry starchy soil (amylase-specific); and dry proteinaceous soil (protease-specific). The method shall be performed in a household machine and be tested at 130 ± 5 deg F (54.4 ± 3.8 deg C).

[4] The dilution level for routine cleaning is considered the medium dose or normal dose on the label for the typical use of the product.

[5] ASTM D4488 has been withdrawn, however it is still the best available method for this performance testing, is still available for purchase, and is regularly used by laboratories to test performance.

2.1.6.2 Rinse Agent Products and Combined Dish Cleaning/Rinse Agent Products for Automatic Dishwashers. *Rinse agent products* shall achieve a visual rating of at least two (2) when evaluated according to the method in ASTM D3556 or Consumer Specialty Products Association (CSPA) DCC-05A.

2.1.6.3 Hand Dish Cleaning Products. *Hand dish cleaning products* shall demonstrate soil removal efficacy with an appropriate method following section 2.2 Alternative Performance Requirements herein. The soils used in the comparison testing shall be soils B and D as defined in ASTM D4009, or equivalent. The product shall be tested at 110 °F (43°C).[6]

2.1.7 Furniture Polish Products. *Furniture polish products* shall be tested for gloss, water and smear protection, and clean-ability (i.e., buffing, soil and dust removal) with an appropriate method following section 2.2 Alternative Performance Requirements herein.

2.1.8 Graffiti Removers. *Graffiti remover products* shall demonstrate effectiveness in removing graffiti markings (e.g., aerosol paint, felt tip pen, crayon, lipstick) while maintaining the appearance of the underlying substrate (e.g., brick, sandstone, metal, wood) for its marketed use, with an appropriate method following section 2.2 Alternative Performance Testing herein.

2.1.9 Metal Cleaning Products. *Metal cleaning products* shall have a Cleaning Effectiveness Factor (CEF) of at least 0.80 as measured according to ASTM G122.

2.1.10 Motor Vehicle Windshield Washing Fluid Products. *Motor vehicle windshield washing fluid products* shall be tested according to CSPA DCC-09 and achieve at least a rating of three (3) in each of the following categories: soil removal, smearing, and streaking. Additionally, "winter formula" *products as used* shall remain a liquid for at least twenty-four (24) hours at 0°F (-17.8°C).

2.1.11 Optical Lens Cleaning Products. *Optical lens cleaning products* shall be tested according to CSPADCC-09 and achieve at least a rating of three in each of the following categories: soil removal, smearing, and streaking.

2.1.12 Oven Cleaning Products. *Oven cleaning products* shall achieve at least a 90% soil removal in CSPA DCC-12 using test soils A or B.

2.1.13 Upholstery Cleaning Products. *Upholstery cleaning products* shall be tested for cleaning efficiency and resoiling resistance with an appropriate method following section 2.2 Alternative Performance Requirements herein. *Upholstery cleaning products* may be diluted with warm or hot water where required by the test method or performance considerations if the product is proven to suffer significant performance degradation in cold water.

[6] Lowest effective temperature as specified in the current FDA Food Code regulations.

2.2 Alternative Performance Requirements. Alternatively, the product shall demonstrate that it performs equivalent to or better than a nationally-recognized or market-leading product of its type, compared at the most dilute/least concentrated manufacturer-recommended dilution level for routine cleaning,[7] using an objective, scientifically-validated method conducted under controlled and reproducible laboratory conditions. The water temperature requirement in 2.0 shall apply, unless the noted exceptions in 2.1.7 for *dish cleaning products* and 2.1.14 for *upholstery cleaning products* apply. Test methodology and results shall be documented in sufficient detail and provided to the certification program.

2.3 Antimicrobial Pesticide Products. Any product that makes an antimicrobial, *disinfecting*, or *sanitizing* claim shall be a *registered antimicrobial pesticide product* with no unresolved efficacy failures and no unresolved compliance or enforcement actions or *a minimum risk pesticide*-based product. *Minimum risk pesticide*-based products shall demonstrate that they meet the efficacy requirements for the target organism in accordance with appropriate FIFRA Efficacy Test Protocols.

Products that are manufactured and sold outside of the US shall demonstrate that they meet appropriate efficacy requirements for the target organism(s).

3.0 PRODUCT-SPECIFIC SUSTAINABILITY REQUIREMENTS

3.1 *Formula Disclosure for Certification. For certification to this standard, all of the formula *components* shall be disclosed to the certification program including the chemical name, the Chemical Abstracts Service (CAS) registry number, and the levels (% by weight) of each *component* in the formula.

3.2 *Animal Testing. To avoid new animal testing, previous test results will be accepted as evidence of meeting a criterion. When existing data is not available, the preferred methods for new testing include methods that replace, reduce, or refine animal use, particularly those recommended by the Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM) or the European Centre for the Validation of Alternative Methods (ECVAM), unless indicated otherwise. In addition, other non-animal (in-vitro) test results, modeling data, data from structural analogs, and other lines of evidence may be accepted, provided that the methods are peer-reviewed and applicable. Specific in vitro or modeling methods may be noted in the standard, but additional options may be accepted by the certification program**.**

Further, a mixture need not be tested if existing information demonstrates that each of the applicable *components* complies with the criterion.

[7] The dilution level for routine cleaning is considered the medium dose or normal dose on the label for the typical use of the product.

3.3 *Acute Toxicity. The *undiluted product* shall not be toxic to humans. A product is considered toxic if any of the following criteria apply[8,9]:

Oral lethal dose (LD_{50})	≤ 5,000 mg/kg
Inhalation lethal concentration (LC_{50})	≤ 20,000 ppmV at 1 hr
Dermal lethal dose (LD_{50})	≤ 2,000 mg/kg

For purposes of demonstrating compliance with this requirement, existing acute toxicity data for each of the product's *components* at 0.01% or more in the *undiluted product* may be used. These data are used to calculate a weighted average that assumes that the toxicity of the individual *components* is additive. The toxicity values are adjusted by the weight of the *components* in the product and summed using the following formula:

$$TP = \left(\sum_{i=1}^{n} \frac{wt_i}{TV_i} \right)^{-1}$$

Where,
TP = toxicity of the product
wt_i = the weight fraction of the *component*
TV_i = the toxicity value for each *component* (LD_{50})
n = number of *components*

Inhalation toxicity shall be determined from all *components* at 0.01% or more in the *undiluted product*, when the *component* has a vapor pressure greater than 1 mm Hg at 1 atm pressure and 20°C.

Note: Refer to Annex B for potential alternate thresholds for products as *powders/solids/non-aqueous liquids.*

3.4 *Skin and Eye Damage. The *undiluted product* shall not cause *skin corrosion* or cause *serious eye damage.* For purposes of demonstrating compliance with this requirement, data may be evaluated for each of the product's *components* present at 0.01% or more in the *undiluted product*. If these *components*, at their concentrations in the *undiluted product*, are not shown to cause *skin corrosion* or *serious eye damage*, then the product will not be considered to cause *skin corrosion* or *serious eye damage*.

Further, a product is considered to cause *skin corrosion* or to cause *serious eye damage* if it has a pH less than or equal to 2.0 or greater than or equal to 11.5, unless data prove otherwise.

Results from peer-reviewed studies or standard in vivo or in vitro test methods may also be accepted. Testing is not required for any *component* at 0.01% for which sufficient information exists.

[8] Products meeting the requirements in 3.3 will not fall into hazard categories 1 through 5 for acute oral and dermal toxicity and will not fall into hazard categories 1 through 4 for acute inhalation toxicity under the GHS when the whole product is evaluated using the weighted average approach.
[9] Recognizing the need to protect animal welfare, testing to demonstrate conformance should only be done after consulting with the certification program to ensure that other means of determining/estimating conformance have been exhausted as provision 3.2 outlines including existing data, modeling data, data from structural analogs, and other lines of evidence.

Refer to Annex B for potential alternate thresholds for products as *powders/solids/non-aqueous liquids.*

3.5 *Carcinogens and Reproductive Toxins. The *undiluted product* shall not contain any *components* that are *carcinogens* or *reproductive toxins.* The *undiluted product* shall not contain any *components* at 0.01% or more that, according to published uses, [10] are typically added for the purpose of releasing substances into a raw material or final product, if those substances are *carcinogens*.

Note: Refer to Annex C for the exemption of titanium dioxide in products that contain *enzymes*.

3.6 *Mutagens and Neurotoxins/Systemic Toxins. The *undiluted* product shall not contain any *components* that have been identified as *mutagens* or *neurotoxins/systemic toxins.*

3.7 *Endocrine Disruptors. The *undiluted product* shall not contain any *components* that are on the EPA List of Chemicals for Tier 1 Screening that have been shown to disrupt hormones (e.g., have estrogen- or androgen-mediated effects), tested according to the EPA Series 890 - Endocrine Disruptor Screening Program Test Guidelines.

3.8 *Asthmagens. The *undiluted product* shall not contain any *components* at 0.01% or more that have been identified as *asthmagens*. Refer to Annex C, Requirement D for potential exemptions for *enzymes*.

3.9 *Respiratory Sensitization. The *undiluted product* shall not contain any *components* at 0.01% or more that have been identified as *respiratory sensitizers*. Refer to Annex C, Requirement D for potential exemptions for *enzymes*.

3.10 *Skin Sensitization. The *undiluted product* shall not be a *skin sensitizer*. For purposes of demonstrating compliance with this requirement, data may be evaluated for each of the product's *components* at 0.01% or more in the *undiluted product*. If these *components,* at their concentrations in the *undiluted product*, are not shown to be *skin sensitizers*, then the product will not be considered to be a *skin sensitizer*.

3.11 *Skin Absorption. The *undiluted product* shall not contain *components* at 1% or more in the product that are listed on the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) list carrying a skin notation or substances that are listed on the German Deutsche Forschungsgemeinschaft (DFG) maximum allowable concentrations (MAK) list with a skin absorption H notation. Further, the product shall not contain *components* at 0.01% or more in the *undiluted product* that sum to 1% in the formula that are listed on ACGIH or DFG with the same target organ.

3.12 *Volatile Organic Compound (VOC) Content. VOCs include all organic *components* at 0.01% or more that have a vapor pressure of greater than 0.1 mm mercury at 1 atm pressure and 20º C. "VOC content" means the total weight of VOCs in a product expressed as a percentage of the product weight.

[10] Published uses include sources such as peer-reviewed research, industry practice, or manufacturer documentation.

The VOC content of the *product as used* shall contain no more than the current regulatory limits of the Air Resources Board for the State of California (CARB) for its product category.

For product categories not regulated by CARB, the VOC content shall not exceed the higher of the following options:

- 1% by weight.
- A limit set by CARB or the South Coast Air Quality Management District for a similar product category, which the manufacturer can prove is more appropriate.

Additionally, the following shall apply:

- CARB VOC requirements for glass cleaners shall apply to *optical lens cleaning products*.
- CARB VOC requirements for *motor vehicle wax, polish, sealant, or glaze products* shall apply to *motor vehicle dressing products*.
- CARB VOC requirements for bug and tar removers shall apply to chewing *gum remover products*.

The VOC content shall be determined in one of the following ways:

- By summing the percent by weight contribution from all volatile organic *components* present in the product at 0.01% or more.
- According to the California Air Resources Board Method 310 (or equivalent), modified to include all *fragrances* and all volatile organic *components* present in the product at 0.01% or more[11].

  Current CARB regulatory limits for VOCs[12].

Product Category	**Effective Date**	**Limit (%)**
Adhesive Remover		
(Floor or Wall Covering)	12/31/2006	5
(Gasket or Thread Locking)	12/31/2006	50
(General Purpose)	12/31/2006	20
(Specialty)	12/31/2006	70
Dual Purpose Air Freshener/Disinfectant		
(aerosol)	1/1/1994	60
(liquid/pump spray)	1/1/1993	18
(solid/semisolid)	1/1/1993	3

[11] Evaluation of the VOC content in this standard includes all *fragrances* and VOCs present in the product at 0.01% or more. Evaluation of the VOC content under Method 310 exempts *fragrances* and all volatile organic compounds present below 0.1%.

[12] These limits are a reference to the current CARB regulatory limits and will be updated to reflect any amendments made by CARB in the future.

Product Category	Effective Date	Limit (%)
Automotive Wax/Polish/Sealant/Glaze		
(hard paste wax)	1/1/2005	45
(instant detailer)	1/1/2001	3
(all other forms)	1/1/2005	15
Brake Cleaner	12/31/2010	10
Bug and Tar Remover	1/1/2002	40
Carburetor or Fuel-injection Air Intake Cleaner	12/31/2010	10
Upholstery Cleaner		
(aerosol)	12/31/2010	5
(nonaerosol - dilutable)	1/1/2001	0.1
(nonaerosol - ready-to-use)	12/31/2010	1
Disinfectant		
(aerosol)	12/31/2008	70
(nonaerosol)	12/31/2008	1
Dusting Aid		
(aerosol)	12/31/2010	17
(nonaerosol)	12/31/2010	3
Electrical Cleaner	12/31/2006	45
Electronic Cleaner	12/31/2007	75
Engine Degreaser		
(aerosol)	12/31/2010	10
(nonaerosol)	12/31/2004	5
Fabric Refresher		
(aerosol)	12/31/2006	15
(nonaerosol)	12/31/2006	6
Footwear or Leather Care Product		
(aerosol)	12/31/2006	75
(solid)	12/31/2006	55
(all other forms)	12/31/2006	15
Furniture polish		
(aerosol)	12/31/2004 (12/31/2013)	17 (12)
(nonaerosol - except solid/paste forms)	1/1/1994	7
(all other forms- except solid/paste forms)	12/31/2008	3
Glass cleaners	12/31/2012	3
Graffiti Remover		
(aerosol)	12/31/2006	50
(nonaerosol)	12/31/2006	30

Product Category	Effective Date	Limit (%)
Metal Polish or Cleanser		
(aerosol)	12/31/2012	15
(nonaerosol)	12/31/2012	3
Motor Vehicle Wash (nonaerosol)	12/31/2010	0.2
Odor Remover/Eliminator		
(aerosol)	12/31/2010	25
(nonaerosol)	12/31/2010	6
Oven or Grill Cleaner		
(aerosol/pump spray)	1/1/1993	8
(liquid)	1/1/1993	5
(nonaerosol)	12/10/2011	4
Sanitizer		
(aerosol)	12/31/2008	70
(nonaerosol)	12/31/2008	1
Spot Remover		
(aerosol)	12/31/2012	15
(nonaerosol)	12/31/2012	3
Tire or Wheel Cleaner		
(aerosol)	12/31/2010	8
(nonaerosol)	12/31/2010	2
Wood Cleaner		
(aerosol)	12/31/2006	17
(nonaerosol)	12/31/2006	4

3.13 *Inhalation Toxicity. The product shall meet either 3.13.1 or 3.13.2.

3.13.1 Chronic Inhalation Toxicity. The *product as used* shall not contain *components* at 0.01% or more with a vapor pressure above 1 mm mercury at 1 atm pressure and 20°C that are classified as producing significant toxic effects in mammals from repeated inhalation exposure at or below 1.0 mg/L as a vapor according to Organization for Economic Co-operation and Development (OECD) Harmonized Integrated Classification System for Human Health and Environmental Hazards of Chemical Substances and Mixtures. For the purposes of this standard, significant toxic effects in mammals from repeated inhalation exposure at or below 1.0 mg/L as a vapor shall be established by a No-Observed Adverse Effect Level (NOAEL), based on a test duration of 90 days at 6 hours per day; values from other exposure regimes shall be estimated (extrapolated) per the principles of *Haber's rule*. In lieu of a NOAEL, the Lowest-Observed Adverse Effect Level (LOAEL) can be used with a ten-fold safety factor (i.e., LOAEL/10).

3.13.2 Chamber Testing. A *product as used* shall be tested according to the method used for the GREENGUARD Children and Schools Certification for Cleaners and Cleaning Maintenance Products and Systems (also called the GREENGUARD Standard Method for Measuring and Evaluating Chemical Emissions from Cleaners and Cleaning Maintenance Systems Using Dynamic Environmental Chambers) and meet the inhalation

toxicity criteria in the method (noted in the table referencing Green Seal Standard GS-37).

3.14 *Toxicity to Aquatic Life. The *product as used* shall not be toxic to aquatic life. A product is considered not toxic to aquatic life if the lowest available and most representative acute LC50 data for fish, daphnia, or algae is greater than or equal to 100 mg/L. For purposes of demonstrating compliance with this requirement, data for each of the product's *components* at 0.01% or more in the product as used may be used to calculate a weighted average (as in section 3.3).

The preferred sources of data come from the following appropriate protocols in the International Organization for Standardization (ISO) 7346-2 for fish, OEDC Test Guidance (TG) 203 for fish, OECD TG 202 for daphnia, or OECD TG 201 for algae.

3.15 *Aquatic Biodegradability. Each of the organic *components* at 0.01% or more in the *product as used* shall exhibit ready biodegradability in accordance with the OECD definition, except for polymers. Biodegradability shall be measured according to any of the following methods: ISO 7827, 9439, 10707, 10708, 9408, 14593; OECD Methods 301A–F; or OECD 310. Specifically, within a 28-day test, the organic *component* shall meet one of the following criteria within 10 days of the time when biodegradation first reaches 10%:

- Removal of Dissolved Organic Carbon (DOC) > 70%
- Biochemical Oxygen Demand (BOD) > 60%
- BOD, as % of Theoretical Oxygen Demand (ThOD) > 60%
- CO_2 evolution, as % of theoretical CO_2 > 60%

Per OECD guidance the 10-day window requirement does not apply to structurally-related *surfactant* homologues.

Alternative Evaluation Options: Substances that Do Not Exhibit Ready Biodegradability. For organic *components* at 0.01% in the *product as used* that do not exhibit ready biodegradability, one of the following options may be acceptable:

1. The manufacturer may demonstrate biodegradability in sewage treatment plants using the Coupled Units Test found in OECD 303A by demonstrating DOC removal > 90%.
2. The manufacturer may demonstrate that the compound has low aquatic toxicity (acute LC50 ≥ 100 mg/L for algae, daphnia, or fish) and exhibits inherent ultimate biodegradability with biodegradation rates above 70% (measured as BOD, DOC, or COD), per ISO test methods 9887 or 9888 or OECD 302A-C.

Note: Testing is not required for any *component* for which sufficient information exists concerning its biodegradability, either in peer-reviewed literature or databases. In the absence of experimental data, Quantitative Structure-Activity Relationship data from EPA's BioWin (EpiSuite) models may be considered.

3.16 *Bioaccumulating Compounds. The *product as used* shall not contain any *components* at 0.01% or more that bioaccumulate or that are known to form degradation products that bioaccumulate. A *component* is considered to bioaccumulate when it has a bioconcentration factor (BCF) ≥ 500 (or log K_{ow} ≥4). The preferred source of data is from OECD TG 305 (for BCF). If the *component* meets the requirement for biodegradability, 3.15 herein, it may be considered to not bioaccumulate.

3.17 *Eutrophication. The product *as used* shall not contain phosphorus at more than 0.5% by weight.

3.18 *Prohibited Components. The *undiluted* product shall not contain the following *components*[13]:

- 2-butoxyethanol
- Alkylphenol ethoxylates
- *Halogenated organic solvents*
- The heavy metals lead, hexavalent chromium, or selenium; either in the elemental form or compounds
- Nitro-musks
- o-Phenylphenol
- *Ozone-depleting compounds*
- Phthalates
- Polycyclic musks
- Toxic Release Inventory Persistent, Bioaccumulative, and Toxic (TRI PBT) Chemicals
- Triclosan

3.19 *Combustibility. The *undiluted product* shall not be combustible. The product or 99% by volume of the product c*omponents* at 0.01% or more in the *undiluted product* shall have a flashpoint above 150°F, as tested using either the Cleveland Open Cup Tester (ASTM D92-05a), the Abel Closed-Cup method (ISO 13736), or the Pensky-Martens Closed-Cup method (ISO 2719). Alternatively, the product shall not sustain a flame when tested using ASTM D 4206 Standard Test Method for Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus.

3.20 *Fragrances. All *fragrances* used shall be produced and handled following the code of practice of the International Fragrance Association (IFRA).

3.21 Colorants. Each *colorant* shall meet one of the following:

- Be certified by the U.S. Food and Drug Administration (FDA) and permitted for ingestion
- Be a *natural colorant*
- Not have any of the following heavy metals intentionally added: arsenic, cadmium, cobalt, hexavalent chromium, lead, manganese, mercury, nickel, and selenium

[13] The listed *components* are prohibited because they have demonstrated one or more of the following health concerns: endocrine disruption, neurotoxicity, and systemic toxicity. Other chemicals may have such health concerns but are not listed because they may already be prohibited through other criteria in the standard.

3.22 Optical Brighteners. The *undiluted product* shall not contain any *components* at 0.01% or more that are *optical brighteners*.

3.23 Concentrates and Dosing. Products may be sold in a ready-to-use form except for *boat cleaning product*s, *motor vehicle cleaning products*, and *deck, siding,* and *outdoor furniture cleaning products*, which shall be concentrated to at least 1:8.

3.24 *Products Containing Enzymes. Products that contain *enzymes* shall meet all Annex C criteria.

3.25 *Products Containing Microorganisms. Products that contain *microorganisms* shall meet all Annex D criteria.

3.26 *Antimicrobial Agents. Except for *antimicrobial pesticide products*, the use of *antimicrobial agents* is permitted only for the preservation or stabilization of the product.

3.27. *Disposable Wipes. Products that are sold in a ready-to-use format may contain disposable towelettes or other disposable single-use materials if the wipes are made from agricultural products, wood pulp, and other cellulosic materials. An exception shall be made for reusable wipes/towelettes/sheets that are intended to be used multiple times (e.g., three or more uses).

4.0 MANUFACTURING SUSTAINABILITY REQUIREMENTS

4.1 *Social Responsibility. Documentation shall be provided that the production of the product meets the following social responsibility requirements:

4.1.1 Freedom of Association and Collective Bargaining. Workers shall have the right to join or form trade unions of their own choosing and their right to bargain collectively shall be recognized and respected. An exception shall be made for inmate workers.

4.1.2 Freedom of Labor. There shall not be forced or bonded labor or use of *child labor*.

4.1.3 Freedom from Discrimination. There shall not be discrimination in terms of race, color, sex, religion, age, disability, gender, marital status, sexual orientation, union membership, political opinion, national extraction or social origin such that it affects the opportunity or treatment in employment and there shall be no support or tolerance of corporal punishment, physical or verbal coercion, sexual or other harassment, intimidation or exploitation.

4.1.4 Occupational Health and Safety. A safe and hygienic workplace environment shall be provided with access to potable water. Adequate steps shall be taken to minimize

the hazards of the workplace and workers shall receive health and safety training to prevent accidents and injury.

4.1.5 Conditions of Employment. Workers shall work under fair conditions of employment. Wages, working hours and overtime shall meet at a minimum the national legal or industry benchmark standard and regular employment shall be provided.

5.0 PACKAGING SUSTAINABILITY REQUIREMENTS

5.1 Primary Package. The *primary package* shall be at least one of the following[14]:

- A *source-reduced package*
- *Recyclable*
- Contain 25% *post-consumer material*
- *A refillable package* with an effective *take-back program*
- An alternative approach that has been independently proven to have a similar life cycle benefit as one of the options listed above

5.1.1 *Plastic Labeling. If plastic, the packaging shall be marked with the appropriate Resin Identification Code to identify the type of plastic for recycling.

5.2 *Concentrated Product Packaging. *Concentrates* are prohibited from being packaged in spray-dispenser bottles, disposable wipes, or other ready-to-use package types.

5.3 Secondary Package. A s*econdary package* shall only be used for *concentrates* such as solid dish tablets. An exception may be made for packaging of multiple units when at least one of the units is a ready-to-use form and total packaging (*primary* plus *secondary*) is a reduction in overall packaging material use.

5.4 Aerosol Packaging. *Aerosol packaging* shall meet the following:

- Manufacturers shall demonstrate that recycling programs for *aerosol packaging* are available to a substantial majority of communities where the product is sold
- Manufacturers shall provide documentation establishing why *aerosol packaging* is necessary for a given product addressing environmental, health, and performance considerations
- *Aerosol packaging* propellant shall meet all of the product-specific sustainability requirements in section 3.0 herein and shall not be a *hazardous air pollutant* (HAP)
- For Section 3.3 Acute Toxicity and 3.13 Inhalation Toxicity, *aerosol packaging components* will be evaluated regardless of vapor pressure level

[14] For products sold in a ready-to-use format, there is currently no requirement for product refills; however, Green Seal encourages that efforts be taken to provide product refills in concentrate (with explicit instructions for safe dilution and use), as a source reduced package, or in another manner that minimizes resources used in the packaging and transport of product refills.

- The product contents from the nozzle to the point-of-delivery shall be in a form that does not contain any inhalable or respirable particles, such as but not limited to foams, or if the product contents are delivered in particle form the particles between 10-2.5 microns shall not comprise more than 1% of the total particles and no particles shall be below 2.5 microns

5.5 *Heavy Metal Restrictions. The heavy metals lead, mercury, cadmium, and hexavalent chromium shall not be *intentionally introduced.* Further, the sum of the concentration levels of these metals shall not exceed 100 ppm; an exception is allowed for *refillable packages* or packages that would not exceed this maximum level but for the addition of *post-consumer material*.

5.6 *Other Restrictions. Phthalates, bisphenol A, and chlorinated packaging material are prohibited from being *intentionally* introduced to a plastic *primary package*; an exception is allowed for *primary packages* that would not have added phthalates, bisphenol A, or chlorinated packaging material but for the addition of *post-consumer material*.

6.0 CERTIFICATION AND LABELING REQUIREMENTS

6.1 Label Dilution or Dosage Directions for Concentrates. For *concentrates,* the label shall state clearly and prominently that dilution with water from the unheated tap is recommended, unless tested otherwise to meet the performance requirements in Section 2 herein (e.g., u*pholstery cleaning products* and *dish cleaning products),* and shall state the recommended level of dilution or dosage (e.g., for products that use manual dilution or dosage, state amount of product in common and measurable terms such as milliliters, teaspoons, or capfuls).

6.2 Label Use and Disposal Directions. The product label shall have explicit disposal, recycling, reuse, or refill instructions, proper and clear directions for use, and appropriate precautions and recommendations for the use of personal protective equipment. *Direct release products* shall include instructions describing best management practices (such as choosing a site with the potential for runoff to be diverted to a sanitary sewer or detention pond) for recapture of waste water. *Boat cleaning products* and *bilge cleaning products* shall be labeled with explicit instructions that bilges should be pumped out at marina facilities and not overboard and that the boat should be cleaned away from shorelines.

6.3 Labeling of Dish Cleaning Products for Resource Conservation.

6.3.1 Hand Dish Cleaning Product. The *hand dish cleaning product* label shall include a statement encouraging energy and water conservation during the use of the *hand dish cleaning product*, such as, “Conserve energy and water and avoid running the water continuously when washing dishes,” or equivalent language as approved by the certification program.

6.3.2 Automatic Dish Cleaning Product. *Automatic dish cleaning product* labels shall include a statement encouraging energy and water conservation, such as, “Conserve

energy and water and run a full load of dishes whenever possible," or equivalent language as approved by the certification program.

6.4 *Antimicrobial Claims. Except for antimicrobial pesticide products, antimicrobial, antibacterial, disinfecting, or sanitizing product claims are prohibited.

6.4.1 Products Making Antimicrobial Claims. *Antimicrobial pesticide products* shall have label instructions that the product should only be used on surfaces that have been identified to be at risk for disease transmission or where required by regulation. Equivalent language may be approved by the certification program.

6.4.2 Minimum Risk Pesticides. *Minimum risk pesticide* labels shall include a statement indicating that a pre-cleaning step is needed for heavily soiled surfaces.

6.5 *Organic Claims. Organic claims shall only be based on *certified-organic component* content and shall be supported with documentation that they meet the United States Department of Agriculture (USDA) National Organic Program (NOP) or programs determined to be equivalent by or have recognition agreements with the USDA NOP.

6.6 *Natural and Biobased Claims. Only the following natural and *biobased*, or related, claims are allowed when the product meets the criteria outlined:

- "100 percent Natural", "All Natural", "100 percent Biobased", or "All Biobased" shall only contain *natural* or *biobased components*, respectively, excluding water, and with no petroleum, silicone, or *synthetic components*.
- "Natural" or "Biobased" products shall contain 95% *natural*, *naturally-derived*, or *biobased components*, respectively, excluding water.
- Claims on specific product *components* being "natural" or "biobased" may be permitted if it is a *natural* or *biobased component*.

6.7 *Ingredient Line. The product label shall list the product ingredients using the naming convention of the International Nomenclature of Cosmetic Ingredients (INCI), or the HCPA Ingredient Dictionary, in order of predominance. Where an INCI name does not exist for an ingredient, alternative nomenclature may be used[15]. Ingredients in concentrations of less than 1% may be listed in any order after those in concentrations of more than 1%. A chemical function or chemical class descriptor may be used to protect trade secret information.

6.7.1 Consumer and User Communication. The product ingredient line (6.8 herein) shall be made available to end-users in an easily accessible means in addition to the product label, such as the company website or technical data sheet.

6.7.2 Fragrances. The general term 'fragrance' may be used for *fragrance components*; in this case, the product label shall direct end-users to additional information. A list of the *fragrance components* that are present in the product at 0.01%

[15] Alternative nomenclature may include International Union of Pure and Applied Chemistry (IUPAC) name, Chemical Abstract Service (CAS) name, or the common chemical name.

or more shall be made available to end-users in an easily accessible means, such as the company website or technical data sheet. Chemical class descriptors may be used to protect trade secret information. Alternatively, the company may provide a link to the IFRA Transparency List,[16] or a subset of this list.

6.8 Fragrance and Allergen Labeling. The product label shall declare if a *fragrance* has been added or if no *fragrance* has been added, and shall also indicate any *allergen components* present in the product at 0.01% or more (e.g., "Contains allergen [*allergen's* INCI name]"). Where an INCI name does not exist, alternative nomenclature may be used[14].

6.9 Certification Mark. The Green Seal® Certification Mark may appear on the product, packaging, secondary documents, and promotional materials, only in conjunction with the certified product. Use of the Mark must be in accordance with *Rules Governing the Use of the Green Seal Certification Mark*[17].

The Green Seal Certification Mark shall not be used in conjunction with any modifying terms, phrases, or graphic images that might mislead consumers as to the extent or nature of the certification.

Green Seal must review all uses of the Certification Mark prior to printing or publishing.

6.10 Use With Other Claims. The Green Seal Certification Mark shall not appear in conjunction with any human health or environmental claims, unless verified and approved in writing by Green Seal.

6.11 Statement of Basis for Certification. Wherever the Green Seal Certification Mark appears, it shall be accompanied by a description of the basis for certification. The description shall be in a location, style, and typeface that are easily readable.

The description shall read as follows, unless an alternate version is approved in writing by Green Seal:

> This product meets Green Seal® Standard GS-52 based on effective performance, concentration of product, minimized/recycled packaging, and protective limits on VOCs and human & environmental toxicity. GreenSeal.org.

If the *powder/solid/non-aqueous liquid* product was evaluated in accordance with Annex B, the description shall read as follows, unless an alternate version is approved in writing by Green Seal:

> This product meets Green Seal® Standard GS-52 based on effective performance, concentration of product, minimized/recycled packaging, and protective limits on VOCs and human & environmental toxicity. [Powders OR Solids OR Non-aqueous liquids][18]

[16] IFRA's Transparency List, http://www.ifraorg.org/en-us/ingredients#.VjpTmitWLxw
[17] www.greenseal.org/TrademarkGuidelines
[18] The specific type of product shall be listed.

> have alternate thresholds for [acute toxicity and/or skin/eye damage][19] and added requirements for packaging and labeling. GreenSeal.org.

For products that are not concentrated, the words "concentration of product" shall be deleted.

[19] Only the criteria that were evaluated according to the relevant Annex shall be listed.

ANNEX A – DEFINITIONS (Normative)

Note that the defined terms are italicized throughout the standard.

Aerosol Packaging. A *package* that requires a pressurized propellant to dispense product through a nozzle.

Air Freshener. Products designed or labeled for the purpose of masking odors, freshening, or scenting the air, but providing no cleaning or odor removal function.

Allergen. Allergenic substances included in Annex III of the European Union Regulation 1223/2009 on Cosmetic Products, 30 November 2009, and those listed by the FDA (including food allergens Food Allergen Labeling and Consumer Protection Act of 2004 [Public Law 108-282, Title II]).

Antimicrobial Agent. A substance intended to disinfect, sanitize, reduce, or mitigate growth or development of *microorganisms* and protect inanimate objects, industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime.

Antimicrobial Pesticide Product. A product intended for and capable of *disinfecting*, *sanitizing*, reducing, or mitigating growth or development of *microorganisms* and protecting inanimate objects, industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime.

Asthma. *Asthma* is a chronic inflammatory disorder of the airways that impairs breathing. *Asthma* affects children and adults, may be intermittent or persistent, and is further classified as mild, moderate, or severe. The chronic inflammation associated with variable airflow obstruction commonly causes difficulty breathing, coughing, wheezing, shortness of breath, and/or chest pain. Symptoms may resolve completely between active episodes. Symptoms may occur during exposure, immediately after exposure, or up to 24 hours later in a "late phase," frequently interrupting sleep.

Asthmagen. A substance designated as an *asthma* causing agent by the Association of Occupational and Environmental Clinics (AOEC), which after review by AOEC have met the AOEC sensitization criteria**.**

Automatic Dish Cleaning Product. A product intended to clean dishes, utensils, pots, pans, glasses, cups or other food service tools for use in household automatic dishwashers.

Bilge Cleaning Product. A product intended to clean the lowest interior compartment in a boat.

Biobased. The content of a product that is from biological products, forestry, or agricultural materials (including plant, animal, and marine materials)**.**

Boat Cleaning Product. A product designed to clean aluminum, fiberglass, and wood surfaces of boats. These products are designed to remove algae and marine residues, grease and rust. Hull cleaning products are considered *boat cleaning products*.

Boat Wax, Polish, Sealant, or Glaze Product. A product designed to seal out moisture, increase gloss, or otherwise enhance a boat's surface. For the purposes of this standard, products that are intended as wash and wax products are considered *boat vehicle wax, polish, sealant or glaze* and *boat cleaning products***.**

Carcinogen. A substance listed as a known, probable, reasonably anticipated, or possible human carcinogen by any of the following agencies or programs: International Agency for Research on Cancer (IARC Groups 1, 2A, and 2B); National Toxicology Program (NTP Groups 1 and 2); U.S. Environmental Protection Agency Integrated Risk Information System (EPA IRIS weight-of-evidence classifications A, B1, B2, C, carcinogenic, known/likely human carcinogen, likely to be carcinogenic to humans, and suggestive evidence of carcinogenicity or carcinogen potential); Occupational Safety Health Administration (OSHA as *carcinogens* under 29 Code of Federal Regulations (CFR) 1910.1003(a)(1)); and those chemicals that fall into Carcinogenicity Hazard Category 1A and 1B under the *Globally Harmonized System for Classification and Labeling of Chemicals (*GHS*).*

Certified-Organic Component. A *component* certified as organic (by meeting the USDA organic standards) by a USDA-accredited certifying agent or programs determined to be equivalent by or have recognition agreements with the USDA NOP.

Chewing Gum Remover Product. A product designed to remove chewing gum from floors, carpets, furniture, and upholstery.

Child Labor. Work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development. To avoid *child labor* the International Labour Organization (ILO) provides the following instruments: Minimum Age Convention (e.g., a minimum age not less than 15 and 18 for hazardous work) and the Worst Forms of Child Labour Convention.

Child-Resistant Packaging. Child-resistant packaging, as defined by the Poison Prevention Packaging Act, is packaging that is designed or constructed to be significantly difficult for children under five years of age to open or obtain a toxic or harmful amount of the substance contained therein within a reasonable time, and not difficult for normal adults to use properly, but does not mean packaging which all such children cannot open or obtain a toxic or harmful amount within a reasonable time. Code of Federal Regulations, Title 16, Part 1700 and Title 40, Part 157.

Colony Forming Unit (CFU). A measure of bacteria concentration assuming that each bacterium is capable of forming a colony.

Colorant. A product *component*, such as a dye or pigment, whose only function is to change the product's color.

Component. A constituent that is deliberately added at any level for its continued presence in the final product to provide a specific characteristic, appearance, or quality, or a contaminant that was not deliberately added but is present above 0.01% by weight.[20]

Concentrate. A product, as sold that must be diluted by water prior to its intended use or that is diluted during use, such dishwasher detergents.

Critical Medical Device. An item used in medical procedures that confers a high risk for infection if it is contaminated with any *microorganism*. This includes objects that enter sterile tissue or the vascular system, which must be sterile, including, but not limited to: surgical instruments, cardiac and urinary catheters, implants, and ultrasound probes used in sterile body cavities.

Deck, Siding, and Outdoor Furniture Cleaning Product. A product intended to remove common soils from outdoor surfaces including wooden, brick, concrete, or stone decks, patios, furniture, siding, and fences.

Direct Release Product. A product that are intended for use outdoors that are likely to bypass sewage treatment with a high likelihood of being discharged directly to storm sewers or the aquatic environment, shortening the time for degradation prior to entering sensitive environments. This may include, but is not limited to, *boat cleaning products, deck, siding, and outdoor furniture cleaning products, graffiti removers*, *waterless motor vehicle cleaning products*, and *motor vehicle cleaning products*. For the purposes of this standard, *motor vehicle windshield washing fluid* is not considered a direct release product.

Dish Cleaning Product. A product intended to clean dishes, utensils, pots, pans, glasses, cups, and other food service tools in household settings. This includes *automatic dish cleaning product* and *hand dish cleaning products* and for the purposes of this standard it also includes *rinse agent products* used in automatic dishwashers.

Disinfecting. Destroying or irreversibly inactivating infectious *microorganism*s but not necessarily their spores on inanimate objects or surfaces.

Drain Additive/Cleaning Products. Products designed to remove soil or grease from drains, pipes, or traps through chemical, biological, or enzymatic action. Products designed to remove soil or grease from drains, pipes, or traps through physical action, such as air pressure devices, plungers, or augurs, are not included.

[20] This definition excludes substances that are intentionally added to a raw material but not intended for their continued presence in the final product. Examples include residual monomers, preservatives, anti-caking agents, and raw material byproducts or contaminants. Naturally occurring elements and chlorinated organics, which may be present as a result of chlorination of the water supply, are not considered component*s* if the concentrations are below the applicable maximum contaminant levels in the National Primary Drinking Water Standards found in 40 CFR Part 141.

Enzyme. A protein that acts as a catalyst in biochemical reactions. Each enzyme is specific to a particular reaction or group of similar reactions.

Fragrance. An additive, often (but not limited to) a multi-*component* additive, used in a product with the purpose of imparting or neutralizing a scent in the product.

Furniture Polish Product. A product used for cleaning and improving the appearance of furniture finishes. It does not include products designed solely for the purpose of cleaning or dusting, floor polish products, or products designed to leave a permanent finish (e.g., stains, finishes).

General Purpose Cleaning Product. A product used for routine cleaning of hard surfaces, including impervious flooring such as concrete, stone surfaces, or tile. This does not include cleaning products intended primarily for the removal of rust, mineral deposits, or odors. This does not include products intended primarily to strip, polish, or wax floors, and it does not include cleaning products intended primarily for cleaning dishes, laundry, toilets, restrooms, glass, carpets, upholstery, wood, or polished surfaces, nor does it include biological cleaning products. Another term used for these cleaning products may be multi-surface cleaning products.[21]

Genetically Modified Microorganism (GMM). A *microorganism* in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination. The methods or techniques by which *GMM* are produced are listed by the European Commission Directive 2009/41/EC on the Contained Use of Genetically Modified Microorganisms.

Graffiti Remover Product. A product used to remove graffiti markings (spray paint, ink, marker, crayon, lipstick, nail polish, or shoe polish) from masonry and a variety of non-cloth or non-fabric substrates. Products labeled for use as both a paint remover and graffiti remover are included, however products labeled for use only as paint removers are not included.

Haber's Rule. For a given toxic gas, the concentration of the gas multiplied by the duration of exposure equals a constant ($C \times t = k$); for example, doubling the concentration will halve the time for a given toxic effect.

Hand Dish Cleaning Product. A product labeled and intended for manual washing of dishes, utensils, pots, pans, glasses, cups, and other food service tools.

Halogenated Organic Solvent. An organic solvent containing halogens, including, but not limited to, fluorine, chlorine, bromine, astatine, and iodine.

Hazardous Air Pollutant (HAP). A substance listed by the EPA in the Clean Air Act Section 112(b) (1) as a hazardous air pollutant.

[21] General purpose cleaning products for household use are included in the scope of the Green Seal Standard for Household Cleaning Products, GS-8.

Household Use. Use of products that are typically sold to consumers (usually through retail outlets such as stores or online sites) for their own personal use rather than for professional use. This typically includes, but is not limited to, cleaning their households or their personal property.

Intentionally Introduced. The use of substances for their desired or deliberate presence in the primary package for the purpose of providing a specific characteristic or quality. It does not refer to the use of substances as processing aids or the use of an intermediate that imparts certain chemical or physical changes during manufacturing, as long as the substance or intermediate is present in the primary package at concentrations below 100 ppm.

Metal Cleaning Product. A product designed primarily to remove tarnish (the oxidation of metal) or other surface blemishes from finished metal, metallic, or metalized surface (e.g., steel or aluminum surfaces) by physical or chemical action. Products marketed as suitable for cleaning soils in production and maintenance applications are included in the GS-34 Standard for Cleaning and Degreasing Agents and are not included in this product category unless they include *microorganisms* or *enzymes* at greater than 0.01% of the formulation. Products marketed as suitable for cleaning soils from metalized surfaces are included in the GS-37 Standard for Cleaning Products for Industrial and Institutional Use and the GS-8 Standard for Cleaning Products for Household Use.

Microorganism. An organism that cannot be seen by the naked eye (microscopic organisms) including, but not limited to, bacteria, fungi, archaea, and protists. Also included in this category are viruses or virus-like particles, although they are generally regarded as non-living.

Minimum Risk Pesticide. A special class of *antimicrobial pesticide products* that are not subject to federal registration requirements through the EPA because they meet specific requirements under section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), including, but not limited to, that the *components*, both active and inert, are demonstrably safe for the intended use.

Motor Vehicle Cleaning Product. A detergent, shampoo, rinse, and multipurpose cleaning product used to clean and maintain the interior and exterior surfaces of cars, trucks, motorcycles, recreational vehicles and other motor vehicles. For the purposes of this standard, *tire and wheel cleaning products* are separate from motor vehicle cleaning products.

Motor Vehicle Dressing Product. A product designed to enhance gloss and create a protective barrier on internal and external rubber vinyl and plastic surfaces of motor vehicles.

Motor Vehicle Windshield Washing Fluid Product. A *motor vehicle cleaning product* designed or labeled for use in a motor vehicle windshield washer fluid system for the purpose of cleaning, washing, bug removal, or wetting the windshield. Winter formula products include *components* to depress the freezing point.

Motor Vehicle Wax, Polish, Sealant, or Glaze Product. A product designed to seal out moisture, increase gloss, or otherwise enhance a motor vehicle's painted surfaces including, but not limited to, rubbing and polishing compounds, instant detailer, and hard paste wax. Products

designed for use on unpainted surfaces such as bare metal, chrome, glass, or plastic are excluded. For the purposes of this standard, products that are intended as wash and wax products are considered both motor vehicle wax, polish, sealant, or glaze and *motor vehicle cleaning products***.**

Mutagen. A substance designated as known to induce, be regarded as if they induce, or which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans and thus meet the criteria for germ cell mutagenicity hazard categories 1 and 2 (H340 and 341) under the GHS.

Natural Colorant. *A colorant* that comes from biological products or renewable materials, forestry or agricultural materials (including plant, animal, and marine materials), or minerals.

Natural Component. A *component* that comes from materials found in nature including mineral, forestry, agricultural, or biological materials such as, but not limited to, animal products produced by the animal but not part of the animal; do not contain petroleum or petroleum-derived compounds; do not contain transgenic hybrid organisms (inserted deoxyribonucleic acid (DNA) that originated in a different species); have been processed without irradiation; and are not chemically altered.

Naturally-Derived Component. A *component* that is partially chemically altered without petroleum *components* and have been minimally processed such that they not be altered to such an extent that they are substantially less biodegradable or more toxic (examples of potentially acceptable processes are included in Appendix 2).

Neurotoxin/Systemic Toxin. A substance designated as producing a specific target organ toxicity arising from either single exposure or repeated exposure and meets the criteria for hazard categories 1 or 2 (H370, H371, H372, H373) under the GHS.

Odor Remover Product. A product designed or labeled to inhibit the ability of soils to create malodors, or functions to entrap, encapsulate, neutralize, convert, or eliminate malodor molecules through a physio-chemical process that is not simply masking or overpowering odors.

Optical Brightener. An additive designed to enhance the appearance of colors and whiteness in materials by absorbing ultraviolet radiation and emitting blue radiation. These compounds are also known as fluorescent whitening agents**.**

Optical Lens Cleaning Product. A product designed to remove oil, grease, and other common soils from exposed hard surfaces of optical equipment including glasses, photography equipment, and microscopes. Cleaning products for contact lenses are excluded.

Oven Cleaning Product. A product intended for use in removing organic soil from metallic or porcelain surfaces of ovens, barbeques, fryers, and grills.

Ozone-Depleting Compound. A compound with an ozone-depletion potential greater than 0.01 (Chloroflourocarbon - CFC 11=1) according to the EPA list of Class I and Class II Ozone-

Depleting Substances, or any substances or mixtures falling into category 1 (H420), hazardous to the ozone layer, under the GHS.

Package. This includes the *primary package* and any *secondary package* used for the product.

Pathogenic Microorganism. For the purposes of this standard this includes microorganisms that cause disease and can be classified as World Health Organization (WHO) Risk Group 2, 3, or 4, including, but not limited to: coliforms, Escherichia coli, Salmonella, Staphylococcus aureus, Pseudomonas aeruginosa, and some yeasts and molds.

Post-Consumer Material. Material that would otherwise be destined for solid waste disposal, having completed its intended end-use and product life cycle. Post-consumer material does not include materials and by-products generated from, and commonly reused within, an original manufacturing and fabrication process.

Powders/Solids/Non-Aqueous Liquids. Products that cannot be formulated with additional water due to the form of the product, including, but not limited to: powdered detergents, solid bar soaps, detergents in tablet form, detergents as extruded or cast solids, non-aqueous liquid products in a dissolvable shell.

Primary Cleaning Function. For the purposes of this standard, a cleaning product's primary function is to remove soil.

Primary Package. *Package* material that physically contains and contacts the product, not including the cap or lid. For products sheathed in a dissolvable film, the film components are considered product *components* rather than packaging material. For products that meet the annex requirements for Products as Powders/Solids/Non-Aqueous Liquids, the primary package is the material that holds the individually packaged product units or the entire product.

Product As Used. The most concentrated form of the product that the manufacturer recommends for a product's intended use. For example, if a manufacturer recommends a product be diluted 1:64 or 2:64 for use, the product shall meet the health and environmental requirements at a dilution of 2:64.

Recyclable. The package can be collected in a substantial majority of communities, separated or recovered from the solid waste stream and used again, or reused in the manufacture or assembly of another package or product through an established recycling program.

Refillable Package. A *package* that is routinely returned to and refilled by the product manufacturer at least five times with the original product held by the *package*, and demonstrated in practice. For the purpose of this standard, the product manufacturer or the product manufacturer's agent may refill a *package*.

Registered Antimicrobial Pesticide Product. A product registered with the EPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, 7 U.S.C. 136) or registered with

Health Canada's Therapeutic Products Directorate or Pesticide Management Regulatory Agency (PMRA).

Reproductive Toxin. A substance listed as a reproductive toxin (including developmental, female, and male toxins) by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (California Code of Regulations, Title 22, Division 2, Subdivision 1, Chapter 3, Sections 1200, et. Seq., also known as Proposition 65); or a substance designated as Category 1 (H360), known or presumed reproductive toxicant, or Category 2 (H361), suspected human reproductive toxicant, or having adverse effects on or via lactation (H362), under the GHS.

Respiratory Sensitizer. A substance designated as leading to hypersensitivity of the airways following inhalation of the substance and meeting the classification criteria of Category 1 respiratory sensitization (H334) in accordance with the GHS.

Restroom Cleaning Product. A product used to clean hard surfaces in a restroom such as counters, walls, floors, fixtures, basins, tubs, toilets, urinals and tile. Other terms used for these cleaning products may include bathroom cleaning products, toilet bowl cleaning products, or urinal cleaning products.[22]

Rinse Agent Product. A product which is formulated to improve the drying effect and the appearance of articles cleaned by means of automatic household dishwashing machines.

Sanitizing. Reducing, but not necessarily eliminating, *microorganisms* from the inanimate environment to levels considered safe as determined by public health codes or regulations.

Secondary Function. For the purposes of this standard, the secondary function of a cleaning product may be to enhance the primary cleaning function through bubble or foam formation or to provide some other added functional enhancement (e.g. longer-term cleaning effect).

Secondary Package. Any packaging or material other than the primary package, including wrappers, boxes, and blister packs, but excluding shipping containers.

Semicritical Medical Device. An item used in medical procedures that contacts mucous membranes or non-intact skin. This category includes respiratory therapy and anesthesia equipment, some endoscopes, laryngoscope blades, esophageal manometry probes, cystoscopes, anorectal manometry catheters, and diaphragm fitting rings.

Serious Eye Damage. The production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the anterior surface of the eye, which is not fully reversible within 21 days of application. Substances classified as Category 1 for Serious Eye Damage/Eye Irritation (H318) under the GHS are also considered to cause serious eye damage.

[22] Restroom cleaning products for household use are included in the scope of the Green Seal Standard for Household Cleaning Products, GS-8.

Skin Corrosion. The production of irreversible damage to the skin, namely visible necrosis through the epidermis and into the dermis, following the application of a test substance for up to 4 hours. Corrosive reactions are typified by ulcers, bleeding, bloody scabs, and, by the end of observation at 14 days, by discoloration due to blanching of the skin, complete areas of alopecia, and scars. Substances designated as Category 1A, 1B or 1C for Skin Corrosion/Irritation (H314) under the GHS are also considered to cause skin corrosion.

Skin Sensitizer. A substance that will lead to an allergic response following skin contact. Identified under Category 1 for skin sensitization (H317) under the GHS.

Specialty Cleaning Product. Products marketed and intended for specialized cleaning functions and *antimicrobial pesticide products.*

Spray Packaging. A *package* that dispenses the product through a nozzle and the product is in small droplets (i.e., a spray). It does not require a pressurized propellant to dispense the product. Trigger bottles or squeeze bottles that dispense a foam or a viscous liquid stream are not considered spray packaging.

Source-Reduced Package. A *package* that has at least 20% less material (by weight) compared to containers commonly used for that product type. For bag-in-the-box type packages, the box is included in the weight if the box is used during product use or in product merchandising.

Surfactant. A compound that reduces interfacial tension between two liquids or a liquid and a solid. This includes detergents, wetting agents, and emulsifiers.

Synthetic Component. A *component* created artificially rather than naturally or from *natural components*. For the purposes of this standard, *naturally-derived components* are not considered synthetic *components*.

Take-Back Program. A program sponsored by the original product manufacturer that has been demonstrated to receive at least 50% of sold *packages* for recycling or reuse.

Tire and Wheel Cleaning Product. A product designed or labeled exclusively to clean either tires, wheels, or both.

Toxic Release Inventory Persistent, Bioaccumulative, and Toxic (TRI PBT) Chemicals. The chemicals listed by the EPA on the Toxic Release Inventory as Persistent, Bioaccumulative and Toxic (PBT) Chemicals.

Undiluted Product. The most concentrated form of the product produced by the manufacturer for transport outside its facility.

Upholstery Cleaning Product. A product designed or labeled for the purpose of eliminating dirt or stains on objects upholstered or covered with fabrics such as wool, cotton, nylon, or other synthetic fabrics, including but not limited to products used on household furniture.

Waterless Motor Vehicle Cleaning Product. A *motor vehicle cleaning product* that is not rinsed with water following application. For the purposes of this standard, products that are intended as waterless wash and wax products are considered both *motor vehicle wax, polish, sealant, or glaze* and *waterless motor vehicle cleaning products*. These products may also be known as spray and wipe products.

World Health Organization (WHO) Risk Group 1. Microorganisms that are unlikely to cause human or animal disease under the basis for classification defined by the World Health Organization in the Laboratory Biosafety Manual. In the case that a particular strain has conflicting risk group designations on various international lists, the most hazardous (highest level) designation will be utilized. The biosafety designation lists that will be consulted include:

- Australia/New Zealand
- Belgium
- Switzerland
- United Kingdom
- Germany
- United States Department of Health and Human Services, National Institutes of Health (NIH)
- European Commission
- Singapore
- Japan

ANNEX B – POWDERS/SOLIDS/NON-AQUEOUS LIQUIDS (Normative)

Products as Powders/Solids/Non-Aqueous Liquids. *Powder/solid/non-aqueous liquid* products that meet all of the following requirements may be exempt from the skin and eye damage criterion (3.4) and may have an alternate threshold of 300 mg/kg for oral acute toxicity (3.3) herein.

A. Packaging Requirements. The product shall meet the requirements under **either** A(1) Child-Resistant Packaging Requirements **or** A(2) Packaging Durability Requirements.

(1) Child-Resistant Packaging. The product shall be packaged in *child-resistant packaging* following the ASTM D3475 classification. *Child-resistant packaging* must be tested per ISO 8317 or European Standard (EN) 862.

(2) Packaging Durability. The product shall meet the following requirements to be considered durable.

i. Drop Test. The *primary package*, including any lid, shall be durable as demonstrated by passing the following drop test: drop the product from a height of 48 inches with 4 drops scenarios: flat-on-bottom, flat-on-top, flat-on-side, and corner; with passing results including that the packages must not leak, contents must be retained, and no damage to the outer package likely to adversely affect safety must be sustained.

ii. Spill Resistant. The *primary package* shall not spill when tipped over, turned upside down or shaken and shall not leak when exposed to water.

iii. Practically Inaccessible. The *primary package* shall not allow for easy access/exposure of the product during routine handling of the package, such as while transferring from shipping cartons, during storage, or after opening (e.g. the user still cannot get at the contents, or the contents are protected or wrapped).

B. Dispensing Exposure Requirements. Documentation shall be provided to demonstrate that expected dispensing situations will not result in incidental contact exposure to oral consumption/toxicity, skin corrosion, or serious eye damage.

C. Labeling Requirements. The product label shall include the following in a conspicuous location:

- The signal word "WARNING" or 'CAUTION" on products which cause *skin corrosion*, cause *serious eye damage*, or have an acute toxicity greater than or equal to 300 mg/kg and less than or equal to 5,000 mg/kg, with the applicable precautionary measures:
    - May cause skin corrosion, do not get on skin
    - May cause serious eye damage, do not get in eyes
    - Harmful if swallowed, do not ingest

- Instruction, when necessary or appropriate, for first-aid treatment
- The statement "KEEP OUT OF REACH OF CHILDREN" or its practical equivalent in capitalized text

ANNEX C– ENZYMES (Normative)

Products Containing Enzymes. Products that contain *enzymes* shall meet all of the following:

A. Enzyme Form. *Enzymes* in the product shall be in liquid form or an encapsulated solid (or other dust-free solid) with a minimum diameter of 0.15 mm. Smaller diameters may be permitted for solid products if they are demonstrated to result in airborne *enzyme* concentrations equivalent to or less than encapsulated solids with a 0.15mm diameter.

B. Enzyme Source. The source from which *enzyme*s were derived shall be identified to a species level and disclosed to the certification program.

C. Enzyme Source Microorganisms. For *enzymes* derived from *microorganisms*, documentation shall be provided that the source *microorganism* is absent from the finished product. Test methodology and results shall be documented in sufficient detail and provided to the certification program. If the product does not conform to this provision, then all *microorganism*s shall meet the requirements in Annex D herein.

D. Exemptions. *Enzymes* are exempted from the requirements for *Asthmagens* (3.8) and *Respiratory Sensitization* (3.9) herein. Titanium dioxide[23] is exempt from the prohibition on *carcinogens* (3.5 herein) when it is present only due to the use of *enzymes.* For products sold in solid form, e.g., powders, bars, tablets, titanium dioxide must be bound within the product matrix or bonded to other *ingredients*.

E. Labeling Requirements. Products containing *enzymes* shall include the following on the product label:

- A declaration that the "product contains enzymes", in addition to the listing in the ingredient line
- A statement that immune-compromised individuals or those with asthma should avoid exposure to products containing enzymes from both direct use and incidental contact during or shortly after application to these products and instruction, when necessary or appropriate, for follow-up treatment

F. Industrial Hygiene. Documentation shall be provided to the certification organization that demonstrates that the manufacturer has implemented an industrial hygiene plan intended to minimize concentrations of and exposure to airborne *enzymes* (e.g., engineering controls, work practices, and personal protective equipment) and monitor the air concentrations of the *enzymes* and worker illness/sensitization due to the *enzymes*. An example of best practices that may be applicable for this plan is available at AISE.

[23] Titanium Dioxide: EC Number 236-675-5, CAS Number 13463-67-7

ANNEX D – MICROORGANISMS (Normative)

Products Containing Microorganisms. Products that contain *microorganisms* shall meet all of the following, with any specified testing conducted with an objective, scientifically-validated method under controlled and reproducible laboratory conditions (and appropriate testing details provided to the certification program):

A. Genetically Modified Microorganisms in Microbial Products. The presence of *GMM* as *components* in finished products is prohibited.

B. Microorganism Biosafety. All *microorganisms* shall be classified as *WHO Risk Group 1* or equivalent biosafety designation. For strains that do not appear on any international biosafety designation lists, alternative means may be acceptable; consultation with the certifying organization may be required.

C. Microorganism Strain Identification. *Microorganism* strains shall be identified through a taxonomic review (e.g., genetic or phenotypic analysis) that is provided by a full-service culture collection listed with the World Federation of Culture Collections, whether or not the strain is part of the collection.

D. Absence of Contaminants. *Pathogenic microorganisms* shall not be present in the microbial strain, finished product, or at the end of the product's intended shelf life. Testing for the presence of *pathogenic microorganisms* shall be conducted according to the Joint Food and Agriculture Organization of the United Nations /WHO Expert Committee on Food Additives (JECFA) Combined Compendium of Food Additive Specifications standard microbiological analytical methods or comparable method and a Certificate of Analysis shall be provided to the certification program.

E. Effective Prevention Measures and Treatment. All *microorganisms* shall be demonstrated to be susceptible to the following prevention and treatment measures:

- *An antimicrobial agent*, as demonstrated by testing the microbial strain against an acceptable substance (i.e., an EPA general disinfectant, Center for Disease Control low-level disinfectant, or a registered *antimicrobial agent* by Health Canada) in accordance with the EPA/Office of Pesticide Programs Standard Operating Procedure (SOP) or the AOAC International Use Dilution Method for Testing Disinfectants, SOP Number: MB-05-04

- One of the five major antibiotic classes (aminoglycoside, macrolide, beta-lactam, tetracycline, and fluoroquinolones), as demonstrated by testing the microbial strain in accordance with the Kirby-Bauer disc diffusion method.

F. Microbial Count. A *microorganism* used to serve the *primary cleaning function* in the *undiluted product* shall have a plate count that is greater than or equal to $1x10^7$ *CFU* per milliliter for liquid products and $1x10^9$ *CFU* per gram for solid products. A total plate count shall be conducted in accordance with the methods for microbiological analyses listed in

the JECFA Combined Compendium of Food Additive Specifications or comparable method. An exception shall be made for *microorganisms* used to serve a *secondary function* in the *undiluted product*.

G. Labeling Requirements. Products containing *microorganisms* shall include the following on the product label:

- A declaration that the product contains *microorganisms*
- A statement that immune-compromised individuals should avoid exposure to products containing *microorganisms* from both direct use and incidental contact during or shortly after application to these products, especially when the treated areas are still wet
- Contact with open cuts or sores should be avoided
- Users should wash their hands after using the product
- Instructions that *microorganisms* may not be effective in the presence of *antimicrobial agents* such as chlorine bleach
- Instructions that the product shall not be used on food-contact surfaces
- Instructions that products containing *microorganisms* should not be sprayed directly into the air

APPENDIX 1 – SCOPE (Informative)

Examples of products included in or excluded from the scope of GS-52:

Household Products Included in GS-52

- Adhesive remover products
- *Boat cleaning products* (e.g., hull or bilge)
- *Boat wax, polish, sealant, or glaze products*
- *Chewing gum remover product*
- *Deck, siding, and outdoor furniture cleaning products*
- *Dish cleaning products* (e.g., *hand dish, automatic dish, rinse agent* products)
- *Antimicrobial pesticide products (e.g.,* disinfectant and sanitizer products)
- *Drain additive/cleaning products*
- Dusting aid products
- Electronic cleaning products
- Fruit and vegetable wash products
- *Furniture polish products*
- *Graffiti remover products*
- Grout cleaning products
- Leather cleaning products
- *Metal cleaning products*
- Mold and mildew stain remover products
- *Motor vehicle cleaning products*
- *Motor vehicle dressing products*
- *Motor vehicle windshield washing fluid products*
- *Motor vehicle wax, polish, sealant, or glaze products*
- *Odor remover products*
- *Optical lens cleaning products*
- *Oven cleaning product*
- Pressurized gas dusting products
- Products that contain *enzymes* or *microorganisms* and are packaged in trigger bottles or squeeze bottles
- Rust stain remover products
- Stone cleaning products
- *Tire and wheel cleaning products*
- *Upholstery cleaning products*
- *Waterless motor vehicle cleaning products*

Products Excluded from GS-52

- *Air freshener*s (designed to mask odor)
- Cleaners/degreasers marketed as suitable for cleaning soils in production and maintenance applications without *enzyme*s or *microorganisms* (included in GS-34)
- Dry erase board cleaning products (included in GS-37)
- Floor finish and finish strippers for industrial and institutional use (included in GS-40) and for household use
- General-purpose, restroom, glass and carpet cleaners for industrial and institutional use with or without *enzymes* or *microorganisms* (included in GS-37)
- General-purpose, bathroom, glass, and carpet cleaner products marketed specifically for *household use* with or without *enzymes* or *microorganisms* (included in GS-8)
- Hand cleaning products for industrial and institutional use (covered in GS-41) or *household use* (covered in GS-44)
- *Hand dish cleaning products* formulated with *antimicrobial agents* to support antimicrobial claims
- Holding tank treatment products
- Industrial and institutional versions of those included on the left column
- Laundry care products (included in the standard in development, GS-48)
- Paint remover/thinner products
- Products that contain *enzymes* or *microorganisms* and are sold in, or with, spray packaging
- Pump and sewer treatment products
- Sterilizers or high level disinfectants for *critical medical devices*

APPENDIX 2 – NATURALLY DERIVED COMPONENTS (Informative)

Examples of Potentially Acceptable Processing Methods of Naturally-Derived *Components* (which must also meet all the requirements in the standard):

- Esterification, Etherification, and Transesterification (to produce esters and ethers like polyglycerols)
- Glucosidation (to produce glucosides)
- Hydrogenation (of fats and oils)
- Hydrolysis and Hydrogenolysis (to produce hydrolyzed proteins, glycerin and fatty acids, and fatty alcohols)
- Other Condensation Reactions like Acylation of proteins and Sulfation of fatty alcohols
- Saponification (to produce soap)