D

FED. SUP CLASS
7610

GROUPING OF METALS AND ALLOYS

CORRODED END - ANODIC (LEAST NOBLE)

GROUP I
MAGNESIUM ALLOYS - ALL
ALUMINUM ALLOYS (RIVETS, BOLTS, ETC. FOR FASTENING MAGNESIUM ALLOYS), 5052, 5056, 6061, 6063 (ANODIC COMPONENT)
TIN ALLOYS

GROUP II
ZINC
ALUMINUM ALLOYS 5052,5056, 6061, 6063 (CATHODIC COMPONENT), CLAD 7075, CLAD 6061, CLAD 2024, 7075, 7178, 7079, 220, A140, 195, 355, 356, 40E
CADMIUM
ALUMINUM ALLOYS 2014, 2017, 2020, 2024
BERYLLIUM ALLOYS
TITANIUM ALLOYS

GROUP III
CARBON AND LOW ALLOY STEELS CORTEN, NAX AC 9115, T-1
HIGH STRENGTH STEELS 4130, 4137, 4140, 4330, 4335, 4340, 52100, 8630, E9310 17-22A, USS STRUX, D6A, HY-TUF, NITRALLOY 135, X200, 300M, H11, VASCO MA, 18 NI MARAGING, 9Ni-4Co, 12Ni MARAGING.
LEAD ALLOYS
TIN ALLOYS
ZINC
CADMIUM
TITANIUM (SCREWS, BOLTS)
CORROSION RESISTANT STEELS

GROUP IV
MARTENSITIC STAINLESS STEELS 403, 410, 416, 420, 422, 431, 440, USS 12 Mo V, GREEK ASCALOY, AM363
AGE HARDENING STEELS (STAINLESS) 17-4PH, 17-7PH, PH15-7Mo, AM350, AM355, H00M, PH14-8Mo, AF 71, AF 77, AFC 77, PH13-8Mo, STAINLESS W.
AUSTENITIC STAINLESS STEELS 301, 302, 303, 303Se, 304, 304L, 305, 310, 310S, 31L, 316, 317, 321, 347, 348, 17-5 MnV, 19-9DL, 19-9DX, 201
TUNGSTEN
COPPER, BRASSES, BRONZES, 70 Cu-30Ni
TITANIUM
MONEL K500
NICKEL BASE ALLOYS INCONEL 600, 702, 718, 722, X750, X751, 901; 713C, D976, HASTELLOY C, R235, HASTELLOY X NIMONIC 80A, GMR 235, TD NICKEL, INCONEL 625, 700; M252, NICROTUNG, NIMONIC 105, 115, 90, RENE 41; UDIMET 500, 700; WASPALLOY, MAR-M-200
COBALT BASE ALLOYS HAYNES 151, L605, S816, STELLITE 6, 31; VITALLIUM, V36, W152, MAR-M-302
SILVER ALLOYS
GRAPHITE
GOLD ALLOYS
PLATINUM ALLOYS
RHODIUM

GROUP V
NICKEL BASE ALLOYS
INCONEL
MONEL
TITANIUM (all)
AUSTENITIC STAINLESS STEELS
HASTELLOY C
CHROMIUM

GROUP VI
GRAPHITE
GOLD
PLATINUM

PROTECTED END- CATHODIC (MOST NOBLE)

EXPLANATORY NOTES

1. GROUPS ARE BASED ON THE GALVANIC SERIES IN SEA WATER OF METALS AND ALLOYS WITH THE LEAST NOBLE (ANODIC) MATERIAL AT THE TOP OF THE GROUP AND THE MOST NOBLE (CATHODIC) MATERIAL AT THE BOTTOM OF THE GROUP. EACH GROUP CONSISTS OF ALLOYS CONSIDERED SIMILAR TO ONE ANOTHER.

2. GALVANIC CORROSION. GALVANIC CORROSION OCCURS WHEN METALS DIFFERING IN ELECTROCHEMICAL ACTIVITY ARE PLACED IN CONTACT WITH EACH OTHER IN THE PRESENCE OF AN ELECTROLYTE. THE FARTHER APART THE METALS ARE IN THE ELECTROCHEMICAL OR GALVANIC SERIES THE GREATER WILL BE THE GALVANIC TENDENCY, AS CAN BE DETERMINED BY THE ELECTRICAL POTENTIAL DIFFERENCE BETWEEN THEM.

3. WHERE REFERENCE IS MADE TO A METAL IN A PARTICULAR GROUP THE REFERENCE APPLIES TO THE METAL ON THE SURFACE OF THE PART, i.e., ZINC INCLUDES ZINC COATED PARTS ON SIMILAR OR DISSIMILAR METALS AS WELL AS ZINC DIE CASTINGS.

(B) **CANCELED AFTER 25 SEPTEMBER 1969.**
USE MIL-STD-889.

THIS STANDARD TAKES PRECEDENCE OVER DOCUMENTS REFERENCED HEREIN.
REFERENCE DOCUMENTS SHALL BE OF THE ISSUE IN EFFECT ON DATE OF INVITATIONS FOR BID.

APPROVED 14 Dec 56 REVISED (A) 14 Dec 58 (B) 25 SEPT 1969

Review activities: Navy - AS, USAF - 11

This military standard is approved by the Department of the Air Force and the Naval Air Systems Command and is mandatory for use by these activities. All other military activities are required to employ this standard where suitable.

P.A. USAF - 11	TITLE	MILITARY STANDARD
Other Cust: Navy - AS	METALS, DEFINITION OF AND PROTECTION FOR DISSIMILAR	MS33586(ASG)
PROCUREMENT SPECIFICATION: NONE	SUPERSEDES: AND 10398	SHEET 1 OF 2

DD FORM 672-1 (Limited coordination)
ASG use only

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

4. DISSIMILAR METALS. WHEN DISSIMILAR METALS MUST BE USED IN CONTACT WITH ONE ANOTHER, THE FOLLOWING METHODS OR COMBINATIONS OF METHODS SHALL BE EMPLOYED TO MINIMIZE GALVANIC CORROSION.

4.1 DESIGN SO THAT THE ANODIC MEMBER OF THE COUPLE IS LARGER, i.e., PLATED STEEL SCREWS IN ALUMINUM ASSEMBLY.

4.2 INTERPOSE A MATERIAL COMPATIBLE TO EACH OF THE DISSIMILAR METALS, SUCH AS CADMIUM PLATE ON STEEL IN CONTACT WITH ALUMINUM.

4.3 INSERT AN INSULATING MATERIAL BETWEEN THE DISSIMILAR METALS, i.e., SEALANT, PLASTIC TAPE OR PAINT.

4.4 APPLY ORGANIC COATINGS TO THE CONTACT FACES OF EACH OF THE DISSIMILAR METALS SUCH AS PAINT COATINGS ON STEEL AND ALUMINUM SURFACES IN CONTACT.

4.5 APPLY CORROSION INHIBITING MATERIALS SUCH AS PAINT AND SEALANT BETWEEN THE DISSIMILAR METALS TO PREVENT CORROSION IN THE EVENT AN INCOMPLETE OR METALLIC CONTACT IS AFFECTED.

4.6 LIMIT THE AMOUNT OF OXYGEN AND CORROSION MEDIA (ELECTROLYTE) FROM CONTACTING DISSIMILAR METAL BY SEALING WITH WET ZINC CHROMATE PRIMER OR POLYSULFIDE SEALANT.

5. THIS STANDARD DOES NOT APPLY TO STANDARD ATTACHING PARTS SUCH AS RIVETS, BOLTS, NUTS, AND WASHERS WHICH ARE COMPONENT PARTS OF ASSEMBLIES WHICH WILL BE PAINTED PRIOR TO BEING PLACED IN SERVICE, UNLESS OTHERWISE SPECIFIED BY MIL-F-7179, AS APPLICABLE.

6. FOR FURTHER BACKGROUND INFORMATION ON THE BEHAVIOR OF COUPLED DISSIMILAR METALS, REFERENCE IS MADE TO THE FOLLOWING:

CORROSION HANDBOOK EDITED BY H. H. UHLIG (WILEY 1948)
CORROSION EDITED BY L. L. SHREIR (WILEY 1963)
CORROSION AND CORROSION CONTROL BY H. H. UHLIG (WILEY 1963).

7. FOR FURTHER BACKGROUND INFORMATION ON CORROSION CONTROL AND SURFACE TREATMENT REFERENCE IS MADE TO AIR FORCE T.O. 1-1-2, AND NAVY WEPS 01-1A-509.

RULES

1. THE GALVANIC TENDENCY IS SMALL BETWEEN THESE ALLOYS CLASSIFIED IN THE SAME GROUP. HOWEVER, DIFFERENT METALS EVEN THOUGH SIMILAR ARE RECOMMENDED IN ASSEMBLIES SUCH THAT THE SMALL PART IS CATHODIC OR PROTECTED AND THE LARGER PART IS ANODIC OR CORRODED, IF ANY CORROSION TAKES PLACE.

2. MATERIALS CLASSIFIED IN DIFFERENT GROUPS ARE CONSIDERED DISSIMILAR TO ONE ANOTHER. THE GALVANIC TENDENCY IS GREATER BETWEEN WIDELY SEPARATED GROUPS THAN BETWEEN ADJACENT GROUPS. METALS FROM ONE GROUP SHOULD NOT BE PLACED IN CONTACT WITH METALS FROM ANOTHER GROUP UNLESS SUITABLY PROTECTED AGAINST GALVANIC ACTION.

3. THE CLASSIFICATION OF METALS NOT LISTED HEREON SHALL BE AS RELEASED BY THE NAVAL AIR SYSTEMS COMMAND (CODE AIR-52031C) OR THE AIR FORCE SYSTEMS COMMAND (CODE 11), AS APPLICABLE.

Review activities: Navy - AS
USAF - 11

APPROVED 14 Dec 95 REVISED (a) FOR CHANGES SEE SHEET 1

This military standard is approved by the Department of the Air Force and the Naval Air Systems Command and is mandatory for use by these activities. All other military activities are required to employ this standard where suitable.

P.A. USAF-11 Other Cust Navy - AS	TITLE METALS, DEFINITION OF AND PROTECTION FOR DISSIMILAR	MILITARY STANDARD MS33586(ASG)
PROCUREMENT SPECIFICATION NONE	SUPERSEDES AND 10398	SHEET 2 OF

DD FORM 672-1 (Limited coordination)
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