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AD-742 000

EMBRITTLEMENT

A DDC BIBLIOGRAPHY

DDC-TAS-72-21-1

MAY 1972

NATIONAL TECHNICAL
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13. ABSTRACT References in this bibliography cover such topics as: embrittlement of metals by organic liquids, embrittlement of high strength steel and aluminum in the presence of water, alcohols, glycols, ethers, and aldehydes, embrittlement of polycrystalline silver chloride, investigation of thermal embrittlement in managing steel, liquid metal embrittlement, stress-relief embrittlement of HY-130(T) weld metals and effect of embrittled 110-18 weld metal on the fatigue life of HY-80 steel butt weldments, etc. Corporate Author-Monitoring Agency, Subject, Title, Contract, and Report Number Indexes are included.			

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*Embrittlement						
Steel Embrittlement						
Titanium Alloys						
Brass						
Metals						
Steel						
Radiation Damage						
Managing Steels						
Reactor Materials						
Crystals						
Copper Alloys						
Liquid Metals						
Zinc Alloys						
Aluminum Alloys						
Pressure Vessels						
Lead Alloys						
Chromium Alloys						
Complex-ion Embrittlement						
Stress Corrosion						
Fracture (Mechanics)						
Plating						
Heat Treatment						
Corrosion						
Hydrogen Embrittlement						
Ductility						
Weldability						
Plastics						
Nuclear Reactors						
Vanadium						
Welds						
Composite Propellants						

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ALEXANDRIA, VIRGINIA 22314**

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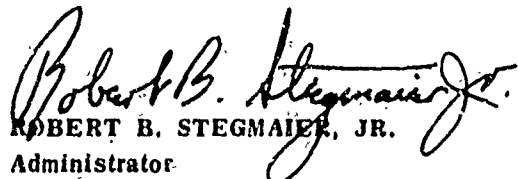
FOREWORD

This bibliography is a compilation of references on *Embrittlement*. Entries were selected from reports processed into the AD data bank from January 1953 to February 1972, and it revises and updates an earlier bibliography, AD-708 700, on the same subject.

Computer-generated indexes for Corporate Author-Monitoring Agency, Subject, Title, Contract Number, and Report Number are included.

BY ORDER OF THE DIRECTOR, DEFENSE SUPPLY AGENCY

OFFICIAL



ROBERT B. STEGMAIER, JR.
Administrator
Defense Documentation Center

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CONTRACT.....	C-1
REPORT NUMBER.....	R-1

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-426 464

MIT RESEARCH INST CHICAGO ILL

EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS.

(U)

DESCRIPTIVE NOTE: SUMMARY REPT., 1 DEC 62-30 NOV 63.

JAN 64 37P

REPT. NO. MITRI B1B3B2 4

CONTRACT: DALL 0220RD3108

UNCLASSIFIED REPORT

DESCRIPTORS: (*ALUMINUM, BRITTLNESS),
(*STEEL, BRITTLNESS), (*BRITTLNESS,
METALS), (*ORGANIC COMPOUNDS, BRITTLNESS),
TENSILE PROPERTIES, FATIGUE (MECHANICS),
FAILURE (MECHANICS), FRACTURE (MECHANICS),
WATER, ETHERS, ALCOHOLS, ALDEHYDES,
SOLUTIONS.

IDENTIFIERS: 1964, EMBRITTLEMENT.

(U)

(U)

HIGH-STRENGTH STEEL AND ALUMINUM ARE SHOWN TO BE
EMBRITTLED IN NOTCHED FATIGUE TESTING IN THE PRESENCE
OF WATER, ALCOHOLS, GLYCOLS, ETHERS, AND ALDEHYDES.
IT IS SHOWN THAT LONGER CARBON CHAINS, BRANCHING
MOLECULAR SHAPES, AND CLOSED RINGS REDUCE THE DEGREE
OF EMBRITTLEMENT WHILE MULTIPLICITY OF (-OH) OR (-
O-) GROUPS ENHANCE IT. BY A VARIETY OF
EXPERIMENTS AND DEDUCTIONS, WATER IS SHOWN TO BEHAVE
MORE LIKE A ZERO CHAIN LENGTH ORGANIC MOLECULE RATHER
THAN AN ELECTROLYTIC MEDIUM. (AUTHOR)

(U)

UNCLASSIFIED

1ZBML1

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY - SEARCH CONTROL NO. 1ZBML1

AD-444 017

FRANKFORD ARSENAL PHILADELPHIA PA PITMAN-DUNN RESEARCH
LABS

THE EFFECT OF EXPOSURE TIME ON THE EMBRITTLEMENT OF
CU-2 PERCENT BE ALLOY BY LIQUID AMALGAM, (U)

JUN 64 BP RINNOVATORE, J. V. ; CORRIE, J.
D. MARKUS, H. ;
PROJ: 1A 0105018010
MONITOR: PDLG A64 8

UNCLASSIFIED REPORT

REPRINT FROM ASM TRANSACTIONS QUARTERLY, 57:2, PP.
474-481, JUNE 1964. (COPIES NOT SUPPLIED BYDDC).
SUPPLEMENTARY NOTE:

DESCRIPTORS: (*LIQUID METALS, MERCURY ALLOYS), (*COPPER
ALLOYS, BRITTLENESS), SODIUM ALLOYS, STRAIN (MECHANICS),
BERYLLIUM ALLOYS, FRACTURE (MECHANICS), AGING
(MATERIALS), GRAIN BOUNDARIES (U)
IDENTIFIERS: EMBRITTLEMENT, COPPER ALLOY 2BE,
WETTING (U)

THE EMBRITTLEMENT OF CU-2% BE AS A FUNCTION
OF TIME OF EXPOSURE TO A HG-2% NA AMALGAM HAS
BEEN STUDIED. IT IS SHOWN THAT TIME OF EXPOSURE TO
LIQUID AMALGAM HAS A PRONOUNCED EFFECT ON THE DEGREE
OF EMBRITTLEMENT INDUCED IN THE ALLOY. THE EFFECT
IS EVIDENCED BY A DECREASE IN WETTED FRACTURE
STRENGTH AND BY GRAIN BOUNDARY PENETRATION OF THE
ALLOY BY THE AMALGAM. THIS OCCURS IN BOTH THE AGED
AND AGED PLUS COLD WORKED CONDITIONS, BUT TO A
GREATER DEGREE IN THE LATTER CONDITION. IT IS
SHOWN ALSO THAT PENETRATION IN THE FORM OF GRAIN
BOUNDARY GROOVING DOES NOT PRODUCE A DETRIMENTAL
EFFECT IN ITSELF. EMBRITTLEMENT DOES NOT OCCUR IF
THE AMALGAM IS REMOVED REGARDLESS OF THE PAST HISTORY
OF WETTING. (AUTHOR) (U)

UNCLASSIFIED

ODC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-489 216 11/6
GENERAL ELECTRIC CO PHILADELPHIA PA MISSILE AND SPACE
DIV

DEVELOPMENT OF COMPOSITE STRUCTURAL MATERIALS FOR
HIGH TEMPERATURE APPLICATIONS. (U)

DESCRIPTIVE NOTE: QUARTERLY REPT. NO. 2, 23 FEB-22 MAY
66,

MAY 66 53P CHORNE, J. ; BRUCH, C. ;
SUTTON, N. H. ;
CONTRACT: N66-0443

UNCLASSIFIED REPORT

DESCRIPTORS: (*COMPOSITE MATERIALS, *HEAT-RESISTANT
METALS + ALLOYS), (*ALUMINUM, *SINGLE CRYSTALS),
CRYSTAL GROWTH, WHISKERS (CRYSTALS), TEMPERATURE,
TENSILE PROPERTIES, DUCTILITY, ELECTROPLATING,
EMBRITTLEMENT, BONDING, OXIDES, REINFORCING
MATERIALS, FILAMENTS, NICKEL, FEASIBILITY STUDIES,
CRYSTAL LATTICE DEFECTS, HEAT TREATMENT (U)

THE PURPOSE OF THIS PROGRAM IS THE DEVELOPMENT OF
NEW STRUCTURAL COMPOSITE MATERIALS WITH HIGH
STRENGTH-TO-WEIGHT RATIOS AT ELEVATED TEMPERATURES.
THE CURRENT EFFORT IS BEING DIRECTED TOWARDS THE
REINFORCEMENT OF NICKEL BY USING ULTRA-HIGH STRENGTH
AL₂O₃ SINGLE CRYSTAL WHISKERS. THE MAJOR
EMPHASIS WAS PLACED ON THE FABRICATION AND TESTING OF
EXPERIMENTAL NI-AL₂O₃ WHISKER COMPOSITES
PREPARED BY ELECTRODEPOSITION AND PRESSURE BONDING
TECHNIQUES. SUBSTANTIAL PROGRESS WAS MADE IN THE
WHISKER GROWTH AREA. EXPERIMENTS UTILIZING AN AIR
ELUTRIATION TECHNIQUE HAVE DEMONSTRATED GOOD
POTENTIAL FOR BENEFICIATING, CLASSIFYING AND
ORIENTING THE TYPE OF ALUMINA WHISKERS GROWN AT THIS
LABORATORY. STUDIES OF ELECTROPLATED NICKEL SHOW
THAT IT IS SUBJECT TO EMBRITTLEMENT WHEN HEATED TO
THE TEMPERATURE RANGE OF 800 TO 1000 C. ELECTRO-
FORMED BUNDLES OF WHISKERS WERE PRESSURE BONDED AT
HIGHER TEMPERATURES THAN PREVIOUSLY USED. (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12B.11.1

AD-600 932

UNITED STATES STEEL CORP MONROEVILLE PA

THE EFFECT OF SPECIAL ADDITIONS ON THE NOTCH
TOUGHNESS OF MARAGING STEELS.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.

APR 64

2LP

BIRKLE, A. J.; DABKOWSKI, D. S.

PORTER, L. F. ;

CONTRACT: N08588540

PROJ: SS050 000

TASK: 1507

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*MARAGING STEELS, TOUGHNESS), (*BORON,
METALLURGY), (*ZIRCONIUM, METALLURGY), (*STEEL,
MECHANICAL PROPERTIES), NICKEL, CHROMIUM, MOLYBDENUM,
COBALT, GRAIN BOUNDARIES, HEAT TREATMENT, CHEMICAL
PROPERTIES, MELTING

(U)

IDENTIFIERS: STEEL HY-180/210, NOTCH TOUGHNESS,
ANNEALING, EMBRITTLEMENT

(U)

THE RESULTS INDICATED THAT WHEN LABORATORY AIR-
MELTED OR VACUUM-MELTED HEATS OF 12NI-3CR-3MO,
12NI-5CR-3MO, OR 18NI-8CO-3MO MARAGING
STEELS CONTAINED ABOUT 0.02 PERCENT ZIRCONIUM, THEIR
NOTCH TOUGHNESS IN THE SOLUTION-ANNEALED AND IN THE
SOLUTION-ANNEALED AND AGED CONDITIONS WAS MARKEDLY
LOWER THAN THAT OF THE SAME STEELS CONTAINING NO
BORON OR ZIRCONIUM OR CONTAINING ONLY BORON. THE
RESULTS ALSO INDICATED THAT THE STEELS CONTAINING
BORON WERE SLIGHTLY MORE NOTCH TOUGH THAN THE STEELS
CONTAINING NO BORON OR ZIRCONIUM, AND THAT THE STEELS
CONTAINING ABOUT 0.005 PERCENT CARBON WERE MORE NOTCH
TOUGH THAN THE STEELS CONTAINING ABOUT 0.017 PERCENT
CARBON. IN ADDITION, THERE WAS SOME INDICATION
THAT THE ELIMINATION OF ALUMINUM MAY ALSO
SIGNIFICANTLY IMPROVE NOTCH TOUGHNESS. ON THE
BASIS OF THE ABOVE RESULTS, LABORATORY AND
PRODUCTION HEATS OF MARAGING STEELS HAVING YIELD
STRENGTHS IN THE RANGE 180 TO 210 KSI ARE NOW BEING
MELTED WITHOUT THE SPECIAL ZIRCONIUM ADDITION.
ADDITIONAL LABORATORY STUDIES ARE NOW IN PROGRESS
TO DETERMINE THE OPTIMUM TITANIUM AND ALUMINUM
CONTENT FOR MARAGING STEELS HAVING YIELD STRENGTHS IN
THE RANGE 180 TO 210 KSI, AFTER WHICH THE EFFECT OF
NICKEL, CHROMIUM, COBALT, AND MOLYBDENUM WILL BE
INVESTIGATED WITH THE AIM OF DEVELOPING THE OPTIMUM
OVER-ALL COMPOSITION FOR THESE TYPES OF MARAGING. (U)

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12BML1

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-630 420

11/6

FRANKFORD ARSENAL PHILADELPHIA PA QUALITY ASSURANCE
DIRECTORATE

RELATIONSHIP BETWEEN EMBRITTLEMENT BEHAVIOR AND
INTERFACIAL ENERGIES FOR COPPER WETTED WITH BINARY
BISMUTH-THALLIUM LIQUID METAL ALLOYS AT 650 F, (U)

FEB 66 30P ROGUS, BERNARD J. ;
MONITOR: FA ; R-1800

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (COPPER, EMBRITTLEMENT), (LIQUID
METALS, COMPATIBILITY), (BISMUTH ALLOYS, THALLIUM
ALLOYS), SURFACE PROPERTIES, SURFACE-ACTIVE
SUBSTANCES, TEMPERATURE, FRACTURE (MECHANICS) (U)

EMBRITTLEMENT BEHAVIOR OF COPPER WAS STUDIED IN
TERMS OF INTERFACIAL ENERGIES BETWEEN THE SOLID
COPPER AND BINARY BISMUTH-THALLIUM LIQUID METAL
COMPOSITIONS. WETTED FRACTURE STRENGTH
DETERMINATIONS WERE MADE ON COPPER TENSILE SPECIMENS
WHICH WERE IN CONTACT WITH THE LIQUID METAL ALLOYS AT
650 F. TESTS WERE MADE AS THE RELATIVE PROPORTIONS
OF BISMUTH AND THALLIUM IN THE LIQUID WETTING METAL
WERE VARIED. IT WAS FOUND THAT THE EMBRITTLING
EFFECT OF BISMUTH ON COPPER DECREASES AS THE THALLIUM
CONTENT OF THE WETTING BISMUTH-THALLIUM ALLOY IS
INCREASED. THIS TREND TO HIGHER STRENGTH VALUES
WAS CORRELATED WITH THE CORRESPONDING INCREASE IN
INTERFACIAL ENERGIES FOR THE COPPER-BISMUTH-THALLIUM
SYSTEM. THE EMBRITTLEMENT OF SOLID COPPER MAY BE
RELATED TO REDUCTIONS IN SURFACE ENERGY REQUIREMENTS
NEEDED FOR CRACK PROPAGATION AS A RESULT OF THE
PRESENCE OF THE LIQUID METAL. HOWEVER, DEVIATIONS
NOTED IN THE RELATIONSHIP BETWEEN WETTED FRACTURE
STRENGTH VALUES AND INTERFACIAL ENERGIES SUGGEST THAT
EMBRITTLEMENT BEHAVIOR CANNOT BE EXPLAINED FULLY ON
THE BASIS OF INTERFACIAL ENERGIES ALONE. (AUTHOR)

(U)

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-632 072 11/6 13/8 13/10
NAVY MARINE ENGINEERING LAB ANNAPOLIS MD

PROPERTIES OF THE WELD HEAT-AFFECTED ZONE IN HY-130/
150 STEEL. (U)

DESCRIPTIVE NOTE: RESEARCH AND DEVELOPMENT PHASE REPT.,
APR 66 15P HOLSBERG, P. W. ; SCHREITZ, W. G. ;
REPT. NO. MEL-87/66,
PROJ: S-F020-01-05,
TASK: 0728;

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*STEEL, *WELDABILITY),
(*METALLOGRAPHY, STEEL), (*EMBRIITLEMENT,
STEEL), IRON ALLOYS, NICKEL ALLOYS, CHROMIUM
ALLOYS, MOLYBDENUM ALLOYS, VANADIUM ALLOYS, SHIP
PLATES, HIGH-TEMPERATURE RESEARCH, WELDING,
THERMAL STRESSES, STRESS RELIEVING, IMPACT TESTS,
MARINE ENGINEERING, SIMULATION, WELDS (U)
IDENTIFIERS: STEEL HY-130/150 (U)

PROPERTIES OF THE WELD HEAT-AFFECTED ZONE,
INCLUDING HOT-CRACKING TENDENCIES AND EFFECTS OF
THERMAL CYCLING ON STRENGTH AND TOUGHNESS, WERE
DETERMINED FOR A 5NI-CR-MO-V STEEL DEVELOPED
AS AN HY-130/150 HULL PLATE ALLOY. THE HOT-
CRACKING TENDENCY OF THE ALLOY WAS LOW. THE YIELD
STRENGTH OF THE HEAT-AFFECTED ZONE WAS EQUIVALENT TO
THAT OF THE BASE METAL. THE CHARPY V-NOTCH
IMPACT STRENGTH OF SAMPLES WHICH HAD RECEIVED DOUBLE
THERMAL CYCLES, SIMULATING MULTIPASS WELDMENTS, WAS
EQUIVALENT TO THAT OF THE BASEPLATE IN BOTH THE AS-
WELDED AND THE STRESS-RELIEVED CONDITIONS. THESE
RESULTS, OBTAINED BY WELD-SIMULATION METHODS, WERE
CONFIRMED BY IMPACT TESTS OF SAMPLES FROM THE HEAT-
AFFECTED ZONE OF ACTUAL WELDMENTS. THE IMPACT
STRENGTH OF THE AS-DEPOSITED WELD METAL WAS LOW
COMPARED TO THE BASEPLATE AND WAS GREATLY REDUCED BY
STRESS-RELIEF TREATMENT. (AUTHOR) (U)

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-633 018 2074 1176
FRANKLIN INST RESEARCH LABS PHILADELPHIA PA

LIQUID METAL EMBRITTLEMENT. PHASE III. A STUDY OF
THE EFFECT OF LIQUID MERCURY ON SLIP ACTIVITY IN
NEAR-SURFACE REGIONS OF ALPHA-BRASS SINGLE
CRYSTALS.

(U)

DESCRIPTIVE NOTE: FINAL TECHNICAL REPT., 1 SEP 65-31
MAR 66,

APR 66 32P ORAVA, R. N. I
REPT. NO. F-82119-2,
CONTRACT: NONR-4425(001),
PROJ: NR-036-056.

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PHASE 3 OF STUDY OF THE PHENOMENON
OF METAL EMBRITTLEMENT.

DESCRIPTORS: (•EMBRITTLEMENT, •LIQUID METALS),
(•DEFORMATION, CRYSTAL LATTICE DEFECTS), BRASS,
MERCURY, ETCHED CRYSTALS, SINGLE CRYSTALS,
FRACTURE(MECHANICS), PLASTICITY

(U)

MICROSTRAIN AND ETCHING EXPERIMENTS WERE CONDUCTED
ON 70/30 BRASS SINGLE CRYSTALS TO DETERMINE THE
EFFECT OF THE PRESENCE OF LIQUID MERCURY AT THE
SURFACE ON DEFORMATION CHARACTERISTICS IN THE EARLY
STAGES OF PLASTIC FLOW. IT WAS REVEALED THAT
DISLOCATIONS BECOME MOBILE AT STRESSES AS LOW AS 0.04
KG/MM- TO THE -2 IN ANNEALED CRYSTALS, A SHARP
CONTRAST TO PREVIOUS OBSERVATIONS. A MODEL IS
PRESENTED TO EXPLAIN THE MICROSTRAIN CHARACTERISTICS.
A DEBRIS LAYER NEAR THE SURFACE WAS OBSERVED TO A
DEPTH OF ABOUT 20 MICRONS AFTER 2 X 10 TO THE -3
PLASTIC SHEAR STRAIN, IRRESPECTIVE OF THE PRESENCE OF
MERCURY. THUS, LIQUID MERCURY IS EQUALLY AS
EFFECTIVE AS AN OXIDE FILM IN IMPEDING THE EMERGENCE
OF DISLOCATIONS FROM A CRYSTAL. SINCE THE DEGREE
TO WHICH THIS TYPE OF BEHAVIOR INHIBITS CRACK
RELAXATION COULD NOT BE DETERMINED, IT WAS NOT
POSSIBLE TO RIGOROUSLY ESTABLISH THIS AS THE
MECHANISM FOR LIQUID METAL EMBRITTLEMENT.
(AUTHOR)

(U)

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-635 844 18/10 18/8 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS I
FEBRUARY - 30 APRIL 1966. (U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT.
MAY 66 63P STEELE,LENDELL E. ;
HAWTHORNE ,RUSSELL J. ;SERPAN,CHARLES Z. ,
JR.;
REPT. NO. NRL-MR-1700,
CONTRACT: AT(49-5)-2110.
PROJ: RR007-01-46-5409,SFO20-01-05-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-630 937.

DESCRIPTORS: (*REACTOR MATERIALS; STEEL), (*STEEL,
RADIATION DAMAGE), (*RADIATION DAMAGE, REACTOR
MATERIALS); NICKEL ALLOYS, EMBRITTLEMENT;
DUCTILITY, CHROMIUM ALLOYS, MOLYBDENUM ALLOYS,
STRESS RELIEVING, SENSITIVITY, MICROSTRUCTURE,
STAINLESS STEEL, NOTCH SENSITIVITY, HEAT
TREATMENT, TRANSITION TEMPERATURE, NEUTRONS (U)
IDENTIFIERS: STEEL A302-B (U)

THE INVESTIGATION INCLUDES THE FOLLOWING: (1)
THE RELATIVE RADIATION SENSITIVITY OF A302-B
STEELS PREPARED BY SPECIAL MELTING AND HEAT TREATMENT
PRACTICE, (2) THE EVALUATION OF NICKEL CONTENT
AS A RADIATION SENSITIVITY VARIABLE, (3)
COMPARATIVE IRRADIATION ENBRITTLEMENT OF SELECTED
HIGHER STRENGTH STEELS, AND (4) THE EFFECT OF
NEUTRON SPECTRA UPON THE OBSERVED CHANGES IN THE
NOTCH DUCTILITY OF IRRADIATED STEELS. (AUTHOR)
(U)

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DDG REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

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AEROSPACE TECHNOLOGY DIV LIBRARY OF CONGRESS WASHINGTON, D.
C

LIQUID-METAL EMBRITTLEMENT: ANNOTATED
BIBLIOGRAPHY.

(U)

DESCRIPTIVE NOTE: REPT. NO. 1 ON ATD WORK ASSIGNMENT NO.
89/b.

APR 66 25P
REPT. NO. ATD-66-38,
MONITOR: TT 66-62135

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (•LIQUID METALS, •EMBRITTLEMENT),
METALLOGRAPHY, COPPER ALLOYS, STEEL, CORROSION,
MECHANICAL PROPERTIES, ZINC, MERCURY,
CRYSTALLOGRAPHY, BIBLIOGRAPHIES, USSR

(U)

THE BIBLIOGRAPHY WAS COMPILED FROM SOVIET OPEN
SOURCES PUBLISHED 1959-1965 WITH ONE ENTRY FROM
JANUARY 1966. IT IS THE FIRST REPORT IN THIS
SERIES. THE 52 ENTRIES ARE ARRANGED
CHRONOLOGICALLY AND, WITHIN EACH YEAR, ALPHABETICALLY
BY AUTHOR: 1959 (1 ENTRY), 1961 (6
ENTRIES), 1963 (21 ENTRIES), 1964 (3
ENTRIES), 1965 (14 ENTRIES), AND 1966 (1
ENTRY). AN AUTHOR INDEX IS PROVIDED AT THE END OF
THE REPORT. PERTINENT INFORMATION INCLUDED:
COPPER ALLOY TESTING IN MERCURY SALT SOLUTION, CREEP
PROCESS, DIFFUSION AND SOLUBILITY COEFFICIENTS OF
MOLTEN METALS, POLYCRYSTALLINE METAL, TIN
RECRYSTALLIZATION, ALLOY STEEL NONSELECTIVE
CORROSION, SURFACE TENSION REDUCTION IN SOLID METALS,
SOFTENING ACTION OF AGGRESSIVE MELTS ON SOLID METAL,
STEEL CYCLIC TORSION IN LOW-MELTING METALS,
ADSORPTION-INDUCED REDUCTION OF STRENGTH, IRRADIATION
EFFECT ON MECHANICAL PROPERTIES, ANISOTROPY OF
ELECTRON AND GAMMA IRRADIATION EFFECT ON DEFORMATION
PROCESS, METAL CORROSION FATIGUE, EFFECT OF LOW
MELTING COATING ON MECHANICAL PROPERTIES OF METALS,
METAL DIFFUSION IN LIQUID COPPER. (AUTHOR)

(U)

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-639 481 11/6
STANFORD RESEARCH INST MENLO PARK CALIF

EMBRITTLEMENT BY LIQUID METALS.

(U)

DESCRIPTIVE NOTE: FINAL REPT., 1 MAR 64-28 FEB 66,
FEB 66 10P GOGGIN, W. R. MOBERLY, J. W. I
CONTRACT: NONR-4408(00)
PROJ: NR-U36-058,

UNCLASSIFIED REPORT

AVAILABILITY: PUBLISHED IN TRANSACTIONS QUARTERLY
V59 N2 P315-23 JUN 2 1966.
SUPPLEMENTARY NOTE:

DESCRIPTORS: (*ALUMINUM, EMBRITTLEMENT),
(*EMBRITTLEMENT, LIQUID METALS), GALLIUM, FOILS,
FRACTURE(MECHANICS), SINGLE CRYSTALS, ELECTRON
MICROSCOPY

(U)

THE ALUMINUM-LIQUID GALLIUM EMBRITTLEMENT COUPLE WAS STUDIED USING TECHNIQUES OF TRANSMISSION ELECTRON MICROSCOPY. SINGLE AND POLYCRYSTALLINE ALUMINUM FOILS WERE WETTED WITH LIQUID GALLIUM AND TESTED USING A TENSILE DEVICE IN AN ELECTRON MICROSCOPE. THE INFLUENCE OF THE LIQUID GALLIUM ON THE FRACTURE BEHAVIOR OF ALUMINUM WAS OBSERVED. POLYCRYSTALLINE ALUMINUM CAN FAIL WHEN WETTED WITH LIQUID GALLIUM BY A GRAIN BOUNDARY PENETRATION OF THE METAL BY THE LIQUID. THIS IS A SLOW-FAILURE PROCESS AND IS OBSERVED TO OCCUR WITH OR WITHOUT EXTERNAL LOADING. IN BOTH ANNEALED AND COLD WORKED ALUMINUM. HOWEVER, IF SUFFICIENT TENSILE STRESSES ARE APPLIED, POLYCRYSTALLINE ALUMINUM CAN ALSO FAIL IN A CATASTROPHIC MANNER WITH A HIGH CRACKING VELOCITY ALONG INTERGRANULAR PATHS. LIQUID GALLIUM IS NECESSARY FOR BOTH CRACK NUCLEATION AND PROPAGATION. THE CRACK WAS ALWAYS OBSERVED TO INITIATE IN REGIONS WHERE GRAIN BOUNDARY PENETRATION OF THE ALUMINUM HAD OCCURRED. THIN LAYERS OF LIQUID METAL WERE ALWAYS DETECTED ALONG THE FRESH FRACTURE SURFACE. IF INSUFFICIENT GALLIUM WAS PRESENT, THE CRACK WOULD BECOME BLUNTED AND THE METAL WOULD EVENTUALLY EXPERIENCE DUCTILE FAILURE, CHARACTERISTIC OF UNWETTED ALUMINUM. ALUMINUM SINGLE CRYSTALS NEARLY ALWAYS FAIL IN A DUCTILE MANNER, EVEN WHEN AN ABUNDANT SUPPLY OF LIQUID GALLIUM IS AVAILABLE. THE LIQUID GALLIUM CAN INITIATE MICROCRACKS IN SINGLE-CRYSTAL ALUMINUM, BUT THE CRACKS DO NOT PROPAGATE IN THE BRITTLE MANNER OBSERVED IN POLYCRYSTALLINE ALUMINUM. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-639 567 11/6 14/4 13/10
PACIFIC NAVAL LAB ESQUIMALT (BRITISH COLUMBIA)

RELIABILITY AND CORROSION.

(U)

66 12P BAREK, R. D. ;
REPT. NO. REPRINT-66-2,

UNCLASSIFIED REPORT
AVAILABILITY: PUBLISHED IN NAVAL ENGINEERS
JOURNAL P321-33; APR 1966.
SUPPLEMENTARY NOTE:

DESCRIPTORS: (*CORROSION, RELIABILITY), ALUMINUM
ALLOYS, CASTING ALLOYS, STRESS CORROSION, PIPES,
EMBRITTLEMENT, CATHODIC PROTECTION, STAINLESS
STEEL, BRASS, FATIGUE (MECHANICS), MARINE
ENGINEERING, CANADA, CORROSION INHIBITION

(U)

THE EXAMPLES GIVEN AND DISCUSSED ARE FAR FROM AN
EXHAUSTIVE TREATMENT OF HAZARDS BETWEEN DESIGN OFFICE
AND FIELD EXECUTION, OF THE NEED FOR ATTENTION TO
DETAIL AND OF THE WEAKNESSES INHERENT IN SOME ALLOYS,
OF THE IMPORTANCE OF CORRECT DIAGNOSIS AND FINALLY,
THAT IN SOME CASES RELIABILITY CAN BE RESTORED.
RELIABILITY IS NOT SIMPLE-IT REQUIRES AN ATTENTION
TO DETAIL IN CHOICE OF MATERIAL AND IN DESIGN. IT
DEMANDS AN UNDERSTANDING OF CORROSION MECHANISMS.
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-639 668

11/74

ILLINOIS UNIV URBANA DEPT OF THEORETICAL AND APPLIED
MECHANICS

MECHANISMS OF ENVIRONMENT INDUCED SUBCRITICAL FLAW
GROWTH IN AISI 4340 STEEL, (U)

DESCRIPTIVE NOTE: INTERIM TECHNICAL REPT.,
SEP 66 47P VAN DER SLUYS, WILLIAM A. N

REPT. NO. T/AM-292,
CONTRACT: DA-31-124-ARO(D)-378,
PROJ: DA-20014501B320,
MONITOR: AROU 5612:1

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*STEEL, *FRACTURE(MECHANICS)),
HYDROGEN ENBRITTELEMENT, CORROSION, ENBRITTELEMENT,
ENVIRONMENTAL TESTS, STRESS CORROSION, LIQUID
IMMERSION TESTS, WATER (U)
IDENTIFIERS: STEEL 4340 (U)

RESULTS OF AN EXPERIMENT DESIGNED TO STUDY THE
EFFECT OF SEVERAL VARIABLES ON SUBCRITICAL CRACK
GROWTH RATE OF A HIGH-STRENGTH STEEL IN A WATER
ENVIRONMENT ARE PRESENTED. ENVIRONMENTAL VARIABLES
INCLUDED TEMPERATURE, PH OF THE LIQUID ENVIRONMENT,
ELECTRIC CHARGING, AND THE COMBINED EFFECT OF PH
AND ELECTRIC CHARGING. TAPERED DOUBLE CANTILEVER
BEAM SPECIMENS WERE DESIGNED SO THAT THE LEVEL WAS
MAINTAINED CONSTANT AT A CONSTANT LOAD AND
INDEPENDENT OF CRACK LENGTH. THUS STEADY-STATE
CRACK GROWTH MEASUREMENTS WERE POSSIBLE IN CONSTANT
LOAD AND CONSTANT ENVIRONMENT EXPERIMENTS. WITH
THIS SPECIMEN DESIGN, IT WAS POSSIBLE TO MAKE A
SERIES OF MEASUREMENTS THAT COVERED THE ENTIRE RANGE
OF EFFECTS OF A PARTICULAR VARIABLE USING ONLY ONE
SPECIMEN. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-639 748 18/8 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

DAMAGING NEUTRON EXPOSURE CRITERIA FOR EVALUATING THE
EMBRITTLEMENT OF REACTOR PRESSURE VESSEL STEELS IN
DIFFERENT NEUTRON SPECTRA. (U)

DESCRIPTIVE NOTE: INTERIM REPT.,
JUL 66 31P SERPAN, CHARLES Z. , JR. ;
STEELE, LENDELL E. ;
REPT. NO. NRL-6415,
CONTRACT: AT(49-5)-2110,
PROJ: RR007-01-46-5409, SFD20-01-25-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE),
EMBRITTLEMENT, PRESSURE VESSELS, REACTOR MATERIALS,
NEUTRON FLUX, NUCLEAR REACTORS, DETERMINATION,
TRANSITION TEMPERATURE (U)

SEVERAL SUCH EXPOSURE CRITERIA HAVE BEEN EVALUATED THROUGH USE OF THE RESULTS OF METALLURGICAL TESTS OF REFERENCE STEEL SPECIMENS AFTER IRRADIATION IN LIGHT AND HEAVY WATER MODERATED REACTOR ENVIRONMENTS AS WELL AS IN GRAPHITE MODERATED REACTOR ENVIRONMENTS. THE RADIATION-INDUCED TRANSITION TEMPERATURE OR NIL-DUCTILITY TRANSITION (NDT) TEMPERATURE INCREASES OF THE SEVERAL STEELS INVOLVED ARE PRESENTED VERSUS N/CM² DETERMINED BY EACH OF THE FOLLOWING TECHNIQUES: (A) ASSUMPTION OF A FISSION SPECTRUM, EXTRAPOLATION OF ACTIVATION DATA INDUCED AT A HIGH MEV THRESHOLD TO 1 MEV, AND REPORTING EXPOSURE > 1 MEV, AND (B) CALCULATION OF SPECTRA USED TO DETERMINE ACTIVATION CROSS SECTION FOR EXPOSURES ABOVE ENERGY LIMITS OF 1, 0.5, AND 0.183 MEV. THE DIFFERENCES OBSERVED BY THIS ANALYSIS WERE INTERCOMPARED IN RELATION TO ABSOLUTE MAGNITUDE AS WELL AS IN TERMS OF ENGINEERING SIGNIFICANCE. BY APPLYING THESE CRITERIA TO DATA RELATING DIRECTLY TO A PRESSURIZED LIGHT WATER POWER REACTOR, BENEFITS TO THE LIFETIME OF THE REACTOR CAN BE REALIZED. THE RESULTS OF THIS STUDY TO DATE INDICATE THAT DATA RELATING TO THE PROPERTIES OF STEELS IRRADIATED IN OR NEAR THE CORE OF PRESSURIZED LIGHT WATER MODERATED REACTORS CAN BE CONFIDENTLY INTERCOMPARED FOR ENGINEERING APPLICATIONS ASSUMING A FISSION SPECTRUM AND ACCOUNTING FOR NEUTRONS OF ENERGIES > 1 MEV.

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-639 835 18/10 - 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS. (U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT., 1 MAY-31
JUL 66.

AUG 66 39P STEELE,LENDELL E. ;
HAWTHORNE,JO. RUSSELL ;GRAY,ROBERT A. , JR. ;
KLIER,EUGENE P. ;SERPAN,CHARLES Z. , JR. ;
REPT. NO: NRL-MR-1719,
PROJ: RR007-01-45-5409,SF-020-01-05-0898

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: RESEARCH SUPPORTED IN PART BY AEC
CONTRACT AT(49-5)-2110.

DESCRIPTORS: (*RADIATION DAMAGE, *REACTOR
MATERIALS), (*REACTOR SYSTEM COMPONENTS, REACTOR
MATERIALS), STEEL, EMBRITTLEMENT, TENSILE
PROPERTIES (U)

THE RESEARCH PROGRAM OF THE NRL METALLURGY
DIVISION, REACTOR MATERIALS BRANCH, IS
DEVOTED TO THE DETERMINATION OF THE EFFECTS OF
NUCLEAR RADIATION UPON THE PROPERTIES OF STRUCTURAL
MATERIALS. THE OVERALL PROGRAM IS SPONSORED BY THE
OFFICE OF NAVAL RESEARCH, THE NAVAL SHIP
SYSTEMS COMMAND, THE U. S. ATOMIC ENERGY
COMMISSION, AND THE ARMY NUCLEAR POWER
PROGRAM. SINCE RESEARCH FINDINGS WHICH APPLY TO
THE OBJECTIVES OF ONE SPONSORING AGENCY ARE ALSO OF
INTEREST TO THE OTHERS, THE OVERALL PROGRAM PROGRESS
IS REPORTED HEREIN. THIS REPORT INCLUDES THE
FOLLOWING: (1) RESULTS OF A COMPARATIVE
IRRADIATION OF WELD HEAT AFFECTED ZONE AND BASE METAL
SPECIMENS OF HY-80 STEEL, (2) PRELIMINARY DATA
ON THE NOTCH DUCTILITY CHARACTERISTICS OF IRRADIATED
MARAGING AND NICKEL-COBALT STEELS, (3) TENSILE
PROPERTIES OF SELECTED STEELS HAVING POTENTIAL FOR
NUCLEAR STRUCTURAL APPLICATION, (4) IRRADIATION
DAMAGE SURVEILLANCE RESULTS FROM SPECIMENS EXPOSED
NEAR THE YANKEE REACTOR PRESSURE VESSEL, AND
(5) DESCRIPTION OF THE RECENTLY COMPLETED
METALLOGRAPHIC CELL OF THE NRL HIGH LEVEL
RADIATION LABORATORY. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-640 615 18/8 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

NEUTRON IRRADIATION EMBRITTLEMENT OF SEVERAL HIGHER
STRENGTH STEELS, (U)

SEP 66 22P STEELE,LENDELL E. ?
HAWTHORNE, J. RUSSELL GRAY, ROBERT A. , JR.
REPT. NO. NRL-6419,
CONTRACT: AT(49-5)-2110,
PROJ: R-007-U1-46-5409, SF020-01-05-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE), MARAGING
STEELS, TRANSITION TEMPERATURE, PRESSURE VESSELS,
EMBRITTLEMENT, NEUTRONS, PRESSURIZED WATER
REACTORS, DUCTILITY, MECHANICAL PROPERTIES (U)

SEVERAL STEELS REPRESENTATIVE OF RECENTLY DEVELOPED
TYPES AND HAVING POTENTIAL FOR NUCLEAR STRUCTURAL
APPLICATIONS WERE EXPOSED TO HIGH ENERGY NUCLEAR
RADIATION, AND THE RESULTANT PROPERTIES WERE COMPARED
WITH THOSE OF THE CURRENTLY USED A212-B AND
A302-B NUCLEAR REACTOR PRESSURE VESSEL STEELS.
PRELIMINARY RESULTS FROM SEVERAL COMPARATIVE
IRRADIATION EXPERIMENTS INDICATE THAT CERTAIN HIGHER
STRENGTH STEELS, IN ADDITION TO HAVING INITIAL
QUALITIES OF HIGHER STRENGTH AND LOWER INITIAL
DUCTILE-BRITTLE TRANSITION TEMPERATURES, SHOW SMALLER
EMBRITTLEMENT, EARLIER EMBRITTLEMENT SATURATION, AND
A SUPERIOR OVERALL RESPONSE TO IRRADIATION AT 550F
THAN THAT OBSERVED FOR THE STEELS IN CURRENT REACTOR
PRESSURE VESSELS. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-641 283 18/10 18/12
NAVAL RESEARCH LAB WASHINGTON D C

NEUTRON SPECTRAL CONSIDERATIONS AFFECTING PROJECTED
ESTIMATES OF RADIATION EMBRITTLEMENT OF THE ARMY SM-
1A REACTOR PRESSURE VESSEL. (U)

DESCRIPTIVE NOTE: FINAL REPT.,
SEP 66 SERPAN, C. Z. JR.; STEELE, L. E.

REPT. NO. NRL-6474,
PROJ: USA-ERG-4-66,

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE:

DESCRIPTORS: (*EMBRITTLEMENT, STEEL), (*PRESSURE
VESSELS, *PRESSURIZED WATER REACTORS), (*RADIATION
DAMAGE, *STEEL), REACTOR MATERIALS, NEUTRON
REACTIONS, POWER REACTORS, ARMY, ALASKA (U)
IDENTIFIERS: ARMY REACTORS(SM-1A) (U)

THE PRESSURE VESSEL OF THE ARMY SM-1A REACTOR
IS LOCATED CLOSE TO THE ACTIVE CORE IN SUCH A MANNER
THAT THE NEUTRON EXPOSURE IS RELATIVELY HIGH.
CONSEQUENTLY, THE PRESSURE VESSEL STEEL UNDERGOES A
RELATIVELY RAPID RISE IN THE DUCTILE-BRITTLE
TRANSITION TEMPERATURE. THE MAXIMUM PERMISSIBLE
DELTA NDT FOR THE SM-1A IS ESTABLISHED BY THE
ARMY AS 340F. SINCE IT IS PHYSICALLY IMPOSSIBLE
TO IRRADIATE SURVEILLANCE TEST SPECIMENS AT THE SM-
1A VESSEL WALL, ONLY THE NEUTRON FLUX WAS MEASURED
AT THE WALL, AND REPRESENTATIVE TEST SPECIMENS WERE
IRRADIATED IN A TEST REACTOR, THE LOW INTENSITY
TEST REACTOR (LITR). IN TRANSLATING THE DELTA
NDT VERSUS NEUTRON EXPOSURE DATA FROM THE LITR TO
THE CASE OF THE SM-1A REACTOR VESSEL WALL, THE
NEUTRON SPECTRA OF THE TWO REACTORS WERE USED TO
ADJUST BOTH THE SM-1A REACTOR VESSEL FLUX AND THE
LITR EXPOSURE VALUES IN TERMS OF $N/SQ\ CM < 1.0 \times 10^5$
0.5, AND 0.183 MEV. SINCE THE DISTRIBUTION OF
NEUTRONS BY ENERGY GROUPS WAS DIFFERENT WITHIN EACH
REACTOR AT THE SPECIFIC LOCATION OF INTEREST, THAT
IS, THE VESSEL WALL OF THE SM-1A AND AN IN-CORE
LOCATION OF THE LITR, THE DAMAGING POTENTIAL OF THE
SM-1A REACTOR SPECTRUM LOCATION WAS RELATED TO
THAT OF THE LITR, WITH DAMAGE EQUIVALENCE
ESTABLISHED BETWEEN THE TWO REACTORS, A CRITICAL
NEUTRON EXPOSURE ($N/SQ\ CM > 0.5\ MEV$) MAY BE
PROJECTED FOR PRODUCING THE MAXIMUM DELTA NDT ON
THE SM-1A REACTOR VESSEL WALL. (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-641 315 11/6
ROYAL AIRCRAFT ESTABLISHMENT FARNBOROUGH (ENGLAND)

A STUDY OF THE SIZE EFFECT IN THE PLATING
EMBRITTLEMENT OF HIGH STRENGTH STEELS. (U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JUN 66 22P DAVIS, H. C. GRAY, JOSEPHINE

A. ?
REPT. NO. TR-66168

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, EMBRITTLEMENT), PLATING,
CADMIUM, NICKEL ALLOYS, CHROMIUM ALLOYS,
MOLYBDENUM ALLOYS, VANADIUM ALLOYS,
LOADING(MECHANICS), TESTS, LIFE EXPECTANCY,
STRESSES, FRACTURE(MECHANICS), GREAT BRITAIN (U)

THE REPORT DESCRIBES SUSTAINED LOAD TESTS MADE ON
CADMIUM PLATED NOTCHED (K SUB T = 3.2)
SPECIMENS 1/4 IN AND 1 IN DIAMETER. TWO STEELS
WERE STUDIED, EN 24 AND NCMV HEAT TREATED TO 120
TON/SQ IN TS. THE RESULTS SHOWED THAT EN 24 WAS
VERY SUSCEPTIBLE TO PLATING EMBRITTLEMENT, THE
MAXIMUM STRESS FOR UNLIMITED LIFE BEING IN THE REGION
OF 43 TON/SQ IN (308 NTS). NCMV STEEL WAS FOUND
TO BE LESS SENSITIVE HAVING A CORRESPONDING VALUE OF
62-70 TON/SQ IN (40 TO 458 NTS). COMPARATIVE
TESTS ON NCMV STEEL SHOWED NO SIGNIFICANT
DIFFERENCE BETWEEN THE LIVES OF LARGE AND SMALL
SPECIMENS. IN DETERMINING THE LIFE UNDER SUSTAINED
LOAD, A MINIMUM TESTING TIME OF 500 HR WAS FOUND TO
BE NECESSARY. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL No. 1ZBML1

AD-642 290 11/6 18/8 18/10
NAVAL RESEARCH LAB WASHINGTON D C

INITIAL EVALUATIONS OF METALLURGICAL VARIABLES AS
POSSIBLE FACTORS CONTROLLING THE RADIATION
SENSITIVITY OF STRUCTURAL STEELS, (U)

SEP 66 40P HAWTHORNE, J. R. STEELE, L. E.

REPT. NO. NRL-6420
CONTRACT: AT(49-5)-2110
PROJ: KRUC-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE), REACTOR
MATERIALS, PRESSURE VESSELS, SENSITIVITY,
DUCTILITY, EMBRITTLEMENT, NEUTRONS, HEAT
TREATMENT, MICROSTRUCTURE (U)
IDENTIFIERS: STEEL A302-B (U)

EXPERIMENTAL INVESTIGATIONS FOR THE ISOLATION AND
ASSESSMENT OF METALLURGICAL FACTORS CAUSING VARIABLE
RADIATION EMBRITTLEMENT SENSITIVITY OF REACTOR
STRUCTURAL STEELS WERE UNDERTAKEN, USING BOTH LARGE-
TONNAGE COMMERCIAL HEATS AND SPECIAL LABORATORY HEATS
OF STEEL. METALLURGICAL VARIABLES BEING EVALUATED
INCLUDE THE IDENTITY AND QUANTITY OF MAJOR ALLOYING
ELEMENTS AND OF RESIDUAL ELEMENTS, STEEL-MAKING
PRACTICE--BOTH MELTING (REFINING) AND HEAT
TREATMENT PRACTICE, MICROSTRUCTURE, AND GAS CONTENT.
EXPERIMENTAL RESULTS FROM THE INITIAL SERIES OF THE
EXPLORATORY SCREENING STUDIES DEMONSTRATE THAT THE
RADIATION SENSITIVITY OF A STEEL CAN BE ALTERED
APPRECIABLY THROUGH HEAT TREATMENT PRACTICES AND THAT
MICROSTRUCTURE PLAYS A DOMINANT, IF NOT THE MOST
INFLUENTIAL, ROLE IN RADIATION SENSITIVITY
DEVELOPMENT. A TEMPERED MARTENSITE STRUCTURE WAS
NOTED TO BE GENERALLY LESS RADIATION SENSITIVE THAN
TEMPERED UPPER BAINITE AND FERRITE STRUCTURES. THE
DATA ALSO INDICATE THAT VACUUM MELTING AND THE
MINIMIZATION OF RESIDUAL ELEMENT CONTENT YIELDS
STEELS HAVING A SUPERIOR IRRADIATION PERFORMANCE
COMPARED WITH STEELS PRODUCED BY CONVENTIONAL OPEN
HEARTH MELTING. HOWEVER, LONG-TERM STRESS
RELIEVING HEAT TREATMENTS WERE NOT FOUND TO ALTER THE
IRRADIATION RESPONSE OF A302-B STEEL.
(AUTHOR) (U)

CLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-643 082 11/6
ARMY MATERIALS RESEARCH AGENCY WATERTOWN MASS

MECHANICAL PROPERTIES AND FRACTURE SURFACE TOPOGRAPHY
OF A THERMALLY EMBRITTLED STEEL. (U)

DESCRIPTIVE NOTES: TECHNICAL REPT.,
SEP 66 36P GARR, FRANK L. ; NUNES, JOHN ;
LARSON, FRANK R. ;
REPT. NO. AMRA-TR-66-26
PROJ: DA-1A010501B010

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, EMBRITTLEMENT), MECHANICAL
PROPERTIES, FRACTURE (MECHANICS), TENSILE
PROPERTIES, FRACTOGRAPHY, DUCTILITY, GRAIN
STRUCTURES (METALLURGY), BRITTLENESS, IMPACT TESTS,
NOTCH SENSITIVITY (U)
IDENTIFIERS: STEEL 3140 (U)

TENSILE FLOW AND FRACTURE PROPERTIES OF 3140 STEEL
IN BOTH THE UNEMBRIITLED AND EMBRITTLED CONDITIONS
ARE PRESENTED AND DISCUSSED. CHARPY IMPACT
PROPERTIES WHICH REFLECT THE INFLUENCE OF THERMAL
EMBRITTLEMENT ON THE TRANSITIONAL BEHAVIOR ARE
PRESENTED. FRACTURE SURFACE TOPOGRAPHY IS
DESCRIBED. QUANTITATIVE DATA RESULTED IN
TRANSITIONAL CURVES FOR ALL THREE TYPES OF SPECIMENS
UTILIZED. THIS FRACTURE SURFACE TOPOGRAPHY ALSO
INDICATES THAT INTERGRANULAR FRACTURE HAS VARYING
DEGREES OF DEFORMATION, DUCTILITY, AND ENERGY
REQUIRED FOR SEPARATION. SEVERAL ASPECTS OF
THERMAL EMBRITTLEMENT ARE DISCUSSED RELATIVE TO THE
OBSERVATIONS MADE IN THIS STUDY. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-646 662 18/10 11/6 18/8
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS. (U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT., 1 AUG-31
OCT 66.

NOV 66 3UP STEELE, L. E. HAWTHORNE, J. R.
SERPAN, C. L. GRAY, R. A. ;
REPT. NO. NRL-MR-1731
PROJ. RR-007-01-46-5409 , SF-U20-01-05-0058

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-669 839.

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE),
(*REACTOR MATERIALS, RADIATION DAMAGE), STAINLESS
STEEL, NICKEL ALLOYS, CHROMIUM ALLOYS, MOLYBDENUM
ALLOYS, WELDS, EMBRITTLEMENT, STRUCTURAL PARTS,
DUCTILITY, NUCLEAR RADIATION (U)

THE RESEARCH PROGRAM OF THE NRL METALLURGY
DIVISION, REACTOR MATERIALS BRANCH, IS
DEVOTED TO THE DETERMINATION OF THE EFFECTS OF
NUCLEAR RADIATION UPON THE PROPERTIES OF STRUCTURAL
MATERIALS. THE OVERALL PROGRAM IS SPONSORED BY THE
OFFICE OF NAVAL RESEARCH, THE NAVAL SHIP
SYSTEMS COMMAND, THE U. S. ATOMIC ENERGY
COMMISSION, AND THE ARMY NUCLEAR POWER
PROGRAM. SINCE RESEARCH FINDINGS WHICH APPLY TO
THE OBJECTIVES OF ONE SPONSORING AGENCY ARE ALSO OF
INTEREST TO THE OTHERS, THE OVERALL PROGRAM PROGRESS
IS REPORTED HEREIN. THIS REPORT, COVERING RESEARCH
FOR THE PERIOD 1 AUGUST - 31 OCTOBER 1966,
INCLUDES THE FOLLOWING: (1) A COMPARATIVE
RESPONSE OF A302-B AND SEVERAL HIGHER STRENGTH
STEELS AFTER IRRADIATION AT 200F AND AT 550F, (2)
A COMPARATIVE EVALUATION OF THE NOTCH
DUCTILITY OF 3-1/2%Ni-CR-MO WELD AND BASE PLATE
AFTER IRRADIATION AT 200F AND AT 550F, (3) THE
NOTCH DUCTILITY CHARACTERISTICS OF IRRADIATED AISI
304L AND 347 STAINLESS STEELS AFTER EXPOSURE TO 1
AND 10 X 10 TO THE 19TH POWER, (4) THE RESPONSE
OF A350-LF1 (MODIFIED) STEEL TO CYCLIC
IRRADIATION AND ANNEALING TREATMENT, AND (5) THE
THROUGH-THICKNESS EMBRITTLEMENT AND NEUTRON FLUX
VARIATIONS IN A SIMULATED WALL OF A REACTOR PRESSURE
VESSEL. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-650 204 11/6
FRANKFORD ARSENAL PHILADELPHIA PA PITMAN-DUNN RESEARCH
LABS

THE EFFECT OF GRAIN BOUNDARY PENETRATION ON THE
DELAYED FAILURE OF CU-28 BE,

(U)

JUN 66 12P RINNOVATORE, JAMES V. I
CORRIE, JOHN D. ; MARKUS, HAROLD ;
PROJ: DA-1C014501B32A
MONITOR: FA A66-17

UNCLASSIFIED REPORT
AVAILABILITY: PUBLISHED IN TRANSACTIONS QUARTERLY
V59 N4 P665-71 DEC 1966.

DESCRIPTORS: (*COPPER ALLOYS,
*FAILURE(MECHANICS)), BERYLLIUM ALLOYS, LIQUID
METALS, GRAIN BOUNDARIES, PENETRATION,
EMBRITTLEMENT

(U)

THE DELAYED FAILURE CHARACTERISTICS OF CU-28
BE IN THE PRESENCE OF A HG-28 NA AMALGAM WAS
STUDIED. IT WAS SHOWN THAT GRAIN BOUNDARY
PENETRATION OCCURS IN DELAYED FAILURE AND THAT A
CRITICAL DEPTH OF PENETRATION IS NECESSARY FOR
EMBRITTLEMENT. IT WAS ALSO SHOWN THAT THE CRITICAL
DEPTH OF PENETRATION IS RELATED INVERSELY TO THE
APPLIED STRESS. GRAIN BOUNDARY PENETRATION,
HOWEVER, WAS NOT SUFFICIENT BY ITSELF TO PRODUCE
EMBRITTLEMENT. ALTHOUGH THE CONCEPT THAT A
CRITICAL DEPTH OF PENETRATION IS NECESSARY TO PRODUCE
EMBRITTLEMENT IS VALID, IT WAS SHOWN THAT THE
GRIFFITH EQUATION OF CRACK PROPAGATION IS NOT
DIRECTLY APPLICABLE TO THE PHENOMENON OF DELAYED
FAILURE. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-650 349 18/10 18/8 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY REPT. NO. 7, 1 NOV 66-31
JAN 67,

FEB 67 45P HAWTHORNE, J. R. ; SERFAN, C.
Z. , JR. ; WATSON, H. E. ; GRAY, R. A. ; JKI
REPT. NO. NRL-MR-1753
PROJ: RR-007-01-46-5409; SF-020-01-05-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-646 662.

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*RADIATION DAMAGE, *REACTOR MATERIALS),
EMBRIITLEMENT, NEUTRONS, DUCTILITY, TENSILE
PROPERTIES, STRESSES

(U)

IDENTIFIERS: STAINLESS STEEL A302-B

(U)

THE REPORT, COVERING RESEARCH FOR THE PERIOD 1
NOVEMBER 1966-31 JANUARY 1967, INCLUDES THE
FOLLOWING: (1) EXPERIMENTAL A302-B STEEL
HEATS INSENSITIVE TO 550F IRRADIATION, (2)
RADIATION EMBRIITLEMENT OF STEELS UNDER CYCLIC VERSUS
CONSTANT TEMPERATURE EXPOSURE CONDITIONS, (3)
EFFECTS OF APPLIED STRESS DURING IRRADIATION ON THE
NOTCH DUCTILITY OF A302-B STEEL, (4) TENSILE
PROPERTY CHANGES THROUGH THE WALL THICKNESS OF A
SIMULATED REACTOR PRESSURE VESSEL, (5)
COMPARISON OF NEUTRON FLUX VALUES FOR FISSION VERSUS
THRESHOLD-TYPE MONITORS, AND (6) EQUIPMENT AND
PROCEDURES DEVELOPED FOR ELEVATED TEMPERATURE REMOTE
TENSION TESTING OF RADIOACTIVE SPECIMENS.
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-651 066 11/6
ARMY MATERIALS RESEARCH AGENCY WATERTOWN MASS

TEMPERED MARTENSITE EMBRITTLEMENT AND FRACTURE
TOUGHNESS IN 4340 STEEL.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JAN 67 29P KULA, ERIC B. JANCTIL,
ALBERT A. J.
REPT. NO. AMRA-TR-67-03
PROJ: DA-1C024401A328

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *EMBRITTLEMENT),
MARTENSITE, FRACTURE MECHANICS), TOUGHNESS,
TENSILE PROPERTIES
IDENTIFIERS: STEEL 4340

(U)

(U)

TEMPERED MARTENSITE EMBRITTLEMENT (500 F
EMBRITTLEMENT) WAS STUDIED IN 4340 STEEL BY MEANS
OF CHARPY IMPACT, TENSION, AND FRACTURE TOUGHNESS
TESTS CARRIED OUT OVER A RANGE OF TEST TEMPERATURES.
EMBRITTLEMENT WAS SHOWN IN THE IMPACT TESTS BY A
MINIMUM IN ROOM TEMPERATURE IMPACT PROPERTIES FOR
TEMPERING TEMPERATURES RANGING FROM 500 TO 650 F,
THE SAME RANGE FOR WHICH THE TRANSITION TEMPERATURE
IS A MAXIMUM. NO EVIDENCE OF EMBRITTLEMENT WAS
FOUND IN TENSION OR ROOM TEMPERATURE FRACTURE
TOUGHNESS TESTS. EMBRITTLEMENT WAS NOTED, HOWEVER,
IN FRACTURE TOUGHNESS TESTS CARRIED OUT AT -50 AND -
100 F, WHICH INDICATES THAT LOW TEMPERATURE TESTING
WILL BE NECESSARY FOR PROPER MATERIALS EVALUATION.
THE PLANE STRAIN FRACTURE TOUGHNESS (K SUB
IC) OF VARIOUS HEATS OF 4340 STEEL HAS BEEN
CORRELATED WITH THE WEIGHT PERCENT SULFUR AND
PHOSPHORUS IN THE STEEL. A MECHANISM FOR TEMPERED
MARTENSITE EMBRITTLEMENT IS PROPOSED. CERTAIN
IMPURITY ELEMENTS, SUCH AS PHOSPHORUS, WHICH ARE MORE
SOLUBLE IN FERRITE THAN IN CEMENTITE, WILL SEGREGATE
IN THE FERRITE ADJACENT TO THE CEMENTITE SHORTLY
AFTER THE CEMENTITE PRECIPITATION. THIS TRANSIENT
ENRICHMENT OF FERRITE BY IMPURITY ELEMENTS WILL BE
EMBRITTLING WHEN THE CEMENTITE IS IN A PLATELET OR
FILMY FORM, AND PARTICULARLY SO IN THE REGION OF THE
PRIOR AUSTENITE GRAIN BOUNDARIES, WHERE THE IMPURITY
CONTENT MAY BE HIGHER THAN AVERAGE. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-653 156 11/6 13/8
FRANKFORD ARSENAL PHILADELPHIA PA

METHODS FOR MINIMIZING THE EMBRITTLING EFFECT OF
HYDROGEN IN ELECTROPLATED HIGH STRENGTH ALLOY STEEL
ITEMS. (U)

DESCRIPTIVE NOTE: FINAL ENGINEERING REPT.,
MAR 63 37P DOUGHERTY, EDWARD E. ;
PROJ: IEP-60-6110-2

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: REPT. ON INDUSTRIAL ENGINEERING
PROJ.

DESCRIPTORS: (*EMBRITTEMENT, *STEEL), (*ALLOYS,
STEEL), ELECTROPLATING, MECHANICAL PROPERTIES,
HYDROGEN, STRUCTURAL PROPERTIES, CADMIUM,
THEORY, CHROMIUM, TESTS (U)

THE PAPER CONTAINS METHODS FOR ELIMINATING HYDROGEN
EMBRITTEMENT OF CADMIUM AND CHROMIUM ELECTROPLATED
ULTRA HIGH STRENGTH ALLOY STEEL ITEMS FOR CARTRIDGE
OR PROPELLANT ACTUATED DEVICES. SINCE THE
INITIATION OF THE PROJECT, IT HAS BEEN CONCLUDED THAT
THE ONLY WAY TO COMPLETELY ELIMINATE HYDROGEN
EMBRITTEMENT IS TO AVOID COMPLETELY THE INTRODUCTION
OF HYDROGEN INTO THE ITEM BEING PLATED. METHODS TO
MINIMIZE EMBRITTEMENT, TO THE POINT THAT IT WILL NOT
INTERFERE WITH THE FUNCTION OF APPLICABLE ITEMS, HAVE
BEEN DETERMINED. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-653 454 13/8 20/11
NAVY MARINE ENGINEERING LAB ANNAPOLIS MD

STRESS-RELIEF EMBRITTLEMENT OF AX-140 AND E-11018
WELD METALS, (U)

MAR 67 29P ROSENSTEIN, ALAN H. IASCHÉ,
W. H. I
REPT. NO. MEL-116/67
PROJ: S-F020-01-01
TASK: 0720

UNCLASSIFIED REPORT

DESCRIPTORS: (*WELDS, STRESS RELIEVING),
(*STRESS RELIEVING, *METALS), (*EMBRITTLEMENT,
WELDS), THERMAL STRESSES, SURFACE PROPERTIES,
TRANSITION TEMPERATURE, THICKNESS, STRESSES,
TEMPERATURE, IMPACT TESTS, TIME,
FRACTURE (MECHANICS), TOUGHNESS, ANALYSIS,
TESTS (U)

AN ATTEMPT WAS MADE TO ARRIVE AT OPTIMUM STRESS-
RELIEF TREATMENTS (MAXIMUM RELIEF OF RESIDUAL
STRESS WITH MINIMUM INCREASE IN TRANSITION
TEMPERATURE) FOR AX-140 AND E-11018 WELD
METALS. STRESS-RELIEF OF E-11018 RESULTS IN
ACCEPTABLE TOUGHNESS (ALTHOUGH SOFTENING MUST BE
CONSIDERED), WHEREAS, STRESS-RELIEF OF AX-140 CAN
PRODUCE SEVERE EMBRITTLEMENT. A SATISFACTORY
THERMAL STRESS-RELIEF TREATMENT CANNOT BE SPECIFIED
FOR WELDMENTS INVOLVING AX-140. WELD METAL
PROPERTIES VARY THROUGH THE THICKNESS OF THE WELD.
CENTER-OF-WELDMENT MATERIAL IS NOT AS TOUGH AS
SURFACE MATERIAL IN THE AS-WELDED CONDITION AND
EXHIBITS A GREATER SUSCEPTIBILITY TO STRESS-RELIEF
EMBRITTLEMENT. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-656 578 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 FEB-30
APR 67,

MAY 67 62P HAWTHORNE, J. R. ISERPAN, C.
Z. , JR. WATSON, H. E. GRAY, R. A. , JR.
REPT. NO. NRL-MR-1780
PROJ: RR-007-01-46-5409, SF-020-01-05-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-650 349.

DESCRIPTORS: (*REACTOR MATERIALS, *RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE), NEUTRON
REACTIONS, METAL PLATES, DUCTILITY, MARAGING
STEELS, EMBRITTLEMENT, NOTCH SENSITIVITY, WELDS,
ANNEALING, PRESSURE VESSELS, MILLING MACHINES,
AUTOMATIC, TEST EQUIPMENT, REMOTE CONTROL SYSTEMS,
POWER REACTORS, PRESSURIZED WATER REACTORS, HEAVY
WATER REACTORS

(U)

IDENTIFIERS: ARMY REACTORS(MH-1), ARMY
REACTORS(SM-1), CAROLINAS-VIRGINIA TUBE
REACTOR, STEEL A302-B, STEEL A350-LF1

(U)

THE REPORT INCLUDES THE FOLLOWING: (1) A
COMPARISON OF THE RESPONSE OF SELECTED STRUCTURAL
STEELS TO IRRADIATION AT 550 AND 650F TO HIGH
NEUTRON FLUENCES, (2) THE THROUGH-THICKNESS
CHARPY-V NOTCH DUCTILITY PERFORMANCE OF A 10-1/2-
IN.-THICK PLATE OF IRRADIATED A302-B STEEL,
(3) AN INVESTIGATION OF THE EFFECTS OF OXYGEN AND
NITROGEN CONTENTS ON THE RADIATION EMBRITTLEMENT
SENSITIVITY OF 7-1/2NI-CR-MO STEEL AT 250F,
(4) THE NOTCH DUCTILITY BEHAVIOR OF IRRADIATED
12NI-5CR-3MO MARAGING STEEL WELDMENTS, (5)
THE RESPONSE OF A350-LF1 (MODIFIED) STEEL TO
POSTIRRADIATION ANNEALING AT TEMPERATURES IN THE
RANGE OF 550 TO 590F, (6) THE NOTCH DUCTILITY
BEHAVIOR OF A350-LF1 (MODIFIED) STEEL WITH
CYCLIC 430F IRRADIATION-168 HOUR ANNEALING,
(7) THE PREIRRADIATION MECHANICAL PROPERTIES OF
THE MH-1A REACTOR PRESSURE VESSEL STEEL, (8)
THE NOTCH DUCTILITY OF SEVERAL REACTOR STRUCTURAL
STEELS AFTER IRRADIATION IN A HEAVY WATER MODERATED
REACTOR, (9) THE MODIFICATION, INSTALLATION, AND
INITIAL OPERATION OF A REMOTELY OPERATED, TAPE-
CONTROLLED MILLING MACHINE.

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-652 379 11/6
MCMASTER UNIV HAMILTON (ONTARIO) DEPT OF METALLURGY AND
METALLURGICAL ENGINEERING

THE EMBRITTLEMENT OF COPPER-17 ATOMIC % ALUMINUM
ALLOY BY LIQUID MERCURY. (U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
AUG 67 119P IVEs, M. B. ; HANCOCK, P.
C. J.
REPT. NO. TR-9
CONTRACT: NONR-3925(UO)

UNCLASSIFIED REPORT

DESCRIPTORS: (*EMBRITTLEMENT, *LIQUID METALS),
(*COPPER ALLOYS, EMBRITTLEMENT), DEFORMATION,
(CRACKS, STRESSES, FRACTURE(MECHANICS)),
MERCURY, HARDENING, PLASTICITY, MICROSTRUCTURE,
GRAIN STRUCTURES(METALLURGY), ALUMINUM ALLOYS (U)
IDENTIFIERS: COPPER ALLOY 17AL (U)

THE ROLE OF PLASTIC DEFORMATION IN THE INITIATION
AND PROPAGATION OF CRACKS IN CU-17AL ALLOY
EMBRITTLED BY LIQUID MERCURY HAS BEEN STUDIED. IT
IS PROPOSED THAT EXTENSIVE PLASTIC DEFORMATION AND
WORK HARDENING MUST OCCUR AT THE CRACK-TIP DURING
PROPAGATION IN ORDER TO RAISE THE LOCAL FLOW STRESS
TO A CRITICAL LEVEL AT WHICH THE MAXIMUM NORMAL
STRESS IS EQUAL TO THE COHESIVE STRENGTH. STRONG
INDICATION IS GIVEN THAT A 'CRITICAL APPLIED STRESS'
CRITERION FOR FRACTURE IS NOT APPLICABLE FOR THIS
MATERIAL. MICRO-CRACKS ARE FORMED AT WEAKENED
GRAIN BOUNDARIES AND A PERIOD OF STABLE CRACK GROWTH
MADE OVER A PERIOD OF INCREASING APPLIED STRESS MAY
BE NECESSARY BEFORE THE CRACK IS LONG ENOUGH TO
BECOME UNSTABLE. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-657 854 7/4 11/6
NEW YORK UNIV N Y RESEARCH DIV

STUDY OF THE EFFECT OF LIQUID ENVIRONMENT ON THE
EMBRITTLEMENT OF SOLIDS.

(U)

DESCRIPTIVE NOTE: FINAL REPT. 1 JAN 59-31 DEC 66,
JUN 67 63P CADOFF, I. B. ;

CONTRACT: NONR-265(43)

PROJ: RR-007-08-U1

UNCLASSIFIED REPORT

DESCRIPTORS: (*EMBRITTLEMENT, *SOLIDS),
(*LIQUIDS, EMBRITTLEMENT), COPPER ALLOYS,
MERCURY, LIQUID METALS, MICROSTRUCTURE, GRAIN
SIZE, ADSORPTION, GRAIN BOUNDARIES, STRESSES,
FRACTURE(MECHANICS), SILVER COMPOUNDS,
CHLORIDES, SOLUTIONS, DUCTILITY, MERCURY
ALLOYS

(U)

THE EFFECT OF ENVIRONMENT ON THE MECHANICAL
PROPERTIES OF SOLIDS WAS INVESTIGATED. THE TWO
PRINCIPAL SYSTEMS STUDIED WERE: THE EMBRITTLEMENT
OF COPPER AND COPPER ALLOYS IN MERCURY AND MERCURY
AMALGAMS. THE EMBRITTLEMENT OF SILVER CHLORIDE IN
AQUEOUS SOLUTIONS. THE PRINCIPAL FACTORS STUDIED
WERE ALLOY COMPOSITION; MICROSTRUCTURE, INCLUDING
GRAIN SIZE, PRECIPITATION EFFECTS, GRAIN BOUNDARY
ORIENTATION RELATIONSHIPS; AND COMPOSITION OF THE
LIQUID ENVIRONMENT. IN GENERAL IT WAS FOUND THAT
EMBRITTLEMENT COULD BE ATTRIBUTED TO ADSORPTION OF
'ACTIVE' IONS AT SITES OF HIGH STRESS CONCENTRATION
IN THE SOLID, WITH THIS ADSORPTION RESULTING IN LOWER
COHESION BETWEEN SOLID-SOLID BONDS. HIGH STRESS
CONCENTRATIONS ARE ASSOCIATED WITH THE DISLOCATION
INTERACTIONS AT HIGH ANGLE GRAIN BOUNDARIES,
PRECIPITATES AND NOTCHES. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-658 019 11/6 18/8 18/10
NAVAL RESEARCH LAB WASHINGTON D C

THROUGH-THICKNESS NOTCH DUCTILITY AND TENSION
PROPERTIES AS A FUNCTION OF NEUTRON EXPOSURE TO A
SIMULATED PRESSURE VESSEL WALL OF A302-B STEEL. (U)

DESCRIPTIVE NOTE: FINAL REPT.
JUN 67 18P SERPAN, CHARLES Z. , JR.;
HAWTHORNE, J. RUSSELL ;
REPT. NO. NRL-6575
PROJ: SF-020-01-05-0858, RR-007-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE),
PRESSURE VESSELS, DUCTILITY, EMBRITTLEMENT,
NOTCH SENSITIVITY, TENSILE PROPERTIES, NEUTRON
REACTIONS, POWER REACTORS, LIGHT WATER REACTORS,
THICKNESS (U)
IDENTIFIERS: STEEL A302-B (U)

NOTCH DUCTILITY AND TENSION-PROPERTY MEASUREMENTS
HAVE BEEN MADE USING SPECIMENS IRRADIATED WITHIN A
LARGE STEEL TEST ASSEMBLY SIMULATING THE PRESSURE-
VESSEL WALL OF A LIGHT-WATER-MODERATED POWER REACTOR.
THE A302-B STEEL SPECIMENS, SPACED AT INTERVALS
THROUGH THE 6-IN. THICKNESS OF THE ASSEMBLY, SHOWED
THE GREATEST EMBRITTLEMENT AND TENSILE PROPERTY
CHANGES FROM IRRADIATION LOCATIONS NEAREST THE FUEL
CORE, AND CORRESPONDINGLY SMALLER CHANGES FARTHER
FROM THE CORE. MEASURED NEUTRON FLUXES OF ENERGIES
GREATER THAN 1 MEV, BASED UPON AN ASSUMED FISSION
SPECTRUM, COMPARED WELL WITH CALCULATED SPECTRUM
NEUTRON FLUXES OF ENERGIES GREATER THAN 1 MEV FOR
ALL TEST ASSEMBLY LOCATIONS, THUS PROVIDING THE BASIS
FOR FUTURE ESTIMATES OF PROPERTY CHANGES THROUGH THE
THICKNESS OF HEAVY-WALLED REACTOR PRESSURE VESSELS.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-658 210 20/11 11/8
MARTIN CO BALTIMORE MD RESEARCH INST FOR ADVANCED
STUDIES

ADSORPTION-INDUCED BRITTLE FRACTURE IN LIQUID METAL
ENVIRONMENTS. (U)

DESCRIPTIVE NOTE: ANNUAL REPT.,
MAY 67 IGUP WESTWOOD, ALBERT R. C. ;
PREECE, CAROLYN M. ; KAMDAR, MADHUSUDAN M. ;
REPT. NO. RIAS-TR-67-8C, 1
CONTRACT: DA-18-UOI-AMC-1109(X)

UNCLASSIFIED REPORT

DESCRIPTORS: (*EMBRITTLEMENT, LIQUID METALS),
(*FRACTURE(MECHANICS), METALS), BRITTLENESS,
CHEMICAL BONDS, ADSORPTION, SURFACE-ACTIVE
SUBSTANCES, DIFFUSION, STRESSES, CRACKS, CRACK
PROPAGATION, FATIGUE(MECHANICS), ALLOYS (U)

SOLID METALS CAN BE CAUSED TO BEHAVE IN A BRITTLE
MANNER BY EXPOSURE TO A VARIETY OF PHYSICAL OR
CHEMICAL ENVIRONMENTS. PERHAPS THE MOST DRAMATIC
EXAMPLES OF SUCH EFFECTS, HOWEVER, RESULT FROM
EXPOSURE TO SURFACE ACTIVE LIQUID METALS.
SPECIMENS PRE-STRESSED ABOVE SOME CRITICAL VALUE
FAIL VIRTUALLY INSTANTLY ON BEING WETTED BY AN
APPROPRIATE LIQUID METAL, AND 'BRITTLE' CRACK
PROPAGATION RATES OF ORDER 100 CM PER SEC. HAVE BEEN
RECORDED IN OTHERWISE DUCTILE METALS UNDER SUCH
ENVIRONMENTAL CONDITIONS. SUCH EFFECTS ARE
PRESENTLY CONSIDERED TO RESULT FROM ADSORPTION-
INDUCED REDUCTIONS IN THE COHESIVE STRENGTH OF ATOMIC
BONDS AT REGIONS OF STRESS CONCENTRATION IN THE SOLID
METAL, E.G. AT THE TIPS OF CRACKS OR IN THE VICINITY
OF PILED UP GROUPS OF DISLOCATIONS. THIS PAPER
DESCRIBES THE RESULTS OF A NUMBER OF RECENT
INVESTIGATIONS ON THIS TYPE OF LIQUID-METAL
EMBRITTLEMENT, AND DISCUSSES THE PREREQUISITES AND
POSSIBLE MECHANISMS FOR ITS OCCURRENCE. ALSO
DISCUSSED ARE THE EFFECTS OF SUCH VARIABLES AS
CHEMICAL COMPOSITION OF THE SOLID AND LIQUID METAL
PHASES, TEMPERATURE, PRESTRAIN, RATE OF LOADING,
ETC., ON SEVERITY OF EMBRITTLEMENT, AND SUCH TOPICS
AS THE POSSIBLE CORRELATION BETWEEN SEVERITY OF
EMBRITTLEMENT AND ELECTRONEGATIVITY, THE USE OF
'INERT CARRIER' LIQUID METALS, POSSIBLE MEANS OF
INHIBITING LIQUID-METAL EMBRITTLEMENT, AND CRITERIA
FOR BRITTLE FAILURE. (AUTHOR) (U)

UNCLASSIFIED

DOC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-661 429 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 MAY-31
JUL 67;

AUG 67 47P HAWTHORNE, J. RUSSELL ;
SERPAN, CHARLES E. , JR. ; WATSON, HENRY E. ;
LOSS, FRANK J. ; POTAPOVS, ULDIS ;
REPT. NO. NRL-MR-1808
PROJ: SF-020-01-05-0858, RR-007-01-46-5409

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-656 578.

DESCRIPTORS: (*REACTOR MATERIALS, *RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE), PRESSURE
VESSELS, METAL PLATES, NICKEL ALLOYS, CHROMIUM
ALLOYS, MOLYBDENUM ALLOYS, VANADIUM ALLOYS,
DUCTILITY, TENSILE PROPERTIES, EMBRITTLEMENT,
AGING (MATERIALS), NEUTRONS, SENSITIVITY

(U)

THE REPORT INCLUDES THE FOLLOWING: (1)
THROUGH-THICKNESS RADIATION RESISTANCE OF TWO A533
GRADE B, CLASS 1 STEEL PLATES AT 550 F,
(2) DIRECTIONAL NOTCH DUCTILITY PERFORMANCE OF
IRRADIATED 3-1/2NI-CR-MO AND 5NI-CR-MO-
V STEEL PLATES, (3) RADIATION SENSITIVITY OF
A353 (9% NICKEL) STEEL AS INFLUENCED BY
PERCENT RETAINED AUSTENITE, (4) TENSILE
PROPERTIES BEHAVIOR VERSUS POSTIRRADIATION TEST
TEMPERATURE OF SELECTED STRUCTURAL STEELS, (5)
POTENTIAL FOR AGING EMBRITTLEMENT OF PRESSURE VESSEL
STEELS, (6) POSTPRESSURIZATION TEST OPERATIONS ON
PM-2A REACTOR PRESSURE VESSEL, AND (7)
AUXILIARY EQUIPMENT DEVELOPED FOR ELEVATED
TEMPERATURE REMOTE TENSION TESTING OF RADIOACTIVE
SPECIMENS. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-661 463 11/6
NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER ANNAPOLIS MD
ANNAPOLIS DIV

EMBRITTLEMENT OF TITANIUM IN SEAWATER, (U)

OCT 67 48P CAVALLARO, J. L. ;
PROJ: S-F020-01-U1
TASK: 1189, 0721
MONITOR: NSRUC 2483

UNCLASSIFIED REPORT

DESCRIPTORS: (*TITANIUM ALLOYS, EMBRITTLEMENT),
(*STRESS CORROSION, TITANIUM ALLOYS), SEA WATER,
MICROSTRUCTURE, FRACTURE (MECHANICS), RUPTURE,
ALUMINUM ALLOYS, NIOBIUM ALLOYS, TANTALUM ALLOYS (U)
IDENTIFIERS: TITANIUM ALLOY 7AL2NB17A (U)

SEA-WATER STRESS-CORROSION TESTS ON NOTCHED
CANTILEVER-BEAM SPECIMENS OF ALLOY TI-7AL-
2CB-1TA (TI-721) DEMONSTRATED THAT IT HAS A
TRANSITION IN BEHAVIOR WITH INCREASING NOTCH
SHARPNESS. SEA-WATER TESTS ON ALLOY TI-721
INDICATE THAT A THRESHOLD STRESS LEVEL EXISTS BELOW
WHICH STRESS CORROSION DOES NOT OCCUR. SEA-WATER
STRESS CORROSION IS DEPENDENT ON THE PRESENCE OF
EMBRITTLING CONSTITUENTS IN THE ALLOY. ALLOY
CHEMISTRY AND HEAT TREATMENT ARE THE MOST SIGNIFICANT
FACTORS WHICH CONTROL SENSITIVITY. THE RESULTS OF
TESTS MADE ON A SERIES OF TI-AL BINARY ALLOYS
INDICATE THAT ALUMINUM IN SOLID SOLUTION DOES NOT
CAUSE STRESS CORROSION, BUT THAT IT IS CAUSED BY A
FINITE AMOUNT OF A COHERENT T13AL. A DECREASE
IN ALUMINUM AND OXYGEN CONTENTS AND THE ADDITION OF
ISOMORPHOUS BETA STABILIZERS IMPROVE THE RESISTANCE
OF TI-AL ALLOYS TO SEA-WATER STRESS CORROSION BY
SUPPRESSING THE FORMATION OF T13AL. A STRESS-
SORPTION CRACKING MECHANISM IS SUGGESTED AS A GENERAL
MODEL FOR THE EMBRITTLEMENT OF TITANIUM AND TITANIUM
ALLOYS IN SEAWATER. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-661 603 18/10 11/6 18/8

NAVAL RESEARCH LAB WASHINGTON D C

YANKEE REACTOR PRESSURE-VESSEL SURVEILLANCE: NOTCH
DUCTILITY PERFORMANCE OF VESSEL STEEL AND MAXIMUM
SERVICE FLUENCE DETERMINED FROM EXPOSURE DURING CORES
II, III, AND IV, (U)

SEP 67 38P SERPAN, CHARLES Z. , JR. ;
HAWTHORNE, J. R. ;
REPT. NO. NRL-6616
PROJ: KR-007-01-48-5409, SF-020-01-05-0858

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*RADIATION DAMAGE, *REACTOR MATERIALS),
EMBRITTLEMENT, NEUTRON FLUX, DUCTILITY,
TEMPERATURE, PRESSURE, VESSELS, TRANSITION
TEMPERATURE (U)

IDENTIFIERS: STEEL A-302-B, YANKEE ATOMIC
POWER REACTOR (U)

CHARPY V-NOTCH SPECIMENS, REPRESENTATIVE OF ONE
OF THE SEVERAL HEATS OF A302-B STEEL FORMING THE
YANKEE REACTOR PRESSURE VESSEL AND IRRADIATED AS
PART OF THE YANKEE SURVEILLANCE PROGRAM, WERE
TESTED. SPECIMENS OF THIS PARTICULAR HEAT,
IRRADIATED IN NEAR-CORE (ACCELERATED) AS WELL AS
IN VESSEL-WALL LOCATIONS, SHOWED MORE EMBRITTLEMENT
THAN DID SPECIMENS OF A REFERENCE STEEL HEAT OF THE
SAME NOMINAL A302-B COMPOSITION IRRADIATED
SIMULTANEOUSLY IN THE SAME SURVEILLANCE CAPSULES.
THOSE SPECIMENS FROM BOTH THE YANKEE VESSEL HEAT
AND THE REFERENCE HEAT IRRADIATED AT THE VESSEL-WALL
LOCATION DEPICTED A HIGHER DAMAGE RATE THAN THAT FOR
THE ACCELERATED LOCATION. THE CAUSE OF THIS
DIFFERENCE IN EMBRITTLEMENT RESPONSE COULD NOT BE
ATTRIBUTED TO AN EFFECT OF CYCLIC, SERVICE
IRRADIATION TEMPERATURES, BUT COULD BE TRACED TO A
QUALITATIVE RELATIONSHIP OF THERMAL TO FAST (>1
MEV) NEUTRON FLUXES. THIS RATIO WAS IN EXCESS
OF ABOUT 9:1 AT THE VESSEL-WALL LOCATION VERSUS A
RATIO LESS THAN ABOUT 9:1 FOR THE ACCELERATED
LOCATION. THE COMPUTATION OF A MAXIMUM SERVICE
FLUENCE OF 1.46×10^{10} TO THE 19TH POWER N/SQ CM (>0.5
MEV) WAS MADE POSSIBLE BY ESTABLISHMENT OF THE
NEUTRON SPECTRUM AT THE REACTOR VESSEL WALL USING
COMPUTER CALCULATIONS. THE MAXIMUM FLUENCE DERIVED
BY THIS TECHNIQUE COMPARED FAVORABLY WITH ANOTHER
VALUE GIVEN BY AN INDEPENDENTLY-DEVELOPED CALCULATED (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-653 084 11/9 9/3 6/6
NAVAL RESEARCH LAB WASHINGTON D C

TERMITE RESISTANCE OF POLYVINYL CHLORIDE PLASTIC -
TWO YEARS' EXPOSURE IN THE TROPICS, (U)

OCT 67 19P BULTMAN, J. D. ; LEONARD, J.
M. ; SOUTHWELL, C. R. ;
REPT. NO. NRL-6601
PROJ: Y-F015-06-03-201

UNCLASSIFIED REPORT

DESCRIPTORS: (*POLYVINYL CHLORIDE, TROPICAL
TESTS), (*ELECTRIC INSULATION, TROPICAL TESTS),
PLASTICS, TROPICAL DETERIORATION, ENVIRONMENTAL
TESTS, PLASTICIZERS, INSECTICIDES, ADDITIVES,
EMBRIITLEMENT, PEST CONTROL, ISOPTERA (U)

AN INVESTIGATION OF TERMITE ATTACK UPON POLYMERIC
MATERIALS IS IN PROGRESS. SO FAR, THIRTY-TWO
FORMULATIONS CONTAINING POLYVINYL CHLORIDE RESIN HAVE
BEEN PREPARED INCORPORATING, VARIOUSLY FOUR
PLASTICIZERS, THREE TOXICANTS AND TWO DEGREES OF
HARDNESS. OF THE 480 SPECIMENS EXPOSED FOR ABOUT
TWO YEARS IN THE PANAMA JUNGLE, 122 SPECIMENS
(258) SHOW EVIDENCE OF ATTACK, RANGING FROM LIGHT
TO HEAVY, ALTHOUGH IN GENERAL THE ATTACK WAS LIGHT.
SEVENTY-SEVEN OF THE DAMAGED SPECIMENS CONTAINED NO
TOXICANT. OF THE TOXICANTS, LINDANE WAS GENERALLY
MORE EFFECTIVE THAN EITHER ALDRIN OR DIELDRIN.
SPECIMENS CONTAINING DIOCTYL PHTHALATE PLASTICIZER
HAD THE HIGHEST INCIDENCE OF ATTACK, ALTHOUGH, IN THE
ABSENCE OF A TOXICANT, SPECIMENS CONTAINING OTHER
PLASTICIZERS WERE ATTACKED NEARLY AS MUCH. NO
SIGNIFICANT DIFFERENCE IN THE INCIDENCE OF ATTACK
DEVELOPED BETWEEN THOSE SPECIMENS CONTAINING LOW AND
HIGH PERCENTAGES OF SILICA. AFTER TWO YEARS'
EXPOSURE, SPECIMEN SHRINKAGE OCCURRED IN ALL SAMPLES
PLASTICIZED WITH DIOCTYL ADIPATE. THIS SHRINKAGE
WAS ACCOMPANIED BY AN EMBRITTLEMENT WHICH PRESUMABLY
ADDED TO TERMITE RESISTANCE. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-664 598 20/11 11/6 14/2
NATIONAL TECHNICAL UNIV ATHENS (GREECE) LAB FOR TESTING
MATERIALS

THE EFFECT OF TORSIONAL PLESTRAIN ON THE
EMBRITTELEMENT OF MILD STEEL.

(U)

DESCRIPTIVE NOTE: FINAL TECHNICAL REPT. JUL 66-JUN 67,
JUN 67 24P THEOCARIS, PERICLES S. ;
CONTRACT: DA-91-591-EUC-4085
PROJ: DA-20014501B33G

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, EMBRITTELEMENT),
(*METALLURGICAL LABORATORIES, GREECE), CRACK
PROPAGATION, FAILURE(MECHANICS),
FRACTURE(MECHANICS), TORSION, DUCTILE BRITTLE
TRANSITION, STRESSES, DEFORMATION, RODS, NOTCH
TOUGHNESS

(U)

IDENTIFIERS: PLESTRAIN(MECHANICS)

(U)

THE PAPER PRESENTS THE RESULTS OF A SERIES OF TESTS
ON NOTCHED SPECIMENS MADE OF LOW-CARBON DIN 37
STEEL, WHICH WERE TORSIONALLY PRESTRAINED BY
DIFFERENT AMOUNTS AT THEIR PLAIN OR NOTCHED STATE AND
THEN TESTED IN TENSION TO FAILURE. THESE TESTS
SHOWED THE DELETERIOUS INFLUENCE OF PRETWISTING ON
THE EXHAUSTION OF DUCTILITY OF THE METAL. IT WAS
SHOWN THAT THE MOST EFFECTIVE MODE FOR EXHAUSTING THE
DUCTILITY OF THE METAL WAS ACHIEVED WHEN PRETWISTED
BARS WERE SHARPLY NOTCHED AND TWISTED, BEFORE
FRACTURING IN TENSION. GENUINE BRITTLE FRACTURES
OCCURRING AT A NOMINAL STRESS LOWER THAN THE VIRGIN
YIELD STRENGTH OF THE MATERIAL WERE CONSISTENTLY
PRODUCED IN THIS MANNER. A SERIES OF PLAIN TORSION
BARS SUBMITTED TO SEVERE TWISTING, FOLLOWED BY A
GRADUAL REVERSE TORSION, SHOWED THAT THE FAILURE
STRESSES OF THE SUBSEQUENTLY SLICED TENSION SPECIMENS
PASSED THROUGH CONSECUTIVE RELATIVE MAXIMA AND MINIMA
BEFORE REACHING A MAXIMUM FAILURE STRESS
CORRESPONDING TO AN UNTWISTING ANGLE EQUAL TO THE
INITIAL TWISTING. ALL FRACTURES IN THESE SPECIMENS
WERE HIGH STRESS FAILURES. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-664 640 18/10
NAVAL RESEARCH LAB WASHINGTON D C

THE EFFECTS OF COUPLING NUCLEAR RADIATION WITH STATIC
AND CYCLIC SERVICE STRESSES AND OF PERIODIC PROOF
TESTING ON PRESSURE VESSEL MATERIAL BEHAVIOR. (U)

DESCRIPTIVE NOTE: PHASE I OF FINAL REPT.,
AUG. 67 45P HAWTHORNE, J. R. ; LOSS, F.

J. ;
REPT. NO. NRL-6620
PROJ: RR-007-01-46-5409, SF-020-01-05-0858

UNCLASSIFIED REPORT

DESCRIPTORS: (*REACTOR MATERIALS, *STEEL),
(*PRESSURE VESSELS, *RADIATION DAMAGE),
STRUCTURAL PARTS, NUCLEAR RADIATION, STRESSES,
TEST METHODS, AGING(MATERIALS),
FATIGUE(MECHANICS), TRANSITION TEMPERATURE,
EMBRIITLEMENT, DUCTILITY, NEUTRON REACTIONS (U)
IDENTIFIERS: HYDRO-TESTING, STEEL A-302, STEEL
A-350 (U)

THE NUCLEAR SERVICE PERFORMANCE OF STRUCTURAL
STEELS AS INFLUENCED BY STATIC AND CYCLIC STRESS
APPLICATIONS DURING RADIATION EXPOSURE WAS EXAMINED
AND DOCUMENTED WITH EXPERIMENTAL RESULTS. THE
SIGNIFICANCE AND MERITS OF INITIAL AND SUBSEQUENT
PROOF TESTS OF LARGE STRUCTURAL COMPONENTS SUCH AS
THE HYDRO-TESTING OF NUCLEAR REACTOR PRESSURE VESSELS
WERE ALSO REVIEWED AND EVALUATED. PERFORMANCE
FOLLOWING PRELOAD IN THE FORM OF WARM PRESTRESSING AS
WELL AS AGING EMBRIITLEMENT WERE AMONG THOSE FACTORS
CONSIDERED. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-665 093 11/6
MARTIN CO BALTIMORE MD RESEARCH INST FOR ADVANCED
STUDIES

CRITICAL SPECIES IN STRESS CORROSION PHENOMENA, (U)

67 23P PUGH, E. N.; WESTWOOD, A.

R. C. ;
CONTRACT: DA-31-124-ARO(D)-258
PROJ: DA-20014501B32D
MONITOR: AROD 5023:5

UNCLASSIFIED REPORT

AVAILABILITY: PUBLISHED IN STRESS CORROSION
TESTING, SPECIAL TECHNICAL PUBLICATION, NO. 425
P228 1967.

SUPPLEMENTARY NOTE: RESEARCH SUPPORTED IN PART BY
ONR.

DESCRIPTORS: (*STRESS CORROSION,
FRACTURE(MECHANICS)), BRASS, STAINLESS STEEL,
MAGNESIUM ALLOYS, ALUMINUM ALLOYS, CRACKS,
CORROSION, CHLORIDES, FAILURE(MECHANICS),
COMPLEX COMPOUNDS, AMMONIUM COMPOUNDS, SILVER
COMPOUNDS, EMBRITTLEMENT, SOLUTIONS, PHYSICAL
CHEMISTRY (U)

CONSIDERATION HAS BEEN GIVEN TO THE IDENTIFICATION
OF THE CRITICAL SPECIES IN SEVERAL STRESS CORROSION
SYSTEMS. IT IS SHOWN THAT IN THE ALPHA-BRASS/
AQUEOUS AMMONIA SYSTEM, CUPRIC COMPLEX IONS OF THE
TYPE $\text{Cu}(\text{NH}_3)\text{N}(2+)$ PLAY A CONTROLLING ROLE
IN THE CRACKING PROCESS. COMPLEX IONS ARE ALSO
FOUND TO CONSTITUTE THE CRITICAL SPECIES IN THE
EMBRITTLEMENT OF SILVER CHLORIDE IN CERTAIN AQUEOUS
ENVIRONMENTS. IN THE CASE OF MATERIALS SUCH AS
STAINLESS STEELS AND MAGNESIUM AND ALUMINUM ALLOYS,
WHICH UNDERGO STRESS CORROSION CRACKING IN CHLORIDE
ENVIRONMENTS, THE CRITICAL SPECIES MAY BE THE
CHLORIDE ION ITSELF OR METAL-CHLORIDE COMPLEXES.
ATTENTION IS GIVEN TO BOTH THE ROLE OF THE CRITICAL
SPECIES IN THE MECHANISMS OF FAILURE AND THE
PRACTICAL SIGNIFICANCE OF THESE FINDINGS TO STRESS
CORROSION TESTING. IT IS SUGGESTED THAT MORE
ATTENTION TO THE CHEMISTRY OF ENVIRONMENTS WHICH
CAUSE STRESS CORROSION CRACKING, WITH PARTICULAR
REGARD TO THE IDENTIFICATION OF THE CRITICAL SPECIES,
COULD BE OF SIGNIFICANT PRACTICAL VALUE.
(AUTHOR) (U)

UNCLASSIFIED

ODC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-666 293 11/3 11/9
OLIN MATHIESON CHEMICAL CORP NEW HAVEN CONN CHEMICALS
GROUP

DEVELOPMENT OF FLEXIBLE EPOXY RESINS AND COATINGS, (U)

DESCRIPTIVE NOTE: FINAL REPT. 1 MAR 67-29 MAR 68,
FEB 68 37P URS, S. VENKATARAMAJ;
PUGLIA, SALVATORE A. ;
CONTRACT: NOU019-67-C-0295

UNCLASSIFIED REPORT

DESCRIPTORS: (*EPOXY PLASTICS, *PLASTIC COATINGS),
MECHANICAL PROPERTIES, EMBRITTLEMENT,
AGING (MATERIALS), ISOCYANATE PLASTICS,
AIRCRAFT FINISHES, WEAR RESISTANCE (U)
IDENTIFIERS: POLYOXYALKYLENE DIAMINE,
POLYOXYBUTYLENE DIAMINE, POLYOXYPROPYLENE
DIAMINE (U)

COATINGS WITH EXCELLENT LOW TEMPERATURE FLEXIBILITY
WERE MADE BY BLENDING 20 PARTS POLYETHER DIEPOXIDE
DER 732 AND 80 PARTS AROMATIC EPOXY RESIN EPON
1001 AND CURING WITH POLYETHER DIAMINE POPDA 400.
ALSO COATINGS WITH GOOD FLEXIBILITY AT -45F, HIGH
ADHESION AND ABRASION RESISTANCE WERE PREPARED FROM
MOISTURE-SET POLYTETRAMETHYLENE GLYCOL/TDI
POLYURETHANES. HOWEVER, THESE COATINGS NEEDED LONG
CURING TIMES. EPON 828 CURED WITH POLYETHER
DIAMINE POPDA 400 AND POLYETHER TRIAMINE PPE
640TA GAVE COATINGS WITH GOOD GLOSS AND HIGH
ABRASION RESISTANCE. BUT, THE COATINGS HAD ONLY
MARGINAL LOW TEMPERATURE PROPERTIES. ANTICIPATED
HIGH TEMPERATURE RESISTANT COATINGS WERE NOT REALIZED
FROM OXYDIPHENOL EPOXY RESINS. ALSO, THE RESINS
HAD POOR SOLUBILITY PROPERTIES. A URETHANE-EPOXY
HYBRID COATING WAS SYNTHESIZED WHICH SHOULD HAVE LOW
TEMPERATURE FLEXIBILITY OF URETHANE POLYMERS AND THE
FAST CURING RATE OF EPOXY RESINS. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-667 464 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 NOV 67-31
JAN 68,

FEB 68 SIP HAWTHORNE, J. RUSSELL ;
POTAPOVS, ULUIS ; SERPAN, CHARLES Z. , JR ;
REPT. NO. NRL-MR-1853
PROJ: RR-007-01-46-5409, SF-02U-01-05-0858

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-663 888.

DESCRIPTORS: (*REACTOR MATERIALS, *RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE), PRESSURE
VESSELS, METAL PLATES, NICKEL ALLOYS, CHROMIUM
ALLOYS, MOLYBDENUM ALLOYS, NOTCH TOUGHNESS,
DUCTILITY, AGING (MATERIALS), EMBRITTLEMENT,
ANNEALING, NEUTRON REACTIONS, SENSITIVITY
IDENTIFIERS: A302-B STEEL, SM-1A REACTOR

(U)

(U)

THE RESEARCH PROGRAM OF THE NRL METALLURGY
DIVISION, REACTOR MATERIALS BRANCH, IS
DEVOTED TO THE DETERMINATION OF THE EFFECTS OF
NUCLEAR RADIATION UPON THE PROPERTIES OF STRUCTURAL
MATERIALS. THE OVERALL PROGRAM IS SPONSORED BY THE
OFFICE OF NAVAL RESEARCH, THE NAVAL SHIP
SYSTEMS COMMAND, THE U. S. ATOMIC ENERGY
COMMISSION, AND THE ARMY NUCLEAR POWER
PROGRAM. SINCE RESEARCH FINDINGS WHICH APPLY TO
THE OBJECTIVES OF ONE SPONSORING AGENCY ARE ALSO OF
INTEREST TO THE OTHERS, THE OVERALL PROGRAM PROGRESS
IS REPORTED HEREIN. THIS REPORT, COVERING RESEARCH
FOR THE PERIOD 1 NOVEMBER 1967 - 31 JANUARY 1968,
INCLUDES THE FOLLOWING: (1) AN EVALUATION OF
COPPER, VANADIUM, AND NITROGEN CONTENT AS VARIABLES
IN RADIATION EMBRITTLEMENT SENSITIVITY OF A302-B
STEEL, (2) THE THERMAL AGING RESPONSE OF A302-
B PLATES FROM A LABORATORY SPLIT HEAT MODIFIED WITH
SULFUR AND PHOSPHORUS ADDITIONS, (3) AN
EVALUATION OF THE EFFECT OF ALUMINUM AND NITROGEN
ADDITIONS ON RADIATION EMBRITTLEMENT SENSITIVITY OF
NI-CR-MO STEEL, (4) THE NOTCH DUCTILITY
CHARACTERISTICS OF EXPERIMENTAL CR-NI-MO
PRECIPITATION HARDENING STAINLESS STEEL AFTER <
250F IRRADIATION, AND (5) AN ASSESSMENT OF
EMBRITTLEMENT RELIEF ACCOMPLISHED THROUGH IN-PLACE
ANNEALING THE SM-1A REACTOR PRESSURE VESSEL.

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-668 172 20/14

MARTIN MARIETTA CORP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

ADSORPTION-SENSITIVE MECHANICAL BEHAVIOR.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,

MAR 68 35P WESTWOOD, ALBERT R. C. ;
PREECE, CAROLYN M. ; GOLDHEIM, DAVID L. ;
REPT. NO. RIAS-TR-68-6C
CONTRACT: NONR-4162(U)
PROJ: NR-036-055

UNCLASSIFIED REPORT

DESCRIPTORS: (*EMBRITTELEMENT, *ADSORPTION),
(*LIQUID METALS, MECHANICAL PROPERTIES),
(*CRYSTALS, MECHANICAL PROPERTIES), SILVER
COMPOUNDS, CHLORIDES, CHEMISORPTION, CRACKS,
COMPLEX COMPOUNDS, DISLOCATIONS,
CARRIERS(SEMICONDUCTORS), MAGNESIUM OXIDES,
LITHIUM FLUORIDES, CALCIUM FLUORIDES, HARDNESS
IDENTIFIERS: REBINDER EFFECTS

(U)

(U)

IT HAS BEEN SUGGESTED THAT CERTAIN TYPES OF
ADSORPTION-SENSITIVE MECHANICAL BEHAVIOR MAY BE
UNDERSTOOD, IN A GENERAL WAY, BY CONSIDERING THE
TYPE, CONCENTRATION, MOBILITY AND ADSORPTION-INDUCED
REDISTRIBUTION OF THE CHARGE CARRIERS IN THE SOLID.
SOME RECENT EXPERIMENTAL OBSERVATIONS ON THE
EMBRITTELEMENT OF AGCL, AND REBINDER EFFECTS
(ADSORPTION-INDUCED REDUCTIONS IN MICROHARDNESS)
IN IONIC CRYSTALS ARE DESCRIBED AND DISCUSSED IN
TERMS OF THIS HYPOTHESIS. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-671 094 18/8 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 FEB-30
APR 68,

MAY 68 41P STEELE, L. E.; HAWTHORNE,
J. R.; SERPAN, C. Z., JR.; POTAPOVS, ULDIS

REPT. NO. NRL-MR-1872
PROJ: RR007-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*NUCLEAR REACTORS, *STRUCTURAL
PARTS), (*RADIATION DAMAGE, *PRESSURE VESSELS),
STEEL, CHEMICAL PROPERTIES, NEUTRONS,
EMBRITTLEMENT, ABSORPTION, DEPOSITS, MECHANICAL
PROPERTIES, NICKEL ALLOYS, CHROMIUM ALLOYS, WELDS,
MOLYBDENUM ALLOYS, NOTCH SENSITIVITY, DUCTILITY,
IRON ALLOYS

(U)

IDENTIFIERS: STEEL A302B, STEEL A533B,
STEEL A350

(U)

THE RESEARCH PROGRAM OF THE NRL METALLURGY
DIVISION, REACTOR MATERIALS BRANCH, IS
DEVOTED TO THE DETERMINATION OF THE EFFECTS OF
NUCLEAR RADIATION UPON THE PROPERTIES OF STRUCTURAL
MATERIALS. THE OVERALL PROGRAM IS SPONSORED BY THE
OFFICE OF NAVAL RESEARCH, THE U.S. ATOMIC
ENERGY COMMISSION, AND THE ARMY NUCLEAR
POWER PROGRAM. SINCE RESEARCH FINDINGS WHICH
APPLY TO THE OBJECTIVES OF ONE SPONSORING AGENCY ARE
ALSO OF INTEREST TO THE OTHERS, THE OVERALL PROGRAM
PROGRESS IS REPORTED HEREIN. THIS REPORT, COVERING
RESEARCH FOR THE PERIOD 1 FEBRUARY-30 APRIL 1968,
INCLUDES THE FOLLOWING: (1) CONTROLLING THE
RADIATION EMBRITTLEMENT SENSITIVITY OF NI-CR-MO
WELD DEPOSITS BY VARYING THEIR CHEMICAL COMPOSITION,
(2) INFLUENCE OF PRIOR TEMPER EMBRITTLEMENT ON
THE IRRADIATION RESPONSE OF NI-CR-MO STEEL,
(3) RELATIVE SSUF IRRADIATION RESPONSE OF BASE
PLATE, WELD METAL, AND WELD HEAT AFFECTED ZONE OF A
7-1/2-IN.-THICK A533-B CLASS I PRODUCTION
WELDMENT, (4) DROP WEIGHT NOT VERSUS CHARPY-
V ENERGY ABSORPTION LEVEL IN 6-3/8-IN. TYPE
A533-B CLASS I AND II STEEL PLATE, AND
(5) MECHANICAL PROPERTIES EVALUATION OF PM-2A
REACTOR PRESSURE VESSEL STEEL. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-671 807 18/8 18/9 13/4
NAVAL RESEARCH LAB WASHINGTON D C

NOTCH DUCTILITY PROPERTIES OF SM-1A REACTOR PRESSURE
VESSEL FOLLOWING THE IN-PLACE ANNEALING
OPERATION. (U)

DESCRIPTIVE NOTE: FINAL REPT.

MAY 68 31P POTAPOVS, ULDIS ; HANTHORNE, J.
RUSSELL ; SERPAN, CHARLES Z. , JR;
REPT. NO. NRL-6721
PROJ: USA-ERG-3-67, USA-ERG-19-66
TASK: MOI-14

UNCLASSIFIED REPORT

DESCRIPTORS: (*PRESSURE VESSELS, *RADIATION
DAMAGE), IMPACT TESTS, DUCTILE BRITTLE TRANSITION,
NUCLEAR INDUSTRIAL APPLICATIONS, NON-DESTRUCTIVE
TESTING, ANNEALING, MAPS, EMBRITTLEMENT, STEEL,
NOTCH TOUGHNESS (U)
IDENTIFIERS: GRAPHS(CHARTS), SM-1A REACTOR
VESSEL (U)

THE EMBRITTLEMENT CONDITION OF THE ARMY SM-1A
REACTOR PRESSURE VESSEL, AS MODIFIED BY THE RECENTLY
COMPLETED IN-PLACE ANNEAL, WAS ASSESSED AND AN
ANALYSIS WAS MADE OF THE REEMBRITTLEMENT BEHAVIOR OF
THE VESSEL STEEL WITH SUBSEQUENT RADIATION SERVICE.
EXPERIMENTAL RESULTS FROM THE REACTOR SURVEILLANCE
PROGRAM DEVELOPED THROUGH ONE COMPLETE IRRADIATION
AND ANNEALING CYCLE ARE PRESENTED, TOGETHER WITH A
SUMMARY OF EXPERIMENTAL INFORMATION ON THE ANNEALING
RESPONSE OF THE VESSEL STEEL (A350-LF1, MOD.)
FROM ACCELERATED IRRADIATION PROGRAMS. THESE DATA
INDICATE A 0 DEG F MAXIMUM PRESSURE VESSEL WALL
CHARPY-V 30 FT-LB TRANSITION TEMPERATURE AFTER
THE IN-PLACE ANNEAL VERSUS A -80 DEG F PRESERVICE
TRANSITION TEMPERATURE (BASED ON THE NOTCH-
DUCTILITY PROPERTIES OF A DUPLICATE RING FORGING).
THE MAXIMUM CHARPY-V 30 FT-LB TRANSITION
TEMPERATURE OF THE PRESSURE VESSEL BEFORE THE
ANNEALING OPERATION WAS ESTIMATED AT 190 DEG F.
A PROJECTION OF POSTANNEAL PRESSURE VESSEL LIFETIME
IN TERMS OF NEUTRON FLUENCE >0.5 MEV WAS DERIVED
FROM SPECTRA CALCULATIONS AND THE EXPERIMENTALLY
PREDICTED REIRRADIATION RESPONSE OF THE PRESSURE
VESSEL STEEL. THE MAXIMUM PERMISSIBLE VESSEL WALL
FLUENCE IS ESTIMATED AT 5.5×10 TO THE 19TH POWER M/SQ
CM > 0.5 MEV. THIS IS COMPARABLE TO 124.7
MEGAWATT YEARS OF REACTOR OPERATION. (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-671 851 13/1
COMBUSTION ENGINEERING INC WINDSOR CONN. KREISINGER
DEVELOPMENT LAB

A RESEARCH STUDY ON INTERNAL CORROSION OF HIGH-
PRESSURE BOILERS.

(U)

DESCRIPTIVE NOTE: FINAL REPT.,
MAY 68 SUP GOLDSTEIN, P. BURTON, C. L.
;

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PRESENTED AT ASME - EEI CORROSION
SEMINAR, HARTFORD, CONN., 21-22 MAY 1968.

DESCRIPTORS: (*BOILERS, *CORROSION), HIGH-
PRESSURE RESEARCH, WATER, IMPURITIES, TEST
FACILITIES, TEST METHODS, PHOTOMICROGRAPHY, PH,
NUCLEATE BOILING, CORROSION INHIBITION, CHEMICAL
ANALYSIS, DEPOSITS, CONDUCTIVITY,
FAILURE(MECHANICS), EMBRITTLEMENT, OXIDATION,
HEAT TRANSFER

(U)

IDENTIFIERS: *HIGH-PRESSURE BOILERS,
GRAPHS(CHARTS), FLOW REGIMES, *DUCTILE
GOUGING

(U)

THE GOAL OF THIS STUDY WAS TO DETERMINE THE CAUSE
AND PRACTICAL PREVENTIVE SOLUTION FOR THE TYPE OF
INTERNAL CORROSION COMMONLY EXPERIENCED IN BOILERS
OPERATING AT PRESSURES BETWEEN 800 AND 2600 PSIG.

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-672 890 18/13 13/4 20/11
NAVAL RESEARCH LAB WASHINGTON D C

NOTCH DUCTILITY AND TENSILE PROPERTY EVALUATION OF
THE PM-2A REACTOR PRESSURE VESSEL: (U)

DESCRIPTIVE NOTE: INTERIM REPT.,
JUN 68. 2JP SERPAN, CHARLES Z. , JR;
REPT. NO. NRL-6739
PROJ: RR-007-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTIONS: (*NUCLEAR REACTORS, PRESSURE
VESSELS), (*PRESSURE VESSELS, MECHANICAL
PROPERTIES), NOTCH SENSITIVITY, REACTOR OPERATION,
TENSILE PROPERTIES, NEUTRONS, DOSIMETERS, LIGHT
WATER REACTORS, RADIATION DAMAGE, EMBRITTLEMENT,
THICKNESS, BRITTLENESS, NON-DESTRUCTIVE TESTING,
TRANSITION TEMPERATURE, STEEL,
DEFECTS(MATERIALS), FRACTURE(MECHANICS),
PRESSURIZATION (U)
IDENTIFIERS: *FRACTURE TOUGHNESS (U)

FOLLOWING THE PRESSURIZATION-TO-FAILURE TESTING OF
THE PM-2A REACTOR PRESSURE VESSEL, SEVERAL
SECTIONS OF STEEL WERE REMOVED FROM THE VESSEL WALL
IN A REGION ADJACENT TO THE ARTIFICIAL DEFECT.
CHARPY V-NOTCH AND TENSION TEST SPECIMENS
MACHINED FROM ONE OF THESE SECTIONS HAVE BEEN
EVALUATED. THE IRRADIATED-CONDITION 30 FT-LB
TRANSITION TEMPERATURES FOR THE 1/4-THICKNESS
(NEAREST TO THE CORE) AND 3/4-THICKNESS LOCATIONS
IN THE VESSEL WALL WERE +115F AND +55F,
RESPECTIVELY, FOR MEASURED FISSION-SPECTRUM FLUENCES
OF 7.3 AND 4.0 $\times 10$ TO THE 18TH POWER N/SQ CM
(GREATER THAN 1 MEV). THE 1/4-THICKNESS
PROPERTIES AND FLUENCE MOST NEARLY REPRESENTED THOSE
AT THE TIP OF THE ARTIFICIAL DEFECT. THE 0.2%
YIELD STRENGTH FOR THE 1/4-THICKNESS LOCATION WAS 97,
620 PSI AT -20F (FAILURE TEMPERATURE) AND 92,
200 PSI AT +72F (TEMPERATURE AT TIME OF ACID-
SHARPENING TREATMENT OF ARTIFICIAL DEFECT).
SIGNIFICANT UNIFORM ELONGATION, REDUCTION OF AREA,
AND ELONGATION PER IN. WERE RETAINED BY THE STEEL.
AN ASSESSMENT OF THE STRESS, TEMPERATURE, AND FLAW-
SIZE CONDITIONS FOR THE PM-2A FAILURE, AS INDEXED
BY THE IRRADIATED-CONDITION MECHANICAL PROPERTIES,
INDICATES THAT THE FAILURE IS IN AGREEMENT WITH THE
GENERALIZED FRACTURE ANALYSIS DIAGRAM. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-673 65U 11/6 20/11 13/8
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO

THE STRAIN AGING OF OXYGEN IN MOLYBDENUM, (U)

SEP 67 1/P MA, YING-LIENG ; SUNG, TSU-
YI ;
REPT. NO. FTD-HT-67-206

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: EDITED TRANS. OF CHIN SHU HSUEH
PAO (CHINESE PEOPLE'S REPUBLIC) V8 N3 P332-338
1965.

DESCRIPTORS: (*STRAIN HARDENING, MOLYBDENUM),
(*MOLYBDENUM, *STRAIN HARDENING), OXYGEN,
EMBRIITLEMENT, AGE HARDENING, DISLOCATIONS,
CRYSTALLOGRAPHY, CRYSTAL LATTICE DEFECTS, CHINA (U)
IDENTIFIERS: TRANSLATIONS (U)

THE REPORT DISCUSSES INVESTIGATIONS WHICH HAVE BEEN
CARRIED OUT TO STUDY THE PROCESS OF STRAIN AGEING
CAUSED BY OXYGEN IN MOLYBDENUM BY MEASURING THE
VARIATION OF THE HEIGHT OF THE INTERNAL FRICTION PEAK
WITH AGEING TIME. IT WAS FOUND THAT THE PEAK
HEIGHT DECREASES GRADUALLY AND EVENTUALLY DISAPPEARS
WITH AGEING-TIME BOTH IN QUENCH-AGED AND IN STRAIN-
AGED SPECIMENS. SYSTEMATIC STUDIES HAVE BEEN MADE
ON THE KINETICS OF STRAIN AGEING AND ON THE EFFECT OF
DEFORMATION ON THE PEAK HEIGHT. ACCORDING TO
EXPERIMENTAL RESULTS, IT IS BELIEVED THAT THE
DECREASE OF THE PEAK HEIGHT IS ASSOCIATED WITH THE
SEGREGATION OF OXYGEN ATOMS TO DISLOCATIONS DURING
AGEING. ON THE BASIS OF THE ASSUMPTION, THE
DISLOCATION DENSITY AND THE ATMOSPHERE CONCENTRATION
WERE ESTIMATED. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-674 126 11/6 13/8
FRANKFORD ARSENAL PHILADELPHIA PA

EFFECT OF COLD WORK UPON THE EMBRITTLEMENT OF 70:30
ALPHA-BRASS IN 2% NA AMALGAM, (U)

MAR 68 12P RINNOVATORE, J. V. ; CORRIE,
J. D. ; MEAKIN, J. D. ;
REPT. NO. FA-A68-4
PROJ: DA-1T014501B32A

UNCLASSIFIED REPORT
AVAILABILITY: PUB. IN TRANSACTIONS QUARTERLY,
V61 N2 P321-329 JUN 68.
SUPPLEMENTARY NOTES: REVISION OF REPORT DATED 11 SEP
67.

DESCRIPTORS: (*BRASS, *EMBRITTLEMENT), (*COLD
WORKING, EMBRITTLEMENT), LIQUID METALS, MERCURY
ALLOYS, SODIUM ALLOYS, COPPER ALLOYS, ZINC ALLOYS,
FRACTOGRAPHY, ELECTRON MICROSCOPY (U)

THE SUSCEPTIBILITY TO EMBRITTLEMENT OF COLD ROLLED
70:30 ALPHA BRASS IN THE PRESENCE OF A HG-2%
NA AMALGAM HAS BEEN STUDIED. IT IS SHOWN THAT
FOR SMALL AMOUNTS OF COLD WORK, THE ALLOY IS SEVERELY
EMBRITTLED, AND THAT FAILURE OCCURS INTERGRANULARLY.
AS THE AMOUNT OF COLD WORKING INCREASES,
SUSCEPTIBILITY TO EMBRITTLEMENT DECREASES AND THE
MODE OF FAILURE BECOMES TRANSGRANULAR. FOR
EXTREMELY LARGE AMOUNTS OF COLD WORK, ESSENTIALLY NO
EMBRITTLEMENT IS OBSERVED. IT IS CONSIDERED THAT
THE ELIMINATION OF GRAIN BOUNDARIES, RESULTING FROM
INCREASING COLD WORK, IS THE DOMINANT FACTOR
RESPONSIBLE FOR THE OBSERVED CHANGES IN
SUSCEPTIBILITY AND FRACTURE MODE. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-674 852 11/6 20/11
BROWN UNIV PROVIDENCE R I DIV OF ENGINEERING

PLASTIC DEFORMATION IN BRITTLE AND DUCTILE FRACTURE,
(U)

JUL 68 56P DRUCKER, D. C. ; RICE, J.
R. ;
CONTRACT: SD-86
MONITOR: ARPA E57

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PRESENTED AT NATIONAL CONFERENCE
ON FRACTURE MECHANICS, LEHIGH UNIV., BETHLEHEM,
PA., JUN 67.

DESCRIPTORS: (*FRACTOGRAPHY, DEFORMATION),
FRACTOGRAPHY, STEEL, ALUMINUM ALLOYS, CRACK
PROPAGATION, STRAIN(MECHANICS), STRUCTURAL
SHELLS, PLASTICITY, YIELD POINT, IRREVERSIBLE
PROCESSES, EMBRITTLEMENT, TENSILE PROPERTIES,
LOADING(MECHANICS), ELASTICITY, STRESSES,
MATHEMATICAL ANALYSIS, DUCTILE BRITTLE TRANSITION,
SYMPOSIA (U)

AN EFFORT IS MADE TO COVER THE FULL ELASTIC-PLASTIC
RANGE FROM FRACTURES WHICH INITIATE AND PROPAGATE AT
NOMINAL OR NET STRESS IN THE ELASTIC RANGE TO THE
FRACTURES AT FULLY PLASTIC OR LIMIT LOAD CONDITIONS.
SIMILARITIES AND DIFFERENCES OF BEHAVIOR BETWEEN
STEELS WHICH ARE HIGHLY RATE-SENSITIVE AND ALUMINUM
ALLOYS OR OTHER RATHER INSENSITIVE MATERIALS ARE
EXAMINED. A DEMONSTRATION IS GIVEN OF THE
LIKELIHOOD OF CONFUSING LIMIT LOAD FRACTURES WITH LOW
STRESS FRACTURES. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-676 157 11/6 20/11
ILLINOIS INST OF TECH CHICAGO DEPT OF METALLURGICAL
ENGINEERING.

THE EFFECT OF LEAD ON MICRO-CRACK INITIATION AND
PROPAGATION IN ALLOY STEELS. PART A: EMBRITTLEMENT
OF LEADED STEELS AT INTERMEDIATE TEMPERATURES. (U)

DESCRIPTIVE NOTE: FINAL TECHNICAL REPT. ON PHASE I,
JUL 68 194P MOSTOVY, SHELDON BREYER,
NORMAN N. ;
REPT. NO. TR-10022-F
CONTRACT: DA-20-113-AMC-10820(T)

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO PART B, AD-676 158.

DESCRIPTORS: (*STEEL, EMBRITTLEMENT), (*LEAD,
CRACK PROPAGATION), FAILURE(MECHANICS),
FRACTOGRAPHY, CRACKS, FATIGUE(MECHANICS),
IMPACT TESTS, TENSILE PROPERTIES, HIGH-TEMPERATURE
RESEARCH, DUCTILITY (U)
IDENTIFIERS: STEEL 4145 (U)

A DETAILED INVESTIGATION WAS MADE OF THE INFLUENCE
OF 0.30% LEAD ON THE ROOM AND ELEVATED TEMPERATURE
MECHANICAL PROPERTIES OF A 4145 STEEL. LEADED AND
NON-LEADED VERSIONS OF THIS IDENTICAL STEEL WERE
QUENCHED AND TEMPERED TO ROOM TEMPERATURE STRENGTH
LEVELS RANGING FROM 120 TO 240 KSI. THE PROPERTIES
MEASURED INCLUDED BOTH COMPLETE TENSILE DATA AND
IMPACT ENERGIES FOR ALL STRENGTH LEVELS.
MACROFRACTOGRAPHS DETAILING DIFFERENCES IN FRACTURE
MORPHOLOGY AT SPECIFIC TEST TEMPERATURES WERE ALSO
INCLUDED. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-676 315 18/10
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT., 1 MAY-31
JUL 68

AUG 68 37P STEELE, L. E.; HAWTHORNE, J.
R.; SERPAN, C. Z., JR.; POTAPOVS, ULDIS;
GRAY, R. A., JR;
REPT. NO. NRL-MR-1908
PROJ: RRU07-CT-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (1) REACTOR MATERIALS, RADIATION
DAMAGE), PRESSURE VESSELS, THERMAL STABILITY,
MARAGING STEELS; NOTCH SENSITIVITY, EMBRITTLEMENT,
STEEL, RESPONSE, DUCTILITY, HEAT TREATMENT,
NUCLEAR RADIATION, SENSITIVITY

(U)

IDENTIFIERS: STEEL A-543, STEEL A-537, STEEL
SCR 3MU 12NI, STEEL A-302

(U)

THE RESEARCH PROGRAM OF THE NRL METALLURGY
DIVISION, REACTOR MATERIALS BRANCH, IS
DEVOTED TO THE DETERMINATION OF THE EFFECTS OF
NUCLEAR RADIATION UPON THE PROPERTIES OF STRUCTURAL
MATERIALS. THE OVERALL PROGRAM IS SPONSORED BY THE
OFFICE OF NAVAL RESEARCH, THE U. S.
ATOMIC ENERGY COMMISSION, AND THE ARMY
NUCLEAR POWER PROGRAM. SINCE RESEARCH
FINDINGS WHICH APPLY TO THE OBJECTIVES OF ONE
SPONSORING AGENCY ARE ALSO OF INTEREST TO THE OTHERS,
THE OVERALL PROGRAM PROGRESS IS REPORTED HEREIN.
THIS REPORT, COVERING RESEARCH FOR THE PERIOD 1
MAY-31 JULY 1968, INCLUDES THE FOLLOWING:
(1) IRRADIATION RESPONSE OF A 4-IN. A533-C,
CLASS 2, SUBMER ED ARC WELDMENT, (2) RELATIVE
550F IRRADIATION RESPONSE OF A HEAVY SECTION
A533-B ELECTROSLAG WELDMENT, (3) SPECIAL
A533-B STEEL HEAT FOR VARIABLE RADIATION
EMBRITTLEMENT STUDIES, (4) THERMAL STABILITY
EVALUATION OF NI-CR-MO WELD DEPOSITS, (5)
THERMAL STABILITY EVALUATIONS OF 12NI-SCR-3MU
MARAGING STEEL PLATE AT 550, 650, AND 740F, (6)
LONG-TERM IRRADIATION OF PRESSURE VESSEL STEELS IN
THE BIG ROCK POINT REACTOR, (7) PLATE
DIRECTIONALITY CHARACTERISTICS OF IRRADIATED
LACROSSE REACTOR PRESSURE VESSEL STEEL, AND
(8) PRELIMINARY STUDY OF THE IRRADIATION RESPONSE.

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UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AJ-480 602 18/10 11/6 13/5
NAVAL RESEARCH LAB WASHINGTON D C

THE EFFECT OF RESIDUAL ELEMENTS ON SSOF
IRRADIATION RESPONSE OF SELECTED PRESSURE VESSEL
STEELS AND WELDMENTS. (U)

DESCRIPTIVE NOTE: FINAL REPT.,
NOV 68 33P POTAPOVS, ULDIS ; HAWTHORNE, J.
RUSSELL ;
REPT. NO. NRL-6803
PROJ: RR-007-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*WELDS, RADIATION DAMAGE), (*RADIATION DAMAGE,
PRESSURE VESSELS), NUCLEAR REACTORS,
EMBRITTEMENT, NUCLEAR RADIATION, IMPURITIES,
SENSITIVITY (U)

IDENTIFIERS: STEEL A-302-B, STEEL A-54J (U)

THE EFFECT OF VARIABLE RESIDUAL ELEMENT CONTENTS ON
SSOF RADIATION EMBRITTEMENT SENSITIVITY OF
PRESSURE VESSEL STEELS WAS EXAMINED. RESULTS
INDICATE THAT PHOSPHORUS AND COPPER CAN CONTRIBUTE
SIGNIFICANTLY TO THE SSOF RADIATION EMBRITTEMENT
SENSITIVITY OF TYPE A302-B STEEL. THE
RESULTS ALSO SHOW THAT VANADIUM MAY HAVE A SLIGHT
ADVERSE EFFECT AND THAT SULFUR IS NEUTRAL, ALTHOUGH
IT SERVES TO DECREASE THE FULL SHEAR ENERGY
ABSORPTION LEVEL OF THE STEEL. NITROGEN VARIATIONS
FROM APPROXIMATELY EQUAL TO 0.008% TO 0.015% IN
ALUMINUM DEOXIDIZED STEEL HAVE NO SIGNIFICANT EFFECT,
WHILE THE ADDITION OF ALUMINUM TO NI-CR-MO
STEEL WITH A GIVEN NITROGEN CONTENT MAY SLIGHTLY
PROMOTE IRRADIATION EMBRITTEMENT. THE PROGRAM
RESULTS DEMONSTRATE THAT APPARENT INSENSITIVITY TO
SSOF IRRADIATION EMBRITTEMENT CAN BE CONSISTENTLY
ACHIEVED WITH LABORATORY HEATS OF A NOMINAL A302-
B STEEL COMPOSITION BY MAINTAINING THE TOTAL
RESIDUAL ELEMENT CONTENTS AT A LOW LEVEL.
RADIATION EMBRITTEMENT SENSITIVITY OF WELDMENTS
WAS INVESTIGATED IN A PROGRAM AIMED AT THE
DEVELOPMENT OF LOW SENSITIVITY WELD FILLERS FOR
JOINING NI-CR-MO STEEL. DATA FROM THIS NEW
PROGRAM AGAIN POINT TO COPPER AS A DOMINATING FACTOR
IN DETERMINING RADIATION EMBRITTEMENT SENSITIVITY,
FURTHER VERIFYING THE RESULTS OBTAINED IN THE NRL-
USS A302-B STEEL INVESTIGATION.

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DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 148ML1

AD-681 359 11/6
WASHINGTON UNIV SEATTLE COLL OF ENGINEERING

THE MICROSTRUCTURAL ASPECTS OF DEFORMATION AND
FRACTURE AT ELEVATED TEMPERATURES. (U)

DESCRIPTIVE NOTE: FINAL REPT., 1 JUN 64-31 DEC 68,
DEC 68 14P TAGGART, R. ; POLONIS, D. H.

CONTRACT: NONR-477(4U)
PROJ: NR-D36-061

UNCLASSIFIED REPORT

DESCRIPTORS: (COPPER ALLOYS, PHASE STUDIES),
SOLID SOLUTIONS, DEFORMATION, MICROSTRUCTURE,
GERMANIUM ALLOYS, SILICON ALLOYS, EMBRITTLEMENT,
LIQUID METALS, MERCURY, ZINC, ALUMINUM,
GALLIUM, CRACK PROPAGATION, CORROSION (U)
IDENTIFIERS: PHASE TRANSFORMATIONS (U)

A DEFORMATION HOT STAGE METALLOGRAPHIC FACILITY WAS
DESIGNED, CONSTRUCTED AND OPERATED SUCCESSFULLY
DURING THE INVESTIGATION OF SEVERAL SPECIFIC PROBLEM
AREAS. THE TOPICS THAT WERE STUDIED INCLUDE
VACANCY CONDENSATION PIT FORMATION ON ALUMINUM
SURFACES, CRACK PROPAGATION IN ALUMINUM POLYCRYSTALS
AND THE STRAIN INDUCED TRANSFORMATION OF METASTABLE
ALLOY PHASES. SOME SELECTED EXPERIMENTS WERE
CONDUCTED TO STUDY THE EFFECTS OF TEMPERATURE AND
PRESSURE ON THE EMBRITTLEMENT OF ALUMINUM AND ZINC BY
LIQUID METALS. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-681 373 18/10 11/6 18/8
NAVAL RESEARCH LAB WASHINGTON D C

INITIAL ASSESSMENTS OF NOTCH DUCTILITY BEHAVIOR OF
A533 PRESSURE VESSEL STEEL WITH NEUTRON
IRRADIATION:

(U)

DESCRIPTIVE NOTE: FINAL REPT.,
NOV 68 23P HAWTHORNE, J. RUSSELL ;
PUTAPOVS, ULOIS ;
REPT. NO. NRL-67/2
PROJ: RR-007-01-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*REACTOR MATERIALS, STEEL), DUCTILITY,
EMBRITTLEMENT, WELDS, METAL PLATES, NEUTRONS,
SENSITIVITY

(U)

IDENTIFIERS: STEEL A 533-B, STEEL A 533-

(U)

EXPLORATORY ASSESSMENTS WERE MADE OF THE CHARPY-
V NOTCH DUCTILITY CHARACTERISTICS OF HEAVY SECTION
A533-B AND A533-C STEEL PLATE AND SUBMERGED
ARC WELDMENTS FOLLOWING NEUTRON IRRADIATION AT
SSOF. THE EXPERIMENTAL EVALUATIONS WERE
PERFORMED LARGELY WITH COMMERCIAL PRODUCTION
MATERIALS AND INCLUDED COMPARISONS OF MATERIALS IN
BOTH CLASS 1 AND CLASS 2 STRENGTH RANGES.
POSTIRRADIATION NOTCH DUCTILITY PROPERTIES OF ONE
5-3/4-IN. A533-B CLASS 1 ELECTROSLAG WELDMENT
WERE ALSO DEVELOPED. ASSESSMENTS MADE OF RELATIVE
IRRADIATION PERFORMANCE WERE ASSISTED BY A
COMPILATION OF RECENT INFORMATION ON THE RESPONSE OF
THE ASTM REFERENCE A302-B STEEL PLATE. MAJOR
RESEARCH FINDINGS INCLUDE THE OBSERVATION OF
SIGNIFICANT VARIABILITY IN RADIATION EMBRITTLEMENT
SENSITIVITY OF A533-B AND A533-C STEEL
WHEREIN THE SENSITIVITY LEVEL OF PLATE AND WELD METAL
IN SOME CASES EXCEEDED THAT OF THE ASTM REFERENCE
PLATE. HIGH RADIATION EMBRITTLEMENT SENSITIVITY
WAS NOTED FOR BOTH SUBMERGED ARC WELD DEPOSITS
EXAMINED; HOWEVER, THE DATA SUGGEST THAT THE
PERFORMANCE OF THE WELD-HEAT-AFFECTED ZONE PARALLELS
THAT OF THE PARENT PLATE. HIGH EMBRITTLEMENT
SENSITIVITY WAS ALSO NOTED FOR THE ELECTROSLAG WELD
DEPOSIT, IN CONTRAST TO MARKEDLY LOW SENSITIVITY OF
THE WELDMENT PARENT PLATE.

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UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-682 380 11/6 20/11
ILLINOIS UNIV URBANA DEPT OF THEORETICAL AND APPLIED
MECHANICS

THE EMBRITTLING EFFECT OF SMALL ELASTIC STRESS WAVES
ON CRACK TOUGHNESS OF A STRUCTURAL STEEL, (U)

67 29P SHOEMAKER, A. KENT ;
CONTRACT: DA-31-124-ARO(D)~66
MONITOR: AROD 3216:4=MC

UNCLASSIFIED REPORT

AVAILABILITY: PUB. IN JNL. OF MATERIALS, V2 N3
P597-624 SEP 67.

SUPPLEMENTARY NOTE: PRESENTED AT THE ANNUAL MEETING OF
THE AMERICAN SOCIETY FOR TESTING AND MATERIALS
(70TH), BOSTON, MASS., 25-30 JUN 67.

DESCRIPTORS: (STEEL; MECHANICAL PROPERTIES);
IMPACT TESTS, STRESSES, STRESS CORROSION, LOW-
TEMPERATURE RESEARCH, FRACTOGRAPHY, EMBRITTLEMENT,
NOTCH SENSITIVITY, FATIGUE (MECHANICS) (U)

THE REDUCTION IN STATIC LOW-TEMPERATURE CRACK
TOUGHNESS, AS MEASURED BY FRACTURE MECHANICS WAS
STUDIED IN AN A201B STRUCTURAL GRADE STEEL FOR
THE EMBRITTLEMENT CAUSED BY SMALL-AMPLITUDE ELASTIC
STRESS WAVES SUPERIMPOSED ON THE STATIC STRESS STATE
OF AN EDGE-NOTCHED SPECIMEN. THE STRESS WAVES WERE
GENERATED BY FIVE DIFFERENT METHODS OF IMPACTING THE
EDGE OF THE SPECIMEN ON THE SIDE OPPOSITE THE CRACK
TIP WHEN A STATIC LOAD EXISTED ON THE SPECIMEN.
THE DATA SHOWED AN AVERAGE REDUCTION OF 26 PER CENT
IN THE STATIC STRESSES OVER A TEMPERATURE RANGE OF -
220 TO -190F FOR IMPACTING THE SPECIMEN WITH A
STEEL BALL, A STEEL BAR, OR A BALL PEEN HAMMER.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-682 601 11/6
MARTIN MAKIETTA CURP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

EFFECTS OF ALLOYING ON THE BRITTLE FRACTURE OF ZINC
IN LIQUID MERCURY, (U)

MAR 68 12P KAMDAR, M. H. WESTWOOD, A.
R. C. ;
CONTRACT: DA-31-124-ARO(U)-63
PROJ: DA-2-0-061102-D-32-D
MONITOR: AROU 3937:10-MC

UNCLASSIFIED REPORT
AVAILABILITY: PUB. IN ACTA METALLURGICA, V16
P1335-1342 1968.
SUPPLEMENTARY NOTE: REVISION OF REPT. DATED 2 JAN 68.
SUPERSEDES REPT. DATED DEC 67, AD-668 661.

DESCRIPTORS: (*ZINC ALLOYS, BRITTLENESS), COPPER
ALLOYS, GOLD ALLOYS, LIQUID METALS, MERCURY,
FRACTURE (MECHANICS), STRESSES, EMBRITTLEMENT (U)

THE SUSCEPTIBILITY OF POLYCRYSTALLINE ZINC TO
EMBRITTLEMENT BY LIQUID MERCURY IS MARKEDLY INCREASED
BY ALLOYING WITH AS LITTLE AS 0.2 AT.% OF COPPER OR
GOLD IN SOLID SOLUTION. TO DETERMINE THE CAUSE OF
THIS PHENOMENON, A STUDY HAS BEEN MADE OF THE EFFECTS
OF 0.05 OR 0.2 AT.% COPPER ON THE FLOW AND FRACTURE
BEHAVIOR OF AMALGAMATED ZINC MONOCRYSTALS AND
ASYMMETRIC BICRYSTALS. FRACTURE STRESS DATA FROM
THESE EXPERIMENTS WERE USED IN CONJUNCTION WITH A
CRITERION FOR CRACK INITIATION TO DETERMINE THE
INFLUENCE OF ALLOYING ON CLEAVAGE SURFACE ENERGY,
GAMMA. IT WAS FOUND THAT ALLOYING INCREASED THE
CRITICAL RESOLVED SHEAR STRESS (C.R.S.S.) (τ _{SUB C}) OF AMALGAMATED BICRYSTALS BY A FACTOR OF
TEN, AND THEIR FRACTURE STRESSES BY FACTORS OF 2-4,
BUT THAT GAMMA WAS INCREASED ONLY FROM 45 PLUS OR
MINUS 5 ERGS/SQ CM (PURE ZINC) TO 60 PLUS OR
MINUS 7 ERGS/SQ CM. THE SIGNIFICANCE OF THIS AND
OTHER OBSERVATIONS ARE DISCUSSED, AND IT IS CONCLUDED
THAT THE INCREASED SUSCEPTIBILITY TO EMBRITTLEMENT BY
LIQUID MERCURY OF POLYCRYSTALLINE ZINC ON ALLOYING IS
NOT RELATED TO SOLUTE-INDUCED CHANGES IN MACROSCOPIC
FLOW STRESS, STACKING FAULT ENERGY, SLIP MODE, OR
STATE OF BONDING, BUT IN τ _{SUB C}. INCREASING τ _{SUB C}
INHIBITS THE RELAXATION BY PLASTIC FLOW OF
STRESS CONCENTRATIONS AT GRAIN BOUNDARIES, AND, IN
THE PRESENCE OF MERCURY, FACILITATES CRACK
INITIATION. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-682 603 11/6

MARTIN MARIETTA CORP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

EMBRITTLEMENT OF DILUTE ALLOYS OF ZINC BY LIQUID
MERCURY,

(U)

68

6P

KANDAR, M. H. WESTWOOD, A.

R. C. :

CONTRACT: DA-31-124-ARO(D)-63

PROJ: DA-2-0-061102B-32-U

MONITOR: AROD 3937:12-MC

UNCLASSIFIED REPORT

AVAILABILITY: PUB. IN TRANSACTIONS OF THE JAPAN
INST. OF METALS, V9-SUPPL. P979-980 1968.

SUPPLEMENTARY NOTE: PRESENTED AT PROCEEDINGS OF THE
INTERNATIONAL CONFERENCE ON THE STRENGTH OF METALS
AND ALLOYS.

DESCRIPTORS: (*ZINC ALLOYS, *EMBRITTLEMENT),
MERCURY, LIQUID METALS, COPPER ALLOYS,
FRACTURE(MECHANICS), TENSILE PROPERTIES

(U)

WHEN POLYCRYSTALLINE ZINC IS ALLOYED WITH 0.1-0.4
A/O COPPER, SILVER, OR GOLD, ITS SUSCEPTIBILITY TO
EMBRITTLEMENT BY LIQUID MERCURY AT ROOM TEMPERATURE
IS MARKEDLY INCREASED. IN ORDER TO CLARIFY SOME OF
THE FACTORS INVOLVED, A STUDY HAS BEEN MADE OF THE
TENSILE FLOW AND FRACTURE BEHAVIOR OF AMALGAMATED
MONOCRYSTALS AND ASYMMETRIC BICRYSTALS OF ZINC
CONTAINING 0.05 A/O AND 0.2 A/O COPPER IN SOLID
SOLUTION. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-683 183 21/9.2 20/11
EXPLOSIVES RESEARCH AND DEVELOPMENT ESTABLISHMENT WALTHAM
ABBAY (ENGLAND)

THE TENSILE PROPERTIES OF A POLYURETHANE
PROPELLANT, UP 2,

(U)

DEC '68 26P BRYANT, R. W. ; DUKES, W.
A. ;
REPT. NO. ERDE-22/R/68

UNCLASSIFIED REPORT

DESCRIPTORS: (*SOLID ROCKET PROPELLANTS, TENSILE
PROPERTIES), (*ISOCYANATE PLASTICS, TENSILE
PROPERTIES), EMBRITTLEMENT, STRAIN(MECHANICS),
BENDING, RUPTURE, STRESSES, GREAT BRITAIN

(U)

A SAMPLE OF A POLYURETHANE PROPELLANT, DESIGNATED
UP 2, HAS BEEN CHARACTERISED IN UNIAXIAL TENSION
USING TIME-TEMPERATURE SUPERPOSITION PRINCIPLES, OVER
WIDER RANGES OF STRAIN-RATE AND TEMPERATURE THAN HAVE
BEEN USED PREVIOUSLY. NEAR THE EMBRITTLEMENT
TEMPERATURE THE TRUE STRAIN (PHOTOGRAPHICALLY
DETERMINED) RAPIDLY BECOMES MUCH LESS THAN THE
NOMINAL STRAIN. CONSIDERATION OF NOMINAL STRAINS
CAN THUS BE MISLEADING. UNDER THE CONDITIONS OF
ROCKET IGNITION AT LOW TEMPERATURES THE TRUE STRAIN
IS RAPIDLY DECREASING, AND THE TRUE MODULUS
INCREASING, WITH DECREASING TEMPERATURE.

(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-686 183 11/6
RENSSELAER POLYTECHNIC INST TROY N Y

LIQUID METAL EMBRITTLEMENT, (U)

68 29P STOLOFF, N. S. ;
CONTRACT: DA-31-124-ARO(D)-468
PROJ: DA-2-0-061102-5-32-D
MONITOR: AROU 633912-MC

UNCLASSIFIED REPORT
AVAILABILITY: PUB. IN SURFACES AND INTERFACES, V2
P157-182 1968.

DESCRIPTORS: (*EMBRITTLEMENT, *LIQUID METALS),
DUCTILE BRITTLE TRANSITION, LIQUID METALS, GRAIN
BOUNDARIES, DIFFUSION, CRACK PROPAGATION, REVIEWS (U)

LIQUID METAL EMBRITTLEMENT SOMETIMES OCCURS BY
DIFFUSION-CONTROLLED PROCESSES SUCH AS GRAIN BOUNDARY
PENETRATION. THIS TYPE OF BEHAVIOR, WHICH ALWAYS
LEADS TO INTERGRANULAR FAILURE, HAS BEEN TREATED
THEORETICALLY BY GRAIN BOUNDARY WETTING CONCEPTS AND
BY A STRESS-ENHANCED DISSOLUTION MODEL. DIFFUSION
ALONG BOUNDARIES MAY ALSO PLAY A ROLE IN DELAYED
FAILURE (STATIC FATIGUE) PHENOMENA, AS THERE IS
EVIDENCE OF SURFACE NOTCHING DURING EXPOSURE OF
SUSCEPTIBLE SOLIDS TO LIQUID METALS. REFRACTORY
METALS ARE SUBJECT TO A CORROSION-TYPE ATTACK BY
BOILING MERCURY AT TEMPERATURES GREATER THAN 600C;
THIS REPRESENTS THE THIRD MAJOR CLASS OF LIQUID METAL
EMBRITTLEMENT PHENOMENA. THE INTERRELATIONSHIP
AMONG AND THE DISTINGUISHING FEATURES OF THE VARIOUS
FORMS OF EMBRITTLEMENT WILL BE DISCUSSED.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-686 398 21/4.2
EXPLOSIVES RESEARCH AND DEVELOPMENT ESTABLISHMENT WALTHAM
ABBAY (ENGLAND)

MEASUREMENT OF EMBRITTLEMENT TEMPERATURES (BRITTLE
POINTS) OF COMPOSITE PROPELLANTS BY THE BENDING BEAM
METHOD. (U)

DESCRIPTIVE NOTE: TECHNICAL MEMO.,
OCT 68 1BP BRYANT, R. W. DUKES, W.
A. ;
REPT. NO. LRDE-15/M/68

UNCLASSIFIED REPORT

DESCRIPTORS: (•COMPOSITE PROPELLANTS,
EMBRITTLEMENT), TRANSITION TEMPERATURE,
IGNITION, STRAIN(MECHANICS),
FRACTURE(MECHANICS), RUPTURE, BENDING,
TENSILE PROPERTIES, ELASTICITY, PLASTICITY,
DEFORMATION, TEST EQUIPMENT, STRAIN GAGES,
ISOCYANATE PLASTICS, TEMPERATURE, GREAT BRITAIN,
SOLID ROCKET PROPELLANT BINDERS, POLYETHYLENE,
PLASTICS, BUTADIENES (U)
IDENTIFIERS: •BENDING BEAM TEST METHOD,
POLYISOBUTYLENE, POLYBUTADIENE (U)

A BENDING-BEAM METHOD FOR MEASURING EMBRITTLEMENT
TEMPERATURES HAS BEEN REINTRODUCED AND EVALUATED BY
COMPARING THE RESULTS OBTAINED WITH IT USING THREE
DIFFERENT KINDS OF COMPOSITE PROPELLANT (BASED ON
POLYISOBUTYLENE, POLYURETHANE OR CARBOXY-TERMINATED
POLYBUTADIENE BINDERS) WITH MASTER CURVES OF
STRAIN-AT-RUPTURE AS A FUNCTION OF 'REDUCED' STRAIN-
RATE (ITSELF A FUNCTION OF STRAIN-RATE AND OF
TEMPERATURE) DERIVED INDEPENDENTLY. THREE
DEGREES OF BENDING, IMPOSING STRAINS OF 5, 10 AND 25
PER CENT, WERE USED. GOOD AGREEMENT BETWEEN THE
TWO GROUPS OF RESULTS WAS FOUND, AND IT IS CONCLUDED
THAT THIS BENDING-BEAM METHOD IS IN PRINCIPLE
SUITABLE AS A ROUTINE INSPECTION TEST. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-690 245 11/6 20/12
ARMY MATERIALS AND MECHANICS RESEARCH CENTER WATERTOWN
MASS

FATIGUE-CRACK PROPAGATION IN 4340 STEEL AS
AFFECTED BY TEMPERING TEMPERATURE.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JUN 69 2/P ANCTIL, ALBERT A. IKULA,
ERIC S. I
REPT. NO. AMMRC-TR-69-15
PROJ: DA-1-T-D62105-A-328

UNCLASSIFIED REPORT

DESCRIPTORS: (STEEL, CRACK PROPAGATION),
FATIGUE (MECHANICS), TEMPERING, MARTENSITE,
FRACTURE (MECHANICS), TOUGHNESS, IMPACT TESTS,
STRESSES, STRAIN (MECHANICS), EMBRITTLEMENT,
LIFE EXPECTANCY, ETHANOLS
IDENTIFIERS: STEEL 4340

(U)

(U)

THE FATIGUE-CRACK PROPAGATION BEHAVIOR OF HEAT-
TREATED 4340 STEEL HAS BEEN STUDIED AS A FUNCTION OF
TEMPERING TEMPERATURE FROM 400 TO 800 F AND AT +
80 AND -50 F TEST TEMPERATURES. FRACTURE
MECHANICS ANALYSIS OF THE DATA WAS USED FOR THROUGH-
THICKNESS CRACKS IN CENTER-NOTCHED SHEET SPECIMENS.
SPECIAL EMPHASIS WAS PLACED ON THE PHENOMENON OF
TEMPERED MARTENSITE EMBRITTLEMENT, WHICH OCCURS IN
THE 500 TO 700 F RANGE OF TEMPERING TEMPERATURES,
TO SEE IF IT CAN BE DETECTED BY FATIGUE TESTING.
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-690 806 11/6
ARMY MATERIALS AND MECHANICS RESEARCH CENTER WATERTOWN
MASS

THERMAL EMBRITTLEMENT OF STEEL FOR 175-MM GUN
TUBES. (U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JUN 69 2UP CARR, FRANK L.; FLARSON,
FRANK R. ;
REPT. NO. AMMRC-TR-69-16
PROJ: DA-1-C-024401-A-110

UNCLASSIFIED REPORT

DESCRIPTORS: (*GUN BARRELS, *EMBRITTLEMENT),
(*STEEL, HEAT TREATMENT), BRITTLENESS,
TEMPERING, TOUGHNESS, FRACTURE(MECHANICS),
IMPACT TESTS, HARDNESS (U)
IDENTIFIERS: TRANSITION TEMPERATURE, M-113
GUNS(175-MM), 175-MM GUN TUBES (U)

SECTIONS OF TWO 175-MM M113 GUN TUBES WERE
UTILIZED TO STUDY THE DEVELOPMENT OF BOTH REVERSIBLE
AND IRREVERSIBLE TEMPER BRITTLENESS IN 3 PERCENT
NICKEL-CHROMIUM GUN STEEL. RELATIVE MATERIAL
TOUGHNESS INDICATED BY THE 100 PERCENT FIBROUS
TRANSITION TEMPERATURE WAS DETERMINED ON NUMEROUS
GROUPS OF SPECIMENS TEMPERED BETWEEN 900 AND 1200 F
FOR VARIOUS TIMES. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-692 072 18/8 11/6 18/10
NAVAL RESEARCH LAB WASHINGTON D C

DAMAGE-FUNCTION ANALYSIS OF NEUTRON-ENERGY AND
SPECTRUM EFFECTS UPON THE RADIATION EMBRITTLEMENT OF
STEELS. (U)

DESCRIPTIVE NOTE: INTERIM REPT.,
JUL 69 2UP SERPAN, C. Z. , JR.;
MCELROY, W. N. ;
REPT. NO. NRL-6925
PROJ. NRL-MOI-14, RR-007-11-41-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *RADIATION DAMAGE),
REACTOR MATERIALS, PRESSURE VESSELS,
EMBRITTLEMENT, NEUTRON FLUX, NEUTRONS (U)
IDENTIFIERS: STEEL A-302-B (U)

THE REPORT PRESENTS THE RESULTS OF A NEW,
COMPREHENSIVE SET OF EXPERIMENTAL DATA CONFORMING TO
THE IRRADIATION CONDITIONS OF THE DERIVED DAMAGE
FUNCTION (MATERIAL, TEMPERATURE, AND FLUENCE).
THE RESULTS OF THIS EXPERIMENT ARE DISCUSSED IN
TERMS OF THEIR ESTABLISHING THE VALIDITY OF THE
DAMAGE FUNCTION. AVERAGED VALUES OF THE DAMAGE
FUNCTION ARE TABULATED FOR A TYPICAL REACTOR PHYSICS
CALCULATION ENERGY GROUP STRUCTURE, AND THEIR
APPLICATION TO TWO DIFFERENT SPECTRA IS DESCRIBED.
FINALLY, THE DAMAGE-FUNCTION FLUENCES REQUIRED TO
CAUSE A 200F DELTA-TT IN A302-B STEEL ARE
PRESENTED FOR MANY DIFFERENT REACTOR LOCATIONS.
FOR EACH OF THE SPECTRA INVOLVED, THE UPPER AND
LOWER ENERGY LIMITS OF SIGNIFICANTLY DAMAGING
NEUTRONS ARE GIVEN, AND SOME DETAIL IS ALSO PROVIDED
REGARDING THE CONTRIBUTION OF SUBGROUPS WITHIN THE
OVERALL ENERGY SPECTRUM. (AUTHOR) (U)

UNCLASSIFIED

UDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-694 058 20/2 20/1.
MARTIN MARIETTA CORP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

SURFACE AND ENVIRONMENT-SENSITIVE MECHANICAL
BEHAVIOR.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JUL 69 159P WESTWOOD, ALBERT R. C. ;
LATANISION, R. M. ;
REPT. NO. TR-12, RIAS-TR-69-9C
CONTRACT: NONR-4162(UD)
PROJ: NR-DJ6-U55

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PREPARED IN COOPERATION WITH
NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.

DESCRIPTORS: (*CRYSTAL STRUCTURE, SURFACE
PROPERTIES), (*CRYSTALS, MECHANICAL PROPERTIES),
INORGANIC COMPOUNDS, METALLIC CRYSTALS,
CRYSTALLOGRAPHY, ENVIRONMENT, DEFORMATION,
CRYSTAL LATTICE DEFECTS, ATOMIC PROPERTIES,
ADSORPTION, EMBRITTLEMENT, FILMS, CHEMICAL
CONTAMINATION, SOLVENT ACTION, DIFFUSION
IDENTIFIERS: IONIC CRYSTALS, REBINDER EFFECT

(U)

(U)

THE INFLUENCES OF SURFACE STRUCTURE AND ENVIRONMENT
ON THE MECHANICAL BEHAVIOR OF CRYSTALLINE INORGANIC
SOLIDS ARE REVIEWED AND POSSIBLE MECHANISMS
DISCUSSED. IN PARTICULAR, THE VARIOUS ROLES OF
SUCH FACTORS AS THE ATOMIC, ELECTRONIC, AND DEFECT
STRUCTURES OF THE NEAR-SURFACE REGIONS, THE PRESENCE
OF ADSORBED SURFACE-ACTIVE SPECIES, ALLOYED LAYERS,
OXIDE FILMS, GASEOUS OR LIQUID ENVIRONMENTS, ETC. ARE
CONSIDERED IN CONNECTION WITH THE ROSCOE,
REBINDER, AND JUFFE EFFECTS, LIQUID-METAL
EMBRITTLEMENT, COMPLEX-ION EMBRITTLEMENT, HYDROGEN
EMBRITTLEMENT, AND OTHER PHENOMENA. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-695 371 18/10 18/8 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 MAY-31
JUL 69,

AUG 69 48P STEELE, L. E. ; SERPAN, C.
Z. , JR. ; GRAY, R. A. , JR. ; WATSON, H. E. ;
SMITH, F. A. ;
REPT. NO. NRL-MR-2027
PROJ: NRL-M01-14, RR-007-01-41-5409

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SPONSORED BY U. S. ATOMIC
ENERGY COMMISSION. SEE ALSO QUARTERLY REPT. DATED
APR 69, AD-690 863.

DESCRIPTORS: (REACTOR MATERIALS, STEEL),
(STEEL, RADIATION DAMAGE), EMBRITTLEMENT,
POWER REACTORS, PRESSURE VESSELS, WELDS, NEUTRON
SPECTRUM, NEUTRON FLUX, FRACTURE (MECHANICS),
FRACTOGRAPHY, CRACKS, ANNEALING, MICROSTRUCTURE
IDENTIFIERS: STEEL A543, STEEL A550, STEEL
A537, STEEL A533

(U)

(U)

THE REPORT, COVERING RESEARCH FOR THE PERIOD 1
MAY - 31 JULY 1969, INCLUDES THE FOLLOWING:
(1) IRRADIATION RESPONSE OF A543 STEEL TO
DIFFERENT THERMAL/FAST NEUTRON FLUXES, (2)
MECHANICAL PROPERTY AND NEUTRON SPECTRUM ANALYSES OF
THE BIG ROCK POINT REACTOR PRESSURE VESSEL,
(3) CHARPY-V NOTCH CHARACTERISTICS OF
IRRADIATED A350-LF2 AND A537-B WELDMENTS FOR
PRESTRESSED CONCRETE LINER APPLICATIONS, (4) AN
ANALYSIS OF FRACTURE SURFACE MICROSTRUCTURE OF
RADIATION SENSITIVE STEELS BY SCANNING ELECTRON
MICROSCOPY, (5) THE INITIAL ASSESSMENT OF 550F
RADIATION EMBRITTLEMENT SENSITIVITY OF A SPECIAL
A533-B CLASS 1 ELECTROSLAG WELDMENT, AND
(6) MECHANICAL PROPERTIES ASSESSMENTS OF THICK
SECTION PLATES FROM LOW RESIDUAL A533-B SPECIAL
HEAT. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-696 057 18/10 11/6 20/11
NAVAL RESEARCH LAB WASHINGTON D C

BEHAVIOR OF MECHANICAL PROPERTIES IN NEUTRON
IRRADIATED 12NI-5CR-3MO MARAGING STEEL PLATE
AND COMPANION WELD METALS.

(U)

DESCRIPTIVE NOTE: INTERIM REPT.,
OCT 69 2UP GRAY, R. A. , JR.;
HAWTHORNE, J. R. ;
REPT. NO. NRL-6945
PROJ: RR-007-11-41-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*REACTOR MATERIALS, MARAGING
STEELS), (*MARAGING STEELS, RADIATION DAMAGE),
(*NEUTRON REACTIONS, MARAGING STEELS), WELDS,
HEAT TREATMENT, NOTCH TOUGHNESS, MICROSTRUCTURE,
AGING(MATERIALS), EMBRITTLEMENT, THERMAL
STABILITY, DETERIORATION, TENSILE PROPERTIES,
ELONGATION, REDUCTION OF AREA, YIELD POINT
IDENTIFIERS: *NEUTRON IRRADIATION

(U)

(U)

CHANGES OF CHARPY-V-NOTCH DUCTILITY AND TENSILE
STRENGTH IN NEUTRON-IRRADIATED 12NI-5CR-3MO
MARAGING STEEL HAVE BEEN EVALUATED FOLLOWING LOW
(LESS THAN 250F) AND ELEVATED (550 TO 740F)
TEMPERATURE EXPOSURE. THE STUDY WAS PERFORMED WITH
SIX HEATS OF 1-IN.-THICK PLATE MATERIAL AGED AT
900F FOR 2 AND 20 HR TO NOMINAL YIELD STRENGTHS OF
160 AND 180 KSI, RESPECTIVELY. THE LONG-TERM
THERMAL STABILITY OF BOTH HEAT-TREATMENT CONDITIONS
WAS INVESTIGATED FOR THE CONDITIONS OF IRRADIATION.
THE LESS THAN 250F AND 550F IRRADIATION
PERFORMANCE OF MATCHING (15-5-3) AND MISMATCHING
(17NI-2CO-3MO) TIG WELD DEPOSITS MARAGED
TO 180 KSI YIELD STRENGTH WAS ALSO ASSESSED IN THIS
STUDY. CHANGES IN THE GENERAL PROPERTIES OF THE
12-5-3 MARAGING STEEL PLATE AND COMPANION WELD METALS
WERE FOUND TO BE RATHER SMALL WITH LESS THAN 250F
EXPOSURES, INDICATING GOOD RESISTANCE TO NEUTRON-
INDUCED EMBRITTLEMENT. HOWEVER, A MARKED
DETERIORATION OF NOTCH-DUCTILITY PROPERTIES WITH
LONG-TERM EXPOSURE AT ELEVATED TEMPERATURE WAS
REVEALED AND TRACED TO A NONNUCLEAR THERMAL
INSTABILITY. THE OBSERVED INSTABILITY IS BELIEVED
TO BE A CONTINUATION OF AGING PROCESSES AT
TEMPERATURES WELL BELOW THE INITIAL MARAGING
TEMPERATURE.

(U)

UNCLASSIFIED

UDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-696 519 11/6 20/11
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO

FATIGUE AND EMBRITTLEMENT OF METALLIC MATERIALS,

(U)

SEP 69 303P IVANOVA, V. S. IGUREVICH, S.
E. KOPEV, I. M. KUDRYASHOV, V. G. ;
STEPANOV, V. N. ;
REPT. NO. FTD-HT-23-258-69(JPRS)
PROJ: FTD-723D178

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: UNEDITED ROUGH DRAFT TRANS. OF MONO.
USTALOST I KHRUPKOST METALLICHESKIKH MATERIALOV,
MOSCOW, 1968 P1-215.

DESCRIPTORS: (*FATIGUE(MECHANICS), METALS),
(*METALS, BRITTLNESS), (*EMBRITTLEMENT, TEST
METHODS), FRACTURE(MECHANICS), CRACK
PROPAGATION, EMBRITTLEMENT, STRESSES, STRESS
CORROSION, LOADING(MECHANICS), DEFORMATION,
DISLOCATIONS, USSR

(U)

IDENTIFIERS: TRANSLATIONS

(U)

THE SUBJECTS COVERED INCLUDE: METHODS OF
DETERMINING METAL SUSCEPTIBILITY TO BRITTLE FRACTURE
AND THE PATTERN OF CRACK PROPAGATION UNDER STATIC AND
CYCLIC LOADS, THE EMBRITTLING EFFECT OF CYCLIC LOADS,
THE INFLUENCE OF STRESS CONCENTRATORS AND FRETTING-
CORROSION ON FATIGUE RESISTANCE, PROBLEMS OF
DEVELOPING MATERIALS WITH HIGH RESISTANCE TO CRACK
PROPAGATION, AND VARIOUS ASPECTS OF ELASTIC MATERIALS
AND THEIR MECHANICAL PROPERTIES.

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-697 820 11/6 20/11
MARTIN MARIETTA CORP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

THE CHEMICAL AND PHYSICAL ASPECTS OF LIQUID METAL
EMBRITTEMENT, (U)

DESCRIPTIVE NOTE: FINAL REPT. MAY 66-JUN 69,
AUG 69 52P PREECE, CAROLYN H. WESTWOOD,
ALBERT R. C. ;
REPT. NO. RIAS-TR-69-4C
CONTRACT: DA-18-UOI-AMC-1109(X)

UNCLASSIFIED REPORT

DESCRIPTORS: (•EMBRITTEMENT, •LIQUID METALS),
(•METALS, FRACTURE(MECHANICS)), ALUMINUM,
CADMIUM, SILVER, BRASS, SILVER ALLOYS, GOLD
ALLOYS, BRITTLNESS, GRAIN SIZE, TRANSITION
TEMPERATURE, PHASE STUDIES, ADSORPTION (U)

A STUDY WAS MADE OF THE INFLUENCE OF VARIOUS LIQUID
METALS AND SOLUTIONS ON THE FRACTURE BEHAVIOR OF
ALUMINUM, CADMIUM, SILVER, BRASS AND SILVER-GOLD
ALLOYS. THE PRINCIPAL EXPERIMENTAL VARIABLES WERE
COMPOSITION AND GRAIN SIZE OF THE SOLID, COMPOSITION
OF THE LIQUID METAL PHASE, TEMPERATURE AND RATE OF
LOADING. THE RESULTS INDICATE THAT, BY USING
APPROPRIATE VALUES OF THESE VARIABLES, IT IS POSSIBLE
TO CONTROL (EITHER ENHANCE OR INHIBIT)
EMBRITTEMENT OVER FAIRLY WIDE RANGES.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-698 275 18/10 18/8 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 AUG-31
OCT 69,

NOV 69 27P STEELE, L. E.; HAWTHORNE, J.
R.; WATSON, H. E.; SERPAN, C. Z., JR.;
GRAY, R. A., JR;
REPT. NO. NRL-MR-2058
PROJ: RR-007-01-41-5409

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-695 371.

DESCRIPTORS: (1) REACTOR MATERIALS, STEEL;
(2) STEEL; (3) RADIATION DAMAGE; PRESSURE VESSELS,
FRACTURE (MECHANICS); EMBRITTLEMENT, ANNEALING,
THERMAL STABILITY, STAINLESS STEEL, DUCTILITY,
SENSITIVITY

(U)

THE REPORT INCLUDES: (1) INITIAL COMPARISONS
BETWEEN DYNAMIC TEAR TEST AND CHARPY V-NOTCH
IMPACT DATA FOR IRRADIATED STEELS, INCLUDING THE
PM-2A VESSEL STEEL; (2) THE RECOVERY OF
DUCTILITY BY ANNEALING HEAT TREATMENT OF STEELS
IRRADIATED TO DIFFERENT RATIOS OF THERMAL TO FAST
NEUTRONS; (3) THE UNIRRADIATED PROPERTIES OF
SPECIAL A533-B STEEL HEAT PROCURED FOR LOW
EMBRITTLEMENT SENSITIVITY; (4) DATA DESCRIBING
THE THERMAL STABILITY OF A POTENTIAL ADVANCED REACTOR
STRUCTURAL ALLOY, 5Ni-CR-MO-V STEEL, AND
(5) INITIAL STRENGTH AND DUCTILITY DATA ON
SELECTED AUSTENITIC STAINLESS STEELS, 304, 304L,
316, AND 316L, AFTER IRRADIATION IN THE EBR-II
REACTOR TO FLUENCES BETWEEN 0.4 AND 9.0 X 10 TO THE
20TH POWER N/SQ CM > 1 MEV AT TEMPERATURES
RANGING FROM 700F (371C) TO 830F (443C).
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-698 474 20/11
COLUMBIA UNIV NEW YORK HENRY KRUMB SCHOOL OF MINES

FUNDAMENTAL STUDIES OF FRACTURE. (U)

DESCRIPTIVE NOTE: FINAL REPT. 7 MAY 65-6 MAY 69,
DEC 69 1UP GENSAMER, MAXWELL ; LI, JAMES
C. M. ;

CONTRACT: DA-31-124-ARO(D)-382
PROJ: DA-2-0-061102-a-32-D
MONITOR: AROD 5642:4-MC

UNCLASSIFIED REPORT

DESCRIPTORS: (*FRACTURE(MECHANICS),
*STRAIN(MECHANICS)), BRITTLENESS, DEFORMATION,
STRAIN HARDENING, EMBRITTLEMENT, STRESSES,
DISLOCATIONS, FATIGUE(MECHANICS), IRON ALLOYS,
SILICON ALLOYS, CRACK PROPAGATION, BRASS (U)

THE INVESTIGATION OF FRACTURE FOCUSED ON
ELUCIDATING THE MECHANISMS BY WHICH STRAIN BECOMES SO
CONCENTRATED THAT THE WORK OF DEFORMATION, LIMITED TO
A SMALL VOLUME BECOMES LITTLE. THE RESEARCH
CONCERNED PRIMARILY WITH ENGINEERING MATERIALS
CONSISTED OF THE FOLLOWING PHASES: (1) A
THEORETICAL STUDY OF THE ELASTIC CONTRIBUTION TO THE
SURFACE ENERGY CONTROLLING FINAL SEPARATION OF THE
MATERIAL EMBRITTLED BY PLASTIC DEFORMATION. (2)
AN EXPERIMENTAL STUDY OF HOW TO REVEAL THE PLASTIC
ZONE AND MEASURE ITS SIZE IN MATERIALS OF INTEREST.
(3) A STUDY OF STRAIN HARDENING, WHICH CONTROLS
THE PLASTIC ZONE SIZE, BY STUDYING THE EFFECTS OF
PRIOR STRAIN ON THE OPERATION OF LATENT SLIP SYSTEMS.
(4) A STUDY OF STRAIN HARDENING BY CALCULATING
THE STRESS AT A POINT DUE TO PILE-UP COMPLETE
DISLOCATION LOOPS. (5) A STUDY OF THE PROCESS
OF FRACTURE IN FATIGUE, BOTH EXPERIMENTAL BY OPTICAL
AND ELECTRON MICROSCOPY, AND THEORETICAL BY APPLYING
DISLOCATION DYNAMICS. (6) AN EXPERIMENTAL AND
THEORETICAL STUDY OF PLASTIC ZONE STRAIN
DISTRIBUTION, CONTROLLING FRACTURE TOUGHNESS, AND
PROPAGATION VELOCITY CONTROLLING CRACK SPEED, IN IRON
AND AN IRON-SILICON ALLOY. (7) A SIMILAR STUDY
OF BRASS, INVOLVING STACKING-FAULT ENERGY AS A
VARIABLE. (8) A STUDY OF CREEP, RELATING TO THE
SLOW GROWTH OF CRACKS PRECEDING RAPID CRACK
PROPAGATION, BY APPLYING THE THEORY OF THERMALLY AND
STRESS ACTIVATED RATE PROCESSES TO DISLOCATION
MOVEMENTS. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-700 233 11/4 18/8 18/10
NAVAL RESEARCH LAB WASHINGTON D C

TRENDS IN CHARPY-V SHELF ENERGY DEGRADATION AND
YIELD STRENGTH INCREASE OF NEUTRON-EMBRITTLED
PRESSURE VESSEL STEELS. (U)

DESCRIPTIVE NOTE: INTERIM REPT.,

DEC 69 29P HAWTHORNE, J. RUSSELL ;
REPT. NO. NRL-7011
PROJ: NRL-M01-14, RR-007-11-46-5409

UNCLASSIFIED REPORT

DESCRIPTORS: (*NUCLEAR REACTORS, MATERIALS),
(*STEEL, *RADIATION DAMAGE), PRESSURE VESSELS,
EMBRITTEMENT, IMPACT TESTS, NEUTRON REACTIONS,
TRANSITION TEMPERATURE, DUCTILITY, TOUGHNESS,
TENSILE PROPERTIES, WELDS (U)

IDENTIFIERS: STEEL A-302-B, STEEL A-533,
STEEL A-543 (U)

THE EFFECTS OF NEUTRON IRRADIATION ON CHARPY-V
SHELF ENERGY AND YIELD STRENGTH WAS EXAMINED FOR
THREE PRESSURE VESSEL STEEL COMPOSITIONS: A302-B,
A533, AND A543. THE EFFECTS OF RADIATION
EXPOSURE AT LOW TEMPERATURE (<300F (149C))
AND AT ELEVATED TEMPERATURE (550F (288 C) TO
740F (393C)) ON THE OVERALL NOTCH DUCTILITY ARE
DOCUMENTED AND COMPARED. SUMMARY PLOTS SHOWING THE
SIMULTANEOUS DEGRADATION IN SHELF ENERGY AND THE
INCREASE OF YIELD STRENGTH LEVELS BROADLY ILLUSTRATE
THE PROGRESSIVE CHANGE FROM DUCTILE FRACTURE
PERFORMANCE TO RELATIVELY BRITTLE CHARACTERISTICS.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-700 298 13/8
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO

METAL SOLDERING,

(U)

SEP 69 441P LASHKO, V. F. (LASHKO, S.
V. I.
REPT. NO. FTD-MT-24-390-68
PROJ: FTD-7230278

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: EDITED MACHINE TRANS. OF MONU. PAIKA
METALLOV, MOSCOW, 1967 P1-367.

DESCRIPTORS: (*SOLDERING, REVIEWS), SOLDERED
JOINTS, SOLDERING ALLOYS, SOLDERING FLUXES, METAL
PLATES, EMBRITTLEMENT, STRESSES, DIFFUSION
BONDING, BONDING, BRAZING, METAL JOINTS,
CRACKS, CRYSTALLIZATION, HEAT-RESISTANT MATERIALS,
INTERACTIONS, USSR

(U)

IDENTIFIERS: TRANSLATIONS

(U)

THE BOOK INCLUDES MATERIAL ON NEW VARIETIES OF
SOLDERING: DIFFUSION, RESISTANCE-REACTION; THE
LATEST ACHIEVEMENTS IN THE REGION OF SOLDERING
TECHNOLOGY OF ALLOYS BASED ON ALUMINUM, COPPER
TITANIUM AND OTHERS ARE DESCRIBED. BASIC
INFORMATION ON THE PHYSICAL CHEMISTRY FUNDAMENTALS OF
PROCESSES OF SOLDERING ARE DISCUSSED, ESPECIALLY ON
THE INTERACTION OF THE METAL TO BE SOLDERED WITH THE
LIQUID SOLDER. PRACTICAL EXPERIENCE IS GENERALIZED
IN THE APPRAISAL OF THE EFFECT OF COMPOSITIONS OF
SOLDERS, SOLDERABLE METALS AND BASIC TECHNOLOGICAL
FACTORS ON THE QUALITY OF SOLDERED JOINTS.

(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-701 047 11/6
ILLINOIS INST OF TECH CHICAGO DEPT OF METALLURGICAL
ENGINEERING

THE EFFECT OF LEAD ON MICRO-CRACK INITIATION AND
PROPAGATION IN ALLOY STEELS. THE EFFECT OF
COMPOSITION AND TEST CONDITIONS ON LEAD-
EMBRITTLEMENT OF STEEL. (U)

DESCRIPTIVE NOTE: FINAL REPT. ON PHASE 2,
NOV 69 149P WARKE, WILLIAM R. ; BREYER,
NORMAN N. ;
CONTRACT: DA-20-113-AMC-10820(T)
MONITOR: TACUM TR-10752

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, EMBRITTLEMENT),
(*EMBRITTLEMENT, *LEAD); LEAD ALLOYS,
FRACTURE(MECHANICS), CRACK PROPAGATION,
FATIGUE(MECHANICS), GRAIN SIZE,
STRAIN(MECHANICS), CRACKS, TEMPERATURE,
FRACTOGRAPHY (U)

IDENTIFIERS: STEEL 4145 (U)

THE EFFECTS OF COMPOSITION GRAIN SIZE, STRAIN RATE
AND OTHER VARIABLES ON THE LEAD-EMBRITTLEMENT OF
STEELS WERE STUDIED. THE LEAD EMBRITTLEMENT OF
STEEL WAS OBSERVED AS A LOSS IN DUCTILITY AND TRUE
FRACTURE STRENGTH OF HEAT TREATED STEEL TESTED AT
ELEVATED TEMPERATURES IN THE PRESENCE OF LEAD. THE
EMBRITTLEMENT WAS SEEN WHEN THE LEAD WAS PRESENT
EITHER INTERNALLY IN THE STEEL (LEADED STEEL) OR
SOLDERED TO THE SURFACE. THE PHENOMENON WAS FOUND
TO EXIST OVER A RANGE OF TEMPERATURES FROM ABOUT
300F (I.E. MORE THAN 300 F BELOW THE MELTING
POINT OF LEAD) TO A BRITTLE-TO-DUCTILE TRANSITION
TEMPERATURE WHICH RANGED FROM 700 F TO OVER 900 F
DEPENDING ON A NUMBER OF FACTORS B. IT WAS FOUND
THAT THE EMBRITTLEMENT VARIED WITH COMPOSITION AND
SEEMED, AT AN EQUIVALENT STRENGTH LEVEL, TO BE MORE
SEVERE THE LOWER THE CARBON OR ALLOY CONTENT OF THE
STEEL. THE LEAD CONTENT OF A LEADED STEEL WAS
FOUND TO BE UNIMPORTANT, BUT THE COMPOSITION OF THE
LEAD WAS CRITICAL. OTHER VARIABLES WHICH WERE
STUDIED INCLUDED GRAIN SIZE, LOADING RATE, PRIOR
PLASTIC STRAINING AT ROOM TEMPERATURE AND CYCLIC
LOADING. (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 148ML1

AD-706 004 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

POSTIRRADIATION CHARPY-V AND DYNAMIC TEAR SHELF
LEVEL PERFORMANCE OF 12-IN. THICK A533-B
PLATES AND WELD METAL. (U)

DESCRIPTIVE NOTE: MEMORANDUM REPT.,
APR 70 12P HANTHORNE, J. R. ;
REPT. NO. NRL-MR-2114
PROJ: RRU07-11-41-5409, NRL-MD1-14

UNCLASSIFIED REPORT

DESCRIPTORS: (*REACTOR MATERIALS, STEEL),
(*STEEL, RADIATION DAMAGE), METAL PLATES,
WELDS, PRESSURE VESSELS, NEUTRON REACTIONS,
EMBRIITLEMENT, DUCTILITY, IMPACT TESTS (U)
IDENTIFIERS: STEEL A-533B (U)

CHARPY-V (CV) AND DYNAMIC TEAR (DT) TEST
COMPARISONS AT SHELF LEVEL TEMPERATURES WERE
DEVELOPED FOR THE IRRADIATED CONDITION OF TWO 12-IN.-
THICK A533-B STEEL PLATES AND A SUBMERGED ARC
WELD DEPOSIT. MATERIALS FOR THIS INVESTIGATION WERE
PROVIDED BY THE U. S. ATOMIC ENERGY
COMMISSION'S HEAVY SECTION STEEL TECHNOLOGY
(HSSST) PROGRAM. INDIVIDUAL PLATES WERE
IDENTIFIED AS HSSST PLATES NOS. 01 AND 02; THE
WELD PREPARED BY COMBUSTION ENGINEERING WAS
IDENTIFIED AS WELD 50. LOW TEMPERATURE (<300F,
149C) AND ELEVATED TEMPERATURE (550F, 288C)
IRRADIATIONS WERE CONDUCTED. FLUENCES FOR THE EIGHT
IRRADIATION EXPERIMENTS RANGED FROM 2 TO 3 X 10 TO
THE 19TH POWER N/SQ CM >1 MEV. EXPERIMENTAL
RESULTS INDICATE THAT THE PERCENT REDUCTION IN C
SUB V SHELF ENERGY IS COMPARABLE TO THE PERCENT
REDUCTION IN DT SHELF ENERGY/C SUB V SHELF ENERGY
RATIO FOR AN INDIVIDUAL MATERIAL ARE RETAINED UNDER
IRRADIATION. OBSERVATIONS ARE IN AGREEMENT WITH
RECENT FINDINGS FOR A543 AND OTHER A533 STEEL
PLATES. RATIO RETENTION WOULD PERMIT THE DERIVATION
OF AN APPROXIMATE POSTIRRADIATION DT SHELF ENERGY
FROM POSTIRRADIATION C SUB V SHELF ENERGY FOR
FRACTURE SAFETY ANALYSES. (AUTHOR) (U)

UNCLASSIFIED

UDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-708 377 11/6 13/8
NAVAL RESEARCH LAB WASHINGTON D C

CORROSION FATIGUE CRACK GROWTH BEHAVIOR ABOVE AND
BELOW K SUB ISCC. (U)

DESCRIPTIVE NOTE: FINAL REPT.,
MAY 70 23P GALLAGHER, J. P. ;
REPT. NO. NRL-7064
PROJ: NRL-M01-08, RR07-01-46-5416

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *CRACK PROPAGATION),
(*STRESS CORROSION, STEEL),
FATIGUE(MECHANICS), FRACTURE(MECHANICS),
HYDROGEN EMBRITTLEMENT (U)
IDENTIFIERS: STEEL HY-80, STEEL 4340 (U)

THE PURPOSE OF THIS INVESTIGATION WAS TO CONTRAST
THE SALT WATER CORROSION FATIGUE CRACK PROPAGATION
BEHAVIORS OBSERVED IN THE TWO REGIMES OF NO
MEASURABLE SUSTAINED LOAD CRACK PROPAGATION AND OF
MEASURABLE STRESS-CORROSION CRACKING RATES. A
TYPICAL STRUCTURAL STEEL, HY-80 STEEL, HAVING
INTERMEDIATE STRENGTH AND HIGH TOUGHNESS, WAS
SELECTED FOR ITS HIGH RESISTANCE TO ENVIRONMENTAL
CRACKING UNDER SUSTAINED LOAD. A HIGH-STRENGTH 4340
STEEL WHICH WAS PREVIOUSLY SHOWN TO BE HIGHLY
SUSCEPTIBLE TO ENVIRONMENTAL CRACKING UNDER SUSTAINED
LOADS WAS CHOSEN FOR THE STUDY. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-709 164 11/6
TRW EQUIPMENT LABS CLEVELAND OHIO MATERIALS TECHNOLOGY
DEPT

EVALUATION OF HYDROGEN EMBRITTLEMENT
MECHANISMS.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
JUL 70 25P BARTH, C. F.; STEIGERWALD,
E. A.;
REPT. NO. ER-7477
CONTRACT: N00014-69-C-0286

UNCLASSIFIED REPORT

DESCRIPTORS: (*HYDROGEN EMBRITTLEMENT, THEORY),
(*STEEL, HYDROGEN EMBRITTLEMENT), CRACK
PROPAGATION, STRESSES, DIFFUSION

(U)

THE INCUBATION TIME WHICH PRECEDES THE INITIATION
OF SLOW CRACK GROWTH IN THE DELAYED FAILURE OF HIGH-
STRENGTH STEEL CONTAINING HYDROGEN WAS REVERSIBLE
WITH RESPECT TO THE APPLIED STRESS. THE KINETICS OF
THE REVERSIBILITY PROCESS INDICATED THAT IT WAS
CONTROLLED BY THE DIFFUSION OF HYDROGEN AND HAD AN
ACTIVATION ENERGY OF APPROXIMATELY 9000 CAL/MOLE.
REVERSIBLE HYDROGEN EMBRITTLEMENT STUDIES WERE ALSO
CONDUCTED AT LIQUID NITROGEN TEMPERATURES WHERE
DIFFUSIONAL PROCESSES SHOULD NOT OCCUR. THE
PREVIOUSLY REPORTED LOW TEMPERATURE EMBRITTLEMENT
BEHAVIOR WAS CONFIRMED INDICATING A BASIC INTERACTION
BETWEEN HYDROGEN AND THE LATTICE. THE EXPERIMENTAL
RESULTS COULD BE SATISFACTORILY EXPLAINED BY THE
LATTICE EMBRITTLEMENT THEORY PROPOSED BY TROIANO.
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 148ML1

AD-709 554 16/10
NAVAL RESEARCH LAB WASHINGTON D C

THE INFLUENCE OF COMPOSITION ON THE FRACTURE
TOUGHNESS OF COMMERCIAL NUCLEAR VESSEL WELDS. (U)

DESCRIPTIVE NOTE: INTERIM REPT.,
JUN 70 22P STEELE,LENDELL E. ;
REPT. NO. NRL-7095
CONTRACT: AT(49-5)-2110
PROJ: KR007-11-41

UNCLASSIFIED REPORT

DESCRIPTORS: (•NUCLEAR POWER PLANTS, PRESSURE
VESSELS), (•PRESSURE VESSELS, EMBRITTLEMENT),
METAL JOINTS, WELDS, FRACTURE(MECHANICS),
TOUGHNESS, RADIATION DAMAGE, STATISTICAL DATA (U)
IDENTIFIERS: FRACTURE MECHANICS, RADIATION
EMBRITTLEMENT, STEEL A302-B, STEEL A533-B,
ELECTROSLAG WELDING (U)

IRRADIATION STUDIES OF WELDS OF THE ASTM TYPE
A302-B AND A533-B STEELS, MOST COMMONLY USED
FOR COMMERCIAL WATER REACTOR VESSELS, DEMONSTRATED
SEVERAL INSTANCES IN WHICH THE WELD METAL EXHIBITED
LOWER FRACTURE TOUGHNESS OR GREATER ELEVATION OF THE
BRITTLE-TO-DUCTILE TRANSITION TEMPERATURE THAN THAT
OBSERVED FOR THE COMPANION BASE-PLATE AND WELD HEAT-
AFFECTED-ZONE MATERIAL. EXAMINATION OF THE
STRUCTURE AND COMPOSITION LED TO THE CONCLUSION THAT
COMPOSITION IS CRITICAL TO THE LEVEL OF RADIATION-
INDUCED EMBRITTLEMENT. THE LEVEL OF COPPER AND
PHOSPHORUS CONTENTS HAS BEEN SHOWN TO BE ESPECIALLY
CRITICAL TO THE LEVEL OF EMBRITTLEMENT WITH WELDS
HAVING HIGH COPPER (>0.20%) AND PHOSPHORUS (>
0.015%) SHOWING GREATER EMBRITTLEMENT THAN THOSE
CONTAINING LESSER AMOUNTS. THESE EXPERIMENTAL
OBSERVATIONS WERE VERIFIED THROUGH LABORATORY TESTS
IN WHICH THESE CONSTITUENTS AND OTHER RESIDUAL
ELEMENTS WERE CONTROLLED IN WELDMENTS SIMULATING
THOSE FOR REACTOR SERVICE. (AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 128ML1

AD-709 898 -79 11/6
NAVAL RESEARCH LAB WASHINGTON D C

ANALYSIS OF NEUTRON-EMBRITTLEMENT AND FLUX-
DENSITY CONSIDERATIONS OF THE ARMY SM-1 REACTOR
PRESSURE VESSEL, (U)

JUN 70 24P SERPAN, CHARLES Z. , JR;
REPT. NO. NRL-7101
PROJ: NRL-M01-14, USA-ERG-11-69

UNCLASSIFIED REPORT

DESCRIPTORS: (•PRESSURIZED WATER REACTORS, PRESSURE
VESSELS), (•STEEL, EMBRITTLEMENT), NEUTRON
FLUX, DOSIMETERS, NEUTRON SPECTRUM, TEMPERATURE,
POWER REACTORS, STATISTICAL ANALYSIS, TRANSITION
TEMPERATURE, REACTOR SYSTEM COMPONENTS (U)
IDENTIFIERS: FLUENCE, STEEL A-212, SM-1A
REACTORS (U)

THE ARMY SM-1 REACTOR HAS BEEN EVALUATED WITH
RESPECT TO THE INCREASE IN TRANSITION TEMPERATURE OF
THE A212-B STEEL PRESSURE VESSEL. ALTHOUGH
STEEL FROM THE HEAT FORMING THE VESSEL IS NOT
AVAILABLE FOR IRRADIATION-RESPONSE BEHAVIOR TESTING,
THE INITIAL TRANSITION TEMPERATURE OF 40 DEG F (4
DEG C) WAS DETERMINED FROM VESSEL STEEL. A
RELATIONSHIP BETWEEN INCREASING EMBRITTLEMENT FOR A
4-IN.-THICK PLATE OF A212-B STEEL, REPRESENTING
THE ASTM REFERENCE HEAT FOR THIS COMPOSITION, AND
INCREASING NEUTRON FLUENCE WAS ESTABLISHED FOR THE
IRRADIATION TEMPERATURE CONDITIONS OF THE SM-1
REACTOR. COMBINING WITH THIS THE ARMY-IMPOSED
TRANSITION TEMPERATURE LIMIT FOR THE SM-1 REACTOR
VESSEL OF 295 DEG F (146 DEG C) RESULTS IN A
FLUENCE VALUE OF 2.65×10 TO THE 19TH POWER N/5Q.CM.
> 0.5 MEV FOR A LIFETIME VESSEL EXPOSURE. THE
NEUTRON FLUX LEVEL FOR THE VESSEL WAS ESTABLISHED BY
EXTRAPOLATING A CORE-REGION FLUX MEASUREMENT USING
THE RESULTS OF A CALCULATED NEUTRON SPECTRUM AT THE
REACTOR VESSEL. (AUTHOR) (U)

UNCLASSIFIED

DOC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-711 321 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 MAY-31
JUL 70,

AUG 70 36P STEELE, L. W. ; HAWTHORNE, J.
R. ; SERPAN, C. Z. ; JR. ; SMIDT, F. A. ; JR. ;
REPT. NO. NRL-MR-2153
CONTRACT: AT(49-5)-2110
PROJ: RR007-14-41-5409, NRL-M01-14

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO AD-707 336.

DESCRIPTORS: (*REACTOR MATERIALS, RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE),
(*VANADIUM, RADIATION DAMAGE),
FRACTURE (MECHANICS), PRESSURE VESSELS, NEUTRON
REACTIONS, EMBRITTLEMENT
IDENTIFIERS: STEEL A-533b

(U)

(U)

THE REPORT INCLUDES: (1) ASSESSMENTS OF
RADIATION RESISTANT A533-B PLATE FROM A
CONTROLLED COMPOSITION 30-TON DEMONSTRATION MELT,
(2) A STUDY OF THROUGH-THICKNESS DUCTILITY IN AN
IRRADIATED REACTOR VESSEL WALL, (3) NEUTRON
EMBRITTLEMENT IN A SIMULATED REACTOR PRESSURE VESSEL
WALL, AND (4) FUNDAMENTAL EXPLORATION OF
RADIATION DAMAGE IN VANADIUM. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-714 166 11/6 18/8
NAVAL RESEARCH LAB WASHINGTON D C

DEMONSTRATION OF IMPROVED RADIATION
EMBRITTLEMENT RESISTANCE OF A533-B STEEL
THROUGH CONTROL OF SELECTED RESIDUAL
ELEMENTS.

(U)

DESCRIPTIVE NOTE: SUMMARY REPT.:

MAY 70 34P HARTHORNE, J. RUSSELL ;
REPT. NO. NRL-7121
CONTRACT: AT(49-5)-2110
PROJ: RR007-11-41-5409, NRL-M01-14

UNCLASSIFIED REPORT

DESCRIPTORS: (STEEL, RADIATION DAMAGE),
EMBRITTLEMENT, SENSITIVITY, PRESSURE VESSELS,
REACTOR MATERIALS, DUCTILITY, TRANSITION
TEMPERATURE, IMPURITIES, REDUCTION
IDENTIFIERS: STEEL A-533B

(U)

(U)

THE PRIMARY OBJECTIVE OF SPECIAL MELT
SPECIFICATIONS AND MELT PLANNING WAS THE REDUCTION OF
CUPPER AND PHOSPHORUS CONTENTS TO THE LOWEST POSSIBLE
LEVEL. RESTRICTIONS WERE ALSO IMPOSED ON THE
CONTENT OF OTHER RESIDUAL IMPURITY ELEMENTS WITH
KNOWN OR SUSPECTED INFLUENCES ON RADIATION
EMBRITTLEMENT RESISTANCE. FOR A BROAD EXPERIMENTAL
ANALYSIS, THE MELT WAS SPLIT TO PROVIDE MATERIAL
REPRESENTING THE PRIMARY MELT ANALYSIS (0.038
CU) AND A MELT MODIFICATION (0.138 CU).
PLATES REPRESENTING EACH ANALYSIS WERE ALSO SPLIT
AND SECTIONS INDIVIDUALLY HEAT-TREATED TO CLASS 1
OR CLASS 2 STRENGTH CONDITIONS. ALL PROCEDURES
USED WERE STANDARD MILL PRACTICES. RADIATION
ASSESSMENTS SHOWED THE PRIMARY MELT ANALYSIS TO HAVE
VERY LOW SENSITIVITY TO RADIATION EMBRITTLEMENT AT
550F (288C). (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-715 437 81/11
LOCKHEED-GEORGIA CO MARIETTA MATERIALS SCIENCES RESEARCH
LAB

CLEANING AND CHEMICAL TREATMENT OF AIRCRAFT
SURFACES TO PROVIDE OPTIMUM CLEANING
PROPERTIES.

(U)

DESCRIPTIVE NOTE: FINAL SUMMARY REPT. 23 OCT 67-23 OCT
70,

OCT 70 129P MILLER, R. N. HUMPHREY, F.
T. BLEICH, A. ;
REPT. NO. LGR-ER-9703-8
CONTRACT: N00019-66-C-0017

UNCLASSIFIED REPORT

DESCRIPTORS: (*AIRCRAFT FINISHES, *CLEANING),

QUALITY CONTROL, HYDROGEN EMBRITTLEMENT,
RADIOACTIVE ISOTOPES, SURFACE PROPERTIES,
COATINGS, ADHESION, EPOXY PLASTICS, PAINTS,
CLEANING COMPOUNDS

(U)

IDENTIFIERS: C-130 AIRCRAFT, P-3 AIRCRAFT,
STRIPPABLE COATINGS

(U)

FINAL RESULTS ARE PRESENTED OF A PROGRAM TO DEVELOP
IMPROVED METHODS OF CLEANING AIRCRAFT SURFACES PRIOR
TO PAINTING. THE FIRST OBJECTIVE OF THE PROGRAM WAS
MET BY THE DEVELOPMENT OF A SIMPLE AND ACCURATE
METHOD FOR DETERMINING THE DEGREE OF CLEANLINESS OF
SURFACES. IT CONSISTS, ESSENTIALLY, OF PLACING 5-
MICROLITER DROPS OF DISTILLED WATER ON THE TEST
SURFACE, MEASURING THE DROP DIAMETER AND CONVERTING
THE DROP DIAMETER TO A QUANTITATIVE VALUE OF SURFACE
ENERGY. NINE CLEANING PROCEDURES WERE EVALUATED BY
MEANS OF RADIOISOTOPE, SURFACE ENERGY, HYDROGEN
EMBRITTLEMENT, AND COATING ADHESION TESTS. THE
BEST TWO PROCEDURES WERE APPLIED TO A C-130 AT
LOCKHEED-GEORGIA AND TO A P-3 AIRCRAFT AT
LOCKHEED-CALIFORNIA BEFORE THE FINAL EPOXY-
POLYAMIDE PAINT SYSTEM WAS APPLIED. FIVE HAND-
PEELABLE AND FIVE ALKALINE-REMOVABLE COATINGS WERE
EVALUATED FOR THEIR ABILITY TO PROTECT CLEAN SURFACES
FROM CONTAMINATION. THE STRIPPABLE COATINGS WHICH
GAVE THE BEST RESULTS IN LABORATORY TESTS WERE
APPLIED TO P-3 FUSELAGE PANELS. HAND-STRIPPABLE
COATING NO. 14 PROVIDED GOOD PROTECTION FOR THE
PANELS DURING CHEMICAL CLEANING AND DURING DRILLING,
COUNTERSINKING, AND RIVETING OPERATIONS.
CHEMICALLY STRIPPABLE COATING NO. 11 PROVIDED
GOOD PROTECTION FOR THE PANELS DURING THE DRILLING, (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-715 741 11/6
NORTHROP CORPORATE LABS HAWTHORNE CALIF

EMBRITTEMENT BY LIQUID METALS.

(U)

DESCRIPTIVE NOTE: FINAL REPT. 9 MAR-8 OCT 70,
NOV 70 OP KAMDAR, M. H. ;
REPT. NO. NCL-70-75R
CONTRACT: JAHCO4-7U-C-0028
MONITOR: AROD 9218:1-MC

UNCLASSIFIED REPORT

DESCRIPTORS: (•LIQUID METALS; •EMBRITTEMENT),
ZINC ALLOYS, CADMIUM ALLOYS, MERCURY, ALUMINUM
ALLOYS

(U)

THE REPORT GIVES A SUMMARY OF THE INVESTIGATIONS PERFORMED UNDER THE GENERAL TITLE, 'EMBRITTEMENT BY LIQUID METALS.' DURING THE PERIOD OF THE REPORT, AN EARLIER INVESTIGATION OF THE EFFECTS OF SECOND PHASES ON THE SUSCEPTIBILITY OF ZINC-CADMIUM ALLOYS TO EMBRITTEMENT BY LIQUID MERCURY AT AMBIENT TEMPERATURE WAS CONTINUED. THE INVESTIGATION WITH ZINC-CADMIUM ALLOYS WAS INTENDED TO ELUCIDATE THE ROLE OF PHASE IN INHIBITING THE EMBRITTEMENT OF THE MATRIX PHASE (ZINC) IN MERCURY. IN OTHER STUDIES, POLYCRYSTALLINE ALUMINUM 2.5 W/O-ZINC 5.3 W/O-MAGNESIUM ALLOYS CONTAINING VARYING THICKNESSES (0.04 TO 0.35 MICRONS) OF DENuded ZONES AT THE GRAIN BOUNDARY WERE TESTED IN TENSION TO FRACTURE IN LIQUID MERCURY AT 25C. IN ADDITION, STUDIES WERE UNDERTAKEN TO INVESTIGATE THE ROLE OF THE CHEMICAL NATURE OF THE LIQUID METAL OR LIQUID METAL SOLUTIONS IN DETERMINING THE OCCURRENCE AND THE SEVERITY OF LIQUID METAL EMBRITTEMENT IN A GIVEN EMBRITTEMENT COUPLE. THESE STUDIES REVEALED THAT THE SEVERITY OF LIQUID METAL EMBRITTEMENT IS RELATED TO THE ELECTRONEGATIVITIES OF THE PARTICIPATING SOLID AND LIQUID METAL. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-715 807 11/6
PENNSYLVANIA UNIV PHILADELPHIA SCHOOL OF CHEMICAL
ENGINEERING

FUNDAMENTAL CORROSION STUDIES: HYDROGEN
EMBRIITLEMENT.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
DEC 70 38P NAMBUODHIRI, T. K. G. ;
NANIS, LEONARD ;
REPT. NO. UPH2-TR-002
CONTRACT: N00014-67-A-0216-0004
PROJ: NR-036-077

UNCLASSIFIED REPORT

DESCRIPTORS: (*HYDROGEN EMBRIITLEMENT, *IRON),
DIFFUSION, COLD WORKING, ROLLING (METALLURGY),
DEFORMATION

(U)

THE ELECTROCHEMICAL PERMEATION METHOD WAS EXTENDED
BY ANALYSIS OF THE DECAY TRANSIENT FOLLOWING STEADY
STATE PERMEATION. FROM THE AMOUNT OF EXTRACTED
HYDROGEN COMPARED WITH THE AMOUNT PREDICTED BY THE
PERMEATION MODEL, IT IS POSTULATED THAT HYDROGEN
DIFFUSIVITY IN ARMCO IRON IS CONCENTRATION
DEPENDENT. PERMEATION STUDIES OF COLD-ROLLED
ARMCO IRON INDICATE (A) DIFFUSIVITY $D(21C)$
DECREASES FROM, 5×10^{-5} TO THE $-5TH$ TO 0.5×10^{-5} TO THE
 $-5TH$ SQ CM/SEC. IN GOING FROM ANNEALED TO 2%
REDUCED SAMPLES; (B) DEFORMATION RESULTS IN
INCREASING ABSORPTION OF HYDROGEN FROM 1×10^{-8} TO THE
 $-8TH$ TO 300×10^{-8} TO THE $-8TH$ MOLE H/C.C. OF FE.,
IN GOING FROM ZERO TO 17.6% REDUCTION IN THICKNESS;
(C) ADDITIONAL COLD WORK PRODUCES LITTLE FURTHER
CHANGE IN HYDROGEN ABSORBED OR IN APPARENT
DIFFUSIVITY. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 128ML1

AD-716 405 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C.

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 AUG-31
OCT 70,

NOV 70 61P STEELE, L. E. ; SERPAN, C.
Z. , JR. ; LOSS, F. J. ; HAWTHORNE, J. R. ;
PUZAK, P. P. ;
REPT. NO. NRL-MR-2181
CONTRACT: AT(49-5)-2110
PROJ: RR007-11-41-5409, NRL-M01-14

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO QUARTERLY PROGRESS REPT.
DATED 15 AUG 70, AD-711 321.

DESCRIPTORS: (*REACTOR MATERIALS, RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE),
(*VANADIUM, RADIATION DAMAGE), PRESSURE VESSELS,
FRACTURE (MECHANICS), EMBRITTLEMENT, NEUTRON
REACTIONS, DISLOCATIONS, ANNEALING

(U)

THE REPORT, COVERING RESEARCH FOR THE PERIOD 1
AUGUST - 31 OCTOBER 1970, INCLUDES: (1)
INITIAL RADIATION DAMAGE SURVEILLANCE RESULTS FOR THE
MH-1A REACTOR VESSEL, (2) DEVELOPMENT OF A
REFERENCE FLUENCE DECREASE THROUGH A REACTOR VESSEL
WALL, (3) ANALYSIS OF THE FLUENCE GRADIENT IN
TERMS IN TERMS OF FRACTURE BEHAVIOR, INCLUDING
FRACTURE EXTENSION RESISTANCE FOR THE THROUGH-WALL
VESSEL PROPERTIES, (4) CORRELATION OF CHARPY-
V AND DYNAMIC TEAR TEST RESULTS FOR REACTOR STEELS
AFTER IRRADIATION, (5) TRUE STRESS-NATURAL STRAIN
DETERMINATIONS FOR SEVERAL HIGH TEMPERATURE ALLOYS
IRRADIATED IN THE EBR-11 REACTOR, AND (6) THE
NATURE OF DISLOCATION LOOP GROWTH DURING ANNEALING OF
IRRADIATED VANADIUM. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-717 460 13/5 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

RADIATION RESISTANT EXPERIMENTAL WELD
METALS FOR ADVANCED REACTOR VESSEL STEELS,

(U)

7U 9P HAWTHORNE, J. R. ; FORTNER,
E. ; GRANT, S. P. ;

UNCLASSIFIED REPORT

AVAILABILITY: PUB. IN WELDING JNL., 9P OCT
70.

SUPPLEMENTARY NOTE: PRESENTED AT THE AWS NATIONAL FALL
MEETING HELD IN BALTIMORE, MD., ON 5-8 OCT 70.

DESCRIPTORS: (•WELDS, RADIATION DAMAGE),
(•REACTOR MATERIALS, WELDS), (•STEEL,
RADIATION DAMAGE), PRESSURE VESSELS,
EMBRITTEMENT, INHIBITION, WELDING RODS,
CHEMICAL ANALYSIS, MECHANICAL PROPERTIES

(U)

THE STUDY CLEARLY DEMONSTRATES EFFECTIVE CONTROL
OVER THE RADIATION EMBRITTEMENT BEHAVIOR OF A 2 1/4
CR-1MO WELD COMPOSITION. EXPERIMENTAL FINDINGS
OPEN THE WAY FOR THE USE OF PROMISING HIGHER STRENGTH
STEELS IN ADVANCED REACTOR VESSEL CONSTRUCTION.
OPTIMUM RADIATION EMBRITTEMENT RESISTANCE IS SHOWN
TO REQUIRE COPPER CONTENTS APPRECIABLE LESS THAN
0.168. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-717 553 11/6 1976
WATERVLIET ARSENAL N Y

SUSCEPTIBILITY OF GUN STEELS TO STRESS
CORROSION CRACKING.

(U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,

NOV 70 47P

COLANGELO, VITO J. ; FERGUSON,

MARTIN S. ;

REPT. NO. WVT-7012

PROJ: DA-66661

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, *STRESS CORROSION), (*GUN
BARRELS, STRESS CORROSION), EMBRITTLEMENT,
FRACTURE (MECHANICS), CRACK PROPAGATION

(U)

IDENTIFIERS: HIGH STRENGTH STEELS

(U)

PRECRACKED CANTILEVER BEAM SPECIMENS EXTRACTED FROM
SPECIFIC GUN TUBES WERE SUBJECTED TO A CONSTANT LOAD
IN VARIOUS ENVIRONMENTS TO DETERMINE FRACTURE TIMES.
SPECIMENS EXHIBITED STRESS CORROSION SUSCEPTIBILITY
IN 3% NaCl, DISTILLED WATER AND 100% RH
AIR, WITH 3% NaCl BEING THE MOST DEGRADING
ENVIRONMENT. VARIATIONS IN SUSCEPTIBILITY APPEARED
ON A TUBE TO TUBE BASIS AND WERE RELATED TO THE
TEMPER EMBRITTLED CONDITION OF THE TUBE. ADDITIONAL
TESTS IN DISTILLED WATER, VARYING YIELD STRENGTH
MATERIAL, SHOWED THAT FRACTURE TIME WAS DECREASED AND
CRACK GROWTH RATES INCREASED AS THE YIELD STRENGTH
WAS INCREASED. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-718 041 11/6
TRM EQUIPMENT GROUP CLEVELAND OHIO MATERIALS TECHNOLOGY
LAB

EFFECT OF ALLOYING ELEMENTS ON TEMPERED
MARTENSITE EMBRITTLEMENT AND FRACTURE
TOUGHNESS OF LOW ALLOY HIGH STRENGTH
STEELS.

(U)

DESCRIPTIVE NOTE: FINAL REPT. 13 MAR 69-13 AUG 70,
JAN 71 8/P VISHNEVSKY, C. ;
REPT. NO. EP-7384-1
CONTRACT: DAAG46-69-C-0060
PROJ: DA-1-T-062105-A-328
MONITOR: ANMRC CR-69-18/F

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO REPORT DATED FEB 70, AD-
702 908.

DESCRIPTORS: (*STEEL, NOTCH TOUGHNESS),
MARTENSITE, TENSILE PROPERTIES,
FRACTURE (MECHANICS), EMBRITTLEMENT
IDENTIFIERS: *HIGH STRENGTH STEELS

(U)

(U)

A STUDY WAS PERFORMED ON THE INFLUENCE OF VARIOUS
ELEMENTS ON THE NOTCH BEND FRACTURE TOUGHNESS AT
75F AND -100F OF .35% C, 3% Ni-CR-MO-V
MARTENSITIC STEELS TEMPERED BETWEEN 400 AND 800F.
THE ELEMENTS EXAMINED INCLUDED C, MN, SI,
CR, Ni, MO, CO, V AND AL. THE OVERALL
VARIATION IN ROOM TEMPERATURE YIELD AND TENSILE
STRENGTHS FOR TWENTY-FOUR STEELS WAS 155-230 KSI
YIELD STRENGTH AND 188-288 KSI TENSILE STRENGTH.
(AUTHOR)

(U)

UNCLASSIFIED

UDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-720 217 11/6 20/11
VIRGINIA POLYTECHNIC INST BLACKSBURG DEPT OF ENGINEERING.
MECHANICS

UTILIZATION OF HOLLOW NOTCHED ROUNDS IN
FRACTURE TOUGHNESS EVALUATION, (U)

MAR 71 2dP MCNITT, R. P. THOMPSON,
W. F. ISANYER, S. O. III;
REP. NO. VPI-E-71-2
CONTRACT: DAAFG7-69-C-0444

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: PRESENTED AT THE SESA FALL
MEETING, BOSTON, MASS. OCT 70.

DESCRIPTORS: (•METALS, •FRACTURE (MECHANICS)),
HYDROGEN EMBRITTLEMENT, CRACK PROPAGATION, STEEL,
ALUMINUM ALLOYS, NOTCH TOUGHNESS (U)
IDENTIFIERS: •FRACTURE TOUGHNESS, STEEL 4340,
STEEL 4330, ALUMINUM ALLOY 7075-T651 (U)

RESULTS OF AN EXPERIMENTAL PROGRAM TO DETERMINE
FRACTURE TOUGHNESS DATA UTILIZING SMALL NOTCHED ROUND
TENSILE SPECIMENS ARE PRESENTED. HYDROGEN
EMBRITTLEMENT WAS UTILIZED AS A CRACK STARTER FOR
SEVERAL SOLID AISI 4340 STEEL SPECIMENS. THE
FRACTURED AREAS WERE EXAMINED TO DIFFERENTIATE THE
SLOW CRACK GROWTH DUE TO HYDROGEN AND THE FINAL RAPID
CATASTROPHIC FRACTURE. HOLLOW NOTCHED ROUND
SPECIMENS OF AISI 4340 STEEL, ALUMINUM 7075-
T651 AND GUN STEEL 4330 WERE TESTED TO FAILURE FOR
VARIOUS OUTSIDE DIAMETER, NOTCH ROOT RADIUS AND
INTERNAL HOLE SIZE. THE RESULTING APPARENT
FRACTURE TOUGHNESS VALUES ARE COMPARED TO KNOWN
VALUES OBTAINED FROM PRECRACKED SPECIMENS.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-720 676 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

ANALYSIS OF RADIATION-INDUCED EMBRITTLEMENT
GRADIENTS ON FRACTURE CHARACTERISTICS OF
THICK-WALLED PRESSURE VESSEL STEELS.

(U)

DESCRIPTIVE NOTE: INTERIM REPT.,

MAR 71 23P LOSS, F. J. HANTHORNE, J.
R. SERPAN, C. Z. , JR.; PUZAK, P. P. ;
REPT. NO. NRL-7209
CONTRACT: AT(49-5)-2110
PROJ: RRO07-11-41-5409, NRL-MD1-14

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*REACTOR MATERIALS, EMBRITTLEMENT),
FRACTURE(MECHANICS), PRESSURE VESSELS
IDENTIFIERS: STEEL A-533a

(U)

(U)

THE FRACTURE BEHAVIOR OF THICK-WALLED NUCLEAR VESSELS IS CONSIDERED FOR THE CASE OF A RADIATION-INDUCED TOUGHNESS GRADIENT THROUGH THE WALL WHICH CHARACTERISTICALLY RESULTS FROM NEUTRON ATTENUATION BY THE WALL MATERIAL ITSELF. FRACTURE-SAFE DESIGN ANALYSES BASED ON LINEAR ELASTIC FORMULATIONS OR EXTRAPOLATIONS OF THESE FORMULATIONS TO THE ELASTIC-PLASTIC REGIME ARE NOT SUFFICIENTLY DEVELOPED TO CHARACTERIZE THE INTEGRATED BEHAVIOR OF A WALL WHOSE TOUGHNESS CAN RANGE FROM BRITTLE AT THE INNER SURFACE TO HIGHLY DUCTILE AT THE OUTER SURFACE. SOLUTIONS TO THE PROBLEM IN THE FORESEEABLE FUTURE WILL BE OBTAINED ONLY BY EXPERIMENTAL MEANS. THE PRESENT APPROACH USES THE FRACTURE ANALYSIS DIAGRAM (FAD) TOGETHER WITH A NEW INTERPRETATIVE METHOD FOR FRACTURE EXTENSION RESISTANCE BASED ON MODIFIED DYNAMIC TEAR SPECIMENS AS THE TOOLS FOR GRADIENT ASSESSMENTS. WITH THESE TECHNIQUES THE SIGNIFICANCE OF THE TOUGHNESS GRADIENT THROUGH THE WALL IS ASSESSED IN TERMS OF THICK SECTION MECHANICAL CONSTRAINT, AND FRACTURE CHARACTERISTIC OF THE COMPLETE WALL ARE PREDICTED. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-720 678 18/10 11/6 13/8
NAVAL RESEARCH LAB WASHINGTON D C

MAJOR FACTORS AFFECTING NEUTRON IRRADIATION
EMBRITTLEMENT OF PRESSURE-VESEL STEELS AND
WELDMENTS.

(U)

DESCRIPTIVE NOTE: SUMMARY REPT.,
OCT 70 22P STEELE,LENDELL E. ;
REPT. NO. NRL-7176
CONTRACT: AT(49-5)-2110
PROJ: RR007-41-11-5409, NRL-M01-14

UNCLASSIFIED REPORT

DESCRIPTORS: (*STEEL, RADIATION DAMAGE),
(*WELDS, RADIATION DAMAGE), REACTOR MATERIALS,
EMBRITTLEMENT, PRESSURE VESSELS
IDENTIFIERS: *NEUTRON IRRADIATION EMBRITTLEMENT

(U)

(U)

THE MAJOR ASPECTS OF NEUTRON IRRADIATION
EMBRITTLEMENT IN STEEL PRESSURE VESSELS OF LARGE
COMMERCIAL NUCLEAR-POWER REACTORS ARE REVIEWED,
DRAWING ON THE RESULTS OF AEC-SPONSORED PROGRAMS
WHICH HAVE EMPHASIZED RESEARCH RELATED TO REACTOR
VESSEL RELIABILITY. (AUTHOR)

(U)

UNCLASSIFIED

UDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 148ML1

AD-721 068 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS.

(U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 NOV 70-31
JAN 71,

FEB 71 34P STEELE, L. E. ; SERPAN, C.

Z. , JR. ; WATSON, H. E. ; HAWTHORNE, J. R. ;

SMIDT, F. A. , JR. ;

REPT. NO. NRL-MR-2214

CONTRACT: AT(49-5)-2110

PROJ: RR007-11-41-5409, RR007-11-41-5425

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: SEE ALSO QUARTERLY PROGRESS REPT.
DATED 15 NOV 70; AD-716 405.

DESCRIPTORS: (*REACTOR MATERIALS, RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE),
(*VANADIUM, RADIATION DAMAGE), PRESSURE VESSELS,
FRACTURE(MECHANICS), EMBRITTLEMENT, WELDS,
NEUTRON REACTIONS, DISLOCATIONS, RECOVERY

(U)

THE REPORT, COVERING RESEARCH FOR THE PERIOD 1
NOVEMBER 1970-31 JANUARY 1971, INCLUDES:

(1) AN ANALYSIS OF THE COMPARATIVE RESULTS OF
VARIOUS REACTOR PHYSICS CODES FOR PREDICTING THE
NEUTRON SPECTRUM IN A SIMULATED PRESSURE VESSEL,
(2) THE FRACTURE RESISTANCE OF IRRADIATED A533-
B STEEL PLATE AND WELD METAL AS DEFINED BY SHELF
LEVEL IN DYNAMIC NOTCHED IMPACT TESTS, AND (3)
RESULTS SUGGESTING POSSIBLE MECHANISMS OF LOOP GROWTH
DURING DAMAGE RECOVERY IN VANADIUM. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-723 224 11/6
CARNEGIE-MELLON UNIV PITTSBURGH PA METALS RESEARCH
LAB

GRAIN BOUNDARY SEGREGATION OF IMPURITIES IN
METALS AND INTERGRANULAR BRITTLE FRACTURE. (U)

DESCRIPTIVE NOTE: TECHNICAL REPT.,
MAY 71 41P LOW, JOHN R. , JR.; SMITH,
CRAIG L. ;
REPT. NO. CMU-031-727-3
CONTRACT: N00014-67-A-0314-0002
PROJ: NR-031-727

UNCLASSIFIED REPORT

DESCRIPTORS: (STEEL, EMBRITTLEMENT), GRAIN
BOUNDARIES, IMPURITIES, DUCTILE BRITTLE TRANSITION,
TRANSITION TEMPERATURE, NEUTRON ACTIVATION (U)
IDENTIFIERS: STEEL 3340 (U)

TEMPER EMBRITTLEMENT IN LOW ALLOY STEELS WAS
STUDIED BY EXAMINING CHANGES IN THE COMPOSITION OF
PRIOR AUSTENITIC GRAIN BOUNDARIES RESULTING FROM
EMBRITTLING TREATMENTS PERFORMED ON AN SB DOPED
3340 STEEL. NEUTRON ACTIVATION ANALYSIS WAS USED
TO CHEMICALLY ANALYSE ETCHANT RESIDUES OBTAINED FROM
INTERCRYSTALLINE FRACTURE SURFACES. ANTIMONY WAS
SHOWN TO SEGREGATE TO THE GRAIN BOUNDARIES DURING
EMBRITTLING WHILE THE CONCENTRATION OF NICKEL IN
FERRITIC PORTIONS OF THE BOUNDARIES DECREASED.
EMBRITTLEMENT TREATMENTS PRODUCED NO DETECTABLE
CHANGES IN THE CHROMIUM CONTENT OF THE BOUNDARIES.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-725 945 11/6
NORTHROP CORPORATE LABS HAWTHORNE CALIF

THE OCCURRENCE OF LIQUID-METAL
EMBRIITLEMENT,

(U)

OCT 70 12P KANDAR, M. H. ;
CONTRACT: DAHCD4-70-C-0028
MONITOR: AROD 9218:2-MC

UNCLASSIFIED REPORT
AVAILABILITY: PUB. IN PHYSICA STATUS SOLIDI
(A) V4 N1 P225-233 1971.

DESCRIPTORS: (*CADMIUM, *EMBRIITLEMENT),
(*MERCURY, EMBRIITLEMENT),
FRACTURE (MECHANICS), LIQUID METALS, SOLUTIONS,
MERCURY ALLOYS
IDENTIFIERS: *LIQUID METAL EMBRIITLEMENT

(U)

(U)

A STUDY HAS BEEN MADE OF THE FRACTURE BEHAVIOR OF CADMIUM IN LIQUID MERCURY AND SEVERAL LIQUID MERCURY SOLUTIONS. IT IS SHOWN THAT THE DEGREE OF EMBRIITLEMENT INDUCED IN A SOLID METAL CAN BE SIGNIFICANTLY AND PREDICTABLY AFFECTED BY INCORPORATING SELECTED EMBRIITTLING ELEMENTS IN SOLUTION IN THE LIQUID-METAL ENVIRONMENT. FOR EXAMPLE, ADDITIONS OF MORE THAN 8 AT % OF INDIUM TO MERCURY AT ROOM TEMPERATURE CAUSED CADMIUM TO BEHAVE IN A BRITTLE MANNER IN THIS OTHERWISE 'INERT' ENVIRONMENT. FOLLOWING CONSIDERATION OF THE EXPERIMENTAL DATA FROM SUCH EXPERIMENTS, AND ALSO FROM THE PUBLISHED LITERATURE, IT IS SUGGESTED THAT A CORRELATION EXISTS BETWEEN THE OCCURRENCE AND SEVERITY OF LIQUID-METAL EMBRIITLEMENT AND THE ELECTRONEGATIVITIES OF THE PARTICIPATING SOLID AND LIQUID METALS. IT APPEARS THAT MAXIMUM EMBRIITLEMENT OCCURS WHEN THE SOLID METAL AND THE ACTIVE LIQUID METAL ARE OF SIMILAR ELECTRONEGATIVITY, AND THAT THE SEVERITY OF EMBRIITLEMENT DECREASES AS THE DIFFERENCE IN ELECTRONEGATIVITY BETWEEN THE TWO METALS INCREASES. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-726 099 13/8 11/6
AEROSPACE RESEARCH LABS WRIGHT-PATTERSON AFB OHIO

THE INFLUENCE OF THE THERMOMECHANICAL
PROCESSING ON THE MECHANICAL PROPERTIES OF
BETA III TITANIUM ALLOY.

(U)

DESCRIPTIVE NOTE: FINAL REPT. 1 SEP 69-31 DEC 70;
MAR 71 12P ROBERSON, JAMES A.; ADAIR,
ATTWELL M. ;
REPT. NO. ARL-71-0031
PROJ: AF-7021
TASK: 702100

UNCLASSIFIED REPORT

DESCRIPTORS: (*TITANIUM ALLOYS, *MECHANICAL
WORKING), (*EXTRUSION, TITANIUM ALLOYS),
MECHANICAL PROPERTIES, AGE HARDENING, HEAT
TREATMENT, TENSILE PROPERTIES, EMBRITTLEMENT
IDENTIFIERS: *METAL SWAGING, TITANIUM ALLOY BETA

(U)

3

(U)

THE EFFECTS OF EXTRUSION AND COLD SWAGING ON THE
STRUCTURE AND PROPERTIES OF BETA III TITANIUM
WERE INVESTIGATED; DIE LOADS FOR EXTRUSION WERE
DETERMINED AT VARIOUS TEMPERATURES AND COMPARED TO
DIE LOADS FOR OTHER ALLOYS; THE EFFECTS OF AGE
HARDENING AFTER VARIOUS THERMAL AND MECHANICAL
TREATMENTS WERE STUDIED. OPTIMUM TENSILE PROPERTIES
WERE OBTAINED IN EXTRUDED AND AGED MATERIAL WHEN THE
EXTRUSION TEMPERATURE WAS LOW AND THE COOLING RATE
WAS HIGH. THE DIE LOADS DURING EXTRUSION COMPARED
FAVORABLY WITH THOSE OF OTHER TITANIUM ALLOYS. COLD
SWAGING PRIOR TO AGE HARDENING INCREASED HARDNESS AND
TENSILE STRENGTH BUT CAUSED EMBRITTLEMENT WHEN THE
AMOUNT OF DEFORMATION WAS SMALL. DUCTILITY WAS
RESTORED BY LARGE AMOUNTS OF COLD SWAGING. FRACTURE
TOUGHNESS WAS UNIVERSELY PROPORTIONAL TO ULTIMATE
TENSILE STRENGTH. THESE OBSERVATIONS ARE EXPLAINED
ON THE BASIS OF METALLOGRAPHY, ELECTRON MICROSCOPY,
AND X-RAY DIFFRACTION. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-726 165 11/6 14/2
NAVAL AIR DEVELOPMENT CENTER WARMINSTER PA AERO MATERIALS
DEPT

A COMPARISON OF VARIOUS TEST METHODS FOR
DETECTING HYDROGEN EMBRITTLEMENT.

(U)

DESCRIPTIVE NOTE: PROGRESS REPT.,
JUN 71 19P JANKOWSKY, E. J. ;
REPT. NO. NADC-MA-7066
PROJ: A320-5203/202-0/1F51-541-201

UNCLASSIFIED REPORT

DESCRIPTORS: (•HYDROGEN EMBRITTLEMENT, TEST
METHODS), (•PAINT REMOVERS, HYDROGEN
EMBRITTLEMENT), STEEL, STANDARDS
IDENTIFIERS: EVALUATION

(U)

(U)

FOUR HYDROGEN EMBRITTLEMENT TEST METHODS WERE
EVALUATED USING THREE PAINT STRIPPERS AS THE
EMBRITTLING MEDIA. RESULTS WERE COMPARED WITH
THOSE OBTAINED WITH NOTCHED C-RINGS, THE METHOD NOW
PRESCRIBED IN PAINT STRIPPER SPECIFICATIONS. IN
GENERAL, ALL THE METHODS GIVE GOOD RESULTS AND GOOD
CORRELATION. THE MAIN DIFFERENCES WERE IN EASE OF
USE. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML1

AD-726 308 11/6
MARTIN MARIETTA CORP BALTIMORE MD RESEARCH INST FOR
ADVANCED STUDIES

CRACK INITIATION IN THE ZINC-MERCURY
EMBRITTLEMENT COUPLE

(U)

70 EMP KAMDAR, M. H. I
CONTRACT: DA-31-124-AR0(D)-63
PROJ: DA-2-0-061102-5-32-D
MONITOR: AR00 392,816-MC

UNCLASSIFIED REPORT

AVAILABILITY: PUB. IN CORROSION BY LIQUID
METALS, P449-459 1/70.

SUPPLEMENTARY NOTE: PREPARED IN COOPERATION WITH
NORTHROP CORPORAT LABS., HANTHORNE, CALIF.

DESCRIPTORS: 1. ZINC, 2. CRACK PROPAGATION,
3. EMBRITTLEMENT, 4. ZINC, 5. FRACTURE (MECHANICS),
6. LIQUID METALS, 7. MERCURY, 8. CORROSION,
9. NUCLEATION

(U)

IDENTIFIERS: 1. LIQUID METAL EMBRITTLEMENT

(U)

CLEAVAGE FRACTURE DATA FROM ZINC CRYSTALS TESTED IN
TENSION IN LIQUID MERCURY ENVIRONMENT AT 298K AND
IN AN INERT ENVIRONMENT AT 77K HAVE BEEN USED TO
PROVIDE SUPPORT FOR THE VALIDITY OF A FRACTURE
CRITERION AND TO DERIVE RELIABLE VALUES OF THE ENERGY
TO INITIATE CLEAVAGE FRACTURE. THE RESULTS OBTAINED
ARE CONSIDERED TO PROVIDE QUANTITATIVE SUPPORT FOR
THE MECHANISM OF LIQUID METAL EMBRITTLEMENT IN WHICH
ADSORPTION OF LIQUID METAL ATOMS REDUCES COHESION AT
THE SITES OF HIGH STRESS CONCENTRATIONS ON THE
SURFACE OF THE SOLID AND AT THE TIP OF THE
PROPAGATING CRACK, FACILITATING THEREBY CRACK
NUCLEATION AND CRACK PROPAGATION IN THE SOLID METAL.
(AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 14BML

AD-727 038 21/9.2 20/14
EXPLOSIVES RESEARCH AND DEVELOPMENT ESTABLISHMENT WALTHAM
ABBEY (ENGLAND)

COMPOSITE PROPELLANTS: STATISTICAL
EVALUATION OF BRITTLE POINT (EMBRITTLEMENT
TEMPERATURE) TESTS.

(U)

DESCRIPTIVE NOTE: TECHNICAL NOTE,
NOV 70 15P BRYANT, R. W. ;
REPT. NO. ERDE-TN-22
MONITOR: TRC BR-23383

UNCLASSIFIED REPORT

DESCRIPTORS: (*TEST EQUIPMENT, RELIABILITY),
(*COMPOSITE PROPELLANTS, EMBRITTLEMENT),
DEFECTS(MATERIALS), CRACKS, TEMPERATURE,
STRAIN(MECHANICS), TENSILE PROPERTIES, TEST
METHODS

(U)

IDENTIFIERS: EVALUATION, EMBRITTLEMENT TESTS,
BENDING BEAM TESTS, PENDULUM TESTS

(U)

EMBRITTLEMENT TEMPERATURES OF COMPOSITE
PROPELLANTS, AT NOMINAL UNIAXIAL STRAINS OF 5, 10 AND
25 PER CENT, HAVE BEEN MEASURED BY TWO BENDING BEAM
METHODS, AND THE RESULTS COMPARED STATISTICALLY WITH
INTERPOLATIONS FROM WLF MASTER CURVES OF RUPTURE
STRAIN IN TENSION AGAINST LOG REDUCED STRAIN-RATE.
EFFECTIVE STRAINS ARE DEDUCED WHICH PLACE THE
MAJORITY OF THE EMBRITTLEMENT TEMPERATURE VALUES
WITHIN THE SCATTER OF THE WLF MASTER CURVES. IT
IS CONCLUDED THAT THE RELATIVELY SIMPLE EMBRITTLEMENT
TESTS YIELD MEASUREMENTS OF THE STRAIN AT RUPTURE NO
MORE VARIABLE THAN THOSE DERIVED FROM A SIMILAR
NUMBER OF UNIAXIAL TENSILE TESTS. (AUTHOR)

(U)

UNCLASSIFIED

DOC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 1ZBML1

AD-727 422 11/6 20/12
FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO

BRITTLENESS OF STEEL; ITS CONNECTION WITH
LOW-CYCLE FATIGUE, AND A CALCULATION
PROVIDING WARNING OF BRITTLE FAILURE.

(U)

FEB 71 IUP BYKOV, V. A. INKISHINA, M.

L. ;
REPT. NO. FTD-HT-23-38-71
PROJ. AF-1368

UNCLASSIFIED REPORT

SUPPLEMENTARY NOTE: EDITED TRANS. OF TERMOPROCHNOST
MATERIALOV I KONSTRUKTIVNYKH ELEMENTOV SBORNIK
(USSR) NO P197-200 1969, BY D. KOOLBECK.

DESCRIPTORS: (*STEEL, BRITTLENESS);
FAILURE(MECHANICS); FATIGUE(MECHANICS);
USSR

(U)

IDENTIFIERS: TRANSLATIONS

(U)

THE ARTICLE DEALS WITH BRITTLE FAILURE OF SHIP-HARD
STEEL. IT IS CONCLUDED THAT LOW-CYCLE FATIGUE
DAMAGE DOES NOT HAVE AN ESSENTIAL INFLUENCE ON THE
RESISTANCE OF THE INVESTIGATED STEEL TO PLASTIC
DEFORMATION, BUT DOES NOTICEABLY REDUCE RESISTANCE TO
BRITTLE FAILURE. BRITTLE FAILURE IS PREDETERMINED
BY AN UNFAVORABLE FORM OF THE STRESSED STATE AND ALSO
BY OPERATING CONDITIONS WHICH HAVE A NEGATIVE
INFLUENCE ON THE TOTALITY OF VALUES OF THE STEEL
STRENGTH DURING BRITTLE FAILURE AND PLASTIC
DEFORMATION. IN CALCULATIONS PROVIDING FOREWARNING
OF BRITTLE FAILURE IT IS ADVISABLE TO COMPILE
DIMENSIONLESS VALUES OF THE STRESS PARAMETER AND
RHEOLOGICAL CHARACTERISTICS OF THE STEEL
INDEPENDENTLY OF THE MAGNITUDE OF EXTERNAL
FORCES.

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 148ML1

AD-729 690 11/6
ISRAEL ATOMIC ENERGY COMMISSION YAVNE SOREQ NUCLEAR
RESEARCH CENTRE

HYDROGEN BEHAVIOR IN METALS USING NUCLEAR
MAGNETIC RESONANCE. (U)

DESCRIPTIVE NOTE: FINAL SCIENTIFIC REPT. MAR 66-NOV
70,
NOV 70 166P ZAMIR, DAVID ; KORN, CHARLES ;
CONTRACT: AF 61(052)-904

UNCLASSIFIED REPORT

DESCRIPTORS: (*TITANIUM ALLOYS, HYDROGEN
EMBRITTLEMENT), (*NUCLEAR MAGNETIC RESONANCE,
*HYDROGEN EMBRITTLEMENT), PHASE STUDIES,
RELAXATION TIME, HYDRIDES, ALUMINUM ALLOYS, X-
RAY DIFFRACTION ANALYSIS, DIFFUSION, ISRAEL (U)
IDENTIFIERS: SPIN LATTICE RELAXATION, *TITANIUM
HYDRIDES (U)

PARAMETERS CONSIDERED IMPORTANT FOR THE EXPLANATION
OF HYDROGEN EMBRITTLEMENT OF TITANIUM AND ITS ALLOYS
HAVE BEEN MEASURED USING NMR TECHNIQUES. THE
PROTON SPIN LATTICE RELAXATION TIME T_1 HAS BEEN
MEASURED BY THE PULSE TECHNIQUE AT 19.00 MHZ AS A
FUNCTION OF TEMPERATURE IN THE RANGE 25-500C FOR A
SERIES OF SAMPLES IN THE ALPHA, BETA, GAMMA PHASES OF
TITANIUM HYDRIDE. THE DIFFUSIONAL ACTIVATION ENERGY
WAS FOUND TO BE CONSTANT WITH RESPECT TO THE HYDROGEN
CONCENTRATION. THE ACTIVATION ENERGY BEHAVIOR AND
JUMP ATTEMPT FREQUENCY IS DISCUSSED IN RELATION TO A
HARMONIC OSCILLATOR POTENTIAL WELL DERIVED FROM
NEUTRON INELASTIC SCATTERING EXPERIMENTS AND FROM
THIS STUDY. THE CONDUCTION ELECTRON CONTRIBUTION TO
THE RELAXATION MECHANISM INCREASED WITH HYDROGEN
CONCENTRATION, INDICATING AN INCREASE IN ENERGY
DENSITY OF STATES AT THE FERMI LEVEL. HYDROGEN IN
TITANIUM ALUMINUM ALLOYS WAS FOUND TO EXIST IN TWO
DIFFERENT CRYSTALLOGRAPHIC ENVIRONMENTS, ONE
DIFFUSING FASTER THAN THE OTHER. THE HYDRIDE SYSTEM
IS PROBABLY BASED ON THE TIZAL STRUCTURE AND THE
POSSIBLE LOCATION OF HYDROGEN IN THE LATTICE IS
DISCUSSED. X-RAY MEASUREMENTS ON HYDROGEN FREE
TIZAL AND TIZAL CONTAINING HYDROGEN GIVING AN
H/TI RATIO OF 1.3, SHOWED EXTREME DISTORTION TO
THE LATTICE UPON HYDROGEN ABSORPTION. THE X-RAY
DIFFRACTION LINES FOR THE HYDRIDE COULD NOT BE
RESOLVED. (AUTHOR)

(U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-730 435 18/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

IRRADIATION EFFECTS ON REACTOR STRUCTURAL
MATERIALS. (U)

DESCRIPTIVE NOTE: QUARTERLY PROGRESS REPT. 1 MAY-31
JUL 71;

AUG 71 48P STEELE, L. E. ; LOSS, F. J.
; HATHORNE, J. R. ; WATSON, H. E. ; SHAMINIAN,
P. ;

REPT. NO. NRL-MR-2338
CONTRACT: AT(49-5)-2110
PROJ: RR022-11-41-5409, NRL-M01-14

UNCLASSIFIED REPORT

DESCRIPTORS: (*REACTOR MATERIALS, RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE),
FRACTURE (MECHANICS), WELDS, PRESSURE VESSELS,
EMBRIITLEMENT, LASERS, NEUTRON REACTIONS,
FATIGUE (MECHANICS) (U)

IDENTIFIERS: STEEL A-5538 (U)

THE RESEARCH PROGRAM INVOLVES A BROAD STUDY OF THE
EFFECTS OF NUCLEAR RADIATION UPON MATERIALS. THE
REPORT, COVERING RESEARCH FOR THE PERIOD, 1 MAY-31
JULY 1971, INCLUDES: (1) THE PLASTIC
FRACTURE RESISTANCE OF THICK-SECTION A533-B
STEEL, (2) A RADIATION RESISTANT WELD FOR
FABRICATING A533-B REACTOR VESSELS, (3) THE
EFFECTS OF IRRADIATION AND TEMPERATURE ON THE FATIGUE
PROPERTIES OF A533-B STEEL, (4) THE VACANCY
CONDENSATES PRODUCED BY LASER BOMBARDMENT, AND
(5) THE LOW-ENERGY NEUTRON CONTRIBUTIONS TO
EMBRIITLEMENT OF PRESSURE VESSEL STEEL.
(AUTHOR) (U)

UNCLASSIFIED

DDC REPORT BIBLIOGRAPHY SEARCH CONTROL NO. 12BML1

AD-730 439 16/10 11/6
NAVAL RESEARCH LAB WASHINGTON D C

RESIDUAL ELEMENTS AND IRRADIATION
EMBRIITLEMENT. (U)

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DESCRIPTORS: (*REACTOR MATERIALS, RADIATION
DAMAGE), (*STEEL, RADIATION DAMAGE), PRESSURE
VESSELS, EMBRIITLEMENT, IMPURITIES (U)

PAST WORK ON THE ROLE OF RESIDUAL ELEMENTS
(PARTICULARLY COPPER AND PHOSPHORUS) IN THE
ENHANCED IRRADIATION EMBRIITLEMENT OBSERVED IN
PRESSURE-VESSEL STEELS IRRADIATED AT 550F
(288C) IS REVIEWED. ONLY THREE MECHANISMS FOR
EXPLAINING THE EMBRIITLEMENT ARE PLAUSTIBLE--TEMPER
EMBRIITLEMENT, IRRADIATION-ENHANCED DIFFUSION TO AN
INTERFACE, AND ENHANCED NUCLEATION OF DEFECT
AGGREGATES WHICH PRODUCE HARDENING AND EMBRIITLEMENT.
EXPERIMENTS EMPLOYING SCANNING MICROSCOPY AND
AUGER SPECTROSCOPY SHOW THAT THE EMBRIITLEMENT IS
NOT PRODUCED BY SEGREGATION OF COPPER OR PHOSPHORUS
AT AN INTERFACE. MICROHARDNESS RECOVERY EXPERIMENTS
INDICATE THAT THE EMBRIITLEMENT IN COPPER-CONTAINING
ALLOYS IS ACCOMPANIED BY GREATER IRRADIATION
HARDENING. TRANSMISSION ELECTRON MICROGRAPHS OF
SPECIAL IRON ALLOYS DOPED WITH 0.3 AT-% COPPER SHOW
A MICROSTRUCTURE INDICATIVE OF A HIGHER CONCENTRATION
OF DEFECT AGGREGATES THAN PURE IRON IRRADIATED UNDER
THE SAME CONDITIONS. THESE AGGREGATES ARE BELIEVED
TO BE VACANCY IN NATURE BECAUSE VACANCIES ARE MOBILE
DURING IRRADIATION AT 550F (288C) AND BECAUSE
NO CORRELATION BETWEEN EMBRIITLEMENT AND COPPER OR
PHOSPHORUS CONTENT ARE NOTED AFTER IRRADIATION AT
TEMPERATURES WHERE VACANCIES ARE NOT MOBILE.
(AUTHOR) (U)

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EMBRITTLEMENT IN LOW-CARBON STEELS DUE TO
MANGANESE; (U)

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ALLOYS, CARBON ALLOYS (U)

IDENTIFIERS: CARBON STEELS (U)

THE ADDITION OF MANGANESE TO MILD STEEL INCREASES THE TOUGHNESS BY GRAIN REFINEMENT AND BY A CHANGE IN THE PEARLITE MORPHOLOGY FROM A LAMELLAR TO GRANULAR CARBIDE FORM. IN LOW-CARBON STEELS MANGANESE ADSORBS TO VARYING DEGREES AT THE CEMENTITE-AUSTENITE-FERRITE INTERFACES AND EFFECTIVELY INCREASES THE CEMENTITE-FERRITE INTERFACIAL ENERGY. THIS PREVENTS SPREADING OF THE CEMENTITE ALONG GRAIN BOUNDARIES AND THEREBY REDUCES THE TENDENCY FOR THE FORMATION OF DEGENERATE PEARLITE AND CARBIDE FILMS WHICH ARE KNOWN TO CRACK READILY DURING DEFORMATION AND INITIATE UNSTABLE FRACTURE IN THE MATRIX. THE PRESENT WORK SHOWS, HOWEVER, THAT THE RESULTING HIGHER PARTICLE-MATRIX INTERFACIAL ENERGY CAN PRODUCE ITS OWN PROBLEMS IN THAT CRACKING AT PARTICLE-MATRIX INTERFACES OCCURS MORE READILY DURING DEFORMATION AND CAN INDUCE EMBRITTLEMENT WHEN LARGE VOLUME FRACTIONS OF CARBIDE PHASE ARE PRESENT. (AUTHOR) (U)

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