



# TEST PROTOCOL RIGID PP-2

## MANUFACTURE OF RIGID RECYCLED PP POTS BY INJECTION MOULDING

### COTREP

The mission of the Technical Committee for the Recycling of Plastic Packaging (COTREP) is to help designers and decision-makers develop recyclable plastic packaging while also providing scope for innovation. The committee includes various stakeholders in the plastic household packaging chain (Valorplast, Elipso, Citeo and SRP) and works on all types of plastic packaging (bottles, dispenser bottles, pots and trays, films and flexible packaging). Protocols for tests performed by COTREP are devised based on work with stakeholders in plastic household packaging end-of-life.

VERSION NO.	DATE	DESCRIPTION
1	November 2025	Initial version

## 1. CONTEXT

COTREP has drawn up this protocol in collaboration with French manufacturers of injection-moulded polypropylene pots. It is representative of industrial practices adopted by producers receiving rPP granulate from streams of rigid PP sourced from French selective collection. Its purpose is to specify tests to be performed for assessing the suitability of rigid recycled PP granulate produced during regeneration tests in accordance with protocol Rigid PP-1 for transformation into plant pots by injection moulding (one of the most common outlets for rigid recycled PP<sup>1</sup>). Today, the grades of rigid rPP produced by regeneration of French selective collection streams are similar to the grades used for injection moulding process applications. For this reason, the protocol is currently geared towards transformation of recycled material by injection moulding but COTREP does not preclude other manufacturing processes over the long term.

Results obtained from tests described below may be submitted to COTREP for analysis and potentially included in French recommendations on eco-design aimed at improving recyclability.

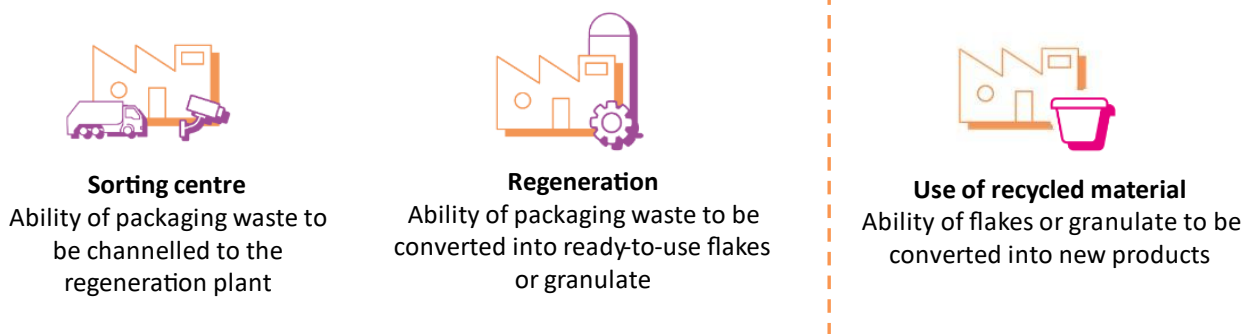


Figure 1: Scope of the Rigid PP-2 protocol

<sup>1</sup> In this protocol "PP" and "rigid PP" are used interchangeably; rPP means recycled PP, i.e. recycled material from the regeneration of rigid PP household packaging.

This protocol takes account of current technical knowledge and processes for transforming rPP granulate into injection-moulded pots.

COTREP may review this protocol with regard to developments in the use of granulate from recycled rigid PP household packaging and related manufacturing processes if needed.

Results obtained from tests performed based on this protocol are insufficient for determining packaging recyclability. This protocol merely reflects the process of transforming regenerated granulate into injection-moulded pots and provides no basis for judging the suitability of packaging for sorting.

## 2. AIMS

This test protocol should be implemented after and in addition to the rigid PP packaging regeneration protocol (Rigid PP-1). Its aim is to allow companies to test the production of injection-moulded recycled PP pots including regenerated granulate produced from test packaging in semi-industrial conditions. It covers:

- Technical feasibility of transforming granulate into pots
- An analysis of the quality of the pots produced.

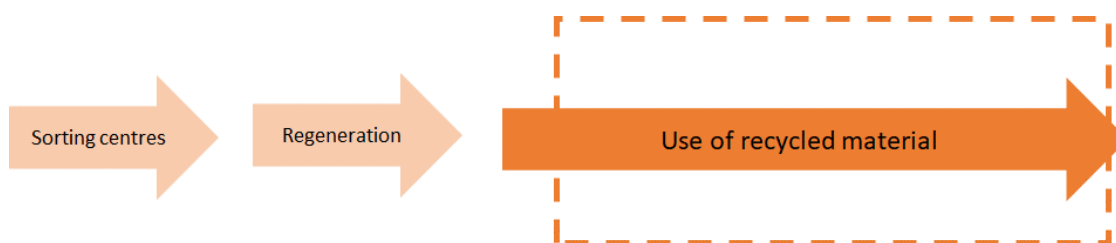


Figure 2: Analytical scope of the injection moulding protocol

## 3. TERMS OF REFERENCE

Any company (packaging manufacturer, marketer, resin manufacturer, distributor, etc.) seeking to determine how granulate produced from a specific packaging item according to protocol Rigid PP-1 impacts the process of forming by injection moulding can use this protocol to perform testing.

Companies wishing to perform tests shall be referred to hereafter as "**Requesters**". COTREP-certified test laboratories able to comply with this test protocol shall be referred to hereafter as "**Laboratories**". A list of certified laboratories is provided in the "Practical information" section.

## 4. PREPARATION FOR TESTS

### Step 1: After validating the success criteria for protocol Rigid PP-1

Once success criteria for protocol Rigid PP-1 have been validated, the **Requester** should confirm that it wishes the **Laboratory** to perform tests in accordance with protocol Rigid PP-2.

### Step 2: Prepare for application of protocol Rigid PP-2

The **Requester** should provide the selected **Laboratory** with GM1, GM2 ... and GT granulate prepared in accordance with the COTREP test protocol on rigid PP regeneration. The test comprises the following steps:

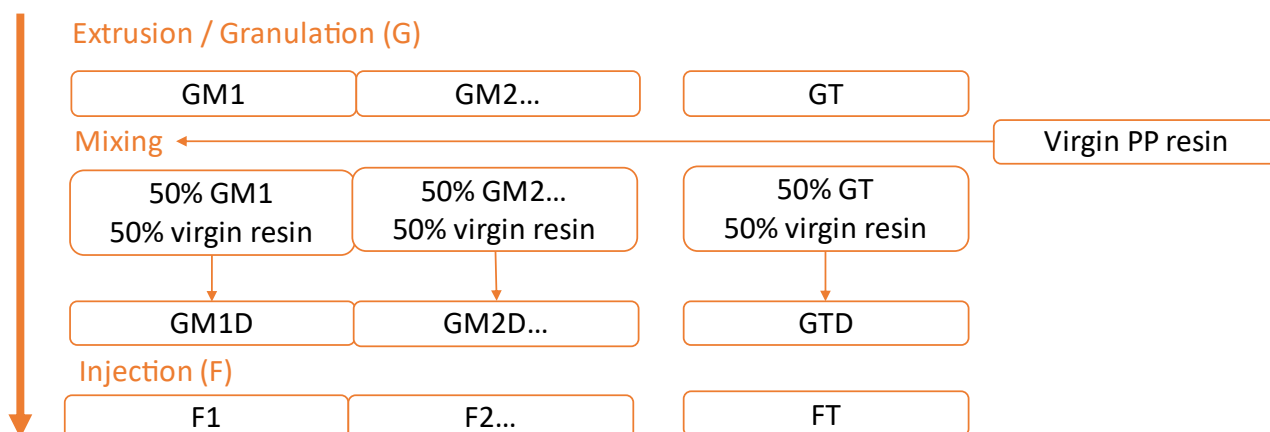


Figure 3: Description of injection moulding protocol steps

A sufficient quantity of granulate should be supplied to manufacture **20kg** of each blend (GTD, GM1D, GM2D, etc.).

## 5. METHODOLOGY

The protocol set out below is intended for COTREP-certified **Laboratories** with equipment representative of current transformation processes applied in industrial units. The following steps should be performed:

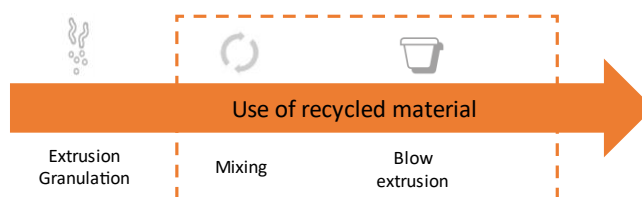


Figure 4: Detailed description of injection moulding steps

### Step 1: Preparing mixtures

The moisture content of granulate GT, GM1, GM2, etc. prepared in advance according to the COTREP PP regeneration protocol (Rigid PP-1) should be measured. This granulate should then be mixed with a virgin PP resin at a rate of 50% by weight to produce mixtures GTD, GM1D, GM2D, etc. The mixtures should ideally be produced mechanically.

The virgin PP granulate used for these tests should be PP granulate of a density of ~ 0.90 to 0.92 g/cm<sup>3</sup> and a grade (melt flow index) close to 65g/10min. The following products may be used:

SUPPLIER	TRADE NAME	MFI (230°C / 2.16KG)	DENSITY
TOTAL	PPC 12712	70	0.905
PINNACLE	PP 2160H	65	0.900

The **Laboratory** should order the materials required for testing and specify the product used in its final report. A sample of approximately 150g of virgin PP granulate and 150g of each mixture should be kept by the **Laboratory**.

## Step 2: Injection moulding

The prepared mixtures should be injection-moulded to produce a pot using the injection moulding process. The following implementing conditions are recommended for testing:

- Pot thickness: 1mm for specimen cut-out
- Injection moulding temperatures  $220^{\circ}\text{C} \pm 10^{\circ}\text{C}$

The equipment used and the injection moulding conditions applied should be recorded in the final report including the following information:

- Type of injection moulding machine (screw diameter, locking force)
- Barrel temperature profile
- Mould temperature
- Screw rotation speed
- Injection rate
- Switching pressure
- Holding time and pressure
- Cooling time
- Cycle time and production period
- Pot properties (thickness, mass, dimensions, shape, visual appearance)
- Smell if unusual

The parameters of the injection moulding process used on each batch should be the same as those used on the standard batch first implemented for the run. Any variations should be recorded in the report.

3 copies of pots for each mixture should be kept by the **Laboratory**.

### Injection moulding: success criteria

- No faults or damage to the line due to the nature of samples (clogging, etc.)
- No deterioration of the injection-moulded parts during implementation

The final report should include the following observations:

PROPERTIES EXAMINED	ANTICIPATED RESULTS
IMPLEMENTATION	Observations
EMISSIONS OF FUMES OR ODOURS	Observations
INJECTION MOULDING PARAMETERS	Variation compared to the control sample
POT APPEARANCE	Observations (burn marks, flow lines, weld lines, inclusions, etc.)
TOOL CLOGGING	Observations

### Step 3: Characterisation of pots produced

All pots produced should be characterised based on the tests set out below. Results should be included in the report.

#### → Dimensional properties

PROPERTIES EXAMINED	STANDARDS	ANTICIPATED RESULTS
THICKNESS PROFILE	According to the inspection plan determined with the laboratory	Values
POT MASS	/	Values
OVERALL HEIGHT	/	Values

#### → Mechanical properties

PROPERTIES EXAMINED	STANDARDS	ANTICIPATED RESULTS
TOP LOAD	ASTM D2659	Values
BENDING (MODULUS)	ISO 178	Values
TRACTION (MODULUS / TENSILE STRESS / ELONGATION)	NF EN ISO 527-1	Values
SQUEEZE TEST <sup>2</sup>	According to the method determined with the laboratory	Values and defect types
DROP-WEIGHT SHOCK	/	Value

#### → Optical and visual properties

PROPERTIES EXAMINED	STANDARDS	ANTICIPATED RESULTS
COLORIMETRIC TESTING	/	Testing of Delta E versus a standard sample
POT APPEARANCE	/	Observations regarding gels, surface defects, etc.

#### Characterisation of pots: success criteria

- Variation < 10% for dimensional properties versus control sample
- Variation < 10% for mechanical properties versus control sample

<sup>2</sup> A squeeze test is a specific rigid PP protocol test developed by COTREP and IPC based on industrial practices. The test consists of pushing the two edges of the pot close together and measuring the force needed for the edges to make contact as well as assessing pot defects (rim whitening, rim cracking, pot rupture). The pots are kept at 4°C for 12 hours prior to testing.

## 6. TEST REPORT

The commissioned **Laboratory** should draw up a test report including the following details:

- The report concerning regeneration protocol Rigid PP-1
- A description of samples received including photographs
- **APPENDIX 1** completed and appended to the report
- The operating conditions and equipment used for each test
- Results for each step and observations versus the control sample including the required photographs for each step and achievement of success criteria
- Any observations to be made during the tests should be included in the report and are provided in **APPENDIX 2**
- Sampling performed by the **Laboratory** at the different stages will be available to the **Requester** upon request. All materials relating to the run should be kept by the **Laboratory** for 6 months following publication of the corresponding COTREP Notice unless otherwise instructed by **COTREP**

### Important:

The methodology used for testing all samples submitted for analysis should be strictly identical. The **Laboratory** undertakes to follow the entire protocol, record any deviations in the test report, and send the test reports to COTREP.

#### The report should include the following declaration:

*"The tests were performed according to COTREP protocol Rigid PP-2 for rigid PP packaging (Reference/Version/Date). These results do not constitute a full packaging recyclability assessment and are not valid as a recyclability certificate."*

Any deviations should be clarified and will be examined by COTREP to determine whether the results are valid.

## 7. CONFIDENTIALITY

By signing a confidentiality agreement to be observed with respect to all third parties except COTREP, the **Laboratory** undertakes to maintain the confidentiality of any information concerning the request, the content of the report, and in particular, any results and observations.

## 8. PRACTICAL INFORMATION

### COTREP contact

Alexana Bellegarde

**Tel.:** +33 (0)6 81 06 83 24

**Email:** [a.bellegarde@cotrep.org](mailto:a.bellegarde@cotrep.org)

### Laboratory contact

**IPC**

Jérôme Piejak

**Tel.:** +33 (0)4 26 61 90 48

**Email:** [Jerome.PIEJAK@ct-ipc.com](mailto:Jerome.PIEJAK@ct-ipc.com)

### Cost of tests

For information: the approximate cost of performing tests in accordance with protocol Rigid PP-2 is €10,000 excl. VAT for the standard and two concentrations of a product.

The **Requester** should also budget for the cost of shipping samples to the **Laboratory**.

## APPENDIX 1: COTREP test request form

### REQUESTER

**COMPANY:** *Please complete*

**FIRST NAME/LAST NAME:** *Please complete*

**POSITION:** *Please complete*

**EMAIL:** *Please complete*

**TELEPHONE:** *Please complete*

IMAGE  
OF  
THE PACKAGING

### DESCRIPTION OF THE TEST PACKAGING

**PACKAGING TYPE:**

*E.G. BOTTLE, DISPENSER  
BOTTLE, POT, TRAY, TUBE, ETC.*

**MAJORITY RESIN:** *Please complete*

**PACKAGING  
STRUCTURE:**

*IF MULTILAYER, DESCRIBE THE  
LAYERS.  
SPECIFY THE % BY MASS OF  
EACH COMPONENT (BARRIER,  
ADDITIVES, ADHESIVE, TIE  
LAYER, ETC.)*

**FORMING METHOD:**

**COLOUR/PRINTING:**

*SPECIFY IF ON SURFACE OR  
BLENDED*

**ASSOCIATED ELEMENTS:**

*LABELS, TAP, ZIP, TIE, ETC.  
SPECIFY THE COMPOSITION OF  
EACH ASSOCIATED ELEMENT*

**VOLUME MARKETED:**

*TONNES PER YEAR  
IF NOT YET MARKETED, PROVIDE  
PROJECTIONS*

**COMMENTS:**

*ANY OTHER POTENTIALLY  
USEFUL INFORMATION FOR THE  
TEST*

<b>Company stamp:</b>	<b>Date:</b>	<b>Last name, first name and signature</b>



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## APPENDIX 2: OBSERVATIONS TO INCLUDE IN THE REPORT

The Rigid PP-2 protocol provides the assessment criteria for the different stages in the protocol.

The observations to include in the report at the different stages are provided below.

### Injection moulding:

- Operation due to the nature of samples (clogging, etc.)
- Appearance of the material to be injected or pots during implementation

### Characterisation of pots:

- Variation for dimensional properties versus control sample.
- Variation for mechanical properties versus control sample.