Henkel Technologies

Technical Information Bulletin

TURCOFORM ETCHANT 17L

CAUSTIC ALUMINIUM ETCHANT WITH HIGH ETCH RATE

DESCRIPTION:

TURCOFORM ETCHANT 17L is a specially compounded caustic etchant for use on the majority of aluminium alloys. When used as recommended TURCOFORM ETCHANT 17L will produce smooth surface finishes. Etched areas will have RMS readings of 35 to 60 micro inches on most alloys of the T-3, T-4 and successive heat treats. TURCOFORM ETCHANT 17L may be used on clad and bare aluminium parts with excellent results.

BENEFITS:

TURCOFORM ETCHANT 17L offers the following benefits:

1. Fast etch rate.
2. Excellent surface finish.
3. Minimizes and tends to polish out flow lines and channelling in aluminium.
4. Can improve the surface finish of some alloys from an RMS of 100-200 to 35-50 RMS.
5. Supplied in liquid form for ease of handling.

PROPERTIES:

1. Appearance ..... Reddish brown liquid
2. Specific Gravity..... 1.36
3. Heat generated in dissolving 1 pound of aluminium..... 7000 BTU
4. Etch Rate* .....2.0-2.8 mils/side/min.
5. Etch Factor*..... 0.85-1.5
6. Hydrogen generated per pound of aluminium dissolved .....20 cu.ft.

*Depending on bath condition and alloy.

HOW TO USE TURCOFORM ETCHANT 17L:

1. EQUIPMENT:

Tank: stainless steel with stainless plumbing and heating coils. Protect exterior surfaces by using a red lead primer and an alkaline resistant paint such as Tygon or Amercoat.

Tank Cover: A tank cover is recommended to reduce heat loss during periods of non-use.

Insulation: Optional.

Agitation: Oil-free compressed air source required. Use stainless steel pipe.

(NOTE: Agitation is required only during addition of chemicals or water, or while heating the solution to operating temperature. Continuous agitation should be avoided since it has a deteriorative effect on the etchant.)

Ventilation: Air-flow of 200-250 CFM per square foot of tank surface, with provisions for venting on four sides. A pull system should be used.

Air-duct construction: Use mild steel protected with alkali resistant paint.

Temperature instrumentation: Sufficient to control etchant solution to 105 ± 3° C.

Heating facilities: In general, steam will provide the most uniform heating and ease of control. However electricity and gas have also proven satisfactory for heating these tanks. Final choice should depend upon facilities available and local conditions at each installation.

2. INITIAL CHARGE:

Basis: 1000 litres, N_1 = 21 to 23, N_2 = 0.8 to 1.2

TURCOFORM ETCHANT 17L .....500 litres

Water .....500 litres

Total Charge .....1000 litres

Fill the process tank to ½ of working capacity with TURCOFORM ETCHANT 17L.

Add water to operating level, with moderate agitation.

Heat the solution to maintain an operating temperature of 105 ± 3° C.

Discontinue agitation. See item #5 - Agitation.

NOTE: N_1 and N_2 are defined under the section **Method for Determination of etchant and Dissolved Aluminium.**

3. PRECLEANING:

All parts are to be chemically cleaned before etching to insure the best results. Your TURCO Territory Manager can recommend suitable cleaners based on your production needs.

4. RACKING:

Suspend parts vertically or horizontally depending on part configuration. Rotate in the vertical plane every 15 minutes or as often as necessary to avoid tapering.

5. AGITATION:

Agitation is required only during addition of chemicals or water, or when heating the solution to operating temperature (105 ± 3^{o} C). Avoid continuous agitation since it has a deteriorating effect on the etchant.

6. ETCHING:

   7075-T-6 and 7078-T6 alloys: Desmut after the first five minutes or 10 -12 mils of etching. This must be done as each new etch pocket or step is opened. On a one step part, the desmut process need only be performed once at 5 minutes and when the part is finished.

   Immediately after etching, rinse parts in cold water and remove smut in TURCO SMUTGO solution followed by a final water rinse.

   The initial charge of 500 litres of TURCOFORM ETCHANT 17L to make 1,000 litres of etchant solution will provide an N_1 value of 22.0 and N_2 of 1.0.

   NOTE: N_1, unused etchant and N_2, dissolved aluminium, are further defined under the section **Method for Determination of Etchant and Dissolved Aluminium.**

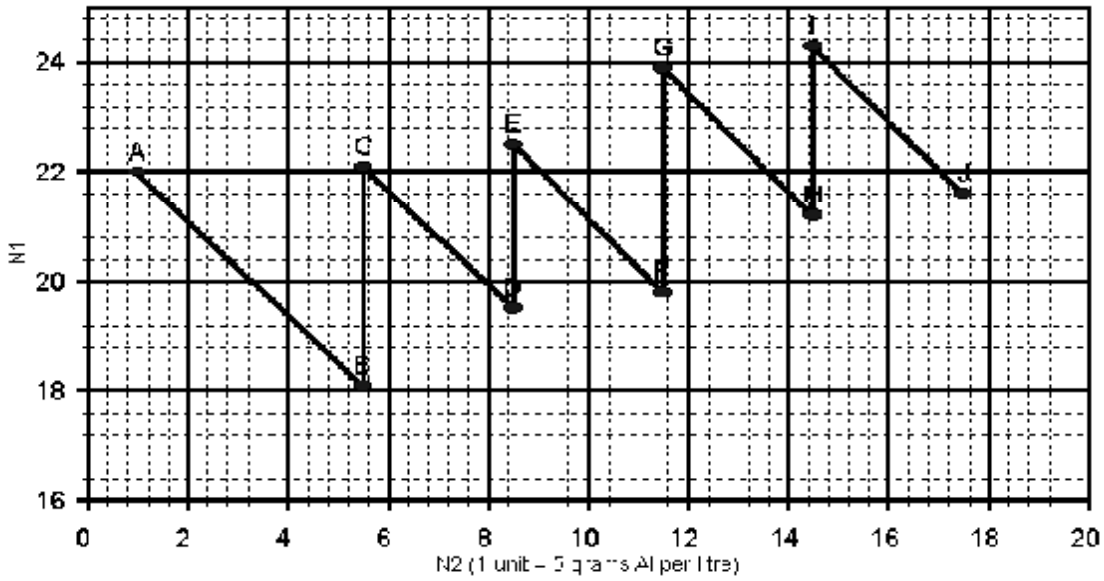
   To increase the INITIAL N_1 by 1 ml, add 22.7 litres of TURCOFORM ETCHANT 17L per 1,000 litres of etchant solution.

   The etchant solution should be discarded when the N_2 value reaches the top of the recommended range. When the tank is dumped or recharged, do not clean or remove the black smut that forms on the tank walls.

CHEMICAL CONTROL:

Aluminium is dissolved during the etching operation causing a reduction in the strength of the etchant solution. To maintain concentration of chemicals at the proper level, it is necessary to make periodic additions of TURCOFORM ETCHANT 9HL. No further ADDITIONS of TURCOFORM ETCHANT 17L are required after the initial charge. To increase N_1 by 1 ml, add 18 ml of TURCOFORM ETCHANT 9HL per litre of etchant solution.

The following is a typical example of one way to control the etchant solution:



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2 (1 unit = 5 grams Al per litre)

Example: (Refer to Fig. 1)

A fresh 1,000 litre bath has an N_1 value of 22.0 and an N_2 of 1.0 (this corresponds to Point **A**).

Parts are then etched until 180 pounds of aluminium have been dissolved in this solution. The N_1 value is now 18.1 and N_2 is 5.5 (this corresponds to Point **B**).

The bath is rejuvenated by adding 72 litres of TURCOFORM ETCHANT 9HL changing N_1 to 22.1 (the N_2 value remains essentially unchanged). The bath condition is represented by Point **C**.

Points **D** through **I** are obtained by dissolving 120 pounds of aluminium each time and then adding 54, 72 and 54 litres of TURCOFORM ETCHANT 9HL.

When Point **J** is reached or when the tank ceases to produce good parts, the etchant is dumped.

Neglecting the original charge of TURCOFORM ETCHANT 17 L which is needed only once, the ratio of TURCOFORM ETCHANT 9HL to dissolved aluminium will vary from 3.5 to 1 to 2.5 to 1 depending on the dump point. The more aluminium dissolved on the final pass, the higher the etch bath efficiency.

The concentrations of two constituents of the solution, (a) N_1, unused etchant and (b) N_2, dissolved aluminium, should be determined each day or as often as experience dictates.

METHOD FOR DETERMINATION OF ETCHANT AND DISSOLVED ALUMINIUM

Test:

A. Reagents and Apparatus

1 Beckman Model pH-16 Pocket pH meter, or equivalent. Use a high glass electrode, accurate from pH 0 to 1 4.

2. Magnestir and Teflon-coated stirring rod.
3. 250-ml Griffin Beaker.
4. 5-ml pipette.
5. 25 or 50-ml burette.
6. Sample jars (approximately 50 ml).
7. 1 N H_2SO_4.
8. 10 pH Buffer Solution.

B. Sampling

1. Obtain a sample from the well-mixed etchant bath.

C. Titration Procedure

1. Pipette a 5-ml sample of the etchant into a 250-ml beaker. Add the teflon-coated Magnestir stirring rod and 120 ml of distilled water.
2. Standardize the pH meter with 10 pH buffer solution.
3. Rinse the electrode of the pH meter and place it in the beaker containing the sample.
4. Titrate with 1 N H_2SO_4 until a pH of 11.3 is reached. Approach the end-point slowly and allow sufficient time for the pH meter to reach equilibrium.
5. Continue the titration with 1 N H_2SO_4 until a pH of 8.2 is reached.
6. N_1 is the volume in ml of 1 N H_2SO_4 required to neutralize the free sodium hydroxide.

   N_2 is the volume in ml of 1 N H_2SO_4 required to neutralize the free sodium aluminate.

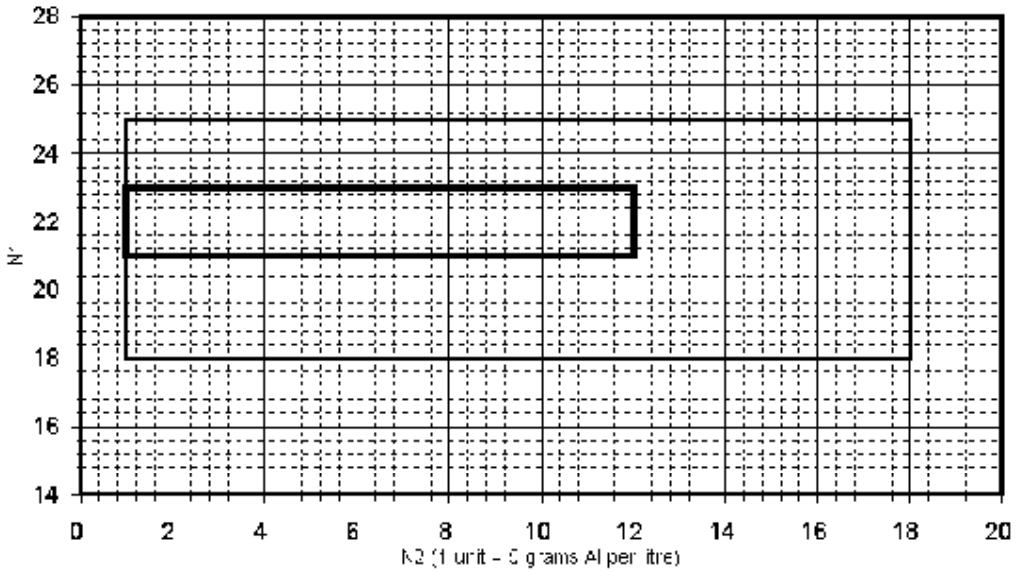
OPTIMUM CONTROL RANGE:

To obtain the best overall results the N_1 and N_2 must be controlled within a certain range. The optimum range will vary depending on the alloy and heat treat condition of the aluminium part.

The following graphs indicate the range for some of the more common alloys and at several heat-treat conditions:

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOYS 2024-T3, -T4 CLAD AND BARE



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

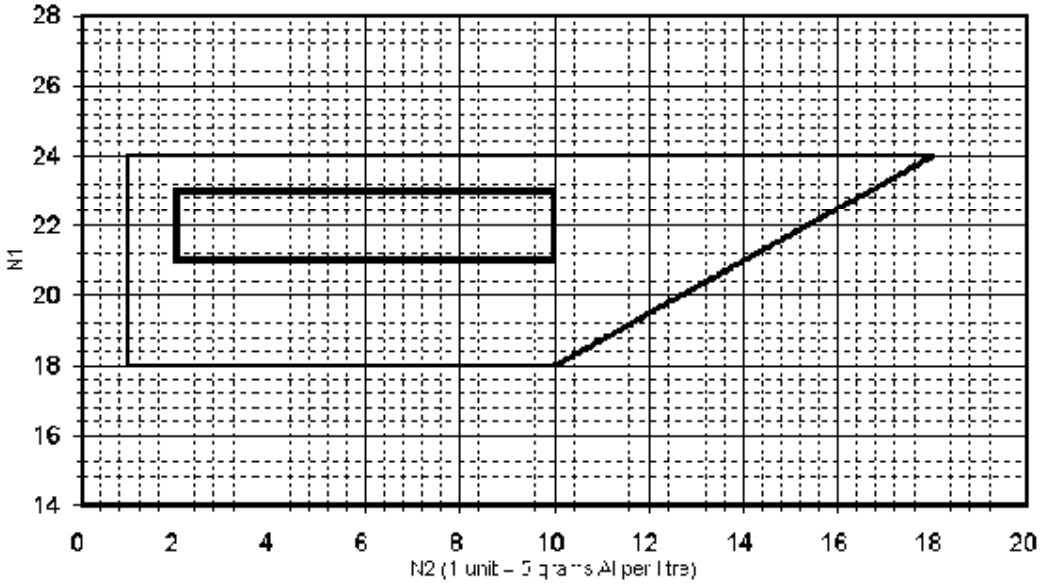
N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

	Control Range	Optimum
N_1	18.0 - 25.0	21.0 - 23.0
N_2	1.0 - 18.0	1.0 - 12.0

Parts may be etched in the total range. As the N_2 increases beyond optimum, roughness may occur in the fillet without frequent de-smutting.

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOY 7075-T6 CLAD



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

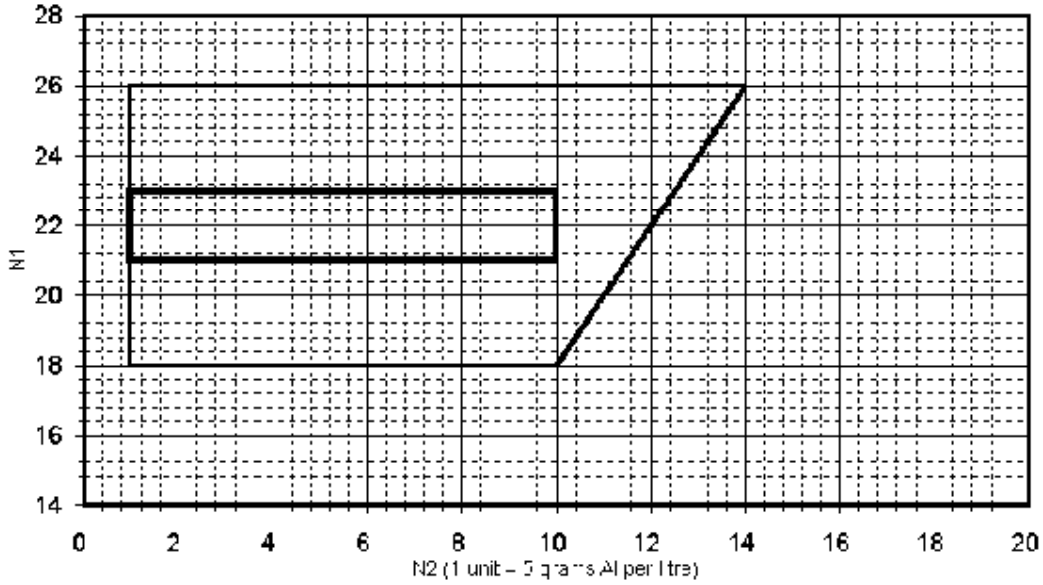
N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

	Control Range		Optimum
N_1	18 - 24	21 - 24	21 - 23
N_2	1 - 10	1 - 18	2 - 10

Parts may be etched in the total range. As the N_2 increases beyond optimum, roughness may occur in the fillet without frequent de-smutting.

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOY 7075-T6 BARE



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

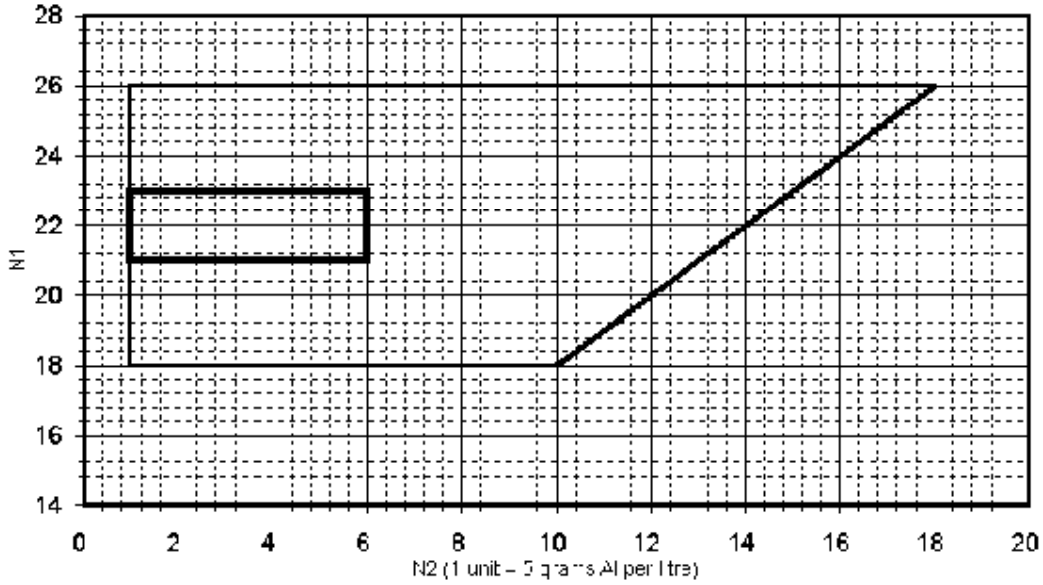
	Control Range		Optimum
N_1	18 - 26	21 - 26	21 - 23
N_2	1 - 10	1 - 14	1 - 10

Parts may be etched in the total range. As the N_2 increases beyond optimum, roughness may occur in the fillet without frequent de-smutting.

NOTE: 7075-T6 bare parts must be de-smutted after the first five minutes of etching to avoid a rough fillet due to heavy smut. The de-smutting need only be done once on each step cut.

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOY 7075-0 BARE



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

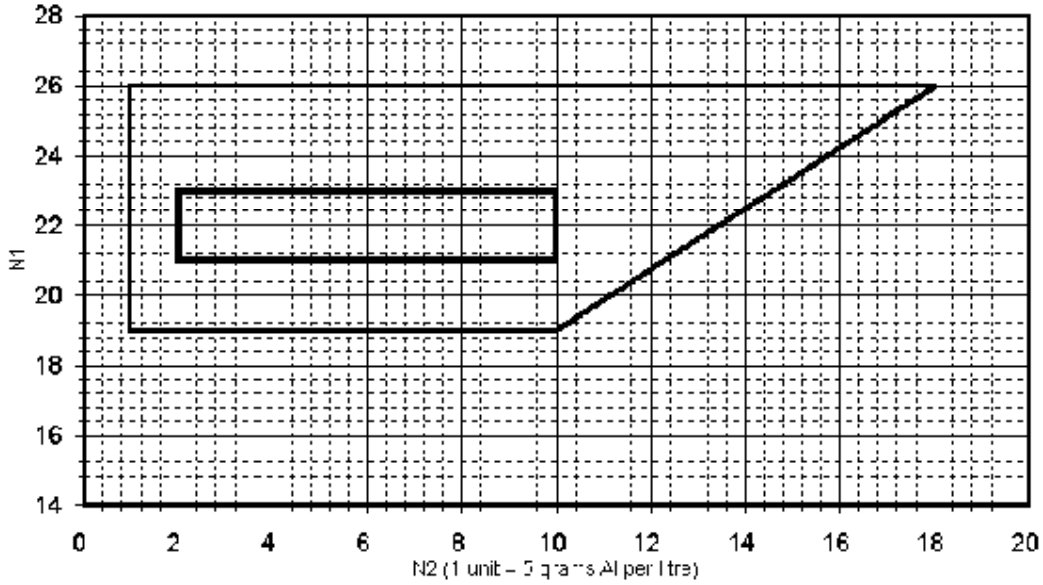
	Control Range	Optimum
N_1	18.0 - 26.0	21.0 - 23.0
N_2	1.0 - 18.0	1.0 - 6.0

Parts may be etched in the total range. As the N_2 increases beyond optimum roughness may occur in the fillet without frequent de-smutting.

NOTE: It is recommended that parts in the 0 - condition be etched in a fresh tank. RMS values in excess of 150 have been obtained on 0 - condition aluminium in old tanks.

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOY 7075-0 CLAD



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

	Control Range*	Optimum*
N_1	18.0 - 26.0	21.0 - 23.0
N_2	1.0 - 18.0	2.0 - 10.0

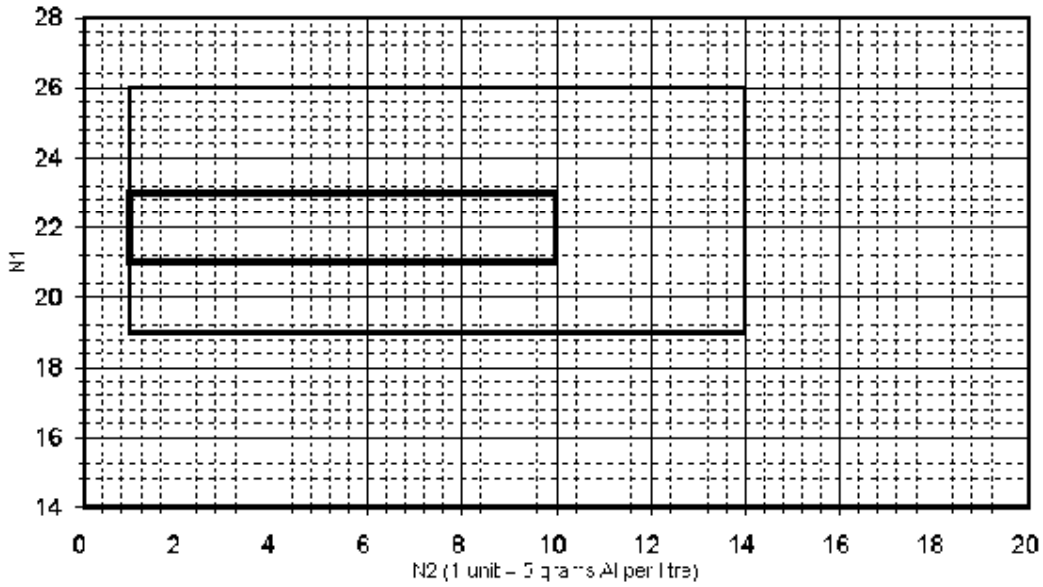
*if de-smutted every 10 minutes

Parts may be etched in the total range. As the N_2 increases beyond optimum, roughness may occur in the fillet without frequent de-smutting.

NOTE: It is recommended that parts in the 0 - condition be etched in a fresh tank. RMS values in excess of 150 have been obtained on 0 - condition aluminium in old tanks.

RECOMMENDED OPERATING RANGES FOR TURCOFORM ETCHANT 17L

ALUMINIUM ALLOY 2024-0 CLAD AND BARE



N_1: mls of 1 N H_2SO_4 to neutralize 5 ml of etchant to pH 11.3

N_2: mls of 1 N H_2SO_4 to continue neutralization to pH 8.2(1 unit = 5 grams Al per litre)

	Control Range	Optimum
N_1	19.0 - 26.0	21.0 - 23.0
N_2	1.0 - 14.0	1.0 - 10.0

Parts maybe etched in the total range. As the N_2 increases beyond optimum, roughness may occur in the fillet without frequent de-smutting.

NOTE: It is recommended that parts in the 0 - condition be etched in a fresh tank. RMS values in excess of 150 have been obtained on 0 - condition aluminium in old tanks.

DISPOSAL INFORMATION:

Dispose of spent material per local and national regulations. Refer to your TURCO MATERIAL SAFETY DATA SHEET for additional disposal information.

CAUTION:

TURCOFORM ETCHANT 17L contains sodium hydroxide and sulphides. Avoid contact with eyes, skin and clothing. Do not take internally. Use with adequate (equivalent to outdoor) ventilation.

Protective clothing such as a chemical face shield or goggles, gloves, boots and apron made of chemically resistant material equivalent to neoprene should be worn when handling and using this product.

Refer to container label, TURCO MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

NOTICE:

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience. However, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage, or injury, direct or consequential, arising out of the use of this product.