

## Technical Bulletin

# JEFFAMINE<sup>®</sup> Polyetheramines

Huntsman's JEFFAMINE<sup>®</sup> range offers the world's most extensive selection of polyetheramines, many of which are unavailable elsewhere. These highly versatile products contain primary amino groups attached to the end of a polyether backbone normally based on propylene oxide (PO), ethylene oxide (EO), or a mixture of both oxides.

Historically, the core JEFFAMINE<sup>®</sup> polyetheramine family consisted of monoamines, diamines and triamines based on the core polyether backbone structure. More recently, the addition of hindered, high-conversion, and polytetramethylene glycol (PTMEG) based polyetheramines has increased the breadth of utility of the product line.

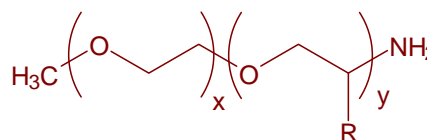


The JEFFAMINE<sup>®</sup> polyetheramines typically impart increased flexibility and toughness and are easily handled low viscosity, low color products. The broad range of molecular weights, amine functionality, repeating unit type and distribution offers great scope to design new compounds or mixtures. The amines are particularly important in the production of polyurea coating technologies, epoxy applications and pigment formulations.

## JEFFAMINE<sup>®</sup> Monoamines (M series)

JEFFAMINE<sup>®</sup> monoamines are designated as the JEFFAMINE<sup>®</sup> M series. The letter M signifies a monoamine and the number represents the approximate molecular weight. JEFFAMINE<sup>®</sup> M series products are prepared by reaction of a mono-alcohol initiator with EO and/or PO, followed by conversion of the resulting terminal hydroxyl groups to amines. M series products have the following representative structure:

JEFFAMINE <sup>®</sup> Amine	Hydrophilicity	MW
M-600	More hydrophobic	600
M-1000	More hydrophilic	1,000
M-2005	More hydrophobic	2,000
M-2070	More hydrophilic	2,000



JEFFAMINE <sup>®</sup> M-series Monoamines	Average AHEW, g/eq	Applications and Benefits
<b>Polypropylene glycol (PPG) based</b>		Relative hydrophobic. Preparation of comb polymers with poly(acrylic acid) or similar linear polymers.
JEFFAMINE <sup>®</sup> M-600 amine JEFFAMINE <sup>®</sup> M-2005 amine	291 1045	<ul style="list-style-type: none"> <li>Molecular weight control in polyamides</li> </ul>
<b>Polyethylene glycol (PEG) based</b>		Relatively hydrophilic. Formulating emulsifiers and corrosion inhibitors.
JEFFAMINE <sup>®</sup> M-1000 amine	489	<ul style="list-style-type: none"> <li>Ore flotation agent</li> <li>Agricultural emulsifier</li> <li>Emulsification of epoxy resins</li> </ul>
JEFFAMINE <sup>®</sup> M-2070 amine	1040	<ul style="list-style-type: none"> <li>Formulating pressure sensitive adhesives</li> <li>Reactive dispersant</li> </ul>

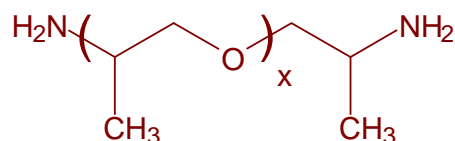
## JEFFAMINE® Diamines (D, ED, and EDR series)

JEFFAMINE® diamines include the D, ED, and EDR series products. The D signifies a diamine with a PPG backbone, ED signifies a diamine with a predominately PEG backbone, and EDR designates a highly reactive, PEG based diamine. As with the M series, the number represents the approximate molecular weight.

### JEFFAMINE® D Series Diamines

JEFFAMINE® D series products are amine-terminated polyoxypropylene glycols. The amines are of low viscosity, color and vapor pressure and are miscible with a variety of solvents.

JEFFAMINE® Amine	MW
D-230	230
D-400	430
D-2000	2,000
D-4000	4,000

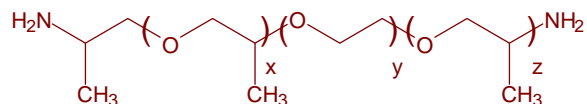


JEFFAMINE® D-series Diamines	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE® D-230 amine	60	<ul style="list-style-type: none"> <li>Provides tough, clear, impact resistant coatings, castings, and adhesives</li> <li>Reacts with carboxylic acids to form hot melt adhesives</li> <li>Reacts quickly with isocyanates</li> <li>Readily forms salts for surfactant use</li> <li>Gives coatings free of surface blush prevalent with many amine curing agents</li> </ul>
JEFFAMINE® D-400 amine	115	<ul style="list-style-type: none"> <li>Used in polyurethanes, polyureas, and thermoplastic polyamide adhesives</li> <li>Forms salts for use in cutting fluids</li> </ul>
JEFFAMINE® D-2000 amine	514	<ul style="list-style-type: none"> <li>Key ingredient in the formulation of polyurea spray</li> <li>Co-reactant in epoxy systems which require increased flexibility and toughness</li> <li>Increases peel strength</li> </ul>
JEFFAMINE® D-4000 amine	1000	<ul style="list-style-type: none"> <li>Co-curing agent in epoxy systems which require increased flexibility and toughness</li> <li>General polymer flexibilizer</li> <li>Increases peel strength in adhesives</li> </ul>

### JEFFAMINE® ED Series Diamines

JEFFAMINE® ED series products are polyether diamines based on a predominantly PEG backbone. PEG imparts complete water solubility to each of the products in this series. The JEFFAMINE® ED products, which are miscible with a variety of solvents, provide tough, clear, impact-resistant coatings, castings and adhesives.

JEFFAMINE® Amine	MW
ED-600	600
ED-900	900
ED-2003	2,000



JEFFAMINE® ED-Series Diamines	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE® ED-600 amine	132	<ul style="list-style-type: none"> <li>• Molecular weight control in polyamides</li> <li>• Preparation of comb polymers with poly(acrylic acid) or similar linear polymers</li> <li>• Preparation of epoxy resin adducts</li> </ul>
JEFFAMINE® ED-900 amine	250	<ul style="list-style-type: none"> <li>• Modification of polyamides for enhanced hydrophilicity</li> <li>• Preparation of biocompatible articles and coatings</li> <li>• Preparation of hydrogels with isocyanates</li> <li>• Hydrophilicity from polyethylene glycol</li> <li>• Reactivity from amine end group</li> <li>• Biocompatibility of polyethylene glycol</li> </ul>
JEFFAMINE® ED-2003 amine	575	<ul style="list-style-type: none"> <li>• Hydrophilic polymers</li> <li>• Antistatic agents</li> <li>• Epoxy modifiers</li> <li>• Textile treating</li> <li>• Water-based coatings</li> <li>• Water-soluble, water-dispersible, water-swelling polyamides</li> <li>• Water-soluble polyurea formulations</li> <li>• Reactivity of the primary amine end groups</li> </ul>

## JEFFAMINE® EDR Series Diamines

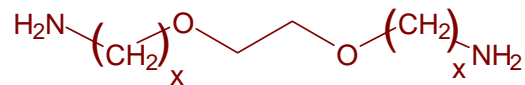
JEFFAMINE® EDR-148 and EDR-176 amines are much more reactive than the other JEFFAMINE® diamines and triamines due to the unhindered nature of the amine groups.

**JEFFAMINE®  
Amine**

EDR-148  
EDR-176

**MW**

148  
176



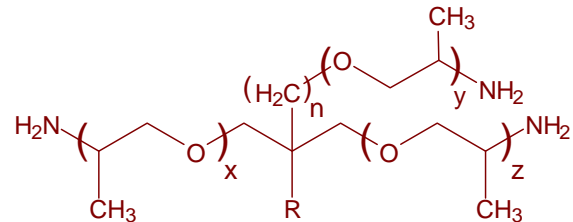
JEFFAMINE® EDR Series Diamines	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE® EDR-148 amine	37	<ul style="list-style-type: none"> <li>• Epoxy curing agent</li> <li>• Monomer for polyamides</li> <li>• Imparts flexibility and toughness to thermoset polymers</li> <li>• Can be formulated to cure at room temperature</li> <li>• Rapid cure at elevated temperatures</li> <li>• Excellent thermal shock resistance in cured epoxies</li> </ul>
JEFFAMINE® EDR-176 amine	44	<ul style="list-style-type: none"> <li>• Epoxy curing, polyamide preparation; other applications for reactive, high purity diamines</li> <li>• Relatively rapid cure rate, good cured resin mechanical properties in epoxy curing</li> <li>• Low viscosity, high purity</li> <li>• May add flexibility and hydrophilicity to polyamides</li> <li>• Potential partial replacement for TETA in polyamide preparation</li> </ul>

## JEFFAMINE® Triamines (T series)

JEFFAMINE® T series products are triamines prepared by reaction of PO with a triol initiator, followed by amination of the terminal hydroxyl groups.

### JEFFAMINE® Amine

T-403	440
T-3000	3000
T-5000	5000



JEFFAMINE® T-Series Triamines	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE® T-403 amine	81	<ul style="list-style-type: none"> <li>Moderate reactivity in epoxy curing.</li> <li>Anti-sag agent for polyurethanes</li> <li>Low color, viscosity, and vapor pressure. Can be blended with higher-viscosity curing agents to reduce viscosity, or with cycloaliphatics to improve the elongation of higher-T<sub>g</sub> cured resins.</li> <li>Completely miscible with a wide variety of solvents, including water</li> <li>Improves flexibility and strength</li> </ul>
JEFFAMINE® T-3000 amine	530	<ul style="list-style-type: none"> <li>Highly reactive soft block in polyurea spray applications</li> <li>Thermoplastic polymer modifier and adhesion promoter in epoxy systems</li> <li>Modifier and curative in polyurethane elastomers and foams</li> <li>Flexible crosslinking</li> <li>Moderate reactivity</li> </ul>
JEFFAMINE® T-5000 amine	952	<ul style="list-style-type: none"> <li>Crosslinker for polyurea</li> <li>Co-reactant in epoxy systems where adhesion promotion and flexibility are important</li> <li>Surfactant and corrosion inhibitor applications</li> <li>Low color</li> <li>Increased peel strength in epoxy adhesives</li> <li>Increased toughness</li> </ul>

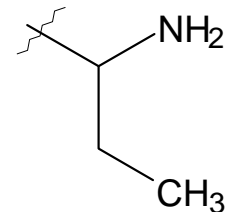
## NEW POLYETHERAMINES

### JEFFAMINE® THF-series Amines

The JEFFAMINE® THF products are diamines or triamines based on a PTMEG [poly(tetramethylene ether glycol)]/PPG (polypropylene glycol) copolymer. Polyetheramines of this type are useful in a variety of polymers, including cured epoxy resins, polyurea, and polyamides. In particular, higher molecular weight polyetheramines are effective in flexibilizing and promoting adhesive peel strength in epoxy formulations. They have also been used to improve flexibility and low temperature properties of polyamides. As with most other JEFFAMINE® polyetheramines, the amine groups in JEFFAMINE® THF-100 amine are adjacent to methyl groups, which moderates their reactivity somewhat. The amine groups in THF-170 are not, so they are more reactive.

## Slower Amines

Slower amines analogous to JEFFAMINE® D-230 and T-403 polyetheramines are now available under the names XTJ-568 and XTJ-566, respectively. These unique materials are primary amines created by amination of modified alcohols. This process results in primary amines with the terminal end group structure represented to the right. While XTJ-568 is a new commercial product, XTJ-566 remains an experimental product at present.



## XTA 801

XTA 801 is a new highly reactive cycloaliphatic amine with unhindered primary amine functional groups, as well as some secondary amine functionality. When used for epoxy resin curing, this product provides fast curing and useful combinations of enhanced glass transition temperature, modulus and hardness performance. XTA-801 finds use in both ambient and heat cured epoxy resin applications.

New Products	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE® THF-100 amine JEFFAMINE® THF-170 amine	260 380	<ul style="list-style-type: none"> <li>Improved anticorrosion property in polyurea formulations</li> <li>Increasing flexibility and adhesion in cured epoxy resins and other thermoset polymers</li> <li>Improved mechanical properties from PTMEG segment</li> </ul>
XTJ 568	55	<ul style="list-style-type: none"> <li>Longer pot life than most traditional polyetheramines</li> <li>Lower exotherm than other low molecular weight polyetheramines</li> <li>Good cured resin mechanical properties</li> <li>Relatively high glass transition temperature</li> </ul>
XTA 801	39.5	<ul style="list-style-type: none"> <li>Fast curing at low and ambient temperatures</li> <li>Provides fast strength development</li> <li>Provides enhanced glass transition temperature and hardness</li> <li>Provides good chemical and solvent resistance</li> </ul>

## EXPERIMENTAL POLYETHERAMINES

### JEFFAMINE® RFD-270 Amine

JEFFAMINE® RFD-270 amine is a 270 average formula weight, novel amine containing both rigid (cycloaliphatic) and flexible (polyetheramine) segments in the same molecule. “RFD” stands for “Rigiflex diamine”. The product offers a unique formulating option for composites, coatings, and adhesives. When used for epoxy resin curing, this amine can provide synergistic processing and cured resin performance advantages relative to simple mixtures of polyetheramines and cycloaliphatic amines.

JEFFAMINE<sup>®</sup> RFD 270 amine can be used as an epoxy curing agent in composite applications such as wind turbine rotor blades, coatings, and other applications, polyamides and polyureas. One of the benefits of this material is its higher glass transition temperature capability for epoxy curing agent applications.

### XTJ-616

XTJ-616 is a predominantly tetrafunctional, primary amine with an average molecular weight of about 660. The primary amine groups are located on secondary carbon atoms near the ends of the aliphatic polyether chains.

XTJ-616 provides tough, clear, impact resistant coatings, castings, and adhesives and improves nylon shear-thinning properties. Other benefits are low vapor pressure and inhibited “amine blush” formation in epoxy systems.

Experimental Products	Average AHEW, g/eq	Applications and Benefits
JEFFAMINE <sup>®</sup> RFD-270 amine	67	<ul style="list-style-type: none"> <li>• Faster curing and property development, allowing reduction of any accelerator usage</li> <li>• Low viscosity, color and vapor pressure</li> <li>• Lower blushing or carbamation (reaction with atmospheric carbon dioxide) compared to cycloaliphatic amines</li> <li>• Faster strength development than PEA curatives and excellent mechanical properties</li> <li>• Potential cost savings when formulated with JEFFSQL<sup>®</sup> PC carbonate-diluted resin vs. aliphatic epoxy-diluted resin</li> <li>• Improved chemical resistance to typical acids and bases in coating applications.</li> </ul>
XTJ-616	83	<ul style="list-style-type: none"> <li>• Curing agent for epoxy resins</li> <li>• Reacts quickly with isocyanates, increasing crosslinking in polyurea systems</li> <li>• Salts may be readily formed for use in surfactants</li> <li>• Co-monomer in nylons</li> </ul>

### Oleophilic Monoamines

XTJ-435 and XTJ-436 are monofunctional amines similar to the JEFFAMINE<sup>®</sup> M series products. These products are more oleophilic than the equivalent M series products and not water soluble.

### XTJ-435 Chemical Intermediate

XTJ-435 is a monoamine derived from a modified fatty alcohol. Due to a regulatory restriction, XTJ-435 may be used only as a chemical intermediate.

## XTJ-436

XTJ-436 is a 1000 molecular weight monoamine which contains an aromatic segment.

The hydrophobic nature of this amine makes it especially useful for oil- or solvent-based systems. The product finds application in emulsifiers and corrosion inhibitors.

## Higher Conversion Amines

Processes have been developed to increase conversion to primary amines for several of the core JEFFAMINE<sup>®</sup> polyetheramines. Two such products are currently available: a high conversion 440 molecular weight diamine (XTJ-582), and a high conversion 2000 molecular weight diamine (XTJ-578). The higher functionality and conversion are beneficial in polymerizations such as polyamide formation.

## STORAGE AND HANDLING

### Materials of Construction

#### At temperatures of 75-100°F (24-38°C)

Tanks	Carbon steel
Lines, valves	Carbon steel
Pumps	Carbon steel
Heat exchange Surfaces	Stainless steel
Hoses	Stainless steel, polyethylene, polypropylene, TEFLON <sup>®</sup> Polypropylene or TEFLON <sup>®</sup> (elastomers such as neoprene, Buna N, and VITON <sup>®</sup> should be avoided).
Atmosphere	Nitrogen or dry air

#### At temperatures above 100°F (38°C)

Tanks	Stainless steel
Lines, Valves	Stainless steel
Pumps	Stainless steel or Carpenter 20 equivalent
Atmosphere	Nitrogen

JEFFAMINE<sup>®</sup> polyetheramines may be stored under air at ambient temperatures for extended periods. A nitrogen blanket is suggested for all storage, however, to reduce the effect of accidental exposure to high temperatures and to reduce the absorption of atmospheric moisture and carbon dioxide. It should be noted that pronounced discoloration is likely to occur at temperatures above 140°F (60°C), whatever the gaseous pad. Dispose of waste in strict accordance with local, state, and federal regulations.

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