MIL-R-81903A(AS)
22 December 1977
SUPERSEDING
MIL-R-81903(AS)
26 May 1972

MILITARY SPECIFICATION

REMOVER, ACID ACTIVATED, FOR AMINE-CURED EPOXY COATING SYSTEMS

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for removers used on amine-cured epoxy coating systems(see 6.1).

1.2 Classification. Coating removers covered by this specification shall be of the following types as specified (see 6.2).

Type I - Hydroxyacetic acid

Type II - Formic acid

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet

QQ-A-250/5 - Aluminum Alloy Alclad 2024, Plate and Sheet

FSC 8010

FEDERAL (continued)

QQ-A-250/13	- Aluminum Alloy Alclad 7075, Plate and Sheet
QQ-P-416	- Plating, Cadmium (Electroplated)
TT-T-291	- Thinner, Paint, Volatile Spirits (Petroleum Spirits)
PPP-P-704	- Pail,Metal: (Shipping, Steel,1 through 12 gallons)

MILITARY

MIL-C-5541	- Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys
MIL-S-7952	- Steel, Sheet and Strip, Uncoated Carbon (1020 and 1025) (Aircraft Quality)
MIL-A-8625	- Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-T-9046	- Titanium and Titanium Alloy, Sheet, Strip and Plate
MIL-P-23377	- Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant
MIL-C-81773	- Coating, Polyurethane, Aliphatic, Weather Resistant

STANDARDS

FEDERAL

FED-STD-141	- Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling and Testing
FED-STD-313	- Material Safety Data Sheet, Preparation and Submission of

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	- Marking for Shipment and Storage

(Copies of specifications, standards, and publications required by suppliers in connection with specific procurement functions, should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic, Tariff Department, 1616 P Street, N. W., Washington, DC 20036.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

DEPARTMENT OF TRANSPORTATION

49 CFR 100-199 - Department of Transportation (DOT) Regulations for the Transportation of Explosive and Other Dangerous Articles by Land and Water

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Orders for the publications should cite "The latest issue and supplements thereto".)

3. REQUIREMENTS

3.1 Qualification. The coating remover furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3). In addition, the retention of the coating remover on the applicable qualified products list shall be dependent on periodic verification of continued compliance with the requirements of this specification (see 4.3.1).

3.2 Material. The remover covered by this specification shall consist of organic solvents, evaporation retarders, and other ingredients needed to impart properties which conform to the requirements specified herein. The acid active ingredient of type I shall be hydroxyacetic acid, and the acid active ingredient of type II shall be formic acid.

3.2.1 Composition. The formulation of the remover shall be optional with the manufacturer, except that it shall be restricted by other requirements specified herein.

3.2.2 Toxicity. The material shall have no adverse effect on the health of personnel when used for its intended purpose in accordance with the directions specified herein. The remover shall contain no components which produce noxious vapors in such concentrations as to be an annoyance to personnel during coating removal operations under conditions of adequate ventilation while exercising caution to avoid prolonged contact with the skin and while observing Occupational Safety and Health Administration (OSHA) guidelines. Questions pertaining to the toxic effect shall be referred by the procuring activity to the appropriate departmental medical service who will act as an advisor to the procuring activity (see 6.5).

3.3 Consistency and flow. When tested as specified in 4.5.1. the remover shall flow to a point within 18 and 23 cms in five minutes.

3.4 Flammability. When the remover is tested as specified in 4.5.2, it shall not continue to burn longer than 3 seconds after removal of the flame.

3.5 Effect on metals. When the remover is tested as specified in 4.5.3 on the metals listed in table I (see 4.5.3.1), there shall be no discoloration or evidence of corrosion. Slight discoloration of cadmium plated steel panels shall not be considered objectionable.

3.6 Rinsability. The remover, when tested as specified in 4.5.4, shall be rinsable with water. If residue or noticeable water break occurs it shall not adversely affect the drying or adhesion of an applied polyurethane system.

3.7 Paint stripping efficiency. The remover, when tested as specified in 4.5.5. shall remove epoxy finish from all panels specified in table II (see 4.5.5.1) better than the control formula product (see 4.5.5.2).

3.8 Refinishing properties of stripped surfaces. After the stripping operation specified in 4.5.5 has been completed, the remover shall leave a surface suitable for refinishing as described in 4.5.6.

3.9 Volatility. The volatility of the remover shall not exceed the volatility of distilled water when distilled water and the remover are tested as specified in 4.5.7.

3.10 Storage stability. The remover shall conform to all requirements of this specification after 6 months storage at 21.1± 2.8°C (70 ±5°F).

3.11 Service test. When required by the qualifying activity, the remover shall be tested as specified in 4.5.9 and shall show satisfactory performance in actual use.

3.12 Workmanship. The remover, when examined visually at room temperature, shall be a homogeneous liquid that shows no caking, or gelation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. Inspection requirements specified herein are classified as follows:

1. Qualification inspection (see 4.3).

2. Quality conformance inspection (see 4.4).

4.2.1 Inspection conditions. Unless otherwise specified, all inspections required by this specification shall be performed at a temperature of 21.1 ±2.8°C (70±5°F) and relative humidity of 50 ±5 percent.

4.3 Qualification inspection. The qualification inspection shall consist of all the examinations and tests required under this specification.

4.3.1 Retention of qualification The retention of qualification of products approved for listing on the qualified products list (QPL) shall be accomplished by a periodic verification to determine continued compliance of a supplier's product with the requirements of this specification. The verification intervals shall not exceed two years. Unless otherwise specified by the activity responsible for the qualified products list, verification of qualification may be made by certification.

4.3.2 Qualification samples. Qualification inspection samples shall consist of two gallons of remover contained in two one-gallon glass containers. Samples shall be forwarded to the Supply Officer, Naval Air Development Center, Warminster, Pennsylvania 18974, Attention: Director, Aircraft and Crew Systems Technology Directorate, Code 60622. Samples shall be plainly identified by securely attached durable tags with the following information:

Sample for qualification inspection
Remover, Acid Activated for Amine-Cured Epoxy Coating Systems
Manufacturer's formula No._____
Date compounded _____
Manufacturer's name
Batch or lot number
Submitted by (name) (date) for qualification inspection in accordance with the requirements of speciifcation MIL-R-81903A(AS) under authorization of (reference authorizing letter)

4.3.2.1 Service test samples. Service test samples shall consist of 150 gallons of paint remover contained in thirty (5 gallon) steel pails conforming to PPP-P-704, Type I, Class 4. No overpacking is required. Samples shall be forwarded in accordance with instructions contained in the authorizing letter granting service test which will be sent to the manufacturer on satisfactory completion of all laboratory tests.

4.3.2.2 Inspection report and other data. The contractor shall submit a report, in duplicate, to accompany the qualification inspection sample. This report shall include the results of the manufacturer's tests, reported quantitatively, where applicable, in the units specified for all of the requirements specified herein. Tests not conducted due to lack of special test facilities or materials shall be so noted in the report. The contractor shall also furnish toxicological data necessary to evaluate the safety of the cleaning compound for the proposed use, and a certified statement specifically identifying each ingredient in the compound by a readily recognizable chemical name, source, and percentage by weight. Trade names alone will not be considered satisfactory. The formulation shall be clearly identified by the manufacturer's formula number.

4.3.3 Qualification tests. The qualification tests of the remover shall consist of all the tests required under this specification.

4.4. Quality conformance inspection. The quality conformance inspection of the remover shall consist of the following tests:

Consistency
Flammability
Effect on metals
Paint stripping efficiency
Volatility
Rinsability

4.4.1 Lot formation. A lot shall consist of all the coating remover produced by one manufacturer, at one plant, from the same materials, and under essentially the same conditions provided the operation is continuous. In the event the process is a batch operation, each batch shall constitute a lot (see 6.4).

4.4.2 Quality conformance test samples. Quality conformance test samples shall be selected in accordance with Fed. Test Method Std. No. 141, except that the sample shall consist of at least one gallon of remover. The applicable test methods of Fed. Test Method Std. No. 141 shall be used throughout this specification where test methods of Fed. Test Method Std. No. 141 are specified. Each sample shall be clearly identified by the manufacturer's formula number as specified in 4.3.2. The test samples shall be forwarded to the Naval Air Development Center as specified in 4.3.2. The manufacturer

shall furnish with each lot a certificate to the effect that the material has been processed in the same manner and degree using the same base ingredients as the approved qualification sample.

4.4.3 Packaging inspection. A random sample of filled containers shall be selected from each lot and inspected for fill, packing and marking. The sampling shall be in accordance with MIL-STD-105, Inspection Level I and Acceptable Quality Level (AQL) 2.5 percent defective. The packing shall be in accordance with PPP-P-704 and the marking shall conform to the requirements of MIL-STD-129.

4.5 Test methods.

4.5.1 Consistency and flow. The consistency and flow of the remover shall be determined with a Consistometer (Central Scientific Company Catalog No. 24925) or equivalent type instrument.

4.5.2 Flammability.

4.5.2.1 Panel preparation. One end of a clean, 4 by 3/4 by 0.040 inch aluminum alloy panel, conforming to QQ-A-250/4 and anodized in accordance with MIL-A-8625, shall be held at an angle of approximately 45 degrees. The remover shall be poured along the upper edge of the panel, allowing the remover to drain freely over the surface. Remover settling on the reverse side of the panel shall be wiped clean before proceeding with the test.

4.5.2.2 Procedure. A microburner flame, not exceeding 3/16 inch in length shall be passed, within a 2-second period, back and forth along the lower edge of the panel. This operation shall be repeated three times at 3-second intervals. If the remover ignites, the burner flame shall be removed and observation shall be made to ascertain whether the remover continues to burn. The above procedure shall be repeated on another similarly prepared panel except that the panel shall be placed in an oven for 15 minutes at 45 $\pm$2.2°C (113 $\pm$4°F). The panel shall then be removed from the oven and subjected to the flame test.

4.5.3 Effect on metals.

4.5.3.1 Preparation of test panels. Test panels, 1 by 6 inches, shall be made in accordance with Table I. The panels shall be bent along a line 1-1/4 inches from one end to form an angle of 45 degrees. The panels shall then be cleaned in a beaker of hot petroleum spirits conforming to type I, grade A of TT-T-291 by using a surgical gauze swab. The panels shall then be rinsed in hot petroleum spirits, boiled in 95 percent methanol, and finally boiled in absolute methanol. In handling the panels, care should be exercised

to avoid fingerprint markings. After the panels have been cleaned, they shall be placed on a rack or other suitable device so that the long dimension of the panel forms a sixty degree angle with the horizontal.

4.5.3.2 Procedure. The upper surface of the panels shall be completely covered with approximately 8 ml of thoroughly mixed remover. The remover shall be allowed to drain for 30 minutes at room temperature. The panels shall then be placed in an oven maintained at a temperature of 60 ±1.2°C (140 ±4°F) for 1 hour. After the panels have been removed from the oven, they shall be rinsed under a stream of tapwater and brushed, if necessary, until free from remover residues. The panels shall be cleaned as specified in 4.5.3.1 and examined for discoloration or evidence of corrosion.

4.5.4 Flexibility. A 3 by 6 by 0.20 inch bare aluminum alloy panel conforming to QQ-A-250/4 and anodized in accordance with MIL-A-8625 shall have corners and edges broken and smoothed. The clean, unpainted, anodized aluminum alloy panel shall be coated with approximately 10 ml of the thoroughly mixed test sample of the remover and placed in a draft-free location for 45 minutes. After the 45-minute interval, the panel shall be rinsed with tapwater and gently brushed with a soft bristled brush. The rate of flow shall be 4 gallons of water per minute and the duration of rinsing 5 minutes. The wet panel shall be examined for residue and water-break. The panel shall then be oven dried for 15 minutes at 71.1 ±5.0°C (160 ±9°F) allowed to cool to room temperature, and re-examined for residue. If noticeable water-break and residue occur, the panels shall be finished in accordance with Table IV. The finished surface shall then be examined for evidence of a tack free film. A tack free film is defined in Method 4061 of Fed. Test Method Std. No. 141. The adhesion of the finish shall be determined in accordance with Method 6034 (Adhesion, Knife test) of Fed. Test Method Std. No. 141 and shall be compared with the adhesion of the finish on a new panel that had been finished at the same time.

4.5.5 Paint stripping efficiency.

4.5.5.1 Preparation of test panels. Test panels shall be made from 0.02 inch thick aluminum alloy conforming to QQ-A-250/5. The edges shall be broken and smoothed and the panels shall be prepared as specified in Table II. After the finishes have been applied, the edges of the panels shall be protected with wax. A strip of masking tape shall be applied to divide the panel into equal parts, each approximately 6 by 1.25 inches.

4.5.5.2 Procedure. The panels listed in Table II shall be placed in a rack so that the six-inch dimension forms a 60 degree angle with the horizontal. The test shall be performed in a well ventilated room maintained at 21.1 ±2.8°C (70 ±5°F) and at a relative humidity of 50 ±5 percent. Just enough

of the test sample shall be poured along one-half of the top edge of each panel so that one-half of the panel will be completely covered, taking 15 seconds for each wetting procedure. On the other half of the panel a similar procedure shall be followed, using the control formula product (Table III). After 30 minutes the top surface shall be broken by light brushing with a hard fiber brush and a second application made of each stripper. After 30 additional minutes the loosened film shall be brushed off and the panel rinsed while brushing under a stream of cold water. Observation shall be made to determine if coating has been removed by test sample more completely than by control formula product.

4.5.6 Refinishing properties of stripped surfaces. The panels, prepared and stripped in accordance with 4.5.5, shall be refinished as specified in Table IV. The finished surface shall then be examined for evidence of a tack free film. A tack free film is defined in Method 4061 of Fed. Test Method Std. No. 141. The adhesion of the finish shall be determined in accordance with Method 6304 (Adhesion, Knife test) of Fed. Test Method Std. No. 141 and shall be compared with the adhesion of a similar new panel prepared at the same time. The surface shall be considered suitable for refinishing if refinishing produces a tack free film with undiminished adhesion.

4.5.7 Volatility. A Petri dish 9 cm in diameter and 1.5 cm deep, shall be placed on each pan of a two-pan beam balance. Sufficient remover shall be added to cover the entire bottom of one of the dishes. Distilled water shall be carefully poured in the other dish until the dish containing the remover is counterbalanced. The balance with the Petri dishes or the pans shall be exposed for 30 minutes in a draft free atmosphere having a temperature of 21.1 ±2.8°C (70 ±5°F) and relative humidity of 50 ±5 percent. At the end of the exposure period, the comparative loss in weights shall be observed.

4.5.8 Storage stability. After 6 months storage at 21.1 ±2.8°C (70 ±5°F), the remover shall be subjected to all of the tests in this specification.

4.5.9 Service test. The service test, performed by a NARF designated by the activity responsible for qualification, shall consist of field evaluation of the service test sample under service conditions conducted in accordance with standard operating procedures on as many aircraft as needed to determine suitability of the product for military use. The service test shall be performed when paint removers have met all the requirements of Section 3 including storage stability.

4.6 Rejection criteria. If a sample fails to meet any of the test requirements of this specification, the lot represented by the sample shall be rejected.

5. PREPARATION FOR DELIVERY

5.1 Preservation. Preservation shall be level A or minimum protection as specified (see 6.2).

5.1.1 Level A. Unless otherwise specified, the remover shall be furnished in 5 gallon pails conforming to PPP-P-704.

5.1.2 Minimum protection.

5.1.2.1 Level C. The coating remover, unless otherwise specified in the contract or order, shall be packaged in 5-gallon quantities in a manner that will afford adequate protection against deterioration and physical damage during shipment from supply source to the first receiving activity and for a minimum of 30 days storage, utilizing containers required by the Department of Transportation in Title 49, Code of Federal Regulations, Parts 100-199.

5.2 Packing. Packing shall be level A, B or minimum protection, as specified (see 6.2).

5.2.1 Levels A and B. The coating remover as packaged in accordance with 5.1.1 requires no overpacking. Standard 4-way entry pallets are required to permit handling by mechanical equipment.

5.2.2 Minimum protection.

5.2.2.1 Level C. The coating remover as packaged in 5.1.2 shall, when unit package quantities are less than 5 gallons, be packed in shipping containers in a manner that will afford adequate protection, at the lowest rate, against damage during direct shipment from the supply source to the first receiving activity. The containers shall conform to the rules and regulations of the mode of transportation utilized. Five gallon pails require no overpacking. Handling pallets are required to permit handling by mechanical equipment.

5.3 Marking. In addition to any special marking required by the contract (see 6.2), each unit container shall be marked in accordance with MIL-STD-129, plus the following information:

PRECAUTIONS

a. Remover contained herein is toxic and contains ingredients harmful to skin and eyes.

b. Avoid contact of remover with steel, rubber, asphaltic base floors and walkways.

c. Avoid enclosed and unventilated areas.

d. Personnel shall not enter the interior of the airplane during removing or subsequent clean-up.

e. Attach suitable safety devices to stands used in the removing procedure.

f. Use remover within six months of the date of manufacture.

g. Mix thoroughly prior to use.

h. Do not use with nylon brushes.

i. Store remover indoors, or in an area well-protected against weather conditions.

j. Remover shall not be allowed to come in contact with highly stressed low alloy steel components such as arresting gear, wing butt and landing gear areas.

k. This remover shall not be used on magnesium.

l. Wear goggle-type eye glasses and solvent resistant quantlet style gloves, aprons, and boots. If remover gets on skin, immediately flush affected area with large quantities of water. If remover gets in eye, flush with large quantities of water for at least 15 minutes and obtain medical attention.

m. Use respiratory protective equipment approved by the industrial hygienist.

5.4 Safety data. Material safety data sheets shall be prepared and submitted in accordance with FED-STD-313, one copy of which shall be forwarded to the preparing activity of this specification.

6. NOTES

6.1 Intended use. The remover covered by this specification is intended for use only in stripping amine-cured epoxy systems that cannot be satisfactorily removed with conventional alkaline epoxy strippers.

6.1.1 The use of this paint remover on magnesium surfaces is forbidden.

6.1.2 This remover is intended for use only at Class A Rework Facilities under strict engineering controls.

6.2 Ordering data. Procurement documents should specify the following;

a. Title, number, and date of this specification

b. Quantity required in gallons

c. Level of preservation and packing (see 5.1 and 5.2)

d. Type required (see 1.2).

e. Date of manufacture

f. Marking data with requirements in detail if other than as specified in 5.3.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command, Department of the Navy, Washington, D.C. 20361; however, information pertaining to qualification of products may be obtained from the Director, Aircraft and Crew Systems Technology Directorate, Code 60622, Naval Air Development Center, Warminster, PA 18974.

6.3.1. The remover furnished under contract shall be identical in every respect to the qualification samples which have been inspected and approved. In the event that the remover furnished under contract is found to deviate from the composition of the approved product or that the product fails to perform satisfactorily, approval of such product will be subject to immediate withdrawal from the Qualified Products List.

6.4 Batch. A batch is defined as that quantity of material which has been manufactured by some unit chemical process or subjected to some physical mixing operation intended to make the final product substantially uniform.

6.5 Toxicity. Questions pertaining to the requirements of 3.2.2 should be referred, by the procuring activity, to the appropriate Naval Regional Medical Center listed in BUMEDINST 5450.116, CH-1 who will act as an advisor to the procuring activity.

6.6 Unit of purchase. The unit of purchase for the remover is the U.S. gallon of 231 cubic inches at 15.6°C (60°F).

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activities:
Navy - AS
(Project No. 8010-N133)

TABLE I. Metals for corrosion test.

Metal	Specification	Surface	Specification
Aluminum Alloy Alclad 2024	QQ-A-250/5	-	-
Aluminum Alloy Alclad 7075	QQ-A-250/13	-	-
Aluminum Alloy 2024	QQ-A-250/4	Anodized	MIL-A-8625 (Type I or II)
Mild Steel	MIL-S-7952	Cadmium Plated	QQ-P-416
Titanium Alloy 6AL-4V	MIL-T-9046	-	-

TABLE II Test panel finishes.

Processing step	Material	No. of coats	Thickness per coat	Drying time between coats	Drying time before baking	Baking after final coat
1	Chemical Film MIL-C-5541 (Iridite 14-2 or equivalent)	-	-	-	-	-
2	DeSoto Super Koropon Primer	1	0.6-0.8 mil	1 hr at room temp.	-	-
3	DeSoto Super Koropon Top-coat (Gray)	1	mist coat	0.5 hr at room temp.	-	-
4	DeSoto Super Koropon Top-coat (Gray)	3-Wet coats	0.4-0.6 mil	1 hr at room temp.	4 days at room temp.	24 hours at 82.2°C (180°F,

TABLE III. Control formula product.

Methylene chloride	120 ml
Phenol (89) U.S.P.	70 ml
Distilled water	10 ml
Aerosol 22 1/	4 g
Tall oil fatty acid	8 g
Aerosol OT (75) 1/	4 c

A. Mix compounds in order named while stirring

B. While stirring very slowly add:
Klucel "H" 2/ 2 g

C. Melt 2g of paraffin wax M.P. 53.3-54.4°C (M.P. 128 - 130°F) and add 80 ml methylene chloride to wax.

D. Slowly add "C" to the mixture of "A" and "B"

E. Add 20 percent by volume of hydroxyacetic acid (75 percent) to "D" and stir thoroughly

1/ Manufactured by American Cyanamid Co.

2/ Manufactured by Hercules Powder Co.

TABLE IV. Test panel refinishing.

Processing step	Material	No. of coats	Thickness per coat	Drying time between coats	Drying time before baking	Baking after final coat
1	Chemical Film, MIL-C-5541 (Iridite 14-2 or equivalent)	-	-	-	-	-
2	Primer Coating Epoxy Polyamide, MIL-P-23377	1	0.6-0.8 mil	1 hr at room temp.	-	-
3.	Coating, Polyurethane, Gloss White, MIL-C-81773	Mist coat	-	30 min. at room temp.	-	-
4.	Coating, Polyurethane, Gloss White, MIL-C-81773	3-Wet coats	0.4-0.6 mil	1 hr at room temp.	air dry 4 days at room temp.	24 hrs at 82.2°C (180°F)