The APR Design® Guide for Plastics Recyclability

Supplemental Guidance

The following supplemental information is intended to be used alongside the Circular Packaging Assessment Tool. The information within is consistent with the APR Design® Guide HDPE Rigid – Colored and HDPE Rigid - Natural.

Melt Flow Rate Calculation for HDPE blends

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Introduction – Scope, Significance and Use

For HDPE, LLDPE, and LDPE components attached to HDPE containers the melt index[1] (MI) of the component(s) and container body resin blend needs to be less than 4.00 g/10 min at 190 °C, 2.16 kg to be categorized as APR Preferred. The MI of the blend can be measured experimentally by following ASTM D1238. Alternatively, MI of the component(s) and container body resin blend can be estimated via calculations described below in lieu of laboratory testing. Please note that large differences between the MI of the package body and the component may result in an inaccurate estimate of the MI for the overall package.

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[1] APR recognizes that ASTM D1238 refers to the use of the melt flow rate (MFR) nomenclature. However, since melt index (MI) is commonly used in the PE industry, it is utilized throughout this document. APR treats MFR and MI with the same technical definition and calculation as long as they are tested under the specific testing conditions for each plastic per ASTM D1238 or other standard testing methods. In the case of MI for polyethylene, testing is to be performed at 190 °C with a 2.16 kg weight.

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Calculation

APR Guidance given in the Critical Guidance method HDPE-CG-01 is that the MI of a 50/50 blend of control resin with an innovation should be less than 0.75 units greater than the control alone. Please note the MI testing conditions and datapoints for calculations for this resource document are 190 °C, 2.16 kg per ASTM D1238. The following calculation is offered and can be employed as an alternative to laboratory testing to determine the MI of a blend of two different polyethylene resins:

$$log(MI_{blend}) = \sum w_i log(MI_i) \quad (1)$$

So that an estimate for the 50/50 blend between the control and the total package would be given as:

$$log(MI_{Blend}) = 0.5log(MI_{Control}) + 0.5log(MI_{Package}) \quad (2)$$

With $$log(MI_{Package}) = w_{Body}log(MI_{Body}) + w_{Component}log(MI_{Component}) \quad (3)$$

As the maximum MI for the blend is given as $MI_{Blend} = MI_{Control} + 0.75$. Equation 2 can be solved for the maximum MI of the package to meet Critical Guidance requirements and the following table can be constructed:

Control Resin MI (g/10 min)	Maximum Package MI (g/10 min)
0.25	4.0
0.35	3.4
0.80	3.0

Using equation 3, the table below gives some illustrative component/container body blends that do not exceed the 4.00 g/10 min limit for a control resin with MI = 0.25 g/10 min.

Component (wt%)	Component MI (g/10 min)	Body (wt%)	Body MI (g/10 min)	Calculated Final MI (g/10 min)	Calculated Critical Guidance MI 50% Innovation + 50% Control (g/10 min)
10	15	90	0.25	0.38	0.31
20	20	80	0.7	1.37	0.58
30	30	70	0.35	1.33	0.58

When using the highest MI control choice in O-P-01 of 0.80 g/10 min and targeting 1.55 g/10 min (0.80 + 0.75 = 1.55 g/10 min) the maximum MI of the blend of component and container body resin is 3.00 g/10 min.

The table below gives some illustrative component/container body blends that do not exceed the 3.00 g/10 min limit for a control resin with MI = 0.8 g/10 min.

Component (wt%)	Component MI (g/10 min)	Body (wt%)	Body MI (g/10 min)	Calculated Final MI (g/10 min)	Calculated Critical Guidance MI 50% Innovation + 50% Control (g/10 min)
10	15	90	0.25	0.38	0.55
20	20	80	0.70	1.37	1.05
30	30	70	0.35	1.33	1.03

Document Version History

Version	Publication Date	Revision notes
1	3/04/2024	Initial publications
2	09/09/2024	Changed naming convention for testing protocol to match; Updated hyperlinks to match new website
3	03/11/2025	Clarified control resin calculation; Added 0.8 g/10 min control resin example; edited units; Changed MFR to MI.