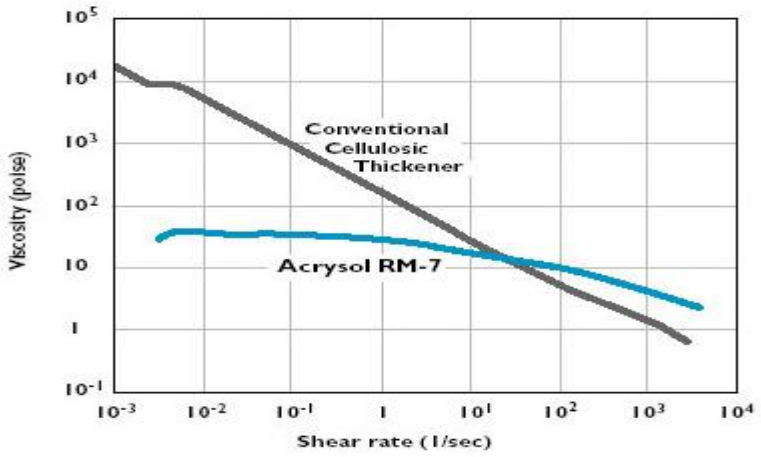
# ACRYSOL™ RM-7 Rheology Modifier

## Description

ACRYSOL™ RM-7 Rheology Modifier is a remarkably versatile hydrophobically modified alkali-soluble emulsion (HASE) thickening agent for latex coatings. Like other HASE modifiers, ACRYSOL RM-7 offers a nearly Newtonian rheology profile with lower viscosity in low-shear conditions and higher viscosity in high-shear conditions than cellulosic thickeners deliver (Figure 1). As a result, it can produce paints with a very desirable combination of good flow/leveling and film build properties.

ACRYSOL RM-7 Rheology Modifier is distinguished by a capacity to generate high-shear viscosity very efficiently, a feature that makes it exceptionally well suited to use with all-acrylic emulsions—RHOPLEX™ SG-30 Emulsion in particular—being developed for low-VOC, nonflat waterborne paints.

**Figure 1**
**Pigmentless Paint Rheology**




## Exceptional ICI Efficiency

RHOPLEX™ SG-30 Emulsion and products like it have a surface treatment that gives them a greater demand for associative thickeners than many conventional all-acrylic binders. As a result, more traditional HASE products do not provide high shear (ICI) viscosity at economical use levels in paints based on these new emulsions. ACRYSOL™ RM-7 Rheology Modifier addresses this problem through a unique design that helps make it much more efficient than previous HASE agents. This efficiency offers the opportunity for notable cost savings with the new low-VOC binders. Moreover, because ACRYSOL RM-7 permits lower thickener levels, paints form films with much improved resistance properties (Figure 2).

**Figure 2**
**Early Blister Resistance**
**(gloss alkyd, 2 coats/1 day dry/1 hour fog box)**


The advantages of ACRYSOL™ RM-7 Rheology Modifier are not limited to formulations employing the new all-acrylic binders. The exceptional efficiency of ACRYSOL RM-7 is equally advantageous in paints based on hydrophilic PVA binders. ACRYSOL RM-7 can also be used with more hydrophobic all-acrylic binders, although typically not by itself.

With these binders, ACRYSOL RM-7 Rheology Modifier tends to build both Stormer (KU) and ICI viscosity very effectively. For that reason, it is often paired with a less Stormer-efficient, ICI-viscosity-building cothickener such as ACRYSOL DR-5500 Rheology Modifier to obtain the appropriate balance of mid- and high-shear viscosity.

Comparisons of HASE modifiers in paints based on RHOPLEX™ SG-30 Emulsion and a PVA emulsion, ROVACE™ 9900 Emulsion, clearly demonstrate the advantages offered by ACRYSOL RM-7 Rheology Modifier (Tables 1 and 2). The data from these formulations indicate that ACRYSOL RM-7 offers a unique balance of efficiency, flow/sag balance, and film build across a fairly broad formulation range.

**Table 1— Rheology Modifier Performance**
**(45% PVC Sheen Formulation ROVACE™ 9900 Emulsion)**

| | Dry Pounds/ 100 gallons | Viscosity KU | ICI | FLOW | SAG |
|---|---|---|---|---|---|
| ACRYSOL™ DR-73 Rheology Modifier | 5.2 | 90 | 1.5 | 1 | 16 |
| ACRYSOL DR-6600 Rheology Modifier | 15.4 | 89 | 2.9 | 9 | 6 |
| ACRYSOL RM-7 Rheology Modifier | 7.4 | 89 | 2.9 | 9 | 10 |

**Table 2— Rheology Modifier Performance**
**(20% PVC Semigloss, RHOPLEX™ SG-30 Emulsion**

| | Dry Pounds/ 100 gallons | Viscosity KU | ICI | FLOW | SAG |
|---|---|---|---|---|---|
| ACRYSOL DR-73 Rheology Modifier | 2 | 95 | 0.75 | 4 | 12 |
| ACRYSOL RM 6600 Rheology Modifier | 11 | 90 | 1.8 | 10 | 4 |
| ACRYSOL RM-7 Rheology Modifier | 5 | 92 | 1.5 | 9 | 8 |

## Standard HASE Advantages

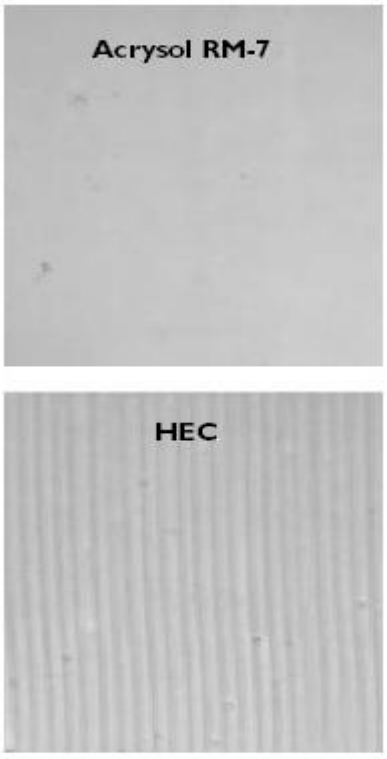
Apart from a good fit with PVAs, acrylic/PVA blends, and the new wave of all-acrylic polymers, ACRYSOL™ RM-7 Rheology Modifier offers all the advantages typically associated with high-performance HASE modifiers such as ACRYSOL DR-5500 and ACRYSOL DR-6600 Rheology Modifiers.

As indicated previously, the rheology furnished by ACRYSOL RM-7 Rheology Modifier results in a very desirable balance of flow/leveling and film build. These viscosity properties are complemented by the modifier's associative thickening mechanism, which creates a nonflocculated paint film. The flow/leveling properties and associative thickening provided by ACRYSOL RM-7 translate into a paint film that is smoother and more uniform with fewer brush marks than one produced by HEC (Figure 3). These features facilitate maximum gloss development.

ACRYSOL RM-7 Rheology Modifier also produces paints with superb spatter resistance. It is supplied a liquid, which makes for easier handling and formulating than HEC-type thickeners, which come in powder form. Finally, the structure and composition of ACRYSOL RM-7 make it chemically resistant to microbial and enzymatic degradation.

Like ACRYSOL DR-5500 and ACRYSOL DR-6600 Rheology Modifiers, ACRYSOL RM-7 Rheology Modifier can be used very successfully as a sole thickener in many formulations. It can also be used in combination with other associative rheology modifiers—anionic or nonionic—or with cellulosic products to address a wide array of rheological needs.

**Figure 3**
**Paint Drawdowns**



| Features | Benefits |
|---|---|
| Efficient High-shear-viscosity builder | Greater film build |
| Broad latex compatibility | Potential for thickener consolidation |
| Low-viscosity Liquid | Ease and convenience of handling |
| Synthetic | Resistance to microbial attack |
| Excellent flow and leveling | Minimal brush marks |

## Typical Physical Properties

(These properties are typical but do not constitute specifications).

| Property | Typical Values |
|---|---|
| Compositon | HASE<br>(hydrophobically modified alkali-soluble emulsion) |
| Apperance | White liquid |
| Solids, % | 30 |
| pH | 3-4 |
| Brookfield viscosity, cP (max) #4 spindle @60 rpm | 100 |
| Density, lb/gal | 8.9 |
| Storage temperature, °F[1]<br>Minimum<br>Maximum | <br>34<br>120 |
| [1] Protec from freezing | |

## Formulating Recommendations

One of the more useful attributes of ACRYSOL™ RM-7 Rheology Modifier is impressive formulating latitude. In addition to being compatible with a wide variety of binders employed in low-VOC paints, ACRYSOL RM-7 offers formulators the option of adding the modifier at different stages in the manufacturing process.

Paints employing ACRYSOL RM-7 Rheology Modifier do not require a thickener premix stage; the modifier can be added directly to a formulation without being first diluted or solubilized so long as two conditions are met: 1) there must be sufficient base [e.g., ammonia hydroxide, 2- dimethylamino-2-methyl-1-propanol (AMP-95™ Multifunctional Amine) in the mix before the rheology modifier is added; and 2) the mix must be agitated thoroughly enough to completely incorporate the modifier. Diluting ACRYSOL RM-7 with water before adding it will facilitate blending.

**Options for Adding ACRYSOL RM-7 Rheology Modifier**

***Pigment Grind***

1. Adjust pH and add liquid ingredients, including ACRYSOL RM-7 Rheology Modifiers, to millbase before charging the pigments and extenders

or

2. Adjust pH, begin grind, then add liquid ingredients to millbase for the last 5 to 10 minutes.

***Letdown/Post Viscosity Adjustment***

1. If necessary, adjust pH of paint to at least 9.0.
2. Slowly add dilute ACRYSOL™ RM-7 Rheology Modifier.
3. Ensure adequate agitation.
4. Adjust final pH (if necessary).

## Guidelines for Optimizing Performance

**Dispersant Choice**

In some instances, interactions between dispersants and associative thickeners can make latex paints unstable. In paints utilizing HASE thickeners such as ACRYSOL™ RM-7 Rheology Modifier, problems of this sort frequently involve the presence of an acid copolymer dispersant. In these cases, a HASE agent can displace the copolymer dispersant from the pigment and extenders, a phenomenon that may lead to a flocculated paint.

If circumstances permit, a paint manufacturer can minimize the chance of adverse interactions by employing polyacid dispersants such as TAMOL™ 1254 Dispersant or TAMOL 851 Dispersant at a level of 0.5%–1.2% with ACRYSOL RM-7.

Unfortunately, paint manufacturers do not always have the option of using a polyacid dispersant with ACRYSOL RM-7 Rheology Modifier. In some formulations, key performance requirements may compel the manufacturer to use an acid copolymer dispersant such as TAMOL 165A Dispersant. If such is the case, the formulator should be wary of possible compatibility problems.

Stability may also be an issue in formulations that employ a combination of ACRYSOL RM-7 Rheology Modifier and a HEUR modifier. Just as difficulties can result from interactions between ACRYSOL RM-7 and an acid copolymer dispersant, they can also occur from interactions between the HEUR agent and a polyacid dispersant. In tests on paints containing both HASE and HEUR products, TAMOL 1124 Dispersant, an acid copolymer with a hydrophilic comonomer, has produced good results.

**Base**

The type of base used to neutralize the associative thickener is important on account of the detrimental effect on film character and formulation stability. Properties that can be impacted by the neutralizer include thickening efficiency, water sensitivity (scrub and blister resistance), and pH stabilization.

The best bases to use as neutralizers are ammonium hydroxide and 2-amino-2-methyl-1-propanol. Most formulations require a minimum of 0.1 pound of 28% ammonium hydroxide or 0.15 pound of AMP-95™ Multifunctional Amine per 100 gallons of paint to ensure that all the acid groups in one pound of ACRYSOL RM-7 Rheology Modifier are neutralized. “Hard” bases such as potassium hydroxide or sodium hydroxide can also be used, but ACRYSOL RM-7 does not respond as well to them so higher concentrations are necessary.

With a 2% solution of ACRYSOL RM-7 Rheology Modifier neutralized with 28% ammonium hydroxide, thickening begins at a pH of approximately 6. The thickener polymer is completely solubilized at a pH of about 8.

**Recommended Usage Levels**

The concentration of ACRYSOL™ RM-7 Rheology Modifier required in a paint depends both on the type of binder (i.e. composition, particle size, mode of stabilization) and the nature of the formulation itself. ACRYSOL RM-7 is best suited to use as a sole thickener in gloss, semigloss and satin paints based on comparatively hydrophilic acrylic or acrylic/vinyl acrylic polymers. When ACRYSOL RM-7 is employed in this role, formulators typically employ from 8 to 30 wet pounds of polymer per 100 gallons of paint. ACRYSOL RM-7 Rheology Modifier is normally used at lower levels when employed as a cothickener. In such applications, it can be paired with other HASE (e.g., ACRYSOL DR-1, ACRYSOL TT-935) or HEUR (e.g., ACRYSOL RM-8W, ACRYSOL SCT-275) Rheology Modifiers, clay, and cellulosic thickeners to good effect.

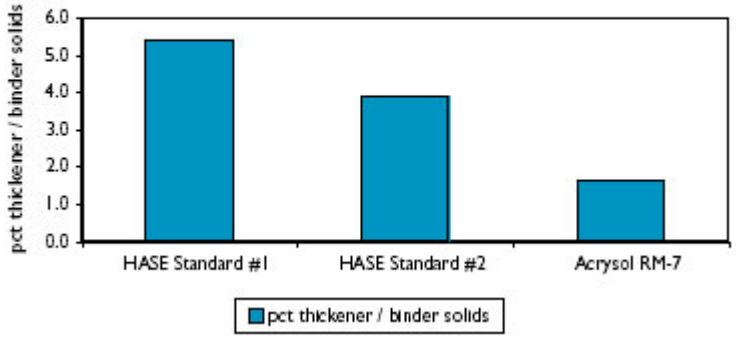
**Applications**

As indicated previously, the exceptional thickening efficiency of ACRYSOL RM-7 Rheology Modifier makes it appropriate for some exterior paints. In a trial conducted with a 24% PVC/34% VS exterior semigloss experimental paint based on a comparatively hydrophilic binder and neutralized with ammonium hydroxide, formulators needed 2-1/2 to 4 times as much conventional HASE thickener to achieve the same viscosity as with ACRYSOL RM-7 (Figure 4). In fact, the results from this trial actually suggest that ACRYSOL RM-7 can be a viable alternative to less efficient *HEUR* modifiers in some formulations.

One caution: While formulations thickened with ACRYSOL RM-7 Rheology Modifier can function successfully outdoors, *all manufacturers should verify water sensitivity (e.g., early blister resistance and alkali resistance) by testing before proceeding to commercial production.* Following are general rules of thumb to help obtain maximum exterior properties with ACRYSOL RM-7 (These recommendations are meant only as guidelines; all formulations should be verified by testing):

- limit use level to 2% (dry pounds) or less on binder solids;
- use quality exterior binders;
- use zinc oxide when practical;
- use fugitive base (i.e., ammonium hydroxide).

**Figure 4**
**Typical Rheology Modifier Levels**



## Starting Point Formulations

Following are three starting point formulations incorporating ACRYSOL™ RM-7 Rheology Modifier. These formulations have been qualified with the specified components; substitutions should be tested carefully to ensure that users obtain the same properties.

| Low-VOC Interior Satin<br>Formulation SH-7-1 (ROVACE™ 9900 Emulsion, ACRYSOL™ DR-1 and ACRYSOL RM-7 Rheology Modifiers) | | |
|---|---|---|
| **Ingredient** | **Pounds** | **Gallons** |
| Water | 150.0 | 17.97 |
| AMP-95™ Multifunctional Amine | 2.0 | 0.26 |
| TAMOL™ 1254 Dispersant | 5.1 | 0.50 |
| Igepal™ CTA 639W[1] | 2.0 | 0.23 |
| Colloids 643 deformer[2] | 2.0 | 0.28 |
| KATHON™ LX 1.5% Preservative[2] | 1.7 | 0.20 |
| Ti-Pure™ R-706 titamium dioxide[3] | 150.0 | 4.49 |
| Nytal™ 200 extender[4] | 40.0 | 1.68 |
| Duramite™ extender[5] | 75.0 | 3.32 |
| Minex™ 4 extender[6] | 75.0 | 3.44 |
| | | |
| Water | 50.0 | 5.99 |
| Colloids 643 deformer | 1.5 | 0.21 |
| ROVACE™ 9900 Emulsion | 315.0 | 35.03 |
| ROPAQUE™ Ultra Opaque Polymer | 60.0 | 7.02 |
| Propylene glycol | 24.0 | 2.78 |
| TRITON™ X-405 Surfactant | 2.0 | 0.22 |
| AMP-95™ Multifunctional Amine | 3.2 | 0.41 |
| ACRYSOL™ DR-1 Rheology Modifier | 11.4 | 1.28 |
| ACRYSOL™ RM-7 Rheology Modifier | 10.7 | 1.21 |
| Water | 112.3 | 13.48 |
| **Totals** | **1092.9** | **100.00** |

| | |
|---|---|
| Initial Stormer viscosity, KU | 93±2 KU |
| Initial ICI viscosity, poise | 1.20±0.1 |
| Initial pH | 9.0±0.2 |
| Typical gloss, 60°/85° | 6/7 |
| Total PVC, % | 48 |
| Volume solids, % | 35 |
| Voc, g/l | <10 |

[1]Rhone-Poulenc
[2]Rhodia
[3]E.I. Dupont de Nemours Company
[4]R.P. Vanderbilt Company, Inc.
[5]ECC America,Inc.
[6]Unimin Corporation

| Low-VOC Interior Semigloss<br>Formulation SG-Tex-5 (RHOPLEX™ SG-30 and ROVACE™ 9900 Emulsions, ACRYSOL™ RM-7 Rheology Modifier) | | |
|---|---|---|
| **Ingredient** | **Pounds** | **Gallons** |
| Water | 50.0 | 5.99 |
| TAMOL™ 1254 Dispersant | 4.6 | 0.45 |
| TRITON™ CF-10 Surfactant | 2.2 | 0.25 |
| Drewplus™ L-475 defoamer[1] | 1.1 | 0.15 |
| KATHON™LX 1.5% Preservative | 1.7 | 0.20 |
| Ti-Pure™ R-900 titamium dioxide[2] | 175.3 | 5.25 |
| | | |
| Water | 50.0 | 5.99 |
| ROPAQUE™ Ultra Opaque Polymer | 51.3 | 6.00 |
| Drewplus L-475 defoamer | 1.9 | 0.25 |
| | | |
| RHOPLEX™ SG-30 Emulsion | 230.0 | 26.03 |
| ROVACE™ 9900 Emulsion | 230.0 | 25.58 |
| Texanol coalescent[3] | 12.0 | 1.51 |
| AMP-95™Multifunctional Amine | 4.0 | 0.51 |
| ACRYSOL™ RM-7 Rheology Modifier | 25.4 | 2.87 |
| Water | 158.4 | 18.97 |
| **Totals** | **997.9** | **100.00** |

| | |
|---|---|
| Initial Stormer viscosity, KU | 95±2 |
| Initial ICI viscosity, poise | 1.9±0.2 |
| Initial pH | 9.0±0.2 |
| Typical gloss, 20°/60° | 30/65 |
| Total PVC, % | 25 |
| Volume solids, % | 34 |
| Voc, g/l | <60 |

1Ashland Inc.
[2]E.I. Dupont de Nemours Company
[3]Eastman Chemical Company

| Interior/Exterior semigloss<br>SG-7-3 (RHOPLEX™ SG-30 Emulsion, ACRYSOL™ RM-7 Rheology Modifier) | | |
|---|---|---|
| **Ingredient** | **Pounds** | **Gallons** |
| Water | 83.5 | 10.00 |
| Propylene glycol | 37.4 | 4.32 |
| BYK™-022 defoamer[1] | 1.0 | 0.12 |
| KATHON™ LX 1.5% Preservative | 1.8 | 0.21 |
| Ti-Pure™ R-746 titamium dioxide[2] | 326.8 | 16.82 |
| | | |
| RHOPLEX™ SG-30 Emulsion | 501.4 | 56.75 |
| Texanol™ coalescent[3] | 12.5 | 1.58 |
| Aerosol™ OT-75 surfactant[4] | 1.5 | 0.16 |
| BYK-022 defoamer | 1.0 | 0.13 |
| | | |
| Ammonia (28%) | 3.0 | 0.40 |
| ACRYSOL™ RM-7 Rheology Modifier | 17.0 | 1.92 |
| Water | 63.3 | 7.59 |
| **Totals** | **1050.2** | **100.00** |

| | |
|---|---|
| Initial Stormer viscosity, KU | 90±2 |
| Initial ICI viscosity, poise | 1.6±0.2 poise |
| Initial pH | 9.0±0.2 |
| Typical gloss, 20°/60° | 30/70 |
| Total PVC, % | 22 |
| Volume solids, % | 34 |
| Voc, g/l | 150 |

[1]BYK- Chemie
[2]E.I. Dupont de Nemours Company
[3]Eastman Chemical Company
[4]Cytec Industries, Inc.

## Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

## Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

## Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Coating Materials Technical Representative for more information.

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**Contact:**
North America: 1-800-447-4369
Latin America: (+55)-11-5188-9000
Europe: (+800)-3-694-6367
Asia-Pacific: (+800)-7776-7776
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