

Polimeri Riciclati: Valutazione di Proprietà Critiche e Sistema Qualità



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Agenda

Recycled Plastics

- What is Recycled Plastic?
- Recycled vs. Regrind
- Recycled Plastics Safety Testing vs. UL Environment Validation
- What are the safety concerns
- Quality Assurance Program
- Quality Management System
- Test Program
- Follow Up



Introduction to Recycled Plastics

The definition of Recycled from UL 746D:



2.10 RECYCLED PLASTICS – Those plastics composed of post-consumer material or recovered material only, or both, that may or may not have been subjected to additional processing steps of the types used to make products such as recycled-regrind, or reprocessed or reconstituted plastics.

What is Recycled Plastic?

- A plastic prepared in a production process from plastic-waste materials by using:
 - Plastic articles from the field (post-consumer)
 - Waste (i.e. out of specification) generated during the manufacturing process (post-industrial)
 - Plastic-waste materials separated from the solid-waste stream (recovered).

Introduction to Recycled Plastics

What a UL Component Recycled Plastic is NOT:

- An UL Environment claims validation per UL 2778
- A plastic evaluated for compliance with regrind requirements per UL 746D



Environmental Claim Validation

Environmental Claim Validations (ECVs) provide independent verification that products live up to their marketing claims — from recycled content to bio based content, to landfill waste diversions claims. This kind of validation gives both manufacturers and their customers peace of mind.



Environmental Claim Validations



ECVs lend **3rd - party credibility** to environmental claims by providing **validation** to **build trust** with customers, equipping manufacturers with a **powerful tool for differentiation & recognition** in an increasingly cluttered marketplace. Can help contribute to LEED points and raise visibility among key specifiers and **drive demand**.

Applies to:

- Building materials
- Cleaning products
- Electronics
- Components
- **Plastics**

- Recycled Content
- Bio Based Content
- VOC Content
- Regional Materials
- Rapidly Renewable
- Recyclability
- Reclamation Facility
- Landfill Waste Diversion (Zero Waste to Landfill)
- Mold Resistance
- PVC Free
- Energy Saving Power Strips
- Innovative Claims



Regrind vs Recycled



The definition of Regrind from UL 746D:

2.12 REGRIND – A noncontaminated product or scrap such as sprues and runners that have been reclaimed by shredding and granulating for use in-house.

Regrind

- Specifically defined as coming from molding operations
- Up to 25% can be re-introduced without testing by molders
- More than 25% requires testing

Recycled

- Can come from post-consumer sources or post-industrial sources
- Any level of recycled plastic needs to be tested

What are the safety concerns of Recycled Plastics?



The same as Virgin Plastics!

The material must perform consistently in the end component or product application.

The Challenge:

- The feed stream of Recycled Plastics may be coming from different sources and therefore, the formulation of the material is not always identical and more difficult to control.
- The goal of the Recycled Plastics program is to ensure consistent performance of the material despite the number of sources, Recycled content or any other factors that may cause variation in the formulation of the material.

What are the different paths of UL Recognition of Recycled Plastics?

Recycled Plastic with Consistent Identification (Traceable)

- Recycled plastics that are expected to meet the identification criteria in UL 746A.

Recycled Plastic **without** Consistent Identification (Untraceable)

- Recycled plastics not meeting the requirements for recycled plastics with consistent identification are to be categorized as recycled without consistent identification.



General Requirements of Recycled Plastics

For a Recycled Plastic to be Recognized, the Customer must comply and undertake the following:

- Have a Quality Assurance Program
- Have a Quality Management System
- Perform a test program
- Conduct Follow Up

Quality Assurance Program
and
Quality Management System



Quality Assurance Program

The **Quality Assurance Program** of a manufacturing location is the test program developed and approved by the manufacturer to ensure material consistency, meeting compliance with UL 746D, Table 10.1.

GOAL: Ensure consistency of performance during the production of material .

Note: This is not the same as the Follow Up Services (FUS) test program.



Quality Assurance Program

Requirements of QA Program

- Provided during the initial investigation
- For ALL Recycled Material, with and without consistent identification (traceable and untraceable)
- Test program conducted *on location* or at an *accredited lab*

Quality Assurance Program

Quality Testing for Recycled Materials in Manufacturer's Responsibility Section (Table II) in the Follow Up procedure

Grade	Property	Units	Method	Range Of Acceptability		Frequency
				Minimum	Maximum	
ABC	Tensile Strength	MPa	ASTM D638	80	120	
	Izod Impact	kJ/m ²	ASTM D256	5.0	9,0	
	Flame	Rating	UL 94	HB		

Note: The test methods and ranges of acceptability are only examples.



Quality Management System

A **Quality Management System** must exist and the manufacturers production facilities.

Section 10.4.2, from UL 746D

10.4.2 The Quality Management System is to be compliant with ISO 9001 or an equivalent internationally recognized standard.

*if no ISO 9001 or eq. std. Certification provided
manufacturing location audited by UL during initial investigation*

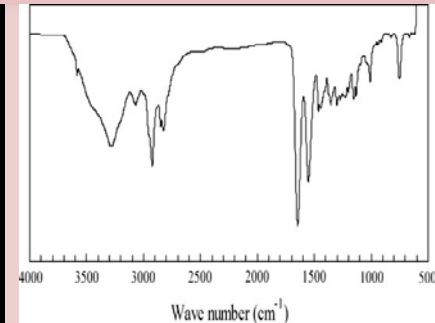
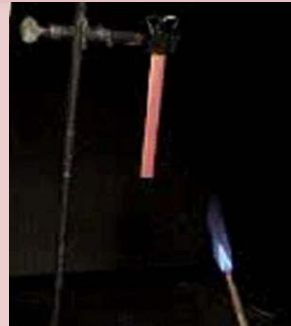


New Work Investigation

Recycled Plastics with Consistent IDs: New Work Investigation

Required Test Program

- 3 Production Batches:
- Flammability
- ID



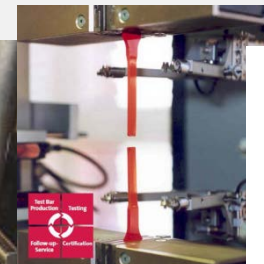
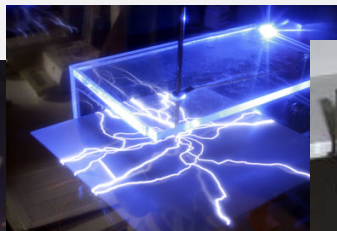
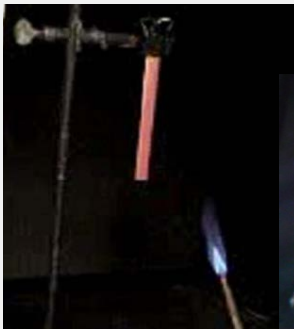
Optional Test Programs

- only 1 production batch is required for testing for the following ratings:
 - Index ratings (HWI, HAI, CTI etc.)
 - Long term thermal aging (RTI)
 - UV and Water Immersion (f1), (f2)
 - Re grind

Recycled Plastics **without** Consistent IDs: New Work Investigation

Required Test Program

- **5 Production Batches** of the following test methods, even if the Customer has not requested the ratings of these properties:
 - Flammability
 - Hot Wire Ignition (HWI) or Glow Wire Ignition (GWIT)
 - Heat Deflection Temperature (HDT)
 - Dielectric Strength
 - Tensile Strength
 - Impact
- 1 Production Batch of ID testing to confirm generic polymer type



Recycled Plastics **without** Consistent IDs: New Work Investigation

Optional Test Program

- Once the material has demonstrated consistency of the performance of the material, 3 production batches are required for testing for the following ratings:
 - Index ratings (HAI, CTI etc.)
 - Long term thermal aging (RTI)
 - UV and Water Immersion (f1), (f2)
 - Regrind

Follow Up



Follow Up

UL Field Representative Requirements

- The Follow Up Investigation conducted by the UL Field Representative includes:
 - Pick up samples for testing
 - Verify the manufacturer is maintaining a production log and all copies of test results of production batches. [Quality Assurance Program]
 - Verify status of the ISO 9001 Certification or documents verified for the Quality Management System during the new work investigation



Follow Up

Follow Up Testing Program for Recycled Plastics with Consistent IDs

- Follow Up Testing program is the same as Virgin Plastic material, typically:
 - Flame testing at each flame rating at the minimum thickness and color.
 - Identification comparison testing for IR, TGA and DSC.

Follow Up

Follow Up Testing Program for Recycled Plastics without Consistent IDs

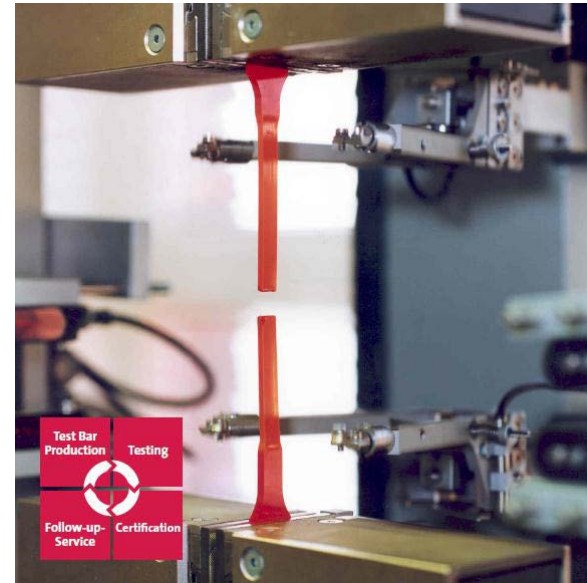
- Follow Up Testing program is defined by the testing conducted in the initial investigation:
 - *Flame Testing* is required for all ratings, including HB.
 - *Impact Strength*
 - *Tensile Strength (TS)*
 - *Heat Deflection (HDT)*
 - *Dielectric Strength (DS)*
 - *Hot Wire Ignition (HWI) or Glow Wire (GWIT)*

UL TTC
Thermoplastics Testing Center



Ilaria Nicoli
Account Executive

UL Thermoplastics Testing Center



“Accredited Testing Center with One-Stop-Service”:

- Compounding (on lab scale)
- Test specimen production
- Testing technology
- Testing towards certification
- Follow-up Service

Component - Plastics E999999

ANY PLASTICS CORP.
PLASTIC RD. 1, NORTHBROOK, IL, USA

ABC123 +
Polypropylene (PP), furnished as pellets

Color	Min THK (mm)	Flame Class	HWI	HAI	RTI Elec	RTI Imp	RTI Str
ALL	1.5	V-2	3	0	65	65	65
	3.0	V-0	1	0	65	65	65
	6.0	V-0	0	0	65	65	65

Comparative Tracking Index (CTI): 0
High Voltage Arc Tracking Rate (HVTR): 1
Dielectric Strength (kV/mm): -

Dimensional Stability (%): -
High Volt. Low Current Arc Resig (D496): 4
Volume Resistivity (10¹² ohm-cm): 12

Material designations may be followed by suffix numbers and/or letter(s) denoting color.

UL's email-access data does not pertain to building materials, furnishings and related contents. UL's email-access data is intended solely for determining the flammability of plastic materials used in the components and parts of end-product devices and appliances, where the acceptability of the combination is determined by Underwriters Laboratories, Inc.

Underwriters Laboratories Inc.



DAP Deutsches Akkreditierungssystem Prüfwesen GmbH

Signatory to the Multilateral Agreement of EA for Mutual Recognition
and to the Mutual Recognition Arrangement of ILAC

represented in the

Deutscher Akkreditierungsrat



Accreditation

The DAP Deutsches Akkreditierungssystem Prüfwesen GmbH herewith confirms that the

UL International TTC GmbH

Rheinuferstraße 7 - 9
47829 Krefeld

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the fields of

**mechanical, physico-technological, rheological, thermo-mechanical tests and
artificial light aging and weathering of plastics;
physico-technological tests of plastics through compounding and
injection moulding**

in accordance with the test methods listed in the annex. The annex forms part of the certificate
and comprises 5 pages.

The accreditation is valid from 2009-08-11 to 2011-10-05.

DAR registration number: **DAP-PL-3471.00**

Berlin, 2009-08-11

Univ.-Prof. Dr.-Ing. habil. K. Ziegler
Managing Director
DAP Deutsches Akkreditierungssystem
Prüfwesen GmbH

Translation for information purposes only. The German certificate is authoritative.
See notes overleaf.

1st issue

Accreditation
according to
DIN EN ISO / IEC 17025
for physical-technological
test procedures on
thermoplastic
polymers
Incl. processing

First given in 10/2001



Compounding by Twin Screw Extrusion

Production of compounds or blends

- addition of additives like flame retardants or UV stabilizers
 - addition of colorants
 - addition reinforcing fillers like glass fibers, nano particles, nano tubes
- 5 twin screw extruder with diameters of 25 to 32 mm Quantities range:
1.3 to 100 kilograms



Test Specimen Production

Modern injection molding technology and exchangeable mold insert system for efficient and reliable manufacturing of test specimen

100 different mold inserts acc. to ASTM and ISO
(21 machines, 80-300 Ton)

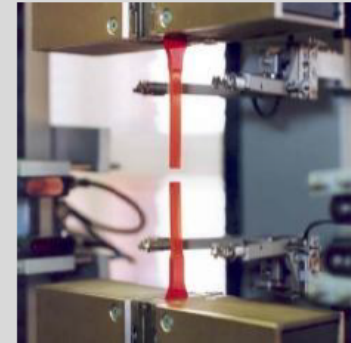


Insert mold



Key-properties – Mechanical testing

Test		Key-properties
Tensile test (short and long term)		E-modulus, tensile strength, stress-strain-curve
Flexural test		E-modulus, flexural strength, stress-deflection-curve
Flexural impact test (notched and unnotched)	Izod	Izod impact strength
	Charpy	Charpy impact strength
Tensile impact test		tensile impact strength
Penetration test		puncture energy, force-deflection-curve
Ball indentation hardness		indentation hardness, force-deflection-curve



High speed tensile testing

Aim: Measurement of tensile properties at high speeds for the determination of true stress-strain-curves as basis for crash simulations

Test speed: 100 mm/min ... 20 m/s (72 km/h)

Force transducer up to: 20 kN

Strain determination: by high speed camera

recording rate: 1 Mio. images /s

resolution: 640 x 512 Pixel

image memory for 16 images

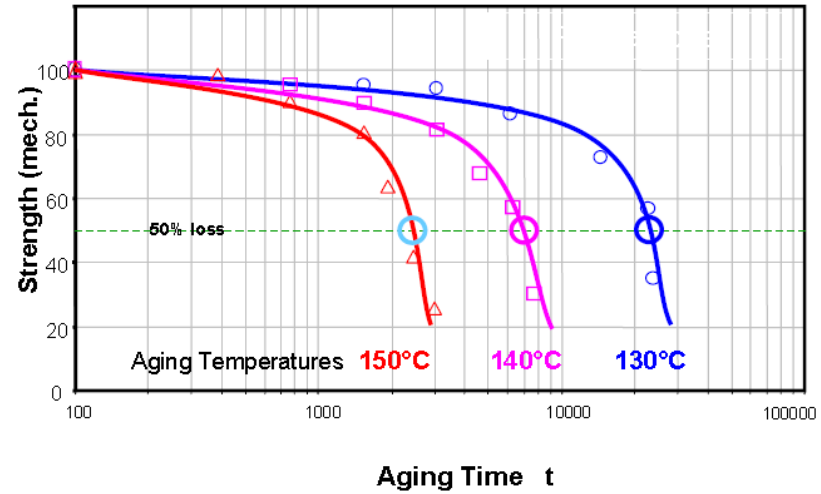
Temperature chamber: - 40 °C ... +200 °C



Thermal Aging



High capacity for thermal aging
210 ovens



Xenon arc weatherometers

Controlled parameters:

- irradiation dose
- light/dark cycles
- humidity
- water spray
- chamber temperature
- black panel/standard temperature
- spectral power distribution by filter

10 standard Xenon arc weatherometer



4 Xenon α -High-Energy weatherometer



Flammability Tests

- Horizontal-Test (HB)
- Vertical-Test (V-0, V-1, V-2)
- Films (VTM-0, VTM-1, VTM-2)
- Test bars (5V)
- Plaques (5VA, 5VB)

Relevance of Flammability Testing

Testing the ignition and combustion behavior of materials used in household products like TV or monitor housing, vacuum cleaners, coffee machines or other electrical devices

UL 94 V

Glow Wire Test

Needle Flame Test

FMVSS (Federal Motor Vehicle Safety Standard)

LOI (Lowest Oxygen Index)



Housing without flame retardant



Housing with flame retardant

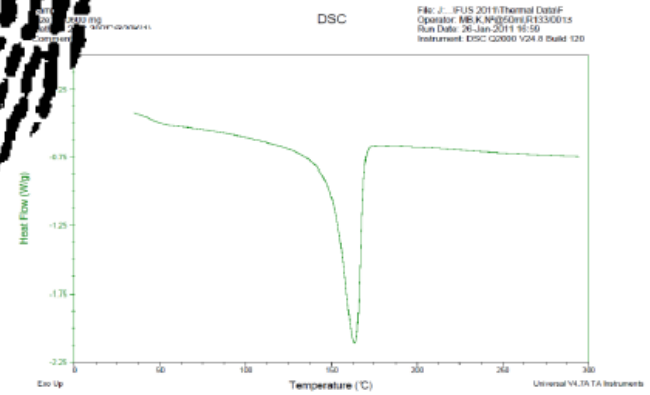
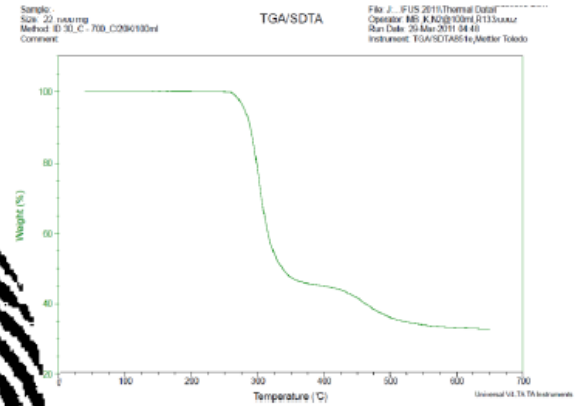
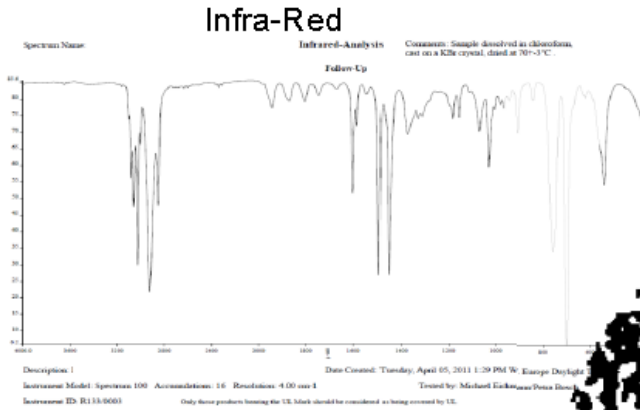


Electrical testing

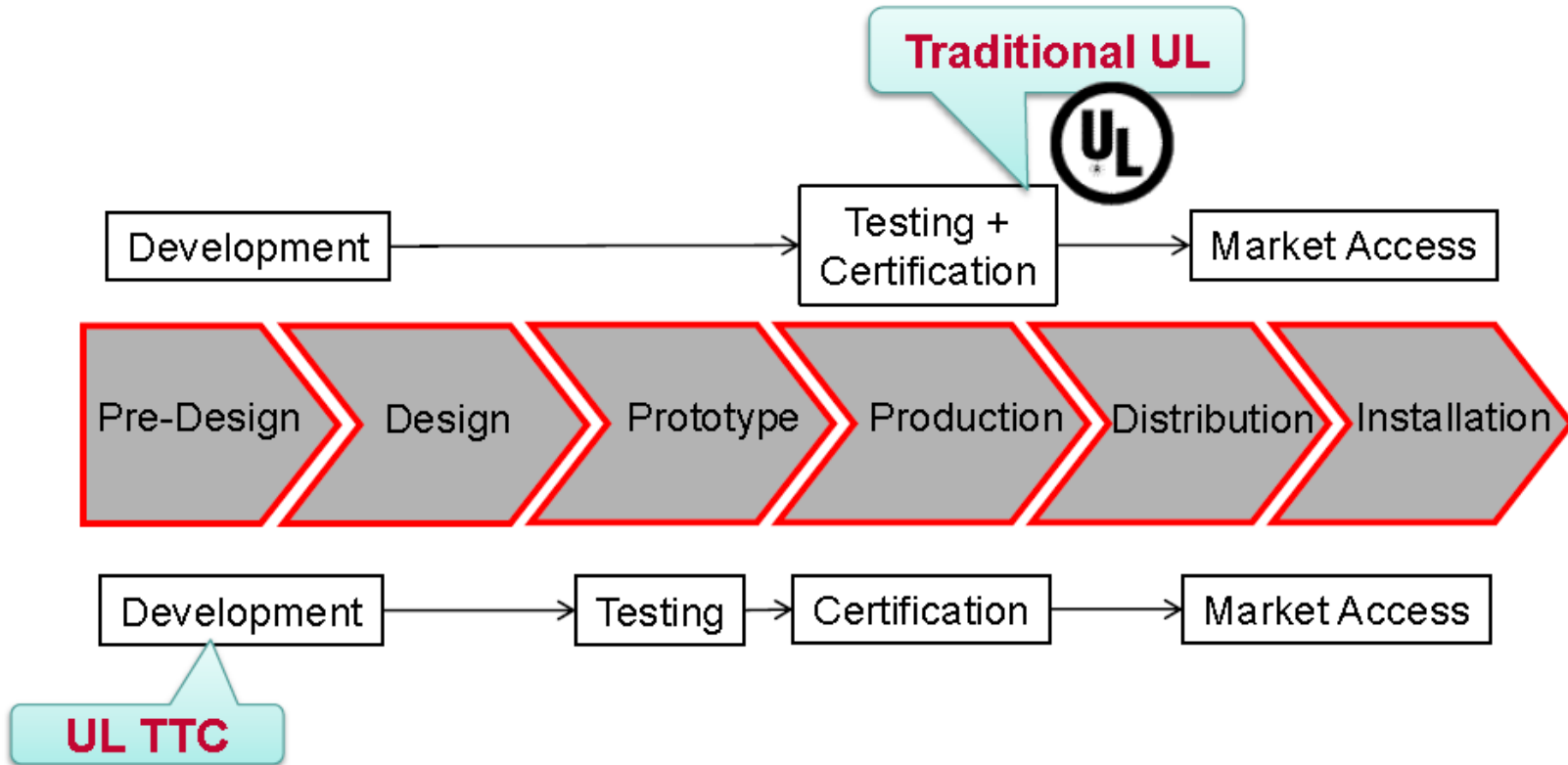
- Electrical resistivity
- Dielectric constant and loss factor
- Dielectric strength
- Comparative Tracking Index (CTI)
- Arc resistance Electrolytic corrosion



ID-Testing (Analytical identification)



Early engagement: Testing Towards Certification



Benefits of Testing at UL TTC *For materials that need UL certification:*

- One-time specimen preparation and one-time testing
- No failing or unexpected results to delay your market entry and add cost
- Pay for your tests at market competitive prices, instead of having them bundled with certification fees
- shorter timeline for the certification process Resulting in: **shorter time-to-market and reduced cost!**



Material testing you can trust!



Thank you for your attention.