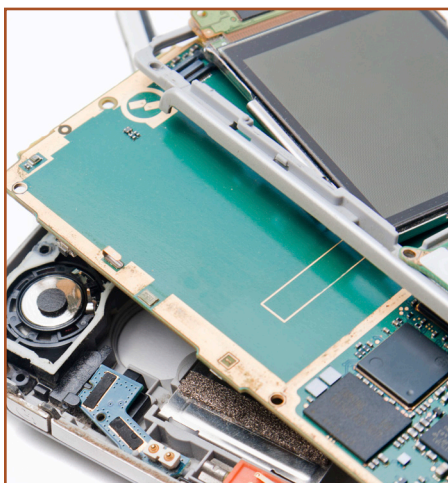


Key Performance Advantages

- Provide customizable functionality for a variety of exacting demands
- Perform as chelating agents for metals
- Deliver tunable buffering capability



Electronic Chemicals

VOLTAN™ SPECIALTY ELECTRONICS-GRADE ADDITIVES

For Customizable Functionality in Cleaning and Stripping Solutions Used in Semiconductor and Electronic Display Manufacturing.

Advanced semiconductors and electronic displays are manufactured with highly sensitive materials that can be easily damaged during the manufacturing process. Manufacturers require cleaning and stripping solutions that can be effectively used on fragile electronics components and during precision fabrication steps. ANGUS provides an array of specialty chemical additives that deliver the unique functionality that formulators need—without the harsh effects of existing chemical solutions.

Benefits of developmental VOLTAN specialty electronics-grade additives from ANGUS:

- Reliable supply of consistently high-quality amino alcohols
- Thoroughly clean semiconductor wafers after etching, chemical-mechanical planarization (CMP) and photoresist stripping
- Effective in cleaners and strippers with lower copper corrosion for ultra-high-definition large-screen flat panel displays
- Remove unwanted debris during manufacturing, while preserving end-product functionality
- Multiple options available for water- and solvent-based systems
- A broad range of chemical structures with varied polarity, basicity and solvency characteristics

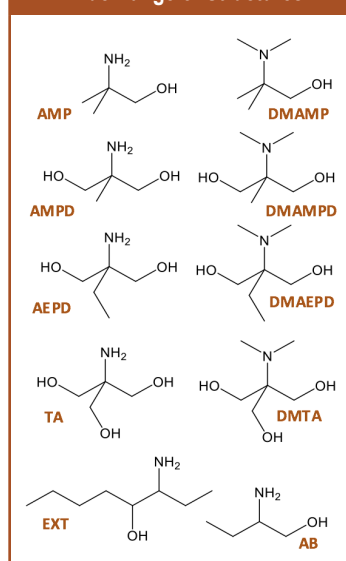
ANGUS' Wide Range of Solutions and Properties in Electronics-Grade Chemicals

ANGUS amino alcohols can be used in a variety of processes during electronics manufacturing. Our products cover a range of pKa, solubility and other physical-chemical properties. We also have a demonstrated ability to meet demands with new molecules providing discrete changes in chemical properties allowing the formulation of a broad spectrum of effective cleaning and stripping solutions. Common applications of amino alcohols include CMP, post-CMP cleaning, photoresist stripping and removal of organic and organometallic etch residues.

ANGUS Electronics Chemicals Product Chart

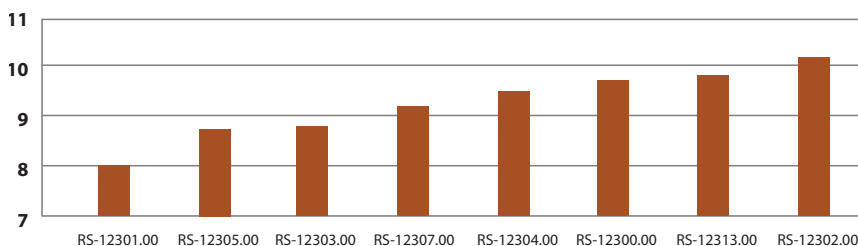
| Product | Chemistry | Molecular Wt. (calc.) | Freeze/Melting Point, °C | pKa | Log P(ow) | Dipole Moment ^b (Debye) | Boiling point at 760mm ^e Hg, °C |
|-----------------------|-----------|-----------------------|--------------------------|------|--------------------|------------------------------------|--|
| RS-12300 ^a | AMP | 89.1 | -2 | 9.7 | -0.63 | 1.09 | 165 |
| RS-12301 | TA | 121.1 | 171-172 | 8.0 | -2.31 | 2.03 | 219-220 ^d |
| RS-12302 ^a | DMAMP | 117.0 | -20 | 10.2 | 0.09 | 1.59 | 160 |
| RS-12303 ^a | AEPD | 119.2 | -24 | 8.8 | -1.02 | 3.21 | 152-153 ^d |
| RS-12304 ^a | AB | 89.1 | -2 | 9.5 | -0.45 | 1.3 | 178 |
| RS-12305 | AMPD | 105.1 | 109-111 | 8.8 | -1.75 ^b | 3.22 | 151-152 ^e |
| RS-12307 ^a | DMTA | 149.1 | <25 | 9.2 | -0.81 | 2.57 | 305 |
| RS-12313 ^a | EXT | 145 | -3 | 9.8 | 1.3 | ^c | 218 |

Wide Range of Structures



^aTypically supplied as concentrated aqueous solution | ^bCalculated | ^cTo be determined | ^dat 10 mmHg | ^eFor anhydrous active ingredient

pKa of ANGUS Amines for Electronics



Contact Information

angus.com

North America
+1-844-474-9969

Latin America
+55-11-4700-8427

Western Europe
+49-69-38-079-1799

Central and Eastern Europe
+49-69-38-079-1799

Middle East and Africa
+49-69-38-079-1799

Indian Subcontinent
+000-800-440-5098

Greater China
+86-40-0881-1243

Japan and Korea
+81-34-477-4961
+82-2-3483-6665

Southeast Asia, Australia and New Zealand
+66-2787-3335
+65-6723-1010

ANGUS
CHEMICAL COMPANY

©TMTrademark of ANGUS Chemical Company

Notice: No freedom from infringement of any patent owned by ANGUS or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where ANGUS is represented. The claims made may not have been approved for use in all countries. ANGUS assumes no obligation or liability for the information in the document. References to "ANGUS" or the "Company" mean the ANGUS Chemical Company legal entity selling the products to Customer unless expressly noted. NO WARRANTIES ARE GIVEN: ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

Published February 2017 Form No. VOL-2086-0217-TCG