ORNL-2971

Vol. 5 2

CHEMISTRY—SEPARATION PROCESSES
FOR PLUTONIUM AND URANIUM

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BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL

Volume 5

Plants and Equipment

T. F. Connolly

Oak Ridge National Laboratory
operated by
Union Carbide Corporation

United States Atomic Energy Commission
Division of Technical Information

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3 4456 0361533 6

PROCESSING OF NUCLEAR REACTOR FUELS – A BIBLIOGRAPHY

Introduction

This volume includes Section 5.0 of eight sections of a bibliography on nuclear reactor fuel reprocessing and waste disposal. The collection will be a unit, and cross references are made between volumes. The decimal coding of headings is designed for ease of cross referencing, filing, expansion, and for future use in an automatic microfilm viewer-printer now being developed.

Cutoff points are somewhat arbitrary: overlapping into the area of feed materials, for example, is kept to a minimum, even though fuel reprocessing and fuel refabrication can be a continuous operation. Continuous on-site reprocessing of aqueous reactor fuels is only lightly covered.

Section 1.0, Chemistry and Physics of Important Elements, contains many references to separation methods and conditions, particularly on a laboratory scale. Cross references to that section from Sections 2.0, 3.0, and 6.0 – to each of which it may be considered as peripheral – would be too numerous to be included and should be assumed for each element. Special tests or uses (e.g., as construction materials or reagents in standard processes) are treated in the appropriate sections.

The complete collection includes about 7000 abstracts, nearly all from Nuclear Science Abstracts, representing books, bibliographies, symposia, journals, and contractors' topical reports. Most of the material dates from the 1955 Geneva Conference to the present. A serious lack is material from progress reports, and a program for the detailed abstracting and indexing of progress reports is therefore under way at ORNL (with the helpful cooperation of the Cataloging Section of the AEC-DTI Extension).

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PLANTS AND EQUIPMENT

BEARINGS 5.01

11823 CF-59-2-1
Oak Ridge National Lab., Tenn.
HYDROSTATIC JOURNAL BEARING WATER TESTS CONDUCTED IN MODIFIED PK-A PUMP. H. E. Gilkey and P. G. Smith. Feb. 1, 1959. 17p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

A hydrostatic journal bearing mounted near the impeller of an overhung vertical shaft centrifugal pump was subjected to water testing as a part of the molten salt lubrication investigation at ORNL. Three tests were performed with bearings having radial clearances of 0.003 in., 0.0075 in., and 0.005 in. The first journal and bearing (0.003 in. radial clearance) were found to be heavily scored after testing. Only faint localized scratches were found on the second journal (0.0075 in. radial clearance) and these may have been caused by the many test starts and stops. Localized scratches, somewhat deeper than those on the second journal, were observed on the third journal, but no measurable wear had occurred from testing. An apparent inconsistency was noted in that at the same pump operating condition the bearing load as computed from pocket pressure data

2514
STUDY OF GAS-LUBRICATED, HYDRODYNAMIC, FULL JOURNAL BEARINGS. S. Whitley and C. Betts (U.K.A.E.A., Capenhurst, Ches., Eng.). Brit. J. Appl. Phys. 10, 455-63 (1959) Oct.

The two most important characteristics of gas-lubricated, full journal bearings are load-carrying capacity and half-speed whirl. These two characteristics have been investigated. The gases used as lubricants were mainly hydrogen, nitrogen, and neon, giving a large viscosity variation. Argon and carbon dioxide were also used to investigate the effect of the ratio of specific heats (γ). The bearings used were plain cylinders with a longitudinal groove cut into the upper surface of each bearing, extending over half the bearing length. It has been shown that this groove improved the half-speed whirl characteristics, and tests on bearings without the groove, demonstrate that the groove does not affect the load capacity. The parameters investigated are bearing length, diameter, clearance, rotational velocity, ambient pressure, and the gas viscosity and ratio of specific heats. It is shown that, in general, the existing theories of load performance for compressible lubricants, operating in isothermal conditions, give a satisfactory correlation with the experimental results. The half-speed whirl results are not related to a complete analytical theory, but useful stability criteria are established. (auth)

5287 NP-8205
General Electric Co. General Engineering Lab., Schenectady, N. Y. (NP-8205)
DYNAMIC STABILITY ASPECTS OF CYLINDRICAL JOURNAL BEARINGS USING COMPRESSIBLE AND INCOMPRESSIBLE FLUIDS. B. Sternlicht, H. Poritsky, and E. Arwas. [1959]. 110p. Contract Nonr-2844(00).

Solutions of Reynolds equation are presented for cylindrical journal bearings in which the velocity of the journal center is considered; however, the inertia terms are neglected. Solutions are obtained for both compressible and incompressible fluids. Analysis of the steady state forces that exist in compressible fluid, externally-pressurized cylindrical journal bearings with one plane of feeding is also included. From these analyses the gradients of the radial and tangential forces with respect to displacement and velocity are obtained. The equations of motion for small and large oscillation in terms of these forces and gradients are set up, and stability criteria are established for small oscillations and for large oscillations of a massless rotor. Calculations for threshold of instability are given and, where existing experimental data are available, theoretical predictions are compared with results attained in practice. (auth)

BIBLIOGRAPHY ON NON-METALLIC BEARINGS. New York, Engineering Societies Library. 1950. 13p.

This annotated bibliography of 101 references to literature from 1938 to 1950 covers all aspects of non-metallic bearings such as manufacture, design, properties, wear, lubrication, performance, testing, and application.

Franklin Inst. Labs. for Research and Development, Philadelphia.
A BIBLIOGRAPHY ON GAS-LUBRICATED BEARINGS. Interim Report. Eugene B. Sciulli. Dec. 1, 1957. 97p. Contract Nonr-2342(00). (NP-6557; I-A2049-1).

The bibliography is made up of references which deal with all phases of gas-lubricated bearings: theoretical, experimental, conjectural and otherwise. Abstracts of 108 reports, journal articles, and patents are given. Author and subject indexes are also included.

BEARINGS 5.01

3726 AERE-T/R-622(Rev.)
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE INCLINED GROOVE BEARING. R. T. P. Whipple. Oct. 1958. 28p. $0.42(BIS).

Self-lubricating bearings can be constructed if the fixed surface contains parallel inclined grooves, and they can be used either with liquid or gaseous lubricants. The theory of such self pumping inclined groove bearings is developed from first principles and is applied to the "herring bone" bearing in which, from symmetry, there is no net flow of lubricant across the bearing, and also to a bearing in which the grooves are only inclined in one direction. In the latter case there are complications when compressible fluid (i.e., gas) is used as lubricant. (auth)

10529 HW-55178
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FABRICATION OF GLASS BEARINGS. B. B. Brenden. Apr. 9, 1958. 13p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Sleeve bearings made of Pyrex Brand #7740 glass are used in multiple-stage turbine pumps to pump uranyl nitrate hexahydrate (UNH) solutions. The glass bearings replace pile graphite bearings and boron carbide bearings. At present the glass bearings cost approximately $70 apiece, but have been shown to last about 30 times as long as the pile graphite bearings. Boron carbide bearings are difficult to make and do more damage to the pump when they fail. (auth)

13883 APEX-390
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
HYDRODYNAMIC AND HYDROSTATIC LUBRICATED BEARINGS WITH PARTICULAR REFERENCE TO AIR BEARINGS: A LITERATURE SURVEY. M. A. Koenders. Apr. 1958. 32p. Contracts AF33(038)-21102 and AT(11-1)-171. $1.00(OTS).

A search of the unclassified literature and General Electric reports has been made with reference to the use of air as the lubricating fluid in hydrostatic and hydrodynamic bearing applications. (auth)

8900 CF-57-5-45
Oak Ridge National Lab., Tenn.
EVALUATION OF COATED Al_2O_3 AND TUNGSTEN CARBIDE BEARING-JOURNAL ASSEMBLIES IN WESTINGHOUSE 100A PUMP. Summary of Runs S-96A and S-97. A. S. Kitzes and C. A. McLaughlin. May 3, 1957. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Preliminary results of tests with the Westinghouse 100A pump indicate that Al_2O_3 and WC coated bearing-journal assemblies prepared by the Linde process are not promising as substitutes for the graphitar–stellite combination. The front Al_2O_3 assembly failed at start-up with water and both front and rear WC assemblies failed after 121 hours with water at 245°C. (auth)

6343 HW-41394
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
BEARING EVALUATION TESTS OF CARBON GRAPHITE BEARING MATERIALS. J. Dunn and P. B. McCarthy. Feb. 13, 1956. 14p. Contract W-31-109-Eng-52. $3.30 (ph OTS); $2.40(mf OTS).

The results of corrosion tests showed that the common graphite bearing materials are not resistant to concentrated HNO_3 at elevated temperatures. On the other hand, three specially compounded pure graphite materials; Pile Graphite CSGBF, National Carbon Company Graphite CS312, and Carbone Corporation Graphite Carbolube AP80 are resistant to boiling concentrated HNO_3. Although these three materials do not have bearing characteristics equivalent to Graphitars and other carbon graphite mixtures, they will make suitable sleeve bearings. Pile Graphite CSGBF has been given extensive tests in operating pumps where it performed satisfactorily against journals of 309S, 316, and 347 stainless steel. The other

3354 NYO-3738
Columbia Univ., New York.
INVESTIGATION OF "ANTI-WHIRL" BEARINGS FOR OPERATING IN AN ACIDIC SOLUTION CONTAINING ABRASIVE PARTICLES. Final Report for Period November 1, 1954 to May 31, 1955. Carl F. Kayan, Gilbert F. Boeker, and Dudley D. Fuller. Mar. 1956. 14p. Contract AT(30-1)-1274, Extension. $0.15(OTS).

"Anti-whirl" bearings which consisted of synthetic acid-resistant rubber in a modified bearing form in contact

BEARINGS 5.01

with abrasive solutions were tested and showed little evidence of wear. The bearings which used a ceramic mechanical face seal gave excessive wear rates in abrasive solutions. (For preceding period see NYO-3737.) (C.W.H.)

769 WAPD-Re-V(A)-30
Westinghouse Electric Corp. Atomic Power Div., [Pittsburgh].
A LITERATURE SURVEY ON CAUSES OF BALL BEARING FAILURE IN COMMERCIAL APPLICATIONS. C. S. Galtz. Aug. 7, 1953. Changed from OFFICIAL USE ONLY Jan. 16, 1958. 28p. $4.80(ph OTS); $2.70 (mf OTS).

The causes of ball bearing failure are discussed, including dirt, inadequate lubrication, and high loads introduced by improper mounting of the bearing. The corrosion mechanisms such as chemical attack and fretting are considered, along with failure caused by defects and failures in which the general bearing performance is unsatisfactory. (J.R.D.)

2405 R52GL51
General Electric Co. General Engineering Lab., Schenectady, N. Y.
SLEEVE BEARING DESIGN DATA. Harry Apkarian. Mar. 1, 1952. Decl. Nov. 29, 1955. 25p. $4.80(ph OTS); $2.70(mf OTS).

The results derived from an investigation to determine design data for sleeve bearings lubricated with Hanford process solutions are reported. Two basic types of bearing materials were tested: metallic materials (boron carbide and stellite J) and non-metallic materials (Graphitar 41, Keystone Carbon 353, and 60% carbon filled fluorothere). The journal materials tested were stainless steel 304, stellite J and welded stellite No. 6 on stainless steel 304. Bearing tests are also reported on Duralon and Epon. Data show that stellite J or boron carbide bearings have excellent wear and abrasion resistance but should be used only when conformability is

7168 AEC-tr-2920
THE AERODYNAMIC BEARING. G. Heinrich. Translated by R. Todd from Maschinenb. u. Wärmewirtsch. 7, 129-35 (1952). 15p.

Various forms of flow bearings were studied. The theory of flow bearings with a compressible working fluid (air) was developed. The general differential equation for the flow of compressible films was derived and the cylindrical load bearing with laminar and with turbulent flow was determined. The optimum quantities, i.e., those which correspond to the smallest value for the energy of the compressor, were calculated, and the method of calculation was demonstrated by numerical examples. Finally the double sided, annular tracked bearing was dealt with and formulas for the average bearing pressure and the energy necessary for the compressor were derived. By means of a numerical example, it was shown how the quantities corresponding to a minimum energy requirement are determined. (tr-auth)

NACA-RM-E57K12
Lewis Flight Propulsion Lab.; Cleveland.
PRELIMINARY STUDIES OF ROLLING-CONTACT FATIGUE LIFE OF HIGH-TEMPERATURE BEARING MATERIALS. Thomas L. Carter. Apr. 1, 1958. 28p.

Preliminary studies of rolling-contact fatigue life of both races and balls of some promising high-temperature bearing materials were made at room temperature in the rolling-contact fatigue spin rig. The results may be of assistance in judging the relative potential of bearing steels for use at high temperatures. The following materials were investigated: SAE 52100, MHT, TMT, MV-1, Halmo vacuum-melt, and AISI T-1, M-10, M-1, and M-50. (auth)

CALCINERS 5.02

11147 BNL-447
Brookhaven National Lab., Upton, N. Y.
DEVELOPMENT OF A WASTE CALCINER. Progress Report on WASTE PROCESSING DEVELOPMENT PROJECT. B. Manowitz and S. Zwicker. Apr. 1957. 11p. $0.15(OTS).

The work of the Waste Processing Development Project at BNL has led to the development of a piece of equipment capable of substantially reducing the volume of high activity aqueous waste streams. This equipment, known as a "continuous calciner," is a heated-tube auger-agitated concentrator which dehydrates and fuses the various aqueous salt solutions to an anhydrous free-flowing melt on a

continuous basis. A pilot plant model of this equipment has been operated successfully with an attendant decontamination factor of approximately 1000. The corrosion rate of mild steel in neutralized solutions and in the fused salt product was studied. No corrosive effects were detected, which indicated that mild steel is a safe storage container material. An economic evaluation was also made to compare relative costs of processing and storing an acid waste solution in a raw, neutralized, or anhydrous state.

8003 ✓ HW-43745
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
AN INVESTIGATION OF THE CRACKING OF CONTINUOUS CALCINERS DURING FABRICATION. W. R. Smith and W. L. Walker. June 13, 1956. Changed from OFFICIAL USE ONLY May 22, 1957. 21p. Project CG-613. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

After final heat treatment during fabrication of continuous calciners, cracking was observed in base metal and welds. The cracking was found to be due to formation of a grain boundary eutectic though both metal and welding rod were from "good" heats of 347 stainless steel. Experiments which demonstrate the relative cracking tendencies of 1-in. and $^1/_4$-in. thick sections of welded 304-L and 347 stainless steel are described. (T.R.H.)

CENTRIFUGES 5.03

5247 ✓ AERE-CE/R-2777
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
CYCLONES AS LIQUID-LIQUID CONTACTOR-SEPARATORS. J. W. Hitchon. Sept. 1959. 30p. BIS.

The use of cyclones for contacting and separating two immiscible liquids was investigated using a system 0.25M aqueous nitric acid/20% by volume tri-butyl phosphate in odorless kerosene/uranyl nitrate, for which accurate equilibrium data were available. Good separation of the two liquids was achieved by use of a system of two cyclones and a recycle circuit, and mass transfer efficiency was good. The possibility of using such a system as a stage in a multistage countercurrent solvent extraction apparatus is considered. Such a system would have a high processing rate/unit volume or low residence time, a characteristic which would be favorable for the treatment of enriched fissile-material solutions or highly active solutions. (auth)

19753 ORO-202
Virginia. Univ., Charlottesville. Ordnance Research Lab.
THE DEVELOPMENT OF SHORT BOWL ULTRACENTRIFUGES. Progress Report. Gernot Zippe. July 1, 1959. 19p. Contract [AT(40-1)-2400]. (UVA/ORL-2400-59-PR-1). $3.30(ph), $2.40(mf) OTS.

Progress is reported on lifetime tests of rotors and determination of power loss of the scoop system. (T.R.H.)

12443 ✓ ORNL-2689
Oak Ridge National Lab., Tenn.
AN EVALUATION OF HYDROCLONES FOR SIZE CLASSIFICATION OF THORIUM OXIDE. E. L. Youngblood and P. A. Haas. May 18, 1959. 44p. Contract W-7405-eng-26. $1.25(OTS).

The performance of hydraulic cyclones or hydroclones was evaluated theoretically and experimentally for size classification of thorium oxide. Oversize material was removed from 1-3 μ mean diameter thorium oxide by use of commercial (modified TM-3 Dorr Clones) equipment. Batch and continuous classification were demonstrated with product rates of up to 1 kg of ThO_2 per minute and removal of over 95% of material three times the mean diameter. Good agreement was obtained between experimental results and calculations from literature correlations. Dispersion was not complete even with dispersing agents; therefore, effective removal of undersize ThO_2 was not practical. The advantages of hydroclones are that they require no dispersing agents and have an ability to classify below 7-μ material, as compared with hydraulic classification by sedimentation and air classification, respectively. (auth)

13212 ✓ AERE-M-405
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
AMMONIUM DIURANATE PRECIPITATE SEPARATION IN HYDRAULIC CYCLONES. D. Bradley. Apr. 1959. 11p.

CENTRIFUGES 5.03

Experiments were carried out to determine if it is feasible to separate ammonium diurante (ADU) in hydraulic cyclones. (W.L.H.)

2548 CF-58-10-111
Oak Ridge National Lab., Tenn.
HRT-CHEMICAL PLANT RUN 16 SUMMARY. O. O. Yarbro. Oct. 9, 1958. 15p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The HRT chemical plant hydroclone loop, designed for the continuous removal of fission and corrosion product solids from the HRT, began radive operation during reactor run 15. Cell equipment was operated without difficulty and only minor troubles were encountered with auxiliary equipment. Operating variables, and data on corrosion product solids' removal during three periods of operation are summarized. Approximately 20% of the stainless steel corrosion products produced in the reactor were removed by the hydroclone. (auth)

TID-3527
Technical Information Service Extension, AEC.
HYDROCLONES AND LIQUID CENTRIFUGES. A Literature Search. James M. Jacobs, comp. Mar. 1959. 7p. $0.50(OTS).

A literature search for information concerning centrifugal devices was conducted. A listing containing 47 references to unclassified report literature dealing with hydroclones and centrifuges is presented. Availability is given for all reports. (J.R.D.)

15130
CENTRIFUGAL SEPARATORS. Charles Skarstrom (to U. S. Atomic Energy Commission). U. S. Patent 2,876,949. Mar. 10, 1959.

A centrifugal separator is described for separating gaseous mixtures where the temperature gradients both longitudinally and radially of the centrifuge may be controlled effectively to produce a maximum separation of the process gases flowing through. The invention provides for the balancing of increases and decreases in temperature in various zones of the centrifuge chamber as the result of compression and expansion, respectively, of process gases and may be employed effectively both to neutralize harmful temperature gradients and to utilize beneficial temperature gradients within the centrifuge.

ROTOR END CAP. F. C. Rushing (to U. S. Atomic Energy Commission). U. S. Patent 2,872,105. Feb. 3, 1959.

An improved end cap is described for the cylindrical rotor or bowl of a high-speed centrifugal separator adapted to permit free and efficient continuous counter current flow of gas therethrough for isotope separation. The end cap design provides for securely mounting the same to the hollow central shaft and external wall of the centrifuge. Passageways are incorporated and so arranged as to provide for continuous counter current flow of the light and heavy portions of the gas fed to the centrifuge.

A THEORETICAL STUDY OF THE HYDRAULIC CYCLONE. D. Bradley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Ind. Chemist. 34, 473-80(1958) Sept.

The pressure drop and efficiency of a hydraulic cyclone are considered theoretically, leading to equations which predict the performance of a particular cyclone design. The equations may be used in the design of a hydraulic cyclone with sharp separation at minimum particle size. (J.R.D.)

512 ORO-210
Virginia. Univ., Charlottesville. Ordnance Research Lab.
THE DEVELOPMENT OF SHORT BOWL ULTRACENTRIFUGES. Progress Report No. 1. Gernot Zippe, J. W. Beams, and A. R. Kuhlthau. Dec. 1, 1958. 27p. Contract AT(40-1)-2400. (UVA/ORL-2400-58-PR-1). OTS.

Russian developments in ultracentrifuges for U isotope separation are described. Progress on development of the short-bowl centrifuge is reported. (For preceding period see ORO-202.) (T.R.H.)

MEANS FOR DETERMINING CENTRIFUGE ALIGNMENT. W. Q. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,848,817. Aug. 26, 1958.

An apparatus is presented for remotely determining the alignment of a centrifuge. The centrifuge shaft is provided with a shoulder, upon which two followers ride, one for detecting radial movements, and one upon the shoulder face for determining the axial motion. The followers are attached to separate liquid filled bellows, and a tube connects each bellows to its respective indicating gage at a remote location. Vibrations produced by misalignment of the centrifuge shaft are transmitted to the bellows, and thence through the tubing to the indicator gage. This apparatus is particularly useful for operation in a hot cell where the materials handled are dangerous to the operating personnel.

2829 AERE-CE/M-227
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE EFFICIENCY OF HYDRAULIC CYCLONES FOR HOMOGENEOUS AQUEOUS REACTOR FUEL PROCESSING. D. Bradley. Aug. 1958. 17p. $0.49(BIS).
Available data on the use of the hydraulic cyclone for the separation of solid corrosion and fission products from the HAR fuel solution are reviewed. These data are compared with the results of recent work at AERE to give detailed prediction of the performance of such a cyclone system. (auth)

7788 NYO-4613
Harvard Univ., Boston. Air Cleaning Lab.
PERFORMANCE OF THE HOFFMAN CYCLONE. Richard Dennis, Edward Kristal, and Leslie Silverman. Mar. 31, 1958. 43p. Contract AT(30-1)-841. $6.30(ph OTS); $3.00(mf OTS).
Performance tests were conducted on a cyclone collector developed and manufactured by the U.S. Hoffman Company to determine whether it had any special advantages for precleaning feed materials gas streams prior to bag filtration. Weight collection efficiency and resistance were determined at flow rates ranging from 50 to 185 cu. ft per min. for atmospheric dust, copper sulfate microspheres, talc, and resuspended fly ash. Dust concentrations varied from 0.05 grain per 1000 cu. ft (atmospheric dust) to 31 grains per cu. ft (fly ash). Fly ash collection was investigated as a function of gas temperature, 70 to 700°F, and inlet loading, 0.1 to 31 grains per cu. ft. Test results indicated that special design features of this unit did not

2271 ORNL-2301
Oak Ridge National Lab., Tenn.
HYDRAULIC CYCLONES FOR APPLICATION TO HOMOGENEOUS REACTOR CHEMICAL PROCESSING. P. A. Haas. Nov. 29, 1957. 38p. Contract W-7405-eng-26. $1.00(OTS).
Results are reported for studies of application of liquid cyclones, or hydroclones, to removal of 1 to 10-micron particles from aqueous streams. Optimum dimensions were determined, and 0.25 and 0.40-in. diam. units were found to have capacities of 0.2 and 0.5 gpm for 80-ft liquid pressure drops. Under these conditions, hydroclones of these dimensions removed 50% or more of precipitated rare earth sulfates, ZrO_2, or iron oxides (sp. gr. 2.5 to 5) of 1-micron particle size from aqueous streams at 250 to 300°C. Results with 0.16, 0.25, 0.40, 0.50, and 0.56-in. diam. hydroclones were used to extrapolate and test literature correlations of flow capacities and efficiencies. A method of batch underflow accumulation gave heavy-phase concentration factors of up to 4500.

MIDGET HYDROCLONES REMOVE MICRON PARTICLES. P. A. Haas, E. O. Nurmi, M. E. Whatley, and J. R. Engel (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Chem. Eng. Progr. 53, 203-7(1957) Apr.
The use of hydroclones, in removing 1-μ solid particles from aqueous solutions, was developed in order to supply a simple, durable, liquid-solid separation apparatus to remove precipitated fission and corrosion products from UO_2SO_4 solutions employed in homogeneous reactors. (W.L.H.)

10478 AEC-tr-3216
CLASSIFICATION EFFICIENCY OF A TWO-STAGE HYDRAULIC CYCLONE. Naoya Yoshioka, Yutaka Hotta, and Tsutomu Mizutani. Translated from Chem. Eng. (Japan) 21, 32-6(1957). 13p.
A two-stage hydraulic cyclone system is described which classifies particles into four classes. A recovery curve and data on the ratio of accumulation of certain sizes of particles are included. The classification efficiencies of one- and two-stage hydraulic cyclone systems are compared. Data are tabulated. 8 figures. (C.H.)

CENTRIFUGES 5.03

7765 NP-tr-63
REPORT ON THE STATE OF RESEARCH ON NOVEMBER 14, 1956, ON A HYDROCYCLONE FOR THE SEPARATION OF UO_2 PARTICLES FROM AN AQUEOUS SUSPENSION. P. J. Kreyger and L. J. Deelman. Translated by S. Fitzgerald from Report from Naamloze Vennootschap voor Kenring van Elektrotechnisch Materialen, Arnhem, Holland. (KEMA). 17p.

Measurements were made of the yield of a hydrocyclone designed by KEMA. In order to test the installation and become familiar with its behavior, tests were first made with sand particles whose diameters were such as to give a falling speed comparable to that of uranium oxide particles of diameters between 4 and 20 μ in water at 20°C. One measurement was made for a UO_2 suspension with particles between 0 and 20 μ. By this measurement the lower limit of separated particles was established. It is pointed out that only one measurement was made for a UO_2 suspension. This should be borne in mind when judging the conclusions with respect to the UO_2 suspension. Conclusions were drawn due to the extreme exactness of the measurement.

HRP-HYDRAULIC CYCLONE STUDY FOR LIQUID-SOLID SEPARATION. P. A. Haas, E. O. Hurmi, M. E. Whatley, and J. R. Engel. Aug. 7, 1956. 19p. (CF-56-8-132)

The results of this study indicate that hydroclones are practical for separating particles in the 1 to 10 μ range from reactor coolants or fuel solutions. Even in high-temperature, high-pressure, corrosive systems hydroclones are more durable and trouble-free than present equipment. Heavy phase concentration factors up to 4,500 were obtained in the studies.

6292 CF-56-3-171
Oak Ridge National Lab., Tenn.
DESIGN AND PERFORMANCE OF A DUAL-CLONE LIQUID SEPARATOR. James C. Bresee. Mar. 26, 1956. 9p. Contract [W-7405-eng-26]. $0.15(OTS).

A separator based upon hydroclones with a very high separation efficiency has been developed. The separator, called a "dual-clone," uses two hydroclones connected and operated in such a manner that the first clone produces essentially pure solvent and the second, pure water. Phase purities in excess of 99.9% have been obtained with throughputs of approximately one liter per minute with a total separator pressure drop of 20 psi. (auth)

CENTRIFUGE SYSTEMS. R. H. Selkirk (to U. S. Atomic Energy Commission). U. S. Patent No. 2,756,925, July 31, 1956.

A centrifuge was specifically designed to handle radioactive materials within a shielded space. This necessitates the basket or receptacle for radioactive material being well removed from the driving motor, and controls which should be relatively accessible for ease of repair. A provision is made for the remote charging and recovery of liquid and precipitate, and for the sealing of shafts and piping to prevent leakage of the dangerously radioactive material. The shafts are composed of sections progressively smaller in diameter toward the socket extending through a bore of like design to reduce the passage of radiation. This design uniquely solves the problems encountered in the remote handling of radioactive material.

12993 CF-56-2-154
Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT [FOR] FEBRUARY 1956. W. K. Eister. Decl. Apr. 2, 1957. 86p. Contract [W-7405-eng-26]. $0.60(OTS).

Chemical Engineering Research. A successful demonstration of hydraulic cyclones in liquid-liquid extraction is reported, and a steam pulser for solvent extraction columns was demonstrated. Excer. Electrolytic cell design and $UF_4 \cdot {}^3/_4H_2O$ filtering are reported. Fluorox. Produc-

7164 NP-tr-43
THE SEPARATION OF SOLID PARTICLES FROM LIQUIDS BY MEANS OF A CYCLONE. E. Lindner. Translated by E. Poole from Maschinenbau-technik 5, 455-(?)(1956). 24p.

Cyclones are used to separate solid particles from liquids

MODIFICATIONS TO UNDERFLOW POT AND COOLING SYSTEM. H. O. Weeren. Oct. 17, 1955. Decl. Feb. 20, 1956. 8p. (CF-55-10-83)

Design information is presented on the underflow retention tank which is used for the temporary storage of the concentrated wastes separated from reactor solution by the hydroclone. Modifications in the temperature regulating system of the tank are also outlined.

CENTRIFUGES 5.03

19121 ✓ ALI-C-59535
Little (Arthur D.) Inc., Cambridge, Mass.
CENTRIFUGE FOR RADIOCHEMICAL PROCESSING.
Sept. 23, 1955. 35p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract 587. $6.30(ph), $3.00(mf) OTS.

The feasibility of designing and developing a canned centrifuge capable of operating for extended periods in a highly radioactive area was investigated. A preliminary design for the entire unit is outlined. It is concluded that such apparatus can be designed and built. Cost estimates are given, and recommended features for incorporation in the centrifuge are listed. (J.R.D.)

2049 ✓ AERE-Lib/Trans-617
THE STATE OF THE DEVELOPMENT AND APPLICATION OF HYDROCYCLONES. F. J. Fontein. Translated by J. B. Sykes from Chem. Ing. Tech. 27, 190-2(1955).

Several uses including sizing by sedimentation and washing of crude coal are outlined for single and multiple hydrocyclones. Equipment descriptions are included. (C.W.H.)

4030 ✓ AEC-tr-2476
LIQUID CYCLONE AS A HYDRAULIC CLASSIFIER.
Naoya Yoshioka and Yutaka Hotta. Translated from Chem. Eng. Japan 19, 632-40(1955). 20p

The classifying characteristics, capacity, required power, and the sensitivity of classification, and 50% point of the hydraulic cyclone for the treatment of relatively dilute suspensions were discussed. The hydraulic cyclone is an excellent apparatus for the classification of small particles whose size is less than 50 to 60μ; it is more economical to use small cyclones in series for the same degree of classification. (auth)

Babcock and Wilcox Co. Research Center, Alliance, Ohio.
SEPARATOR LITERATURE SURVEY. W. H. Moyer. July 29, 1954. 58p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract 534. (AECU-3414; BW-5315).

The results are given of a literature survey of 444 references on all types of cyclone separators. Capacity as a function of void fraction and pressure drop is the specific subject of the search.

Kansas. Univ., Lawrence.
CENTRIFUGATION BIBLIOGRAPHY. J. O. Maloney and Archer C. Wilcox. Apr. 1950. 44p. (Engineering Bulletin No. 25).

The arrangement of this bibliography is as follows: Articles and books are first discussed under the heading General, Liquid-Solid Separation, Liquid-Liquid Separation, and Centrifugal Filtration. The patent literature which follows is arranged by; General Applications, Centrifuge Design and Auxiliaries; Continuously Operating Machines; and Specific Industrial Applications. There are a total of 701 references of which 171 are articles and books and 530 are patents.

6831 ✓ AERE-Lib/Trans-618
MULTIPLE HYDROCYCLONES OF THE LATEST TYPE.
H. Trawinski. Translated by J. B. Sykes from Chem.-Ing.-Tecn., 27, No. 4 (Suppl.). 5p.

Hydrocyclones of diameter 10 and 15 mm. have been developed in which 36 and 24 individual cyclones, respectively, are combined to form a complete block. It is thus possible to decrease the separated grain size limit to about 3 μ. Information is given about results of operation and fields of application. (auth)

11687 DP-346
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
PRECIPITATION OF MANGANESE DIOXIDE. James T. Grace, Hugh E. Henry, and David G. Karraker. Dec. 1958. 12p. Contract AT(07-2)-1. $0.50(OTS).

The reaction of Mn^{2+} with MnO_4^- under vigorous agitation produces a precipitate of MnO_2 that can be more easily centrifuged from the supernatant than a precipitate formed under mild agitation. Increased temperature during precipitation also improved the ease of centrifugation. The effects are interpreted in terms of the kinetics of the precipitation. (auth)

COOLING SYSTEMS 5.04

Martin Co., Baltimore.
NUCLEATE BOILING LITERATURE SEARCH. J. J. Jicha and E. J. Lemanski. Apr. 1957. 56p. Contract DA-44-009-ENG-3043. (MND-1062-1).

The literature search deals with the mechanism of boiling heat transfer. The effects of different liquid conditions on this mechanism are discussed. Forced convection and nucleate boiling modes of heat transfer are identified as well as partial film boiling. Equations and graphs are given. 210 references to report and published literature are listed.

5301
FINNED TUBE. ITS PLACE IN NUCLEAR ENGINEERING. Nuclear Eng. 2, 115-16(1957) March.

7704 K-211
Carbide and Carbon Chemicals Corp. [K-25 Plant], Oak Ridge, Tenn.
BIBLIOGRAPHY ON PHOSPHATE SCALE REMOVAL. Fred E. Croxton, comp. May 12, 1948. 45p. Contract [W-7405-eng-26]. $7.80(ph OTS); $3.30(mf OTS).
The references shown in this bibliography were collected in connection with the scale removal problem present in the K-25 plant cooling system. The removal of the phosphate type scale was emphasized, but various related problems are also treated. Many references concerning phosphates and removal methods were not included because the process would have necessitated the removal of the cooler unit, and fusion treatment with various salts. The bibliography is divided into three sections; Scale Removal, Phosphate Solubilization and Other Properties, and Analytical Techniques. The references listed were obtained from a search of Chemical Abstracts, 1917 to 1947, Industrial Arts Index, 1938 to 1948, and Engineering Index, 1946. (auth)

CORROSION 5.05

CORROSION INHIBITION 5.05.01

5.05.04
See also
under process Chemistry and Engineering
Dorex process (6.17.04)

[5.05]
See also this section
Materials (Construction) (5.14)

563 AEC-tr-3305
ON A COLLOIDAL INTERPRETATION OF THE PHENOMENA OF CORROSION AND INHIBITION. (Sur une interprétation colloidale des phénomènes de corrosion et d'inhibition. Jean Frasch. Translated by the Oak Ridge National Lab. Library Staff from Corrosion et anti-corrosion 6, 9-14(1958). 13p.
Certain theories are presented which are based on experiments carried out on the colloidal nature of a majority of corrosion products. Attempts are made to introduce them into electro-chemical theory of corrosion and inhibition. (auth)

11888 ✓
TITANIUM FOR PROCESS EQUIPMENT—NEW ALLOYS. Chem. Eng. Progr. 55, No. 4, 114; 120(1959) Apr.
The addition of as little as 0.1% Pd to Ti has been found to produce an alloy resistant to boiling solutions of reducing acids without impairing the metals' resistance to oxidizing acids. Mechanical and working properties are unaffected. Equal improvement in corrosion can also be affected by addition of most of the other noble metals. The choice of Pd is dictated by its price, lowest of any of the noble metals. (W.L.H.)

PROTECTIVE COATINGS. Harry Burrell (Interchemical Corp., Cincinnati). Ind. Eng. Chem. 51, No. 1, 53A, 56A(1959) Jan.
A general review of the development of satisfactory water-based industrial coatings is presented. (J.E.D.)

16216 ✓ NP-7611
Gt. Brit. Inter-Services Metallurgical Research Council, London.
CORROSION AND ITS PREVENTION AT BIMETALLIC CONTACTS. July 1958. 10p. $0.35(BIS).
The extent to which the rate of corrosion of one metal is affected by contact with a dissimilar metal immersed with it in a corrosive liquid and means of mitigating the effect are discussed. (J.E.D.)

CORROSION 5.05

CORROSION INHIBITION 5.05.01

14434
CORROSION INHIBITION. G. H. Cartledge (to U. S. Atomic Energy Commission). U. S. Patent 2,837,474. June 3, 1958.

The protection of ferrous metals from the corrosive action of aqueous solutions is accomplished by the incorporation of small amounts of certain additive agents into the aqueous solutions. The method comprises providing a small concentration of technetium, in the form of pertechnetate ion, dissolved in the solution.

10592
QUANTITATIVE HIGH-TEMPERATURE OXIDATION OF PORCELAIN ENAMELED IRON. H. G. Lefort and A. L. Friedberg (Univ. of Illinois, Urbana). J. Am. Ceram. Soc. 41. 216-26(1958) June.

Continuous gain-in-weight method was used for quantitative measurement of the oxidation taking place at elevated temperatures for long periods of time on enameled iron and stainless steel. Studies included the effect of various thicknesses of nickel plate on iron. the effect of nickel plating on enameled and unenameled specimens, the effect of sand blasting or mechanical abrading and chemical cleaning before enameling. and the effect of temperature on the rate of oxidation. (auth)

10591
PORCELAIN ENAMEL. CORROSION PROTECTION FOR CHEMICAL PROCESS EQUIPMENT. Ind. Eng. Chem. 50. No. 6. 75A-6A(1958) June.

A discussion is presented of the uses of porcelain enamel in corrosion protection for chemical process equipment, including physical properties of the enamels. heat transfer efficiency. ease of cleaning enameled surfaces, and cost comparisons. (J.R.D.)

8932
FACTORS IN THE SELECTION OF CORROSION RESISTANT MATERIALS. F. L. Whitney, Jr. (Monsanto Chemical Co., St. Louis, Mo.). Metal Progress 71, No. 6, 90-6(1957) June.

The selection of metals for various environments is discussed. The case of fabrication, corrosion rate, and cost are most important items, but operating factors such as temperature, concentration, purity, velocity of corrosive fluids, and erosion by sludge are of equal influence on over-all economics. (W.L.H.)

7391
CORROSION-RESISTANT FIBROUS WEB OR FABRIC. D. Deverell and N. C. W. Judd (to U. K. Atomic Energy Authority). British Patent 766,841. Nuclear Eng. 2, 224 (1957) May.

A web or fabric of glass or mineral fibers is impregnated with a dispersion of polytetrafluorethylene in a volatilizable liquid and heated to remove the liquid by evaporation. It is then subjected to pressure (5 ton/sq in.) at an elevated temperature (300°C) below the sintering temperature of the polytetrafluorethylene. After repeating the steps at least once, the web or fabric is thus heated to sintering temperature. The process may be made continuous by running the cloth through a series of stages (baths and chambers). For low-pressure pump diaphragms, laminated board, parts of chemical plant, tubular and other bodies (shaped before sintering). (auth)

19263 CEA-tr-A-365
LA PROTECTION DU MOLYBDÈNE CONTRE L'OXYDATION AUX HAUTES TEMPERATURES. (Protection of Molybdenum Against High Temperature Oxidation.) K. Wassmann. Translated into French from VDI Zeitschrift 99, 421-2(1957). 9p.

There are three methods currently used for the protection of molybdenum against high-temperature oxidation, molybdenum alloys, impermeable inert coating, and coatings formed of stable oxides. The methods for testing the efficiency of the stable oxides in corrosion protection are described. The method of coating the molybdenum with a stable oxide using a spray gun is discussed, and the efficiency of the coatings obtained are reviewed. (J.S.R.)

KORROZIYA I ZASHCHITA METALLOV. (Corrosion and Protection of Metals.) R. S. Ambartsumyan, M. S. Lagovskaya, et al., eds. Moscow, Oborongiz, 1957. 366p.

CORROSION 5.05

CORROSION INHIBITION 5.05.01

A compilation of sixteen articles on the corrosion and protection of metals and alloys is presented. The topics discussed include corrosion and passivation of metals in various oxidizing media, corrosion of high-strength steels under tension, corrosive cracking, intergranular corrosion and pitting of aluminum alloys, anodic oxidation of aluminum alloys, corrosive cracking of magnesium alloys, and protection of magnesium alloys. (TCO-J.S.R.)

THE MECHANISM OF THE INHIBITION OF CORROSION BY THE PERTECHNETATE ION. IV. COMPARISON WITH OTHER XO_4^{n-} INHIBITORS. R. F. Sympson and G. H. Cartledge (Oak Ridge National Lab., Tenn.). J. Phys. Chem. 60, 1037-43(1956) Aug.

The effect of the addition of electrolytes on the potential of iron electrodes immersed in solutions of four inhibitors — CrO_4^{2-}, TcO_4^-, MoO_4^{2-}, WO_4^{2-} — has been determined at 57.5°. The behavior of the electrode potentials confirms the previous conclusion that a labile state exists at the metal-solution interface, and that the mechanism of corrosion inhibition is reversible with respect to addition or removal of electrolyte. All four inhibitors maintained the iron electrodes at potentials more noble than the Flade potential in the presence of dissolved air, but only the pertechnetate ion did so in deaerated solutions. In deaerated

8009 ✓ WADC-TR-56-521
Vitro Labs., West Orange, N. J.
PREPARATION OF PROTECTIVE COATINGS BY ELECTROPHORETIC METHODS. [Period covered] July 1955 to July 1956. Allen C. Werner, James J. Shyne, Harold N. Barr, and Bernard Triffleman. July 31, 1956. 52p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-3118. (AD-118224).

An investigation was conducted of the preparation of oxidation-resistant coatings for Mo by electrophoretic methods. Multilayer coatings of 80% Ni–20% Cr and Ni-bonded Cr_3C_2 provided good static air-oxidation resistance. Inclusion of a 50% dense Ni–Cr layer resulted in satisfactory ballistic impact resistance. Erosion was fair. All the test panels failed under severe thermal shock. Electrokinetic impregnation of graphite to provide increased

2709 ✓
THE MECHANISM OF THE INHIBITION OF CORROSION BY THE PERTECHNETATE ION. II. THE REVERSIBILITY OF THE INHIBITING MECHANISM: G. H. Cartledge (Oak Ridge National Lab., Tenn.). J. Phys. Chem. 60, 28-32 (1956) Jan.

An attempt has been made to determine the extent to which the process responsible for the inhibition of corrosion by the pertechnetate ion is reversible. It has been found that the disturbance of inhibition by added electrolytes involves a specific action and not merely an increase in electrical conductivity of the solution phase. The electrode potential of electrolytic iron was measured both in potassium pertechnetate and in mixtures of this with other electrolytes. The potential was found to respond quickly to changes in the composition of the solution in a manner that clearly represented kinetic influences at the interface. It is concluded that the potential and the inhibition alike depend upon a labile state at the interface that is quickly responsive to changes in the composition of the solution. (auth)

2710 ✓
THE MECHANISM OF THE INHIBITION OF CORROSION BY THE PERTECHNETATE ION. III. STUDIES ON THE PERRHENATE ION. G. H. Cartledge (Oak Ridge National Lab., Tenn.). J. Phys. Chem. 60, 32-6(1956) Jan.

It has been shown that the perrhenate ion, ReO_4^-, which is very similar to the pertechnetate ion, TcO_4^-, in most respects, differs from it radically in failing to inhibit corrosion under aerated conditions. Radioactive Re^{186} was used, in part, to eliminate the possibility that the radioactivity of technetium is involved in this difference. Measurements of the electrode potential of electrolytic iron in the presence of potassium perrhenate and sodium sulfate demonstrated the weakness of the ennobling effect of the perrhenate ion in aerated solutions and the greater susceptibility of this effect to competition with the sulfate ion, in comparison

3852 CEA-tr-A351
LE MOLYBDÈNE DANS LES ACIERS ET LES ALLIAGES RÉSISTANT AUX AGENTS CHIMIQUES. (Molybdenum in Steels and Alloys Resistant to Chemical Reagents.) L. Wetternik. Translated by A. Courtot from Werkstoffe u. Korrosion 7, 628-33 (1956). 21p.

CORROSION 5.05

CORROSION INHIBITION 5.05.01

The effect of molybdenum additions on the chemical resistivity of various steels and alloys was investigated. Cr steels, Cr–Ni steels, Ni–Fe alloys, Fe–Ni–Cu alloys, Fe–Cr–Ni–Cu alloys, and Fe–Si systems were studied. The results as a function of increasing Mo content are graphed. The resistance of pure molybdenum to various chemical reagents was determined. (J.S.R.)

1228

PLASTICS FOR CORROSION-RESISTANT APPLICATIONS. Raymond B. Seymour and Robert H. Steiner. New York, Reinhold Publishing Corp., 1955. 423p.

Information is presented on plastic materials of construction, thermoplastic applications, application of plastics in masonry construction, and the selection for the solution of corrosion problems. (J.E.D.)

62 AERE-C/R-2180

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

CONTROL OF pH BY ION EXCHANGE. P. C. Davidge and D. E. Glanville. (Contains an addendum by E. Glueckauf.) Sept. 28, 1954. Decl. with amendment Oct. 16, 1956. 14p.

Declassified version of LEO/RDC-8.

A method is presented for treating water to minimize the corrosion obtained in a stainless steel–water system. It consists of a mixed-bed ion exchanger with the cation resin in the Li state. This should remove all the soluble corrosion products and replace them with LiOH, thereby maintaining the pH. (W.L.H.)

6037 A/CONF.15/P/2198

INVESTIGATION OF MECHANISM FOR PROTECTING FRICTION SURFACES FROM CORROSION WEAR.

Y. S. Zaslavskii (Zaslavsky), G. I. Shor, and R. N. Shneyerova (U.S.S.R.). 26p.

Radiochemical methods which allow observing both the formation of the protecting film on the metal surface and kinetics of the corrosion of metals were employed to study the action mechanism of additives reducing the corrosion of bearing brasses. The investigation of various phosphorus- and sulfur-containing organic compounds labelled with P^{32}, S^{35}, and C^{14} has made it possible to observe and study the protecting films retarding the corrosion of metal caused by lubricant oxidation products. (auth)

BY FLUORIDES AND FLUORINE 5.05.02

577 HW-53636

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

INHIBITION OF HNO_3– HF CORROSION OF TYPE 304-L STAINLESS STEEL WITH $Al(NO_3)_3 \cdot 9H_2O$. W. L. Walker. Nov. 18, 1957. 3p. OTS.

To prevent corrosion of equipment by nitric acid–hydrofluoric acid mixture, aluminum nitrate nonohydrate is added to tie up the fluoride, either as aluminum fluoride or a tight complex. It was found that a solution of nitric acid, hydrofluoric acid, and aluminum nitrate nonohydrate in which the hydrofluoric acid – aluminum nitrate nonohydrate molar ratio is 3, did not show serious corrosive attack on the 300-series stainless steel. (J.E.D.)

15080

RATES OF DISSOLUTION AND PASSIVATION OF HAFNIUM-FREE ZIRCONIUM IN HYDROFLUORIC ACID. Martin E. Straumanis and William J. James (Univ. of Missouri, Rolla) and Alfred S. Neiman (Stanford Research Inst., Menlo Park, Calif.). Corrosion 15, 286t-90t(1959) June.

The dissolution reaction of Zr in HF is: $Zr + 4H^+ \rightarrow Zr^{4+} + 2H_2$. The over-all rate of dissolution V at 25°C and under the conditions of the experiments is much faster than that of Ti, and is a linear function of the HF concentration (up to N = 0.5): $V = 2000\ N\ mm^3cm^{-2}min^{-1}$. A black hydride film is formed on Zr during its dissolution. Fluoride additions (NH_4F, KF, NaF) to the acid initially increase the rate of dissolution. When added in greater amounts, passivation of Zr is caused which is quite complete for NaF additions. The order of increasing effectiveness is $NH_4F \rightarrow KF \rightarrow NaF$, apparently caused by the decreasing solubility of fluozirconate salt film formed on the metal. Potential measurements of Zr in HF showed an approach to a steady potential of about –0.74 volt with increasing concentration of the

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acid. The potential time curves had in general a logarithmic shape, the potential becoming more positive with elapsing time. Fluoride additions caused a breakdown of the initial film, formed during dissolution in pure HF, and a sudden drop of potential down to −1.112 volt (in 6.5 M NH_4F). The potential gradually became more positive, because of the salt film formation on the surface of Zr, until a steady potential was reached. Of the three additions, NaF produced and the most positive potential (−0.528 volt) and a complete passivation of Zr. (auth)

11688 DP-348
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
CORROSION BY FLUORIDE SOLUTIONS. Woodfin E. Shuler. Feb. 1959. 15p. Contract AT(07-2)-1. $0.50 (OTS).

A number of alloys were tested for resistance to corrosion in HF and HNO_3 and mixtures of the two acids. The austenitic stainless steels and the higher chrome-nickel alloys of iron were most promising. Of the materials tested, stainless steel, type 309Cb, Carpenter 20, Durco D-10, Durimet 20, and Chlorimet 3 were the most resistant to separate solutions of HF and HNO_3. Each of these alloys showed a significant increase in corrosion rate with increase in temperature. Exposure to HNO_3 appeared to passivate Carpenter 20 toward HF. In the mixed acids, fluoride ion increased markedly the rate of corrosion of all materials tested. The corrosion data indicate that the use of HF or acidic fluoride solutions will require relatively frequent replacement of dis-

11827 IDO-14449
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
CORROSION OF TYPE 316 ELC STAINLESS STEEL IN FLUORIDE-BEARING ZIRCONIUM PROCESS WASTES. T. L. Hoffman and C. M. Slansky. Jan. 9, 1959. 20p. Contract AT(10-1)-205. $0.75(OTS).

A study was made of the life of the waste storage tanks under actual storage conditions in order to provide data for the design of future storage facilities. The work reported involved corrosion studies on specially prepared stainless steel samples and on stainless samples cut from weld coupons prepared at the tank fabrication site. Bench-type corrosion tests were run using synthetic HF process waste solutions and boiling 65% HNO_3. The corrosion of stainless steels in fluoride-containing process waste indicated type 316 ELC stainless steel as likely material for tank construction. More elaborate experiments are described under bench-scale and plant conditions. (J.E.D.)

10580 NP-6729
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
CORROSION OF TITANIUM AND TITANIUM-BASE ALLOYS IN LIQUID AND GASEOUS FLUORINE. G. L. Ericson, W. K. Boyd, and P. D. Miller. Apr. 30, 1958. 8p.

Unalloyed titanium and four titanium-base alloys were subjected to a simple preliminary corrosion evaluation in liquid and gaseous fluorine at temperatures between −320 and +220°F. All materials exhibit promising corrosion resistance under the test conditions. More elaborate experiments would be desirable to fully establish the utility of titanium in fluorine service. (auth)

3574 IGR-TN/CA-387
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.
THE STABILISATION OF COPPER AND NICKEL APPARATUS AGAINST CORROSION BY ANHYDROUS HYDROGEN FLUORIDE. R. E. Worthington. Sept. 20, 1956. 9p. (IGC-CTC/R-182).

Unfluorinated nickel and copper apparatus reacts rapidly with hydrogen fluoride to form hydrogen and the appropriate metal fluoride. Prefluorination of the apparatus with hydrogen fluoride has no protective effect. Prefluorination with chlorine trifluoride prevents subsequent attack by hydrogen fluoride only if it is performed at a temperature which is 40 to 50°C higher than the reaction temperature used with the hydrogen fluoride. (auth)

CORROSION 5.05

BY FLUORIDES AND FLUORINE 5.05.02

4540 ANL-5557
Argonne National Lab., Lemont, Ill.
CORROSION STUDIES PERTINENT TO BROMINE TRIFLUORIDE PROCESSES. J. G. Schnizlein, R. K. Steunenberg, and R. C. Vogel. Apr. 1956. 27p. Contract W-31-109-eng-38. $0.35(OTS).

The corrosion rates of certain metals and alloys have been determined in several solutions typical of bromine trifluoride processes. Nickel, Monel and K. Monel showed excellent corrosion resistance in the following solutions at 125°C: BrF_3, 10 mol.% Br_2 in BrF_3, 10 mol.% BrF_5 in BrF_3, and 10 mol.% UF_6 in BrF_3. Inconel and Duranickel also proved satisfactory. Stainless steel, mild steel, Mg, and Al

8422 AEC-tr-3199
CORROSION OF STAINLESS STEELS IN SOLUTIONS CONTAINING HYDROFLUORIC ACID. M. M. Kurtepov and A. S. Gryaznova. Translated from Trudy Komissii Bor'be s Korroziei Metal. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 2, 59-68(1956). 7p.

Stainless steels of 18/8 type containing Ti, Mo, Nb, Ti, and Mo, or Mo and Nb were submitted to the action of HF alone and that of HF + HNO_3. The concentration of HF was varied from 0.1 to 10%. HNO_3 was used either as a 10% or

13057 Y-714
Oak Ridge National Lab., Y-12 Area, Tenn.
CORROSION RESISTANCE OF ZIRCONIUM METAL AND STAINLESS STEELS ON EXPOSURE TO CONCENTRATED SOLUTIONS OF URANYL FLUORIDE. C. D. Susano. Jan. 22, 1951. Decl. Mar. 6, 1957. 22p. Contract W-7405-eng-26. $0.25(OTS).

The results of exploratory tests to determine the degree of corrosion resistance of Zr metal and of various grades of stainless steels when exposed to highly concentrated solution of UO_2F_2 up to 100°C are reported. It is concluded that Zr metal is not sufficiently resistant to merit consideration for application in homogeneous reactors. Some tests were made to determine the suitability of chromates, H_2O_2, and triethanolamine for use as corrosion inhibitors, but with no apparent success. It is shown that under the particular conditions used all the various grades of stainless steels are equally and satisfactorily resistant to the corrosive attack of UO_2F_2 solutions at 100°C. (D.E.B.)

3597 K-373
Carbide and Carbon Chemicals Corp. K-25 Plant, Oak Ridge, Tenn.
CORROSION OF VARIOUS METALS IN HYDROFLUORIC SULFURIC ACID SOLUTIONS OF SYNTHETIC HANFORD WASTE. H. A. Bernhardt, W. Davis, Jr., and J. R. Flanary. Mar. 18, 1949. Decl. Dec. 23, 1955. 20p. Contract [W-7405-eng-26]. (KLO-87). $3.30(ph OTS); $2.40(mf OTS).

The precipitation of uranium as uranium tetrafluoride from hydrofluoric–sulfuric acid solutions of Hanford waste as a method of uranium recovery has imposed the problem of determining the type of metal that can be used for reactors. Nickel, monel metal and four stainless steels have been tested for their resistance to corrosion by such acid solutions. Nickel and monel corrode at rates of 0.019 and 0.062 in./year. The former shows extensive flaking after about 20 days exposure. The stainless steels

13118 NP-tr-120
PREVENTION OF OXYGEN CORROSION BY MEANS OF HYDRAZINE. P. A. Akol'zin, D. A. Danilenko, B. A. Kolodeznyi, M. A. Kulakov, and I. Kh. Shmuilovich. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment) from Teploénergetike 4, 96 (1957). 5p.

Preliminary studies of the use of hydrazine hydrate in deoxygenating boiler feed water to prevent boiler corrosion are analyzed. The procedure used at a Russian power station is described. (T.R.H.)

6642 TID-5090
[Columbia Univ., New York].
ANODIZATION OF STEEL IN A FLUORIDE BATH. Homer F. Priest and M. Levitz. Feb. 10, 1943. Decl. Nov. 23, 1959. 2p. (KIDM-30). OTS.

To protect the laminations of motors from UF_6 attack, an anodization procedure in a fused salt bath using a steel cathode is described. (T.R.H.)

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5552 CF-57-7-115
Oak Ridge National Lab., Tenn.
SOME CALCULATIONS OF DIFFUSION CONTROLLED THERMAL GRADIENT MASS TRANSFER. J. J. Keyes, Jr. July 22, 1957. Decl. Oct. 9, 1959. 43p. Contract [W-7405-eng-26]. OTS.

Calculations are presented of the amount of mass transfer to be expected in liquid alkali metal–Ni alloy systems for two assumed diffusion mechanisms. In one, the boundary layer is assumed saturated and the transfer rate is limited by the rate of diffusion of solute into the liquid. In the other, the mass transfer rate is assumed to be limited by the diffusion rate of a component of the solid alloy to the solid surface. It is concluded that a more general hypothesis is needed. (T.R.H.)

EFFECTS OF FUSED ALKALIS OF LITHIUM, SODIUM, AND POTASSIUM ON NICKEL, COPPER, IRON, AND STAINLESS STEEL. E. I. Gurovich. Zhur. Priklad. Khim. 32, 817-22(1959) Apr. (In Russian)

Tests were made of corrosion of nickel, copper, "Armco" iron, and stainless steel X18H9T by fused NaOH at 350, 400, and 450°C, by KOH at 400, 450, and 500°C, and by LiOH at 500, 550, and 600°C. Corrosion isotherms and polytherms were plotted, and the results show that the corrosive attack can be expressed as K > Na > Li. (R.V.J.)

16355 BMI-1284
Battelle Memorial Inst., Columbus, Ohio.
CORROSION AND CREEP BEHAVIOR OF TANTALUM IN FLOWING SODIUM. Gilbert E. Raines, C. Vernon Weaver, and John H. Stang. Aug. 21, 1958. 29p. Contract W-7405-eng-92. $1.00(OTS).

The corrosion behavior of commercial tantalum in high-purity flowing sodium from 700 to 1200°F and the effect of sodium exposure on the creep strength of tantalum at 1200°F were investigated. The tests were conducted in forced-convection flow loops constructed of Type 316 stainless steel. With continuously gettered sodium systems (probably containing less than 10 ppm oxygen) operating for periods up to 50 days, weight losses sustained by 1200°F specimens corresponded to only about 0.1 mil of metal removed per year. Maximum weight losses, encountered with a continuously cold-trapped (about 40 ppm oxygen) sodium system, were equivalent to about 3 mils per year for 1200°F specimens. For the most part, metallographic examinations revealed no deleterious corrosion effects; however, one particular group of arc-cast tubing specimens suffered severe intergranular attack in sodium with about 80 ppm oxygen. In addition to the corrosion findings, the corrosion tests yielded information about the partition of interstitials, particularly oxygen, in the sodium–tantalum system. Oxygen, for example, showed a tendency for migration from tantalum to high-purity sodium considerably stronger than would be predicted from limited thermodynamic data available. In the creep experiments, the oxygen content of the sodium was maintained at the <10 ppm level by continuous gettering. In general, the results demonstrated that sodium exposure at 1200°F had very little, if any, effect on tantalum creep strength. Baseline data necessary to establish this were obtained in supplementary helium-atmosphere creep tests. (auth)

14437
INHIBITION OF CORROSION. J. E. Atherton, Jr., and D. H. Gurinsky (to U. S. Atomic Energy Commission). U. S. Patent 2,840,467. June 24, 1958.

A method is described for preventing corrosion of metallic container materials by a high-temperature liquid bismuth flowing therein. The method comprises fabricating the containment means from a steel which contains between 2 and 12% chromium, between 0.5 and 1.5% of either molybdenum and silicon, and a minimum of nickel and manganese, and maintaining zirconium dissolved in the liquid bismuth at a concentration between 50 parts per million and its saturation value at the lowest temperature in the system.

10578 KAPL-M-GEG-11
Knolls Atomic Power Lab., Schenectady, N. Y.
RESULTS OF STRESS CORROSION TESTS OF TYPE 347 STAINLESS STEEL IN 500°F pH 10-11 LITHIUM HYDROXIDE. G. E. Galonian. May 2, 1958. 29p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

The results of stress-corrosion tests of T-347 stainless steel in 500°F pH 10-11 lithium hydroxide are described. Stressed-bolt specimens heated to 626, 665,

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and 694°F to produce boiling were exposed for four weeks to determine the extent of corrosion to be expected. Also, tests were made to evaluate corrosion under conditions of leakage to the atmosphere. In the

6597

ZIRCONIUM AND TITANIUM INHIBIT CORROSION AND MASS TRANSFER OF STEELS BY LIQUID HEAVY METALS. O. F. Kammerer, J. R. Weeks, J. Sadofsky, W. E. Miller, and D. H. Gurinsky (Brookhaven National Lab., Upton, N. Y.). Trans. Met. Soc. AIME 212, No. 1, 20-5 (1958) Feb.

Zirconium and titanium inhibit solution mass transfer of steels by liquid bismuth, mercury, and lead. It is shown that in bismuth and mercury, these adsorb on the surface of the steels and subsequently react with nitrogen and possibly carbon from the steels to form inert, adherent surface layers of ZrN, TiN, or TiN + TiC. Data are presented which describe the condition under which these deposits form. These inhibitors decrease the solution rate of iron into bismuth, and require a higher supersaturation for precipitation of iron from bismuth. (auth)

5996

MASS TRANSFER IN LIQUID METAL SYSTEMS. 1. THERMAL GRADIENT TRANSFER. J. W. Taylor (Babcock and Wilcox, Ltd.). Nuclear Power 3, 53-7 (1958) Feb.

Mass transfer in liquid metal systems occurs by thermal gradient transfer or isothermal transfer. In liquid-metal systems having a temperature differential, mass transfer of the container material may result in failure of the hot limb component or stoppage of the flow because of precipitation in the cold limb. Experimentally this transfer may be studied in thermal or forced convection conditions. The basic steps of the transfer process are solution of the container components and precipitation at the cold limb. The kinetics of dissolution and the parameters influencing it have been studied and the results are reviewed. Less is known about the kinetics of the second process. (J.S.R.)

235 CF-57-10-6

Oak Ridge National Lab., Tenn.

LITHIUM SYMPOSIUM — ANALYTICAL PROCEDURES AND HIGH-TEMPERATURE CORROSION. Reading List. E. E. Hoffman and D. H. Jansen. Oct. 1, 1957. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A list of 199 references pertaining to corrosion by molten lithium and related subjects has been compiled in connection with a Lithium Symposium held at the Oak Ridge National Laboratory on August 7-8, 1957. This list is by no means exhaustive, but it is thought to contain most of the information presently available on these subjects. In many cases the individual references contain additional references. (auth)

7994

KINETICS OF THE OXIDATION OF CHROMIUM. Earl A. Gulbransen and Kenneth F. Andrew (Westinghouse Electric Corp., Pittsburgh). J. Electrochem. Soc. 104, 334-8(1957) June.

The oxidation of high purity Cr was studied over the temperature range 700 to 1100°C using the vacuum microbalance method. Below 900°C conventional oxidation curves were obtained which can be fitted to the parabolic rate law. Above 900°C and for a film thickness of approximately 4800A, the rate of oxidation increased in an unusual manner. This increase in the rate of oxidation disappeared on further oxidation. At temperatures of 1050°C and higher a large increase occurred in the rate of oxidation, suggesting that the oxide film was no longer protective for film thicknesses greater than 42,000A. A logarithmic plot of the parabolic rate law constant vs. 1/T shows two straight lines separated by a transformation region. This gives 37,500 cal/mole and −15.3 entropy units for heat of activa-

7241 ORNL-2156

Oak Ridge National Lab., Tenn.

CORROSION PRODUCTS FORMED IN THE REACTION BETWEEN FUSED SODIUM HYDROXIDE AND IRON-RICH ALLOYS OF IRON, CHROMIUM, AND NICKEL. G. P. Smith and E. E. Hoffman. May 14, 1957. 9p. Contract W-7405-eng-26. $0.50(OTS).

A study was made of the microstructures of corrosion-product layers formed by the action of fused sodium hydroxide at 815°C on types 304 and 347 stainless steel and on four high-purity iron−chromium−nickel alloys with

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nominal compositions of 80% Fe–20% Cr, 80% Fe–10% Cr–10% Ni, 74% Fe–18% Cr–8% Ni, and 60% Fe–20% Cr–20% Ni. Each corrosion-product layer was found to consist of a nonmetallic network threading through a metallic matrix and to resemble similar layers formed by the action of hydroxide melts on Inconel. (auth)

7196 NP-6292
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
DEVELOPMENT OF OXIDATION AND LIQUID SODIUM RESISTANT BRAZING ALLOYS. Quarterly Report No. 3 [for] January 15, 1957 to April 15, 1957. Domenic A. Canonico and Harry Schwartzbart. Apr. 22, 1957. 9p. ARF Project No. B-110. Contract AF33(600)-33406.

A program is in progress at Armour Research Foundation which has as its objectives: the development of filler metals for brazing stainless steel to Inconel, the brazements to be resistant to oxidation and attack by molten sodium at 1650°F, and the development of a simple test for the ductility of a brazement. Atmospheric difficulties have been encountered during the brazing of T-specimens. A titanium sponge furnace has been added to the purification train in an attempt to eliminate this problem. Approximate melting temperatures have been obtained for 50 out of the 55 alloys originally proposed. Twelve alloys melted below 1900°F. Fifteen additional alloys have been prepared and are under study. These new alloys have as their base four alloys previously studied that had melting points above the maximum permissible temperature. Indium and/or silicon have been added as temperature depressants. (auth)

7186
STATIC AND DYNAMIC CORROSION AND MASS TRANSFER IN LIQUID METAL SYSTEMS. Leo F. Epstein (Knolls Atomic Power Lab., Schenectady, N. Y.). Chem. Eng. Progr. 53, Symposium Ser. No. 20, 67-81(1957).

In many systems involving liquid metals, the principal mechanism of corrosion of a solid exposed to the fluid is simple solution. In a static isothermal assembly the rate of corrosive attack is determined by the classical theory involving the solution rate constant α. The value of this parameter depends on whether the rate-determining step is (1) the diffusion of the solute through the liquid or (2) transfer of the solute through a solid film or some product of chemical reaction at the solid–liquid interface. In dynamic corrosion, such as is encountered in heat transfer loops, where parts of the system are at different temperatures and the fluid flows continually from the hot to the cold zone, different expressions are obtained for the cor-

6766
MASS TRANSFER IN LIQUID METALS. W. E. Dunn, C. F. Bonilla, C. Ferstenberg, and B. Gross (Columbia Univ., New York). A.I.Ch.E. Journal 2, 184-9(1956) June.

The rate of mass transfer was measured for solid metal shapes dissolving into mercury at room temperature. Sherwood numbers for horizontal tin, cadmium, zinc, and lead cylinders dissolving by natural convection agreed with Nusselt numbers for heat transfer in nonmetallic liquids at the same Rayleigh (Grashof × Prandtl) numbers. Dissolving of zinc tubes by mercury flowing turbulently within them agreed with heat transfer to nonmetals in tubes. Dissolving of random beds of lead spheres by mercury flowing through the bed agreed with similar nonmetal systems. It is concluded that mass transfer processes in liquid metals follow substantially the correlations for other fluids in heat or mass transfer, which with moderate safety factors may thus be used for at least preliminary design purposes. (auth)

8373 NP-6051
Mine Safety Appliances Co., Callery, Penna.
CORROSION OF LOW ALLOY STEEL IN HOT NaK. Memo Report 109. W. Milich and E. C. King. Mar. 30, 1956. 6p. Contract NObs-65426.

Consideration is being given to the use of low alloy steels due to the difficulties encountered in the use of type 347 stainless steel for steam generating equipment. As a preliminary experiment, to check the corrosion of such steels by liquid metals, a type 304 stainless steel loop was revised to accomodate a section of 1 in. OD tubing composed of $2^1/_4$% Cr–1% Mo steel. NaK (56 wt. % K) at 850°F was circulated at approximately 8 ft/sec. through this tubing for four months. Four small samples ($^1/_4$ in. weighed sections of the tubing) placed in an in-stream expansion tank were removed after 1, 2, 3, and 4 months

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7654 AERE-C/M-272
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE STATIC CORROSION OF NICKEL AND OTHER MATERIALS IN MOLTEN CAUSTIC SODA. J. N. Gregory, N. Hodge, and J. V. G. Iredale. Mar. 1956. 15p. (RCTC-P/62).

Nickel is a satisfactory container material for molten caustic soda in the temperature range 320 to 580°C, with a mean corrosion rate of about 10 mdd. Above 580°, corrosion is much more rapid. Of the various additions made to molten caustic soda, only LiOH gives a reduction in the corrosion rate. The mean rate of corrosion of Ni in a LiOH/NaOH eutectic mixture between 220 and 580°C is about 2.0 mdd, but this advantage does not extend to temperatures above 600°C. The nickel-base alloys, Inconel, Hastelloy D, and Duranickel have a slightly higher corrosion rate than commercial Ni but have the advantage of better mechanical properties. The only other resistant materials are Al, Ag, Pt, and, to some extent, Zr, and the ceramics, thoria and alumina. (auth)

6657 AERE-M/TN-35
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
INHIBITION OF LIQUID-METAL CORROSION. J. W. Taylor. Feb. 10, 1956. 9p. (MSWP-N/18).

From a consideration of the common mechanisms of liquid metal corrosion, additions to liquid metals which inhibit corrosion are classified as scavenging or diffusion-barrier types. Desirable characteristics of both classes of inhibitor are discussed and possible limitations to the zirconium nitride inhibitor, proposed for liquid metal fuelled systems based on bismuth, are considered. Suggestions are made for overcoming such limitations and it is recommended that surface layers of the metals molybdenum, tantalum, niobium and possibly beryllium be tested as alternative inhibitors of the diffusion-barrier type. (auth)

5343 CF-51-7-135(Del.)
Oak Ridge National Lab., Tenn.
RESISTANCE OF METALLIC MATERIALS TO CORROSION ATTACK BY HIGH TEMPERATURE LITHIUM Interim Report. J. E. Cunningham. July 23, 1951. Decl. with deletions Mar. 8, 1957. 78p. $12.30(ph OTS); $4.50 (mf OTS).

Liquid-metal corrosion studies conducted discourage use of Li as a heat transfer fluid. Data clearly indicate that molten Li is a more difficult coolant to contain than is the alkali metal Na. Specific results on the various pure metals tested in an Fe capsule under static conditions are that Armco Fe, Nb, Ta, Zr, U, and Ti pass good resistance; W limited resistance; and sintered Co, V, Mo, Be, Cr, Ni, Mn, and silicon poor resistance to corrosive attack by Li at 1000°C. At lower temperatures the above metals except for Ni show good corrosion resistance to Li. (W.L.H.)

13762 Y-B15-19
[Oak Ridge National Lab., Y-12 Area, Tenn.]
CORROSION TEST BY FLUORIDE SALTS. H. J. Buttram, R. O. Hutchinson, and P. J. Hagelston. Jan. 16, 1951. Decl. Mar. 21, 1957. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Corrosion tests have been run on a number of different types of stainless steel, Mo, Ni alloys and Nb in $LiF-UF_4$ eutectic at 700°C for 420 hours and in $NaF-UF_4$ eutectic for 600 hr. (W.L.H.)

Oak Ridge National Lab., Y-12 Area, Tenn.
STAINLESS STEEL COATINGS TO PREVENT THE CORROSION OF COPPER. L. O. Love and W. K. Prater. Jan. 12, 1951. Decl. Jan. 5, 1956. 8p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

In separating the stable isotopes of lithium in the calutron, lithium metal was investigated as a possible charge material. First results indicated that the corrosive action of the hot lithium metal, especially on the copper castings of the source unit, would preclude its use unless some method of protecting the casting could be found. The noncorrosive properties of iron suggested the possibility of coating those source parts affected by the lithium metal with non-magnetic stainless steel. This was tried in the following manner: The charge oven casting and the arc chamber casting were sand blasted and a coat of stainless steel, approximately .015" thick was sprayed on. The effectiveness of this treatment in preventing corrosion of the casting is clearly shown. Out of a total of 100 or more runs in which coated castings were used, no failures occurred due to corrosion of the castings. (auth)

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Argonne National Lab., Lemont, Ill.
RESISTANCE OF MATERIALS TO ATTACK BY LIQUID METALS. LeRoy R. Kelman, Walter D. Wilkinson, and Frank L. Yaggee. July 1950. 139p. (ANL-4417).

Tabular data and descriptive material are presented concerning the resistance of materials to attack by Na and Na-K alloys, Li, Hg, Pb, Bi, alloys of Pb and Bi, Mg, Cd, Tl, In, Ga, Al, Sn, Zn, and Sb. A list of 174 references to journal, book, and report literature is included.

6354 A/CONF.15/P/1147
CORROSION DE L'OXYDE DE BERYLLIUM. (Corrosion of Beryllium Oxide). J. Elston and R. Caillat (Commissariat à l'Énergie Atomique, Paris). 56p.

Data are presented on the volatilization of beryllium oxide in moist air. The corrosion rate of powder samples or sintered shapes of various densities is dependent on the temperature and water vapor concentration. Data on the corrosion of sintered beryllium oxide in pressurized water are also presented. At 250°C, under a pressure of 40 kg/cm^2, water is very slightly corrosive. Some data on corrosion in liquid sodium are given. (J.S.R.)

HCl AND CHLORIDES 5.05.04

1869 TML-57
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
THE CORROSION OF TITANIUM. D. W. Stough, F. W. Fink, and R. S. Peoples. Oct. 29, 1956. 184p. Contract AF18(600)-1375.

The corrosion properties of Ti and some Ti alloys are reported. The data were obtained from the results of laboratory investigations and from reports of the behavior of Ti in service. Included are corrosion rates in various environments, a description of industrial and military corrosion experiences with Ti, and the results of fundamental studies of the corrosion and passivating processes on Ti.

17018
CORROSION RESISTANCE OF TITANIUM AND ZIRCONIUM IN CHEMICAL PLANT EXPOSURES. P. J. Gegner and W. L. Wilson (Columbia-Southern Chemical Corp., Barberton, Ohio). Corrosion 15, 341t-50t(1959) July

Corrosion tests were conducted with titanium, zirconium, and a number of other metals in a wide variety of chemical plant exposures. Some of the tests were carried out under similar conditions in as many as five different plants. Titanium was found to possess low or, in many cases, nil corrosion rates in such varied exposures as wet chlorine gas, hypochlorous acid, sodium and calcium hypochlorites, sodium and potassium chlorides, sea water, and a number of solutions containing wet chlorine. It was also found to be very resistant to many concentrations of calcium chloride, sodium and potassium hydroxides, nitric acid, and chlorine-saturated sulfuric acid. Zirconium exhibited low corrosion rates in nitric acid, sodium and potassium hydroxides, hydrochloric acid, dry chlorine, sodium hypochlorite, sodium and potassium chlorides, sea water, and some concentrations of calcium chloride and chlorine-saturated sulfuric acid. Results of 116 exposures involving over 800 corrosion rates on 40 different materials are described. (auth)

CORROSION OF TITANIUM IN SULFURIC ACID AND CHLORINE. L.W. Gleekman (Wyandotte Chemicals Corp., Mich.). Corrosion 14, 401t-2t(1958)Sept.

Corrosion data show the results of a laboratory test in which commercially pure titanium A-70 was tested in 50% sulfuric acid saturated with chlorine-air mixtures. One sample was totally immersed in the acid, one sample partially immersed, and one sample exposed in the vapor phase. The gaseous mixture ranged from 100% air to 100% chlorine with particular interest being directed to the high chlorine and the high air percentages. The gaseous mixture was added to the acid solution for eight hours continuously during the day; the bottles were then closed

off to the atmosphere over night. The test ran for two weeks at room temperature. It is shown that the influence of small amounts of chlorine on the corrosion of titanium in 50% sulfuric acid in that 5% by volume of chlorine in the gaseous mixture reduced the corrosion rate of titanium approximately 100-fold. Larger additions of chlorine did not substantially reduce the corrosion rate. (auth)

7185 BM-RI-5299
Bureau of Mines.
THE RELATIVE CORROSION RESISTANCE OF TITANIUM AND SOME OF ITS ALLOYS. Lex B. Golden, Walter L. Acherman, and David Schlain. Feb. 1956. 28p.

Arc-melted and powder-metallurgy Ti and the Ti-7% Mn, Ti-1.8% Cr-0.9% Fe, and Ti-2.7% V-2.7% Fe alloys all have corrosion properties in acids and in chloride solutions that are quite similar; however, there are some differences in the corrosion behavior of these metals. Arc-melted Ti is slightly superior to Ti consolidated by powder-metallurgy techniques in its resistance to H_2SO_4 and H_3PO_4 solutions. The Ti-V-Fe alloy is a little more resistant than unalloyed Ti in some acid solutions, and the Ti-Mn and Ti-Cr-Fe alloys are usually less resistant. The Ti-Mn, Ti-Cr-Fe, and Ti-V-Fe alloys become embrittled in the more concentrated acid solutions. The degree of embrittlement is usually proportional to the

8374
PROTECTIVE FILM ON TITANIUM IN HYDROCHLORIC ACID. Rikuro Otsuka. J. Sci. Research Inst. (Tokyo) 49, 319-24(1955) Dec.

Titanium immersed in hydrochloric acid solution is coated with titanium-hydride film, and this film shows a protective effect against the acid. Titanium coated with hydride film by pre-treatment of cathodic hydridation resists completely up to approximately 24 wt.% HCl at a room temperature. (auth)

RECTIFICATION BY ZIRCALOY 2 IN HIGH-TEMPERATURE WATER. J. N. Wanklyn and R. Aldred (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electrochem. Soc. 106, 529(1959) June.

Recent corrosion tests of Zircaloy 2 under heat transfer in water at pH 10.5, 280°C, were vitiated by rectification effects. Strips of the material were heated by the passage of a large 50 cps alternating current, and this involved a voltage of about 12 v rms between the specimen and the wall of the apparatus. Corrosion was unexpectedly great, white oxide forming in less than 200 hr, and much hydrogen was taken up by the Zircaloy 2. (auth)

CORROSION OF ALUMINUM AND ITS ALLOYS IN WATERS OF DIFFERENT COMPOSITION. Otakar Sverepa and G. W. Akimow (Staatl. Forschungsinstitut für Materialschutz, Prague, Czechoslovakia). Werkstoffe u Korrosion 9, 533-6 (1958) Aug.-Sept. (In German)

Corrosion tests of aluminum and its alloys were made in river waters and in coolant waters of circulating systems carried out in natural conditions. In river water the corrosion was low and uniform, but there was pitting corrosion in circulating water. The composition and the impurities of the water influence the corrosion. The differences between the corrosion behavior of the different materials were slight. Laboratory tests showed that Al—Mn and Al—Mg alloys undergo the most intensive corrosion by the mutual action of Cu^{2+}, Cl^-, Ca^{2+}, and HCO_3^- in the presence of oxygen. Pitting corrosion depends largely on the concentration

760 NMI-1208
Nuclear Metals, Inc., Cambridge, Mass.
THE CORROSION OF ZIRCONIUM ALLOYS IN 900°F STEAM. J. Paul Pemsler. Aug. 18, 1958. 24p. Contract AT(30-1)-1565. $0.75(OTS).

Steam at 900°F is a very corrosive medium for zirconium alloys. Zircaloy-2 and Zircaloy-3 have poor re-

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sistance at this temperature. The presence of tin is highly detrimental to the corrosion resistance of zirconium alloys. Additions of nickel, chromium, and to a lesser extent, iron extend the life of zirconium-base alloys to as long as sixty days before spalling commences. Quenching from the beta phase impairs the corrosion resistance of nickel and chromium alloys and extends the life of iron alloys and the Zircaloys. In general, a pre-treatment of 10 days in 680°F water has no effect on the corrosion resistance of the alloys tested. (auth)

19233 HW-56995
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CORROSION OF ZIRCONIUM, CARBON STEEL, AND STAINLESS STEEL IN HIGH TEMPERATURE WATER. R. J. Lobsinger. Aug. 6, 1958. 11p. Contract W-31-109-Eng-52. $3.30(ph), $2.40(mf) OTS.

Corrosion data obtained on zirconium, carbon steel, and stainless steel exposed to high-temperature water at pH values from 7.0 to 10.0 are reported. Tests were conducted to support existing data and to determine the important variables in each system. (J.E.D.)

10579 MND-E-1322
Martin Co., Baltimore.
AUTOCLAVE TESTING OF TYPE 304 STAINLESS STEEL. Task 1, Phase 2. L. E. Phillips. May 1958. 63p. Contract DA-44-009-ENG-3043.

AISI Type 304 stainless steel U-bend test specimens were subjected to corrosive water in rocker autoclaves. One sample was suspended in the vapor phase and the other sample in the water phase of each autoclave. Water chemistry was statistically varied. Consistent test results were attained by careful control of the autoclave atmosphere. It was determined that oxygen and chlorides in the water were the only variables which contributed to the cracking of test specimens. The chloride level for cracking is dependent on test time, while the oxygen level appears to be independent of test time. Results indicate that a high oxygen level will not allow cracking at lower chloride levels, and conversely. This is in contradiction to some of the literature. The oxygen level necessary to induce cracking was found to be approximately four per cent. Test results also indicate that oxide film formation on stainless steel may be sufficient to induce stress corrosion cracking in the presence of chlorides, even if the environmental oxygen concentration is low. The most significant result of this work was the surprisingly high concentration of oxygen which was necessary to induce cracking. This suggests the possibility that untreated water can be used safely if adequate deaeration of the boiler is provided. Carbon steel samples were subjected to severe environmental conditions without cracking. General corrosion resistance was poor. Recommendations were made on the test environment of the miniature heat exchangers which are to be tested as a follow-up to the autoclave program. (auth)

14768 A/CONF.15/P/714
Argonne National Lab., Lemont, Ill.
HIGH TEMPERATURE AQUEOUS CORROSION OF ALUMINUM ALLOYS. J. E. Draley, C. R. Breden, W. E. Ruther, and N. R. Grant. 18p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

It has been shown that exposure of commercial aluminum alloys to water at elevated temperature results in intergranular attack and rapid deterioration. It was also shown that alloying aluminum with nickel and iron largely prevents this type of attack. Since that time a considerable amount of testing has been done at several laboratories, to determine in some detail the corrosion behavior of this type of alloy. The one that has received the most attention is alloy X8001, made by the addition of 1% nickel to American commercially pure metal (known as alloy 1100). Typical significant impurities are 0.5% iron, 0.1 to 0.3% silicon, and the order of 0.1%

10080 KAPL-M-GEG-9
Knolls Atomic Power Lab., Schenectady, N. Y.
CORROSION OF SPRING MATERIALS IN HIGH TEMPERATURE WATER. G. E. Galonian and H. L. Tymchyn. Apr. 24, 1957. 18p. Contract W-31-109-Eng-52. $3.30 (ph OTS); $2.40 (mf OTS).

Helical springs of Inconel-X, Haynes 25, and Allegheny A286 were corrosion tested unstressed and stressed in compression for periods up to six months in 600 and 680°F

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water. The purpose of these tests was to determine the rate of corrosion and resistance to stress corrosion cracking under conditions expected in the S3G/S4G control drive mechanisms. The results of static autoclave tests showed that the most corrosion resistant material investigated was Haynes 25. The rate of corrosion of Inconel-X was higher than Haynes 25 but both material should be suitable for use in the water conditions investigated. The presence of dissolved air in the test water increased the total amount of corrosion of all the materials but did not produce stress corrosion cracking. Both Cr and Co–W coatings on Inconel-X were attacked in air saturated water. (auth)

5874 AECU-3424
Case Inst. of Tech., Cleveland.
AN INVESTIGATION OF SCALING OF ZIRCONIUM AT ELEVATED TEMPERATURES. Quarterly Status Report No. 15 [for] December 2, 1956 to March 2, 1957. H. B. Probst, E. B. Evans, and W. M. Baldwin, Jr. Mar. 6, 1957 7p. Contract AT(11-1)-258. $1.80(ph OTS); $1.80(mf OTS).

5862
MECHANISMS OF AQUEOUS CORROSION OF ALUMINUM AT 100°C. K. M. Carlsen (Joint Establishment for Nuclear Energy Research, Lillestrom, Norway). J. Electrochem. Soc. 104, 147-54(1957) March.

Various alloys of Al, as well as superpurity Al material, have been tested in aqueous solutions at 100°C. Samples have been polarized cathodically and anodically to study the effect of cathodic and anodic reactions, respectively, on the corrosion behavior. Results are interpreted as showing that the alkalinity produced at the cathodes facilitates film breakdown in these places. Consequently, alloys containing cathodic constituents were attacked where these constituents were situated, while polycrystalline superpurity material was attacked in the grain boundaries. The influence of bulk pH and inhibitors is discussed in some detail. (auth)

10535 KAPL-1739
Knolls Atomic Power Lab., Schenectady, N. Y.
CORROSION OF ALUMINUM IN HIGH TEMPERATURE WATER. II. APPLICATION OF INFRARED SPECTRA TO CORROSION STUDIES. R. M. Haag. Feb. 28, 1957. 16p. Contract W-31-109-Eng-52. $0.20(OTS).

The application of infrared transmission measurements to corrosion studies has been investigated. Corrosion products may be identified in situ by reflectance measurements, or after removal from the base metal. Data are included from studies on Al alloys and hydrous Al oxides. (auth)

10536 KAPL-1741
Knolls Atomic Power Lab., Schenectady, N. Y.
CORROSION OF ALUMINUM IN HIGH-TEMPERATURE WATER. III. INHIBITION OF CORROSION BY SODIUM SILICATE. R. M. Haag and F. C. Zyzes. Feb. 28, 1957. 18p. Contract W-31-109-Eng-52. $0.20(OTS).

The corrosion rate of 2-S aluminum in high purity water and in 0.01, 0.1 and 1 wt. % sodium silicate solutions has been measured at 200 and 250°C. A marked inhibition of corrosion was observed in the more concentrated solutions. (auth)

11427 CF-57-1-26
Oak Ridge National Lab., Tenn.
CARBON STEEL IN HIGH TEMPERATURE WATER. G. E. Moore. Jan. 31, 1957. 34p. Contract W-7405-eng-26. $6.30(ph OTS); $3.00(mf OTS).

Resistance of carbon steel to corrosion in oxygenated high-temperature (250°C) water was unexpectedly good at high oxygen concentration. Pertinent literature, critically examined, and toroid experiments indicated that at low oxygen concentration attack did increase with concentration, but as oxygen concentration was sufficiently increased, more protective films were formed on the metal. Some corrosion factors in the application of carbon steel to nuclear reactor systems are discussed. (auth)

8454 AEC-tr-3215
OXIDATION OF TITANIUM. Per Kofstad and Karl Hauffe. Translated from Werkstoffe u. Korrosion 7, 642-9(1956). 19p.

Experimental data on the oxidation of Ti exhibit considerable discrepancies, particularly in the high-temperature

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range >800°C. The varying results are shown in the different rates of oxidation, the time laws, and consequently also in the activation energies of oxidation. On the basis of these facts, a critical survey of previous investigations was made to compare these data with experimental results obtained by the authors and to coördinate all the various findings. (J.E.D.)

1349

THE CORROSION BEHAVIOR OF ALUMINUM. Hugh P. Godard. Corrosion 11, 542t-52t(1955) Dec.

The practical corrosion behavior of aluminum is reviewed. Included is a discussion of the following topics: the relative nature of corrosion resistance, resistance criteria, factors influencing corrosion rates, common corrosion problems, how to choose an alloy; and galvanic, deposition, crevice and pitting corrosion. Specific information is given on corrosion in six major environments. Other topics considered include corrosion of brazed and welded joints, atmospheric performance of anodized aluminum and preventive measures. Twenty-nine references are appended for persons interested in further study. (auth)

2058 KAPL-1376

Knolls Atomic Power Lab., Schenectady, N. Y.
CORROSION OF IRON IN HIGH-TEMPERATURE WATER. I. CORROSION RATES BY HYDROGEN EVOLUTION AT 240 TO 360°C. II. KIRKENDALL EXPERIMENTS. D. L. Douglas and F. C. Zyzes. Nov. 1, 1955. 93p. Contract W-31-109-Eng-52.

A new method of measuring the corrosion rate of metals in high-temperature water was developed. The method involves determining the amount of H_2 evolved in the reaction. Corrosion measurements are carried out in small autoclaves, the gas space of which is filled with a known amount of a carrier gas, helium. After corrosion, a sample of the gas is taken, and is analyzed on the mass spectrometer. From the analysis and the amount of gas the H_2 evolved in the corrosion reaction is readily calculated. Using this method, extensive measurements were made of k_1, k_2 and k_3 are constants. An unexplained spread in the data prevented the determination of the constants but the total corrosion for electropolished specimens ranged from about 0.5 to 1.0 millimoles of H_2 evolved per square decimeter in 500 hours. No significant difference between Armco Fe and the high-purity Fe was found. Also, no effect of temperature in the range 316 to 360°C was detected. Corrosion behavior is the same in saturated vapor, superheated vapor, and the dilute solutions. Annealing the Fe for a few hours at 800°C in H_2 or a vacuum somewhat increased the corrosion rate. These results are discussed in terms of a mechanism involving diffusion of Fe ions through a magnetite film. At 240°C the rate-determining

2059 LRL-76

California Research and Development Co. Livermore Research Lab., Livermore, Calif.
MASS TRANSFER OF FOREIGN ELEMENTS FROM ZIRCONIUM DURING HIGH-TMPERATURE WATER CORROSION. L. M. Litz, S. A. Ring, W. R. Balkwell, and R. D. Nethaway. Jan. 1954. Decl. Sept. 29, 1955. 19p. Contract AT(11-1)-74.

The mass transfer of Nb, Zr, Y, Sr, Rb, Se, As, and Ge from Zr metal foils was followed during water corrosion of the Zr at 264, 280, and 300°C, using radioactive tracers of these elements. Diffusion appears to be the predominant transfer process with a decrease in diffusion rate as the corrosion film increases in thickness. Approximate diffusion coefficients were calculated. (auth)

1870 WAPD-T-254

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
AQUEOUS CORROSION OF ZIRCONIUM AND ITS ALLOYS AT ELEVATED TEMPERATURES. D. E. Thomas. 17p. Contract [AT-11-1-GEN-14]. $3.30(ph OTS); $2.40(mf OTS).

The corrosion behavior of Zr and Zr alloys is discussed. Corrosion test specimens are bright etched in a solution of H_2O, HNO_3, and HF in the ratio 10:9:1 and rinsed prior to exposure. Specimens are suspended in stainless steel pressure vessels containing degassed high-purity H_2O at temperatures below the critical point (705°F) at equilibrium pressure. (J.H.M.)

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Utah. Univ., Salt Lake City.
AN ABSTRACT COMPILATION OF THE LITERATURE ON HIGH TEMPERATURE OXIDATION OF METALS. W. Martin Fassell, Jr., Martha S. Chamberlain, and Robert C. Peterson. [nd]. 330p. (NP-4492; Technical Report 2, (Pt. 2)).

This annotated bibliography consists of more than 400 references to published literature and report literature. An author index is provided.

HNO_3 5.05.06

6766 A/CONF.15/P/30
THE EFFECT OF METAL SPECIES PRESENT IN IRRADIATED FUEL ELEMENTS ON THE CORROSION OF STAINLESS STEEL IN NITRIC ACID. A. B. McIntosh (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.), and T. E. Evans (Mond Nickel Co., Ltd., London). 21p.

The presence in solution of dichromate ions or the oxidized members of other redox couples, e.g., Ce(IV) or Ru(VIII), leads to accelerated attack of stainless steel by nitric acid. Chemical processing of irradiated reactor fuel elements may involve dissolution by nitric acid in stainless steel chemical plant and, since isotopes of cerium and ruthenium normally present as fission products will also pass into solution, accelerated corrosion rates are to be expected. Observed corrosion rates are found to be much lower than those predicted on the basis of laboratory experiments conducted under non-irradiated conditions. This is because the beta-gamma activity of the fission products maintains the oxidation potential of the solution below that at which the cerium

CORROSION OF WELDED STAINLESS STEELS IN ACID SOLUTIONS. M. M. Kurtepov and A. S. Gryaznova (Inst. of Physical Chemistry). Metalloved. i. Termich. Obrabotka Metal. No. 4, 41-4(1959) Apr.

The effects of thermal treatment on the corrosion resistance of 1X18H9T in argon arc-welded seams were analyzed. Specimens were quenched in water at 1050°C and stabilized at 850°C for 3 hours, then cooled in air. Comparisons were made with standard untreated specimens. Tests were made in boiling solutions of 57% nitric acid for 200 hours with solution changes after 100 hours. Results showed that thermal treatments lowered the corrosion resistance. Concentrated inter-crystalline corrosion was observed along the welded seams, with the deepest corrosion after repeated short-period heating at 650°C (2 hours). An increased corrosion rate was found in titanium-stabilized seams in acid oxidizing solutions; however, titanium stabilized and nonstabilized seams show the same intercrystalline corrosion after repeated, short-period heating. (R.V.J.)

NITRATION EFFECTS ON STAINLESS STEEL CORROSION RESISTANCE. A. G. Andreeva and L. Ya. Gurevich. Metalloved. i Termich. Obrabotka Metal. No. 4, 34-40(1959) Apr. (In Russian)

Electrode potentials of 4X14H2B2 (0.42% C, 13.75% Cr, 12.6% Ni, 1.5% W, 0.5% Mo, 0.4% Si, and 0.7% Mn) and 4X14H2B2 (0.4% C, 13.5% Cr, 2.68% Ni, 2% W, 0.55% Si, and 0.55% Mn) in 0.01 N of sodium chloride solution were investigated. The 4X14H14B2M steel was nitrated at 560°C for 48 hours; ammonium dissociation was 25 to 35%. The 4X14H2B2 was nitrated at 600°C for 24 hours. The changes in nitrated steel corrosion resistance, depending on the depth of the layer, corresponds to the changes in the electrode potential. The layers with low corrosion resistance and lowered electrode potentials, found at a certain depth of nitrated steels, were composed of chromium nitrides and solid solutions, impoverished by chromium and nitrogen. (R.V.J.)

10848 CF-58-9-63
Oak Ridge National Lab., Tenn.
USE OF 95% NITRIC ACID IN TITANIUM VESSELS. A. Fitch. Sept. 5, 1958. 7p. Contract [W-7405-eng-26]. $1.80(ph), $1.80(mf) OTS.

A literature survey was made to define the maximum safe concentration of nitric acid in titanium process equipment. Acid initially containing 2% more of water and 3% or less of NO_2 appears to be safe to use in the Darex process. (auth)

10587
CORROSION RESISTANCE OF FIVE STAINLESS ALLOYS IN NITRIC ACID CONTAINING CHLORIDE. I. I. Tingley (Dept. of Mines and Technical Surveys, Ottawa, Can.). Corrosion 14, 273t-4t(1958) June.

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A number of stainless steels and the new alloy Ni-O-nel were tested in solutions 8N in nitric acid and 0.2N in chloride. Stainless steels Types 304L, 316, 309S Nb, and 329 were all resistant to the liquid and hot vapor, but only Type 329 showed good resistance to the condensing vapors from these solutions. The resistance of this steel was about 1000 times as great as that of Types 304L, 316, and 309S Nb. (auth)

13920
THE CORROSION OF STAINLESS AND CARBON STEELS DURING CATHODIC POLARIZATION IN NITRIC ACID SOLUTIONS. N. D. Tomashev, M. M. Kurtepov, and E. N. Mirolyubov (Inst. of Physical Chemistry, Moscow). Zhur. Fiz. Khim. 32, 904-8 (1958) Apr. (In Russian)

Corrosion of stainless steel, niobium steel, and carbon steel in nitric acid solutions of 3 to 40% was studied. (R.V.J.)

10582 WADC-TR-57-302
Bell Aircraft Corp., Buffalo.
INVESTIGATION OF CORROSION INHIBITORS FOR FUMING NITRIC ACID. [Period covered] November 21, 1955 to June 7, 1957. William H. Bergdorf and Edward J. Kinsey, Jr. Sept. 12, 1957. 156p. Project title: FINISHES AND MATERIALS PRESERVATION. Task title: CORROSION AND CORROSION PREVENTION. Contract AF33(616)-3056. (AD-151116).

Development of a corrosion inhibitor for fuming nitric acid that has corrosion-inhibiting and scale and sludge-formation properties superior to those of hydrofluoric acid was investigated. Ammonium hexafluorophosphate in amount equivalent to 0.30% by weight hydrofluoric acid was found to provide better inhibition to the corrosion of 61S-T6 aluminum alloy and 17-7PH was effected by these exposure conditions. Film-formation studies were conducted on aluminum and stainless steel specimens that had been exposed to the liquid and vapor phases of the several inhibited systems and subsequently rinsed in water and methylene chloride. Both rinses removed the inhibited acids from the specimens, but methylene chloride failed to remove corrosion products. Hydrofluoric acid, phosphoric acid plus hydrofluoric acid, and ammonium hexafluorophosphate at optimum concentrations dissolved in specification Types I and III acid media were tested in vessels fabricated from the aluminum and stainless steel alloys for a period of 60 days at 70, 120, and 160°F. Ammonium hexafluorophosphate produced the greatest pressures during the test period. This inhibitor, however, suffered the smallest loss in concentration and in general provided the best inhibition. (auth)

4430 KLX-10057
Vitro Labs., West Orange, N. J.
FISSION PRODUCT SEPARATIONS STUDY. Quarterly Progress Report for September 27–November 30, 1956. Vitro Job 2077. R. A. Keeler, C. J. Anderson, G. V. Delaney, and R. Del Grosso. Dec. 31, 1956. 12p. [For Oak Ridge National Lab., Tenn.] Contract W-7405-eng-26, Subcontract 994. $3.30(ph OTS); $2.40(mf OTS).

Compatibility studies of HNO_3 in stainless steel at 300°C and 1500 psi yielded corrosion rates of 0.3, 0.7, 0.8, and 3.0 mils/run for types 347, 304, 310, and 316. The use of a quartz liner is investigated. Some work with $Al(NO_3)_3$ precipitation and $Sr_2(SO_4)$ solubility in H_2O and HNO_3 at various temperatures is reported. (T.R.H.)

11828 ✓ IGR-TN/C-419
Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
NITRIC ACID CORROSION AND POLARISATION OF A AUSTENITIC STEEL–EFFECT OF ADDED SPECIES. T. E. Evans. Nov. 1956. 26p.

The effect of added species on the corrosion of 18/23/Nb austenitic steel in boiling nitric acid is considered in relation to the oxidation potential of the systems. It is shown that stainless steels corrode at an accelerated rate when the standard oxidation potential of redox species added to the solution is between about 1.3 and 1.55. The mechanism of accelerated corrosion involves oxidation of chromium in the oxide film normally present on stainless steels from the Cr-III to Cr-VI oxidation state. This destroys the corrosion resistant properties of the steel. When species which produce accelerated corrosion in nitric acid are present this reaction takes place anodically at a potential of about 1.15 V and is virtually unpolarized. When accelerated corrosion occurs the cathodic reaction is also depolar-

INHIBITION OF NITRIC ACID CORROSION OF STAINLESS STEEL. Interim Report. W. L. Walker. May 1, 1956. 8p. (HW-42100)

An investigation was made to determine the effect of removing NO^- and NO_2^-, on the corrosion rate of a stain-

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less steel in 65 wt. % HNO_3. Samples of type 304-L stainless steel were subjected to a sensitizing heat treatment and exposed in sealed glass capsules to: 65 wt. % HNO_3 solutions which contained 0.2M, 0.1M, 0.01M, and 0.001M urea, and solutions of 65 wt. % HNO_3 which had been respectively sparged with O, air, and an inert gas prior to sealing. No inhibitory action was observed for any of these theoretical inhibitors under the conditions of this test. The testing technique was revised to provide for a continuous addition of the inhibitors to a boiling solution of 65 wt. % HNO_3, and the exposures were re-run; with the exception of the inert gas sparge. The results of these exposures indicate that a reduction of corrosion by a factor of three can be achieved by the use of urea in concentrations of 0.2M, and by a factor of two using 0.1M urea. The other concentrations of urea and the gas sparges exhibited insignificant reductions in the corrosion rate.

CORROSION DATA FOR LaBOUR ALLOY R-55 AND WORTHITE IN UO_3 PROCESS STREAMS. K. L. Sanborn. Decl. Jan. 4, 1956. 3p. (HW-20725)

A corrosion test program to determine the suitability of La Bour R-55 and Worthite for use in the construction of circulating pumps for the UO_3 process was completed. La Bour R-55 did not show satisfactory resistance to 65% HNO_3, though it was satisfactory when used with 78% $UO_2(NO_3)_2$. The Worthite, tested only in the $UO_2(NO_3)_2$ solution, showed satisfactory resistance.

236 HW-32877
Hanford Atomic Products Operation, Richland, Wash.
THE EFFECT OF CHROMIUM IN NITRIC ACID SOLUTION ON THE CORROSION RESISTANCE OF TYPES 304L AND 309SCb STAINLESS STEEL. Kenneth L. Sanborn. Aug. 31, 1954. Changed from OFFICIAL USE ONLY Jan. 28, 1957. 6p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

The corrosive effects of Cr^{3+} and Cr^{6+} in HNO_3 solutions of various concentrations on types 304L and 309SCb austenitic stainless steel are presented. (W.L.H.)

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
THE INFLUENCE OF WELDING ON THE CORROSION RESISTANCE OF 18/13/1 STEEL. EFFECT OF PRESSURE WELDING. H. N. Jones. July 1, 1953. 16p.

When 18/13/1 steel pipes are joined by pressure welding, subsequent exposure to boiling 70% nitric acid causes severe local attack. The regions sensitive to corrosion are on the outer surface of the pipe and take the form of narrow bands immediately adjacent to the weld junction. The inner surface of the pipe corrodes uniformly and at a normal rate. Investigation has shown that the local sensitivity to attack is probably a result of the thermal cycle through which these regions pass during the welding operation. It is not caused by the chemical nature of the heating gases, although an alteration in the character of the flame causes a corresponding alteration in the geometry of the sensitive region. A similar type of attack takes place on flash-welded pipes. (auth)

8864 CF-51-5-190
[Oak Ridge National Lab., Tenn.]
CORROSION NEWSLETTER NO. 3. James L. English. May 29, 1951. Decl. Feb. 7, 1956. 15p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Variations in the appearance of HNO_3-pretreated stainless steel specimens were traced to insoluble Fe compounds introduced into the bath from the treatment-vessel surface. Additional experimental data on the corrosion behavior of 347 stainless steel in 250°C UO_2SO_4 are given. (D.E.B.)

3596 HW-20765
Hanford Works, Richland, Wash.
CORROSION TESTS ON STAINLESS STEEL PLATE-WASTE METAL RECOVERY PROCESS. Kenneth L. Sanborn. Apr. 9, 1951. Decl. Dec. 7, 1955. 5p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mc).

Significant improvement in the resistance of 347 stainless steel to boiling 65% HNO_3 was obtained by annealing for 4 hr at 1650°F, followed by a water quench. Less improvement was noted when the plate was annealed for ½ hr at 1975°F followed by air cooling. (K.S.)

3806 AECD-3735
National Lead Co. of Ohio, Cincinnati.
CORROSION IN A NITRIC ACID CONCENTRATOR. Fred H. Meyer, Jr. [nd.] Decl. Jan. 9, 1956. 11p. $3.30(ph OTS); $2.40(mf OTS).

Corrosion rates of stainless steels and other construction materials in nitric acid concentrator process solutions under operating conditions were determined. Stainless steel No. 347 showed lower corrosion rates in boiling HNO_3–HF solutions under reduced pressures. (C.W.H.)

H_2SO_4 5.05.07

5557 CEA-tr-R-396
COMPORTEMENT ÉLECTROCHIMIQUE DE L'ACIER INOXYDABLE DANS UNE SOLUTION D'ACIDE SULFURIQUE. (Electrochemical Behavior of Stainless Steel in a Sulfuric Acid Solution). N. Ya. Bune (Boune) and Ya. (Ia.) M. Kolotyrkn (Kolotyrine). Translated into French from Doklady Akad. Nauk S.S.S.R. 111, 1050-3(1956). 11p.

A potentiostatic method was applied to the study of the electrochemical behavior of stainless steel in 1.0N H_2SO_4. The potentiostatic method of measuring polarization has several advantages which appear when compared with data from ordinary methods. The study indicated that surface passivation was not involved but a passivation of the steel by reactions forming metallic ions of lower oxidation states. (T.R.H.)

17314 ORNL-2735
Oak Ridge National Lab., Tenn.
CORROSION STUDIES FOR THE HRT CHEMICAL PROCESSING PLANT. J. L. English, J. C. Griess, and D. J. Krause. July 24, 1959. 42p. Contract W-7405-eng-26. $1.25(OTS).

The corrosion resistance of a number of materials considered for use in the HRT Chemical Processing Plant was determined in H_2SO_4 solutions. Ta was found to be fully resistant to boiling 4 M and 10.8 M H_2SO_4 solutions used for the dissolution of corrosion and fission products removed from the homogeneous-reactor fuel solution. Ta was immune to H_2 embrittlement in these solutions. Crystal-bar Zr and Zircaloy-2 were fully resistant to attack by boiling 4 M H_2SO_4 solution but were attacked at rates of 5 to 10 mpy in boiling 10.8 M H_2SO_4 solution. Carpenter 20-Cb stainless steel was completely resistant to 4 M H_2SO_4 solutions at 38°C, the temperature in the decay storage vessels of the chemical processing plant, and generally was resistant to similar H_2SO_4 solutions at atmospheric boiling temperature, ~110°C. In a few isolated cases, however, the alloy was prone to stress-corrosion cracking and to knife-line attack in several of the boiling 4 M H_2SO_4 environments. Corrosion rates of types 347 and 316 stainless steel in boiling 4 M H_2SO_4 solution were in excess of 75,000 mpy; however, in the presence of synthetic corrosion and fission products, corrosion attack was reduced to 10 mpy or less. A similar, but less drastic, reduction in the rate of attack on Carpenter 20-Cb stainless steel was experienced with additives present in the boiling 4 M H_2SO_4 solution. The corrosion rate of the latter alloy in boiling and helium-aerated 4 M H_2SO_4 solution was accelerated by Ru, a fission-product element. (auth)

STUDIES ON THE MECHANISM OF ELECTROCHEMICAL CORROSION OF TITANIUM. I. THE EFFECT OF HALIDE IONS ON THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF TITANIUM IN SULFURIC ACID. N. D. Tomashov and R. M. Al'tovskiĭ (Inst. of Physical Chemistry, Academy of Sciences of SSSR, Moscow). Zhur. Fiz. Khim. 33, 610-16(1959) Mar. (In Russian)

The corrosion behavior of titanium is determined by the presence of a protective oxide film on its surface. The halide ions Cl^- and Br^- in sulfuric acid in an atmosphere of air and of hydrogen have a double effect on the corrosion of titanium activating it in dilute acid solutions and retarding the corrosion in more concentrated solutions. In all sulfuric acid solutions studied I^- ions passivate titanium in air, whereas in hydrogen this is true only for concentrated solutions. The retardation of titanium corrosion by halide ions may be explained by their forming adsorbed or phase protective films on the titanium surface. The dissolution of titanium in sulfuric acid obeys the laws of electrochemical kinetics. (auth)

17125
SULFURIC ACID CORROSION OF STAINLESS STEELS. W. L. Mathay (U. S. Steel Corp.). Ind. Eng. Chem. 50, No. 9, 85A-6A(1958) Sept.

To obtain the greatest economic advantage from the use of stainless steel in the chemical industry, the environment and design of equipment in which the steels are used must be properly selected. The chromium-nickel austenitic steel depend on a passive film on the surface for corrosion resistance to dilute sulfuric acid. Oxidizing agents in sulfuric acid promote the corrosion resistance of these steels; however, it is necessary that the oxidizers have free access to the metal surface continuously. Methods of evaluating steels for various purposes, including laboratory and plant equipment, are discussed. (J.R.D.)

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16371
THE ELECTROCHEMICAL PROPERTIES AND CORROSION BEHAVIOUR OF TITANIUM IN SULFURIC ACID SOLUTIONS. V. V. Andreeva and V. I. Kazarin (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 121, 873-6(1958) Aug. 11. (In Russian)

The corrosion resistance of titanium in solutions of sulfuric acid was investigated. Diagrams were plotted showing the rate of corrosion, potential, and critical anode density of current in various sulfuric acid solutions. (R.V.J.)

13122
ON THE PASSIVATING PROPERTIES OF SULFATE IONS. I. L. Rosenfeld and V. P. Maksimchuk (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk 119, 986-9(1958) Apr. 11. (In Russian)

Sufficient quantities of sulfate ion act as passifiers for the stainless steel. The passivation effect of SO_4^{2-} is conditioned by the presence of chromium and in a lesser degree by nickel. In the presence of chlorine and sulfate ions the processes on the electrode surface are assumed to be adsorptive and the sulfate ion passivation must be caused by its adsorption on the metal surface and its displacement of ions of chlorine. (R.V.J.)

16372
ANODIC PROTECTION OF TITANIUM IN SULPHURIC ACID. N. D. Tomashov, R. M. Al'tovskii, and A. G. Arakelov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 121, 885-8(1958) Aug. 11. (In Russian)

Tests were made of the corrosion resistance of titanium in solutions of sulfuric acid with and without anode protection. (R.V.J.)

4432 NP-6208
Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.
KINETIC STUDY OF THE CORROSION OF NICKEL IN SULFURIC ACID. Technical Report No. 20. Charles H. Pitt and Milton E. Wadsworth. Jan. 31, 1957. 24p. Project NR-051-192. Contract N7-onr-45103.

The corrosion of Ni in H_2SO_4 solutions in the temperature range of 75°C to 125°C and from 0 to 600 psi partial O_2 pressure was investigated. The variation of rate as a function of agitation, time, acid concentration, and partial pressure of oxygen was determined. The rate was found to be linear over the range of time investigated under the experimental conditions of this study and varied directly with O_2 concentration. A systematic variation of acid concentrations using buffered solutions indicated a process in which the undissociated H_2SO_4 molecule plays an important part. Calculation of the activation energy for the process gave a value of approximately 4 kcal for the rate determining step. The rate determining step was considered to be the adsorption of O_2 on a site containing adsorbed H_2SO_4. (auth)

IRRADIATION 5.05.08

13969 AERE-C/R-2826
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THE OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. I. DESTRUCTIVE INTERNAL OXIDATION OF ZIRCALOY-2 IN STEAM UNDER IRRADIATION AT 300°C. K. Alcock and B. Cox. Feb. 1959. 26p. $0.98(BIS).

Destructive localized attack on Zircaloy-2 has been observed and reproduced in steam under irradiation at 300°C in BEPO. Despite visual similarities with the rapid hydriding attack of Zircaloy-2 observed at Chalk River, metallographic examination has failed to reveal any unusual accumulation of hydride in the metal. Possible explanations of this phenomenon are discussed and the future program outlined. (auth)

5895 YAEC-93
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
CORROSION PRODUCT TRANSPORT AND DEPOSITION UNDER IONIZING RADIATION. C. C. Thomas, Jr. and H. W. Lacock—H. Y. Cadoff, ed. Dec. 1958. 34p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $6.30(ph OTS); $3.00(mf OTS).

A study was made of corrosion product transport and deposition on Zircaloy-2 and AISI 304 stainless steel in the presence and absence of ionizing radiation. Three

100-hour irradiation tests, using 2-Mev electrons from a Van de Graaff accelerator, and four 100-hour nonradiation tests were performed in 600°F pressurized water. Data from the seven runs and an additional exploratory run are presented. In addition, complete experimental procedures and descriptions of the apparatus are included. Control of pH was obtained by using H and OH form ion exchange resins for pH 7 and Li and OH form ion exchange resins for pH 10. The major conclusion to be drawn from the present work is that the deposition on Zircaloy-2 at pH 10 and 600°F is higher than on AISI 304 stainless steel at the same conditions. (auth)

9734 NAA-SR-2046

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

DYNAMIC CORROSION IN POLYPHENYLS UNDER IRRADIATION. H. E. Kline, N. J. Gioseffi, and W. N. Bley. May 15, 1958. 29p. Contract AT(04-3)-88. $1.00(OTS).

Corrosion specimens of various materials were exposed to polyphenyls in the NAA-20 loops at MTR, and compared with out-of-pile specimens in the same coolant streams over the temperature range of 500° to 650°F. Aluminum, 304 and 410 stainless steel, carbon steel, and 4130 alloy steel exhibited good to excellent resistance. Magnesium and zirconium were unsatisfactory. Integrated neutron fluxes of the order of 2×10^{19} thermal, and 10^{18} fast, did not affect the corrosion resistance of the materials studied. (auth)

424 AEC-tr-3410

ATMOSPHERIC CORROSION OF METALS UNDER RADIATION. A. V. Byalobzheskii. Translated by Lydia Venters (Argonne National Lab.) from Doklady Akad. Nauk S.S.S.R. 119, 515-17(1958). 8p.

The effect of radiation on the corrosion of iron, copper, aluminum, stainless steel, and zinc in air atmosphere at 98% relative humidity was studied. Results indicate that no corrosion occurs in a dry atmosphere. During irradiation under atmospheric conditions corrosion takes place underneath the moist film appearing on the surface of the metal as the results of condensation or adsorption of water vapor, and consequently this corrosion bears an electrochemical nature as does the usual atmospheric corrosion. Data presented show that nitrogen, inert under general conditions, under radiation turns into a corrosion activating agent. The activation of nitrogen takes place only in the presence of oxygen, and consequently is attributed to the formation of its oxygen products, with the predominant one being N_2O_5.

22108

THE EFFECT OF ELECTRON IRRADIATION ON THE CORROSION OF IRON, STAINLESS STEEL AND ALUMINUM IN SODIUM CHLORIDE SOLUTIONS. M. N. Fokin, T. V. Matveeva, N. D. Tomashov, A. V. Bialobzheskii, and V. D. Val'kov. (Inst. of Physical Chemistry, Academy of Sciences, U.S.S.R.). p. 137-43 of "Radiation Electrochemical Processes."

Studies are presented on the effect of electron irradiation on the corrosion properties of Fe, stainless steel, and Al in NaCl solutions. Results show that Al and Fe and stainless steel corrode at a rapid rate when subjected to electron irradiation in the NaCl solutions. (W.L.H.)

OTHER (MISCELLANEOUS) 5.05.09

HIGH PERFORMANCE MATERIALS, ALLOYS AND REACTIVE METALS. F. S. Badger (Haynes Stellite Co., Kokomo, Ind.). Ind. Eng. Chem. 50, 1608-11(1958) Nov.

Corrosion tests were made of molybdenum, stainless steels, Hastelloy alloys, tantalum, zirconium, tungsten, and niobium under various conditions in widely used mineral acids, such as nitric, hydrochloric, phosphoric, and sulfuric. The results are tabulated and graphically represented. In addition, some comparisons of oxidation rates of metals and alloys are presented. The presentation is intended as a guide for selecting alloys and metals for service under corrosive conditions in the chemical industry. (J.R.D.)

10588

INHIBITION OF CORROSION OF STEEL BY TETRAMETHYLAMMONIUM BROMIDE. Rudolph Macy and B. L. Harris (Army Chemical Center, Md.); W. C. Bull (Spencer Chemical Co., Pittsburg, Kansas); and J. W. Eastes (Scott Paper Co., Chester, Penna.). Corrosion 14, 280t-2t(1958) June.

A review is made of work leading to the discovery that tetramethylammonium bromide (TMB) is an ex-

OTHER (MISCELLANEOUS) 5.05.09

cellent inhibitor of corrosion of steel by bis (2-chloroethyl) sulfide (H). The nature of the corrosion problem involved is considered for both Levinstein H and distilled H. The search for a stabilizer for Levinstein H is described. Data are reported with no stabilizer, 1 percent hexamine stabilizer and 1 percent TMB stabilizer to show the rate of decomposition of Levinstein H in a 75 mm shell, rate of pressure developed in a 75-

4385 HW-61662

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

POWER REACTOR FUELS REPROCESSING. PROGRESS REPORT ON CORROSION STUDIES. R. F. Maness. Aug. 26, 1959. 57p. Contract AT(45-1)-1350. OTS.

Work is reported on corrosion studies of candidate materials of construction for equipment for the dissolution of Zircaloy cladding in $NH_4F-NH_4NO_3$ solutions, the total dissolution of stainless steel clad fuels in HNO_3-HF solutions, and the dissolution of stainless steel cladding in dilute H_2SO_4. A single material of construction which could be used for a processing complex which would handle all of the low-enrichment fuels concerned was searched for. In the Zirflex Process ($NH_4F-NH_4NO_3$) the 300 series stainless steels, vacuum-melted Hastelloy-F, Carpenter 20, Nio-nel, Haynes 25, and Incoloy 804 have satisfactory corrosion resistance to solutions involved in the dissolution of Zr or Zircaloy claddings. Satisfactory dissolution rates for 304-L stainless steel cladding are obtained in the Niflex Process (1MHNO_3-2MHF) solutions. The minimum practical fluoride to stainless steel ratio is about five. Among many materials studied, vacuum-melted Hastelloy-F offers the best corrosion resistance to HNO_3-HF solutions encountered during decladding. In the Sulfex Process (H_2SO_4) dissolution rates for both annealed 304-L and 347 stainless steel in 3 to 3 M H_2SO_4 are from 5 to 10 mils per hour. Vacuum-melted Hastelloy-F and Ni-o-nel show adequate corrosion resistance to the H_2SO_4-stainless steel solutions concerned in H_2SO_4 decladding. During U or UO_2 core dissolution in HNO_3 following decladding, some sulfate (sulfex decladding) or (fluoride zirflex decladding) will be present due to incomplete rinsing or to the presence of solids (UF_4). Residual sulfate in the concentration range has no significant effect on the corrosion of 304-L stainless steel or vacuum-melted Hastelloy-F by HNO_3. Fluoride present will increase the corrosion potential but can be effectively complexed by Al. Corrosion rates of 304-L, vacuum-melted Hastelloy-F, and Ni-o-nel in HNO_3 solutions are not markedly increased by low concentration (0.1 to 0.3M) of ferric nitrate. However, at higher concentrations (~1 M) corrosion of an intergranular nature is severe. (W.L.H.)

CORROSION RESISTANCE OF TITANIUM ALLOYS COMPARED WITH COMMERICALLY PURE TITANIUM. David Schlain and Charles B. Kenahan (Bureau of Mines, College Park, Md.) Corrosion 14, 405t-8t, Sept 1958.

Titanium-8% manganese, titanium-5% aluminum-2 1/2% tin, titanium-2% aluminum, titanium-6% aluminum, titanium-1% copper, and titanium-5% copper alloys are similar to commercially pure titanium in chemical and galvanic corrosion properties. These alloys are completely resistant to corrosion in synthetic ocean water, tap water, 1% sodium hydroxide, and 5% ferric chloride solutions. In sulfuric acid solutions saturated with air, the titanium alloys with the exception of those containing copper are resistant to corrosion in 5% solution at 35°C but corrode rapidly in 10% solution. At 60°C, these alloys are inert in 1% and corrode in 5% acid. The titanium-copper alloys usually are more resistant than commercially pure titanium to corrosion in sulfuric acid solutions and less resistant in hydrochloric acid. In contact with aluminum in 0.5% sulfuric acid saturated with air, titanium and the titanium-base alloys are the cathodic members of the couples. Titanium and titanium-base alloys are generally anodic when in contact with stainless steels in air-saturated 4.7, 9.3, and 17.5% sulfuric acid solutions but the galvanic corrosion of titanium alloys is almost eliminated as a result of contact with stainless steel. (auth)

13127

THE EFFECT OF CHROMIUM ON THE SULFIDE CORROSION OF ITS IRON ALLOYS. A. K. Semenova

OTHER (MISCELLANEOUS) 5.05.09

and P. V. Gel'd (Kirov Ural Polytechnic Inst., Sverdlovsk). Zhur. Fiz. Khim. 32, 1087-94(1958) May.

The similarity of the protective action of chromium in both the oxide and the sulfide corrosion of its alloys with iron was confirmed experimentally. It is shown that in the oxidation of chromium-iron alloys by sulfur, chromium accumulates in the inner scale layer, forming the spinel $FeCr_2S_4$. When the alloy contains over 12% chromium, the inner layer consists predominately of the sulfide spinel, abruptly retarding the diffusion of anions and cations. This renders the alloy corrosion resistant. (tr-auth)

16356 DP-284
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
CORROSION BY SOLUTIONS CONTAINING HNO_3, HF, AND REDUCING AGENTS. M. LaVern Holzworth. May 1958. 24p. Contract AT(07-2)-1. $0.75(OTS).

The corrosion of stainless steel in mixtures of nitric and hydrofluoric acids is markedly increased by the addition of either hydroxylamine nitrate or sulfamic acid, but not by the addition of ascorbic acid. Silver, Hastelloy C, and Monel corroded at rates less than five mils per year in a nitric acid–hydrofluoric acid solution containing hydroxylamine nitrate, sulfamic acid, and ascorbic acid. Hastelloy B, Haynes 25, Carpenter 20, and Nionel corroded at rates up to 26 mils per year. Corrosion rates of about 25 mils per year were considered acceptable for this application. The corrosion of

8688 DP-416
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.
CORROSION OF CARBON STEEL IN WASTE SOLUTIONS CONTAINING MERCURY. Patricia M. Kranzlein. Nov. 1959. 12p. Contract AT(07-2)-1. OTS.

The corrosion behavior of A-285, A-135, A-106, and A-53 carbon steel was studied in multicomponent simulated waste solutions containing mercury. In the liquid phase, the carbon steels corroded at a very low rate; mercury did not increase the corrosion rate in any of the solutions tested. In the vapor phase and at the vapor-liquid interface, pitting occurred; the pitting was independent of solution composition, and was caused mainly by the condensation of oxygenated water from the aqueous wastes. (auth)

14767 A/CONF.15/P/699
Los Alamos Scientific Lab., N. Mex.
THE CORROSION BEHAVIORS OF PLUTONIUM AND URANIUM. James T. Waber. 31p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The many similarities in the chemical reactivity of plutonium and uranium were used to gain a deeper understanding of the mechanisms involved in the corrosion behavior of these metals and their alloys. It may be concluded that the reaction in aqueous environment is controlled by the rate of one or more reactions occurring at local anodes. The corrosion behavior of binary uranium alloys with zirconium, molybdenum, and hafnium, as well as ternary alloys with niobium and molybdenum, was studied to elucidate the role of moisture. Percentages of the order of 15 at. % are needed to affect significant improvements in the corrosion resistance. A cracking of the alloy specimens that is sometimes observed was related to the penetration and subsequent fracture of hydride needles which originate at the surface. Zirconium, aluminum, and thorium which are soluble in the face-centered-cubic delta modification of plutonium, reduce the rate of corrosion and render the plutonium relatively immune to attack by moisture. The observed rates for the better alloys are approximately equal in moist and dry air, and both rates are the same as that of unalloyed plutonium in dry air. (auth)

18952 CEA-tr-R-660
ETUDE DE LA RÉSISTANCE À LA CORROSION DES SOLUTIONS SOLIDES DE MÉTAUX. V. SYSTÈME Cu-Ni. (Study of the Corrosion Resistance of Solid Solutions of Metals. V. The Cu–Ni System.) N. N. Gratzianskii (Gratziansky) and I. A. Gutzev (Goutzev). Translated into French by B. de Trezvinsky from Zhur. Fiz. Khim. 31, 1740-4(1957). 13p.

The corrosion of Cu–Ni alloys and Cu and Ni by 10% H_2SO_4 at ambient temperatures was studied. The compositions used were (in at. % Cu): 80, 75, 65, 55, 50, 45, 35, and 25. The results are given as weight loss in g/m^2hr. The rate of attack varied only slightly with alloy composition, indicating the absence of a limit of corrosion resistance. The compositions of the solutions after attack corresponded to the ratio of the components in the alloys. The corrosion limit seems to depend on internal passivity or film formation. (T.R.H.)

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OTHER (MISCELLANEOUS) 5.05.09

9722 CF-56-11-138
Oak Ridge National Lab., Tenn.
EVALUATION OF VARIOUS OXIDES IN 100-A LOOPS (SUMMARY OF RUNS S-58, 59, 64, 65, 66, 84, 85, 90). A. S. Kitzes, R. B Gallaher, and C. A. McLaughlin. Nov. 30, 1956. 21p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

It was shown in a series of runs at 300°C in a 100-A loop that the attack on stainless steel, titanium, and zirconium was dependent upon at least three factors: calcination temperature of the oxide, particle size of the oxide, and the slurry velocity. It was also found that the addition of 1500 ppm of sulfate to the slurry had little or no effect on the attack rates. Slurries prepared from 800°C fired oxide are more suitable than the 650°C fired oxide for use in the various slurry programs insofar as their handling characteristics are concerned. (auth)

5596
RECENT RESEARCH ON THE OXIDATION OF METALS AT HIGH TEMPERATURES. J. Benard. Ind. chim belge 24, 1328-31(1959) Nov. (In French)

Several years' work in surface oxidation of metals by gases at high temperatures and low pressures is reviewed. (T.R.H.)

7660 AERE-Lib/Trans-705
THE PASSIVITY OF IRON IN NEUTRAL AND SLIGHTLY ACID SOLUTIONS. K. G. Weil and K. F. Bonhoeffer. Translated by F. Hudswell from Z. physik. Chem. (Frankfurt) (N. F.) 4, 175-91(1955). 17p.

The passive state of Fe in aqueous solutions with pH varying from 2 to 6 was investigated. Results indicated that different passivation processes occur in neutral and acid solutions. The higher stability of the passive state in neutral solutions was attributed to low corrosion rate and mixed oxide formation. (C.W.H.)

12466 ESP-52-351
Du Pont de Nemours (E. I.) & Co. Experimental Station, Wilmington, Del.
CORROSION OF STEEL BY HYDROGEN SULFIDE. Progress Report [for] Period September, 15–December 11, 1952. J. C. Rowell. Jan. 8, 1953. Decl. Mar. 20, 1957. 17p. $3.30(ph OTS); $2.40(mf OTS).

The role of the iron sulfide scale in H_2S corrosion of steel is investigated. The structure, characteristics, and mechanism of formation of the iron sulfide are given. (T.R.H.)

2430 HW-21520
Hanford Works, Richland, Wash.
CORROSION OF STAINLESS STEELS BY CONCENTRATED UNH SOLUTIONS. K. L. Sanborn. July 3, 1951. Decl. Dec. 3, 1955. 8p. Contract [W-31-109-Eng-52]. $1.80 (ph OTS); $1.80(mf OTS).

Stainless steels types 309 SCb and 304 ELC were tested for corrosion in UNH solutions boiling at 230°F and in the range 270 to 290°F. Types 309S, Carpenter 20, 309 SCb, and 304 ELC were tested in UNH solutions in the range 244 to 255°F. The performance of Esco 40-T, an alloy of 18-12 chromium-nickel content, was compared to 309 SCb in concentrated UNH solution at 300°F. (auth)

STEELS (GENERAL) 5.05.10

588
NEW CORROSION-RESISTANT HIGH-CHROMIUM ALLOYS FOR CASTING. K. I. Vashchenko and L. I. Rostovtsev. Sbornik Stateĭ Vsesoyuz. Nauch. Issledovatel. i Konstrukt. Inst. Khim. Mashinostroeniya 23, 14-37(1957). (Translated from Referat. Zhur. Met. No. 1, 1959, p.172).

Corrosion resistance of specimens and components were investigated in 67% HNO_3, in boiling 25 and 5% HNO_3, in 93% H_2SO_4, and in 50% CH_3COOH. Mechanical properties (σ_b, δ, and a_k), microstructure and fluidity of cast Cr steels were also investigated. This included steels containing additions of Cu (up to 1.5%) and Ti (up to 0.32%). It was established that an increase in Cr content beyond 23% (at 0.35% C) produces a slight increase in the corrosion resistance of the metal in an HNO_3 solution. Addition of Cu and Ti did not have any effect. Steels are recommended for operations involving contact with HNO_3. The mechanical properties of the alloys (without heat treatment) are σ_b 40–45 kg/mm^2; δ 1.0–2.0%; a_k 0.25–0.8 kgm/cm^2, and H_B 179 to 197.

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STEELS (GENERAL) 5.05.10

14534
NEW STAINLESS STEELS RESIST PITTING, ABRASION. R. B. Norden, ed. Chem. Eng. 66, 210, 212(1959) June 15.

The properties of PH-55A, PH-55B, and PH-55C stainless steels are tabulated and compared with other stainless steels. These metals offer high strength without severe cold working, and they are corrosion and abrasion resistant. (T.R.H.)

11895
FOUR NEW STAINLESS ALLOYS. Norman S. Mott (Copper Alloy Corp., Hillside, N. J.). Iron Age 183, No. 16, 118-21(1959) Apr. 16.

Four corrosion-resistant high-strength stainless steel alloys designated PH-55 alloys are presented. The composition of these alloys are: PH-55A, Cr–Ni–Si–Mo; PH-55B, Cr–Ni–Si–Cu–Mo; PH-55C, Cr–Ni–Si–Cu–Mo; and PH-55D, Cr–Ni–Si–Mo. All of these alloys can be cast and some can be rolled and forged. Physical properties of these materials are presented. (W.L.H.)

STAINLESS ALLOYS, PRESENT AND FUTURE. W. O. Binder (Electro Metallurgical Co., Niagara Falls, N. Y.). Chem. Eng. Progr. 54, No. 11, 45-50(1958) Nov.

The corrosion and metallurgical properties of stainless steels are discussed,

THE CORROSION OF TYPE 304L STAINLESS STEEL BY SOLUTIONS OF NITRIC ACID–SODIUM DICHROMATE AND NITRIC–HYDROFLUORIC ACIDS. William L. Walker. Oct. 29, 1956. 5p. (HW-46369)

13121
OBSERVATIONS ON CORROSION RESISTANCE OF HIGH STRENGTH STAINLESS STEELS FOR AIRCRAFT. John Halbig and O. B. Ellis (Armco Steel Corp., Middletown, Ohio). Corrosion 14, 389t-95t(1958) Aug.

Stainless steels of the precipitation hardening type are used extensively in airframe components. In this paper, compositions and properties of several of these alloys are described. The corrosion performances of the Armco 17-4 PH and 17-7 PH precipitation hardening alloys are compared with those of other hardenable stainless steels. The results of accelerated corrosion tests with these materials in both bar and sheet form are reported for a number of acids of varying concentrations and temperatures. Data also are presented for the new precipitation hardening stainless alloy PH 15-7 Mo. Properties needed in materials used for aircraft structures are itemized. Variables affecting corrosion resistance of precipitation hardening stainless steels are discussed briefly. Other topics covered include resistance to high temperature-high purity water, effects of nitriding, atmospheric corrosion resistance, resistance to sea water, galvanic corrosion, stress cracking, and brazing and welding. (auth)

UO_2SO_4 5.05.11

11905
CORROSION BEHAVIOUR OF RESISTANT METALS IN URANYL SULPHATE SOLUTION. N. Dekleva and I. Perman. "J. Stefan" Inst. Repts. (Ljubljana) 4, 157-63(1957).

Five resistant metals, which might eventually be considered as suitable for protective coatings, e.g., Ru, Ti, Pt, Ta, and Au, were chosen and their resistance tested against acid uranyl sulfate solution at 100°C and at normal pressure as well as at 200°C and at a pressure of 16 atmospheres. Among all five metals tantalum and ruthenium turned out to be the most resistant. Titanium only becomes resistant when a sufficiently strong protective film of titanium oxide is produced, which protects the titanium metal against further dissolving. Gold and platinum cannot be used as they are constantly slowly dissolving. The time dependence of the rate of dissolution for all the metals investigated is also given. (auth)

8866 CF-51-11-196
[Oak Ridge National Lab., Tenn.]
CORROSION NEWSLETTER NO. 7. J. L. English. Nov. 27, 1951. Decl. Feb. 7, 1956. 34p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

Commercial grade Ti metal was extremely resistant to 1.71M UO_2SO_4 at 250°C; a weight gain of 0.01 mg/cm^2 after 227 hr was measured. A second sample gained 0.09 mg/

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UO_2SO_4 5.05.11

cm^2 after 800 hr. Titanium autoclaves were used for these tests. In 0.17M $UO_2SO_4 - O_2$ pressurized systems, Ti metal gained 0.05 mg/cm^2 after 100 hr at 250°C and was slightly anodic to 347 stainless steel after 168 hr at 250°C. A corrosion rate of 0.9 mil/yr was obtained on the coupled Ti as compared to 0.2 mil/yr for the stainless steel. The corrosion rate on 347 stainless steel exposed to 0.17M UO_2SO_4 pressurized with O_2 was 0.3 mil/yr after 268 hr at 250°C. The results of a series of tests to determine variations in total U concentration at different levels in an autoclave operating at 250°C disclosed no such concentration gradients. (auth)

8865 CF-51-10-100
Oak Ridge National Lab., Tenn.
CORROSION NEWSLETTER NO. 6. J. L. English. Oct. 9, 1951. Decl. Feb. 9, 1956. 14p. Contract [W-7405-eng 26]. $3.30(ph OTS); $2.40(mf OTS).

The vapor-phase corrosion behavior of stainless steel and the effect of oxygen exposure on pretreated stainless steel, using UO_2SO_4 at 250°C, are discussed. (W.L.H.)

SURVEYS 5.05.12

Technical Information Service Extension, AEC.
CORROSION: A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. July 1956. 36p. (TID-3302).

This bibliography contains 111 annotated references to unclassified reports on the corrosion of alloys, commercial alloys, ceramics, and plastics. References are included to reports written prior to Dec. 15, 1953. Author, subject, and report number indexes are provided.

Technical Information Service Extension, AEC.
CORROSION. A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. Robert E. Allen, comp. June 1954. 54p. (TID-3048).

This annotated bibliography contains 214 references citing corrosion data found in the unclassified reports held by the Technical Information Service Extension, Oak Ridge, as of Jan. 1, 1954. Author, subject, and report number indexes are included.

THEORY 5.05.13

5553 CF-58-9-3
Oak Ridge National Lab., Tenn.
MULTIFACTOR RATIO ANALYSIS (FACTOR ANALYSIS) OF CORROSION DATA USING LOGARITHMIC TRANSFORMATIONS. E. L. Compere. Sept. 3, 1958. 12p. OTS.

A simplified analysis method for the examination of complex corrosion data is presented in terms of data from slurry corrosion toroid experiments. This method facilitates the assignment of average effects to specific imposed experimental variables in a test series. It is based on statistical analysis of variance procedures but emphasizes the use of averages and presents results relative to a chosen reference experimental condition. The use of the logarithm of attack rate results in the expression of the effects of variables as ratios or multiplicative terms. (auth)

CORROSION REVIEW FOR 1958. Anton de S. Brasunas. Ind. Eng. Chem. 51, No. 1, 93A-5A(1959) Jan.

Corrosion research efforts, foreign and domestic, in 1958 are briefly summarized. References to especially significant research are given. (D.E.B.)

SELECTION OF ALLOYS FOR CORROSION RESISTANT SERVICE. W. T. Bryan (Duriron Co., Dayton, Ohio). Metal. Progr. 74, No. 6, 102-5(1958) Dec.

Factors that should be considered in the selection of alloys for corrosion-resistant service are discussed. Characteristics of the corrosive environment, mechanical properties, and metallurgical structure are some of the factors that are considered. The discussions are limited mostly to the performance of iron–chromium, iron–chromium–nickel, and iron–chromium–molybdenum alloys in corrosion-resistant service. (J.H.M.)

PREDICT RATE OF MASS TRANSFER BY ANALOGY WITH HEAT TRANSFER. James O. Osburn (State Univ. of Iowa, Iowa City). Chem. Eng. 66, No. 1, 136-8(1958) Jan. 12.

Methods are discussed for predicting the rate of mass transfer for turbulent flow by analogy with heat transfer.

THEORY 5.05.13

V16197
OXIDATION OF METALS: DETERMINATION OF ACTIVATION ENERGIES. Per Kofstad (Central Inst. for Industrial Research, Blindern, Oslo). Acta Chem. Scand. 12, 701-7(1958).

A new method is proposed for the determination of energies of activation of oxidation of metals and alloys. Metals are oxidized under conditions of linearly increasing temperature, and the activation energy may be determined from one single oxidation run. In addition the method also gives the approximate temperature regions in which different rate laws of oxidation are found. The described method has been applied to high-temperature oxidation of nickel, zirconium, copper, and titanium. (auth)

13917 S and T Memo-17/57
Gt. Brit. Admiralty Central Metallurgical Lab.
CAVITATION EROSION — A REVIEW OF PRESENT KNOWLEDGE (JUNE 1957). D. J. Godfrey. Sept. 1957. 16p.

Cavitation erosion is a type of damage, characterized by pitting attack, which may occur in hydraulic systems having extreme conditions of turbulence or high-speed liquid flow. It has been explained for many years as physical damage consequent upon "hammer blows" or shock waves following collapse of vacuum or vapor-filled cavities which may form within liquids when local regions of low pressure arise. High pressures have been shown mathematically to occur, but little success has been found with practical measurements of these, due to the extremely transient nature of the pulses. Modifications have been made to the original mathematical calculation of the forces involved, and these are dealt with briefly. Of late it has appeared probable that forces other than of a purely hydromechanical nature may be involved. Thus, the part played by corrosion has been found to be important, especially at low cavitation

585
FRETTING CORROSION OF METALS. R. T. Allsop. Metallurgia 60, 39-43(1959) Aug.

Damage resulting from fretting corrosion is observed in a variety of engineering components including bearings, switchgear, and bolted or riveted joints. The nature and occurrence of fretting corrosion are examined and various theories which have been proposed to explain the phenomenon are discussed. The effect of varying such factors as humidity, duration, load, etc., on the amount of damage occurring during fretting is considered. Methods of eliminating or reducing fretting damage are suggested. (auth)

7993
SOME UNUSUAL EFFECTS OF HYDROGEN IN CORROSION REACTIONS. J. E. Draley and W. E. Ruther (Argonne National Lab., Lemont, Ill.). J. Electrochem. Soc. 104, 329-33(1957) June.

Consideration of corrosion in the presence of water has led to the postulation of damage by hydrogen produced in the reaction. For cases where the metal surface is covered with a protective layer, it is considered that some hydrogen ions diffuse through the layer and form hydrogen atoms beneath it. The consequence of the production of hydrogen in this location is to decrease corrosion resistance. Three types of harmful effects are illustrated. (auth)

5358
DIFFUSION AND OXIDATION OF METALS. Massoud T. Simnad (General Dynamics Corp., San Diego, Calif.). Ind. Eng. Chem. 49, 617-26(1957) March.

A review is presented which includes theory of diffusion, volume self diffusion, chemical diffusion in substitional alloys and interstitial alloys, grain boundary and surface diffusion, and oxidation of metals and alloys. 361 references. (T.R.H.)

13147 AEC-tr-3287
SURFACE REACTIONS ON STAINLESS STEELS. T. N. Rhodin. Translated for Oak Ridge National Lab. from J. chim. phys. 54, 72-89(1957). 46p.

The characteristic chemical reactions which are produced on the surface of an alloy reflect a dynamic equilibrium between the influence of factors such as the composition of the gaseous phase, the surface structure, the properties of the film, and the composition of the alloy. Three gas-metal reactions on the surface of stainless steels; adsorption, oxidation, and decarbonization are considered. The experimental techniques used were microgravimetry under vacuum, electron microscopy, and the micro-analysis of surface residues. (W.L.H.)

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10163 TID-3302
Technical Information Service Extension, AEC.
CORROSION: A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. July 1956. 36p. $0.30(OTS).

This bibliography contains 111 annotated references to classified reports on the corrosion of alloys, commercial alloys, ceramics, and plastics. References are included to reports written prior to Dec. 15, 1953. Author, subject, and report number indexes are provided. (auth)

6663
FUNDAMENTALS OF LIQUID METAL CORROSION. W. D. Manly (Oak Ridge National Lab., Tenn.). Corrosion 12, 336t-42t(1956) July.

The corrosion of structural metals in liquid metals is for the most part the result of solubility of the various constituents of the metal or alloy in the liquid metal. The manner in which this solution manifests itself gives rise to many types of attack, ranging from a simple solution type attack to a deep intergranular attack with the preferential leaching of one constituent of an alloy. Examples of the many types of corrosion experienced with solid metal-liquid metal systems are illustrated. The role of impurities on the corrosion is discussed. In addition to the solution stage, which would soon disappear in a static one metal system on reaching a solubility limit, the corrosion of metals can be continued through the removal of materials from solution in the liquid metal with a temperature gradient or by dissimilar metal transfer. The transfer of metal in a plumbing system by the mechanisms of mass transfer—temperature gradient and dissimilar—will greatly increase the amount of corrosion as compared to the results obtained in static systems. Examples of temperature gradient mass transfer and dissimilar metal transfer are reviewed, and factors governing the occurrence of these phenomena are outlined. (auth)

2708
NOMOGRAPH FOR CORROSION RATE CALCULATIONS. Henry K. Bass, Jr. and Robert V. Andrews (A & M College of Texas, College Station). Corrosion 12, 4t-5t (1956) Jan.

A nomograph which facilitates the determination of corrosion rate in mils per year is described. A typical problem involving calculation of corrosion rate is worked out on the accompanying nomograph. (auth)

13125
ON THE EFFECT OF GASEOUS MEDIA ON THE CORROSION OF ALLOYS AT HIGH TEMPERATURES. S. G. Vedenkin and Ye. L. Kazimirovskaya. Metalloved. i Obrabotka Metal. No. 5, 55-63(1956). (Translated from Referat. Zhur. Khim. No. 3, 1957, Abstract No. 10541).

A survey is presented of the foreign literature from 1951 through 1954. The authors list methods for corrosion testing. Data on the effect of the composition of the gaseous media on the corrosion of alloys, on the effect of V and of its oxides on the heat resistance of alloys, and on the corrosion resistance of highly alloyed alloys and materials used in high-pressure steam boilers are also given.

2061
DISCUSSIONS ON CATALYTIC CORROSIONS. S. Z. Roginskii, I. I. Tret'yakov, and A. B. Shekhter. (Moscow Inst. of Physical Chem.). Zhur. Fiz. Khim. 29, 1921-3 (1955) Oct. (In Russian)

A review is given of the results obtained in electron microscope studies of the corrosive effects on the surfaces of massive metals appearing during catalysis, chemical sorption, or heat treatments. The electron microscopic pictures of catalytic corrosion effected on the palladium and platinum surfaces by hydrogen or ammonium oxidations under various thermal or time working conditions are demonstrated. Also, an illustration of Zn oxide crystals with blown-on layers of Au and Pt + 10% Rh oxidation pictures are given. 20 references. (R.V.J.)

7188
CORROSION OF REFRACTORY MATERIALS IN MELTS. II. A COMPARATIVE STUDY OF CORUNDUM AND SPINEL BY USE OF RADIOACTIVE ISOTOPES. H. Flood and A. Seltveit. Kgl. Norske Videnskab. Selakads. Forh. 28, 154-60(1955).

The corrosion resistance of corundum and spinel in sodium borate melts has been measured by use of radioactive isotopes introduced in the refractory material. Sodium borates were chosen because the boron anomaly makes it possible in certain temperature intervals to use 3 melts with different Na_2O content but the same viscosity at the same temperature. The results indicate that the cor-

CORROSION 5.05

THEORY 5.05.13

rosion is normally a linear function of time, and at constant viscosity increases with increasing sodium-oxide content in the melt. This tendency is more pronounced for corundum than for spinel. Some measurements of the activation energy have also been made, and these results seem to indicate that the rate-determining process is a cation diffusion through the border layer between refractory and melt. (auth)

2060 AEC-tr-2364
OXIDATION AND CORROSION PROCESSES AT MEDIUM AND LOW TEMPERATURES. Karl Hauffe. Translated from Werkstoffe u. Korrosion, 6, 117-30(1955). 25p. Available from Associated Technical Services, (Trans. 93G7G) East Orange, N. J.

An interpretation of the oxidation and corrosion processes occurring at low and medium temperatures in metals is presented. Chemisorption and the formation of lattice defects in ionic crystals are discussed. (C.W.H.)

3278 Y-589
Oak Ridge National Lab., Y-12 Area, Tenn.
CORROSION STUDY FOR A CHEMICAL PROCESSING PLANT. PARTS I AND II. Frank A. Knox. Aug. 17, 1950. Decl. Nov. 18, 1955. 30p. Contract W-7405-eng-26.

An investigation was made of the corrosion-resistant properties of various materials of construction for a chemical processing plant for the production of Hf-free Zr using several corrosive solutions. To date, metals, plastics, packing materials, and protective coatings were tested against hexone, thiocyanic acid, HCl, and H_2SO_4 in various mixtures and the results are reported. (auth)

DECONTAMINATION 5.06

See also, under WASTE TREATMENT AND DISPOSAL, RECOVERY OR REMOVAL OF MATERIALS (8.05).

CHEMICAL 5.06.01

19031 CF-59-7-75
Oak Ridge National Lab., Tenn.
DECONTAMINATION OF THE PRFR PILOT LEACHING PLANT—PRELIMINARY PROCESS DESIGN. H. A. McLain. July 23, 1959. 9p. Contract [W-7405-eng-26]. $1.80(ph), $1.80(mf) OTS.

The Turco 4501 process is recommended for the decontamination of the PRFR pilot leaching plant equipment. The caustic-tartrate-nitric acid process is recommended for the decontamination of the cell and the equipment exterior. (auth)

CF-59-1-23

Oak Ridge National Lab., Tenn.
EVALUATION OF THE TURCO 4501 PROCESS FOR DECONTAMINATION OF THE THOREX DISSOLVER. J.R. Parrott. Jan. 12, 1959. 10p. Contract [W-7405-eng-26].

The Thorex dissolver was decontaminated with Turco reagents after four years operation. The Turco system of decontamination proved far superior to the previously used caustic-tartrate-nitric acid method. (auth)

7160 HW-60767
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PRELIMINARY INVESTIGATION OF ALKALINE PERMANGANATE-SODIUM ACID SULFATE FOR DECONTAMINATION OF HIGH TEMPERATURE RECIRCULATING SYSTEMS. W. A. Oldham. June 10, 1959. 8p. Contract AT(45-1)-1350. OTS.

Results of an investigation of an alkaline permanganate-sodium acid sulfate decontamination process for high-temperature recirculating systems are presented. Bench scale tests revealed consistent decontamination results equal or better than any currently used high-temperature process. The process is equally effective on activated corrosion and fission products on stainless and carbon steels. Composition specifications are given along with decontamination data and cost estimates. Corrosion data are also included. (J.R.D.)

DECONTAMINATION 5.06

CHEMICAL 5.06.01

5899 KAPL-M-SMS-95
Knolls Atomic Power Lab., Schenectady, N. Y.
DECONTAMINATION OF THE KAPL 120 LOOP BY ALKALINE PERMANGANATE–ACID TREATMENTS. F. C. Steiner. Nov. 24, 1958. 66p. Contract W-31-109-Eng-52. $10.80(ph OTS); $3.90(mf OTS).

Failure of a Bettis fuel element in the KAPL-120 loop resulted in extensive radioactive contamination of the facility. The operation and results of the two decontaminations are summarized. (W.L.H.)

18635 HW-58126
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CORROSION FILM REMOVAL AS AN INDICATION OF DECONTAMINATION EFFECTIVENESS. R. D. Weed. Nov. 10, 1958. 20p. Contract AT(45-1)-1350. $3.30 (ph), $2.40(mf) OTS.

The decontamination of high-temperature, high-pressure recirculation loops and components is being investigated. The Turco-4501 process and certain promising modifications of this process are being evaluated according to their film-removing qualities. Two of the processes exhibited more promise than others. These were the Turco-4501 process, substituting either oxalic acid or a chromic acid solution for the nitric acid. Other variations were also tested and results are reported. (W.L.H.)

PROCESS OF DECONTAMINATING MATERIAL CONTAMINATED WITH RADIOACTIVITY. D. C. Overholt, M. D. Peterson, and M. F. Acken (to U. S. Atomic Energy Commission). U. S. Patent 2,852,419. Sept. 16, 1958.

A process is described for decontaminating metallic objects, such as stainless steel equipment, which consists in contacting such objects with nitric acid in a concentration of 35 to 60% to remove the major portion of the contamination; and thereafter contacting the partially decontaminated object with a second solution containing up to 20% of alkali metal hydroxide and up to 20% sodium tartrate to remove the remaining radioactive contaminants.

16908
SOME GENERAL CONSIDERATIONS IN CHEMICAL DECONTAMINATION. P. J. Barry (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Health Phys. 1, 184-8(1958) Sept.

The elementary principles involved in the removal of radioactive contamination from surfaces are discussed. The properties of the materials used in washing formulae and their use in freeing cotton from different forms of contamination are described. The role of detergents and sequestering agents in preventing re-contamination until the wash liquor is removed is discussed in terms of elementary chemical theory. (auth)

535 HW-56875
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INTERIM REPORT ON THE LABORATORY INVESTIGATION OF CARBON STEEL DECONTAMINATION. J. E. Mendel. July 22, 1958. 14p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Indications are that carbon steel can be adequately decontaminated from activated corrosion products. Decontamination factors of 10 to 20 and corrosion rates of less than 0.02 mils/hr were obtained with several formulations. Decontamination of stainless steel in the presence of carbon steel is more difficult. Oxalic acid and modifications of the Turco 4501 process appear promising. Dissolution of UO_2 in several noncorrosive alkaline media has been demonstrated. H_2O_2-carbonate appears most applicable for loop decontamination. Fission product behavior has not yet been investigated.

16922 CEA-868
France. Commissariat a l'Energie Atomique, Paris.
ESSAIS DE DECONTAMINATION DES SURFACES CONTAMINEES PAR DU PLUTONIUM. (Decontamination of Plutonium-contaminated Surfaces.) J. Bertrand, Ch. Clouet d'Orval, and J. Tachon. July 1958. 9p.

The neutron distribution in the core of the Proserpine is measured by activation detectors placed in polyvinyl or polyethylene bags. The bags must be decontaminated before the detectors are removed. The removal of the Pu solution by rinsing with HNO_3, versene, H_2SO_4, citrosyl, and $KMnO_4$ solutions and by fixation with plexiglass was investigated. It was determined that a jet of HNO_3 gives the best decontamination. It is then possible to cover the bag with a layer of plexiglass to fixate the

DECONTAMINATION 5.06

CHEMICAL 5.06.01

residual radioactivity. The tests showed that polyvinyl bags are more readily decontaminated than the polyethylene bags. (J.S.R.)

21649 HW-56001
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INTERIM REPORT ON TESTS PERFORMED AT THE K REACTORS TO EFFECTIVELY DECONTAMINATE THE PROCESS PIPING BY AN INTERNAL CHEMICAL FLUSH. H. F. Jensen. May 22, 1958. 13p. Contract W-31-109-Eng-52. $3.30(ph), $2.40(mf) OTS.

The chemical flush resulted in corrosion of the Al at the rate of 0.04 mils in five minutes using a Turco 4360-B concentration of 3 ounces per gallon at 50°C. Tests indicate that laboratory procedures are inadequate for heavy contamination found in process tubes, however, increasing the Turco concentration and contact time appear to provide satisfactory results. Further tests aimed at optimizing tube decontamination are scheduled. Experimental results are presented graphically and tabularly. (J.R.D.)

16925 HW-56090
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INTERIM REPORT NO. 1 ON THE TURCO 4501 PROCESS FOR THE DECONTAMINATION OF CARBON STEEL. Lyle D. Perrigo, Jr. May 15, 1958. 8p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Steel coupons which had been exposed in the KER loop 1 mockup tube were used in the study. The procedure and results are discussed, and it is pointed out that the process offers promise of low corrosion loss and good decontamination. (J.R.D.)

11252 KAPL-M-SMS-67
Knolls Atomic Power Lab., Schenectady, N. Y.
REPORT ON THE DECONTAMINATION OF KAPL 120 LOOP. F. C. Steiner. May 15, 1957. 19p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

The procedure and data obtained in the decontamination of KAPL-120 loop are summarized. A fill-and-flush procedure using the concentrated reducing decontamination solution was used to solubilize and remove the crud scale from the out-pile loop surfaces. Fuel elements had previously been removed from the pile tube and the latter was isolated from the external portion of the loop. The decontamination factor after a single $3^1/_2$ hour treatment of the loop followed by repeated water flushes ranged from 2 to 2.5 as measured by the dose rate at selected points of the loop. Samples of the decontamination solution and of the initial water flush indicate that about 100 g of crud (Fe_3O_4) was removed from the loop surfaces. Radiochemical analyses of the solution established that Co^{60} was the major constituent contributing to the gamma dose rate. Although an appreciable portion of the activity was retained on the special ion exchange column (as evidenced from a dose rate reading in excess of 2R/hr) it was observed that the Fe-EDTA complex (purple) was contained in the ion exchange effluent. Except for a leak at a thermocouple well to no equipment trouble was experienced after the decontamination test and a hydrostatic test at 2200 psi indicated no leaks. It appears that use of the fill-and-flush procedure is compatible with a stainless steel system and can be applied to portions of the S3G/S4G system. (auth)

7574 ORNL-2058
Oak Ridge National Lab., Tenn.
DECONTAMINATION OF THE ORNL THOREX PILOT PLANT. K. H. McCorkle and W. R. Winsbro. July 25, 1956. 31p. Contract W-7405-eng-26. $4.80(ph OTS); $2.70(mf OTS).

Decontamination of the Thorex Pilot Plant is described. Twenty-four major pieces of highly contaminated stainless-steel processing equipment were decontaminated in 19 days to safe working levels by alternate treatments with 20% sodium hydroxide—2% sodium tartrate and 20% nitric acid. Oxalic acid or citric acid was substituted for tartaric acid in about half the treatments. The average cost per treatment was $222; the total cost was $36,000. (auth)

4931 ORNL-1839
Oak Ridge National Lab., Tenn.
DECONTAMINATION OF THE HOMOGENEOUS REACTOR EXPERIMENT. D. O. Campbell. June 12, 1956. 44p. Contract W-7405-eng-26. $0.35(OTS).

After shutdown the Homogeneous Reactor Experiment system was decontaminated in about 1 month, without descaling, from an activity level of 1000 r/hr to 5 to 200

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CHEMICAL 5.06.01

r/hr. This was sufficient to permit dismantling. The treatment consisted in washing twice with each of the reagents 5% HNO_3, 35% HNO_3, and 10% NaOH – 1.5% $Na_2C_4H_4O_6$ – 1.5% H_2O_2 and numerous times with water. Overall decontamination factors were 22 to 25, including decay. Decontamination factors with a single reagent were between 1 and 2.25. More than 2000 curies each of Ce and Zr, more than 1000 curies each of Ba, Sr, and La, and large amounts of Nb, Ru, and I_2 were removed. The significant contaminants remaining were Nb and Zr. These could have been removed only by descaling the system, which laboratory experiments indicated would have given a further decontamination factor of about 100. (auth)

7931 KAPL-1456
Knolls Atomic Power Lab., Schenectady, N. Y.
INVESTIGATION OF RADIOACTIVE DECONTAMINATION METHODS FOR SODIUM REACTOR SYSTEM COMPONENTS F. G. Haag. Dec. 1, 1955. Changed from OFFICIAL USE ONLY June 3, 1957. 27p. Contract W-31-109-Eng-52. $0.35(OTS).

Experimental results were obtained by decontaminating Na equipment used in an MTR in-pile loop irradiation test. The following procedures were devised and are recommended for any radioactive Na system. A preliminary scrubbing with alcohol at 250°C is followed by decontamination by brushing with 5 wt. % Alconox or Calgonite aqueous solution. Where it is required, a 24-hr soak in Versene is as effective as the detergent scrub. A reduction in activity by a factor of 6 or 7 is thus achieved. A more drastic treatment utilizes 1% citric acid at 25°C. Final treatment involving 1% chromic acid – 5% HNO_3 solution at 175°F should be used with extreme caution. (T.R.H.)

2614 HW-39945
Hanford Atomic Products Operation, Richland, Wash.
SPONTANEOUS DECOMPOSITION OF TRICHLOROETHYLENE. G. F. Yost. Nov. 15, 1955. 5p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The potential hazards of using CCl_2CHCl for degreasing Al were investigated. Descriptive details of the chemical reactions and theory involved are presented, followed by recommendations for the prevention of spontaneous decomposition of CCl_2CHCl under normal operating conditions. (C.W.H.)

9776 KAPL-M-SCT-8
Knolls Atomic Power Lab., Schenectady, N. Y.
MARK B PUMP CLEANING REPORT. R. Demers. Oct. 7, 1955. 12p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Sodium cleaning of the Mark B Pumps was successfully completed without incident. However, an additional step, (a tri-$NaHPO_4$ flush) had to be incorporated into the cleaning procedure to remove an oily-type film which was deposited after Na cleaning. This T.S.P. did not remove all of the residue and localized swabbing with acetone on all accessible parts of the pump interior was necessary. Analysis of the residue indicated that the oily film could have been deposited by the methyl isobutyl ketone, one of the cleaning agent's constituents. The ketone apparently undergoes a condensation reaction to form a water insoluble soap-like compound. In view of the above, SIR Systems Development

3607 CF-54-3-171
Oak Ridge National Lab., Tenn.
THE DECONTAMINATION OF STAINLESS STEEL. Progress Report. D. O. Campbell. Mar. 16, 1954. Decl. Dec. 20, 1955. 30p. $4.80(ph OTS); $2.70(ph OTS).

The contamination on stainless steel exposed to Purex process solutions is predominantly Nb. Besides being the predominant initial contaminant, Nb appears to be the most difficult to remove. The rate of decontamination with time of treatment is reported for nitric acid, oxalic acid, Na hydroxide, Na tartrate in Na hydroxide, and a solution of Na tartrate, hydrogen peroxide, and Na hydroxide. Nitric acid is the least effective; alkaline tartrate peroxide is the most effective. The reagents decontaminate rapidly at first, but the rate drops to about 6% removal per day after several days. Contamination from dilutions of the Purex process waste solution follows the Freundlich adsorption isotherm relationship between the amount of radioactivity adsorbed and its concentration in the contamination solution. The addition of a fluoride solution of stable Nb and Zr to the contamination solution decreases the gamma contamination by decreasing that of Nb and Zr. Ruthenium then becomes relatively important. However, it is difficult to get Nb into solution with nitric acid alone. Hydrofluoric acid (3%) in nitric acid (20%) is the most effective decontamination reagent tested. It is also severely corrosive to stainless steel, although it does not produce interganular corrosion or serious pitting. Ultrasonic radiation of high enough intensity increases the rate of decontamination. (auth)

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9727 ANL-4970
Argonne National Lab., Lemont, Ill.
DECONTAMINATION OF STAINLESS STEEL. F. Johnston and J. J. Katz. Jan. 1953. Decl. Feb. 11, 1957. 14p. Contract W-31-109-eng-38. $0.25(OTS).

The information obtained from absorption curves and radioautographs indicates that the problem of decontaminating stainless steel surfaces which have been immersed in active UO_2 slurries is one not of removing a particular adsorbed radioactive species but of removing minute UO_2 particles which are tenaciously held by the surface. Consistent with these observations, reagents which effectively dissolve UO_2 or have a corrosive effect on stainless steel were efficient decontaminating agents. Complexing agents, detergents, and wetting agents, on the other hand, were, in general, poor decontaminating agents. An exception was Victamul 116C, a non-ionic organic phosphate produced by the Victor Chemical Co. This product was found to be several times more effective than any of the other mild reagents tested. It did not, however, compare with the oxidizing mixtures in equivalent concentrations. The effectiveness of the $H_2O_2-H_2SO_4$ mixture was markedly enhanced by the addition of Solvadine BL, a wetting agent produced by Ciba. (auth)

STABILITY OF SEQUESTERING AGENTS TO GAMMA RADIATION. Paul E. Brown and Philip W. Mathay. [1953?]. Decl. Mar. 9, 1957. 7p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

Considering the change in complexing capacity, both the sulfonated polystyrene and the sulfonated phenol formaldehyde solutions seem to possess adequate stability to gamma radiation for the proposed application. The loss in complexing capacity of polymerized acrylic acid due to gamma radiation would cause it to be less desirable than the others as a cleaning agent for a reactor vessel. No gum or other insoluble material deposited from any of the solutions irradiated. The slight gas pressure developed by these materials under radiation should not be a serious deterrent to their use as cleaning agents. (auth)

4253 CF-51-11-123
Oak Ridge National Lab., Tenn.
EVALUATION OF REAGENT DECONTAMINATION. Quarterly Report for Period August 10, 1951–November 10, 1951. M. R. Bennett. Nov. 21, 1951. Decl. Dec. 22, 1955. 11p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

An evaluation was made of the decontamination and corrosion properties of various reagent mixtures on welded and non-welded specimens of types 309 and 347 stainless steel. A reagent mixture of 20% HNO_3–3% HF (by weight) was found to be superior to all other reagents tested in both decontamination and corrosion properties. (C.H.)

Effectiveness of Various Solutions for Decontaminating Stainless Steel, Lead, and Glass, John B. Huff, AEC-IDO-14379, p. 21, 1956.

Electrolytic methods best for metals. Boiling in phosphate or fluoride solution also effective for stainless steel and glass. Versene better than phosphates for Pb.

ELECTROLYTIC 5.06.02

10072 CRHP-692
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
ELECTROLYTIC DECONTAMINATION OF STAINLESS STEEL. P. J. Barry. Mar. 1957. 18p. (AECL-443).

It has been found that the rate and extent of decontamination increases with the current density applied. The efficiency of current utilization however, reaches a maximum at 30 ma/sq. in. which suggests that a vigorous evolution of gases is not necessarily advantageous. Agitation is desirable. In a study of a few simple electrolytes it has been found that $Na_2C_2O_4$ or $H_2C_2O_4$ in 1% concentration are effective. The addition of 0.5% wetting agent (Nacconal or Hydraclene) improves the performance of the bath. (auth)

ELECTRODECONTAMINATION OF STAINLESS STEEL. M. R. Bennett. Nov. 1, 1954. Decl. Dec. 1, 1955. 28p. (AECD-4169)

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ELECTROLYTIC 5.06.02

Decontamination factors of 1000 to 3000 were obtained by electrostripping deposited radioactivity from stainless steel surfaces, used as the anode, in 2% H_2SO_4 at current densities as low as 0.01 amp/in.^{2}. Stainless steel cathodes were used. The method was successfully applied to contaminated equipment.

2329 CF-52-2-217
Oak Ridge National Lab., Tenn.
ELECTROCHEMICAL STUDIES; QUARTERLY REPORT FOR PERIOD NOVEMBER 10, 1951–FEBRUARY 10, 1952. J. A. McLaren, J. H. Goode, and H. L. Peeler. Feb. 29, 1952. Decl. Dec. 16, 1955. 15p. Contract W-7405-eng-26. $3.30(ph OTS); $2.40(mf OTS).

Progress is reported on the following studies: electrolytic decontamination of process equipment; electrolytic acid adjustment of $UO_2(NO_3)_2$ solutions and $Pu(NO_3)_4$ solutions from the Purex Process; and electrolytic production of H and O. (C.H.)

METHODS AND EQUIPMENT 5.06.03

19663 TID-3535
Technical Information Service Extension, AEC.
RADIOACTIVE DECONTAMINATION. A Literature Search. William E. Bost, comp. Sept. 1959. 36p. $1.00(OTS).

This literature search includes 351 references to unclassified reports on radioactive decontamination. (J.E.D.)

21947 HW-60677
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DECONTAMINATION STUDIES FOR HAPO HIGH TEMPERATURE REACTOR RECIRCULATION SYSTEMS. Progress Report, June 1958–June 1959. L. D. Perrigo and R. D. Weed. June 10, 1959. 34p. Contract W-31-109-Eng-52. $6.30(ph), $3.00(mf) OTS.

Crud contamination has been successfully removed from stainless steel by a proprietary method, the Turco 4501 Process. This process has exhibited good corrosion characteristics and decontaminating efficiency in all phases from the laboratory studies to in-reactor loop tests. The Turco 4501 Process for carbon steel gives good decontamination factors, but this cleaning is associated with a high corrosion loss. The one step acid persulfate process gave excellent decontamination factors for crud contaminated stainless steel in a laboratory study but these were accompanied with moderately high corrosion losses. Crud contamination on both carbon and stainless steel has been efficiently removed with low corrosion losses by the APACE process. No in-reactor tests have been made to date. The proprietary compound, Turco 4512, has been successfully used to remove induced activities from carbon steel on a laboratory scale. It is ineffective for stainless steel cleaning. Laboratory and exploratory work on reagents for the removal of rupture products is being done by the Chemical Research and Development Operation, HLO. In their studies, the APACE process has shown considerable promise as a rupture product decontaminant. H_2O_2 has also been used as an oxidizing pretreatment with the APACE process with notable results for the dissolution of uranium dioxide. The Turco 4501 Process has been able to remove fission products from carbon steel coupons but with a fairly high corrosion loss. Several different methods have been tried for removing rupture products from out-of-reactor test loops. Only moderate success has been obtained to date. The most promising method will be chosen and used in a few months on the in-reactor 3 by 3 loop in the ETR. (auth)

13533 NAA-SR-3261
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
EQUIPMENT DECONTAMINATION BY ABRASIVE BLASTING IN THE PROCESSING REFABRICATION EXPERIMENT. J. W. Savage and D. J. Stoker. Apr. 1, 1959. 53p. Contract AT-11-1-GEN-8. $1.50(OTS).

The purpose of this work was to investigate abrasive blasting as a method for decontamination of radioactive Process Refabrication Experiment (PRE) in-cell equipment. Experiments were carried out, initially with nonradioactive materials, and then with low-level radioactive materials to determine the proper operating conditions and effectiveness of abrasive blasting. It was concluded that abrasive blasting with cut steel wire should be used in PRE for decontamination of recover-

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METHODS AND EQUIPMENT 5.06.03

able non-precision materials and equipment, or for predisposal partial decontamination of non-recoverable items. Blasting with cut wire resulted in less dust production than blasting with mineral abrasives. A design study including a partial equipment mock-up was made to determine the requirements of a special piece of equipment which could perform abrasive blasting in a cell, and which would be remotely operated and maintained. The design study resulted in the establishment of a basic design for a PRE abrasive blast cabinet, and established the requirements for an air-handling system. (auth)

1714 LAMS-2319
Los Alamos Scientific Lab., N. Mex.
PROCEDURES FOR DECONTAMINATION OF PLUTONIUM FROM VARIOUS SURFACES. E. L. Christensen. Apr. 1959. 25p. Contract W-7405-eng-36. OTS.

Decontamination solutions, procedures, and their effectiveness in the removal of plutonium from various types of surfaces are reported. (auth)

22504
METHOD AND COATING COMPOSITION FOR PROTECTING AND DECONTAMINATING SURFACES. D. C. Overhold and M. D. Peterson (to U. S. Atomic Energy Commission). U. S. Patent 2,877,131. Mar. 10, 1959.

A protective coating useful in the decontamination of surfaces exposed to radioactive substances is described. This coating is placed on the surface before use and is soluble in water, allowing its easy removal in the event decontamination becomes necessary. Suitable coating compositions may be prepared by mixing a water soluble carbohydrate such as sucrose or dextrin, together with a hygroscopic agent such as calcium chloride or zinc chloride.

20075
AN APPLIANCE FOR DISTANCE DEACTIVATION OF POLLUTED SURFACES. N. V. Samokhvalov. Gigiena i Sanit. 23, No. 10, 79-80(1958) Oct. (In Russian)

A simple appliance is described for safe, remote cleaning of contaminated surfaces. (R.V.J.)

14684 A/CONF.15/P/516
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
OPERATING EXPERIENCE IN A "HOT" SOLVENT EXTRACTION PILOT PLANT. G. C. Oberg and R. J. Sloat. 17p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The operating experience gained in the "hot" pilot plant constructed at Hanford to evaluate solvent-extraction processes is discussed. After enumeration of the difficulties encountered, design concepts are presented which should be incorporated in new pilot plants to minimize operating and maintenance difficulties in a pilot plant employing a contact maintenance philosophy. During actual pilot plant operation, it was necessary to decontaminate the plant frequently to permit "contact" maintenance. The decontaminating solutions used and their specific applications for various types of radioactivity, and special decontaminating devices and techniques developed for removing surface contamination are discussed. (auth)

64 IGRL-IB/R-27
United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.
RADIOACTIVE DECONTAMINATION PROCEDURES AND EQUIPMENT. Information Bibliography. Sept. 1957. 12p.

This is a selection of report, book, and journal references to publications issued up to December, 1956. Sources used were U.K., Canadian, and U.S. report abstracts, Nuclear Science Abstracts, Engineering Index (1950-1955), and Industrial Arts Index (1956). (auth)

PERSONNEL PROTECTION DURING REPAIR WORK IN CONTAMINATED AREAS. S. M. Gorodinsky and V. L. Shcherpakov. Atomnaya Energiya 3, No. 8, 141-8(1957).

If repairs have to be carried out in radioactively contaminated areas, it is necessary to protect the personnel against γ radiation (by short working hours) and against their skin coming into contact with radioactive isotopes. This is done by protective clothing and face masks. The Russian protective suits LG-1 and LG-2 and the face masks ShB-1 and ShB-2 are described briefly. (TCO)

DECONTAMINATION 5.06

METHODS AND EQUIPMENT 5.06.03

6410
REVIEW OF DECONTAMINATION METHODS USED IN RADIOCHEMICAL LABORATORIES. J. Siejka (Inst. of Nuclear Research, Warsaw). Nukleonika 2, 647-51(1957). (In Polish)

Trends in current research on decontamination from β and γ emitters in low activity level radiochemical laboratories are discussed. Methods for chemical cleaning and deactivation of solids are described. (tr-auth)

157
PURIFICATION OF THE ACTIVE DEPOSIT OF OLD RADIOEMANATION AMPOULES. C. Ferreira de Miranda. Faculty of Sciences in Lisbon B3, 191-5(1957). (In Portuguese)

9733 CF-56-6-87
Oak Ridge National Lab., Tenn.
REPORT OF COPPER DECONTAMINATION WORK AT FEDERATED METALS IN ST. LOUIS. E. S. Bomar. June 14, 1956. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

An industrial-scale experiment involving 100-tons of scrap copper has been completed to check the results of laboratory experiments on the use of fire refining as a means of removing uranium contamination. Samples of the refined metal were checked at ORNL for uranium content by activation analyses and found to have on the average less than 0.66 micrograms of uranium per gram of metal sample. The bulk of the activity was found in the slag. The above level of activity was considered acceptable by the ORO of the AEC and the metal has been released for resale. (auth)

DECONTAMINATION AND WASTE DISPOSAL IN INDIUM GAMMA IRRADIATION FACILITY. Lawrence C. Widdoes. May 14, 1956. 7p. A-1 Project. (AECU-3339; IC-LCW-56-6)

Flushing and draining should sufficiently decontaminate the irradiation equipment so that it can be maintained easily, but experimental work should be performed to make positive that In, or some radioactive impurity, is not preferentially absorbed on equipment walls so that it cannot be removed by simple flushing. Even after 5 yr decay it may be difficult to reduce, by dilution, the Tl and perhaps other impurities in commercial $In_2(SO_4)_3$ solution to drinking water tolerance, but the use of high purity In in the loop could alleviate this situation.

DEPOSITION OF AIRBORNE PARTICLES ON A LARGE HEATED SURFACE. Martin Harwit. Feb. 1956. 35p. (CWLR-2046)

The effect of a large heated surface on the deposition pattern from a polluted atmosphere is studied. It is concluded that the use of heat to avert the deposition of particulate matter 20 to 300μ is not practical.

HIGH-LEVEL CONTAMINATION CONTROL AND WASTE DISPOSAL. R. F. Stearns. Nov. 1, 1955. 19p. (KAPL-1406)

The clean-up and disposal of radioactive waste in the Radioactive Materials Laboratory at the Knolls Atomic Power Laboratory is lessened considerably if the problems of radioactive contamination are taken into consideration during the design of irradiation test devices and laboratory equipment. Operational experience and engineering work have also resulted in development of many techniques and equipment which have aided in reducing the costs of high-level radioactive clean-up and waste disposal.

5143 IDO-26081
Oak Ridge National Lab., Tenn.
A GENERAL DECONTAMINATION MANUAL FOR THE IDAHO CHEMICAL PROCESSING PLANT. C. D. Watson. Mar. 11, 1953. Decl. Dec. 7, 1955. 18p. $3.30(ph OTS); $2.40(mf OTS).

Decontamination procedures are outlined for the removal of radioactive contamination from stainless steel chemical processing equipment, stainless steel laboratory surfaces, concrete surfaces, painted surfaces, asphalt floor tile, and Cu and brass surfaces. Two methods for the destruction of oxalic acid are included. (C.H.)

7356 AECD-3998
Oak Ridge National Lab., Tenn.
SUMMARY OF SURFACE DECONTAMINATION EXPERIENCE AT OAK RIDGE NATIONAL LABORATORY. F. N. Browder. Nov. 1943 through July 1948. Decl. with deletions Jan. 5, 1956. 38p. Contract W-7405-eng-26.

DECONTAMINATION 5.06

METHODS AND EQUIPMENT 5.06.03

In the course of five years experience at Oak Ridge National Laboratory, it has been found that all impervious materials such as stainless steel, mild steel, lead, glass, certain plastics, and certain surface coatings can be decontaminated by vigorous washing with the proper reagents. Each decontamination operation is carried out by starting with mild reagents (water) and increasing the severity of the treatment until the desired decontamination is obtained. Porous materials such as bare concrete, wood, and some plastics have been impossible to decontaminate satisfactorily except by the physical removal of the contaminated portions. (auth)

7704 K-211
Carbide and Carbon Chemicals Corp. [K-25 Plant], Oak Ridge, Tenn.
BIBLIOGRAPHY ON PHOSPHATE SCALE REMOVAL. Fred E. Croxton, comp. May 12, 1948. 45p. Contract [W-7405-eng-26]. $7.80(ph OTS); $3.30(mf OTS).

The references shown in this bibliography were collected in connection with the scale removal problem present in the K-25 plant cooling system. The removal of the phosphate type scale was emphasized, but various related problems are also treated. Many references concerning phosphates and removal methods were not included because the process would have necessitated the removal of the cooler unit, and fusion treatment with various salts. The bibliography is divided into three sections; Scale Removal, Phosphate Solubilization and Other Properties, and Analytical Techniques. The references listed were obtained from a search of Chemical Abstracts, 1917 to 1947, Industrial Arts Index, 1938 to 1948, and Engineering Index, 1946. (auth)

8327 WT-347
Office of the Quartermaster General, Washington, D. C.
CLOTHING DECONTAMINATION AND EVALUATION OF LAUNDRY METHODS. Donald C. Hughes, Alfred H. Parthum, Jr., Howard James, and John C. McWhorter, Jr. Apr. 1, 1952. Decl. Oct. 16, 1959. 81p. Project 6.7 [of] OPERATION JANGLE. OTS.

The over-all objectives of this project encompassed testing the suitability of standard and special laundering methods and standard equipment for field decontamination of clothing; evaluating the contaminability and decontaminability of selected fabrics; and testing of experimental clothing monitoring instruments. Garments and fabrics contaminated by controlled methods were used during the operation for testing the equipment and evaluating fabrics and formulae. Standard Army laundering methods and equipment, including wooden washers, were effective for decontaminating clothing in the field. A decontaminating laundry formula employing citric acid and tartaric acid followed by either an organic or inorganic chelating agent results in a higher degree of decontamination than other formulae tested. The standard Quartermaster Corps mobile field laundry formula resulted in satisfactory decontamination with the type of soil and activity encountered and the cost of supplies is approximately one-tenth as much as the special formulae. Woolen garments and fabric swatches were decontaminated by laundering as readily as cotton or synthetic fabrics. Clothing monitoring instruments under development appear suitable for monitoring clothing under field conditions to determine the degree of contamination both before and after processing. (auth)

ULTRASONIC 5.06.04

2203 AECU-3590
General Electric Co. General Engineering Lab., Schenectady, N. Y.
ULTRASONICS FOR RADIOACTIVE DECONTAMINATION. G. E. Henry. Nov. 11, 1957. 30p. $3.30(ph OTS); $2.40 (mf OTS). (57GL337).

Tests have been run to determine in a preliminary fashion whether ultrasonic vibration would be effective in removing mixed radioactive deposits from the inside surface of steel pipes in a heat exchanger. Different frequencies (20 KC/S, 1000 KC/S) have been used at the maximum power levels conveniently attainable. Different liquids were compared for cleaning effectiveness, with and without ultrasonics. Mild stirring of water bath at room temperature produced virtually no cleaning effect on the samples. Ultrasonics in water, at room temperature, gave 50% to

DISTILLATION 5.07

17575

ON DISTILLATION COLUMNS FOR ISOTOPE SEPARATION. F. I. Havliček (J. Stefan Institut, Ljubljana, Yugoslavia). Energia nucleare (Milan) 5, 527-30(1958) Aug.

Equations were derived for steady and transient operation of distillation columns for isotope separation. Some diagrams were also plotted in order to determine the optimal height of the columns in a cascade with respect to the output. The influence of the single-process separation factor on these results was also investigated. (auth)

4806

HIGH-PURITY EVAPORATOR FOR WASTE CONCENTRATION. T. C. Carnavos and J. W. Hagen (Griscom-Russell Co., Massillon, Ohio). Nucleonics 16, No. 2, 125-7(1958) Feb.

A remotely operated evaporator for processing radioactive material was designed which accomplishes a threefold reduction in waste volume with concentration to 70% salt content. The evaporator, with sloped sides to prevent accumulation of solids and a concentrate discharge line located at the lowest point of the bottom, has a low-vapor disengaging rate and high headroom to promote natural separation of water and vapor. The mist eliminator is capable of reducing entrainment by factors of 10^3 to 10^4. A bowed tube heating section permits scale shedding by thermal shock. (J.S.R.)

STILL COLUMN WITH CONCENTRIC CONDENSER. A. K. Brewer and T. I. Taylor (to U. S. Atomic Energy Commission). U. S. Patent 2,780,589. February 5, 1957.

A countercurrent reflux still is described which may be used in high vacuum or molecular distillation comprising an inclined still column in combination with an internal condensing and reflux device. The cooled side of the column is constructed as a series of inclined surfaces sloping in a direction opposite to the general direction of flow of liquid along the heated surface. Increased heat efficiency and greater temperature control of the heated and cooled surfaces are obtained with the disclosed still. (auth)

8093

HORIZONTAL SUBLIMATION APPARATUS. J. C. Hecker (to U. S. Atomic Energy Commission). U. S. Patent No. 2,743,169, Apr. 24, 1956.

A horizontal apparatus designed for the purification of halogen derivatives of U compounds is described. It consists of a horizontal charge boat fitting into a heating shell or crucible, a cooling chamber for condensation of the formed vapors, a scraper to gather the crystals in one end, and a collection pot thereunder for the accumulation of the crystals. The apparatus is designed to operate under reduced pressure and a means to accomplish this is included. The compounds are placed in the charge boat, inserted in the heating chamber, and vaporized, with the vapors being collected in the condensing chamber where they are raked or scraped into the collecting pot and recovered. (auth)

8092

SUBLIMATION APPARATUS. R. Krohn and R. J. Schmidt (to U. S. Atomic Energy Commission). U. S. Patent No. 2,743,168, Apr. 24, 1956.

A sublimation apparatus designed to purify halogen derivatives of U compounds is described. It is desired to vaporize and recondense the material without transition through the normal liquid stage. This may be accomplished by heating the material in a high vacuum obtained by suitable vacuum pumps used in the various stages depending upon the vacuum desired and the amount of gases to be pumped. The material is placed in a receiving container fitted in combination with a condensing chamber, cooling coils and piping. The pressure is first lowered to the order of 10^{-2} mm of mercury, then a heating coil is placed about the protruding charge boat. Subsequently, the temperature is raised to about 800°C and the pressure lowered by a diffusion pump to 5×10^{-5} mm and the material forms as crystals in the condensing chamber. A seal similar to a piston ring maintains the vacuum in the charge boat. At completion of the operation, lasting from 8 to 12 hr the heating shell is removed, an inert gas is bled into the condensing chamber, and the purified crystals are scraped from the walls thereof. (auth)

10822 K-1013(Del.)

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

SEPARATION OF URANIUM HEXAFLUORIDE FROM BROMINE AND BROMINE TRIFLUORIDE. A. I. Krakoviak. June 21, 1954. Decl. with deletions Feb. 26, 1957. 15p. Contract W-7405-eng-26. $3.30(ph OTS); $2.40(mf OTS).

A procedure was developed for separating UF_6 from the reaction products of BrF_3 and U compounds. A product

containing 99.99% UF_6 was obtained by solid condensation of the UF_6 from a 93% UF_6-7% Br mixture on the walls of a water cooled condenser at atmospheric pressure, followed by repeated flashing of this condensed product to another water cooled condenser; over 91% of the UF_6 in the original feed mixture was recovered. Similarly, a product containing 98.5% UF_6 was obtained from a 92% UF_6-8% BrF_3 mixture; over 80% of the UF_6 in the original feed mixture was recovered. (auth)

7287 A/CONF.15/P/102
PRODUCTION OF BORON-10 AND OTHER STABLE ISOTOPES. A. O. Edmunds and F. C. Loveless (20th Century Electronics Ltd., Croydon, Surrey, Eng.). 24p.

An approach to the design of isotope separation plants is outlined with particular reference to the isotopes of boron. A basic separation unit is described which consists of two packed fractionation columns of high separation efficiency. The units can be easily fabricated and economically operated to provide highly enriched isotopes at a moderate price. A unique control system is used to make the columns fully automatic. It is imperative in isotope separation systems that a rapid and reliable analysis of the product enrichment should be available, and the control instrumentation includes equipment for the continuous monitoring of the isotopic enrichment of the product by a neutron absorption technique. A number of high efficiency distillation column packings have been investigated and a new type of packing has been developed, particularly for use in distillation columns greater than 2 in. diameter. The packing is made from rectangular section metal wire woven into a mesh. It can be supplied in alternative materials chosen for their suitability to the fluids to be distilled. Operating characteristics such as pressure drop and height equivalent to a theoretical plate are given. Distillation columns for the production of the isotopes of boron are discussed including experience in operating a larger scale plant owned by U.K. Atomic Energy Authority. A comparison between this method and the chemical exchange system of an organic boron trifluoride complex is given based on operating data available. The economics of each system in relation to the scale of production and the product purity is given. (auth)

FILTERS 5.08

See also, under HAZARDS AND PROTECTION, AIR CLEANING--Filters (4.01.01.04).

2737 ✓ ORNL-2613
Oak Ridge National Lab., Tenn.
METHODS OF REMOTELY REMOVING THE BED FROM A SAND FILTER. C. O. Thornburg. Dec. 3, 1958. 16p. Contract W-7405-eng-26. $3.30(ph OTS); $2.40 (mf OTS).

Methods of remotely removing a sand bed from an isolated sand radiochemical filter were developed and tested, including a water eductor method, a pressurized vessel method, and a steam jet method. The last method appeared most reliable and practical, and special attention was given to determining optimum conditions for bed removal using a steam jet. (auth)

10438 ✓ CF-58-5-32
Oak Ridge National Lab., Tenn.
AN ENGINEERING EVALUATION OF A MAGNETIC FILTER AS A MEANS OF REMOTE CONTROL FILTRATION. R. J. McNamee and L. B. Shappert. [May 1958]. 22p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

For presentation at the Annual Meeting of the American Nuclear Society in Los Angeles, California, June 2-5, 1958.

An evaluation was made of a remote control method of filtration, using a ferromagnetic powder suspended in a magnetic field as the filtering media. A filter of this kind would have the advantage of being able to form and discharge the filter bed (and resulting cake) by control of the current to the electromagnet providing the magnetic field. Studies on a 3-inch diameter filter column showed the principle to be feasible, using ferrosilicon as the filtering media. Data necessary for scale-up and design were obtained, and their use in such calculations is discussed. (auth)

FILTERS 5.08

16198

THE EFFECTIVENESS OF SAND AS A FILTER MEDIUM. R. E. Yoder and F. M. Empson (Oak Ridge National Lab., Tenn.). Am. Ind. Hyg. Assoc. J. 19, 107-10(1958) Apr.

Sand filters were studied under a variety of conditions to determine their usefulness as a filter medium for aerosols in low-velocity air streams. Ruthenium and iodine were removed from the vapor stream from a boiling mixture containing these isotopes, and it is thought that sand may be used to filter aerosols from either dry or moist gas streams. (J.R.D.)

8297 HW-55353

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SOLIDS FILTER FOR HOT CORROSIVE GASES. G. A. Nicholson. Mar. 14, 1958. 4p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The unit was used to remove suspended solids of 1.5 microns average particle size from a hot dry air stream. The pressure drop across the clean filter was 1.2 lb/sq. in./in. of filter thickness. The filter gave very good performance. Absolute removal of solids was obtained. Cake deposits of approximately 0.03-inch thickness were obtained with only a 75 per cent increase in the pressure drop. Essentially complete removal of the cake was accomplished by a sudden reversal of the gas flow. (auth)

AEROSOL FILTERS FOR RADIOACTIVE SUBSTANCES. Z. Smal, J. Schen, and J. Maciejewski. Nukleonika 3, 673-8(1958). (In Polish)

Descriptions are presented of sectional and perforated cylinder-type filters for radioactive aerosols.

11042

AN ELECTROSTATIC FILTER FOR ATOMIC ENERGY PLANTS. M. D. Penrose and F. P. Gilson (Sturtevant Engineering Co. Ltd.). Nuclear Power 2, 315-16(1957) Aug.

11510

METHOD OF MAKING FILTER MEDIA. W. J. Smith et al. (to U. S. Atomic Energy Commission). U. S. Patent 2,797,163. June 25, 1957.

An improved filter material capable of filtering particles in the submicron range, and a process for forming this filter material are described. First, an aqueous slurry of inorganic vitreous monofilament fibers is formed and is then treated with a priming agent capable of lowering the surface affinity of said monofilament fibers for each other to prevent balling of the fibers and to cause them to form a supporting network, an organic binder is then added to a strengthen the network and fibrous filtering material is incorporated in the interstices of the network. Polyacrylic resins are mentioned as suitable binders and unrea-formaldehyde as a suitable primer. (auth)

500 EES-010327

Naval Engineering Experiment Station, Annapolis.

LINDE MOLECULAR SIEVES AS DYNAMIC DEHUMIDIFICATION DESICCANTS. Progress Report. John W. Cadorette and D. M. Zall. Apr. 12, 1957. 19p.

Four samples each of three types of Linde Molecular Sieves were evaluated as dynamic desiccants. The molecular sieves had high water vapor adsorption capacities at low relative humidities. This suggests their possible use in drying compressed gases, such as aviators' breathing oxygen. The high capacity at low and midrange humidities and their rapid absorption rates make them ideally suited for use in dynamic humidifiers. However, they cannot be used in dehumidification machines designed for use with Grades H and L desiccant unless the machines are modified to provide higher reactivation temperatures. The high reactivation temperature indicates ability to adsorb moisture at very high temperatures. This suggests possible use as desiccants for high-temperature air streams, such as between stages of multiple-stage compressors. (C.H.)

7335 CEA-tr-A478

FILTRES À AIR ET À POUSSIERES POUR L'INDUSTRIE. (Air and Dust Filters for Industry.) H. Murmann. Translated into French from Metall 11, 868-73(1957). 26p.

The construction, capacity, and utilization of air and dust filters are described. The four types of filters considered are metallic filters with oil films, dry layer filters, cloth air filters, and electrofilters. (J.S.R.)

5830 AECU-3417
Dow Chemical Co. Rocky Flats Plant, Denver.
EXTENSION OF USEFUL LIFE OF EXHAUST AIR FILTERS AFTER AMMONIUM NITRATE LOADING. R. P. Craig, P. D. Erickson, J. A. Geer, and F. J. Linck, Jr. Oct. 1956. 24p. Contract AT(29-1)-1106.

Air filters were found to be plugging with NH_4NO_3. The useful life of these filters was increased 4 times by occasional humidification with steam. (T.R.H.)

11668 HW-45008
Hanford Atomic Products Operation, Richland, Wash.
HANFORD USE OF EXPERIMENTAL WATER FILTER PLANT. W. R. Conley, C. W. Botsford, and R. W. Pitman. Aug. 20, 1956. Decl. Mar. 13, 1957. 30p. Contract W-31-109-Eng-52. $0.35(OTS).

An improved method of water plant control has been developed at Hanford which employs a sensitive turbidity measuring microphotometer and a model water filtration plant. The microphotometer operates on a light scattering principle and is accurate in the range of 0.0 to 0.1 ppm turbidity. The model filter plant used is a five gallon per minute plant which can simulate the conditions normally occurring in the large water plants. It is the purpose of this report to describe the model filter plant and to demonstrate the value of the model and microphotometer for effective water plant control and water plant design scoping. (auth)

5031
FILTERING APPARATUS. R. W. Dodson et al (to U. S. Atomic Energy Commission). U. S. Patent 2,732,072, January 24, 1956.

A remote-controlled filtering apparatus to handle radioactive slurries and to isolate the filtrate in a shipping container by air pressure or vacuum is described. The apparatus consists of concentric containers, an inner container holding a slurry and an outer container for the filtrate, tubes to charge and discharge the containers, and a filtrate shipping container. The entire apparatus is protected by lead shielding and is a safe convenient method of filtering such fluids. (auth)

ENGINEERING STUDIES OF FILTER BED EFFICIENCY FOR THE TREATMENT OF RADIOACTIVE WASTES. Lee Gemmell. [nd]. 9p. (BNL-1187)

The general layout of the BNL sewage disposal plant is shown. The efficiency of the filter beds in removing some of the most common radioactive isotopes from the laboratory low-level sewage is discussed. The amount of activity coming through the filter beds was calculated, and the radioactive waste distribution was found. About 90% of the total activity adsorbed in the filter beds remains in the top 3 in., 8% in the next 9 in., and 2% in the remaining 5 ft. A number of columns were set up to examine the possibility of the filter beds, or parts of them, becoming saturated and refusing to further hold up certain isotopes at all. For the first 16 dosings (4 days), the column removed about 98% of the activity. For the next 10 dosings ($2\frac{1}{2}$ days), the efficiency dropped to about 70% removal. On the 37th dosing, at the end of 9 days, only 20% of the activity was removed. Tests with specific isotopes indicated that the beds would not become saturated so that the efficiency of activity removal would drop below 50%. Over 1000 yr would be required for saturation.

HIGH PRESSURE SYSTEMS 5.09

SURVEYS AND THEORY 5.09.01

17044 CF-58-6-52
Oak Ridge National Lab., Tenn.
STRESS ANALYSIS OF CONICAL SHELLS. F. J. Stanek. Aug. 28, 1958. 142p. Contract W-7405-eng-26. $21.30(ph OTS); $6.90(mf OTS).

The fundamentals for the stress analysis of conical shells by use of the classical small-deflection theory

16327
HIGH-PRESSURE TECHNIQUES. D. M. Warschauer (Massachusetts Inst. of Tech., Lexington) and William Paul (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr. 29, 675-9(1958) Aug.

This paper supplies information on hydrostatic pressure techniques up to 20,000 kg/cm^2 under two headings. Under general pressure techniques, low temperature seals, experience with small diameter tubing, a pressure measuring bridge, and various tubing seals are described. Under optical techniques, optical windows of sapphire, germanium, and silicon, suitable pressure fluids, and a mechanism for moving samples inside a pressure vessel for use to 10,000 kg/cm^2 are discussed. (auth)

HIGH-PRESSURE SYSTEMS 5.09

SURVEYS AND THEORY 5.09.01

13082 ✓ NYO-2322
Southwest Research Inst., San Antonio.
RESEARCH ON PROPERTIES OF MATERIALS EMPLOYED IN PRESSURE EQUIPMENT. Progress Report No. 1 [for] May 1 to July 1, 1958. L. U. Rastrelli and M. M. Lemcoe. July 10, 1958. 18p. Project No. 774-2. Contract AT(30-1)-2146. $3.30(ph OTS); $2.40(mf OTS).

The over-all objective of the program is to investigate pressure vessel design procedures and through a materials literature survey, determine those areas where information is significantly lacking. The resin of cumulative damage resulting from loads under temperature dependent and independent conditions is further subdivided into more specific areas of concern. Miner's Hypothesis for cumulative damage is discussed in some detail. Indications are that it is quite limited in application. On the other hand, there is reason to believe that the hypothesis can be useful within these well-defined limitations. (auth)

12370 ✓ ORNL-2537
Oak Ridge National Lab., Tenn.
AN INVESTIGATION OF THE STRESSES IN A DISCONTINUITY REGION OF A PRESSURE VESSEL (thesis). B. L. Greenstreet. July 21, 1958. 64p. Contract W-7405-eng-26. $2.00(OTS).

Submitted to Univ. of Tennessee.

A thin-walled cylindrical pressure vessel was held at 1500°F in an inert atmosphere until creep-rupture occurred. The vessel was made of Inconel, and it had a flat-plate head at one end. This configuration yielded high discontinuity stresses in the region of the head-to-shell junction. As the vessel deformed duc to creep of the material, its configuration changed. In order to determine the effect of this continual change in configuration upon the stress distribution at the flat-plate head end of the shell, the test was interrupted at various time intervals. The specimen was removed from the furnace, and it was loaded by internal pressure at room temperature. The resulting

12501 ✓
TEKHNIKA FIZIKO-KHIMICHESKIKH ISSLEDOVANII PRI VYSOKIKH DAVLENIYAKH. IZDANIE VTOROE, PERERABOTANNOE I DOPOLNENNOE. (Techniques of Physico-Chemical Investigation at High Pressures. Second Edition, Corrected and Supplemented.) D. S. Tsiklis. Moscow, State Scientific-Technical Publishing House of Chemical Literature, 1958. 304p.

Data on the selection of materials, construction of apparatuses, and experimental procedures are discussed. Methods for obtaining and measuring high and super-high pressures at high temperatures are analyzed, as well as mixing procedures under pressures. The phase equilibrium, gas compression, measurements of surface tension at liquid-gas boundaries, and wetting of solid bodies in compressed gases are described. The book was planned for engineers and personnel interested in physico-chemical investigations at high pressures. (R.V.J.)

9118 ✓
METALLURGICAL ASPECTS OF CALDER HALL. Tom Bishop (John Miles & Partners., London). Metal Progress 71, No. 6, 65-71(1957) June.

Some of the metallurgical problems involved in the construction of the Calder Hall Reactors are discussed. Among these are U fabrication and canning, selection of steels for pressure vessels, and pressure vessel erection and stress relief. (W.L.H.)

A GENERAL DISCUSSION ON THE PHYSICAL CHEMISTRY OF PROCESSES AT HIGH PRESSURES HELD AT UNIVERSITY OF GLASGOW ON 20-21 SEPTEMBER, 1956. Discussions Faraday Soc. No. 22, 1956. 226p. 50s.

The subject matter is divided into sections on: equations of state, physical properties, thermodynamic transformations; chemical reactions and transformations at high pressures; and detonation and other high temperature phenomena at high pressures. Twenty-five papers are presented and discussed. (T.R.H.)

2050 ✓
CHART COMPARES VESSEL DESIGN THEORIES. R. W. Schneider (Travelers Insurance Co., Hartford, Conn.). Chem. Eng. 63, No. 1, 218(1956) Jan.

Graphs of S(stress)/P(pressure) vs. K(ratio of outside to inside diameter) are presented for an intercomparison of

HIGH PRESSURE SYSTEMS 5.09

SURVEYS AND THEORY 5.09.01

the following design theories: maximum shear; maximum distortion energy; St. venant; maximum principal stress (Lamé); ASME code; and membrane. (C.W.H.)

4681

STRESSES IN WELDED PRESSURE VESSELS. W. P. Kerkhof (N. V. de Bataafsche Petroleum Maatschappij, The Hague, Netherlands). Welding J. (N. Y.) 35, 41s-59s(1956) Jan.

The allowable stresses, design stresses, and rupture theory for welded pressure vessels and boilers are discussed. (auth)

4409

HIGH PRESSURE TECHNOLOGY. Edward W. Comings New York, McGraw-Hill Book Co., Inc., 1956. 581p.

The equipment, materials, experimental techniques, and general considerations involved in designing high-pressure chemical processes are outlined. (T.R.H.)

1777

STRESSES FROM RADIAL LOADS AND EXTERNAL MOMENTS IN CYLINDRICAL PRESSURE VESSELS. P. P. Bijlaard (Cornell Univ., Ithaca, N. Y.). Welding J. (N. Y.) 34, 608-s-17-s(1955) Dec.

Design information on the rotations, bending moments and membrane forces caused in cylindrical vessels by circumferential and longitudinal moments transmitted through various attachments are given. Data for finding the reducing influence of internal pressure on the deflections, rotations, bending moments and membrane forces caused by radial loading as well as by circumferential and longitudinal moments are also given. The cylindrical shell is assumed to be held round at the ends. Comparison with the well known tests by Schoessow and Kooistra shows good agreement between computed and experimental values. (auth)

VALUES AND CLOSURES 5.09.02

MECHANICAL CONNECTION FOR GENERALLY CYLINDRICAL VESSEL CLOSURES. (to Atomic Energy of Canada, Ltd.). British Patent 814,423. June 3, 1959.

A means for closing but not sealing the ends of cylindrical or generally cylindrical pressure vessels is described. The closure piece fits inside the end of the vessel, and it has grooves or keyways in its edge which correspond to keyways in the inside of the end of the vessel. Thus, when the closure piece is inserted in the vessel, the keyways form helical slots into which keys of flexible steel are inserted to secure, through friction, the closure to the vessel. Fluid-tight sealing can be effected by conventional means. (T.R.H.)

HIGH PRESSURE CLOSURE. (to Babcock and Wilcox Co.)(U.S.A.). British Patent 794,551. Nuclear Eng. 3, 510(1958) Nov.

The closure of a pressure vessel for high pressure and/or high temperatures has to be removable for repair or maintenance. Often remote operation is necessary so that heavy bolted flanges cannot be used. Vessel and closure are, therefore, made with flanges held together by C-shaped clamps arranged adjacent to each other around the periphery. Each clamp is pressed on to the oppositely inclined faces of the flanges by a clamping ring axially moved by jack screws to exert a wedging action, inclined plane faces engaging corresponding faces on the C-clamps. The jack screws may be driven by gear mechanisms in combination with a rotating gear ring.

10531

REINFORCEMENT OF OPENINGS IN PRESSURE VESSELS. E. O. Waters (Yale Univ., New Haven, Conn.). Welding J. (N. Y.) 37, 277s-88s(1958) June.

A short account of some of the developments in the field, emphasizing those that have occurred since 1930, is given. What has been done is reviewed and the gaps which the Pressure Vessel Research Committee is attempting to fill are pointed out. (A.C.)

HIGH PRESSURE SYSTEMS 5.09

VALUES AND CLOSURES 5.09.02

7168
THE CLOSURE OF HIGH PRESSURE VESSELS: A HYDRAULIC HIGH-TORQUE TORQUE WRENCH. E. Whalley, A. Lavergne, and R. Goton (National Research Council, Ottawa, Can.). J. Sci. Instr. 35, 113-14(1958) Mar.
The design of a hydraulic torque wrench for use on hexagon head nuts capable of a wide range of torques is presented. (J.R.D.)

PRESSURE VESSELS. A. F. G. Austin (to Whessoe, Ltd.). British Patent 777,599. Nuclear Eng. 2, 494(1957) Nov.
The connection of branch pipes to pressure vessels raises special stress problems. The problems of avoiding an abrupt change of contour and of enabling examination of the weld can be solved by the arrangement in the aperture for the branch of a ring of special shape whose outer edge is equal in thickness to that of the wall of the vessel and which is butt welded to the surrounding wall. The thickness of the ring increases smoothly from its outer edge to a value around its inner edge at a calculated ratio (stress concentration through piercing the vessel). The ring provides at or near its inner periphery a flange to be butt welded to the branch pipe. (auth)

8528
IMPROVEMENTS IN OR RELATING TO SEALING DEVICES. James Carrie Guild (United Kingdom Atomic Energy Authority). British Patent 827,321. Feb. 3, 1960.
A liquid-dip sealing device is offered in which the liquid seal is restored after being ejected by a pressure surge. The liquid on one side of the seal is lowered by the excessive pressure until an opening is exposed which allows gas pressure to escape until the pressure loss allows the liquid to rise again. (T.R.H.)

5831 CF-57-4-17
Oak Ridge National Lab., Tenn.
SUGGESTION FOR HIGH PRESSURE LETDOWN DEVICE. R. N. Lyon. Apr. 2, 1957. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
A letdown valve design is described which reduces erosion of the sealing surfaces. It also provides for water flushing of the sealing surfaces before closing. (T.R.H.)

9754 CF-56-7-13
Oak Ridge National Lab., Tenn.
TENTATIVE RECOMMENDATIONS FOR HIGH PRESSURE FLANGE ASSEMBLIES. C. C. Haws, Jr. July 3, 1956. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

13488 WAPD-CTA(EDX)-265
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
RESULTS OF PWR HYDROSTATIC SEAL WELD TEST. E. M. Tatarzycki. May 18, 1956. 12p. Contract [AT-11-1-GEN-14]. $3.30(ph OTS); $2.40(mf OTS).
A hydrostatic pressure test on two PWR seal weld mockups was conducted for the purpose of evaluating the design of the ASME Pressure Vessel Code. Both mockups were tested to destruction; failures were recorded at pressures of 16,000 and 18,000 psi. The failure in each case resulted from a rupture in the motor tube wall immediately above the simulated stator. In addition, strains were measured on one of the mockups at pressures up to 15,000 psi. (W.L.H.)

10953 KAPL-M-EBJ-3
Knolls Atomic Power Lab., Schenectady, N. Y.
REINFORCING RING FOR OPENINGS IN PRESSURE VESSEL. E. B. Johansson. Nov. 16, 1955. 26p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).
The feasibility of reducing the stress concentration factor near pressure vessel openings to allowable values through the addition of material near the opening was considered. The addition of bending stresses by the reinforcement material allows only approximate calculations, however, the method of calculation and graphical results are given. (D.E.B.)

11989 AEC-tr-3657
ULTRA-PRESSURE. III. PRESSURE-PROOF CHARACTER OF OPTICAL WINDOW. IV. PRESSURE-PROOF PACKING. Ryo Kiyama. Translated for Oak Ridge National Lab. from Rev. Phys. Chem. Japan. 19, 17-19; 21-4(1945). 14p. $3.30(ph), $2.40(mf) JCL or LC.
The design of an electrode insulator made of mica and rubber protected with steel having applications up

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to 20,000 kg/cm² is described. In addition, a method of setting pieces of cylindrical glass or quartz for use as high-pressure windows by pressing them without any cementing material is described. Also, large pipe connection packing is considered along with piston packing and that for hole closures, in which sealing is performed by exerting a pressure on the packing which is greater than the internal pressure. (J.R.D.)

8526

IMPROVEMENTS IN OR RELATING TO SHAFT SEALS. Terence Barrett, Douglas English, and Kenneth John Williams (United Kingdom Atomic Energy Authority). British Patent 827,015. Jan. 27, 1960.

A shaft seal of the viscosity-groove type is offered. Grooves are arranged in one of two drive plates so that rotation of one of the plates causes oil in the grooves to be compressed against the gas pressure being sealed. When not rotating, a spring forces the plates together at ungrooved surfaces to provide a seal. (T.R.H.)

VESSELS 5.09.03

5295

NONMAGNETIC HIGH-PRESSURE VESSELS. William Paul and G. B. Benedek (Harvard Univ., Cambridge, Mass. and D. M. Warschauer (Lincoln Lab., Tech. Massachusetts Inst. of Lexington, Mass.). Rev. Sci. Instr. 30, 874-80 (1959) Oct.

The use of beryllium copper and stainless steel in the construction of pressure vessels to contain 20,000 kg/cm² is described. Machine drawings are given for the construction of different types of pressure vessels, different types of seal, and methods of introducing electrical leads into the apparatus. Experience in the use of high-pressure vessels and plugs beyond the elastic limit of the construction material is reviewed. (auth)

PRESSURE VESSEL NOZZLE DESIGN. A NEW APPROACH TO REINFORCEMENT. R. T. Rose. Nuclear Eng. 3, 523-8(1958) Dec.

New methods of approach to the problem of reinforcing branch connections (nozzles) for pressure vessels are reviewed. Discussions are included on: stress testing of unreinforced and reinforced nozzles, pulsating pressure testing of nozzles, and the testing of various pressure vessel materials. (J.H.M.)

17089

PRESSURE VESSELS. LET THE TUBES SUPPORT THE TUBE SHEET. G. D. Galletly and C. R. Garbett (Shell Development Co., Emeryville, Calif.). Ind. Eng. Chem. 50, 1227-30(1958) Sept.

Substantial monetary and material economics in tube sheet thickness may be effected by taking advantage of the support offered by the tube bundle. In exploration of this design method, values for the ligament and deflection efficiencies must be determined. In addition the effects of tube bowing, in-place forces, and transient thermal effects must be investigated. (J.R.D.)

NYO-2323

Southwest Research Inst., San Antonio.
RESEARCH ON PROPERTIES OF MATERIALS EMPLOYED IN PRESSURE EQUIPMENT. Progress Report No. 2.
L.U. Rastrelli and M.M. Lemcoe. Aug. 8, 1958. 52p.

A literature review concerning pressure vessels and a list of recommended pressure vessel materials research programs providing information in those areas where material data are lacking are presented. In addition, an over-all literature survey emphasizing cumulative damage theories and the phenomenological behavior of pressure vessel materials under dynamic load, elevated temperatures, and environments other than air is given. 80 references. (J.R.D.)

17090

AN APPARATUS FOR HEATING SMALL SAMPLES TO ELEVATED TEMPERATURES AT HIGH PRESSURES. J. Fennell, N. H. Hancock, and R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Metal Treatment and Drop Forging 25, 332-4(1958) Aug.

An apparatus incorporating a pressure-vessel capable of withstanding an internal gas pressure of 6,000 lb/sq in. at a temperature of 950°C is described. Gas from cylinders is compressed by a pump to the pressure required, and the high temperature is obtained by lowering a furnace over the end of the pressure vessel which contains the sample. (auth)

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VESSELS 5.09.03

15242 TID-7569(p.85-91)
Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

LESSONS LEARNED FROM PRESSURE-VESSEL ACCIDENT INVESTIGATIONS. B. F. Langer. p.85-91 [of] PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, HELD AT ATOMIC ENERGY COMMISSION HEADQUARTERS BUILDING, GERMANTOWN, MARYLAND, JUNE 24-25, 1958. 7p.

An accident involving the failure of an autoclave is discussed. The autoclave was 12¾ in. in inside diameter and about 6 ft long. The head came off the vessel at a threaded connection. The separation occurred in the threads between the flange nut and the autoclave vessel wall. The flange nut, bolting ring, and head all stayed together and were found about ¼ mile away. It was found that there was remarkably little tearing of metal. The flange nut had yielded outward so that it assumed an hourglass shape. (W.L.H.)

11396

THE SCOPE OF PRESSURE VESSEL CODES AND ACTIVITIES TOWARD IMPROVED CONTENT. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 78, Session 3. W. E. Cooper (General Electric Co., Schenectady, N. Y.). New York, American Institute of Chemical Engineers, 1958. 23p.

A summary of the scopes of codes currently available for pressure vessel design and certain activities directed toward the improved technical content and coverage of such codes, particularly for application to nuclear reactor components are discussed. (auth)

THERMAL DESIGN OF LARGE STORAGE VESSELS FOR LIQUID HYDROGEN AND HELIUM. Russell B. Scott. J. Research Natl. Bur. Standards 58, 317-25(1957) June.

Principles of insulating vessels for the storage and transportation of liquefied gases are discussed. The use of shields cooled by the vapor leaving the liquid being stored is analyzed, and formulas, graphs, and tables are presented for the convenience of the designer of large vessels for storing and transporting liquid hydrogen and liquid helium. An analysis is given of the use of escaping vapor to intercept heat entering by conduction through solid supporting members. The evidence presented indicates that substantial improvements are possible in the design of such vessels. (auth)

7979

VESSELS FOR THE STORAGE AND TRANSPORT OF LIQUID HYDROGEN. B. W. Birmingham, E. H. Brown, C. R. Class, and A. F. Schmidt. J. Research Natl. Bur. Standards 58, 243-53(1957) May.

The design and construction of a large-scale hydrogen liquefier by the National Bureau of Standards required a concurrent development of large, transportable liquid-hydrogen containers. These containers, known as Dewar vessels after the inventor, James Dewar, had to be capable of road and air transport, which implied ruggedness and light weight. This article reports on large-scale liquid-hydrogen Dewar development conducted by the NBS Cryogenic Engineering Laboratory. A 440-liter and an 840-liter Dewar are discussed. Every effort has been made to design Dewars with very low hydrogen-loss rates within the limitations of the transport requirement. (auth)

METAL SYSTEM FOR CHEMICAL REACTIONS AND FOR STUDYING PROPERTIES OF GASES AND LIQUIDS. H. V. Neher (California Inst. of Tech., Pasadena) and Satya Prakash (Physical Research Lab., Ahmedabad, India). Rev. Sci. Instr. 28, 267-70(1957) Apr.

An all-metal system, made of copper, is herein described It is suitable for working with those chemicals which do not attack copper. In particular it has been found very useful in the purification of BF_3 and $B(CH_3)_3$. Some important features of such a system are (1) a complete absence of contaminants; (2) reactions may be carried out up to 500°C; (3) pressures up to several hundred pounds per square inch may be used; (4) flow of gases from very low to very high pressures may be easily controlled; (5) the system is very rugged. This latter point is particularly desirable where noxious or inflammable gases (such as $B(CH_3)_3$) are used. A method is also described whereby gases from sealed-off containers under either high or low pressures may be easily retrieved without introducing impurities. Other important advantages of such a system are mentioned in the text. (auth)

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PRECIOUS-METAL-COATED BOMBS FOR HIGH-TEMPERATURE STUDIES. R. M. Bidwell, W. R. Wykoff, B. J. Thamer, and C. D. Ross (Los Alamos Scientific Lab., N. Mex.). Nucleonics 14, No. 10, 71-7(1956) Oct.

Designs of several different types of high-temperature and pressure bombs are presented. Ways are presented for coating the inside of these bombs with precious metals. (W.L.H.)

4267 WAPD-A1W(PCh)-170
[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
PURIFICATION OF WATER IN A HIGH TEMPERATURE, HIGH PRESSURE CARBON STEEL SYSTEM. C. F. Paulson. [Sept. 1956]. 78p. A1W Project. Contract NObs-67500.

Results of water purification in a high-temperature high-pressure carbon steel pump test loop are presented. The test covered cold and hot filtration by axial flow magnetite filters, and operation of ion exchangers in the H-OH and Li-OH forms. These tests demonstrated that filters and ion exchangers would operate successfully in a carbon steel system. (W.L.H.)

INVESTIGATION OF STATIC AND FATIGUE RESISTANCE OF MODEL PRESSURE VESSELS. Julien Dubuc and Georges Welter (Ecole Polytechnique, Montreal, Canada). Welding J. (N. Y.) 35, 329s-37s(1956) July.

Results of an investigation sponsored by the Pressure Vessel Research Committee indicate remarkable per formance for vessels subjected to extreme static and cyclic loading. These tests point out the need for careful design details in order to minimize stress concentration effects which produce fatigue failures. (F.S.)

5584 NP-6000
Utah. Univ., Salt Lake City. Coll. of Engineering.
THE DESIGN OF PRESSURE VESSELS FOR EXTREME PRESSURE. Technical Report No. LI. Wayne S. Brown and S. S. Kistler. June 1, 1956. 55p. Project No. NR-052-357. Contract Nonr-1288 (02).

Elastic theory was found to be useful in gaining insight in stresses in vessels designed for extreme pressure. High pressures must be retained by tensile members, the design of which can be accomplished through elastic theory. Weak materials are useful in high pressure design since there is no indication that they distribute stresses h 'ro-statically even when fragmented. Powders are found to support loads in a columnar fashion. (F.S.)

17086 AEC-tr-3300
REGULATION OF A SULZER SINGLE-TUBE STEAM GENERATOR (Regelung des Sulzer-Einrohr-Dampferzeugers). P. Profes. Translated for Oak Ridge National Lab. from Mitt. Ver. Grosskesselbesitzer No. 43, 258(1956). 36p.

The operating principle and control of the Sulzer single-tube steam generator are described and depicted. (T.R.H.)

6273 BNL-2811
Brookhaven National Lab., Upton, N. Y.
INEXPENSIVE EQUIPMENT FOR STUDYING THE IRRADIATION OF ORGANIC MATERIALS IN A PILE UNDER STATIC CONDITIONS. Alfred P. Wolf and A. Oltmann. [1956]. 9p. $1.80(ph OTS); $1.80(mf OTS).

A convenient and inexpensive device for irradiating materials under pressure or irradiating materials which evolve gas upon irradiation is described. It consists of an Al alloy container and an arrangement which permits opening the vessel in a closed system. (T.R.H.)

HIGH TEMPERATURE SYSTEMS 5.10

FURNACES 5.10.01

13531 NAA-SR-2972
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE VACUUM CASTING FURNACE FOR THE PROCESSING REFABRICATION EXPERIMENT. G. L. Schmidt. May 1, 1959. 68p. Contract AT-11-1-GEN-8. $2.00(OTS).

A full-scale prototype vacuum casting furnace was operated successfully in the Processing Refabrication Experiment (PRE) mockup with the aid of in-cell handling and viewing equipment. The operation included the removal and replacement of components of the furnace that would be affected by the high temperature processing of the irradiated metallic uranium fuel. The

HIGH TEMPERATURE SYSTEMS 5.10

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information and experience gained from the mockup operations have been translated into the conceptual design of an in-cell furnace for use in future hot cell facilities. (auth)

12738
IMPROVEMENTS IN OR RELATING TO CRUCIBLES FOR MELTING METALS. Robert James Garmy (to Republic Steel Corp.). British Patent 811,918. Apr. 15, 1959.

A crucible for an electric arc furnace which produces large ingots of Ti or Zr is described. The crucible is cylindrical, mounted on jacks for raising and lowering, and mounted on wheels for moving under an electrode arrangement. It is surrounded by an induction coil which, with the arc current in the melt, causes a stirring motion which leads to a fine-grained homogeneous melt. The magnetic field of this coil also stabilizes the arcs from the electrodes. A water jacket for cooling is also provided. (T.R.H.)

5153
HIGH-TEMPERATURE PRESSURE-VACUUM FURNACE. William Lodding and Laurence Hammell (Rutgers Univ., New Brunswick, N. J.). Rev. Sci. Instr. 30, 885-6(1959) Oct.

A simple high-temperature pressure-vacuum furnace using a recrystallized alumina tube as the vessel with external resistance windings is described. Temperatures to 1900°C can be used in both strongly reducing and oxidizing atmospheres. Pressures to 28 atmos at 1200°C were obtained and no water cooling was required. Differential thermal analysis with continuous gas analysis of reaction products is made possible. (auth)

IMPROVEMENTS IN OR RELATING TO APPARATUS FOR ARC MELTING UNDER REDUCED PRESSURE. (to W. C. Heraeus G.m.b.H. Co.) British Patent 809,561. Feb. 25, 1959.

A laboratory-scale arc melting furnace is described which is safe and easy to operate. It is made of three pieces. The top or head may be fitted with either a consumable or nonconsumable electrode. Handles on the head are equipped with controls for electrode and current; the current is supplied through the cooling water system attached to the handles. The central cylinder is fitted with a vacuum pump and hand-operated sample feeder. The bottom is adapted for attaching a water-cooled crucible. (T.R.H.)

10648
THE COMBUSTION OF ZIRCONIUM IN OXYGEN. W. L. Doyle, J. B. Conway, and A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. & Nuclear Chem. 6, 138-44(1958) Apr.

The combustion of zirconium in oxygen leads to one of the highest temperatures obtainable by the combustion of metals. This temperature has been estimated from available thermodynamic data to be 4930°K at 1.0 atm pressure. A technique has been developed which enables a powdered zirconium–oxygen flame to be operated, thus producing the highest metal flame temperature reported to date. (auth)

7167
A GRAPHITE RESISTANCE FURNACE FOR PHYSICO-CHEMICAL STUDIES UP TO 2200°C. J. D. Mackenzie and J. O'M. Bockris (Imperial Coll., London). J. Sci. Instr. 35, 109-10(1958) Mar.

The design of a graphite resistance furnace with a controllable hot zone capable of reaching 2200°C and withstanding rapid temperature changes is presented. (J.R.D.)

16436
ELECTRICAL RESISTANCE HEATING. S. Nordin. ASEA Journal 31, 47-53(1958).

Electrical resistance heating is arranged by passing a current directly through the work-piece. The current is selected according to the resistance so that the desired degree of heating is obtained at the appropriate time. The theory of electrical resistance heating is discussed and an account of several normal types of machine is given. The advantages and disadvantages of the method are set out. (auth)

INDUCTION FURNACES FOR MELTING METALS AND ALLOYS. Samuil Aronovich Farbman and Ivan Filippovich Kolobnev. Moscow, Metallurgizdat, 1958. 704p.

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This book, intended as a textbook for students of electrometallurgy and as a practical handbook for production engineers and designers, is concerned with the practical application of the theory of induction heating in melting metals and alloys. All types of induction furnaces and individual aspects of furnace operation are described in detail. Ingot molds and their coatings are also discussed. The melting of metals in vacuum and protective atmospheres and the equipment used for this purpose are described. In the present edition, the 4th, an attempt was made to reflect the progress which has been made in the field of induction furnaces during the last 5 to 6 years, both in the USSR and the rest of the world (J.S.R.)

13440 AECU-4131
Los Alamos Scientific Lab., N. Mex.
HIGH TEMPERATURE RESISTANCE FURNACE FOR OPERATIONS AT 3000°C. James M. Dickinson. [1958]. 17p. Contract [W-7405-eng-36]. $3.30(ph), $2.40(mf) OTS.

The design of a furnace for use at 2500 to 3000°C is described. The furnace was used for melting point determinations, sintering, and metal heat treatment. The use of tantalum parts restricts the furnace to use in vacuum or inert gases; however, with modifications the furnace may be used in hydrogen atmospheres. (J.R.D.)

7501
CONVENIENT LABORATORY FURNACE FOR TEMPERATURES UP TO 1700°C IN AIR. John R. Soulen and John L. Margrave (Univ. of Wisconsin, Madison). Rev. Sci. Instr. 31, 68-9(1960) Jan.

Procedures are presented for the construction of a convenient laboratory furnace for temperatures up to 1700°C in air. A hollow tube of silicon carbide insulated with fire brick was used in the construction. After a year of use (and abuse by overheating) there was a 3-in. section in the center over which the temperature was constant to ±3°C at 1480°C. Specifications state that the maximum temperature for the Globar is 1550°C, but it is capable of producing temperatures of up to 1700°C. (B.O.G.)

8597
IMPROVEMENTS IN OR RELATING TO INDUCTION FURNACES. Herbert Noel Jones (to United Kingdom Atomic Energy Authority). British Patent 827,770. Feb. 10, 1960.

An induction furnace for melting and casting refractory metals is described which avoids glow-discharge difficulties. The melting zone is located above the casting zone. In operation, the crucible is raised to the head-box and loaded, then lowered to the melting zone. After evacuation and melting, the crucible is lowered to the casting zone and tilted to pour the charge into the mold. (T.R.H.)

5901 AERE-C/R-2148
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
DEVELOPMENT OF A REMOTELY OPERATED VACUUM INDUCTION FURNACE. G. M. Gillies and B. A. J. Lister. July 1957. 21p.

This report describes the development of a vacuum induction furnace for the melting and bottom-pour casting of uranium by remote operation on a scale up to 5 kg. (auth)

10016
TWO RESISTANCE-TYPE HOT-PRESSING FURNACES FOR LABORATORY USE. R. F. Walker and S. G. Bauer (National Bureau of Standards, Washington). Rev. Sci. Instr. 28, 563-8(1957) July.

11102 AECU-3530
Sandia Corp., Albuquerque, N. Mex.
A HIGH TEMPERATURE ELECTRIC OVEN. L. E. Heames. June 6, 1957. 9p. Contract [AT(29-1)-789]. (TM-165-57-51). $1.80(ph OTS); $1.80(mf OTS).

The construction and operating characteristics of an electric heating chamber capable of rising from ambient temperature to 600°C in approximately twenty-five minutes is presented in detail. The oven is relatively simple to construct, small in over-all size and operates from a standard 115 volt variac. (auth)

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FURNACES 5.10.01

11470 ✓
VACUUM OVEN FOR METALLURGICAL STUDIES.
M. T. Destribats (Centre d'Etudes Nucléaires, Saclay, France). Le Vide No. 68, 184-7(1957) Mar.-Apr. (In French)

The conversion of a laboratory oven with standard commercial elements to vacuum operation is described. (T.R.H.)

10665 ✓
LABORATORY VACUUM FURNACE FOR TEMPERATURES OF 2000–2500°. A. G. Tyutyunik. Zavodskaya Lab. 23, 1126-7(1957). (In Russian)

A vacuum furnace with a tungsten heater is described. The essential advantages offered by this furnace are the lack of ceramics in the high temperature zone, and an efficacious screening system which makes it possible to attain high temperatures in a large volume with a relatively low power consumption. The furnace was tested for a year in the laboratory and is recommended for investigations carried out at high temperatures. A detailed description of the furnace is given. The furnace may be used in any chamber in which the vacuum is not less than 1×10^{-4} mm torr. Basic investigations of metal were carried out in a vacuum of the order of 10^{-5} to 10^{-7} mm torr. The vacuum system consists of a vacuum pump, a diffusion oil pump with 1000 l/sec, and a vacuum metal chamber with 200 l contents and water cooling. (TCO)

EFFECTIVE USE OF RADIATION AND THERMAL SHIELDS IN A VACUUM FURNACE. Yoshikazu Ishikawa and Shozo Sawada (Univ. of Tokyo). J. Phys. Soc. Japan 11, 1184-90 (1956) Nov.

A method for calculating the efficiency of several sheets of thick radiation shields with finite thermal conductivity is presented. It is shown that in case of shields having infinite conductivity, the efficiency and temperatures of the shields are expressed by simple formulas. It is shown by several examples of this method of calculations that the most important factors for the efficiency are found to be emissivity, thermal conductivity of the innermost shield, and its position. Effectiveness of a shield with small conductivity, which we call "thermal shield" in this paper, especially at high temperature is emphasized. Several experimental results are shown; they agree satisfactorily with the calculations. (auth)

A HIGH TEMPERATURE PROPANE–OXYGEN FURNACE. Richard C. Phoenix, Donald R. Robinson, and Edwin Ruh (Rutgers Univ., New Brunswick, N. J.). Am. Ceram. Soc. Bull. 35, 303-4(1956) Aug.

A high temperature furnace has been designed and constructed to fire refractory oxide samples to temperatures above 3500°F. The kiln is fired with propane and oxygen, using water-cooled burners. Stabilized zirconia refractories were used in the construction of the firing chamber. Pictures and specifications are presented. (auth)

3826 ✓ ISC-716
Ames Lab., Ames, Iowa.
INDUCTANCES OF SINGLE LAYER CYLINDRICAL COILS FOR INDUCTION HEATING APPLICATIONS. Charles R. Whitsett. Mar. 2, 1956. 49p. Contract W-7405-eng-82. $0.35(OTS).

5339 ✓ NMI-1142
Nuclear Metals, Inc., Cambridge, Mass.
CONSTRUCTION AND OPERATION OF A LABORATORY SCALE ARC MELTING UNIT. J. F. Kuchta and S. Isserow. Feb. 13, 1956. 19p. Contract AT(30-1)-1565. $0.20(OTS).

An arc melting unit was designed for laboratory use for rapid melting of pure metals or experimental alloys requiring higher temperatures than those readily obtainable in resistance-type furnaces. (J.E.D.)

118 ✓ CCC-1024-TR-142
Wisconsin. Univ., Madison.
A SMALL GRAPHITE FURNACE FOR TEMPERATURES UP TO 3000°K. J. L. Margrave, R. C. Emmons, J. R. Soulen. Oct. 12, 1955. 14p.

A resistance-heated graphite furnace useful to 3000°K was constructed for use in the study of systems containing boron oxides. The heating element consists of a $1\frac{3}{16}$ in. I. D. graphite helix with a $\frac{1}{8}$ in. wall which provides a hot zone 3 in. in length. By using refractory oxide reaction tubes mounted concentrically inside the heating element an oxidizing atmosphere can be maintained at temperatures above 2000°C. The maximum temperature of the furnace can be obtained using graphite reaction tubes and a neutral or reducing atmosphere. (auth)

HIGH TEMPERATURE SYSTEMS 5.10

FURNACES 5.10.01

408 ✓
Ames Lab., Ames, Iowa.
HIGH TEMPERATURE LABORATORY FURNACES. D. R. Wilder. Dec. 1, 1954. 23p. Contract W-7405-Eng-82. (ISC-551).

The bibliography was prepared as a guide and introduction to the literature describing high temperature laboratory furnaces. Each general type of construction is briefly analyzed and design data given for some of the material commonly employed. A total of 129 references to published literature and government reports is included.

9712 ✓ FMPC-296
National Lead Co. of Ohio, Cincinnati.
A FURNACE BUILT TO CONVERT URANIUM METAL TURNINGS TO U_3O_8. A. E. Guay and H. M. Eikenberry. July 15, 1953. Decl. Feb. 20, 1957. 20p. Contract AT(30-1)-1156. $0.25(OTS).

The design, construction, and initial operating period of a furnace built to convert U turnings to U_3O_8 are described. The furnace has a design capacity of 300 lbs of U turnings per hr. (D.E.B.)

1362 NAA-SR-2852
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE OXIDE-DROSSING FURNACE FOR THE PROCESSING REFABRICATION EXPERIMENT. J. L. Ballif. Sept. 1, 1958. 56p. Contract AT-11-1-GEN-8. $1.50 (OTS).

An engineering mock-up was carried out to demonstrate the remote operation and maintainability of the oxide-drossing phase of the PRE process. This effort included installation and full-scale operation of a high-frequency air melting induction furnace; and the design, fabrication, and modification of remotely operated supporting devices such as molds, metal chargers, ventilation hoods, and transfer equipment. It was demonstrated repeatedly that remote operation of this equipment can be carried on in a cell with only a crane for service. The time required for a cycle was 2½ hours. The results of this experience were translated into drawings and specifications for equipment to be utilized in future "hot" facility work. (auth)

3594
AN ELECTRON BOMBARDMENT FURNACE FOR THE PRODUCTION OF VACUUM-MELTED METALS. E. S. Candidus and J. C. Simons, Jr. (National Research Corp., Cambridge, Mass.). p.86-8 of "1958 Fifth National Symposium on Vacuum Technology Transactions."

A furnace for the production of electron bombardment melted metals is described. Incorporated in the furnace design are several features that eliminate arcs and glow discharges which might hamper the melting operation or damage the electron source. The furnace design also permits the use of a relatively inexpensive pumping system. (auth)

MATERIALS 5.10.02

See also, this section,

HIGH TEMPERATURE (AQUEOUS) (5.05.05).

CERAMICS AND CERMETS 5.10.02.01

7684 ARF-2175-3
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
AN INVESTIGATION OF METAL–CERAMIC COMPOSITES FOR HIGH-TEMPERATURE APPLICATIONS. [Progress Report for] June 1, 1959 to June 30, 1959. Sherwood W. McGee. July 13, 1959. 15p. Contract DA-11-022-505-ORD-3038. (AD-219531).

An experimental program is described in which metal–ceramic bond strength developed during hot pressing at temperatures which produce plasticity in both materials is being studied. Induced internal stress is also being studied in these materials, and preparation of specimens for preliminary measurements of transverse rupture strength are being prepared. The metal–ceramic couples which were selected for study include Ta–SiC, W–SiC, and W–Al_2O_3. Apparatus and procedures for the tests are included along with data on hot pressing and thermal expansion. (J.R.D.)

542 ✓ CTR-373
Office of Technical Services, Washington, D. C.
CERAMICS AND REFRACTORIES (INCLUDES COATINGS: CERAMIC, ENAMEL AND REFRACTORY; HIGH TEMPERATURE AND ELECTRICAL PROPERTIES OF

HIGH TEMPERATURE SYSTEMS 5.10

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CERAMICS AND CERMETS 5.10.02.01

CERAMICS; CERAMICS AND REFRACTORIES, GENERAL, 1930–59). Catalog of Technical Reports. 22p. OTS.

A bibliography is presented on ceramic and refractory materials that includes coatings: ceramic, enamel, and refractory, and high temperature and electrical properties of ceramics. (W.L.H.)

20171 NP-7842

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 15 [for] May 1, 1959 to July 31, 1959. C. R. Mason, J. D. Walton, M. D. Bowen, and W. T. Teague. 36p. Project No. A-212. Contract NOrd-15701.

Thermal Protection Systems. Thermal conductivity measurements were made on two sets of unfired, slip-cast, fused silica plates. Four sets of fused silica plates were subjected to various firing temperatures, and thermal conductivity measurements were made up to ~1000°F. Four lots of ¾-in.-diam. slip-cast fused silica test bars were fired for 17 hours each at 1700, 1800, 1900, and 2000°F. Fused silica tubes coated with ZrO_2, Al_2O_3, and Invar were tested in the exhaust of the oxyhydrogen rocket motor with cooling water passing through the tubes. Coatings. Using present arc-spraying techniques, ZrO_2 shapes were obtained having 80 to 90% theoretical density, and Al_2O_3 shapes were obtained having 70 to 80% theoretical density. Preliminary values for tensile strength were obtained on HfO_2, ZrO_2, and Al_2O_3 shapes. Thermets. The physical properties of beryllium–chromic oxide thermets fired dual shrouded in graphite and kaolin wool were determined. (For preceding period see NP-7600.) (W.L.H.)

HIGH-TEMPERATURE-RESISTANT CERAMIC ADHESIVES. Henry G. Lefort and Dwight G. Bennett (Univ. of Illinois, Urbana). J. Am. Ceram. Soc. 41, 476-82 (1958) Nov.

Ceramic adhesives were developed for bonding metal in the operational range 500 to 1000°F. When glassy-bond adhesives were suitably prepared and properly applied to types 302 and 17-7 PH stainless-steel specimens, shear strengths of the order of 2000 psi were obtained at a test temperature of 800°F, and shear strengths of more than 800 psi were obtained at 1000°F. Factors affecting adhesive strength included thermal-expansion fit between ceramic adhesive and metal, metal or metallic oxide additions to the adhesive glass, and the use of metal screens of selected wire and mesh dimensions as carriers in the adhesive joint. The ceramic adhesive could be applied to a precipitation hardenable type of stainless steel during part of the precipitation hardening treatment, which included heating the metal for various times at temperatures up to 1750°F. (auth)

9805 NP-6718

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 11 [for] February 1, 1958 to April 30, 1958. J. D. Walton and C. R. Mason. 35p. Project No. A-212. Contract NOrd-15701.

Thermitic Cermets. Zirconium-carbide- and titanium-carbide-forming thermite reactions were studied with regard to throttling materials (alumina and kaolin), binders (core oil, $Al(OH)_3$ saturated solution), carbon source (graphite, lampblack), and shrouding techniques. Kaolin was superior to alumina. Core oil proved unsatisfactory due to its volatility after drying. Graphite produced harder bodies than lampblack. The best shrouding technique was to shroud in lampblack and an outer wrap of kaolin wool. Rocket Nozzle Mate-

8418 WADC-TR-57-577(Pt. I)

Marquardt Aircraft Co., Van Nuys, Calif.

DEVELOPMENT AND EVALUATION OF INSULATING TYPE CERAMIC COATINGS. PART I. DEVELOPMENT AND SMALL SCALE TESTING. Period covered: May 15, 1956 to June 15, 1957. S. Sklarew, C. A. Hauck, and A. V. Levy. Aug. 15, 1957. 98p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-2957. (AD-150957).

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CERAMICS AND CERMETS 5.10.02.01

Eight systems of metal reinforced refractory coatings were investigated. These systems were based on sodium silicate, frit, aluminum phosphate, and borosilicate glass binders with refractory grain fillers, designed to insulate aircraft structural members operating in the thermal range of 2000 to 3000°F. Thermal drops of as high as 10°F per thousandth in. of coating thickness at equilibrium were observed with lag times up to 60 sec to attain equilibrium under laboratory test conditions. (auth)

8417 WADC-TR-57-535
Mallory (P. R.) and Co., Inc. Metallurgical Research Lab., Indianapolis.
A STUDY OF THE POSSIBILITY OF REINFORCING HIGH-TEMPERATURE ALLOYS BY ADDITION OF REFRACTORY POWDERS. Period covered: April 1956 to July 1957. John D. Burney. Aug. 30, 1957. 48p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-2959. (AD-150971).

The reinforcement of 80 Ni-20 Cr alloy by the addition of such refractory oxides as TiO_2 and Al_2O_3 was attempted. Several powder metallurgical fabrication techniques were investigated such as (1) pressing and sintering, (2) pressing and sintering followed by various working procedures, (3) internal oxidation and (4) liquid phase sintering. In the press-sinter method of fabrication, the best stress-rupture characteristics of 1600°F were obtained with additions of 3.0 to 4.5% TiO_2. An addition of 4.5% TiO_2 resulted

7182
CHEMISTRY AND TECHNOLOGY OF SILICATES IN CHINA. P. P. Budnikov, and V. P. Barzakovskiĭ. Vestnik Akad. Nauk S.S.S.R. 27, 74-9(1957) Feb. (In Russian)

A review is given of the ceramic research and industrial development in China. (R.V.J.)

13171
METAL IMPREGNATION OF PRODUCTS MADE FROM SILICON CARBIDE. A. N. Novikov. Ogneupory No. 12, 557-62(1957). (In Russian)

The impregnation of silicon carbide with metals and their oxides in the gaseous state was investigated. The furnace used for this operation is described in detail. It was found that the impregnation requires no previous annealing. A tabulation of the properties of the impregnated silicon carbides is given. (J.S.R.)

12989
OBTAINING AND INVESTIGATING CERTAIN PROPERTIES OF CERAMICS FROM SILICON NITRIDE. I. S. Brokhin and V. F. Funke. Ogneupory No. 12, 562-6 (1957). (In Russian)

The silicon—nitrogen system has three phases: Si_3N_4, Si_2N_3, and SiN. The Si_3N_4 phase with 39.5% nitrogen is chemically the most stable. The properties and method of preparation of SiN are described in detail. The saturation curve of nitrogen in silicon was obtained for various temperatures. The nitrogen content of silicon was determined as a function of the nitration time at 1600°. The effect of the addition of silicon on the sintering of the nitride was investigated. Bending strength and oxidation resistance were tested as a function of temperature. (J.S.R.)

11425
ELABORATION OF SEVERAL REFRACTORY PIECES USED IN METALLURGICAL LABORATORIES.
R. Pointud and J. Roger (Centre d'Etudes nucleaires, Saclay, France). Rev. mét. 54, No. 4, 283-7(1957). (In French)

The techniques are described by which one is able to obtain alumina, magnesia, lime, thoria, uranium dioxide and calcium fluoride crucibles and boats of large size. Special attention has been given to the purity of the products. (auth-tr)

1346
NEW USES FOR SUPERREFRACTORIES IN THE CHEMICAL INDUSTRY. H. L. Read, F. C. Roe, H. S. Schroeder, and W. L. Wroten (The Carborundum Co., Perth Amboy, N. J.). Ind. Eng. Chem. 47, 2513-16(1955) Dec.

Industrial applications of the superrefractories, silicon carbide, alumina, and mullite, are reported. These materials exhibit resistance to thermal shock and spalling, high resistance to abrasion, and good resistance to acid corrosion. (C.W.H.)

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3589 AECD-3847
California Research and Development Co., Livermore, Calif.
CERAMIC-BASED MATERIALS FOR HIGH TEMPERATURE SERVICE. W. A. Bates. June 11, 1951. Decl. Dec. 3, 1955. 12p. (CRD-T2B-20). $3.30(ph OTS); $2.40(mf OTS).
The properties and fabrication of high-temperature refractory ceramics are discussed. Physical, chemical, and tensile properties of several ceramic materials are tabulated. (auth)

GRAPHITE 5.10.02.02

8334 WADC-TR-57-602
National Carbon Co. Research Labs., Cleveland.
GRAPHITE-BASED MATERIALS FOR HIGH TEMPERATURE APPLICATIONS. Period covered: 12 month period through July 31, 1957. M. Janes. Dec. 2, 1957. 65p. Project No. 2998. Contract AF33(616)-3537. (AD-150962).
Recent aerodynamic developments require a material which will endure under conditions of high heat flux with consequent high surface temperatures and high flow of an oxidizing gas relative to a body of the material. Surface temperature rise may be quite rapid, so that the material must possess resistance to thermal shock. Graphite has outstanding high temperature strength, a high sublimation temperature, and excellent thermal shock resistance in comparison to other agglomerate bodies. However, it is quite reactive with oxygen or other oxidizing gas at high temperatures and high relative gas flow rates. The results of a first year of a program to compare the oxidation, with accompanying erosion, of graphite prepared with variation in raw materials or processing, and of

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533 AD-216830
Carborundum Co. Research and Development Div., Niagara Falls, N. Y.
DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Progress Report No. 17 [for] February 1 through April 30, 1959. Peter T. B. Shaffer. May 15, 1959. 19p. Contract NOrd-17175.
The principal objective of this work is to secure basic information on refractory systems from which may be developed materials suitable for use in air at temperatures in excess of 1930°C for periods up to one hour. Development of equipment including a furnace in which moduli of rupture can be measured, inert atmosphere dilatometer, pressurized furnace, and oxidation furnace is described. Preparation, oxidation testing, and thermal shock testing of specimens are discussed. Materials investigated include $ZrB_2 - Zr_5Si_3$, $ZrSiO_4 - ZrB_2$, $ZrB_2 - MoSi_2$, and $ZrB_2 - WSi_2$. (See also AD-200603.) (W.D.M.)

5578 TID-3524
Technical Information Service Extension, AEC.
REFRACTORY METALS AND THEIR ALLOYS. A Literature Search. Theodore F. Davis, comp. Jan. 1959. 12p. $0.50(OTS).
This literature search includes 93 references to unclassified AEC and non-AEC reports on refractory metals and their alloys. The materials covered include those with reasonably high melting points. (auth)

20277
PLAVLENYYE LITYYE OGNEUPORY. (Cast Fused Refractories.) Adol'f Abramovich Litvakovskii. Moscow, Gosstroyizdat, 1959. 308p.
A historical review of the development of aluminum–silicon refractory production is presented. High melting metal oxides in the $Al_2O_3-SiO_2-ZrO_2$ system and the effects of corrosion on refractory materials are discussed. Methods of controlling the size of refractory crystals, an investigation to establish the optimum composition ratio for the $Al_2O_3-SiO_2-ZrO_2$ system, and the basic method of producing cast fused refractories are also discussed. (TCO)

HEAT RESISTANCE OF COMPLEX ALLOYED FERRITE. A. M. Borzdyka and A. V. Merlina (Central Research Inst. of Ferrous Metallurgy). Metalloved. i Obrabotka Metal. No. 12, 10-16(1958) Dec. (In Russian)

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METALS 5.10.02.03

The microstructure and phase constitution of ferritic steels containing Cr, Si, Mn, Co, W, Mo, and Nb were studied between 750 and 1200°C. Room-temperature mechanical properties were also obtained. The complex alloyed ferritic steels have good mechanical properties at all investigated temperatures. At 500° the heat resistance is as high as that of some perlite-type steels. Additions of Nb (0.4%) to chromium-tungsten steel further improve the oreep resistance and strength of the steel. However, the presence of Nb reduces toughness at standard temperature and the tensile strength at elevated temperatures. (R.V.J.)

1783 JPRS-TR-L-575-N
PROTECTIVE COATINGS OF HEAT RESISTANT ALLOYS. V. A. Parfenov. Translated from Metalloved. i Obrabotka Metal., No. 6, 33-7(1958). 7p. OTS.

The effects of chrome electroplating and enameling on heat resistant alloys at 750 to 800°C were investigated. It was found that deposition of a 0.1 to 0.2 mm thick layer of chrome on the tested heat resistant alloys increases their endurance limit at 750 to 800°C by 14 to 16%. The electroplated layer recrystallizes at 800°C, therefore, the use of Cr as a protective coating is not recommended for units designed to operate at 800°C or above. Enameling also increases the endurance of heat resisting alloys by about 15%. Roasting temperature of enameled units should be decreased to increase the efficiency of enameling. (J.R.D.)

HIGH-ALLOY CASTINGS, SPECIFICATIONS AND PROPERTIES. Ernest A. Schoefer (Alloy Casting Inst., Mineola, N. Y.). Metal Progr. 74, No. 6, 95-7(1958) Dec.

Information is presented on composition ranges, mechanical properties, corrosion resistance, and typical uses of corrosion and heat-resistant high-alloy castings. (J.H.M.)

3832 ORNL-2402
Oak Ridge National Lab., Tenn.
HIGH-TEMPERATURE MECHANICAL PROPERTIES OF HASTELLOY B AND HASTELLOY W. C. R. Kennedy and D. A. Douglas. Nov. 28, 1958. 81p. Contract W-7405-eng-26. $2.25(OTS).

The high-temperature properties of Hastelloys B and W were investigated. The results are discussed in terms of creep, microstructures, effects of aging, and effects of environment. The alloys were found to have good high-temperature strength and resistance to fused-salt corrosion; however, a severe loss of ductility at high temperature restricts their use. Graphs, photomicrographs, and phase diagrams are included. (J.R.D.)

HIGH TEMPERATURE METALLURGY TODAY. L. P. Jahnke and R. G. Frank (General Electric Co., Cincinnati). Metal Progr. 74, No. 5, 77-82(1958) Nov.

A survey of the most promising areas for high-temperature development is presented. In addition, a listing of the best alloys among the light metals and steels is given. (J.R.D.)

15363 NP-7630
Westinghouse Electric Corp. Research Labs., Pittsburgh.
RESEARCH AND DEVELOPMENT IN HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 2 [for] August 27, 1958 through October 26, 1958. L. L. France. Oct. 31, 1958. 14p. Contract NOas-58852-C.

Non-consumable arc melted buttons of alloys in the binary systems Ta–Hf, Ta–W, and W–Hf were prepared. Preliminary microstructural observations and hardness determinations indicate that Ta alloys with up to 20 at. % Hf are single phase and forgeable at 1150°C. Work was continued on modification of the levitation melting equipment, and Ta and Ta-Hf alloys were successfully levitated and melted. Tungsten was levitated and heated to about 3200°C but was melted. A literature survey which is limited to the alloys of immediate interest is included. (auth)

CAST ALLOYS RESIST HEAT. Iron Age 182, No. 16, 192-4(1958) Oct. 16.

The composition, uses, and alloy casting institute identification of nickel–chrome cast alloys are described, including some alloys recommended for use at temperatures of 2000°. (J.R.D.)

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OXIDATION RESISTANCE OF A Cb–Zr–Ti ALLOY. G. M. Gordon, J. W. Spretnak, and Rudolph Speiser (Ohio State Univ., Columbus). Trans. Met. Soc. AIME 212, 659-60(1958) Oct.

The oxidation rate in the Nb–Zr binary system was found to decrease rapidly with increasing Zr content up to 35 at.% Zr. Also, Zr contents higher than 35 at.% gave still better resistance to oxidation. Alloys containing 45 to 60 at.% Zr exhibited the best oxidation behavior at 1000°C, and their oxide films did not spall upon cooling. The addition of 5 to 10 at.% Ti to alloys in this range further improved the oxidation rate and the nature of the oxide film formed. The alloy exhibiting the best behavior of those tested (44.5 at.% Nb, 50.1 at.% Zr, 5.4 at.% Ti) had a very hard and coherent oxide film which was 5 mils thick after 100 hr at temperature. Ternary additions other than Ti to Nb–Zr alloys may still further enhance the oxidation properties. (J.E.D.)

HIGH TEMPERATURE BRAZING ALLOY FOR JOINT Fe–Cr–Al MATERIALS AND AUSTENITIC AND FERRITIC STAINLESS STEELS. R. C. Cost (to U. S. Atomic Energy Commission). U. S. Patent 2,843,478. July 15, 1958.

A new high temperature brazing alloy is described that is particularly suitable for brazing iron-chromium-aluminum alloys. It consists of approximately 20% Cr, 6% Al, 10% Si, and from 1.5 to 5% phosphorus, the balance being iron.

13139 NP-6830

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

RESEARCH AND DEVELOPMENT OF BRAZING ALLOYS FOR HIGH-TEMPERATURE APPLICATIONS AND RESISTANCE TO OXIDATION. Quarterly Progress Report No. 1 [for] April 1, 1958 to June 30, 1958. Domenic Canonico and Harry Schwartzbart. July 1958. 7p. Project No. 8-(8-7351). Contract AF33(616)-5654.

The first quarter of work has been completed on a program which has as its objective the development of oxidation-resistant brazing alloys containing temperature depressants which can be volatilized during vacuum brazing. The temperature depressant may enhance wettability. The result of the vacuum brazing operation will be a joint with a higher remelt temperature than that at which the brazement was made. Progress during this period has consisted of the assembly and construction of experimental equipment, preparing 13 experimental brazing alloys, determining their liquidus tem-

BEHAVIOR OF METALS AND DESIGN REQUIREMENTS FOR ELEVATED TEMPERATURES, JUNE 17 THROUGH JUNE 27, 1958. Cambridge, Massachusetts Institute of Technology, 1958. 439p.

Equations relating elongation to the amount of shear taking place both along grain boundaries and in slip planes of polycrystalline aggregates during creep are presented. The contribution of grain-boundary sliding to total elongation in creep of pure Al was determined quantitatively as a function of temperature and solid solution alloying with Mg. A general treatment is given of creep deformation. The fracture of metals and alloys at elevated temperatures is discussed. Some aspects are presented of the utilization of creep data for engineering design purposes. A summary of the present

9851

A COLUMBIUM PRIMER. Chester T. Sims (Battelle Memorial Inst., Columbus, Ohio). J. Metals 10, 340-5 (1958) May.

The occurrence and economics, extraction, vacuum purification, alloying behavior, fabrication, mechanical properties, and oxidation of Nb are discussed. High-temperature applications in atomic energy and missile or jet engine applications are reviewed. (J.E.D.)

2194 WADC-TR-58-365

Southern Research Inst., Birmingham, Ala.

DETERMINATION OF TENSILE, COMPRESSIVE, BEARING, AND SHEAR PROPERTIES OF SHEET STEELS AT ELEVATED TEMPERATURES. [Period covered]: January 1957 to May 1958. J. Robert Kattus, James B. Preston, and Herman L. Lessley. Sept. 1958. 298p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: DESIGN DATA FOR METALS. Contract AF33(616)-3876.

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The tensile, compressive, bearing, and shear properties of the following sheet metals were determined at various temperatures after exposure times of from ½ hour to 1000 hours at the test temperature: A-286 austenitic alloy, quenched and tempered; 17-7 PH stainless steel, RH 950 condition; Thermold J alloy steel, quenched and tempered; Type 420 stainless steel, quenched and tempered; Type 422 stainless steel, quenched and tempered; and 17-22 A (S) alloy steel, quenched and tempered. The A-286 alloy was tested over a temperature range from 75 to 1200°F, the Thermold J from 75 to 1100°F, and the other alloys from 75 to 1000°F. In all of the test alloys, the strength properties and moduli of elasticity decreased with increasing temperatures. The strength properties of the Thermold J, Type 420, Type 422, and 17-22 A (S) tended to decrease by varying amounts with increasing exposure times at the higher test temperatures. These decreases in strength are believed to be associated with structural changes produced by tempering. At lower temperatures, the properties of these materials did not vary significantly with exposure time, indicating that the structures were stable at those temperatures. The strength properties of the A-286 alloy and the 17-7 PH (RH 950) stainless varied somewhat erratically with increasing exposure times at the higher test temperatures as a result, probably, of aging phenomena in both of these precipitation-hardening alloys. The simple ratio relationships between various properties under equivalent test conditions were approximately equal in magnitude and in consistency to those previously determined for other materials and reported in WADC Technical Report 56-340. For the entire ranges of materials and conditions used in this work, the consistency of the various property relationships ranged from ± 17% to ± 71%. Precise data on the mechanical properties of aircraft-structural materials can be obtained only by testing under the desired condition. (auth)

THERMAL PROPERTIES OF THIRTEEN METALS. ASTM Special Technical Publication No. 227. C. F. Lucks and H. W. Deem. Philadelphia, American Society for Testing Materials, 1958. 31p. $1.25.

Thermal conductivity, linear thermal expansion, specific heat, density, and thermal diffusivity values are reported over the temperature ranges shown for the following metals: 2024-T4 and 7075-T6 aluminum from −250 to 800°F, chromium from 75 to 3000°F (thermal conductivity and diffusivity 400 to 1800°F), copper from 75 to 1900°F (density from 75 to 3000°F), Inconel and Inconel "X" from −250 to 1800°F, AN-M-29 magnesium from −250 to 600°F, molybdenum from 75 to 3000°F (thermal conductivity and diffusivity from 400 to 1600°F), "K" monel from −250 to 1800°F, SAE 1010 steel from −250 to 1650°F, and stainless steels types 301, 316, and 347 from −250 to 1800°F. (auth)

18105 NACA-1392
Michigan. Univ., Ann Arbor.
BORON AND ZIRCONIUM FROM CRUCIBLE REFRACTORIES IN A COMPLEX HEAT-RESISTANT ALLOY. R. F. Decker, John P. Rowe, and J. W. Freeman. 1958. 40p. $0.40(GPO).

Supersedes NACA-TN-4049 and NACA-TN-4286.

The effects of the presence of small amounts of boron and zirconium in a titanium-and-aluminum-hardened nickel-base alloy were studied. Beneficial increases in high-temperature properties of the alloy were obtained by melting in magnesia or zirconia crucibles. Effects similar to those obtained by release of boron and zirconium during crucible-melt reactions were obtained by the intentional additions of boron and zirconium. These additions prolonged the life to fracture and permitted more deformation before fracture. Development of structural changes through the creep process is illustrated by optical and electron photomicrographs. (auth)

4722 WADC-TR-56-423(Pt. II)
Library of Congress. Technical Information Div., Washington, D. C.
THERMAL PROPERTIES OF CERTAIN METALS. PART II. IRON, BERYLLIUM, IRIDIUM, PALLADIUM, PLATINUM, AND TUNGSTEN. Period Covered: July 1, 1956 to December 31, 1957. Thomas C. Goodwin, Jr. and Mauree W. Ayton. Jan. 7, 1958. 321p. Project No. 2998. Contract AF33(616)-55-10. (AD-157169).

The bibliography on the thermal properties of certain metals consists of references, with abstracts, to

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pertinent open literature published from 1920 to 1957 and to unclassified reports issued from about 1944 to 1957. These references were obtained by a comprehensive search of the listed sources. Material included in the bibliography pertains to various thermal properties, namely, heat capacity, thermal conductivity, emissivity, thermal diffusivity, and thermal expansion of iron (pure), beryllium, iridium, rhodium, palladium, platinum, and tungsten. (auth)

8918 IGR-TN/W-513
Gt. Brit. Windscale Works, Sellafield, Cumb., England.
SOME ELEVATED TEMPERATURE HARDNESS MEASUREMENTS ON MAGNOX C ALLOY. D. Shaw and P. N. Sharratt. May 1957. 9p.

Hardness measurements have been made on Magnox C alloy at various temperatures up to 500°C; firstly, with varying loads and a constant time of application of load, and, secondly, with varying times of application of load and a constant load. The Meyer index decreased from 2.5 at room temperature to approximately 2.0 at temperatures of 350°C and higher. A general empirical relationship existing between the mean pressure of indentation and the yield stress has been used to determine the maximum tensile stresses at temperatures of 350°C and higher. At temperatures higher than room temperature, the hardness decreases with time of application of load. Above 200°C, the rate of decrease of hardness is slight after times of 1200 seconds. (auth)

13144 WADC-TR-54-270(Pt. IV)
Cornell Aeronautical Lab., Inc., Buffalo.
INVESTIGATION OF THE COMPRESSIVE, BEARING AND SHEAR CREEP-RUPTURE PROPERTIES OF AIRCRAFT STRUCTURAL METALS AND JOINTS AT ELEVATED TEMPERATURES. Period Covered: March 1956 to May 1957. Luke A. Yerkovich. June 20, 1957. 108p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: DESIGN DATA FOR METALS. Contract AF33(616)-3456. (AD-155570).

A tabular summary of the high-temperature short-time strength properties of a number of test alloys in tension, compression, bearing, and shear is presented. Data representing the bearing creep behavior of 2024-T3 aluminum alloy sheet for a number of variables associated with bearing are included. The creep behavior of several selected joint designs undergoing bearing and shear creep are illustrated as time-deformation charts, and comparisons between the predicted and experimental performances are made. (auth)

8925 ✓ WADC-TR-57-154
General Electric Co. Thomson Lab., Lynn, Mass.
EFFECTS OF PROCESSING VARIABLES ON FRACTURE AND DISC-BURSTING CHARACTERISTICS OF FOUR HIGH TEMPERATURE MATERIALS. Period covered: March 1, 1955 to March 31, 1957. Richard Sakamoto. Apr. 1, 1957. 84p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-2778. (AD-118346).

Generalization of notch sensitivity characteristics of materials evaluated by conventional notch rupture data without due regard to the specific application may represent an unjustified material penalty and unnecessarily preclude the use of a material for a specific application. Elevated temperature spin test data for several alloys are included which indicate that certain alloys are notch insensitive in thin disk tests even though they show significant strength reduction in the conventional notch rupture tests. This difference in behavior is attributed to the greater constraint existing in the notched cylindrical specimen and indicates that the constraint factor may be fully as significant as the stress concentration. (auth)

7206
MOLYBDENUM FOR HIGH STRENGTH AT HIGH TEMPERATURES. Robert R. Freeman and J. Z. Briggs (Climax Molybdenum Co., New York). Jet Propulsion 27, No. 2, 138-47(1957) Feb.

A study is presented of the progress made on the application of molybdenum in missile and powerplant design. Tables of metallurgical properties at high temperatures are included. (J.E.D.)

1907
Fe-Al-Mo ALLOYS FOR HIGH-TEMPERATURE USE. J. F. Nachman and W. J. Buehler (U. S. Naval Ordinance

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Lab., Silver Spring, Md.). Metal Progr. 70, No. 6, 107-10 (1956) Dec.

The light weight, excellent oxidation resistance, and high strength at elevated temperature of Al–Fe–Mo alloys indicate their potential utility as replacements for Cr–Fe and Cr–Fe–Ni alloys in aircraft structural materials. (auth)

8011 WADC-TR-57-40
Michigan. Univ., Ann Arbor. Engineering Research Inst.
AN INVESTIGATION OF THREE FERRITIC STEELS FOR HIGH-TEMPERATURE APPLICATION. [Period covered] September 15, 1955 to December 15, 1956. A. Phillip Coldren and James W. Freeman. Jan. 8, 1957. 117p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-3239. (AD-118204).

An investigation was carried out to survey the relationships between microstructure and properties at 700 to 1100°F for low-alloy, hardenable steels. A Ni–Cr–Mo (SAE 4340) and two Cr–Mo–V ("17-22-A"S and "17-22-A"V) steels were studied. The results, together with those presented in References for previous work on 4340 and "17-22-A"S steels, correlate properties with microstructure for three temperatures of isothermal transformation in the pearlite region and three in the bainite region. Oil-quenched and normalized structures were included for comparison. The properties were evaluated for these structures when tempered to both the 300 and 350 Brinell hardness levels. Data for the "17-22-A"V steel in the form of a TTT diagram obtained to establish heat-treating condition are included. These data are supplemented by similar studies for continuous cooling down to rates simulating the air cooling of a 6-in. round. The influence of increasing the heat-treating temperature was also studied. Controlled mixed structures were developed by transforming about 50% in the upper bainitic range and about 50% in the lower bainitic range. The results of a very limited start for a study of hot-working condition effects are included. The results are correlated and analyzed. Optimum structures (or treatments) vary with both the alloy and test conditions. In general, bainitic structures of one type or another gave best properties. However, for the Cr–Mo–V steels, pearlites formed at relatively low temperatures were often as strong or stronger than the bainites. Tempered martensite was never the strongest structure and most often was the weakest. (auth)

10032 NAA-SR-Memo-1752
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
THE PHYSICS OF REFRACTORY MATERIALS: I. TRANSITION METALS. John E. Hove. Oct. 12, 1956. 23p. $4.80(ph), $2.70(mf) OTS.

The basic question of why some materials melt at lower temperatures than others is considered in relation to the high-melting transition metals. In addition, a brief review of current theories concerning melting and liquids is given. The discussion includes background information on the transition metals as well as a consideration of cohesive energy, the heats of fusion, and other properties of these groups. (J.R.D.)

5896 WADC-TR-56-579
Horizons, Inc., Cleveland.
DEVELOPMENT OF FRICTION-SEAL MATERIALS FOR HIGH TEMPERATURE-HIGH SPEED OPERATION. Period Covered: July 1, 1955 to July 31, 1956. Peter F. Mataich. Oct. 25, 1956. 23p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-3134. (AD-118047).

A study was made in an attempt to find materials suitable for use as friction seals under conditions of high temperature and high rubbing speeds. A special test rig for screening the materials under simulated operating conditions was designed and constructed. It was found that the group of materials evaluated in the present program showed excessive wear under the severe operating conditions required. This excessive wear was attributed to the excessive temperatures reached at the mating surfaces when the lubricating oil film broke down, and it is suggested that this condition could be remedied by incorporating a suitable solid lubricant in the seal material itself. (auth)

5872 AD-105100
Library of Congress. Technical Information Div., Washington, D. C.
THERMAL PROPERTIES OF CERTAIN METALS. (Abstract Bulletin TP11). Apr. 20, 1956. 14p. Contract AF 33(616)55-10.

8367
MATERIALS FOR VERY HIGH TEMPERATURES. R. Steinitz (Schwarzkopf Development Corp., Yonkers, N. Y.). Powder Met. Bull. 7, 155-8(1956) Apr.

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Survey of metals available for use in high temperatures is made. Oxides are considered but are unstable losing O below the stoichiometric ratio. Carbides, borides, and silicides can withstand sudden heating and cooling but they lack oxidation resistance. Other combinations and pure metals are considered. (F.S.)

11193 ✓ AECD-3788
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FEASIBILITY SURVEY OF ZIRCONIUM AND ALTERNATE REACTOR STRUCTURAL MATERIALS FOR HIGH TEMPERATURE OPERATION. S. H. Bush and R. S. Kemper. Nov. 18, 1953. Decl. with deletions Dec. 5, 1955. 40p. Contract W-31-109-Eng-52. $0.30(OTS).

The properties of Al, Al–Mg, sintered Al powder, Zr, type 347 stainless steel, and Zircaloy-2 are examined. The materials are compared for their suitability as slug jacket and process tube materials in a high-temperature high-pressure system. Physical properties, tensile properties, creep properties, impact properties, macroscopic cross sections, radiation effects on properties, and effect of H_2 content on properties of the materials are tabulated. (T.R.H.)

STATUS AND FUTURE OF NICKEL-BASE ALLOYS. F. L. Ver Snyder (General Electric Co., Schenectady, N. Y.). p.3-15 in "High Temperature Materials."

Advances in processing of Ni alloys are discussed, and the mechanical properties of some alloys are given to show their usefulness at high temperatures. Compositions are given for 26 alloys. Structure and intergranular fracture are also discussed. (T.R.H.)

PLASTICS 5.10.02.04

2701 AGARD-178
North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development.
ELASTOMERS FOR HIGH TEMPERATURE APPLICATIONS. E. R. Bartholomew. [1958]. 30p.

Presented at the Seventh Meeting of the Structures and Materials Panel, Mar. 24, to Apr. 3, 1958, Rome.

A review is given of the source and nature of high-temperature elastomer problems, and the limitations of the more conventional elastomer materials are discussed. Recent data on properties of special high-temperature polymers and their compounds are included. (A.C.)

11256 NP-6404
Battelle Memorial Inst., Titanium Metallurgical Lab., Columbus, Ohio.
THE PRESENT STATUS OF GLASS-REINFORCED PLASTICS FOR HIGH-TEMPERATURE SERVICE. G. W. Gynn. July 29, 1957. 17p.

A brief summary is presented of the engineering properties of three representative glass-reinforced plastics fabricated into laminates from Style 181 glass cloth and polyester, phenolic, and silicone resins. Comparisons are made of the properties of the glass-reinforced plastics and Ti, Al, and stainless steel alloys. (L.T.W.)

5765 WAL-397/9
Watertown Arsenal Lab., Mass.
A SURVEY OF THE ELEVATED TEMPERATURE PROPERTIES OF TEFLON AND KEL-F. A. P. Levitt and A. K. Wong. Aug. 24, 1956. 53p. Project title: HIGH TEMPERATURE THERMAL PROPERTIES OF FLUOROCARBON PLASTICS.

The results of a literature survey on the elevated temperature thermal, mechanical, and electrical properties of Teflon and Kel-F are presented. Data on the following elevated temperature properties of these materials are reported: specific heat, thermal expansion, decomposition rate and decomposition products, specific volume, mechanical and electrical properties. The available data clearly indicate that at elevated temperatures Teflon is superior in thermal stability and mechanical properties to Kel-F. (auth)

5853 WADC-TR-54-98(Pt.3)
Connecticut Hard Rubber Co., New Haven.
INVESTIGATION AND DEVELOPMENT OF HIGH-TEMPERATURE STRUCTURAL ADHESIVES. Report No. 3 [for] May 1, 1955 to November 1, 1955. Alfred S. Kidwell and Kenneth L. McHugh. Sept. 1956. 74p. Project title: JET ROTORS. Task title: HEAT RESISTANT ADHESIVES. Contract AF33(616)-2448. (AD-97287).

Wide variations in the composition of the CHR-M-60 epoxy-modified DC-2103 silicone resin with Asbestine X

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filler, which has shown shear strength values as a metal-to-metal adhesive in excess of 1000 psi at 500°F, have been made and the results plotted to indicate composition areas yielding maximum shear strength values. Extended high-temperature aging tests have shown DC-803 silicone resin and epoxy-modified DC-803 to have better aging resistance than DC-2103 and epoxy-modified DC-2103, respectively. The DC-803 showed little loss in shear strength at 500°F after aging 1200 hr at 500°F on both Al panels and stainless steel panels (residual shear strength about 300 psi at 500°F). This resin also withstood 300 hr at 600°F on stainless steel and 200 hr on Al. The 20% epoxy-modified DC-803 lasted 800 hr at 500°F and 100 hr at 600°F (residual strength in each case about 350 psi at room temperature and 150 psi at 500°F). A number of silicone-epoxy-phenolic resin blends were prepared, which showed shear strength values and high-temperature aging resistance slightly better than those for the epoxy-modified silicone resins. Up to 20% of epoxy resin in epoxy-modified DC-2103 silicone resin was found to have relatively little effect on the change in shear strength values when tested over a temperature range from −70 to +900°F; the opoxy resin mainly improved the strength over the lower half of the temperature range. Shear strength at 900°F was about 100 psi. (auth)

SURVEYS, MISCELLANEOUS 5.10.02.05

2733 NP-8044
McDonnell Aircraft Corp., St. Louis.
THERMAL PROPERTIES OF MATERIAL. Report 5926. G. R. Gaumer, D. L. Kummer, and G. Rusert. Feb. 3, 1958. Revised June 18, 1959. 243p.

A compilation of the thermal properties for a number of metallic and non-metallic materials is presented. Included are data on metals, metallic compounds, ceramics, glasses, and plastics. The thermal properties are plotted against temperature and references are given on each graph. (J.R.D.)

8746 NP-8344
Honeywell Research Center, Hopkins, Minn.
REVIEW OF THE THERMAL RADIATION PROPERTY VALUES FOR METALS AND OTHER MATERIALS. G. G. Gubareff, Shao-Yen Ko, and P. E. McNall, Jr. May 1956. 261p. (GR-2462-R3).

Thermal radiation property values for more than 40 metals and their alloys are given. The properties reported are emissivity, absorptivity, reflectivity, and transmissivity at various surface conditions, temperatures, and wavelengths. In addition, radiation properties of building materials, paints, glasses, papers, cloths, and other miscellaneous solid materials have been compiled, and solar absorptivity and equilibrium temperatures for various materials have been tabulated. These values have been gathered from about 200 references in English, German, French, and Russian and have been carefully analyzed to obtain, in the authors' opinion, the most trustworthy data for practical application. Recommended data for technically important materials are also presented graphically. An extensive survey was conducted to compile values for Stefan-Boltzman's, Planck's, and Wien's constants, and the most reliable values for practical application are listed in a separate table. The thermal radiation equations are introduced, and a short discussion of the basic mechanism of heat transfer by radiation and the general tendencies of thermal radiation properties is given. Definitions of the radiation properties and their mutual relationships are also included. (auth)

4668
PROPERTY MEASUREMENTS AT HIGH TEMPERATURES. FACTORS AFFECTING AND METHODS OF MEASURING MATERIAL PROPERTIES AT TEMPERATURES ABOVE 1400°C (2550°F). W. D. Kingery. 424p. New York, John Wiley & Sons, Inc., 1959.

Various methods and instruments employed for property measurements at high temperatures (above 1400°C) are described. The factors that affect results in different kinds of measurements as well as the measurement techniques most suitable for particular systems and temperature ranges are discussed. Various properties and applications of laboratory refractories and designs of laboratory furnaces are given. Applications of the property measurements in research are discussed. (C.J.G.)

14242 ORNL-2738
Oak Ridge National Lab., Tenn.
REVIEW AND BIBLIOGRAPHY ON: DESIGN AND USE OF WINDOWS FOR OPTICAL MEASUREMENTS AT ELEVATED TEMPERATURES AND PRESSURES (1881-

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1959). R. E. Biggers and J. M. Chilton. June 12, 1959. 88p. Contract W-7405-eng-26. $2.25(OTS).

The references in this bibliography cover the period from 1881 to 1959 (4/20), and were obtained from many sources. A brief abstract is given along with almost all of the 117 references that are listed. A review of the present and past status of the research effort in this field is given over the entire time period. The general design considerations for the past and present window designs are thoroughly discussed, and each paper is evaluated from the point of view of window design, temperature limits, and pressure limits. The "Poulter" Window designed by T. C. Poulter in 1929 is extensively discussed. About eighty per cent of the window designs and research projects since 1930 have used this design. The Poulter type window has been very satisfactorily used at simultaneous temperatures and pressures up to 1200°C and 1500 atmospheres. The literature is also reviewed from the standpoint of work carried out with the simultaneous use of elevated temperatures and pressures. Future developments are discussed for four different types of window designs that may permit the study of liquids at temperatures higher than 250°C up to at least 330°C and 200 atmospheres pressure, and probably up to the critical temperature of water. Sections are included on the arrangement of the bibliography, an author index, and a brief review of the source material. (auth)

15593 ✓ DOFL-TM-59-4
Diamond Ordnance Fuze Labs., Washington, D. C.
THE THERMAL CONDUCTIVITY OF SOLIDS AT HIGH TEMPERATURES—A BIBLIOGRAPHY. W. T. K. Johnson. June 1, 1959. 77p.

A bibliography on the thermal conductivity of solids is presented, with emphasis on measurement techniques at high temperatures. The references are presented in two groups; those published between 1940 and early 1958, and those published prior to 1940. A total of 474 references is given. Most of the references since 1940 are accompanied by a brief description of content. This information has been compiled in connection with studies on thermoelectric generators. (auth)

13526 LMSD-2466
Lockheed Aircraft Corp. Missile Systems Div., Sunnyvale, Calif.
PROPERTIES OF REFRACTORY MATERIALS: COLLECTED DATA AND REFERENCES. Wanda G. Bradshaw and Clayton O. Matthews. Jan. 15, 1959. 114p.

A survey of the elevated-temperature characteristics of refractory materials melting above 2500°F was made. Data were tabulated for evaluation of these materials for use in elevated-temperature nuclear reactors, and in high-temperature missile applications. Data on the melting points, ductility, and elevated-temperature stability of the refractory metals, carbides, nitrides, oxides, silicides, sulfides, beryllides, aluminides, other intermetallics, phosphates, and uranates are presented. The thermal shock resistances, thermal conductivities, thermal expansions, and emissivities reported for these materials are given. The effect of nuclear radiation on ceramics is reported. The mechanical properties of refractory materials are briefly reviewed. Sources of thermodynamic data for these materials are presented. The effects of various gas coolants, helium and its major likely contaminants, oxygen and water vapor, hydrogen, nitrogen, and other gases on refractory materials are also reported. Where conflicting or variable data exist, the original authors are cited. (auth)

D2-3285
Boeing Airplane Co., Seattle.
BIBLIOGRAPHY OF HIGH TEMPERATURE MATERIALS. Layton L. Kimmel. Jan. 1959. 18p.

A literature survey of Nuclear Science Abstracts from 1950 through June 9, 1958, was conducted for information on high-temperature materials such as alloys, ceramics, coatings, and graphite. (auth)

14608 A/CONF.15/P/715
Argonne National Lab., Lemont, Ill.
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF REACTOR MATERIALS. R. J. Ackermann and R. J. Thorn. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

High-temperature thermodynamic properties of reactor materials are important to chemical engineers, ceramists, metallurgists, and reactor engineers in

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developing pyrometallurgical processing procedures, fabricating fuel assemblies, and designing high temperature reactors. A critical evaluation and discussion is to be presented so that reliable free energies and phase diagrams if possible are available to enable one to predict the behavior of various chemical systems which may be proposed for use at temperatures above 1000°C. One aspect which will become increasingly more important when systems are considered for high temperatures is the production of gases from condensed phase reactions. The behavior in this respect of two classes of compounds, oxides and carbides, of aluminum, beryllium, hafnium, magnesium, plutonium, tantalum, tungsten, thorium, uranium, and zirconium is examined. The oxides are of interest because of their high stabilities and the carbides because of their high conductivities and because of the desirable nuclear properties of carbon. (auth)

752 CWR-477
Curtiss-Wright Corp. Research Div., Quehanna, Penna.
CONDENSED INFORMATION ON HIGH-TEMPERATURE MATERIALS. Aug. 29, 1957. 77p.

Information is summarized on 37 high-temperature materials. Data are included on chemical composition, physical properties, mechanical properties, thermal properties, the possible supplier, and references stating the source of the information. (C.H.)

10617 NP-6770
Syracuse Univ., N. Y. Research Inst.
HIGH TEMPERATURE MATERIALS, THEIR STRENGTH POTENTIALS AND LIMITATIONS. Proceedings of the Fourth Sagamore Ordnance Materials Research Conference Conducted at Sagamore Conference Center, Racquette Lake, New York. August 21, 22, and 23, 1957. 358p. Contract DA-30-115-ORD-854. (MET-497-582).

Thirteen papers are presented: Theory of High-Temperature Deformation of Metals; Theory of High-Temperature Strength of Alloys; A Survey of Recent Results on Experimental Determinations of Activation Energies for Creep; The Stability of Microstructures and Related Physical Properties at High Temperatures; The Relation of Microstructure and High-Temperature Strength; Tensile Properties of Some Structural Sheet Materials Under Rapid Heating Conditions; Mechanical Properties of Structural Materials Under Conditions of Rapid Heating and Rapid Loading; Thermal Fatigue of Ductile Materials; Plastic Strain Absorption as a Criterion for High-Temperature Design; Strain Cycling and Thermal Fatigue; Design Under Conditions of Relaxing Complex Stress Concentrations; A Survey of the Effects of Nonsteady Load and Temperature Conditions on the Creep of Metals; and Chemistry at High Temperatures and Pressures. Data tabulations are given on: creep activation energy of Al, Au, Cu, Fe, Ni, In, Cd, Pb, Zn, Mg, and Al–Mg; hardness of Cu vs. cold-work; hardness of carbon steel vs. temperature; strength of Al–Mg vs. strain rate; strength of steel vs. cold work and heat treatment; strength of Al–Cu–Mg vs. heat treatment; high-temperature properties of Co–Fe–Ni; tensile properties of steel, aluminum alloys and Inconel-X sheet under rapid heating conditions; and strain cycling and thermal stress fatigue of Inconel, stainless steel, various steels, Cr–Mo–Ni, Al, Cu, and Al–Mg. (T.R.H.)

HIGH TEMPERATURE MATERIALS. Conference held in Cleveland, Ohio, April 16-17, 1957. R. F. Hehemann and G. Mervin Ault, eds. New York, John Wiley & Sons, Inc., 1959. 556p.

A conference on recent developments in high-temperature materials is presented. In Parts I and II, Ni and Co alloys and cermets are treated. Part III deals with refractory metals. Separate abstracts have been prepared for each of twenty eight papers. (T.R.H.)

11179 NP-6365
Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Reports No. 1 through 8. Period Covered: March 15, 1955 to March 15, 1957. 262p. Project A-212. Contract NOrd-15701.

Methods of applying protective metal and ceramic coatings to metals were investigated. The methods included arc evaporation, hot dipping, cementation, vapor deposition, thermite firing of ceramics, and carbon-arc spraying. (T.R.H.)

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HIGH-TEMPERATURE TECHNOLOGY. I. E. Campbell, ed. New York, John Wiley and Sons, Inc., 1956. 526p. London, Chapman and Hall, Ltd., 1956.

The technology of high-temperature refractory materials has been studied. The refractory properties of metals, oxides, carbides, borides, silicides, nitrides, sulfides, cermets, and special properties of carbon and graphite at high temperatures are discussed. The topics include the sintering methods for metallic and non-metallic refractory materials; resistance and induction-heated furnaces; arc furnaces; solar furnaces; and, other methods of achieving high temperatures. The measurement methods, the mechanical and physical properties at high temperatures and high temperature microscopy and x-ray diffraction are, also, described. (R.V.J.)

REFRACTORIES BIBLIOGRAPHY, 1947-1956. Norman, Okla., University of Oklahoma Press, 1959. 1826p. $7.50.

This volume contains over 9,500 references to the periodical literature and to U. S. and foreign patents on refractories. The references contained in this compilation relate to raw materials, manufacture, properties, and uses of refractories. Refractories in all phases of industrial use have been covered, including the glass, petroleum, foundry, iron, and steel industries. (W.L.H.)

1345

SPECIAL REFRACTORIES FOR USE ABOVE 1700°C. O. J. Whittemore, Jr. (Norton Co., Worcester, Mass.). Ind. Eng. Chem. 47, 2510-12(1955) Dec.

The properties, high-temperature applications, and limitations of alumina (Al_2O_3), magnesia (MgO), zirconia (ZrO_2), calcium oxide (CaO), magnesium aluminate ($MgO \cdot Al_2O_3$), beryllia (BeO), thoria (ThO_2), and uranium dioxide (UO_2) are discussed. (C.W.H.)

7187

CORROSION OF REFRACTORY MATERIALS IN MELTS. I. A METHOD FOR QUANTITATIVE MEASUREMENTS OF THE DISSOLUTION OF REFRACTORY MATERIALS IN MELTS BY USE OF RADIOACTIVE ISOTOPES. H. Flood and A. Seltveit. Kgl. Norske Videnskab. Selakads. Forh. 28, 150-3(1955).

A method of testing the corrosion resistance of refractories is described. Small rods of refractory material are irradiated in a U pile, and then corroded in a melt. The dissolution of the rod is followed by measuring the increase of the radioactivity of the melt. This method makes it possible to examine in a simple way the rate of corrosion as a function of time. (auth)

Office of Technical Services, Washington, D. C.
BIBLIOGRAPHY OF REPORTS ON HIGH TEMPERATURE ALLOYS. June 1951. 9p. (IB-149(Rev.)).

Bibliography consists of approximately 73 references to German publications, Government publications, and other published literature.

REFRACTORIES BIBLIOGRAPHY, 1928-1947. Columbus, Ohio, American Ceramic Society. 1950. 2109p.

This bibliography contains 13,300 references to periodical literature and U. S. and foreign patents. It is annotated, arranged alphabetically by author, and has a subject index. It supplements three bibliographies published by the American Ceramic Society which covered magnesite and silica refractories (1924), and the general subject of refractories (1927).

10619 NRL-M-3434
Naval Research Lab., Washington, D. C.
DEVELOPMENT OF ALUMINUM ALLOYS FOR ELEVATED TEMPERATURES: AN INVESTIGATION OF

COMPLEX ALLOYS OF ALUMINUM WITH MISCHMETAL AND OTHER ELEMENTS. Blake M. Loring and James B. Russell. Mar. 22, 1949. 37p.

Report is made of study of strength at elevated temperatures of aluminum alloys containing mischmetal with additions of copper, nickel, silicon, manganese, magnesium, chromium, cobalt, tungsten, molybdenum, and zirconium. Tensile strength and elongation tests were made at room temperature and at 750°F; stress-rupture tests were made at 700°F. In addition, studies were made of the effects of varying normal components and of additional elements in commercial aluminum alloy compositions. (auth)

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7683 APL-JHU-TG-333-1
Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.
A SURVEY OF THE BASIC SCIENTIFIC PROBLEMS ASSOCIATED WITH THE BEHAVIOR OF MATERIALS AT HIGH TEMPERATURES. June 1959. 182p. Contract NOrd-7386.

A survey of aspects of materials behavior at high temperatures is presented. Areas examined include high-temperature chemistry and gas dynamics, fluid dynamics of boundary layers, radiation, condensation, gas and liquid film cooling, ablation, insulation, external cooling, erosion and deposition of solids, instrumentation, propellant chemistry, and thermodynamics. An effort was made to sift out the most important points and establish lines along which research should be conducted. (J.R.D.)

SELECTION OF ALLOYS FOR HEAT RESISTANT SERVICE. R. A. Miller (American Brake Shoe Co., Elyria, Ohio). Metal Progr. 74, No. 6, 98-101(1958) Dec.

Requirements for the selection of alloys for heat-resistance service are discussed. The following operating conditions are considered: the maximum temperature of operation of the cast; atmosphere in which the alloy is used; and service conditions such as continuous or semicontinuous with respect to temperature and atmosphere, discontinuous with respect to slow heating and cooling, rapid heating or cooling, and quenching. A discussion is also included on design considerations for heat-resisting alloys. (J.H.M.)

225
BEHAVIOR OF MATERIALS AT VERY HIGH TEMPERATURES. Irving J. Gruntfest and Lawrence H. Shenker (General Electric Co.). Ind. Eng. Chem. 50, No. 10, 75A-6A(1958) Oct.

The over-all complex process of thermal deterioration of materials at high temperatures is resolved into simpler and more independent phenomena, including heat absorbing capacity, gas rate generation, liquefaction and vaporization, spalling, and oxidation. Materials are considered from these standpoints in choosing the best material for a specific application. (J.R.D.)

13106 AERE-R/R-2525
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
SOME TESTS ON STANDARD ELECTRIC MOTOR INSULATION AT HIGH TEMPERATURES. S. T. Naish and D. M. Harris. May 1958. 14p.

Electric motors designed for high temperature operation were tested at temperatures up to 420°C in an O_2-free atmosphere. (T.R.H.)

8396 UCRL-5083
California. Univ., Livermore. Radiation Lab.
BIBLIOGRAPHY ON HIGH PRESSURE SYSTEMS AND HIGH PRESSURE – HIGH TEMPERATURE SYSTEMS; TECHNIQUES, APPARATUS AND EXPERIMENTAL DATA. John F. Lakner, comp. Jan. 10, 1958. 40p. Contract W-7405-eng-48. $6.30(ph OTS); $3.00(mf OTS).

The bibliography on high pressure-high temperature and high pressure systems is the result of an investigation into the equipment and experimental technique needed to increase the density of powdered compounds, especially those compounds which possess a high vapor pressure of hydrogen at moderate temperatures and pressures. Particular emphasis was given to those articles which discussed the pressure vessel construction in detail, method of internal heating, materials of construction for use under hydrogen atmosphere, and articles which gave experimental data on compounds other than the ones worked with at UCRL. (J.E.D.)

11397
DESIGN BASIS FOR THERMAL STRESSES. W. E. Cooper (General Electric Co., Schenectady, N. Y.). Proc. Soc. Exptl. Stress Anal. 15, 143-7(1958).

The factors which must be considered in the establishment of a structural design basis are considered. These factors include the operational conditions, stress and deformation analysis, general design requirements, fabrication, and stress limits. Attention is restricted to ductile materials at a temperature sufficiently low that long time elevated temperature properties do not control the design. The need for extensive experimental investigations of material and component behavior is emphasized. (auth)

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11162 KAPL-951(Rev. I)
Knolls Atomic Power Lab., Schenectady, N. Y.
EVALUATION OF TRANSIENT TEMPERATURES AND STRESSES. R. J. Fritz. July 1, 1957. 37p. Contract W-31-109-Eng-52. $0.30(OTS).

Solutions to the one-dimensional heat conduction equation for arbitrary surface temperature transients are treated by superposition of other solutions and by a concept of thermal reflections. The maximum thermal stresses are given for a flat plate due to a given surface temperature change at a linear rate. Thermal stresses in thin cylindrical shells are discussed, and an example is evaluated. Design factors are discussed briefly, principally by citing critical problems and giving references. A comprehensive bibliography is presented. (auth)

274 ✓
ULTRA HIGH PRESSURE FOR MATERIALS RESEARCH. Charles M. Schwartz and Wendell B. Wilson (Battelle Memorial Inst., Columbus, Ohio). Battelle Tech. Rev. 6p.(1959) June.

Techniques for achieving unusual combinations of extreme pressures and high temperatures are described. The effects of pressure on liquids and solids and ultra-high pressure apparatus and applications were studied. (J.E.D.)

6367 CF-57-3-60
Oak Ridge National Lab., Tenn.
HIGH-TEMPERATURE PROPERTIES IN RELATION TO DESIGN. J. R. Weir, R. V. Meghreblian, and D. A. Douglas. Mar. 14, 1957. 23p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

The essential physical and mechanical properties of materials which enter into the design considerations of high-temperature systems were outlined, and the relationship of these factors to the detailed design of structural members noted. Particular attention is given to the phenomenon of strain-cycling and relaxation, and several engineering devices wherein these effects can markedly influence design are mentioned. Techniques and apparatus for the measurement of strain-cycling and relaxation properties are described and some recent data on Inconel at 1500°F is reported. A brief discussion is presented on

4273
HIGH TEMPERATURE TECHNOLOGY. N. K. Hiester, F. A. Ferguson, and N. Fishman (Stanford Research Inst., Menlo Park, Calif.). Chem. Eng. 64, 237-52(1957) Mar.

A survey of the field of high temperature chemistry is given. Processes past and present are described and the future outlook as to methods and materials is discussed. (T.R.H.)

8433
STRUCTURES AND STRUCTURAL RELATIONS OF REFRACTORY METALLIC COMPOUNDS. Erwin Parthe (Mass. Inst. of Tech., Cambridge). Powder Met. Bull. 7, 138-45(1956) Apr.

The structures of carbides, nitrides, silicides, and suboxides have been studied with the aim of supplying general laws and structural relationships which should permit the prediction of new high-melting compounds. The following structural postulates have been recognized; bonding must be three dimensional and small structure elements must be dense packed. (F.S.)

5571
CHEMICAL PROCESSING THE NUCLEAR POWER INDUSTRY. II. HIGH TEMPERATURE PROCESSES. F. S. Martin (Atomic Energy Research Establishment, Harwell, Berks, England). Atomics 7, 52-8, 61(1956) Feb.

The application of various high temperature processes to the treatment of nuclear fuels is discussed. The potentialities of different methods are considered in the light of thermodynamic data, and typical experimental results are quoted. (auth)

4272
THERMOCHEMISTRY AND THERMODYNAMICS OF SUBSTANCES. Charles W. Beckett, Melville S. Green, and Harold W. Woolley (National Bureau of Standards, Washington). Ann. Rev. Phys. Chem. 7, 287-310(1956).

Developments in the equation of state at very high temperatures and pressures are reviewed. The sub-topics are: Quantum Statistical Mechanics and the Thomas-Fermi Method; Static and Dynamic High Pressure Compression Measurements; Gases at High Temperature and Moderate Density. (T.R.H.)

HIGH TEMPERATURE SYSTEMS 5.10

SURVEYS AND THEORY 5.10.03

4279
PROCEEDINGS OF THE SYMPOSIUM ON "HIGH TEMPERATURE—A TOOL FOR THE FUTURE." Menlo Park, Calif., Stanford Research Inst., 1956. 226p. $5.00.
A survey of the field of high temperature research is presented. Methods of obtaining high temperatures, materials for containing high temperatures, and processes occurring at high temperatures are described and discussed. (T.R.H.)

4271
HIGH TEMPERATURE CHEMISTRY. Leo Brewer and Alan W. Searcy (Univ. of California, Berkeley). Ann. Rev. Phys. Chem. 7, 259-86(1956).
A review is presented of work reported in periodical literature on the chemistry of systems at temperatures high enough to change the chemical behavior appreciably. (T.R.H.)

1830
VACUUM MELTED METAL—AN INTERIM REPORT. Frank T. Chesnut (Ajax Electrothermic Corp., Trenton, N. J.). Metal Progr. 68, No. 6, 118-23(1955) Dec.
The status of vacuum melting of metals is reviewed. Included are discussions of current problems, uses in the manufacture of jet engine blades and magnetic alloys, and economics. (B.J.H.)

1782
THERMODYNAMIC DATA ON OXIDES AT ELEVATED TEMPERATURES. Harlan P. Tripp and Burnham W. King (Battelle Memorial Inst., Columbus, Ohio). J. Am. Ceram. Soc. 38, 432-7(1955) Dec.
An extensive compilation of data on the free energy of formation of oxides is presented in graphic form. From these curves it is possible to obtain the free energy of most ceramic oxides in the temperature range 0 to 2400°C. (auth)

1342 NYO-6451
Massachusetts Inst. of Tech., Cambridge.
THE MEASUREMENT OF THERMAL CONDUCTIVITY OF REFRACTORY MATERIALS. Quarterly Progress Report for the Period Ending October 1, 1955. W. D. Kingery and F. H. Norton. Oct. 1, 1955. 16p. Contract AT(30-1)-960.
Data for thermal conductivity in the system $MgO-SiO_2$, $Al_2O_3-ZrO_2$, and for polycrystalline TiO_2 are reported. Infrared absorption data in the temperature range from room temperature to 1200°C are reported for fused silica and sapphire. An expression for the radiant heat transfer in opaque powders has been derived. (auth)

7213 AEC-tr-2707
ON THE PROBLEM OF OBTAINING HIGH TEMPERATURES AT HIGH PRESSURES. L. (A.) F. Vereshchagin and Ya. A. Kalashnikov. Translated from Zhur. Tekh. Fiz. 25, 1508-17(1955). 9p.
Previous work is reviewed. Measurements of the temperature field in hydrogen, nitrogen, argon, and a mixture of hydrogen and nitrogen were made with the furnace axis vertical and horizontal. The sharp temperature drop with higher pressure inside a furnace is ascribed to the effect of convection rather than increased thermal conductivity of the gas, as was earlier supposed. The electric furnace and high-pressure vessel use are diagrammed. Results are tabulated and graphed. (M.H.R.)

2770 AEC-tr-2369
THE ATTAINMENT OF HIGH TEMPERATURES (UP TO 55,000°) UNDER LABORATORY CONDITIONS. O. Preĭning [Praining]. Translated from Uspekhi Fiz. Nauk 55, 595-608(1955). 12p. Available from Associated Technical Services (Trans. 84G7R), East Orange, N. J.
Included are some general remarks on the concept and measurement of high temperatures. A review is given on the methods of obtaining high temperatures of short duration, including nuclear reactions, explosions, explosion of wires by electric currents, and superpowerful spark. A more detailed review of the work done on the attainment of very high temperatures under stationary conditions by means of an arc discharge is given. (B.J.H.)

10252
APPARATUS FOR MELTING AND POURING METAL. F. A. Harris (to U. S. Atomic Energy Commission). U. S. Patent 2,824,732. Feb. 25, 1958.
This patent relates to a crucible for melting and pouring a metal under controlled atmospheric condi-

SURVEYS AND THEORY 5.10.03

tions. The crucible has a frangible plug in the bottom and a retaining device to prevent the entrance of the broken portions of the plug into the mold without interfering with the flow of the melt. After the charge has been melted, a knockout rod is lowered through the charge and forced against the frangible plug sufficiently to break off the closure disk along a previously scored line. The disk drops onto a retaining grid large enough to permit the flow of metal around the disk and into the mold below. This arrangement eliminates the entry of broken portions of the plug into the mold, thereby eliminating a common cause of imperfect castings.

REACTION BOMB FOR USE AT ELEVATED TEMPERATURES AND PRESSURES. Edwin M. Larsen and James J. Leddy (Univ. of Wisconsin, Madison). Rev. Sci. Instr. 28, 292-3(1957) Apr.

ELECTROLYTIC CELL FOR HIGH TEMPERATURES. G. Chauvin, H. Coriou, and J. Hure (Centre d'Etudes Nucléaires de Saclay, France). Metaux(Corrosion-Inds.) No. 377, 8p(1957) Jan. (In French)

A detailed description of an electrolytic cell, designed for the electrolytic preparation of metals of very high purity, is given. The cell permits degassing, before the electrolysis, at high temperature (800 to 1000°C) and in vacuum. After the electrolysis the cathodic deposit is cooled either in air or under an inert atmosphere. The application of this cell to the purification of zirconium is discussed. (J.S.R.)

5892 WADC-TR-56-372
Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio.
CERAMIC CRUCIBLE FOR MELTING TITANIUM. Berthold C. Weber, William M. Thompson, Hans O. Bielstein, and Murray A. Schwartz. June 1956. 62p. Project title: CERAMIC AND CERMET MATERIALS. Task title: HIGH TEMPERATURE AND HIGH STRESS CHARACTERISTICS OF CERAMICS AND CERMETS. (AD-97285).

Research studies have resulted in the development of an oxygen-deficient zirconia material modified in a novel way to make it thermally stable and inert against the attack of molten Ti. It was possible to melt Ti in this crucible with no significant increase in hardness. However, limitations regarding overheating and soaking must be taken into account. (auth)

VESSELS 5.10.04

8099
CHARGE BOAT FOR VOLATILIZATION. R. Krohn (to U. S. Atomic Energy Commission). U. S. Patent No. 2,747,972, May 29, 1956.

A charge boat was designed to be readily inserted and removed in a horizontal sublimation apparatus and arranged to provide extensive supporting surface for the material to be treated in order to obtain rapid and complete volatilization. The specific apparatus has proved very useful in the large scale conversion of UCl_5 to UCl_6 at elevated temperature and reduced pressure. (auth)

INSTRUMENTATION AND CONTROL 5.11

See also, under HAZARDS AND PROTECTION, MONITORING (4.01.09).

16259
INDUSTRIAL APPLICATION OF α RADIOACTIVITY IN THE CONTINUOUS DETERMINATION OF URANIUM IN SOLUTION. J.-D. le Franc, P. Pottier, and G. Roux. Énergie nucléaire 2, 195-201(1958) July-Aug. (In French)

A method for the determination of uranium in leaching solutions of uranium minerals by measurement of the α radioactivity of the solutions is described. The method allows the variation of uranium concentration during the recovery of the metal by ion exchange to be followed. The reasons for the choice of α radiation and the factors which interfere in this method are indicated. The application to the recovery of uranium in sulfuric or alkaline solutions is discussed. The apparatus designed for industrial operation is described. (tr-auth)

INSTRUMENTATION AND CONTROL 5.11

CHEMICAL ANALYSIS 5.11.01

12278 DP-276
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
A DEGASSER FOR IN-LINE INSTRUMENTAL ANALYSES. T. Richard Herold and Edward C. Wingfield. Mar. 1958. 12p. Contract AT(07-2)-1. $0.50(OTS).
A device was developed that provided an air-free liquid stream for instrumental analyses from a solution whose air-to-liquid ratio varied greatly. (auth)

2225
AN INDUSTRIAL-TYPE FLOW CELL FOR MONITORING pH. K. J. Hahn and Karl Koyama (General Electric Co., Richland, Wash.). Ind. Eng. Chem. 49, 63A(1957) Nov.
A flow cell was developed with features especially desirable for use in monitoring pH of radioactive as well as nonradioactive streams. (auth)

7456
PHOTOMETER FOR CONTINUOUS DETERMINATION OF URANIUM IN RADIOACTIVE PROCESS STREAMS. F. A. Scott and R. D. Dierks (General Electric Co., Richland, Wash.). Anal. Chem. 32, 268-72(1960) Feb.
A modified single-beam filter photometer for continuous determination of uranium in radioactive process streams is described. Because of a unique standardizing system, it is very stable, having a short-term variation of less than 1% and a calibration stability of 3%. The instrument has a remotely located sensing unit with the ruggedness and simplicity required for production plant applications. The performance of the instrument for monitoring nonradioactive process streams under plant conditions is given. (auth)

8454
A CONTINUOUS GAS TITRATION ANALYZER FOR FLUORINE. C. W. Weber (Oak Ridge Gaseous Diffusion Plant, Tenn.). Anal. Chem. 32, 387-91(1960) Mar.
An automatic fluorine analyzer was developed for precise continuous monitoring and control of complex gas systems. Based upon pneumatic detection of the reduction in molar flow as fluorine reacts with sulfur dioxide, the analyzer is precise to ±1% fluorine. Excellent on-stream performance is achieved in the presence of uranium hexafluoride, hydrogen fluoride, and oxygen. (auth)

8550 IGRL-T/R-71
THE ANALYSIS OF GASES IN THE CHLORINATION PROCESS. A. S. Berengard and M. T. Glushkova. Translated by E. G. Peters from Zavodskaya Lab. 23, 537-9 (1957). 7p.
Constructional and operational details of an apparatus based on a standard type of gas analyzer, which measures the chlorine, hydrogen chloride, carbon dioxide, carbon monoxide, oxygen, and phosgene content of gases evolved in the process of chlorination, to an accuracy of 0.1% are given. This apparatus is in wide use in the Soviet nonferrous metals industry. (auth)

9761 CF-56-8-19
Oak Ridge National Lab., Tenn.
INSTRUMENTATION FOR HRT-CP DISSOLVER SYSTEM. Herman O. Weeren. Aug. 3, 1956. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

7494
MEASUREMENT OF THE ACIDITY OF AQUEOUS SOLUTIONS AT HIGH TEMPERATURES AND PRESSURES. Rathindra N. Roychoudhury and Charles F. Bonilla (Columbia Univ., New York). J. Electrochem. Soc. 103, 241-6(1956) Apr.
The potential of a platinized platinum-hydrogen electrode in two dilute hydrochloric acid solutions was measured with respect to a silver-silver chloride electrode from room temperature to 250°C at a total pressure from atmospheric to 600 psig. A fused quartz cell was employed inside a steel bomb which contained the vapor pressure of the electrolyte plus the added hydrogen pressure. The silver-silver chloride electrode was a silve plated and chloridized platinum gauze at the bottom of the cell. The hydrogen electrode was half immersed in the solution at the top. The results were reasonably reproducible and permit estimating the acidity of the solution within approximately 0.1 to 0.2 pH units. The results agree reasonably well with theoretical calculations from the Debye-Hückel theory by Lietzke. (auth)

INSTRUMENTATION AND CONTROL 5.11

CHEMICAL ANALYSIS 5.11.01

11342
RADIO-FREQUENCY ANALYZERS FOR LABORATORY AND PLANT. D. J. Fisher, M. T. Kelley, R. W. Stelzner, and E. B. Wagner, Jr. (Oak Ridge National Lab., Tenn.). ISA Journal 4, 2-5(1957) Oct.

For the past several years, the Oak Ridge National Laboratory has been investigating the design and use of radio-frequency analyzers for service in both laboratory and plant. Several of these devices for continuously monitoring high concentrations of electrolytes in aqueous and non-aqueous liquids are described. All of these instruments can operate without electrodes immersed in the measured solution. (auth)

2651
INEXPENSIVE MICROTITRATOR. Kenneth A. Allen (Oak Ridge National Lab., Tenn.). Anal. Chem. 28, 277(1956) Feb.

The construction and performance of an inexpensive microtitrator are described. The buret consists of a glass-jacketed precision-bore tube with an oversize teflon plunger which is controlled by a micrometer. Titrations requiring 10μl of reagent may be completed in less than 15 minutes, and the delivered volumes read to within 2 parts in a thousand. (C.W.H.)

2650 AERE-C/R-1757
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
A QUARTZ FIBRE ULTRA MICROBALANCE FOR USE INSIDE AN EVACUATED CONTAINER. W. P. Hutchinson. Oct. 7, 1955. 15p.

A fused quartz fibre ultra microbalance is described, using weights in conjunction with a torsion fibre, with a sensibility of about 10^{-6} g/division. It may be used in a vacuum for weighing quantities from a few μg to 200 mg. (auth)

4328 AECD-3992
National Lead Co. of Ohio, Cincinnati.
UF_6 DETECTOR. W. E. Shaw and J. R. Dearwater. Nov. 24, 1954. Decl. with deletions Dec. 1, 1955. 9p. Contract AT(30-1)-1156. $1.80(ph OTS); $1.80(mf OTS).

A simple detector for determining the presence of UF_6 in a stream of HF, UF_4, and dissociated NH_3 is described. The basic detection element is a sensitized piece of carbon rod. The unit has proved satisfactory on production equipment. (auth)

2046 Y-1087
Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, Tenn.
GAMMA COUNT ESTIMATION OF ENHANCED URANIUM CONCENTRATION IN SOLUTIONS. W[illiam] B. Wright, Jr., R. C. McIlhenny, and J[ohn] W. Wachter. Sept. 1, 1954. Decl. Oct. 11, 1955. 15p. Contract W-7405-eng-26.

The rapid estimation of enhanced uranium concentration in solution is possible by counting the 0.19 Mev gamma of U^{235} with a scintillation detector. The count rate is a linear function of the U concentration at a constant ratio of U isotopes. By using the discriminator circuit of a linear amplifier, correction for the presence of a high energy gamma-active impurity may be made. The method has a lower limit of accurate detection of about 50 ppm of enhanced U in a sample volume of about 500 ml. (See also Y-1080.) (auth)

1316 AECD-3698
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
ASSAY OF ICPP URANIUM SOLUTIONS. S. G. Forbes. May 6, 1954. Decl. with deletions Nov. 17, 1955. 11p. Contract AT-(10-1)-205.

The method of non-destructive assay for U is being developed for application to CPP solutions. The equipment has been calibrated for product strength solutions and used for assaying some "unknowns." Additional work has also been done on solutions diluted to $^1/_{10}$ of product strength. Experimental data on calibration, assaying, and reproducibility tests are given. It appears feasible to obtain data with 1% standard deviation on product solutions with the present facility. (auth)

8444 USNRDL-TR-388
Naval Radiological Defense Lab., San Francisco.
RADIOCHEMICAL ANALYSES THROUGH POLAROGRAPHIC

INSTRUMENTATION AND CONTROL 5.11

CHEMICAL ANALYSIS 5.11.01

METHODS. II. A RAPID PROCEDURE FOR TECHNETIUM AND RUTHENIUM RADIONUCLIDES IN FISSION PRODUCTS. D. L. Love and A. E. Greendale. Nov. 24, 1959. 27p.

An electrochemical determination for Tc^{99m} in fission product mixtures was developed. The precision and accuracy of this method are better than the regular radiochemical methods and approximately fifty analyses may be made in one day. The number of fissions and the quantity of Mo^{99} are determined from the quantity of Tc^{99m} found in the fission product mixture. (auth)

6502 A/CONF.15/P/103
USE OF ELECTROCHEMICAL METHODS FOR REMOTE ANALYSES OF RADIOACTIVE SUBSTANCES OF THE VARIOUS STAGES OF REPROCESSING.
Ph. Mechelynck (Centre D'Étude de l'Énergie Nucleaire. 14p.

It was deemed appropriate, while investigating the Purex process on a semi-pilot scale at Mol, to devise an electrochemical method for the separate determination of uranium, plutonium and some fission products. This method is particularly suitable for analyses to be performed by remote control, in which only the electrolysis cell must be in the hot area. A complete setup was developed, in which uranium and plutonium dosages are made by a polarographic method. For concentrated solutions, the accuracy achieved is of the order of a few percentage points; for very dilute solutions (of the order of some 0.1 Gm U/l), an acceptable precision of ten to twenty percent is obtained. A constant current

15178 JENER-59
Joint Establishment for Nuclear Research, Kjeller, Norway.
REPROCESSING ANALYSIS. M. Bonnevie-Svendsen. Apr. 1959. 63p.

A plan for analytical control of the JENER reprocessing plant is presented. Methods and possibilities of associated chemical determinations are discussed as well as the organization of the analytical work. A manual of methods used at JENER is included as well as a tabulation of the concentrations, activities, aliquots, shielding, number of determinations, and calculated time for the various sampling points. Also, four different time schedules for the analytical work are suggested. (J.R.D.)

7456
PHOTOMETER FOR CONTINUOUS DETERMINATION OF URANIUM IN RADIOACTIVE PROCESS STREAMS. F. A. Scott and R. D. Dierks (General Electric Co., Richland, Wash.). Anal. Chem. 32, 268-72(1960) Feb.

A modified single-beam filter photometer for continuous determination of uranium in radioactive process streams is described. Because of a unique standardizing system, it is very stable, having a short-term variation of less than 1% and a calibration stability of 3%. The instrument has a remotely located sensing unit with the ruggedness and simplicity required for production plant applications. The performance of the instrument for monitoring nonradioactive process streams under plant conditions is given. (auth)

Development of Methods for Chemical Analysis of Uranium. T.W. Steele. S. African Inst Min and Met-J, 57, 4, Nov. 1956, p 144-52.

Methods for routine use on plant samples: classical, photometric, cellulose column, fluorometer, thiocyanate.

8443 PGR-78(W)
United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Windscale, Sellafield, England.
THE RADIOCHEMICAL DETERMINATION OF RUTHENIUM 103 AND 106 IN REACTOR FUEL PROCESSING AND PLANT SOLUTIONS. Dec. 1959. 11p. BIS.

A method for determining Ru^{103} and Ru^{106} in solutions containing mixed fission products is presented. Interchange between added carrier and radioruthenium in the sample is effected by boiling in alkaline solution in the presence of an oxidant. Ruthenium is extracted as tetroxide into carbon tetrachloride and precipitated as the dioxide. After mounting on stainless steel trays, the beta and gamma activities are measured. The observed activities are corrected for the chemical yield of the separation procedure, determined by absorptiometric measurement of a solution prepared from the source after counting. (auth)

INSTRUMENTATION AND CONTROL 5.11

CONTROL SYSTEMS 5.11.02

United Kingdom Atomic Energy Authority. Industrial Group H.Q., Risely, Lancs, England.
SOME RECENT DEVELOPMENTS IN AUTOMATIC CONTROL. Information Bibliography. A. F. Armstrong and G. I. Maughan. Oct. 1957. 40p. (IGRL-IB/R-33).

A wide selection of book and journal references (178), issued up to December 1956, covering automatic control of nuclear reactors, chemical processes, etc., with sections on servomechanisms, and noise in control systems. Sources searched included *Engineering Index* (1952-1955), together with *Industrial Arts Index* (1956), and *Science Abstracts "B"* (1952-1955).

4366 TID-7581(p.139-47)
Oak Ridge National Lab., Tenn.
SS MATERIAL INPUT MEASUREMENTS TO THE ORNL POWER REACTOR FUEL REPROCESSING PILOT PLANT. George S. Sadowski. 9p.

An interim pilot plant facility for processing power reactor fuels has been put into operation at Oak Ridge National Laboratory. This facility will investigate the modifications and additions required in existing solvent extraction technology to assure its usefulness in reprocessing the newer type civilian power reactor fuels and to undertake the development of new processes which may prove more economical and simple than the existing technology. The Purex Process is used for the solvent extraction process with various types of head-end treatments to prepare the irradiated fuels to a form suitable for solvent extraction. S. S. Material input to the pilot plant is determined after the dissolved metal solution is transferred to the feed input measurement vessel. A study is currently being carried out to determine the over-all limits of error for measurements of the uranium and plutonium input. Vessel instrumentation and calibration are discussed and the results obtained from solution mixing, sampling and analytical tests for the feed input measurement vessel are presented. (auth)

20449
PRIMENENIYE YADERNYKH IZLUCHENII V USTROYSTVAKH AVTOMATICHESKOGO KONTROLYA TEKHNOLOGICHESKIKH PROTSESSOV. (Application of Nuclear Radiation in Automatic Control of Production Processes.) Nikolay Nikolayevich Shumilovskii and Lel'Vladimirovich Mel'tser. Moscow, Gosenergoizdat, 1958. 95p.

The basic properties of nuclear radiation and radiation meters employed in automatic control systems are discussed. Examples of specific systems used in industry are given, and their principles of construction are described. Use of nuclear radiation in automatic process control resulted in large savings in labor and material; examples of such applications in Soviet industry are discussed. (TCO)

14457 AEC-tr-3628
UTILIZATION OF NUCLEAR RADIATION IN THE CONTROL AND AUTOMATION OF TECHNOLOGICAL PROCESSES IN THE USSR. (Využití Jaderného Záření v SSSR při Kontrole a Automatisaci Technologických Procesů.) N. N. Sumilovskij and L. V. Meltcer. Translated from Jaderna Energie 4, 45-56(1958). 37p. $6.30(ph), $3.00(mf) JCL or LC.

A survey of progress in the USSR in the field of radiation applications to automatic control is presented. Soviet industry developed original methods and instruments based on radioactivity. Ways to extend the present uses as well as methods of research and development of new systems are discussed. It is concluded that only the solution of the entire group of problems will satisfy the task requirements as set up by the Twentieth Congress of the CSPU. (J.R.D.)

2823 IDO-14420
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
CHEMICAL PROCESSING INSTRUMENTATION AND CONTROL RESEARCH PROGRAM. Harry Schneider. Sept. 18, 1957. 27p. Contract AT(10-1)-205. $1.00(OTS).

A program for the development of analytical instrumentation and improved control techniques using these instruments as applied to nuclear fuel reprocessing is currently being undertaken by the Chemical Development Section of the CPP Technical Branch. The program philosophy and objectives, a survey of the problems involved, general approach, lines of endeavor and specific applications are presented. (auth)

INSTRUMENTATION AND CONTROL 5.11

CONTROL SYSTEMS 5.11.02

11539
REMOTE ADJUSTMENT OF AUTOMATIC CONTROL SYSTEM. K. G. Macleish (to U. S. Atomic Energy Commission). U. S. Patent 2,797,050. June 25 1957.

An invention related to automatic temperature control and particularly concerned with the remote control and remote indication of temperature is described. A control potentiometer comprising a slide wire resistance and slider is automatically adjusted in response to temperature changes in a region to control a heat source and maintain a constant temperature in the region. Remote adjustment of the region temperature is accomplished by a manually adjustable resistance, which is arranged to vary the characteristics of the control potentiometer circuit. A voltmeter is connected in the circuit of the control potentiometer and placed at the remote location to indicate the region temperature. (auth)

5433
COMPUTERS, MATHEMATICS, STATISTICS, AND AUTOMATION. Arthur Rose (Applied Science Lab., Inc., State College, Pa.), R. Curtis Johnson (Washington Univ., St. Louis, Mo.), Richard L. Heiny (Dow Chemical Co., Midland, Mich.), Theodore J. Williams (Monsanto Chemical Co., Ohio), and Joan A. Schilk (Shell Development Co., Emeryville, Calif.). Ind. Eng. Chem. 49, 554-64(1957) March.

A literature review is presented which is divided into sections on: Theoretical Articles of Interest for Process Control; Use of Analogs to Simulate Process Dynamics and Control; Considerations in the Application of Process Control Components; Complete Instrumentation and Control Systems as Now Used; Applications of Digital Computers; Applications of Analog Computers; Instructional and Nontechnical Articles of General Interest. 147 references. (T.R.H.)

THE APPLICATION OF RADIATION IN AUTOMATIC CONTROL DEVICES. Yu. V. Gushchin, L. V. Melttser, and M. I. Tolokonnikov. Avtomat. i Telemekh. 18, No. 9, 814-40(1957).

The utilization of nuclear radiation in automatic control devices in the USSR is reviewed. Typical methods of using these devices are analyzed. The basic characteristics of α, β, and γ radiation are investigated and described. The most frequently used reception devices for the transformation of radiation into electrical energy, such as the ionization chamber, the Geiger tube, and the scintillation counter, are described. Various control devices used in industry are reviewed. The future development of automatic control is discussed. (J.S.R.)

4544
A REMOTE VACUUM-OPERATED PIPETTE CONTROLLER. Evan Wright (Wallaceville Animal Research Station, Wellington, New Zealand). Atomics 7, 30-1, 37(1956) Jan.

6399 A/CONF.15/P/2026
THE DEVELOPMENT OF METHODS OF REMOTE CONTROL OF OPERATIONS AT RADIOCHEMICAL LABORATORIES OF THE U.S.S.R. ACADEMY OF SCIENCES. G. N. Yakovlyev and V. B. Dedov (Academy of Sciences, U.S.S.R.). 22p.

One of the simplest designs of protective equipment and an automatic program device based on this principle are given. The equipment described, three-section lay-out of laboratories, and strict control over observance of safety rules ensure cleanliness in laboratories and protection of personnel from radiations. Application of the latest principles and means of process automation is of great importance for the development of remote-control equipment. This application, however, requires a preliminary estimation of expenditures. Rational approach to the solution of this problem has made it possible to work out a general type of laboratory equipment, which satisfies definite requirements. Various methods of satisfying these requirements and peculiarities of such equipment are discussed. Principles

5089 CEA-tr-R-724
APPAREIL POUR LA MESURE SANS CONTACT DE LA CONDUCTIBILITÉ ÉLECTRIQUE DES ÉLECTROLYTES ET AUTRES SUBSTANCES. (Apparatus for Measurement Without Contact of the Electric Conductivity of Electrolytes and Other Substances). L. M. Suvorov. Translated into French from Zavodskaya Lab. 24, 889-90(1958). 5p.

An apparatus and circuit are given for measuring electric conductivity by induced currents in the sample solution. The apparatus is useful in analytical chemistry, soil analysis, and corrosion studies. (T.R.H.)

INSTRUMENTATION AND CONTROL 5.11

ELECTRONIC COMPONENTS 5.11.03

See also, under PROCESS CHEMISTRY AND ENGINEERING,

RADIATION EFFECTS--On Electronic Components (6.15.02).

GENERAL (AND MISC.) 5.11.03.01

16146 DANATOM-04-59
Danish Assn. for Industrial Development of Atomic Energy, Hellerup.
KOMRONENT-PÅLIDELIGHED OG KOMPONENTFEJL I ELEKTRONISK UDSTYR. (Component Dependability and Failures in Electronic Equipment.) Egon Hansen. Mar. 1959. 48p.

The results of a literature search on component dependability are summarized, and the reliability and failures are analyzed. Techniques for measurement of the dependability were developed, and the basic laws governing the component dependability were determined. Electron tubes, semiconductors, condensers, resistors, and relays were considered. 67 references. (J.S.R.)

11787 SCTM-45-59(14)
Sandia Corp., Albuquerque, N. Mex.
RADIO-FREQUENCY SHIELDING OF CABLES. Charles W. Harrison, Jr. Feb. 28, 1959. 13p. Contract [AT-(29-1)-789]. $3.30(ph), $2.40(mf) OTS.

Cable shielding to minimize radiofrequency pickup is discussed briefly in a qualitative way. Guide lines for the design of effective shields for this purpose are set forth. (auth)

PULSE COUNTER. D. E. Trumbo (to U. S. Atomic Energy Commission). U. S. Patent 2,873,388. Feb. 10, 1959.

A transistorized pulse-counting circuit adapted for use with nuclear radiation detecting detecting devices to provide a small, light weight portable counter is reported. The small size and low power requirements of the transistor are of particular value in this instance. The circuit provides an adjustable count scale with a single transistor which is triggered by the accumulated charge on a storage capacitor.

16159 UCRL-3307(Rev.)
California. Univ., Berkeley. Lawrence Radiation Lab.
LAWRENCE RADIATION LABORATORY COUNTING HANDBOOK. Jan. 1, 1959. 224p. Contract W-7405-eng-48. $3.50(OTS).

A large number of nuclear counting devices are included with detailed descriptions and operating specifications. The listings are as follows: amplifiers, cables and coaxial components, coincidence systems and discriminators, components, definitions and standards, engineering performance and applications, oscilloscopes and monitoring, photomultipliers and scintillators, scalers and readout equipment, and wave-form generators and analyzers. (A.C.)

A SIMPLE PHASE SENSITIVE RECTIFIER FOR USE WITH RADIATION DETECTORS. J. C. S. Richards (Univ. of Aberdeen, Scotland). J. Sci. Instr. 35, 285-6 (1958) Aug.

The ratio of light to dark resistance of a cadmium selenide photocell is sufficiently great for the cell to be used effectively as a light controlled-switch. Where radiation incident on a detector is chopped at a frequency of less than 20 c/s, two such photocells can be used in a very simple arrangement to make a coherent demodulator which has the advantages of a mechanical rectifier without the usual disadvantages. (auth)

3481 TID-7557(p.117-39)
New York Operations Office. Health and Safety Lab., AEC.
RECENTLY DEVELOPED COMPONENTS FOR APPLICATION TO NUCLEAR ELECTRONIC EQUIPMENT. H. D. LeVine. p.117-39 [of] FIFTH INTERNATIONAL CONGRESS AND EXHIBITION OF ELECTRONICS AND ATOMIC ENERGY, ROME, ITALY, JUNE 16-30, 1958. (U. S. Papers). 23p.

A description is given of some new components that can be used in the design of nuclear equipment. Specifically, the expanding transistor component field, the subminiature parts, and special-purpose vacuum and photoemissive tube types are described. The benefits of the new types of components and the greater reliability achieved are also stressed. Methods of constructing photoetched circuits in the laboratory are described, as well as the potential of small-lot production. 21 references. (C.H.)

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ELECTRONIC COMPONENTS 5.11.03

GENERAL (AND MISC.) 5.11.03.01

252 CAL-HF-845-D-19
Cornell Aeronautical Lab., Inc., Buffalo.
DESIGN MANUAL OF METHODS OF FORCED AIR COOLING ELECTRONIC EQUIPMENT. June 1958. 238p. Contract NObsr-63043.

This Manual was prepared under the sponsorship of the Department of the Navy, Bureau of Ships, to aid electronic engineers in the thermal design of reliable electronic equipment. Principles and techniques to be followed in the design of electronic parts, assemblies, and equipments are outlined herein to permit heat transfer by forced convection to be reliably achieved. (auth)

12529
GRID CURRENT IN ELECTRON TUBES. E. Fairstein (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 29, 524-6(1958) June.

The outcome of an experimental study of grid current in currently produced low-power receiving tubes indicates that if the plate dissipation is kept below 75% of the manufacturers' ratings, the grid current is not primarily due to ionized gas, but to photoelectric emission from the grid under the action of soft x rays produced at the plate. A simple empirical formula is given for predicting the grid current from the operating conditions. Data are given for 11 tube types. (auth)

THERMISTORS FOR TIME LAG AUXILIARY RELAYS. F. Gustafsson. ASEA Journal 31, 13-15(1958).

The thermistor constitutes a simple and inexpensive means of delaying the pick-up of an auxiliary relay in those cases which do not call for great accuracy or for independence of variations in voltage and temperature. It requires little space, it can often be mounted directly on the relay terminal, it is suitable for use with both alternating and direct current, and it is easily fitted to relays which are already in use. (auth)

1671
FAST ELECTRONIC CIRCUITS FOR NUCLEAR PHYSICS. J. Mey (Centre d'Études Nucléaires, Saclay, France). Onde élec. 38, 622-8(1958) Aug.-Sept. (In French)

The purpose of fast electronic circuits in the field of nuclear physics is defined. A brief description is given of the techniques and solutions used to realize the principal functions needed, emphasizing the difficulties and limitations encountered. A review is given of particle detectors, amplifiers, scalers, discriminators, pulse-height analyzers, coincidence circuits, and time-of-flight analyzers. (auth)

8561 SCTM-316-57(14)
Sandia Corp., Albuquerque, N. Mex.
PRINTED CIRCUITS. George Voida. Nov. 25, 1957. 35p. Contract AT(29-1)-789. $6.30(ph OTS); $3.00(mf OTS).

Processes used in the production of printed circuits are described. A description is presented of the different measures used for maintaining the quality of printed circuits. The advantages of printed circuits in electronic packaging are enumerated. The importance of printed circuits in the advancement of miniaturization is emphasized. Also included is a glossary of the terminology used in the field of printed circuitry. (auth)

428
POWER SUPPLY FOR INTERCHANGING SCINTILLATION COUNTERS AND SCALERS. W. L. Scaff, K. E. Bagwell, and P. C. Johnson (Veterans Administration Hospital, Oklahoma City). Nucleonics 15, No. 9, 162, 164(1957) Sept.

10614 DP-215
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
A COLD CATHODE REGISTER. Malcolm H. Goosey. May 1957. 7p. Contract AT(07-2)-1. $0.15(OTS).

A 5-decade register has been developed that uses miniature glow-transfer tubes and cold-cathode trigger tubes. The unit features small size, low power consumption, and good reliability. It can be used in timing and medium-speed counting applications. (auth)

TOLERANCE LIMIT OF RESISTORS IN BINARY SCALING UNITS. B. M. Banerjee and Sneha Choudhury (Inst. of Nuclear Physics, Calcutta, India). Electronic Eng. 29, No. 351, 237-41(1957) May.

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6448
TRANSFORMERS IN NUCLEAR INSTRUMENTATION.
T. P. Lynott (Gardners Radio Ltd.). Nuclear Power 2, 135-8 (1957) Apr.
A résumé is presented of current design and manufacture of transformers with reference to nuclear applications. (W.L.H.)

14022 SCL-T-192
THE POLYSTYRENE CONDENSERS (CAPACITORS). (Les Condensateurs au Polystyrene). R. Leprince-Ringuet and J. Leautier. Translated by Marcel I. Weinreich (Sandia Corp.) from Onde électrique 37, 1083-8(1957). 12p.
Paper strips of 5 to 6 μ thickness have good dielectric coefficients of the order of magnitude of 6; however, the porousness of the paper must be remedied by impregnation, which reduces the dielectric constant from 6 to 4 or 5. Polystyrene, which has exceptional electrical characteristics, was used to improve the performance of the paper condensers. A condenser with polystyrene as the dielectric may be charged and preserved for months before its voltage shows any appreciable diminution. (A.C.)

10286 CREL-651
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
A.E.C.L. PREFERRED ELECTRONIC PARTS LIST. June–July 1956. 71p.
All parts listed have been chosen because of past reliable performance within AECL or elsewhere. (W.L.H.)

1983 UCRL-4712
California. Univ., Livermore. Radiation Lab.
ELECTRONICS COUNTING ROOMS FOR NUCLEAR RESEARCH. Alexander J. Stripeika. June 14, 1956. 23p. Contract W-7405-eng-48. $0.25(OTS).
This report describes six electronics areas at the Radiation Laboratory (Berkeley and Livermore) that are being successfully used with various particle accelerators for nuclear research. The electronics equipment, consisting of pulse amplifiers, scalers, coincidence circuits, pulse-height analyzers, automatic recording equipment, high-voltage supplies, etc., is arranged in such a manner that most experiments can be quickly set up, and a number of people can run experiments simultaneously. Advantages and limitations of these areas are discussed. (auth)

Navy Electronics Lab., San Diego, Calif.
NEL RELIABILITY BIBLIOGRAPHY. W. E. Jorgensen, I. G. Carison, and C. G. Gros, comps. May 1956. 103p. (NP-6447).
The bibliography contains 404 annotated references to published and report literature. The publications referenced in the bibliography include material published since 1950 and are listed under the appropriate subject heading from the following: Circuit design, Components, Electron tubes, Failure analysis, General, Human engineering, Maintenance, Mechanical design, Systems, and Testing.

3841 K-1272
Oak Ridge Gaseous Diffusion Plant, Tenn.
A SMALL AND INEXPENSIVE SIGNAL CAN FOR THE SPACE RECORDER. G. A. Smith. Apr. 25, 1956. 11p. Contract W-7405-Eng-26. $3.30(ph OTS); $2.40(mf OTS).
The design of a new signal can or ionization chamber to be used with the Space Recorder is discussed. The Space Recorder is an instrument used to measure concentrations of radioactive gas, normally less than 2%, in a non-radioactive gas such as nitrogen. These improvements were made primarily to reduce the cost and size of the unit. The new signal can is one-third the size of the old can, is appreciably lighter, and costs about one-fourth as much as the old signal can. The new can was extensively tested to determine that it is the functional equivalent of the older can. All signal cans required in the future will utilize this improved design. (auth)

1480
DESIGN FOR A SENSITIVE SELF-RECORDING GOLD-LEAF ELECTROSCOPE. P. Goodman (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia). J. Sci. Instr. 32, 439-40(1955) Nov.
The principle of operation and construction of a gold-leaf electroscope, capable with calibration of measuring steady

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electron currents of the order 10^{-14} amp is described. The output is in the form of voltage pulses, the frequency of which is proportional to current for low values, and logarithmically related for higher currents. (auth)

AMPLIFIERS 5.11.03.02

SPECIAL PURPOSE MULTIPLIER PHOTOTUBES FOR SCINTILLATION COUNTING. Frederick W. Schenkel (Allen B. Du Mont Labs., Inc., Passaic, N. J.). IRE Trans. Nuclear Sci. NS-5, 117-20(1958) Dec.

A discussion on linear and box-type multiplier phototubes is presented. Various aspects of dynode geometry and front-end design of the Du Mont linear type multiplier structure in regard to transit time and transit-time spread are discussed. Several methods of operation of the front end of a multiplier phototube are considered in order to determine the optimum conditions for collection efficiency and transit-time spread. The mechanical requirements of various linear multiplier phototube types are discussed briefly. The development of linear tube types has come about as a result of an increasing demand for fast tubes capable of delivering high peak pulse output currents. (auth)

STATUS OF MULTIPLIER-PHOTOTUBE DEVELOPMENT FOR SCINTILLATION COUNTERS. William Widmaier (RCA Electron Tube Div., Lancaster, Penna.). IRE Trans. Nuclear Sci. NS-5, 114-17(1958) Dec.

A number of recent developments have contributed to the design of multiplier phototubes having improved time discrimination, as well as improved pulse-height resolution. In the 6810-A, a modified version of the first commercial high-gain, high-speed tube, a curved faceplate (flat on the outside) is used to reduce transit-time variations in the region between the photocathode and the first dynode. Special geometrical construction is used to minimize transit-time spread in the 7046 five-inch tube. Curvature of the inner faceplate is also used to improve pulse-height resolution and time discrimination of developmental versions of the 6342 and the 6655. In a new developmental tube, RCA Dev. No. C-7251, cathode curvature is combined with a new electrode structure between the cathode and the multiplier structure to reduce transit-time spread to less than a few tenths of a millimicrosecond. (auth)

LINEAR AMPLIFIER FOR NEGATIVE PULSES. A. S. Penfold (Univ. of Chicago). Rev. Sci. Instr. 29, 765-6 (1958) Sept.

A two-tube, noninverting, linear amplifier is described. It has a gain of 100 and an inherent rise time of 50 mμsec for outputs up to 125 v. The amplifier recovers promptly from pulses which overload it a factor of 100. (auth)

10772

D. C. AMPLIFIERS FOR REACTOR INSTRUMENTATION. M. W. Jervis (AEI-John Thompson Nuclear Energy Co., Ltd.). Nuclear Power 3, 275-9(1958) June.

Large indicators, recorders, and relays in alarm circuits require relatively large operating forces and it is necessary to interpose some form of d.c. power amplifier between the detector and the display equipment or alarm and safety system. The various types available are described. (W.D.M.)

11563 AECU-3734

Du Mont (Allen B.) Labs., Inc. Tube Operations-[Engineering], Passaic, N. J.

EVALUATION OF FOREIGN MULTIPLIER PHOTOTUBES. John Bolakas and Percy G. Parker. [1958]. 30p. Contract AT(30-1)-1336. $4.80(ph OTS); $2.70 (mf OTS).

Several multiplier phototubes produced by England, Russia, or Switzerland were evaluated for amplification, photocathode sensitivity, photoelectron collection efficiency, cathode uniformity, and dark current. A description of the various tubes by designation numbers is given, along with a description of techniques and equipment used in testing. (J.R.D.)

11544

STABLE PHOTOMULTIPLIER AMPLIFIER. L. K. Neher (to U. S. Atomic Energy Commission). U. S. Patent 2,798,165. July 2, 1957.

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AMPLIFIERS 5.11.03.02

A photomultiplier tube circuit for use in the measurement of light intensities creating transient steep wave fronts is described. The novelty of the present invention resides in the discovery that the utilization of resistors of critical damping value in series with any pair of dynodes in a photomultiplier tube results in completely stabilizing the circuit associated with the pairs of dynodes. (auth)

1518
AMPLITUDES AND TRANSIENT CHARACTERISTICS OF A NEW PHOTOMULTIPLIER. G. S. Vil'dgrube, A. P. Zharkov, and E. D. Teterin. (Khlopin Radium Inst.). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 21, 1034-5(1957) July. (In Russian)

RECENT NEUTRON DETECTOR STUDIES AT ARGONNE NATIONAL LABORATORY. G. F. Erickson, S. G. Kaufmann, and L. E. Pahis (Argonne National Lab., Lemont, Ill.). IRE Trans. Nuclear Sci. NS-3, No. 3, 8-10(1956) June.

A neutron sensitive photomultiplier tube has been built and tested in line with a program to investigate unconventional mechanisms of neutron detection. A fission counter following established principles has been designed with emphasis on minimum demands on skill and labor during construction and assembly, and minimum over-all cost. (auth)

6438 BNL-2917
Brookhaven National Lab., Upton, N. Y.
SELECTION OF THE INPUT TUBE FOR A LOW-NOISE PREAMPLIFIER. A. T. Moffet and R. L. Chase. [1956]. 4p. $1.80(ph OTS); $1.80(mf OTS).

A study was made of a number of common tube types which might be suitable for use in the preamplifier for an ionization chamber used in α spectrometry. The line width for simulated α pulses with several tube types are tabulated. The E83F appears to be the best tube for low noise preamplifier service. (B.J.H.)

LEAK DETECTORS 5.11.04

2901 ✓ HW-57700
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PRTR PROCESS CHANNEL LEAK DETECTION FACILITY. Final Report—Design Test PR-63. R. F. Scheloske. Oct. 28, 1958. 11p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

The core of the Plutonium Recycle Test Reactor (PRTR) is filled with water. A leak of any finite size from any of the many possible sources may constitute a serious reactor operational problem. The helium gas filling the annulus or process channel between the process tube and Al shroud tube of the calandria is to act as the leak detection medium for either process tube or shroud tube leaks. A single process channel test facility was constructed for this design test. From results of this test, it is concluded that a leak detection system based on the change of the dew point of the He gas pass-

2551 ✓ Y-1275
Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
PRODUCTION LEAK RATE DETECTION SYSTEMS. Harry S. Corey, III. Apr. 13, 1959. 27p. Contract W-7405-eng-26. OTS.

A discussion of the evolution of leak rate determination methods and systems, for the routine checking of sealed assemblies on a production basis in the Y-12 Plant, is presented. (auth)

5364 ✓
LEAK DETECTION. W. Steckelmacher (Edwards High Vacuum Ltd., [Sussex, Eng.]). Nuclear Eng. 4, 450-3(1959) Dec.

Methods of leak detection of both the vacuum test and positive pressure test type are reviewed. The application, advantages, and operating principle of each type are discussed. (C.J.G.)

LEAKAGE TESTING METHOD. Wm. A. McAdams and M. H. Foss (to U. S. Atomic Energy Commission). U. S. Patent 2,846,872. Aug. 12, 1958.

A method of testing containers for leaks is described, particularly the testing of containers or cans in which the uranium slugs for nuclear reactors are jacketed. This method involves the immersion of the can in water

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under 150 pounds of pressure, then removing, drying, and coating the can with anhydrous copper sulfate. Any water absorbed by the can under pressure will exude and discolor the copper sulfate in the area about the leak.

11415 ✓
LOCATION OF LEAKS WITH RADIOISOTOPES IN MULTIWALLED TANKS. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 75, Session 1. William F. Sullivan and James R. Coleman (National Lead Co., Sayreville, N. J.). New York, American Institute of Chemical Engineers, 1958. 9p.

A technique is described for locating leaks in multiwalled tanks and has been successfully applied to the location of leaks in lead lined, wooden tanks. By dissolving radioiodine in an oil layer, it is possible to introduce the isotope into the leak channel and then remove all surplus radioactivity from the tank. Residual radioactivity is detected with a portable survey meter and the original leak site located readily by external measurement. (auth)

AN OMEGATRON LEAK DETECTOR. D. Charles and R. J. Warnecke. Vide 12, No. 73, 25-45(1958) Jan.-Feb. (In French)

A detailed description is given of an omegatron leak detector. Using Ar as tracer in dynamic operation, leaks of the order of 10^{-4} mm^3/hr can be rapidly detected, and it is possible to detect very small leaks of the order of 10^{-8} mm^3/hr by accumulation. (tr-auth)

CALIBRATION OF A SPECTROMETER LEAK DETECTOR. R. Geller. Vide 12, No. 73, 3-14(1958) Jan.-Feb. (In French)

Methods of calibration of a spectrometer leak detector are studied, and the sensitivity of the instrument is discussed. (tr-auth)

METHOD AND APPARATUS FOR DETECTING LEAKS IN PIPELINES. J. F. Cameron and S. Jefferson (to U. K. Atomic Energy Authority). British Patent 774,136. Nuclear Eng. 2, 408(1957) Sept.

A radioactive solution is injected into fluid flowing in the pipeline behind which a first squee-gee go-devil is introduced. After an interval sufficient to enable the non-radioactive solution to flush the inside of the line clear of radioactivity a second squee-gee go-devil is introduced with a radioactivity recording detector. This detector is recovered at a remote point and the record of any activity is then transcribed in terms of distance along the line. To check the distance, the record may be marked at intervals by arranging sources of radioactivity at certain points along the line which will make a characteristic signal. For penetrating thick metal pipes gamma radioactivity is necessary and detectors with Geiger counters or scintillation detectors. (auth)

9470 ✓ CF-57-5-96
Oak Ridge National Lab., Tenn.
FINAL PROCESS DESIGN FOR LEAK DETECTOR SYSTEM FOR SPECIAL FLANGES. E. A. Mason. May 29, 1957. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The leak detector system consists of one gas pressurized reservoir containing heavy water, a tubing manifold connecting the pressurizer to six separate lines each connected to one of the flanges, tubing lines leading from the second hole on each of three flange pairs (dome and heat exchanger flanges) back into the instrument room, plus required valves and fittings. A schematic diagram of the system is included. (M.H.R.)

6585 ✓
LEAK DETECTION UNIT. A. Bell (to Foster Wheeler Ltd.). British Patent 765,239. Nuclear Eng. 2, 172(1957) Apr.

The detector unit at one of the danger points (e.g., a gland) comprises two chambers separated by a membrane. One of the chambers communicates with the sealing-gas space, the other with an indicating instrument. If liquid Na leaks from the system it contacts the membrane, which will be perforated, and the Na can then react with the sealing gas to form a smoke of oxide carried to the indicator. As a membrane, Klingerit 1000 is used. (auth)

A NEW TYPE OF VACUUM LEAK DETECTOR. F. L. Torney, Jr. (NRC Equipment Corp., Newton, Mass.). pp. 115-19 in "1957 Fourth National Symposium on Vacuum Technology Transactions."

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A new type of halogen leak detector, having a sensitivity which approaches that of a helium mass spectrometer, is described. This paper outlines in detail the reasons for selecting this new approach and the details of circuit design which accomplish this end. Operational characteristics of a halogen sensing element are discussed and their influence on circuit design is analyzed. A brief discussion of the advantages and disadvantages of this method is given, with particular emphasis on the electronic circuit design parameters which make these advantages possible. (auth)

6320 ERG-33
[Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.]
LEAK DETECTION IN DOUBLE WALLED HEAT EXCHANGER TUBES. W. E. Simmons. [195?]. Decl. Jan. 30, 1957. 6p.
It is proposed to form heat exchanger tubes with double walls separated by a rectangular thread, enabling heat transfer to take place across the thread and leaving a spiral groove into which any leaks would occur and be capable of detection. The investigation into the time lag in detection of various leaks is described. (auth)

4324 AERE-GP/M-189
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE 1441A OXYGEN LEAK DETECTOR. R. S. Barton. Jan. 1956. 13p.
An auxiliary power pack, designed for use in conjunction with the 1075 ionization gage control unit, has been developed for the purpose of rapidly converting an ionization gage, used in a vacuum system for pressure measurements, into a diode for leak detection using O_2 as the probe gas. Entrance of the gas into the vacuum envelope leads to a decay of electron emission from the hot cathode of the diode and this is observed on a meter suitably positioned in the gage circuit. A description is given of experiments made to obtain the information necessary for the design of the above mentioned pack followed by a brief description of the type finally built for stores issue. (auth)

LEAK DETECTOR. R. Loevinger, T. A. Chubb, and G. W. Monk (to U. S. Atomic Energy Commission). U. S. Patent 2,727,995. December 20, 1955.
A leak detector is described using He or other appropriate gas for the detection of leaks in tanks, housing, or other equipment where it is necessary to know the effectiveness of the seal or air tightness thereof in connection with maintaining vacuum or pressures therein. If He is used as the gas, it can only enter the detector through the sealed chamber to be tested thus providing an indication of any leak.

RADIATION MEASUREMENT 5.11.05

ALPHA 5.11.05.01

1287 DP-302
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
AN ALPHA MONITOR FOR PROCESS STREAMS. William L. Pillinger. July 1958. 17p. Contract AT(07-2)-1. $0.50(OTS).
A scintillation counter was developed that measures alpha activity in a process stream. The instrument was demonstrated with plutonium solutions that ranged in activity from 10^3 to 10^7 d/m-ml. Plutonium concentration could be determined to ± 10% when the monitor was operated within a span of three decades or less. (auth)

415
AN AUTOMATIC MONITOR FOR URANIUM CONTAINED IN THE AIR. I. Iori and T. Rossini (CISE Labs., Milano). Energia nucleare (Milan) 4, 319-22(1957) Aug.
An automatic and fast instrument for the measurement of alpha radioactivity in the air is described. It is particularly suitable in laboratories where uranium and its salts are handled, because it distinguishes the alpha radioactivity by uranium from that by radon. (auth)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
INFORMATION FOR THE APPLICATION OF A CONTACT ALPHA MONITOR. P. E. Brown. Mar. 26, 1957. Decl. June 15, 1959. 10p. Contract W-31-109-Eng-52. $1.80(ph), $1.80(mf) OTS.

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A scintillation-type α monitor is described which was designed to be used with the sensing element directly in contact with the process solutions. The α particles interacting with the zinc sulfide phosphor produce scintillations detectable with a multiplier phototube and the required electron counting apparatus. Application of the monitor to the measurement of Pu concentration in aqueous solutions is discussed. (C.H.)

AN ALPHA MONITOR FOR WASTE STREAMS. Edward C. Wingfield. Jan. 1957. 8p. (DP-197)

A continuous alpha monitor was developed for aqueous streams that may contain traces of radioactivity. A scintillation screen was submerged directly in the water. The instrument detected concentrations as low as 3.3×10^{-10} curie/ml. The monitor's sample cell could be decontaminated easily if background activity accumulated within it.

7372 AEC-tr-3154
CHARACTERISTICS AND OPERATING MECHANISM OF GERMANIUM-HOLE ALPHA COUNTERS. A. V. Airapetyants and S. M. Ryvkin (Rykin). Translated from Zhur. Tekh. Fiz. 27, 95-105(1957). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 6478.

14386 HW-41525
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DESIGN CRITERIA IN-LINE ALPHA MONITOR. N. T. Hildreth. Feb. 22, 1956. 17p. Contract [W-31-109-Eng-52]. $3.30(ph), $2.40(mf) OTS.

Design requirements for a Redox or Purex in-line alpha monitor for process control are given. (T.R.H.)

A SURVEY METER FOR URANIUM AND PLUTONIUM. A. H. Dexter. Nov. 1954. 23p. (DP-62)

A survey meter was developed to distinguish Pu contamination from U. The instrument consists of an alpha counter with a very shallow sensitive depth and a means for accurately positioning the alpha counter relative to the source of contamination. Since the alpha particles emitted by Pu have a greater range in air than those emitted by U, the instrument can identify the contaminant by measuring the range of alpha particles which are emitted. The survey meter is a self-contained portable instrument which operates on 110 v a-c.

BETA 5.11.05.02

20991 IGR-212(O/W)
United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
ANALYTICAL METHOD FOR THE DETERMINATION OF BETA-ACTIVITY (TRANSMITTED THROUGH A TOTAL ABSORBER THICKNESS 5mg Al/sq.cm) IN PLUTONIUM PLANT SOLUTIONS AND EFFLUENTS. July 1, 1959. 6p.

A measured portion of the sample is evaporated to dryness on a stainless-steel counting tray. The β-activity of the residue is measured using standard G.M. equipment with a thin-end-window counting tube. The equipment is calibrated against standard strontium-90/yttrium-90 sources in equilibrium, prepared from solutions of known strontium-90 content and the observed activity is expressed as d.p.m. Sr^{90}/Y^{90}. (auth)

19117 AECU-4232
Radiochemistry, Inc., Louisville, Ky.
MEDIUM LOW-LEVEL SOFT-BETA COUNTING EQUIPMENT. James E. Lewis. June 15, 1959. 35p. Contract AT(11-1)-530. $6.30(ph), $3.00(mf) OTS.

Developmental studies of a reliable inexpensive scalar, high voltage supply, counter, and counter gas are described. Several organic and inorganic gases were examined for counter properties which permit buzz-bomb packaging and at the same time Geiger characteristics. Results of the study indicate that there is little chance of finding a single Geiger gas suitable for buzz-bomb packaging; however, mixtures of ammonia and argon appear promising as do freons and genetrons. Development work on absolute flow counters for weak beta emitters at medium and low levels of activity was essentially completed. (J.R.D.)

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16572
THE DESIGN, PERFORMANCE AND USE OF FISSION COUNTERS. W. Abson, P. G. Salmon, and S. Pyrah (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Conf. 3, 201-9 (1958) July.

The basic design criteria for electron-collection fission counters are discussed; data are presented on the effect of thickness of fissile material on sensitivity and the effect of electrode spacing and gas pressure on pulse height. High detection efficiencies are obtained with electrode coatings of 1 mg/cm^2, and thicknesses up to 2 mg/cm^2 may be used when high sensitivities are required. When argon is used as the filling gas the product of gas pressure and electrode spacing (pd, in atmosphere-cm) should lie in the region 0.4 to 1.0, the

SIMPLE ABSOLUTE MEASUREMENT TECHNIQUE FOR BETA RADIOACTIVITY. APPLICATION TO NATURALLY RADIOACTIVE RUBIDIUM. W. F. Libby (Carnegie Inst. of Washington, D. C.). Anal. Chem. 29, 1566-70(1957) Nov.

Simple technique of measuring absolute radioactivity of solids and liquids by placing them in a cylindrical position around an ordinary Geiger counter gives results which agree with true absolute assays. Technique is used to measure half life of naturally radioactive rubidium. Method could be useful in introducing isotopes into chemistry classrooms. (auth)

424
SCINTILLATION COUNTING OF BETA EMITTERS. Presented at International Conference on Radioisotopes in Scientific Research held Sept. 9-20, 1957 at Paris. No. UNESCO/RIC/NS/204. H. H. Seliger. London, Pergamon Press, Ltd., 1957. 10p.

6818 ORNL-2298
Oak Ridge National Lab., Tenn.
RESPONSE OF THE ANTHRACENE SCINTILLATION COUNTER TO LOW ENERGY ELECTRONS. Lloyd W. Johnston, R. D. Birkhoff, J. S. Cheka, H. H. Hubbell, and B. G. Saunders. May 9, 1957. 46p. Contract W-7405-eng-26. $0.35(OTS).

Crystals of 0.060- and 0.011-inch thickness with a conical reflector to prevent loss of light were used. For electrons of energies ranging from 10 to 120 kev, the pulse height response is linear with energy within experimental error. The shape of the pulse height distribution curve closely approximates a Gaussian, and there is a linear relationship between energy and the square of the half widths at 1/e. The average amounts of energy required to produce a photoelectron, as calculated from these experiments, were 1.47 and 1.31 kev for crystals of 0.060 and 0.011-inch thickness, respectively. (M.H.R.)

LOW-BACKGROUND COUNTER FOR SOLID β-EMITTING SAMPLES. S. D. Softky and R. E. Nather (Tracerlab, Inc., Richmond, Calif.). Nucleonics 15, No. 5, 90, 92-3(1957) May.

A counting arrangement which employs Epon resin for the central counter body surrounded by an anticoincidence "umbrella" of 11 G-M tubes is described. The photosensitivity and "memory effect" of Epon resin were eliminated by adding lampblack. The standard deviation of the backgrounds observed was 0.01 cpm reflecting a limit of sensitivity of 0.05 cpm for the assembly. (T.R.H.)

9567
IONIZATION CHAMBER FOR FISSION COUNTING. M. J. Bartkus, H. A. Kermicle, and J. H. Lykins (to U. S. Atomic Energy Commission). U. S. Patent 2,790,919. Apr. 30, 1957.

Improvements for ionization chambers that minimize maintenance and reduce fission counting dead time are given. Nitrogen replaces air which speeds up the electron collecting time. The spacing between the electrode has been reduced, thereby lowering the alpha background pulse; and one electrode has been reduced in size, permitting, by reason of lowered capacitance, a greater signal output per unit charge. Reflection of the neutron flux is enhanced by the use of paraffin as the reflector material. Other changes are incorporated as efficiency and maintenance improvements. (auth)

7263 AERE-C/R-2054
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE SELF-ABSORPTION AND WINDOW-ABSORPTION CORRECTION IN THE 2π β-PROPORTIONAL COUNTER FOR CERTAIN FISSION PRODUCTS. PART 2. J. G. Cuninghame, M. L. Sizeland, and H. H. Willis. Feb. 1957. 23p.

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167
IMPROVEMENTS IN THE DETECTION OF BETA PARTICLES BY COOLING THE PHOTOMULTIPLIER. J. Deutsch and P. C. Macq (Univ. of Louvain, Belgium). Ann. soc. sci. Bruxelles 71, No. 3, 172-7(1957). (In French)

A cooling device for photomultipliers is described; their response to anthracene scintillations is studied as well as their thermal noise in the range of temperature between −42°C and +23°C. The temperature coefficient of the response is found to be −0.18 ± 0.06%/°C. Consequently, in some cases, one might have to arrange for stabilizing the temperature of detection systems. The minimum energy required for electrons to be detected by an anthracene—RCA 5819 system can be decreased by approximately 50 kev if the photomultiplier is cooled down to about −40°C. (auth)

8108
LIQUID MONITORING DEVICE. W. M. Hurst (to U. S. Atomic Energy Commission). U. S. Patent 2,738,426, Mar. 13, 1956.

A liquid monitoring device was designed to indicate the radioactivity level in water, especially β. Water tangentially enters a cylindrical container and a vortex is produced by mechanically rotating the cylinder producing a wall of water as thick as probable beta ray penetration. A thin window proportional counter extends down into the vortex. This arrangement leaves the counter relatively free of contamination by splashing, but forms a water blanket about the counter thick enough to measure the expected low beta radiation activity level. Water is continuously flowing through the monitor and out through a bottom egress giving a continued indication of the activity level. This device is especially useful to monitor potable water supplies in the vicinity of nuclear reactors or radioactive waste storage sites. (auth)

3031 UCRL-3210
California. Univ., Berkeley. Radiation Lab.
A SCINTILLATION COUNTER FOR PAPER CHROMATOGRAMS. K. Steenberg and Andrew A. Benson. Dec. 5, 1955. 5p. Contract W-7405-eng-48. $0.15(OTS)

A large-diameter scintillation counter suitable for measurement of the soft beta emitters C^{14}, S^{35}, and Ca^{45} has been developed. The counter offers a solution to problems of geometry errors in counting the irregular radioactive areas of paper chromatographs. (auth)

1479
HOW TO MEASURE BETA ACTIVITY OF FISSION PARTICLES USING FILM. Clarence Skillern (Univ. of Calif., Los Alamos, New Mexico). Nucleonics 13, No. 12, 54-6(1955) Dec.

A radioautographic method of using x-ray and photographic films to measure the beta activity of particles containing fission products is described. Measurements are limited to activity from isolated point sources. Results for various types of x-ray film are shown. (B.J.H.)

977
DISINTEGRATION RATE DETERMINATION BY 4 π-COUNTING. PART III. ABSORPTION AND SCATTERING OF β RADIATION. B. D. Pate and L. Yaffe (McGill Univ. Montreal, Quebec, Canada). Can. J. Chem. 33, 1656-68 (1955) Nov.

The "coincident discharges" in a 4π counter have been examined and found to be due in the main to gas and wall backscattering. This can be resolved into two components, scattering near to and far from the source. Curves have been obtained for the backscattering of β radiation by the source-mounting film and for the absorption of the incident and backscattered radiation. Backscattering by the film is shown to be great enough to introduce a large error into the "sandwich" method which is currently in use for correcting for source-mount absorption. (auth)

3324 ORNL-1064
Oak Ridge National Lab., Tenn.
RADIOACTIVITY OF DISSOLVER GAS. W. A. Brooksbank and E. J. Fuller. Aug. 26, 1953. Decl. Nov. 22, 1955. 32p. Contract W-7405-Eng-26.

The development at ORNL of a method for measuring β activity in the gases from the dissolving of reactor fuel elements at the Chemical Processing Plant in Idaho is reviewed. This method and apparatus were designed to make dilutions of the original gas sample and thus allow a wide range of activities to be measured, to remove the

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radioactive iodine and count only radioactive xenon and krypton, and to count the sample at known dilution, temperature, pressure, volume, and geometry. The results of initial tests have been favorable, and it is concluded that the method is ready for subsequent use in Idaho. (auth)

5325 HW-28047
Hanford Works, Richland, Wash.
BETA IN LINE MONITOR FOR RCU STREAM. M. B. Leboeuf and R. E. Connally. May 15, 1953. Decl. Jan. 7, 1956. 6p. Contract [W-31-109-eng-52]. $1.80(ph OTS); $1.80(mf OTS).

Interest was expressed in continuously monitoring the β activity of the uranyl nitrate solution pumped to the RCU receiver tank, to facilitate operation at higher flow rates and with younger feeds. A β scintillation detector was developed which should make this feasible, and it is proposed that it be tested on stream for this use. This letter is in reply to your request for information on the type of installation required. The monitor consists of a β scintillation detector, a pre-amplifier, a counting rate meter, and a recorder, if desired. The detector element is an anthracene crystal. A β particle emitted in the solution can penetrate the Teflon window and produce ionization in the crystal. This results in a light scintillation which is "seen" by the photomultiplier tube, thus producing an electrical pulse. A pre-amplifier increases the pulse size sufficiently so that it can be transmitted to a remote location and counted by a counting rate meter. The counting rate meter then continuously indicates the β activity level of the solution. The response to β and γ radiation is fairly similar to that of a standard mica window G-M tube. It is necessary to shield the detector with lead to reduce the background counting rate. (auth)

6725 A/CONF.15/P/1208
QUELQUES REMARQUES SUR LA MESURE ABSOLUE DES EMETTEURS β AU COMPTEUR 4 π. (Some Remarks Concerning the Absolute Measurement of β Emitters by the 4 π Counter.) B. Grinberg and Y. Le Gallic (Commissariat à l'Énergie Atomique, Paris). 11p.

The precision obtainable with a proportional or Geiger-Mueller 4 π counter in the determination of radioactivities depends on the precision with which the various corrections are evaluated. One of the most important corrections is the correction for absorption in the film serving as support for the source. To determine conditions in which the absorption could be maintained at a negligible level, a study was made with a 4π Geiger-Mueller tube. The performance of the tube using very thin films was determined. Film thicknesses of 5 $\mu g/cm^2$ were obtained, and such films made it possible to eliminate completely the absorption correction for energies higher than 0.3 Mev. For

6716 A/CONF.15/P/554
LOW LEVEL COUNTING OF BETA EMITTERS. G. W. Barendsen (National Health Research Council T.N.O., Rijswijk-ZH, The Netherlands). 10p.

The factors relevant to the choice of the counting method in order to obtain the best signal-to-noise ratio possible are discussed. The construction of a special counter is described for the measurement of beta radiation of medium and high energy from samples with a very low specific activity. The counter consists of two counters with 60 cm^2 windows facing each other. The samples are mounted between the windows, thereby approximating 4π geometry. (W.D.M.)

6891 A/CONF.15/P/2106
RAPID ASSESSMENT OF SURFACE RADIOACTIVE CONTAMINATION. F. Běhounek (Karlova Univ., Prague). 8p.

The determination of extended surface radioactive contamination by the usual β-ray counting is lengthy, unprecise, and unsensitive. It can be effected very quickly and with high degree of sensitivity when using the method of discharge of a conductor by the ions produced by the β rays of contaminating radioisotopes. The rate of discharge is directly proportional to the first power of the ion density in the vicinity of the conductor and to the square root of the surface specific activity. The experimental arrangement is very simple. The conductor, a piece of aluminum wire, is screwed on the charging plug of a routine pocket stylo-electrometer. The wire is placed in a distance of 10 cm from the active surface and parallel to it. Specific activities as low as 10^{-4} c/cm^2 of β emitters can be assessed within a few minutes with an accuracy of at least 15 per cent. (auth)

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11779 DP-342
Du Pont de Nemours (E. I.) & Co. Savannah River Lab. Augusta, Ga.
A GAMMA MONITOR FOR LIQUID STREAMS.
Edward C. Wingfield. Dec. 1958. 9p. Contract AT (07-2)-1. $0.50(OTS).
A simple and reliable instrument was developed for indicating the gamma activity from fission products in a liquid stream. The range of the instrument was from zero to 12,500 c/(min)(ml). (auth)

13438 AECU-4105
Idaho. Univ., Moscow.
A NULL BALANCE X-RAY ABSORPTION INSTRUMENT FOR CHEMICAL PROCESS MONITORING (thesis).
Bill Everett Dozer. 1959. 62p. [For General Electric Co. Hanford Atomic Products Operation]. $10.80(ph), $3.90(mf) OTS.
The object of this investigation was to design and build an x-ray absorption instrument for measuring heavy element concentration in liquid streams. A detailed description of the instrument along with its sensitivity is given. (W.L.H.)

10270 ✓
METHOD AND MEANS FOR RADIATION DOSIMETRY.
J. W. Shulte and J. F. Suttle (to U. S. Atomic Energy Commission). U. S. Patent 2,824,234. Feb. 18, 1958.
This patent relates to a method and device for determining quantities of gamma radiation and x radiation by exposing to such radiation a mixture of a purified halogenated hydrocarbon chosen from the class consisting of chloroform, bromoform, tetrachloroethane and 1,1,2-trichloroethane, and a minor quantity of a sensitizer chosen from the class consisting of oxygen, benzoyl peroxide, sodium peroxide, and nitrobenzene, the proportion of the sensitizer being at least about 10^{-5} moles per cubic centimeter of halogenated hydrocarbon, the total amount of sensitizer depending upon the range of radiation to be measured, and chemically measuring the amount of decomposition generated by the irradiation of the sensitized halogenated hydrocarbon.

8606 ✓
GAMMA HODOSCOPE. B. S. Dzelepov. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 21, No. 12, 1580-2(1957) Dec. (In Russian)
The working principle of a device for measuring weak intensities of hard γ spectra (γ-ray intensity less than 10^{-5}) is described and evaluated. (R.V.J.)

1519
A WELL SCINTILLATION COUNTER FOR IMPROVED VOLUME EFFICIENCY. William J. MacIntyre and James H. Christie (Highland View Hospital and Western Reserve Univ., Cleveland, Ohio). J. Lab. Clin. Med. 50, 653-6(1957) Oct.

8595
RADIATION DETECTOR. Roy Pasqual Mazzagatti (to Texaco Development Corp.). British Patent 819,561. Sept. 2, 1959.
A pulse-type gas-amplification gamma detector for high-temperature service is described. The construction is of stainless steel, including cathode plates and anode wire. Techniques for constructing the device so as to have a minimum of oxidation and contamination of the filler gas are described. It can be outgassed at temperatures up to 800°F before filling. (T.R.H.)

3073
GAMMA-DETECTION EFFICIENCY OF ORGANIC PHOSPHORS. K. I. Roulston and S. I. H. Naqvi (Univ. of Manitoba, Winnipeg, Can.). Nucleonics 15, No. 10, 86 (1957) Oct.
A nomogram and accompanying curves are presented which make possible a rapid determination of the detection efficiency of an organic phosphor. (L.T.W.)

1520
PRACTICAL USE OF AN IONISATION CHAMBER FOR THE DETERMINATION OF ABSOLUTE INTENSITY OF GAMMA RAYS. P. Savel. J. phys. radium 18, 518-19(1957) Aug.-Sept. (In French)
The efficiency of an ionization chamber for γ rays having been determined, a formula is given for the calculation of the absolute value of a γ ray source, upon the condition that the disintegration scheme is known. (auth)

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GAMMA-RAY DETECTORS. (to Texaco Development Corp. (U.S.A.).) British Patent 770,857. Nuclear Eng. 2, 306(1957) July.

The conventional Geiger-Mueller counter can be made more efficient by filling with a mixture of the rare gases but there remains still the "dead time", i.e., the time interval during which the counter is insensitive after recording a count. The length of the dead time becomes very important where a high intensity of gamma rays is to be measured. A detector of the multi-cathode plate type is 5 to 10 times more efficient than the conventional counter. Its dead time with a filling of a mixture of A and anhydrous NH_3 is about 100 μsec. This time can be reduced as much as 50% by a filling of a mixture of A (19.9 to 65%), He (25 to 80%) and a small proportion of anhydrous NH_3 (0.1 to 10%). The more He is present, the shorter will be the dead time up to an optimum of 77% He, 20% A, and 3% anhydrous NH_3. (auth)

AN APPARATUS WITH LOGARITHMIC SCALE FOR THE MEASUREMENT OF γ-RAY INTENSITY. Robert Genin. J. phys. radium 18, Suppl. No. 3, 36A-8A(1957) Mar. (In French)

6819 UCRL-3434
California. Univ., Berkeley. Radiation Lab.
SCINTILLATION DETECTION OF VERY-LOW-ENERGY GAMMA RAYS. J. C. Hubbs and W. A. Nierenberg. June 4, 1956. 7p. Contract W-7405-eng-48. $0.15(OTS).

A method is reported for the detection of very-low-energy γ rays. The method utilizes scintillation detection with NaI-TlI crystals especially split and mounted for the work, and selected single 5819 or 6292 photomultipliers. Typical performance is unit (2π) efficiency with background of 1 count per minute for γ energies between 5 and 100 kev. (auth)

3842 K-1284
Oak Ridge Gaseous Diffusion Plant. Tenn.
IMPROVEMENTS TO THE ARGON GAMMAGRAPH—A WIDE RANGE GAMMA MONITOR. G. A. Smith. May 3, 1956. 26p. Contract W-7405-Eng-26. $0.25(OTS).

2113
CAVITY ION CHAMBER THEORY. P. R. J. Burch (Univ. of Leeds, England). Radiation Research 3, 361-78(1955) Dec.

A method is presented of cavity ionization chamber dosimetry of x and γ radiation, which takes into account the discontinuous energy losses by electrons in the form of δ-tracks. Calculations are included for the irradiation of an air-filled graphite chamber by Co^{60} γ-rays and for the same chamber by Na^{24} γ-rays. (C.H.)

1469
SCINTILLATION COUNTER FOR DETECTION OF X-RAYS. J. T. Nelson and R. T. Ellickson (Univ. of Oregon, Eugene). J. Opt. Soc. Amer. 45, 984-6(1955) Nov.

A scintillation counter using NaI(Tl) is described. The sensitivity is such that the yield of photoelectrons is about 3.5 per 1000 ev x-ray energy. The response is linear over a range in intensity of 5×10^5. (auth)

1466 ORNL-1929
Oak Ridge National Lab., Tenn.
ELECTRONIC INSTRUMENTATION FOR A MULTIPLE-CRYSTAL GAMMA-RAY SCINTILLATION SPECTROMETER. T. A. Love, R. W. Peele, and F. C. Maienschein. Oct. 25, 1955. 31p. Contract W-7405-eng-26.

Complete circuit diagrams are given for the multiple-crystal γ-ray spectrometer to be used at the Bulk Shielding Facility. Results of measurements of resolution of the electronic equipment are also shown. (B.J.H.)

9809 HW-35291
Hanford Atomic Products Operation, Richland, Wash.
AUTOMATIC IN-LINE MONITOR FOR pH, GAMMA ACTIVITY AND URANIUM IN THE METAL RECOVERY PLANT. W. H. Reas. Feb. 18, 1955. Decl. Feb. 20, 1956. 19p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Design details and data on the operating characteristics are presented for instruments developed for in-line monitoring of process streams. Included are a pH monitor, a continuous γ activity monitor, and an automatic photometer and an automatic polarograph for the determination of U concentrations. (C.H.)

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3639 K-757
Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.
PRELIMINARY REPORT ON A HIGH SENSITIVITY GAMMA PROBE FOR USE WITH THE SAMSON SURVEY METER. R. W. Schede. May 1, 1951. Decl. Dec. 27, 1955. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A high sensitivity gamma extension probe has been developed for use with the Samson survey meter. It has a sensitivity of 0.02 mr/hr full scale. The probe weighs 4.5 lb. and is 19 in. long by 2.5 in. in diameter. The primary function of this probe is to locate deposits of U^{235} in process equipment. (auth)

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6457 A/CONF.15/P/1308
UNE NOUVELLE MÉTHODE (PHOTOGRAPHIQUE) DE DOSAGE DES SOLUTIONS RADIOACTIVES α À L'AIDE DES EMULSIONS NUCLÉAIRES. (A New Dosage Method for Radioactive Solutions by Means of Nuclear Plates). Marieta Nicolae (Inst. de Physique Atomique, Bucharest). 15p.

A gelatin solution is mixed in known proportion with the radioactive solution. A thin layer of this solution supported on a glass plate is brought into contact with a nuclear plate, and the concentration of radioactive substance is determined from the number of tracks per unit area. (auth)

11799
A PORTABLE CALIBRATOR FOR $\beta-\gamma$ SURVEY INSTRUMENTS USING Sr^{90}. C. T. Nelson (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Health Phys. 1, 447-8(1959) Mar.

A Sr^{90} source and its associated manipulating equipment and shielding are described. The arrangement makes it possible to calibrate $\beta-\gamma$ detection instruments locally without routine use of a stationary gamma facility. The instrument minimizes radiation exposure to personnel, saves time, and costs only about $200 including the source. (T.R.H.)

APPARATUS FOR DETECTING IONIZING RADIATION. (To Philips Electrical Industries, Ltd. (U. S. A.)). British Patent 795,036. Nuclear Eng. 3, 556(1958) Dec.

Because of the production of two types of output pulses, main pulses and escape pulses, it has often been impossible to obtain accurate results or to distinguish between the two types. The new apparatus works with two detector tubes one of which is exposed to the primary radiation to be detected and is capable of emitting escape radiation, while the second tube is exposed to this escape radiation but screened from the primary radiation. Both tubes produce in response to the ionizing radiation electrical indications which appear on an output terminal individual to that tube but connected to a utilization circuit common to the two tubes and adapted for comparing the outputs. (auth)

RADIATION INDICATOR, PARTICULARLY FOR RADIOACTIVE RADIATION. (to Forsvarets Forskningsinstitutt, Norway). British Patent 792,424. Nuclear Eng. 3, 466(1958) Oct.

A thin leaf carried by an extended conducting filament constitutes the movable electrode of an electrometer. When moving towards the fixed electrode the leaf rotates about the axis of the filament. The leaf is so arranged that each time a certain charge has been attained, it will make contact with the fixed electrode and then immediately swing back to start again. The oscillation frequency of the leaf will give an indication of the intensity of the occurring ion current and hence of the radiation received.

4523 NP-7126
Brussels. Centre d'Étude de l'Énergie Nucléaire.
PROGRAMME DE CONTROLE DE L'ACTIVITE DES ISOTOPES. (Program for Control of Activities of Isotopes.) F. Leroy. June 22, 1958. 16p.

Techniques to use in diluting and counting radioisotopes so as to minimize systematic errors are outlined. (T.R.H.)

12573 HW-54947(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A SCINTILLATION ALPHA-BETA-GAMMA FIXED-FILTER COUNTER. M. O. Rankin and W. G. Spear. May 1, 1958. 12p. Contract W-31-109-Eng-52. $0.50(OTS).

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A scintillation alpha-beta-gamma filter counter has been developed which simultaneously monitors filters for alpha and beta-gamma contamination with none of the faults of the present equipment. The instrument has two lucite light pipes, two RCA 6655 photomultiplier tubes, two scaling units, and a light-tight box with a roller bearing mounted slide for transporting the filter. The average center geometry for the alpha probe is 20 to 25 per cent with a background of approximately 2 c/m. The average center efficiency for the beta-gamma probe is 0.8 to 1.0 per cent for a 600-kev gamma source and 20 to 25 per cent for a 500-kev beta source. (auth)

13335 ✓

A VERSATILE RADIATION MEASURING APPARATUS. Friedrich H. Rinn. Siemens-Z. 32, 360-5(1958) May. (In German)

A description is given of a versatile radiometric apparatus containing G-M counters, proportional counters, and scintillation counters. The instrument (comprising the following plug-in units: a high tension generator, and imput amplifier, a pulse amplitude analyzer, an average value indicator, a counting unit, and an electronic clock) can be arranged in all kinds of combinations, from the simplest to the most comprehensive. A comparison is given between possible requirements and actual performance. (tr-auth)

1815

APPARATUS FOR DETECTING RADIOACTIVITY. (to Etat Francaise (France)). British Patent 776,576. Nuclear Eng. 2, 452(1957) Oct.

An apparatus is described which includes an ionization chamber (or other detector) with at least two electrodes maintained at a potential difference which varies under the effect of radioactivity. The variations in the intensity of the radioactive radiation produce corresponding variations in the current at the output of the detector and this current is independent of the voltage of the source of the current, provided it is above a minimum or critical value. These currents are very small. For a cylindrical ionization chamber of a volume of 1cc the saturation current corresponding to an intensity of gamma rays equal to 1 roentgen per hour averages 10^{-10} amp. Based on this fact, a high insulation capacitor is used as source of potential which is

1541

WIDE-RANGE RADIATION DETECTOR. L. Cathey (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.). Rev. Sci. Instr. 28, 842-3(1957) Oct.

A simple form of the device in which the collector electrode of an ionization chamber is connected to the grid of an electrometer tube is diagramed. Its circuit is given. (M.H.R.)

1543

MEASUREMENT OF RADIOISOTOPES BY THE METHOD OF IONIZED AIRFLOW. Presented at the International Conference on Radioisotopes in Scientific Research, Sept. 9-20, 1957 at Paris. No. UNESCO/NS/RIC/5. F. Behounek. London, Pergamon Press, Ltd., 1957. 5p.

11533

NEUTRON ION CHAMBER. H. Bryant et al. (to U. S. Atomic Energy Commission). U. S. Patent 2,795,704. June 11, 1957.

A device is described for measuring neutron flux density in a radiation field which is composed of neutron and gamma radiations. The device comprises an ionization chamber having a pair of electrodes, a movable element within said chamber, a portion of said element responsive to neutron bombardment to produce ionization, means to impress a potential between said element and each of said electrodes, means for moving the neutron-responsive portion of said movable element past said electrodes to vary the ionization between said element and each of said electrodes and means for detecting the variation in potential. An a-c current with its amplitude proportional to the neutron density is created by this device. (auth)

7266 ✓

SEWING-NEEDLE PROPORTIONAL COUNTER. A. H. Benade and R. E. Chrien (Case Inst. of Tech., Cleveland, Ohio). Am. J. Phys. 25, 313-17(1957) May.

A simple proportional counter made from common materials, and supplied with high voltage by a circuit made

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from automotive ignition parts, is described and investigated. Alpha particles from Po^{210} are shown to give up to 25-volt pulses, while beta rays from Cs^{137} produce signals with amplitudes up to 2 volts without the use of any external amplification. These pulses are readily heard with headphones, or amplified by standard public-address equipment. (auth)

10615 DP-216
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
A PRESET COUNTING UNIT USING COLD CATHODE TUBES. Richard T. Nowak. May 1957. 9p. Contract AT(07-2)-1. $0.15(OTS).

A counting unit has been built using cold cathode tubes exclusively. The unit consists of an input amplifier, two Dekatron scaling stages, and a coincidence stage. The input requires a pulse height of at least 1.5 volts for triggering. The unit operates in a preset count manner. The stored count that is necessary to give an output from the preset count feature is adjustable from 1 to 99 counts. The unit was designed for use in a personnel monitor. (auth)

9563 ✓
RADIATION DETECTING AND MEASURING SYSTEM. H. G. Beyer, et al (to U. S. Atomic Energy Commission). U. S. Patent 2,790,086. Apr. 23, 1957.

A device is described for detecting and counting the number of fissions occurring within a sample substance. This information may be used in isotopic analysis to determine the proportion of the fissionable isotope existing in the sample substance. The sample substance is placed in several chambers that are adjacent to a source of neutrons of known flux density. The apparatus is well shielded to exclude the incidence of random neutrons from external sources. Accompanying ionization chambers are provided that contain a petroleum substance for slowing or moderating the fissioned radiation to a thermal range, an ionizable gas, and electrodes carrying a high potential. The moderated radiation ionizes the gas which permits a current to flow between the electrodes, then this current is amplified and recorded to indicate the rate of occurred fissioning within the sample substance. (auth)

A SELF-CHECKING RADIATION MONITOR. K. C. Speh and W. E. Landauer (Airborne Instruments Lab., Mineola, N. Y.). IRE Trans. Nuclear Sci. NS-4, 19-25(1957) Mar.

A self-checking system of circuits is expected to provide a new high in operational reliability for the set of radiation monitors described. Developed under sponsorship of the Bureau of Ships, these monitors can readily be adapted for application in any nuclear installation where radiation monitoring must be performed. Three basic channels are provided to measure accurately the gamma radiation in the range from 1 to 1000 mr/hr, the thermal neutron flux from 20 to 20,000 thermal neutrons/cm^2 sec, and the air-particle concentration from 10^{-9} to 10^{-6} $\mu C/cm^3$ or from 10^{-8} to 10^{-5} $\mu C/cm^3$. Checking of each channel is performed by periodically (and automatically) placing a small radioactive source next to the detecting element in each channel. This results in a signal near the maximum range of each channel. During such checks, the alarm-indicating circuit is disconnected

8996 ✓ CU-152
Columbia Univ., New York. Pupin Cyclotron Lab. and Columbia Univ., New York. Pegram Lab.
THIN PLASTIC SCINTILLATOR FISSION DETECTOR. V. K. Fischer, E. Nagel, and W. W. Havens, Jr. Nov. 20, 1956. 10p. Contract AT-30-1-GEN-72. $1.80(ph OTS); $1.80(mf OTS).

A fission fragment detector using a 0.002" thick plastic scintillator was constructed and tested. Pulses due to alpha particles from the fissionable material were eliminated by placing a biased diode at the output of the photomultiplier observing the scintillator. This allowed the electronics which followed the photomultiplier to be slow without resulting in pileup. The detector satisfied three requirements: low gamma ray sensitivity, stability, and fast pulse output. With a foil which had a total activity of about 10^4 α/sec, the ratio of the maximum pulse heights produced by 4.8 Mev α particles to those produced by the

9459 HW-41184
Hanford Atomic Products Operation, Richland, Wash.
A SCINTILLATION EXPOSURE-RATE METER. W. G. Spear. May 28, 1956. 18p. Contract W-31-109-Eng-52. $0.20(OTS).

A compact, rugged, portable scintillation β-γ exposure-rate meter was designed and fabricated. The instrument employs a multiplier phototube and a thin crushed anthracene crystal weighing 200 mg/cm^2 mounted $\frac{1}{8}$ inch from the phototube face. The crystal is covered with a 15 mg/cm^2

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light shield of mylar and opaque tape. The phototube drives a d-c amplifier circuit which in turn activates the meter. The instrument has three ranges: 0-10 mr/hr, 0-100 mr/hr, and 0-1000 mr/hr. The crystal and light shield were made thin to permit good beta response at the lower energies. The device weighs 5½ pounds. Details of design are included. (auth)

5078

MEASURING DEVICE AND APPARATUS. F. R. Shonka (to U. S. Atomic Energy Commission). U. S. Patent 2,736,818, February 28, 1956.

A portable measuring apparatus was constructed as to permit of two different levels of radiation to be read on the same scale, thus permitting direct reading of said two ranges. The device is so constituted that by gravity one resistor falls in series electrically with the ionization chamber and associated meter scale and by inversion of the device, the other resistor is connected with the ionization chamber and its associated meter scale to permit of reading on said inversed scale. (auth)

3843 ✓ KAPL-1467

Knolls Atomic Power Lab., Schenectady, N. Y.

A REMOTELY OPERATED RADIATION SURVEY METER. L. C. Cooper. Jan. 1, 1956. 6p. Contract W-31-109-Eng-52. $0.15(OTS).

An illustrated description is presented of a remotely operated multi-range β-γ radiation survey meter. (C.H.)

A MONITOR FOR LOW-LEVEL RADIOACTIVITY IN LIQUID STREAMS. E. C. Wingfield and P. R. Liller. Jan. 1956. 14p. (DP-145)

A continual monitor for low-activity water streams is described. The monitor automatically collects constant-volume samples of the water, evaporates the samples to dryness, and presents the residues to two scintillation counters. It can reliably detect, within 10 min, an α activity of 5.2×10^{-11} c/ml, a β activity of 7.3×10^{-9} c/ml, and/or a γ activity of 3.3×10^{-9} c/ml.

11600 ✓ AEC-tr-3275

4 π COUNTER AND MEASUREMENTS FOR THE ABSOLUTE DETERMINATION OF SLIGHT SPECIFIC ACTIVITIES OF RADIATORS POOR IN ENERGY. Manfred Leistner. Translated for Westinghouse Electric Corp. from Z. angew. Phys. 8, 331-7(1956). 18p.

The construction of a 4 π counter is described in detail: two different models of the counter tube are indicated and their counter properties are investigated. Absolute determinations on a radiator with varied qualitative and energetic radiations are discussed. Special measurements for the determination of radiation and scattering are evaluated. A combination counter tube is proposed for the simplification and facilitation of the measurements. (auth)

3080 ✓

RADIATION DETECTOR. W. W. Goldsworthy (to U. S. Atomic Energy Commission). U. S. Patent 2,727,154. December 13, 1955.

The detector permits the counting of incident alpha particles only, beta and gamma particles only, or all three types of particles. A counter is arranged to register impulses from a photomultiplier tube in conjunction with an amplifier to establish a threshold of impulse strength which will register the counter. A lucite light conductor leads from the photomultiplier tube to a window and cap holding two scintillating crystals therein. The first crystal, e.g. zinc sulphide, is highly sensitive to alpha particles. The second, e.g. stilbene, being somewhat less sensitive is responsive to beta and gamma particles. The alpha particles do not reach the second crystal as they are stopped in the first crystal, thus by adjusting the amplifier gain only the scintillation from the alpha products may be counted, or by increasing the gain all three particles may be counted. By substituting a similar cap having the first crystal opaque to alpha particles, the second crystal sensitive to beta and gamma particles, the latter impulses may be counted. In this manner, a selective counting is accomplished; space is provided for storing the substitute cap; and the complete device is portable. (auth)

2123 ✓

G-M COUNTERS FOR HIGH TEMPERATURE OPERATION. L. B. Clark, Sr. (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr. 26, 1202-3(1955) Dec.

INSTRUMENTATION AND CONTROL 5.11

RADIATION MEASUREMENT 5.11.05

Mixed Radiation 5.11.05.04

A description is given of stable halogen-quenched G-M tubes having transparent nonmetallic conducting films as cathodes. (B.J.H.)

4330 ✓ HW-13134
Hanford Works, Richland, Wash.
OPTICAL INSTRUMENTS FOR THE ATOMIC INDUSTRY. J. M. Holeman. [nd.] Decl. Dec. 22, 1955. 24p. Contract [W-31-109-eng-52]. $4.80(ph OTS); $2.70(mf OTS).

General descriptions and engineering problems of instruments which permit observation of radiation experiments without danger to the observer are discussed. These instruments include viewers with H_2O shielding, reflecting viewers, periscopes, boroscopes, binocular periscopes, and stereoscopic periscopes. (B.J.H.)

6709 ✓ A/CONF.15/P/236
SPECIAL LOW LEVEL COUNTERS. J. Geiss, C. Gfeller, et al. (Univ. of Bern). 7p.

The anticoincidence volume and the counting volume are separated by a foil of adapted thickness or, in the case of very short-range radiation, by thin wires. Three different types of counters were constructed based on this principle: (1) a 1½ liter counter for gas samples of low specific activity (natural C^{14}, tritium) with a background of 0.8 counts per minute; (2) a 5 cm^3 counter for small gas samples of low total activity (spallation products in meteorites) with a background of 0.1 counts per minute; and (3) a 4π counter surrounded by an anticoincidence ring which is separated from the two counting volumes by a thin foil and a background depending on the foil thickness (lower than 0.5 counts per minute). A full description of the performance of the counters is given. (auth)

NEUTRONS 5.11.05.05

14438 ARF-1118-6
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
A WIDE-RANGE NEUTRON DETECTOR AND MONITORING INSTRUMENT. Final Report. K. G. Porges and C. A. Stone. Apr. 22, 1959. 47p. Contract AT(11-1)-619. $7.80(ph), $3.30(mf) OTS.

A proportional counter has been constructed whose cathode diameter increases towards one end. This instrument may be operated at such a combination of applied voltage, electrical gain and pulse height discrimination that, when short-range ionizing events releasing the same primary ionization occur throughout the counter, only part of the latter contributes to the measured count rate. Specifically, the voltage, at fixed electronic gain and discrimination, may be reduced with increasing irradiation, reducing the "effective" volume or cathode area of the counter to a rather small value near the narrow end; the operating range of the counter is thus increased by the ratio of full to minimum volume or cathode area. The preliminary work described in this report shows that the basic design principles of the proposed type of instrument are sound. A prototype instrument with a boron-coated graphite cathode, exponentially shaped, was built and tested extensively. Background and pile-up problems arising in the operation of such instruments are briefly discussed, and further desirable work suggested. (auth)

11594 ✓ DP-267
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
NEUTRON MONITOR FOR PLUTONIUM INVENTORY CONTROL. William A. Kropp. Jan. 1958. 15p. Contract AT(07-2)-1. $0.50(OTS).

In processes for recovery of spent fuel from nuclear reactors, careful control of plutonium inventory is necessary. Instrumentation is described for determining the plutonium inventory in process vessels by measuring neutron activity associated with plutonium compounds. Instruments have been used successfully in plutonium inventory measurement for more than a year. (auth)

11532 ✓
APPARATUS FOR COUNTING FAST NEUTRONS IN THE PRESENCE OF GAMMA RAYS. I. B. Berlman et al. (to U. S. Atomic Energy Commission). U. S. Patent 2,795,703. June 11, 1957.

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NEUTRONS 5.11.05.05

A device for determining the quantity of fast neutrons in the presence of gamma rays is described. The device utilizes two scintillation counters wherein each has a scintillation medium placed adjacent a photomultiplier tube to the emitted radiation. The two scintillation media are adjusted so that each has the same electron content and luminescent efficiency, but one media contains a greater amount of hydrogen atoms. The neutron response is greater in the latter media while the gamma ray response is the same in both media. When the signals from the two scintillation counters are compared, the resultant difference signal is a measure of the neutron density present. (auth)

SURVEYS AND THEORY 5.11.05.06

5401

THE SCINTILLATION COUNTER. G. A. Morton (RCA Labs., Princeton, N. J.). p.3-13 of "Nuclear Electronics. I." (In English)

A general review is given of the characteristics of scintillation counters. The scintillators and photomultipliers widely used in the United States are tabulated. The sensitivity, energy discrimination, and time resolution of scintillation detectors are examined in some detail. (J.S.R.)

16174

RADIATION DETECTORS. 3. THEIR OPERATING LIMITATIONS. A. L. Gray (Plessey Nucleonics, Ltd.). Nuclear Power 4, No. 37, 103-5(1959) May.

All types of detectors are limited by their response to unwanted radiation. Detectors chosen must be of sufficient sensitivity to provide from the lowest level to be measured a statistical error small enough to be within the limits of accuracy required. The influence of these factors on the choice of a detector and the limits within which corrections may be applied for their effects are considered. Detector resolution is defined and discussed. Decay times of common phosphor materials and count-rate upper limit for common detector/amplifier combinations are tabulated. (A.C.)

6458

RECENT ADVANCES IN SCINTILLATION COUNTERS. Yves Koechlin. Bull. inform. sci. et tech. (Paris) No. 34, 13-21(1959) Nov. (In French)

Scintillation counters have allowed since the beginning a great variety of measurements due to the flexibility of their use. Numerous improvements have been made and they have presently a prominent place among radiation detectors. It is shown how, by technical improvements, in both laboratory and industry, the scintillation counter has become an instrument currently used in the field of nuclear research. (auth)

RADIATION DETECTORS. 2. THEIR EFFICIENCY. W. R. Loosemore (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, No. 36, 97-101(1959) Apr.

The efficiency of radiation detection instruments for different types of radiation are discussed. The detection of charged particles, gamma radiation, and neutrons in gas ionization chambers is considered along with scintillation detectors. (W.D.M.)

ANALYTICAL INSTRUMENTATION PROBLEMS IN RADIOCHEMICAL PROCESSES. Robert C. Axtmann (E. I. du Pont de Nemours & Co., Inc.). Control Eng. 6, 94-7(1959) Jan.

Some of the principal radiochemical processes, the variables to be measured and controlled, and problems encountered by instrument designers are discussed. (A.C.)

ADVANCES IN NUCLEAR ELECTRONICS. EXPERTS MEET IN PARIS AFTER GENEVA CONFERENCE. Denis Taylor and G. D. Smith. Nuclear Power 3, 530-4 (1958) Nov.

A report on the 87 papers presented at the International Symposium on Nuclear Electronics organized by the French Société des Radio-Electriciens is presented Over 400 scientists and engineers met in Paris to discuss current practices and techniques in nuclear electronics. (W.D.M.)

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17594 ORNL-2583
Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY ON SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. James L. Blankenship. Oct. 3, 1958. 12p. Contract W-7405-eng-26. $0.50 (OTS).

This bibliography consists of 72 references from the published literature on the potential uses of semiconductors as nuclear radiation detectors. Most references on the uses of cadmium sulfide have been omitted, except for recent articles, because excellent bibliographies have already been prepared. (auth)

17616
INSTRUMENTATION. Nucleonics 16, No. 9, 83-5(1958) Sept.

A survey is presented of the papers given at Geneva on low-level beta counting, gamma measurement, and scintillation counting. (J.S.R.)

16569
RADIATION MEASURING INSTRUMENTS. H. U. Becker. Atomwirtschaft 3, 347-51(1958) Aug.-Sept. (In German)

The development in the German Federal Republic of facilities for manufacturing and supplying radiation measuring instruments is discussed. At the present there are about twenty firms engaged in this work. Some of the firms manufacture the instruments, while others act as sales agents for foreign producers. The value of domestic production was 9.5 Mio. DM in 1957. (J.S.R.)

14132
VOLTAGE-CURRENT CHARACTERISTICS OF BORON IONIZATION CHAMBERS. A. B. Dmitriev. Atomnaya Energ. 4, 383-5(1958) Apr. (In Russian)

The voltage-current characteristics and performance of various types of boron ionization chambers are plotted and tabulated. (R.V.J.)

13843
THE ADVANTAGES OF CONTINUOUS ANALYZERS IN A PILOT PLANT. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 161, Session 34. C. L. Pleasance (General Electric Co.). New York, American Institute of Chemical Engineers, 1958. 22p.

Twenty-nine continuous analyzers were installed at key points in a radiochemical pilot plant. These analyzers included gross gamma monitors, a gamma spectrometer, turbidimeters, colorimeters, pH monitors, gamma absorptiometers, polarographs, and a low-level alpha counter. The analyzers proved valuable in indicating the approach to equilibrium in the process, in showing immediately how a change in one or more of the process variables affect the process dynamics, and in detecting process upsets or malfunctions of process equipment. (auth)

RADIOACTIVITY MEASURING INSTRUMENTS. A Guide to Their Construction and Use. M. C. Nokes. New York, Philosophical Library, 1958. 80p.

This book is an attempt to show how instruments of fair accuracy can be made with the minimum of expense and without the consumption of too much time. Some rather more complicated circuits are included for those who may wish to make a simple scaler, or to experiment with some of the more recent counting devices. (W.D.M.)

11635
NUCLEAR RADIATION DETECTION. William J. Price. New York, McGraw-Hill Book Company, Inc., 1958. 389p. $9.00.

As the study of nuclear radiation detection requires an understanding of the interaction of radiation with matter, the first chapter covers the essential aspects of that subject. The term detection, as used in this book, refers not only to the detection of radiation, but also to the measurement of the amount and energy. Each detector, therefore consists of two parts: a detector and a measuring device. The classification and characterization of radiation detection instruments are surveyed, and the statistical nature of detection systems

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is discussed for pulse-type counters and for mean-level detection systems. The importance of ionization chambers, the Geiger-Mueller counter, proportional counters, and scintillation detectors required detailed treatment in a separate chapter on each. Other detection systems,

15296
MEASUREMENTS WITH RADIOISOTOPES. III. RESOLVING EFFICIENCY OF MEASUREMENTS.
J. Oppelt (Research Inst. of Radiology, Prague).
Jaderna Energie 4, 377-86(1958). (In Czech.)
The performance of ionization counters and the dependence of their resolving efficiency on various parameters are analyzed. The quality of measurements and various conditions and apparatus efficiencies are compared. (tr-auth)

426
ENCAPSULATION MAKES MONITOR INDEPENDENT OF ENVIRONMENT. Martin H. Jachter and Abraham E. Cohen (U. S. Army Signal Engineering Labs., Fort Monmouth, N. J.). Nucleonics 15, No. 9, 148, 150, 152(1957) Sept.

9502
STUDY OF THE SCINTILLATION PROCESS. E. R. Hardwick (Stanford Univ., Calif.) and W. G. McMillan (Univ. of California, Los Angeles and Rand Corp., Santa Monica, Calif.). J. Chem. Phys. 26, 1463-71(1957) June.
A phenomenological time-dependent relation between phosphor concentration and emission intensity, including effects of self-absorption, is derived for scintillation solutions. The dependence of the integrated intensity equation on concentration of phosphor and quencher is tested experimentally in several ways using α irradiation, and found to give agreement within the (occasionally large) experimental error. Application of this equation to measurements of the decline in scintillation efficiency of anthracene crystals on bombardment with α particles suggests a method of obtaining the effective exciton "range," for which we estimate ~ 3000 A as a lower limit. The question of the mechanism of energy transfer is discussed, and some photographic data are presented which indicate that the large (~ 1 mm) transfer distances in similar experiments may have been due to phosphor photon absorption and reemission. (auth)

658 WADC-TN-57-207
Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.
STANDARD INSTRUMENTATION TECHNIQUES FOR NUCLEAR ENVIRONMENTAL TESTING. [Period Covered] July 1956 to May 1957. Walter R. Burrus, May 17, 1957. 29p. Project title: NUCLEAR INSTRUMENTATION.
Recommendations from the ANP Advisory Committee for Nuclear Measurements are presented and discussed. A minimum number of measurements were selected which can provide a consistent basis for comparison of experiments and correlation of data. A measurement of absorbed dose in C is recommended as the minimum measurement of the gamma radiation field. In addition, determination of the activation of U^{238}, Pu^{239} (B shielded), and S is recommended as the minimum measurement for neutron radiation. Consistent units and symbols for reporting these measurements are recommended. (auth)

8507 TID-7554(p.253-9)
National Science Foundation. Washington, D. C.
RADIATION INSTRUMENTATION. R. L. Butenhoff. p.253-9 [of] PROCEEDINGS OF THE INTER-AMERICAN SYMPOSIUM ON THE PEACEFUL APPLICATION OF NUCLEAR ENERGY, BROOKHAVEN NATIONAL LABORATORY, MAY 13-17, 1957. 7p.
Characteristics of some of the more familiar types of radiation detection instruments are compared. Some recent developments are reviewed. (C.H.)

7275
RADIATION DETECTORS. A SURVEY. J. Sharpe (E.M.I. Electronics Ltd.). Nuclear Eng. 2, 190-7(1957) May.
The various radiation detectors are surveyed. Those included are ionization chambers; conduction, proportional, Geiger, spark, and scintillation counters; and secondary emission, thermal, and passive detectors. Time characteristics, specific applications, diagrams, and data are given. (M.H.R.)

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7248 ✓
RELIABILITY AS A DESIGN PARAMETER. L. A. Kilbey (A.E.R.E., Harwell). Nuclear Eng. 177-81(1957) May.
Information collected over the past seven years regarding the failure of nucleonic instruments based on A.E.R.E. designs are given. Failures have been analyzed by types, instruments, components, and time of occurrence. (M.H.R.)

STANDARD MEASUREMENTS OF RADIOACTIVITY AT THE NATIONAL PHYSICAL LABORATORY. W. E. Perry. Strahlentherapie 102, 370-8(1957) Mar. (In German)
The paper describes the main features of the methods used at the National Physical Laboratory for absolute measurements of the disintegration rates of samples of artificially produced radioactive nuclides by $4\pi\beta$ counting, β-γ coincidence counting, $4\pi\beta$-γ coincidence counting and γ-ray ionization measurements. The procedure for the preparation and calibration of N.P.L. standards of Na^{24}, P^{32}, I^{131} and Au^{198} is described and the results of measurements of these standards, and samples of other nuclides, are reviewed. (auth)

6814 CREL-605 (Rpt: UNCLASSIFIED)
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
TRANSISTOR CIRCUIT DESIGN FOR A RADIOACTIVITY CONTAMINATION METER. F. S. Goulding. Feb. 26, 1957. 34p. (AECL-435).
This report describes the design of circuits used in a portable geiger counter contamination meter. Brief reference is also made to the mechanical design of the instrument. In view of the lack of published information on the general problems of choice of components for miniaturized transistor circuits, some comments on the choice of components are included in this report. (auth)

Argonne National Lab., Lemont, Ill.
INTERPRETATION OF COUNTING DATA. Ellis P. Steinberg. Sept. 26, 1956. 66p. Contract W-31-109-eng-38. (ANL-5622).
This report is a convenient guide for interpretation of counting data. Some of the problems involved and techniques generally employed are reviewed. Over 150 references to pertinent report and published literature are included.

RECENT PROGRESS IN THE AREA OF SCINTILLATION COUNTERS. J. Labeyrie (Centre d'Études Nucléaires, Saclay). J. phys. radium 17, 576-80(1956) July. (In French)
The present state of knowledge on photomultipliers, and on solid, liquid or gaseous phosphors for detecting nuclear particles is described. (auth)

3938 DP-47
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
TEMPERATURE COEFFICIENTS OF SCINTILLATION DETECTORS. T. Richard Herold, William A. Kropp, and James S. Stutheit. Mar. 1956. 23p. Contract AT(07-2)-1. $0.20(OTS).
Photomultiplier scintillation detectors used at the Savannah River Plant for continuous radioactivity measurement were found to be sensitive to changes in temperature. This report describes work done to determine and correct the temperature sensitivity of the detectors. (auth)

10930 CF-56-2-99
Oak Ridge National Lab., Tenn.
HRP-CP: INSTRUMENT INTERLOCKS FOR THE HRT CHEMICAL PROCESSING PLANT. William L. Carter. Feb. 20, 1956. 6p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
Tables are given which describe the entire system of instrument interlocks for the HRT, indicate the affected instruments, and specify the conditions under which each instrument is to function. (B.J.H.)

METHODS OF MEASURING RADIOACTIVE RADIATIONS. Alex Sanielevici. Metrol. Apl. 3, No. 3, 7-11(1956). (Translated from Referat. Zhur. Fiz. No. 2, 1957, abstract no. 3031).

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RADIATION MEASUREMENT 5.11.05

SURVEYS AND THEORY 5.11.05.06

A description is given of the conventional measurement methods and doses of radioactive substances with the aid of Geiger-Mueller counters. (auth)

2787 NBS-C-567
National Bureau of Standards, Washington, D. C.
GUIDE TO INSTRUMENTATION LITERATURE. W. G. Brombacher, Julian F. Smith, and Lyman M. Van der Pyl. Dec. 14, 1955. 160p. Charge $1.00(GPO).

This compilation consists of an introduction, a source list of instrumentation literature, an author index, and a subject index. Over 1200 references are listed, including abstract journals, bibliographies, 660 books on technology, directories of manufacturers, guides to and indexes of technical literature, periodicals of interest, and guides to dissertations, patents and specifications. Articles published in periodicals are not referenced, but indexes and abstracts of such articles on a given subject are indicated in the subject index. (auth)

4576
RADIO ISOTOPE INSTRUMENTATION AND ACCESSORIES. Denis Taylor and A. G. Peacock, eds. London, Scientific Instrument Manufacturers Association of Great Britian Ltd., 1955. 124p.

Some basic information on radioisotope instrumentation is included. Details and illustrations of a number of instruments of British manufacture are given. (B.J.H.)

6726 A/CONF.15/P/1209
ETAT ACTUEL DU DEVELOPPEMENT DES COMPTEURS A SCINTILLATION EN FRANCE. (Present State of Scintillation Counters Development in France.) Y. Koechlin, L. Koch, and A. Lansiart (Commissariat à l'Énergie Atomique, Paris), and G. Pietri (Laboratoire d'Electronique et de Physique Appliquées, France). 36p.

The industrial production of photomultipliers and scintillators has increased steadily in France in the last few years. The general performance of the industrial detectors and the present status of new developments are given. (J.S.R.)

6727 A/CONF.15/P/1210
REALISATIONS FRANCAISES DANS LE DOMAINE DE L'ELECTRONIQUE NUCLEAIRE. (French Accomplishments in the Field of Nuclear Electronics.)
M. Doireau, R. Fabre, H. Guillon, and C. Guyot (Commissariat à l'Énergie Atomique, Paris). 47p.

The steps taken by the Commissariat à l'Énergie Atomique to encourage the industrial production of the electronic devices needed in nuclear research are described. The criteria established for the acceptance of electronic equipment are discussed. (J.S.R.)

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2575
INSTRUMENT DEVELOPMENT AT SAVANNAH RIVER. II. REACTOR, PROCESS INSTRUMENTS. J. N. Wilson (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucleonics 17, No. 11, 140; 142; 144-6; 148(1959) Nov.

A review is given of instrumentation for nondestructive testing of reactor fuel and for chemical separation of irradiated fuel. The application of several "in-line" analytical instruments such as the turbidimeter, gamma absorptometer, conductivity cells, colorimeter, and a gamma monitor are discussed. (C.J.G.)

19989 NP-7862
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
INSTRUMENTATION: PRINCIPLES, SPECIFICATIONS, FLOW SHEETS, DATA SHEETS, ELECTRICAL EQUIPMENT. Technical Report No. 53, Chapter 220.
R. Winckler. 1959. 35p. $9.30(ph), $3.60(mf) OTS.

Instrumentation for the Chemical Processing Plant at Mol for irradiated fuel is considered in terms of principles of operation, specifications for equipment, flow sheets, data sheets, and electrical equipment. The highest possible reliability is required for the instrumentation. This point of view is more important than the accuracy of instruments. Detailed drawings and flow sheets are given. (W.D.M.)

National Bureau of Standards, Washington, D. C.
GUIDE TO INSTRUMENTATION LITERATURE. W. G. Brombacher, Julian F. Smith, and Lyman M. Van der Pyl. Dec. 14, 1955. 160p. (NBS-C-567).

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The compilation consists of (1) an introduction, (2) a source list of instrumentation literature, (3) an author index, and (4) a subject index. Over 1200 references are listed, including abstract journals, bibliographies, 660 books on technology, directories of manufacturers, guides to and indexes of technical literature, periodicals of interest, and guides to dissertations, patents and specifications.

2255
VSESOYUZNAYA NAUCHNO-TEKNICHESKAYA KONFERENTSIYA PO PRIMENENIYU RADIOAKTIVNYKH I STABIL'NYKH IZOTOPOV I IZLUCHENIY V NARODNOM KHOZYAYSTVE I NAUKE; MASHINOSTROYENIYE I PRIBOROSTROYENIYE. (Transactions of the All-Union Conference on the Use of Radioactive and Stable Isotopes and Radiation in the National Economy and Science; Machine and Instrument Manufacturing). Moscow, Izd-vo AN SSSR, 1958. 358p.

A collection of papers covering a wide field of the utilization of tracer methods in industrial research and control techniques is presented. The topic of this volume is the use of radioisotopes in the machine- and instrument-manufacturing industry. The individual papers discuss the applications of radioisotope techniques in the study of metals and alloys, problems of friction and lubrication, metal cutting, engine performance, and defects in metals. Several papers are devoted to the use of radioisotopes in the automation of industrial processes, recording and measuring devices, quality control, flowmeters, level gages, safety devices, radiation counters, etc. (TCO)

19994 NP-7870
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
DRAWING STANDARDS FOR EQUIPMENT AND INSTRUMENT FLOWSHEETS. Technical Report No. 39, Chapter 200. O. Jenne and R. Winckler. [nd]. 13p. $3.30(ph), $2.40(mf) OTS.

Drawing standards for equipment and instrument flowsheets are presented for a radiochemical processing plant. Symbols to define pipelines and armatures are presented. All major items of equipment will be identified by letters, indicating the type of equipment or instrument and consecutive numbers starting at one for each plant section. The instrument type will be identified by two or three letters. (W.L.H.)

1581 CF-59-10-4
Oak Ridge National Lab., Tenn.
EUROCHEMIC ASSISTANCE: INFORMATION ON HAPO INSTRUMENTATION DEVELOPMENT. E. M. Shank. Oct. 5, 1959. 4p. Contract [W-7405-eng-26]. OTS.

Information on performance and availability of various instruments for Eurochemic are presented. Included are data on magnetic flowmeters, alpha printers, gamma monitor cells, gamma absorptiometer sources, electrodeless conductivity apparatus, and gamma scintillation monitor for I^{131}. (J.R.D.)

TEMPERATURE 5.11.07

20317 IGIS-68(RD/CA)
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.
BIBLIOGRAPHY ON GAS TEMPERATURE MEASUREMENT. E. McCoy. June 10, 1959. 14p. $0.25(BIS).

This bibliography is compiled from references to books, articles, unclassified reports and patents taken from Chemical Abstracts, 1951 to 1956, Engineering Index, 1950 to 1957, Index Aeronautics, 1954 to 1957, Industrial Arts Index, 1954 to 1958, Nuclear Science Abstracts, 1948 to 1958, and Physics Abstracts, 1951 to 1958. (J.E.D.)

302 AERE-Bib-125
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
THERMOCOUPLES FOR HIGH TEMPERATURE MEASUREMENT. A BIBLIOGRAPHY. A. C. Foskett. July 1959. 20p. BIS.

A bibliography of 106 references covering the period 1954 to March 1959 is presented. The sources checked included Nuclear Science Abstracts, 1954 to 1959, Science Abstracts A and B, 1954 to 1958, Engineering Index, 1954 to 1957, Applied Science and Technology Index, 1957 to 1959, and indexes at AERE, Harwell. (J.E.D.)

21080 HW-60678
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
AN IMPROVED RECORDING MULTICOLOR PYROME-

TEMPERATURE 5.11.07

TER. B. B. Brenden and H. W. Newkirk. May 27, 1959. 18p. Contract W-31-109-Eng-52. $0.75(OTS).

The construction, calibration, and operation of a multicolor pyrometer are reported. The instrument employs three cadmium sulfide cells as radiation detectors. Interference filters mounted in front of each cell indicate the amount of energy radiated in three different wavelength bands. The output of each cell is printed on a strip-chart recorder in less than three seconds. Analyses of the recorded cell outputs permit a determination of three two-color temperatures. Data obtained by calibrating the instrument during a four-hour period show that the average value of the three temperatures differs from the true temperature by ±40°K. Better reproducibility was achieved by calibrating at more frequent intervals. (auth)

21320 LAMS-2325
Los Alamos Scientific Lab., N. Mex.
HIGH TEMPERATURE MEASURING TECHNIQUES, 1948 TO PRESENT. Bibliography. Ruth H. Lier, comp. Apr. 1959. 43p. Contract W-7405-eng-36. $1.25(OTS).

This bibliography is mainly concerned with thermocouples, resistance bulbs, sonic pyrometer, infra-red and radiation pyrometers, and microwave techniques. The following literature was searched: Physics Abstracts, Volumes 51 through 61, Nuclear Science Abstracts, Volumes 1 through 12, and Los Alamos Scientific Laboratory Report Library Card Catalog. (auth)

11776 AERE-X/R-2779
King's Coll., Newcastle Upon Tyne, England.
THE THIN FILM RESISTANCE THERMOMETER FOR THE MEASUREMENT OF TRANSIENT TEMPERATURES IN HOT GASES. R. M. Hill. Dec. 1958. 15p.

A resistance thermometer was developed for the measurement of heat transfer and temperature in hot gases. The thermometer has very low thermal capacities which will quickly adapt to the temperature of the surroundings without significant perturbation. The low thermal capacity is attained by the use of a very thin film. The theory for the interface temperature between the gas and the backing is reviewed. Methods used for manufacturing films for measuring interface temperature between the gas and the backing are reviewed. Methods used for manufacturing films for measuring interface temperatures are discussed. (J.E.D.)

CALIBRATION OF A CALORIMETER: A MINOR PEACEFUL USE FOR PLUTONIUM. Rothschild (Univ. of Cambridge, Eng.). Nature 182, 789-90(1958) Sept. 20.

Plutonium-239 contained in platinum-iridium needles was used to calibrate a calorimeter. The actual energy output of the needles was measured at the National Bureau of Standards, Washington, D. C. (C.H.)

2899 HW-56506
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
MULTICOLOR PYROMETRY. B. B. Brenden and H. W. Newkirk. Sept. 1, 1958. 13p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

A theoretical analysis is presented which discusses the accuracies which would be required for practical application of three-color temperature measurement methods. The analysis was applied to the errors involved in using brightness pyrometers and two-color pyrometers to determine the three-color temperature. The results show that brightness temperature determinations must be accurate to ±0.5°K, whereas two-color temperature determinations must be made to an accuracy of ±5°K in order to be usable in a three-color temperature measurement. It is concluded that three-color temperature measurements are practical and offer the advantage of permitting a variation of emissivity with wavelength and do not require a knowledge of emissivity. (auth)

16326
A NULL-POINT PRESSURE INDICATOR FOR USE AT HIGH TEMPERATURE. P. E. Liley (Imperial Coll. of Science and Tech., London). J. Sci. Instr. 35, 308-9 (1958) Aug.

A device which enables gas pressures up to 125 atm. at temperatures up to 675°C to be transmitted with high precision is described. (A.C.)

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TEMPERATURE 5.11.07

11570
ROCKING-BOMB CALORIMETER FOR MEASURING HEATS OF SOLUTION. Stuart R. Gunn (Univ. of California, Livermore). Rev. Sci. Instr. 29, 377-80 (1958) May.

A calorimeter designed for measuring the heats of rapid reactions such as dissolution and hydrolysis near room temperature is described. The instrument consists of a sealed copper bomb suspended in an evacuated submarine immersed in a thermostat; stirring is accomplished by rocking the assembly through an arc of 150°. Measurements of the heat of solution of potassium chloride in water at 25.00°C have been performed. (auth)

1476
INDUCTANCE-TYPE THERMOCOUPLE TESTER. Peter R. Morris (National Lead Co. of Ohio, Cincinnati). Instr. and Automation 29, 2217-19(1956) Nov.

Development of a portable battery-operated instrument capable of detecting a short-circuit four or more inches from the hot junction of a five-foot-long thermocouple is described. A signal having a wavelength much greater than the electrical length of the thermocouple is used to measure thermocouple inductance. (auth)

7528
HUMIDITY AND TEMPERATURE CONTROL UNIT FOR A COUNTING ROOM. L. E. Preuss (Edsel B. Ford Inst. for Medical Research, Detroit). Nucleonics 14, No. 4, 98-103 (1956) Apr.

3136 NBS-4420
National Bureau of Standards, Washington, D. C.
A STUDY OF BASIC LIMITATIONS TO THE CONCEPT AND MEASUREMENT OF TEMPERATURE: INCOMPLETE EQUILIBRIUM. C. M. Herzfeld. Jan. 1956. 17p. NBS Project 0301-20-2617. Sponsored by ONR; and AEC under Contracts NAord-21-48 and CS-640-55-9. $3.30(ph OTS); $2.40(mf OTS).

The growing importance of extremely high temperatures has made increasingly important the development of new methods of measuring temperature and the study of temperature under non-equlibrium conditions. The present survey is a contribution towards revealing the state of the art in this area and, as such, provides the background against which future work can be undertaken. (auth)

17207 AERE-Lib/Trans-798
THE INVESTIGATION AND CHOICE OF ALLOYS FOR HIGH-TEMPERATURE THERMOCOUPLES. A. A. Rudnitskii and I. I. Tyurin. Translated by M. de O. Tollemache (U.K.A.E.A. Atomic Energy Research Establishment) from Zhur. Neorg. Khim. 1, 1074-90 (1956). 23p.

11564 AERE-GP/R-2372
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A FULL RADIATION PYROMETER SUITABLE FOR TEMPERATURE MEASUREMENTS IN THE RANGE 0° TO 100°C. M. G. Davies and H. Kronberger. 1958. Date of MS. Sept. 31, 1951. Decl. with amendments Apr. 25, 1957. 6p. $0.24(BIS).

Declassified version of AERE-G/R-783.

A full radiation pyrometer is described having in vacuo an accuracy of ½°C at 70°C. The action depends on a thermal null method. Readings are therefore independent of the emissivity of the surface. (auth)

22859
BIBLIOGRAPHY ON THE MEASUREMENT OF GAS TEMPERATURE. National Bureau of Standards Circular 513. Paul D. Freeze. Washington D. C., National Bureau of Standards, 1951. 16p. $0.15(GPO)

A bibliography of approximately 400 references to articles on and related to the measurement of gas temperature, covering the 20 years prior to January 1951, are included. These references are grouped according to instrument types. (C.J.G.)

TRANSFER OF FLUIDS 5.11.08

DENSITY 5.11.08.01

11565 SCTM-58-58-81
Sandia Corp., Albuquerque, N. Mex.
RADIATION GAGE TECHNIQUES FOR MEASUREMENT

INSTRUMENTATION AND CONTROL 5.11

TRANSFER OF FLUIDS 5.11.08

DENSITY 5.11.08.01

OF DENSITY VARIATION. G. J. Miller. June 6, 1958. 19p. Contract AT(29-1)-789. $3.30(ph OTS); $2.40(mf OTS).

Some of the fundamental principles and techniques involved in measuring density variation with radiation gages are presented. (auth)

THE MAIN PROBLEMS IN DESIGNING SELF-BALANCING RADIATION TYPE LIQUID DENSITY GAUGES. K. S. Furman. Priborostroenie No. 5, 22-4(1958). (In Russian)

Gages using γ transmission or back-scattering are reviewed, including double-beam and single-beam methods. The counter and accessory electronic equipment (discriminator, balancing wedge, etc.) are considered, preference being given to scintillation counters. The theory of the method is presented. No particular apparatus is described in detail. (tr-auth)

THE MAIN PROBLEMS OF DESIGNING SELF-COMPENSATING RADIOACTIVE DENSIMETERS FOR LIQUIDS. K. S. Furman. Priborostroenie No. 5, 22-4(1958).

The theoretical aspects of density determinations from a measurement of the decrease of the intensity of a gamma source irradiating a liquid are discussed in detail. Two Soviet devices which utilize this principle for density measurements are described. (J.S.R.)

1303

GAMMA DENSITY CONTROLS EXTRACTION COLUMN. Bernard G. Ryle (National Lead Co. of Ohio, Cincinnati). Chem. Eng. Progr. 53, 551-5(1957) Nov.

Gamma absorption density gauging can monitor both the organic extract and the aqueous raffinate and can control column feed rates to maintain normal steady-state operation in a liquid-liquid uranium extraction process. (auth)

7502 AEC-tr-3539

AN APPARATUS FOR THE JOINT DETERMINATION OF VISCOSITY, DENSITY AND THE FUSION-SOLIDIFICATION TEMPERATURE. N. S. Bubyreva, B. I. Markin, B. P. Bindas, Yu. (Iu.) A. Silkin, and K. V. Chmutov. Translated for Los Alamos Scientific Lab. from Zhur. Fiz. Khim. 31, 2580-3(1957). 5p. $1.80(ph), $1.80(mf) JCL or LC.

A compound instrument for the joint determination by remote control of certain physico-chemical constants of liquids such as the density, viscosity, and the fusion solidification temperature is described. Diagrams are included as well as operating procedures. The instrument was used in a study of electrolyte solutions, demonstrating good measurement reproducibility. (J.R.D.)

6441 A/CONF.15/P/983

CONTINUOUS MEASURING OF HYDROGEN IN HYDROCARBONS BY BETA-RAY ABSORPTION. R. Berthold (Wildbad/Schwarzwald, Ger.). 7p.

With beta counters fitted on the outside of a pipe-line, continuous density measurements can be carried out with an accuracy of ± 0.2% provided that suitable measuring heads will be used. When high weight per cents of hydrogen are present, the ratio Z/A for this compound will be twice as large as for the neighboring light elements, resulting in an anomalous scattering of the beta radiation in relation to the hydrogen content. This anomaly was used to determine the H/C ratio in aromatic hydrocarbons. As a result of the H/C ratio in hydrocarbons they can now be controlled continuously.

2467 WCAP-6033

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. SPECIFIC GRAVITY INSTRUMENTS FOR A NUCLEAR FUELS REPROCESSING PLANT. W. E. Foster and E. R. Rosal. Dec. 1, 1959. 40p. Contract AT(30-1)-2176, Task 1. OTS.

Specific gravity instrumentation suitable for a nuclear fuels reprocessing plant was evaluated for possible use in a Nuclear Materials Control System (NMCS). Two basic types of instruments were considered: Pneumatic "bubbler" instruments intended primarily for use in process tanks; and Pipe-line units for continuous monitoring of process streams. Pneumatic instrument systems using both a two and a four dip-tube assembly were built and installed in the feed and product tank respectively of the

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TRANSFER OF FLUIDS 5.11.08

Density 5.11.08.01

NMCS Test Loop. The two tube system was tested on various (aqueous) solutions of uranyl nitrate in nitric acid. Two sigma limits on the precision of the two tube system were conservatively estimated to be ±0.009 specific gravity units for a range of 1.0 to 1.6 specific gravity units. At prime accountability points of a chemical processing plant under stringent inventory control, two assemblies with four dip-tubes, dual sensing units, and appropriate tamper-resistant features are recommended. A pipe-line instrument for monitoring the specific gravity of process streams on a continuous basis ("Densitrol") was purchased and installed on the NMCS Test Loop. A calibration on uranyl nitrate-nitric acid (water) solutions yielded a prediction equation with two sigma limits of about ±0.0034 specific gravity units over a span of 0.18 specific gravity units. The instrument appears promising for further evaluation as a continuous monitor of process stream density, or as a supplement to an in-line analytical instrument. Appropriate tamper-resistant features are specified for use with the Densitrol when it is included in a Nuclear Materials Control System. (auth)

FLOW 5.11.08.02

BETTER WAY TO TRACE LIQUID FLOW PATTERNS. Merton Allen (General Electric Co., Schenectady, N. Y.). Chem. Eng. 66, No. 9, 148; 150(1959) May 4.

A method for studying fluid flow which makes use of suspended colored particles, 100 to 500 microns in size, is described. If more than one fluid is to be observed, or more than one pattern, then more than one color can be used. It is possible to color the particles with fluorescent pigments which can be excited by ultraviolet light and will then give off colored visible light. If the ultraviolet source is strong enough, the particles can be photographed in black-and-white or color film with a conventional camera and a timed exposure. (J.H.M.)

LIQUID FLOW METERS. L. R. Blake and British Thomson-Houston Co., Ltd. British Patent 802,017. Nuclear Eng. 4, 238(1959) May.

The flow meter described is designed for measuring the rate of flow of an electrically conductive liquid such as liquid metal in an enclosed duct. A given length of duct is placed in a transverse magnetic field and arrangements are made to vary the field strength at a given intermediate point along that distance, such that current parallel to the flow of the liquid is zero at that point. When the desired field pattern has been obtained, the voltage is measured across terminals on either side of the duct at the measuring position. The voltage V_t thus measured is proportional to the mean velocity of the flow V_m according to the formula. $V_t = kV_m$ where k is a factor which depends on the internal dimensions and wall thickness of the duct, the resistivity of the liquid and on the magnetic field strength at the measuring position. This refinement eliminates the need for calibrating flow meters of this kind of design at several known rates of flow within the range the instrument is built for and, also, for calibrating the apparatus individually for the different liquids to measured.

THE APPLICATION OF RADIOISOTOPES IN HYDROLOGY AND HYDRAULICS. II. A. Montens (Ruhrverbande, Essen, Ger.). Atompraxis 5, 182-87 (1959) Apr.-May. (In German)

The use of various isotopes for examining current and flow processes has increased steadily in recent years as one of the many interesting possibilities for using artificial radioactive substances in hydrology. The results of various experiments and tests in this field have been published in a large number of articles. The present article gives a report on measurements carried out so far, and on the success which has been attained. An extensive bibliography gives helpful pointers for a closer study of various procedures which are here described only briefly. 39 references. (auth)

13876

PHYSICAL PROCESSES IN THE CHEMICAL INDUSTRY. VOL. III. FLOW MEASUREMENT AND CONTROL. W. F. Coxon. London, Heywood & Co., Ltd., 1959. 320p.

The subjects discussed in this volume are fluid meter classification, theoretical discussions on differential heat meters, primary elements for measuring differential pressures, installation of pressure difference devices, theoretical considerations in open channel meters, instruments used in measurement of fluid flow, principles of automatic control, control of continuous processes, and miscellaneous control installations. (W.L.H.)

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FLOW 5.11.08.02

8107 NP-7240
Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.
THE APPLICATION OF MAGNETIC NUCLEAR RESONANCE IN HYDRODYNAMICS. Report No. 56/II. A. Z. Hrynkiewicz. Dec. 1958. 11p.

The recording of the nuclear resonance line by means of a mirror oscillograph has made it possible to employ the phenomenon of nonadiabatic transition in a stream of flowing fluid for studying the character of the flow. Nonadiabatic transition was used to mark the flowing fluid in a given section of a pipe in a time of the order of a microsecond. The nuclear resonance apparatus served as the detector of the marked fluid after it had traversed a certain distance in the pipe. In order to illustrate the method, the shape of pulses in the detector was studied for laminar flow and for turbulent flow in a smooth cylindrical pipe. (auth)

INDUCTION FLOWMETER. Vincent Cushing (Armour Research Foundation, Chicago). Rev. Sci. Instr. 29, 692-7(1958) Aug.

According to Faraday's law of induction an electric field will be induced in a medium moving relative to a magnetic field. This induced electric field is proportional to the intensity of the magnetic field and to the relative velocity of the moving medium. When applied to media of arbitrary electrical conductivity and dielectric constant, it is seen that any potential difference that arises in connection with the induced electric field is attenuated by the shunting effect of the permittivity of free space. For most media this shunting effect is negligible; for media of extremely low conductivity, however, the effect is appreciable. Finally the effect of the electrical properties of the containing pipe is investigated. (auth)

14084 AERE-R/M-159
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A VARIABLE AREA FLOWMETER USING RADIOACTIVE ISOTOPE TECHNIQUES. P. T. Blacker and D. M. Harris. June 1958. 9p.

A variable area flowmeter is described in which a collimated beam of γ rays is interrupted by a tapered float. The degree of absorption of the γ-ray beam by the float is used as a measure of flow rate. Calibration curves and a discussion on possible development are included. (auth)

14756 A/CONF.15/P/1761
California Research Corp., Richmond, Calif.
FLOW MEASUREMENTS BY THE TOTAL-COUNT METHOD. D. E. Hull and M. Macomber. 21p. $0.50 (OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A fundamentally new method of measuring fluid flow uses a pulsed charge of radioisotope and a radiation counter. It is based on this principle: When a discrete quantity of radioactive tracer (A) flows past a counter fixed in or near the stream, the total number of counts (N) from the tracer is inversely proportional to the flow rate (Q). The counter must be calibrated in a geometry simulating that on the stream and with the isotope at a known concentration. The calibration factor (F) is expressed in counts/second per mc/ft^3. Thereafter, to determine the flow in any such stream, all one needs to know is the quantity of isotope put in the stream and

19118 AECU-4249
Los Alamos Scientific Lab., N. Mex.
AN ABSOLUTE MASS RATE FLOWMETER. F. A. Guevara, R. M. Potter, and W. E. Wageman. [1958?]. 9p. Contract [W-7405-eng-36]. $1.80(ph), $1.80(mf) OTS.

A true mass flow rate device has been developed that is absolute in the sense that it requires no calibration. The flow measurement is made by adding a known amount of energy to a gas and finding its resulting temperature increase. The flowmeter is essentially pressure independent and is capable of 0.1% reproducibility. It is suggested that other versions of this flowmeter should be practical over wide ranges of pressure and temperature and should be usable with a variety of gases and liquids. (auth)

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FLOW 5.11.08.02

FLOW GENERATION, MEASUREMENT, AND CONTROL. J. Dunn and H. M. Jones. May 1, 1957. p.869-90 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS HELD AT BRUSSELS, BELGIUM, MAY 20-5, 1957. 1165p. (TID-7534(Bks. 1-3); HW-49545A)

The design criteria for equipment in a flow generation, measurement and control system in a remotely operated aqueous separations plant are presented. Submerged regenerative turbine and deepwell turbine pumps, driven by motors located above and sealed from the tanks, were used to transfer solutions. Improved materials of construction, seal design, and methods of remote replacement have made it possible to adapt these pumps for use in chemical separations service. A brief description of a typical flow system installation, consisting of a specially designed rotameter-transmitter and control valve is presented. A detailed description of the rotameter-transmitter, amplifier-converter, recorder-controller, and control valve then follows. A description is given of a weight factor and specific gravity measurement system used for determining the volume of liquid moved into or out of a vessel which is helpful in calculating flow rate.

7632

USE OF RADIOACTIVE ISOTOPES FOR MEASURING GAS FLOW VELOCITIES AND FOR THE AUTOMATIC CONTROL OF GAS FLOW BY "LABELED MOLECULES". N. N. Shumilovskiĭ, and L. V. Mel'ttser (Inst. of Automatics and Telemechanics). Doklady Akad. Nauk S.S.S.R. 106, 661-4(1956) Feb. 1. (In Russian)

A "labeled molecule" method for measuring flow velocities and for automatic control of gas flow is adapted for technical use. The source of radioactive ionization is placed in a special container outside of the pipe, thus it does not have any direct contact with the investigated media. The flow of radiation is modulated so that it "penetrates" periodically through the pipe at short intervals of time. Consequently, inside of the pipe, ionized media are created which are transferred by the flow. A receiver, placed under the flow, checks the passing of the ionized medium, and a special installation records the time between the generation of ionization and its passage in front of the receiver. Isotopes used within the limits of their natural decay do not contaminate the investigated media. The method of labeled atoms contains excited atomic nuclei emitting radioactive isotopes, while the "labeled molecule method" is a collection of ionized molecules, excited by radioactive isotopes, which are not themselves radioactive but are easily captured by a sensitive receiver. The method was developed by using the strongly ionizing α particles. (R.V.J.)

1451

EXPERIMENTS ON THE DEPENDENCE OF SENSITIVITY ON VELOCITY PROFILE IN ELECTROMAGNETIC FLOWMETERS. J. A. Shercliff (Univ. of Cambridge, England). J. Sci. Instr. 32, 441-2(1955) Nov.

Mercury was passed along a non-conducting circular tube bearing flowmeter-type electrodes situated in a transverse magnetic field downstream of a small offset orifice. When the flow was concentrated near the electrodes the ratio of induced potential difference to the product of magnetic field and flow rate was found to reach more than twice the value appropriate to axially symmetric velocity profiles. When the flow was concentrated at the side of the tube this ratio could fall to zero and even change sign. Further downstream a steady state was reached, sometimes in a oscillatory manner. (auth)

LEVEL 5.11.08.03

2468 ✓ WCAP-6034

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. LIQUID LEVEL INSTRUMENTS FOR A NUCLEAR FUELS REPROCESSING PLANT. E. R. Rosal. Dec. 1, 1959. 46p. Contract AT(30-1)-2176, Task 1. OTS.

Liquid level instrumentation for a nuclear fuels reprocessing plant was evaluated for possible application in a Nuclear Materials Control System (NMCS). Two basic types of instruments were considered: Pneumatic "bubbler" systems, intended primarily for use with radioactive solutions, and fielden (capacitance) probes, intended for use with decontaminated product solutions. A pneumatic instrument system using a two dip-tube assembly was built and installed in the product tank of the NMCS Test Loop. The system was tested with various aqueous solutions of uranyl nitrate in nitric acid. Methods for calibration of tank volumes and liquid level instruments are discussed. The precision of a two dip-tube system was found to be 0.6 percent of the full scale value (65 inches)

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and the results of the statistical analysis of the calibration data are presented at the 95 percent confidence level. A four dip-tube assembly with dual sensing elements and appropriate tamper-resistant features is recommended for NMCS use. The Fielden capacitance instrument has been extensively tested at the Savannah River Plant where it was found to be vulnerable to radiation damage. Therefore, it can be used only with decontaminated material. Shielded capacitance probes with appropriate tamper-resistant features are recommended for NMCS use. (auth)

6004 A/CONF.15/P/982
CONTINUOUS CONTROL AND MEASUREMENT OF LEVELS AND DENSITIES BY GAMMA RAYS. Adolf Trost (Wildbad/Schwarzwald, Ger.). 8p.

Level control, measurement, and regulation by radioisotopes has been largely adopted in all those cases where orthodox methods, such as floats and probing gages, fail when levels of corrosive or highly viscous liquids have to be measured or if measurements have to be carried out at high pressures or temperatures as well as in cases of solid and molten materials. In the Federal Republic of Germany about 400 instruments of this kind are in operation. In most cases the absorption of gamma rays by the filling material is used to obtain an indication of the level. The usual sources applied are Co^{60} or Cs^{137}. (auth)

12334
MAXIMUM LEVEL CONTROL AND REGULATION WITH RADIOACTIVE ISOTOPES. A. Trost. Atompraxis 5, 59-66(1959) Feb. (In German)

The weakening of gamma and beta rays in container contents is used for measuring content levels, for monitoring maximum levels, and for giving a continuous reading and regulation of content levels. Technically tested procedures, arrangements, and equipment are described, and the performances and limitations of these methods are given. Questions of radiation protection are discussed. (auth)

1687
IMPROVEMENTS IN OR RELATING TO LEVEL-INDICATING GAUGES OPERATED BY RADIATION. (to Landis and Gyr AG). British Patent 822,105. Oct. 21, 1959.

A liquid-level gage of greater reliability is described. A radioactive source and counter tube are deployed as the detector element. A differential amplifier with one glow discharge tube relay for the upper level limit and another for the lower is provided. The counting tube is R-C coupled to the amplifier to convert pulses into a voltage proportional to the mean pulse frequency. The anodes of the amplifier are connected to the starters of the glow discharge tubes. Thus both tubes fire when the level is correct, only one when incorrect, and neither for a malfunction. (T.R.H.)

INDUSTRIAL APPLICATIONS OF RADIOISOTOPES, NUCLEAR LIQUID LEVEL GAUGES. Stelios Regas (Radiation Counter Labs., Skokie, Ill.). J. Soc. Non-Destructive Testing, 16, 493-4(1958) Nov-Dec.

Some general properties of radioisotopes and their applications to the field of measurements are reviewed. The operation of nuclear devices in determining the level of a liquid in a container is explained in detail. Two types of level gages, the Predetermined Liquid Level Gage and the Continuous Level Gage, are included in the discussion. (J.H.M.)

2898 DP-304
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
AN INSTRUMENT FOR INDICATING MERCURY LEVEL INSIDE THICK-WALLED STEEL PIPE. T. Richard Herold. Aug. 1958. 7p. Contract AT(07-2)-1. $0.50 (OTS).

An instrument was developed which uses a radioactive source and a scintillation counter to detect the level of a mercury column inside thick-walled steel pipe. (auth)

8560 IGR-R/CA-255
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

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Level 5.11.08.03

MEASUREMENT OF LIQUID-METAL LEVELS BY THE EFFECT OF EDDY CURRENTS ON AN INDUCTANCE. D. F. Davidson. Dec. 1957. 10p.

Remote-reading liquid-metal level indicators were developed for the proposed sodium-cooled test loop in the Dounreay materials testing reactor. The principle used is the effect of eddy currents on the inductance of a coil. The coil is made in the form of a probe which is inserted in a vertical stainless steel pocket in the tank. Tests were made in a test rig, using liquid metals, to prove the instruments and to provide calibration curves. An approximately linear scale is obtained for an instrument in a tank 6 in. deep, but the instrument for a 3-in. tank needs a calibration. A standardizing facility allows for changes in the electronic circuits and enables a simple correction to be applied for temperature changes. A search probe was constructed to assist in the tests. It may prove to be a valuable instrument in some applications, since it is self-calibrating and independent of temperature. (auth)

1474
LEVEL CONTROL USING GAMMA RAYS. Werner Krause die atom wirtschaft 2, 335-6(1957) Oct. (In German)

8166 CF-57-4-64
Oak Ridge National Lab., Tenn.
TEMPERATURE EFFECTS ON THE MEASUREMENT OF AQUEOUS LIQUID LEVEL BY THE DIFFERENTIAL PRESSURE METHOD AND RECOMMENDATIONS FOR PLACEMENT OF TAPS ON THE HRT REPLACEMENT HEAT EXCHANGER. R. L. Moore. Apr. 26, 1957. 18p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Increasing temperature in an aqueous liquid system results in a decrease in liquid density and an increase in vapor density. When level is measured by the differential pressure method, temperature increase results in a decrease in the effective span of the instrument and a shift in zero. When the instrument reference leg is uncompensated, both zero and span shifts occur with the effects being most pronounced at the higher levels. When the reference leg is compensated, zero shifts are eliminated (instrument zero is at 100% level for this type installation). For control purposes at levels above 50% of full level, the compensated reference leg installation will give the best results. For measurement of levels below 50%, the uncompensated installation is best. As errors in level indications will be produced, in either type installation, by temperature, pressure and steam withdrawal (power) effects, the placement of taps should be such as to place the normal or control level in the region of 50% indicated level. Recommendations are made with respect to the placement of the three taps on the replacement heat exchanger. It is further recommended that two level instruments be installed. One instrument should be connected between the upper and middle taps and would be used for control. The other instrument should be connected between the upper and lower taps and would be used for indication of levels below the control range. The reference leg of the controlling instrument should be compensated. The reference leg of the indicating instrument should be uncompensated. (auth)

3207 UCRL-3288
California. Univ., Berkeley. Radiation Lab.
HOT WIRE LIQUID-LEVEL INDICATOR. Arturo Maimoni. Jan. 13, 1956. 14p. Contract W-7405-eng-48. $3.30(ph OTS); $2.40(mf OTS).

The theory of the method of measurement of liquid level by measurement of the resistance of a heated wire is developed, and it is applied to the design of a liquid-nitrogen-level indicator having a power dissipation of 3.4 milliwatts per inch of length and a deviation from linearity in the calibration of less than 0.1 inch over its working length of 2.0 inches. (auth)

PRESSURE 5.11.08.04

12640
IMPROVEMENTS IN OR RELATING TO PRESSURE GAUGES. William Millar (to United Kingdom Atomic Energy Authority). British Patent 812,632. Apr. 29, 1959.

A pressure gage is described in which the speed of a pulse through the gas is measured. The pulse transmitter and receiver are toroidal transformers, the secondary of which is a single turn including the diaphragm. The pulse waveform is square so that transient response of the diaphragm is minimized. A block diagram of the instrument arrangement is given. (T.R.H.)

5379
PRINCIPLE OF A SEMICONDUCTOR MANOMETER IN THE PRESSURE RANGE OF 1 TO 10^{-6} mm Hg.

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PRESSURE 5.11.08.04

M. Varićak and B. Saftić (Inst. of Physics and Rudjer Boskovic Inst., Zagreb, Yugoslavia). Rev. Sci. Instr. 30, 891-5(1959) Oct.

Experiments investigating the use of semiconductors for low-pressure measurements proved that thermistors give the best results. These experiments led to the construction of thermistor systems consisting of miniature thermistors fixed to thin metal foils. With these systems it is possible to measure pressure changes in the range of 1 to 10^{-6} mm Hg. The problem of temperature compensation is discussed and it is shown that in the case of thermistors this problem may be resolved by means of the voltage vs current characteristics. A detailed description of the apparatus, including the gauge head as well as the electric circuit and the calibration curves, is given. (auth)

15312

IONIZATION VACUUM GAGE FOR PRESSURE MEASUREMENTS. V. M. Gavrilyuk and Ya. M. Kucherov (Inst. of Physics, Academy of Sciences, Ukrainian S.S.R.). Pribory i Tekh. Ekspt. No. 2, 83-5(1959) Mar.-Apr. (In Russian)

An ionization vacuum gage for measuring pressures up to 10^{-4} to 10^{-10} mm mercury is described. (R.V.J.)

PRESSURE GAUGE FOR CORROSIVE GASES IN THE MICRON AND SUBMICRON REGION. J. R. Anderson (Univ. of Melbourne). Rev. Sci. Instr. 29, 1073-8(1958) Dec.

A gage is described, for use with corrosive gases in the range 10^{-2} to 10^{-5} mm Hg, in which the pressure is indicated by the rate of damping of a hinged silica fiber pendulum. Amplitude is measured photoelectrically. The gage exposes only glass and silica to the gas, may be baked to 450°C, and gives an accuracy of pressure measurement of better than 5%. (auth)

A CORROSION PROOF VACUUM CONTROLLER FOR PRESSURES UNDER 1 mm OF MERCURY. I. Amariglio and M. M. Benarie (Israel Ministry of Defence, Tel-Aviv). J. Sci. Instr. 35, 385(1958) Oct.

A vacuum controller designed for pressures of less than 1 mm Hg is described. The pressure-sensitive element is an inclined Toepler arrangement. The image of the liquid level in the manometer is projected on a gas-filled photocell which controls a servomotor. A glass leak valve is positioned by the servomotor. (J.R.D.)

13459 WAPD-TH-448

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

AN ANALYSIS OF PRESSURE TRANSDUCER TRANSIENT RESPONSE. E. R. Quandt. [Sept. 1958]. 18p. $3.30 (ph), $2.40 (mf) OTS.

Using Laplace Transform techniques, a generalized transfer function is derived for pressure measuring instruments employing liquids to transmit the pressure. It is shown that the transducer response is of second order, and may be discussed in terms of a natural frequency and damping factor. These two quantities are presented as functions of the physical properties of the system. Using the transfer function and the methods presented in WAPD-TH-421, the response of pressure transducers to step and sinusoidal inputs are specifically derived. A comparison is made between calculated response and data recently obtained. Agreement is shown to be good for response to step function decreases in pressure. Qualitative confirmation of the calculated transfer function was obtained from a preliminary investigation of response to a sine wave input. Application of the results to design of transient pressure measuring systems is discussed. Graphs are presented as an aid in quantitatively evaluating response to step and sine inputs. (auth)

IONIZING MANOMETER CALIBRATIONS ACCORDING TO SOME HALIDE CONTAINING GASES. N. S. Buchel'nikova (Inst. of Chemical Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt. No. 5, 110(1958) Sept. (In Russian)

Correction coefficients for calibrations for air, Cl_2, Br_2, and HCl are tabulated. (R.V.J.)

MANOSTAT FOR HIGH-PRESSURE OPERATIONS. H. H. Reamer and B. H. Sage (California Inst. of Tech., Pasadena). Rev. Sci. Instr. 29, 709-12(1958) Aug.

INSTRUMENTATION AND CONTROL 5.11

TRANSFER OF FLUIDS 5.11.08

PRESSURE 5.11.08.04

The maintenance of isobaric conditions at pressures of the order of 10,000 lb/in.^{2} is sometimes a difficult operation in transport studies. A manostat has been devised which will maintain isobaric conditions with a precision of about 1 part in 100,000 at pressures from 500 to 10,000 lb/in.^{2}. The equipment functions satisfactorily as a pressure transducer for control purposes. (auth)

THE USE OF THE ALPHA-IONIZATION MANOMETER IN SORPTION STUDIES. M. M. Dubinin, K. M. Nikolaev, and A. I. Sarakhov (Inst. of Physical Chemistry, Moscow). Zhur. Fiz. Khim. 32, 1155-9(1958) May. (In Russian)

A modification of the alpha-ionization manometer developed permits pressure measurements to be made over the range 1.10^{-2} to 150 mm Hg, with an accuracy close to and in some regions higher than for the mercury manometer. The manometer may be used in determining adsorption isotherms and in a number of other physico-chemical investigations. The size of the ionization chamber and the shape of the collector electrode depends upon the region of the pressure measured. Therefore for manometers intended for use over a broad pressure range (1.10^{-4} to 1000 mm Hg) it is feasible to have two ionization chambers, one for high and the other for low pressures. (tr-auth)

11571

VAPOR PRESSURE APPARATUS. Marshall W. Cook (Univ. of California, Livermore). Rev. Sci. Instr. 29, 399-400(1958) May.

A vapor pressure apparatus has been developed which has certain manipulative and accuracy advantages over the well-known isoteniscope. A reliable criterion for complete degassing is inherent in the apparatus. Since degassing is required only once for a series of determinations at various temperatures, the apparatus is well adapted where the amount of sample is limited. The useful temperature range of this apparatus is between the freezing point of mercury and the temperature at which the vapor pressure of mercury becomes appreciable. The apparatus may not be used if the sample reacts chemically with mercury. (auth)

12532

HIGH TEMPERATURE PRESSURE MEASUREMENT. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 157, Session 15. Robert J. Ingham and R. Clark DuBois (Manning, Maxwell, and Moore, Inc., Stratford, Conn.). New York, American Institute of Chemical Engineers, 1958. 27p.

A NaK filled diaphragm seal assembly has been developed which can be used up to 1500°F to measure pressure in liquid metal systems. The pressure can be shown on an indicating gauge connected by a suitable length of capillary to the seal. Both pneumatic and electric transmitters can be provided. Units have been made of several materials and with ranges of 0 to 100 to 0 to 400 psi. Minimum material thickness used in contact with the process fluid is 0.025 in., one ply. The change in calibration for temperatures between 70 and 1400°F is approximately 1% of full scale. Extensive testing has indicated good results. (auth)

8904

VACTROLLER. A LABORATORY VACUUM CONTROLLER. C. J. Penther (Shell Development Co., Emeryville, Calif.). Rev. Sci. Instr. 28, 460-3(1957) June.

Pirani gages are used in an a-c bridge circuit to sense deviation from the set point, and with the aid of a proportional leak valve, control the pressure of laboratory-scale vacuum systems over the range of 0.1 to 10,000μ of Hg. Pressure fluctuations from the controller action are negligible and stability of ± 1% has been obtained over long periods without operator attention. Set point is easily adjustable by panel control knob. Commercial components are used except for the leak valve which is of special construction. (auth)

VACUUM GAUGE. G. A. Kuipers (to U. S. Atomic Energy Commission). U. S. Patent 2,780,099. February 5, 1957.

A vacuum measuring device comprising a vane pivotally mounted adjacent a wall within a test chamber is described. An opaque member attached to the vane generates a pulsating current in a photoelectric circuit. The current is supplied to a loop secured to the vane and acts with a magnet to maintain constant, the frequency of oscillation of the vane. The electrical power supplied to the loop is a measure of the pressure, due to the damping effect of the gas between the wall and vane. (auth)

INSTRUMENTATION AND CONTROL 5.11

TRANSFER OF FLUIDS 5.11.08

PRESSURE 5.11.08.04

11165 UTIA-41
Toronto. Univ. Inst. of Aerophysics.
THEORY OF FREE-MOLECULE, ORIFICE-TYPE, PRESSURE PROBES IN ISENTROPIC AND NONISENTROPIC FLOWS. G. N. Patterson. Nov. 1956. 21p. Contract AF18(600)-1185. (OSR-TN-57-13; AD-115045).

The theory is presented of a pressure probe in the form of an orifice in the side of a tube which may be orientated in any direction relevant to that of the mass motion and which is so small compared with the local mean free path that free-molecule flow occurs. The theory shows that such a tube will measure the local speed ratio in isentropic and nonisentropic flows and suggests that in strong shock waves it may be possible to determine the viscosity and heat conduction, that is, the deviation from Maxwellian molecular motion. (auth)

5940 AEDC-TR-56-7
Arnold Engineering Development Center, Tullahoma, Tenn.
A METHOD OF CALCULATING THE RESPONSE TIME OF PRESSURE MEASURING SYSTEMS. Robert C. Bauer. Nov. 1956. 33p. Contract AF40(600)-700. (AD-98978).

Theoretical lag-time equations are developed for single- and double-tube pressure measuring systems connected to manometers or constant-volume instruments. Qualifying parameters which relate the equations to a particular system are developed. (T.R.H.)

4761 K-973(Pt. II)
Oak Ridge Gaseous Diffusion Plant, Tenn.
VIBRATION EFFECTS ON THE TAYLOR 206R PRESSURE TRANSMITTER. PART II. G. H. Job and J. A. Owen. June 19, 1956. 23p. Contract W-7405-eng-26. $0.20(OTS).

The results of a series of tests comparing the performance of a standard Taylor 206R Pressure Transmitter with one altered to overcome the undesirable effects of mechanical vibration are presented. The alterations consist of adding a dashpot, filled with Taylor XC-299 fluid, on the Sensing Lever; replacing the Overthrow Spring with a flexible metal strip; removing the capillary tubing and capacity cylinder in the secondary bellows assembly; and feeding the output signal directly into the secondary bellows. The performance of the altered transmitter is

4755 AERE-GP/M-190
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THEORY AND DESIGN OF AN ACOUSTIC PRESSURE GAUGE. W. Millar. Apr. 1956. 21p.

In the pressure range 10^{-2} to 10^{3} mm me[illegible], a number of well established types of gage are in use. The[illegible] manometers (mercury of oil), McLeod gages, Pirani gages, and comparison devices using a mechanical diaphragm. Each of these types has its own limitations in convenience, accuracy, or working range. A type of gage is proposed here in which these limitations could be less serious, and which will cover the whole of the above range. Operation of the instrument depends on the amplitude of received signal at the end of an "acoustic transmission line", which is simply a tube containing gas at the pressure to be measured. A simple form of the gage has already been constructed, which works well for air; design proposals are given for a gage of general applicability. (auth)

13841 CF-56-2-168
Oak Ridge National Lab., Tenn.
PRESSURE MEASUREMENT BY DISPLACEMENT OF A RESTRAINED DIAPHRAGM. D. M. Richardson. Feb. 15, 1956. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A relatively simple method of determining the pressure of enclosed systems by the displacement of a restrained diaphragm was developed. The method was used to measure unsaturated steam pressure in connection with volumetric water adsorption studies, but is applicable to other systems. (D.E.B.)

2789 NP-5867
Mine Safety Appliances Co., Callery, Penna.
HIGH TEMPERATURE PRESSURE GAGE. Technical Report No. 45. E. C. King and V. K. Heckel. Jan. 5, 1956. 24p. Contract NObs-65426.

A pressure gage has been developed for high temperature liquid metal service that will either record or indicate remotely from a radioactive area. The accuracy achieved in some cases is better than ±1%, and is consistently better than ±2.5% of full scale. (auth)

932
METHOD FOR MAINTAINING LEVEL OF LIQUEFIED GAS REFRIGERANTS. Robert D. Goodwin (Air Reduction Co., Inc., Murray Hill, N. J.). Rev. Sci. Instr. 26, 1052-3 (1955) Nov.

Controls are described for maintaining a constant level of liquid N in a still-head can. A small electric solenoid valve is employed directly in the liquid N line, operating under the control of a sensitive level switch. The method and associated instruments are described, including a rapid means for changing supply cans. (auth)

INSTRUMENTATION AND CONTROL 5.11

TRANSFER OF FLUIDS 5.11.08

PRESSURE 5.11.08.04

National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY AND INDEX ON DYNAMIC PRESSURE MEASUREMENT. W. G. Brombacher and T. W. Lashof. Feb. 14, 1955. 126p. (NBS-C-558).

This circular contains a bibliography of 850 items on dynamic pressure measurement and on related subjects such as static pressure measurement. General information on instrument components is also included. Subject and author indexes are provided.

13703 IDLM-59
Gt. Brit. Capenhurst Works, Capenhurst, Ches., England.
INITIAL EXPERIENCE WITH THE PALLADIUM-ION GAUGE METHOD OF VACUUM TESTING. H. Heath. Oct. 21, 1952. 19p.

A thin heated Pd sheet between an ion gage and a vacuum chamber allows H_2 exclusively to enter the ion gage. Thus, a leak probed with H_2 shows up even with heavy outgassing and with short pumping times. Operation of and operating experience with such a test arrangement are described. (T.R.H.)

924 NYO-5079
Mallinckrodt Chemical Works, St. Louis.
THE MANOMETER SYSTEM ON THE HYDROGEN FLUORIDE STORAGE TANKS. Earl Miller. Feb. 5, 1945. Decl. Nov. 2, 1955. 15p. Contract W-7405-eng-29.

In order to determine the approximate amount of HF in storage tanks, they were equipped with a manometer system. This system is installed so that it measures the differential pressure between the top and bottom of the liquid layers in the tanks. Since this differential pressure is proportional to the liquid level in the tanks, it is possible to derive a relationship between the differential pressure reading of the tanks and their contents. (D.E.B.)

LUBRICANTS AND LUBRICATION 5.12

PETROLEUM LUBRICANTS. THEIR APPLICATION IN NUCLEAR PLANT. C. H. Nailer (Shell-Mex, Ltd.). Nuclear Eng. 3, 203-6(1958) May.

The general application of petroleum-based oils and greases to meet the arduous conditions imposed by radiation and the suitability of certain types of lubricants are reviewed. (auth)

LUBRICANTS RESISTANT TO ATOMIC RADIATION. (to Esso Research and Engg. Co. (U. S. A.)). British Patent 784,793. Nuclear Eng. 3, 186(1958) Apr.

The new lubricant composition is a lubricating oil having incorporated therein a sufficient proportion of an element or compound having a gamma ray absorption coefficient of at least 3 and a sufficient proportion of an element or compound having a capture of at least 2,500 barns.

16323 PRL-5.23
Pennsylvania State Univ., University Park. Petroleum Refining Lab.
FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Quarterly Report for January, February, and March 1958. Mar. 31, 1958. 85p. Contract AF33 (616)-5460.

The high-temperature properties of five paraffinic resins and a synthetic condensation type resin are discussed. The superior over-all stability properties of two Pennsylvania paraffinic resins at 700°F are demonstrated. Batch hydrogenation of a Pennsylvania paraffinic resin is described. The increasing difficulty of hydrogenation is related to increasing molecular weight for conventionally refined fractions from the same crude source. The reduction of dispersant properties of bright stocks and resins by hydrogenation is noted. The thermal stabilities of an ester and a polyester of the neopentyl type are compared with other neopentyl esters evaluated previously. A similarity in high temperature oxidative behavior is shown between monisopropyl biphenyl and a partially hydrogenated condensed ring aromatic hydrocarbon fraction. Low

LUBRICANTS AND LUBRICATION 5.12

molecular weight Acryloid polymers of the dispersant and conventional viscosity-index (V. I.) improver type are compared with commercially available additives of each type. Additional laboratory data are given for a series (MLO 7291 through MLO 7298) of experimental mineral oil jet engine lubricants. These data include lubricity tests, evaporation at 400°F, isothermal successive oxidation tests at 500°F, and non-isothermal successive oxidation tests at 500 and 347°F. The successive oxidation tests adequately illustrate dirtiness of the type noted in the J-57 jet engine tests. The mineral oil formulations MLO 7291 through MLO 7298 show less dirtiness and more oxidative stability in the successive oxidation tests than do the MIL-L-7808 type lubricants. Within the mineral oil series advantages are shown for the higher molecular weight bright stock and the dispersant type additive package in terms of cleanliness in the successive oxidation tests. A trend toward increasing dirtiness in some naphthenic mineral oils and decreasing dirtiness in some paraffinic mineral oils has been shown for silicone antiform additives under 347°F oxidation conditions. The selectivity of dithiocarbamate oxidation inhibitors for paraffinic mineral oils is demonstrated. Batch to batch variation in the effectiveness of a dithiocarbamate additive is also discussed. The use of a dispersant additive to improve the high temperature (500°F) oxidative dirtiness of isosebacate ester formulations is illustrated. A technique for the quantitative determination of oxygen assimilated in the controlled atmosphere panel coker has been developed. Preliminary tests show no correlation between the quantity of oxygen absorbed and the panel deposit value. A severe oxidation effect has been found for the Spec. MIL-L-7808 type evaporation test at 400 and 500°F. Oxidation inhibitors in esters have been shown to be a significant factor in controlling evaporation loss in the 400°F test. The evaluation of a series of experimental phosphorous-type lubricity additives in the four-ball wear tester is discussed. The use of fuel dilution in mineral oils to achieve improved low temperature fluidity is illustrated. Increased test severity in the single-pass high temperature lube rig is demonstrated for tests in which air rate is increased or flow rate is decreased. (auth)

8394 NP-6663

Stanford Research Inst., Menlo Park, Calif.

SYNTHESIS AND EVALUATION OF HIGH TEMPERATURE ANTIOXIDANTS FOR SYNTHETIC HYDRAULIC FLUIDS AND LUBRICANTS. Quarterly Progress Report No. III for November 1957–January 1958. (Report No. 9). R. M. Silverstein. Feb. 15, 1958. 28p. Contract AF33(616)-5276.

A number of additives were found to be effective in preventing oxidative degradation of F-50 silicone oil at 500°F with dry air for 48 hr. With a single exception, all of the effective additives fall into the class of aromatic and heterocyclic compounds, and the most effective of these compounds, except for one, can be classified as condensed aromatic ring compounds. Several of the effective additives are also soluble in the silicone oil. Apparently, condensed aromatic ring compounds containing three or more rings are effective as a class in F-50 silicone oil. Paraffinic mineral oil MLO 57-574 and silane fluid MLO 57-461 were degraded to black tars at 500°F with dry air; none of the additives tested was effective in preventing this degradation. Silane fluid MLO 57-628 was much more stable than silane fluid MLO 57-461. However, even the more stable fluid was degraded to a considerable extent after 48 hr at 500°F with dry air. Several of the additives screened seemed to show some activity, but more runs are needed to verify this tentative observation. Several ferrocene derivatives were prepared in the synthesis phase of the program. (auth)

17091

SYNTHETIC LUBRICANTS. Arkadily Il'ich Dintses and Aleksandra Vasil'yevna Druzhinina. Moscow, Gostoptekhizdat, 1958. 350p.

In this book intended for the specialist in the field of selecting, synthesizing, and using lubricants, synthetic lubricants for equipment and machines which operate under high and low temperatures and heavy loads where a high coefficient of friction is present are discussed. The synthetic hydrocarbon oils, polysiloxane liquids (silicones), esters prepared from carboxylic acids, polyalkylene glycols, fluorine, and carbon chlorofluorides are examined. The additives used in preparing lube oils are also discussed. (J.S.R.)

1708

SPECIAL LUBRICANTS FOR BRADWELL. Nuclear Power 2, 427-8(1957) Oct.

The work at Shell's Co^{60} facility on radiation effects on oils is reported, along with the development of special radiation resistant lubricants. (M.H.R.)

LUBRICANTS AND LUBRICATION 5.12

PROCEEDINGS OF THE CONFERENCE ON LUBRICATION AND WEAR, LONDON, OCTOBER 1st–3rd, 1957. London, The Institution of Mechanical Engineers, 1957. 918p.

The papers presented at this conference include: hydrodynamic lubrication; journal bearing instability; marginal and partial hydrodynamic lubrication; friction of solids; boundary lubrication; bearing materials, solid lubricants, surface treatments, and seals and glands; lubrication of rotating bearings and gears; internal combustion engine lubrication, miscellaneous lubricants, applications, and additives; and wear. (W.L.H.)

10459 AERE-ES/M-21
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
LUBRICATION IN DRY BOXES. J. Sheldon. May 1957. 3p.

9211 NP-6332
Shell Development Co., Emeryville, Calif.
RESEARCH IN HIGH TEMPERATURE BEARING LUBRICATION IN THE ABSENCE OF LIQUID LUBRICANTS. Progress Report No. 7 for February 1957 through April 1957. C. H. Bailey and S. S. Sorem. 19p. Contract AF33(616)-2999. (S-13722).

With respect to the increased temperatures explored during this report period, the following conclusions may be tentatively drawn. Some materials which are effective film forming agents at lower temperatures become ineffective or even detrimental at higher temperatures. A phosphorous additive, triisopropyl phosphite, remains effective at 800°F and in one test permitted operation at 950°F. At 2/3 "catalog rated load" bearing wear and deterioration under "protective atmosphere" appear nearly independent of temperature between 700 and 900°F. Bearing fatigue appears to be a problem with moderately loaded bearings at high operating temperatures. (auth)

5235
GRAPHITE AND MOLYBDENUM DISULPHIDE. E. R. Braithwaite (Acheson Colloids Ltd.). Nuclear Eng. 2, 107-10(1957) March.

The lubricating properties of graphite and MoS_2 are compared and discussed. The lubricity of graphite depends on the presence of an adsorbable vapor. How previous history of MoS_2 affects its frictional behavior is discussed. (T.R.H.)

4378 NP-6198
Denver. Univ. Denver Research Inst.
DEVELOPMENT OF "CHAIN TYPE" POLYPHENYL AND POLYNUCLEAR AROMATIC COMPOUNDS AS BASE MATERIALS FOR HIGH TEMPERATURE STABLE AND RADIATION RESISTANT LUBRICANTS AND HYDRAULIC FLUIDS. Quarterly Progress Report No. 5 [for] October 15, 1956 to January 15, 1957. Josef J. E. Schmidt and John A. Krimmel. Jan. 15, 1957. 38p. Project 7-(1-3044). Contract AF33(616)-2939.

The synthesis of a number of alkylated polyphenyl compounds for use as base materials for high temperature stable and radiation resistant lubricants and hydraulic fluids is outlined. This report also includes as an appendix a summary on the development of high temperature greases. (auth)

NP-6204
Standard Oil Co. of Indiana, Whiting.
DEVELOPMENT OF THICKENERS FOR HIGH TEMPERATURE GREASES. Quarterly Progress Report No. 22 [for] October 10, 1956 to January 10, 1957. John C. Goossens. Jan. 1957. 9p. Contract AF33(038)-23687.

Monthly Progress Report No. 68 is incorporated with this report and will not be submitted separately.

Thickeners are being synthesized and evaluated for use in greases for temperatures in excess of 450°F and as high as 700°F. Organic compounds with melting points above 650°F which can be prepared easily are being prepared as potential thickeners. (W.L.H.)

4420 WADC-TR-56-370(Pt. II)
Shell Development Co., Emeryville, Calif.
RESEARCH IN HIGH TEMPERATURE BEARING LUBRICATION IN THE ABSENCE OF LIQUID LUBRICANTS. Final Report [for] May 1, 1956 through October 31, 1956. Charles H. Bailey and Stanley S. Sorem. Oct. 1956. 22p. Project title: AVIATION LUBRICANTS. Task title: LUBRICANTS. Contract AF33(616)-2999.

The "protective atmosphere" system for operation of high temperature alloy rolling element bearings at temperatures from 600 to 800°F is being investigated. This system involves surrounding the operating bearing with a

special reducing atmosphere. This consists of a "rich" mixture of organic vapor and air with small additions of volatile film forming compounds. The reducing environment prevents the formation of destructive abrasive metal oxides. Reactions of the additive and organic vapor with or on the metal surfaces results in the formation of films which provide the necessary "lubrication" for high temperature operation. Phase I work on mechanisms and atmosphere compositions was continued using size 206 bearings operating under light load at 10,000 rpm. The upper temperature limit of a specific atmosphere composition was found to be 800°F. Possible reasons for the limit are given and means of increasing it are discussed. A group of oxygen and nitrogen containing compounds naturally occurring in JP-4 (approximately 1%w) were found to beneficially effect the nature of the lubricating films formed, thus leading to superior "protective atmosphere" operation. Several representative compounds from this group have been tested individually and of these m-toluidene was outstandingly good. Phase II work, outlining the load, speed, and life characteristics of bearings operated in a "protective atmosphere" was started using size 209 bearings operating at various speeds and loads. A bearing operated at 700°F under ⅔'s of catalog load rating successfully completed 33 hours. Wear was appreciable during this test but compromises in both the mechanical installation and atmosphere composition were necessary in order to work with the available bearings. These may have affected the wear results. (See also WADC-TR-56-370.) (auth)

910 PRL-5.18
Pennsylvania State Univ., University Park. Petroleum Refining Lab.
FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Quarterly Report No. 6 for April, May and June 1956. June 30, 1956. 82p. Contract AF33(616)-2851.

V6618 PRL-5.17
Pennsylvania State Univ., University Park. Petroleum Refining Lab.
FLUIDS, LUBRICANTS, FUELS, AND RELATED MATERIALS. Quarterly Report No. 4 for January, February, and March 1956. Mar. 31, 1956. 95p. Contract AF33(616)-2851.
(For preceding period see PRL-5.16.)

5588 WADC-TR-55-30(Pt.4)
Pennsylvania State Univ., University Park. Petroleum Refining Lab.
FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Final Report for October 1954 through December 1955. E. Erwin Klaus and Merrell R. Fenske. Feb. 1956. 324p. Contract AF33(616)-2851.
(For preceding period see WADC-TR-55-30(Pt.3).)

890 NP-5806
Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.
RELAXATION THEORY OF LUBRICATION. Technical Report No. LIV. Taikyue Ree, Antonino Fava, Izumi Higuchi, and Henry Eyring. Oct. 20, 1955. 19p. Project No. NR-032-168. Contract N7-onr-45101.
A general reduced equation was formulated for transient and steady state behavior of the viscosity of lubricants involving a single relaxation time. The steady state equation is also generalized for systems with multiple relaxation times. (auth)

1780 ✓ WADC-TR-55-102(Pt.2)
Shell Development Co., Emeryville, Calif.
GREASE LUBRICATION OF HIGH SPEED ANTI-FRICTION BEARINGS. Report for the Period January 1 through August 31, 1955. John B. Accinelli and Charles R. Greene. Oct. 1955. 52p. Project title: AIRCRAFT LUBRICANTS. Task title: LUBRICANT MECHANICAL EVALUATION. Contract AF 33(616)-2443.
Progress is reported in the study of grease lubrication of ball bearings operating at very high DN values (1.0×10^6 to 2.0×10^6). Two high-speed rigs were designed and built for the study. These rigs, utilizing 20 mm ball bearings, required considerable development work in order to obtain satisfactory operation at the desired DN values. Before work on greases was initiated each rig was calibrated with oil-air mist lubrication by running continuously for 100 hours at 1.2×10^6 DN in duplicate tests with two oils, a mineral oil of SAE grade 1010 (MIL-O-6081) and a diester synthetic oil (MIL-L-6085A). The rigs are now ready for the grease studies. In the course of these calibration runs it was found that slight dynamic unbalance of the rotating components has a very deleterious effect on bearing operation, and that for successful opera-

tion, in the very high range of DN, microbalancing of the rotor is required. The very high centrifugal forces encountered in very high-speed operation seem to cause continuous stripping of the lubricant film, and this action requires that lubricant be continually applied to the bearing at a fairly high rate of flow in order to obtain prolonged operation. This factor may limit the applicability of greases as lubricants for very high-speed ball bearing application. The laboratory investigation of grease properties in a force field obtained by centrifugation was continued. It was shown that bulk greases will not adhere to metal surfaces subjected to the unimpeded stripping action of centrifugal forces comparable to those encountered in some areas of the operating high-speed bearing. Oil loss from grease structures, through the shearing and crushing action of centrifugal force, was shown to vary with grease type and composition. The results obtained permitted some qualitative conclusions on the way the grease properties studied may affect bearing operation. (auth)

MAINTENANCE 5.13

DIRECT 5.13.01

See also, this section,

DESIGN--Plants (5.18.01).

20350 RADC-TR-59-47
Syracuse Univ., N. Y. Research Inst.
DIAGNOSIS OF EQUIPMENT FAILURES. Technical Report I. Richard A. Johnson, Earl Kletsky, and John Brulé. Apr. 1, 1959. 74p. Contract AF30(602)-1833. (SURI-EE-577-594T1-AD-213876).

This investigation was mainly concerned with one phase of the maintenance problem of electronic equipment, namely, the problem of determining which part of the equipment is in need of repair when the equipment as a whole does not function properly. This work was undertaken in the hope that examination of the basic fundamentals of diagnostic procedures would permit substantial economies to be made in the diagnostic phases of maintenance. (W.L.H.)

ELEVATING MECHANISM. H. S. Frederick and M. A. Kinsella (to U. S. Atomic Energy Commission). U. S. Patent 2,874,852. Feb. 24, 1959.

An elevator is described, which is arranged for movement both in a horizontal and in a vertical direction so that the elevating mechanism may be employed for servicing equipment at separated points in a plant. In accordance with the present invention, the main elevator chassis is suspended from a monorail. The chassis, in turn supports a vertically moveable carriage, a sub-carriage vertically moveable on the carriage, and a turntable carried by the sub-carriage and moveable through an arc of 90° with the equipment attached thereto. In addition, the chassis supports all the means required to elevate or rotate the equipment.

OPERATING EXPERIENCE IN A "HOT" SOLVENT EXTRACTION PILOT PLANT. G. C. Oberg and R. J. Sloat. 17p. (A/CONF.15/P/516)

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The operating experience gained in the "hot" pilot plant constructed at Hanford to evaluate solvent-extraction processes is discussed. After enumeration of the difficulties encountered, design concepts are presented which should be incorporated in new pilot plants to minimize operating and maintenance difficulties in a pilot plant employing a contact maintenance philosophy. During actual pilot plant operation, it was necessary to decontaminate the plant frequently to permit "contact" maintenance. The decontaminating solutions used and their specific applications for various types of radioactivity, and special decontaminating devices and techniques developed for removing surface contamination are discussed.

Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY ON MAINTENANCE, MAINTENANCE EQUIPMENT AND CLOSURES. B. D. Draper. Nov. 4, 1957. 6p. Contract (W-7405-eng-26). (CF-57-11-44).

The references are listed under the following subject headings: maintenance, decontamination, pipe joints and closures, and maintenance equipment and techniques. 80 references.

MAINTENANCE 5.13

DIRECT 5.13.01

Experiences with a Direct Maintenance Radiochemical Processing Plant, R.B. Lemon and D. H. Read, p. 532, Vol. 9, Proceedings of the Air National Conference on the Peaceful Uses of Atomic Energy, United Nations, N.Y., 1956.

11297 WAPD-PWR-CP-2704
[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]
PWR CHEMISTRY PROGRAM FOR JANUARY 1, TO JULY 1, 1957. 29p. $6.30(ph OTS); $3.00(mf OTS).
The chemistry requirements in PWR are directed toward satisfying three basic requirements: The assurance of the structural integrity and operational status of the plant including its mechanical and heat transfer components. Provision for continuous operation and accessibility for maintenance in a radioactive plant. Control and safe disposal of radioactive wastes are made in compliance with established standards. (auth)

DIRECT MAINTENANCE FUEL PROCESSING PLANT IS PRACTICAL. D. G. Reid and K. K. Kennedy (Phillips Petroleum Co., Idaho Falls, Idaho). Chem. Eng. Progr. 52, 394-5(1956) Sept.
The practicality of direct maintenance as opposed to remote maintenance of reactor fuel processing plants is discussed. (T.R.H.)

2170
UNIQUE URANIUM REPROCESSING PLANT DESIGNED FOR DIRECT MAINTENANCE. Chem. Eng. 63, No. 1, 120, 122(1956) Jan.
The design and operation of the fuel reprocessing plant (ICPP) located at Idaho Falls, Idaho are discussed. Direct and remote maintenance plants are compared. (C.W.H.)

20026 HW-39433
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
A PROPOSED NUCLEAR SAFETY INDICATOR FOR CONTACT MAINTENANCE PURPOSES. G. M. Muller and N. Ketzlach. Oct. 10, 1955. Decl. Apr. 2, 1959. 3p. $1.80(ph), $1.80(mf) OTS.
An instrument is described which will make it possible to determine the safety of performing contact maintenance work on certain long columns used in the continuous flow processing of plutonium. Design, calibration, and use of the instrument are discussed. (C.J.G.)

REMOTE 5.13.02

See also, under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Remote Handling (4.02.07).

DESIGNING EQUIPMENT FOR UNDERWATER FACILITIES. J. K. Figenshau and G. C. Kelly (General Mills, Inc., Minneapolis). p.445-56 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
Criteria affecting the design of equipment for use in underwater facilities are discussed. Topics discussed include the advantages and disadvantages of underwater operation, methods of operation, power driven equipment and power requirements, component availability, selection and suitability, material selection and compatability, viewing considerations, lubrication of equipment, and protection of equipment against ambient conditions. (auth)

11376 ✓ CF-58-6-83
Oak Ridge National Lab., Tenn.
REMOTE MAINTENANCE TOOLS CATALOG NO. 58. [1958]. 135p. Contract [W-7405-eng-26]. $25.80(ph), $7.80(mf) OTS.
Catalog number 58, containing information concerning remote maintenance tools which have been used at ORNL, is presented. It is intended as a guide and as a starting point for modification work. Complete information is not available on all tools. (J.R.D.)

MAINTENANCE 5.13

REMOTE 5.13.02

3822 NAA-SR-2981
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
REMOTE MAINTENANCE TECHNIQUES FOR THE PROCESSING REFABRICATION EXPERIMENT. Donald J. Stoker. Dec. 1, 1958. 43p. Contract AT-11-1-GEN-8. $1.25(OTS).

In maintaining in-cell process and handling equipment, it is essential that the equipment piece or its components can be remotely replaced. The general techniques developed for replacement of PRE in-cell equipment or equipment components are outlined. General maintenance philosophy is outlined. Utility couplings, method of supplying utilities, mounting of motors, and coupling drive shafts, gaskets, and fasteners are described. (auth)

20164 NAA-SR-3264
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
AN ELEVATING TURNTABLE FOR REMOTE MAINTENANCE IN THE PROCESSING-REFABRICATION EXPERIMENT. Donald J. Stoker. Aug. 15, 1959. 27p. Contract AT-11-1-GEN-8. $1.00(OTS).

A special in-cell maintenance workbench is required to aid in the remote maintenance of radioactive PRE in-cell equipment. The development and demonstration of such a bench which rotates, moves in a vertical direction, is remotely operable, and has all in-cell components remotely maintainable, is outlined. (auth)

MATERIALS (CONSTRUCTION) 5.14

ALUMINUM 5.14.01

ALUMINIZED STEEL, PROPERTIES AND USES. K. G. Coburn (Armco Steel Corp., Middletown, Ohio). J. Metals 11, 38-9(1959) Jan.

Aluminized steel is manufactured in two grades. One has a Si–Al alloy coating and is best suited in an environment where a combination of heat and corrosion is involved. The second grade has a pure Al coating and has excellent resistance to atmospheric corrosion. The physical properties, welding, corrosion, and uses of these alloys are described. (W.L.H.)

11443 CRMet-753
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
EXAMINATION OF SINTERED ALUMINUM PRODUCT TUBES. W. Evans. Mar. 1958. 17p. (AECL-573). $0.50(AECL).

The metallographic examination of three samples of sintered aluminum product tubing, two of Swiss origin and one of Alcoa M257 material is reported. On annealing, the Swiss samples developed blisters. This is attributed to a high hydrogen content and its diffusion to an oxide rich zone located near the outer surface of the tubes. The Alcoa M257 sample did not blister on annealing, and its microstructure was found to be satisfactory. (auth)

9830 NRL-5124
Naval Research Lab., Washington, D. C.
IRON–CHROMIUM–ALUMINUM ALLOYS. J. E. Srawley. Feb. 28, 1958. 19p.

Alloys containing up to 25% chromium and 11% aluminum were produced by vacuum melting and hot worked by forging. Tensile properties at room and elevated temperatures were determined, and their resistance to oxidation in air and attack by the combustion products of residual fuel oils was studied. Alloys containing about 5% aluminum and 25% chromium appear to offer excellent prospects of improved service as boiler-tube support materials when compared with type 310 stainless steel, which is commonly used. It has been shown in an earlier report that application of aluminum coatings to the type 310 steel offered little prospect of improved life. The vacuum induction melting process as applied to these alloys was studied. The exclusion of air during melting and pouring is important in controlling the cleanliness of the product, but the level of dissolved oxygen is controlled by the aluminum content and is so low that prior deoxidation with hydrogen or carbon cannot affect it. The possibilities of control of carbon and nitrogen require further study. (auth)

MATERIALS (CONSTRUCTION) 5.14

ALUMINUM 5.14.01

10534 DP-214
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
EROSION OF ALUMINUM. Edward H. Honeycutt, Jr. May 1957. 16p. Contract AT(07-2)-1. $0.20(OTS).

Specimens of aluminum were undamaged or eroded only slightly during two months of exposure to deionized water at velocities up to 125 ft/sec. Flow in a narrow annulus at 125 ft/sec produced no detectable wear on 63S aluminum, but it did produce localized pitting up to 0.01 inch deep on 2S aluminum. Specimens of 2S aluminum were undamaged by water flow at 50 ft/sec through a sharp right-angle bend in a narrow annular channel and through a tube with sudden enlargement and contraction of cross section. (auth)

11215 ✓ NP-6384
Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF HYDROGEN ON THE MECHANICAL PROPERTIES OF TITANIUM–ALUMINUM ALLOYS. Summary Report [for] May 1, 1956 to April 30, 1957. L. W. Berger, D. N. Williams, and R. I. Jaffee. Apr. 30, 1957. 39p. Project No. TB 4-15. Contract DA-33-019-505-ORD-7.

Studies were made of the effects of hydrogen on the properties of Ti–Al alloys containing 2.5, 5, and 7% Al and Ti–Al alloys containing O, N, and C. The results showed that an increase of Al increases the hydrogen solubility which enables the alloys to contain higher amounts of hydrogen before the hydride occurs in the structure and impact embrittlement takes place. The alloy showed good weldability and high notch toughness at moderate strength levels. (R.V.J.)

6393 WAL-401/79-33
Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF HYDROGEN ON THE MECHANICAL PROPERTIES OF TITANIUM–ALUMINUM ALLOYS. Interim Report. L. W. Berger, D. N. Williams, and R. I. Jaffee. Mar. 1, 1957. 25p. Project No. TB 4-15. Contract DA-33-019-505-ORD-7.

The effects of H on the properties of binary Ti–Al alloys containing 2.5, 5, and 7% Al were studied. Increasing the Al content increases the apparent solubility of H, which accounts for the property trends determined. Hydrogen additions up to 230 ppm have little effect on the strength of unalloyed Ti and no deleterious effect on tensile ductility. Notch-bend impact strength, however, was seriously lowered by adding 80 ppm H, an addition which was sufficient to show hydride in the structure. The properties of Ti-2.5Al were similarly affected by H with hydride appearing in the microstructure at the lowest addition studied, 75 ppm. In the Ti–5Al and Ti–7Al alloys, hydride did not appear in the microstructure until 315 and 415 ppm, respectively, were added. This increased solubility of H resulted in considerable strengthening without loss in ductility as well as increased tolerance to impact embrittlement. A loss in tensile reduction in area was noted when hydride was present, as a result of the grain boundary distributions of that phase. Loss in impact strength also occurred at the first appearance of hydride. Whether or not high Al contents increase H solubility is still open to question, as there is some evidence that the effect is one of retarding hydride precipitation. If so, these alloys may be susceptible to slow strain embrittlement. (auth)

CORROSION OF ALUMINUM IN URANIUM NITRATE SOLUTIONS. V. H. Troutner. Apr. 6, 1956. 4p. (HW-42364)

The corrosion of Al in $Al(NO_3)_3$ solution has been shown in laboratory tests to be too severe to permit the use of Al for containing hot $U(NO_3)_4$ solutions. A minimum corrosion penetration rate of 2 mils per day was observed with M-329 Al in 1% $U(NO_3)_4 \cdot 6H_2O$ in pH 2 aqueous solution at 100°C.

CERAMICS 5.14.02

THE FUTURE OF CERAMICS AS NUCLEAR FUEL. 1. WHAT ARE CERAMICS? N. C. Moore and J. B. Huffadine (Caswell Research Labs., The Plessey Co., Ltd.). Nuclear Power 4, No. 37, 86-9(1959) May.

An introduction to ceramics in general is given. Data available on the materials being developed to replace metal fuels are reviewed. (A.C.)

CERAMIC MATERIALS FOR HIGH-TEMPERATURE APPLICATIONS IN THE CHEMICAL PROCESS INDUSTRIES. M. Jack Snyder (Battelle Memorial Inst., Columbus, Ohio). Chem. Eng. Progr. 54, No. 11, 65-6(1958) Nov.

MATERIALS (CONSTRUCTION) 5.14

CERAMICS 5.14.02

Recently developed high-temperature processes (above 1500°C) which require ceramic containment and the ceramic materials used are discussed. Tables showing upper operating temperatures of commercial ceramics and pure compounds and their uses and limitations are given. (T.R.H.)

12380

ABOVE 2,500 F, WHAT MATERIAL TO USE?
Luther D. Loch (Carborundum Co., Niagara Falls, N. Y.). Chem. Eng. 65, No. 13, 105-9(1958) June 30.

The properties of cermets and refractories and their applications in the chemical industry and in nuclear reactors are discussed. The properties of silicon carbide, boron nitride, graphite, silicon nitride, titanium diboride, zirconium diboride, hafnium diboride, and molybdenum silicide are tabulated. (T.R.H.)

BONDING OF CERMET-VALVE COMPONENTS TO METALS. G. M. Slaughter. P. Patriarca. and W. D. Manly (Oak Ridge National Lab., Tenn.). Welding J. (N. Y.). 37, 249s-54s(1958) June.

The techniques and procedures utilized to bond cermet-valve components successfully to metals for high-temperature fluid service are described. The carmets studied contained varying percentages of titanium carbide. tungsten carbide, tungsten-titanium complex carbide and niobium-tantalum-titanium complex carbide. The binder materials were primarily nickel and cobalt. The results of wetting tests on these cermets with different brazing alloys are presented, as are photomicrographs of many of the most promising cermet-to-metal joints. A procedure for attaching cermets is described wherein a nickel or tungsten-base alloy cushion is brazed between the cermet and Inconel to absorb stresses resulting from differential thermal expansion. A direct high-temperature bonding procedure is also discussed in which cermets of the titanium carbide-nickel type are joined to nickel without the use of a separately applied brazing alloy. (auth)

7392

CERAMIC MATERIALS. W. G. O'Driscoll and W. E. Dennis (to U. K. Atomic Energy Authority). British Patent 766,885. Nuclear Eng. 2, 224(1957) May.

In the reduction of metal fluorides with calcium, magnesium or other metal capable of displacing the metals, calcium fluoride lined vessels have been employed. The usual preparation of such linings by packing around a former, vibration to settle the mass, firing and sintering results in a large proportion (50%) of rejects owing to cracking during heating or handling. This disadvantage has been overcome by incorporating in an alkali earth metal fluoride a proportion (up to 5%) of an alkali metal fluoride or another alkaline earth metal fluoride which forms a lower melting point eutectic with the alkaline earth metal fluoride. The mixture is shaped (vessel lining; crucible), heated and sintered. (auth)

12726 ✓ CWR-456

Curtiss-Wright Corp. Research Div., Quehanna, Penna.
REPRODUCIBILITY OF THE MECHANICAL PROPERTIES OF CERAMIC MATERIALS. PART I. MODULUS OF RUPTURE OF HIGH PURITY ALUMINA SPECIMENS.
O. W. Thomas, N. R. Wheelock, and C. A. Liedholm. Feb. 28, 1957. Decl. June 28, 1957. 30p. Contract AT(30-3)-220. $4.80(ph OTS); $2.70(mf OTS).

The notion that the properties of ceramic materials vary erratically has been widely accepted. If this view were correct, attempts to develop reliable design criteria for ceramic structures subject to rigid weight limitations and exacting performance requirements could not succeed. Modulus of rupture and thermal shock test data on dense Al_2O_3 specimens have been obtained and analyzed with encouraging results, indicating predictable variations for the articles tested. The results of the modulus of rupture tests are presented and discussed. (auth)

5858 OSR-TN-56-446

Illinois. Univ., Urbana.
THE POLYMORPHIC MODIFICATIONS OF SILICA IN CERAMIC COATINGS. Report No. 77. J. H. Lauchner. Feb. 1957. 23p. Contract AF18(603)-28. (AD-96791).

The polymorphic modifications of silica present in ceramic coatings due to devitrification or as a result of direct additions were identified by thermal strain, x-ray diffraction and differential thermal analyses. Comparison of the analytical results indicated thermal strain analysis to be the most sensitive method in identification of all silica modifications studied. Analysis of the tessellated stresses developed in the systems was applied in determination of effective linear thermal expansion characteristics and interpretation of residual stress development. (auth)

MATERIALS (CONSTRUCTION) 5.14

2701
RECENT DEVELOPMENTS IN THE TECHNOLOGY OF CERAMIC MATERIALS FOR NUCLEAR ENERGY SERVICE. J. M. Warde and J. R. Johnson (Oak Ridge National Lab., Tenn.). J. Franklin Inst. 260, 455-66(1955) Dec.

Recent developments in the technology of ceramic materials are reviewed. Data on uranium oxides are summarized. Thorium oxide is discussed as a potential breeder material. The fabrication of cermets is also briefly discussed. Radiation effects and corrosion of ceramics are reviewed. (B.J.H.)

1782
THERMODYNAMIC DATA ON OXIDES AT ELEVATED TEMPERATURES. Harlan P. Tripp and Burnham W. King (Battelle Memorial Inst., Columbus, Ohio). J. Am. Ceram. Soc. 38, 432-7(1955) Dec.

An extensive compilation of data on the free energy of formation of oxides is presented in graphic form. From these curves it is possible to obtain the free energy of most ceramic oxides in the temperature range 0 to 2400°C. (auth)

CONCRETE 5.14.03

13110
THERMAL CONDUCTIVITY OF REFRACTORY INSULATING CONCRETE. W. C. Hansen and A. F. Livovich (Universal Atlas Cement Co., Buffington, Ind.). Am. Ceram. Soc. Bull. 37, 322-8(1958) July.

Thermal conductivity data are given for 20 insulating and three dense refractory Lumnite cement concretes. Data for 15 concretes were found in good agreement with a curve established by the authors to show the relationship between thermal conductivity and unit weight of the concrete, whereas the data for the remaining eight concretes deviated from the curve by more than 5%, i.e., in excess of limits of accuracy of the test. The 23 concretes were selected for the tests on the basis of the desired unit weights, which were achieved by various means such as the blending of different aggregates, varying size and type of aggregate, varying the method of placing, and by using air-entraining agents. (auth)

CONCRETE IN RADIATION SHIELDING TECHNOLOGY. Thomas Jaeger. Atomkern Energie 2, 338-44(1957) Aug.-Sept. (In German)

9892 BMI-71
Battelle Memorial Inst., Columbus, Ohio.
ENGINEERING PROPERTIES OF HIGH-DENSITY CONCRETES. M. J. Snyder, C. A. Burkart, and J. W. Clegg. May 1951. Decl. Feb. 13, 1957. 59p. Contract W-7405-eng-92. $0.40(OTS).

Methods were developed for measuring various engineering properties of high-density concretes. Data are presented on selected thermal properties of a limonite-iron concrete and the mechanical properties of the limonite-iron concrete, a magnesium oxychloride concrete, and a Portland cement concrete containing steel punchings and shot (no limonite). The properties which were determined included: thermal expansion, thermal conductivity, resistance to thermal stress, heat liberation during setting, effect of temperature and humidity on equilibrium water content, gas permeability, dimensional stability, compressive strength, modulus of elasticity, flexural strength, bonding strength, and shear strength. (auth)

6011 A/CONF.15/P/1152
LES BETONS LOURDS. PROPRIETES PHYSIQUES ET ESSAIS MECANIQUES. (Heavy Concretes).
M. Tourasse (Compagnie Industrielle de Travaux, France). 25p.

The utilization of high-density substances for shielding against nuclear radiation has led to the use of heavy concretes in which the aggregates are iron or barite ores or iron shot. The physical and mechanical properties of these concretes were determined. The results obtained with some other concretes are briefly discussed. (J.S.R.)

GRAPHITE 5.14.04

14637 A/CONF.15/P/702
Los Alamos Scientific Lab., N. Mex.
SOME MECHANICAL PROPERTIES OF GRAPHITE IN THE TEMPERATURE RANGE 20° TO 3000°C. P. Wagner, A. R. Driesner, and E. A. Kmetko. 28p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

MATERIALS (CONSTRUCTION) 5.14

Measurements were made on the following high temperature mechanical properties of graphite: strength in tension and compression, tensile and compressive creep, coefficient of friction, coefficient of thermal expansion, and thermal conductivity. These measurements were performed to study the effects of temperature, stress level, anisotropy, and graphite type. Included in graphite type were graphites manufactured with normal uranium carbide in the graphite matrix. The maximum concentration of the uranium used was 350 mg/cc. (auth)

4321 AERE-Inf/Bib-109
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
PURIFICATION OF GRAPHITE. P. M. Harris. Oct. 1956. 8p.
A bibliography on methods of purifying graphite is presented. The sources consulted are Chemical Abstracts, Nuclear Science Abstracts, Carbon Abstracts, and Proceedings of International Conference on Peaceful Uses of Atomic Energy, Geneva, August, 1955. (T.R.H.)

1270
INTERPRETATION OF THE STORED ENERGY OF IRRADIATED GRAPHITE IN TERMS OF ELASTIC ENERGY ASSOCIATED WITH MICROSCOPIC STRAINS. Alfred E. Austin and Ralph J. Harrison (Battelle Memorial Inst., Columbus, Ohio). Phys. Rev. 100, 1225-6(1955) Nov. 15.
The amount of contraction of the a_0 dimension of irradiated graphite and its behavior on annealing have been determined with greater precision than earlier determinations. It is shown that the observed intralayer distortions have more the character of strains than crystal breakup. Mean square strain and computed stored energy for graphites are tabulated. (B.J.H.)

3737 ✓ Y-389
Carbide and Carbon Chemicals Corp. Y-12 Plant, Oak Ridge, Tenn.
MATERIALS TO RESIST ION BEAM EROSION. W. L. Ross. Apr. 15, 1949. Decl. Dec. 7, 1955. 22p. Contract W-7405-eng-26. $4.80(ph OTS); $2.70(mf OTS).
A series of tests were made to find a material to resist calutron ion beam erosion. Various materials were exposed to ion beams and the amount of erosion compared to a standard, C-18 graphite. Extruded graphites (AGHT and ECA) were only slightly better than C-18. BN and CbC were as good as C-18 graphite. None of the materials were definitely superior to C-18. (auth)

NICKEL 5.14.05

21224
NICKEL AND HIGH-NICKEL ALLOYS. A. J. Marron (International Nickel Co.). Ind. Eng. Chem. 51, 1197-1203(1959) Sept.
Processing methods, uses, and mechanical, physical, and metallurgical properties are discussed for nickel and high-nickel alloys. (C.J.G.)

STUDIES OF THE QUATERNARY ALLOY Ni-Cr-Ti-Al. L. I. Pryashkina and L. A. Ryabtsev. Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk No. 12, 38-42(1957) Dec. (In Russian)
A schematic phase diagram is shown for the Ni-Ni_3Ti-Ni_3Al-Cr alloy at 1000°. The cross section of the Ni-Cr-Ti-Al alloy in the limited solid solution of nickel (γ) and the two phase ($\gamma + \gamma'$) was investigated for constant content of Cr(17%) and Ti(1.8%) and varying content of Al(0 to 12%). The thermal analysis showed the crystallization of the eutectic composition of the alloy at 1280° with 9% Al. The solubility of Al in the solid solution of the Ni-Cr-Ti-Al was found with 6 and 8% Al at 1200°, for nearly 6% Al at 1050°, and with 4 to 6% Al at 900°. The increase of the Al content in the quaternary solid solution of Ni(with 17 to 20% Cr and 1.8 to 2.4% Ti) sharply increased its heat resistance. The alloy with 6.40% Al was tested at 900° and 8 kg/mm^2 tension for 1000 hr and did not show disintegration even under a further test with 12 kg/mm^2 for 100 hr.

7204
EFFECT OF STRAIN AND TEMPERATURE ON THE YIELDING OF COPPER AND NICKEL. J. H. Frye, Jr., L. L. Scott, and J. W. Woods (Oak Ridge National Lab., Tenn.). J. of Metals 9, 708(1957) May.

5885 NACA-TN-3976
Lewis Flight Propulsion Lab., Cleveland.

MATERIALS (CONSTRUCTION) 5.14

NICKEL 5.14.05

RUPTURE STRENGTH OF SEVERAL NICKEL-BASE ALLOYS IN SHEET FORM. James H. Dance and Francis J. Clauss. Apr. 1957. 24p.

The 100-hour rupture strengths of Inconel X, Inconel 700, Incoloy 901, Refractaloy 26, and R-235 at 1200° and 1350°F in both the annealed and heat-treated conditions were determined. Inconel 700 had the highest rupture strength at both temperatures; Incoloy 901 was second strongest at 1200°F, and R-235 second strongest at 1350°F. With the exception of Incoloy 901, ductility was low. Photomicrographs show that fractures are through the grain boundaries. Results are compared with published data for other sheet alloys and bar stock. (auth)

6399

Ni ALLOYS SHINE AT HIGH TEMPERATURES. R. M. Wilson, Jr. and W. F. Burchfield (International Nickel Co., New York). Chem. Eng. 64, No. 5, 298, 300, 302, 304, 306(1957) Apr.

The properties of some Ni alloys which make them suitable for use at high temperatures are discussed. Embrittlement problems, behavior in fabrication, welding, and cleaning are topics included. (T.R.H.)

4478

THERMAL EXPANSION OF SOME NICKEL ALLOYS. Peter Hidnert. J. Research Natl. Bur. Standards 58, 89-92 (1957) Feb.

Data on the linear thermal expansion of some Ni alloys (Mn-Ni, Hoskins Alloy 667, Inconel, Evanohm, Monel metal, M-M-M alloy, Illium alloy, and Waspalloy) for various temperature ranges between 20 and 1,000° C are given. During the first heating of Inconel alloys (probably with a supersaturated content of C), irregularities were noted in the expansion at about 700° C and were ascribed to precipitation of carbide. The coefficients of expansion of the alloys are tabulated. For the range 20 to 300° C, these coefficients varied from 13.1 to 15.5 $\times 10^{-6}$ per deg C. The effects of additions of Cu, Co, and Fe to Ni-Cr alloys (0 to 24% of Cr) are indicated. (auth)

5883 NACA-TN-3828

Lewis Flight Propulsion Lab., Cleveland.

INVESTIGATION OF THE NiAl PHASE OF NICKEL-ALUMINUM ALLOYS. Edward M. Grala. Oct. 29, 1956. 33p.

The effects of composition and homogenization heat treatments on the room- and elevated-temperature mechanical properties of the cast NiAl intermetallic were determined. Small changes in composition within the NiAl phase field resulted in appreciable strength and hardness changes. Room-temperature hardness of alloys containing 25 to 35% Al exhibited a sharp minimum at 31.5% Al (stoichiometric NiAl). Homogenized NiAl specimens had tensile strengths at room temperature ranging from 29,450 psi for the 25% Al alloy to 14,900 psi for stoichiometric NiAl. At 1500°F the tensile strength of homogenized alloys ranged from 29,050 psi for the 25% Al alloy to 14,500 psi for the stoichiometric alloy. Additions of 0.5 to 2.0% Mo to stoichiometric NiAl reduced the as-cast grain size and significantly increased both room- and elevated temperature strength and ductility. (auth)

2741 ORNL-1877(Rev.)

Oak Ridge National Lab., Tenn.

DISSOLUTION OF METALS IN FUSED FLUORIDES. R. E. Leuze, G. I. Cathers, and C. E. Schilling. Oct. 12, 1955. Decl. Mar. 6, 1957. 15p. Contract W-7405-eng-26. $0.30(OTS).

In scouting tests, a number of metals used in nuclear reactor fuel elements were dissolved by ZrF_4–KF–NaF fused salt at 675°C through which HF was being passed. These included type 304 stainless steel at 4 mils/hr; type 347Nb stainless steel at 7 mils/hr; Th at 14 mils/hr; nonirradiated U at 17 mils/hr; Zr at 22 to 35 mils/hr; Ti at 31 mils/hr; and Zircaloy-2 at 22 to 46 mils/hr. Only small amounts of volatile fission products formed when irradiated U was dissolved. Variables that appear to affect the dissolution rate are the composition of the fused fluoride, the fused fluoride temperature, the HF flow rate, the metallurgical characteristics of the material being dissolved, and the presence of other metals. The low dissolution rate of 0.001 mil/hr observed for nickel suggests that it may be suitable as a material of construction for reaction vessels.

OTHER METALS 5.14.06

5537 NP-8227

Battelle Memorial Inst., Columbus, Ohio.

DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. M. J. Wahll, comp. Oct. 1959. 84p.

A listing of selected acquired articles, reports, and papers is presented concerning light metals, high-strength alloys, miscellaneous metals, and special subjects such as

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OTHER METALS 5.14.06

applications, coatings, fabrication, non-metallic refractories, properties, and thermal protection. (J.R.D.)

8785
TUNGSTEN: BIBLIOGRAPHY 1953–1958. PHYSICAL PROPERTIES AND PHASE DIAGRAMS. Towanda, Penna., Sylvania Electric Products, Inc. 42p. $1.00.
A bibliography of 409 references is given on the physical properties of tungsten, covering material published between 1953 to 1958. Phase diagrams of tungsten with various metals are given. (C.J.G.)

20151 DMIC-Memo-32
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
PHYSICAL AND MECHANICAL PROPERTIES OF TANTALUM. H. R. Ogden. Aug. 28, 1959. 18p.
Selected physical and mechanical properties of tantalum at room and elevated temperatures are presented in tabular form. (J.E.D.)

13520 DMIC-Memo-14
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
PHYSICAL AND MECHANICAL PROPERTIES OF MOLYBDENUM AND THE Mo–0.5Ti ALLOY. Richard W. Douglass. Apr. 10, 1959. 23p.
Some physical properties of molybdenum and the Mo–0.5Ti alloy of interest in the elevated temperature applications of these materials are briefly summarized. Mechanical properties, including tensile, impact, and fatigue data, and creep and stress-rupture properties over a wide range of temperatures are also presented. (auth)

LESS COMMON METALS. E. M. Sherwood (Battelle Memorial Inst., Columbus, Ohio). Ind. Eng. Chem. 50, 1455-9(1958) Sept.
The intensified research and development devoted to the less common metals has disclosed a number of heretofore relatively unknown properties useful in new equipment for the nuclear era. A review of the properties and uses of Zr, Hf, Mo, Nb, Ta, Cr, and Re is presented. (J.R.D.)

10649
BERYLLIUM: PRESENT AND POTENTIAL USES. Lawrence F. Boland (Beryllium Corp., Reading, Penna.). J. Metals 10, 401-3(1958) June.
A general run down of the Be industries advance in the past few years is presented. The production, cost, availability, ductility, and toxicity of Be is also included. (W.L.H.)

13160
THE STRUCTURE AND PROPERTIES OF VANADIUM–MOLYBDENUM ALLOY SYSTEM. V. V. Baron, Yu. V. Efimov, and E. M. Savitskii. Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk No. 4, 36-40(1958) Apr. (In Russian)
The microstructure, hardness, microhardness, plasticity, and electroresistance of Mo–V were studied and their melting point was determined. The constitution diagram was constructed. (R.V.J.)

THE METAL MOLYBDENUM. Proceedings of a Symposium sponsored by The Office of Naval Research, Department of the Navy, held September 18 and 19, 1956 at Rackham Memorial Building, Engineering Society of Detroit, Detroit, Michigan. Julius J. Harwood. Cleveland, American Society for Metals, 1958. 703p.
The first section of this volume discusses the future of Mo and its alloys along with the properties and applications of commercial Mo and Mo alloys. The second section discusses the preparation and fabrication of Mo and its alloys. The third section discusses the metallurgy of Mo and Mo-base alloys. The fourth section discusses the application of Mo alloys for gas turbines. The last section reviews European developments of Mo. (W.L.H.)

8444 NMI-1196
Nuclear Metals, Inc., Cambridge, Mass.
A PRELIMINARY INVESTIGATION OF THE TENSILE PROPERTIES OF BERYLLIUM COUPLINGS.
J. Greenspan. Dec. 11, 1957. 29p. Contract AT(30-1)-1565. Dep.; $0.75.
Exploratory tensile testing was performed on various types of couplings, including beryllium to beryllium, beryllium to 316 stainless steel, and beryllium to 2S aluminum. It was found that beryllium in bolted or riveted

MATERIALS (CONSTRUCTION) 5.14

OTHER METALS 5.14.06

joints was capable of considerable plastic deformation before fracture, but in brazed joints it was not. Beryllium as part of a threaded couple has good tensile strength, but little ductility. (auth)

11153 NACA-TN-3784
New York Univ., New York.
HANDBOOK OF STRUCTURAL STABILITY. PART IV. FAILURE OF PLATES AND COMPOSITE ELEMENTS. George Gerard. Aug. 1957. 97p.

Available theories on failure of flat plates are reviewed, and test data on the postbuckling behavior, effective width, and failure of flat and curved plates are correlated. Test data on the crippling strength of various formed and extruded shapes are reviewed, from which a generalized method of crippling analysis is formulated. This analysis is then applied to a variety of sections and materials in common use. (auth)

8937
EFFECTS OF NITROGEN ON THE SOUNDNESS AND DUCTILITY OF WELDS IN MOLYBDENUM. W. N. Platte (Westinghouse Electric Corp., Pittsburgh). Welding J. (N. Y.) 36, 301s-6s(1957) June.

The acquisition of nitrogen by molybdenum weld metal and the effects of nitrogen on mechanical and metallurgical properties were studied. Molybdenum weld metal acquires nitrogen rapidly in argon welding atmospheres containing 1% N_2 or less. Nitrogen does not cause weld porosity or hot cracking but is detrimental to low-temperature ductility. For maximum weld ductility the nitrogen in the weld metal should be held to limits close to the original metal composition. (auth)

6366 BMI-1169
Battelle Memorial Inst., Columbus, Ohio.
STUDIES OF THE OXIDATION AND CONTAMINATION RESISTANCE OF BINARY NIOBIUM ALLOYS. Chester T. Sims, William D. Klopp, and Robert I. Jaffee. Feb. 19, 1957. 54p. Contract W-7405-eng-92. $0.40(OTS).

A study of the effects of binary alloying additions on the oxidation and contamination resistance of Nb has been conducted. The alloys contained up to 35 at. % Ti, Cr, and Zr, 25 at. % V, Mo, Ta, and W, and 5 at. % Be, B, Co, Fe, Mn, Ni, and Si. The oxidation and contamination studies were conducted in air at 600, 800, and 1000°C. Four elements, Ti, V, Mo, and Cr, improved oxidation resistance. The concentrations for optimum oxidation resistance at 1000°C were 25 at. % Ti, 10 at. % V, 5 at. % Mo, and 25 at. % Cr. Titanium was most effective in reducing the rate of oxidation; at 600 to 1000°C, the Nb-25 at. % Ti alloy oxidized one-tenth to one-twentieth as rapidly as pure Nb. Contamination was investigated by hardness-

12418 AEC-tr-3221
THE MECHANICAL PROPERTIES OF CAST RHENIUM. E. M. Savitskii and M. A. Tylkine. Translated for Los Alamos Scientific Lab. from Trudy Inst. Met. (im. A. A. Baikova), Pt. 1, 158-61(1957). 5p.

As a result of the work performed it is definitely shown that cast rhenium can be obtained. Numerical values were obtained for its hardness at different temperatures in the interval from −194° to + 1150°, and for its plasticity at 20 and 1000° by the method of compression. It was found that rhenium possessed a high riveting ability. The temperature at which the recrystallization of rhenium begins is about 1500°. (auth)

11206 NAVORD-4237
Naval Ordnance Lab., White Oak, Md.
APPLICATIONS, PROPERTIES, AND FABRICATION OF THERMENOL TYPE ALLOYS. J. F. Nachman and W. J. Buehler. May 4, 1956. 51p.

The properties of Thermenol (Fe−Al−Mo), a nonstrategic high-temperature and magnetic alloy, are discussed. These include hardness, tensile, stress-rupture, corrosion, oxidation resistance, and magnetic properties at room temperature and elevated temperature. Preparation of the alloy and methods of hot and cold working are also described. Suitable applications for a material of this type are listed. (auth)

6362 AD-105099
Library of Congress. Technical Information Div., Washington, D. C.
THERMAL PROPERTIES OF CERTAIN METALS. (Abstract Bulletin TP10). Mar. 20, 1956. 27p.

9911
CHEMISTRY AND TECHNOLOGY OF NUCLEAR MATERIALS AT THE GENEVA CONFERENCE UPON THE

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OTHER METALS 5.14.06

PEACE-TIME USES OF ATOMIC ENERGY. M. A. Rollier. Chimica e industria (Milan) 38, 20(1956) Jan. (In Italian)

The author gives a brief evaluation of the Geneva International Conference on the peaceful uses of atomic energy from the point of view of the declassification of valuable technical and scientific information. Referring to nuclear materials both as to the building materials of a nuclear reactor and as the materials formed inside a reactor during its operation, a summary is given of the chemistry of the heavy elements as it has been discussed at Geneva. Particular reference is made to Np, Pu, and the transplutonium elements, as well as to the chemistry of the fission products. Radiation damage to metals and to graphite is reviewed, and the report on nuclear technology at Geneva ends with an appraisal of heavy water, Be, and nuclear grade Zr production. (tr-auth)

8012 AEC-tr-2923
THE USE OF BERYLLIUM IN LIGHT METALS. E. A. Smith, Jr. and E. A. Giessen. Translated by D. E. Cardamone from Metall 9, 198-9(1955). 5p.

Battelle Memorial Inst., Columbus, Ohio.
BIBLIOGRAPHY ON THE METAL MOLYBDENUM. July 15, 1954. 96p. Project NR-039-003. Contract N9onr-82100. (AD-129762).

The bibliography, with subject and author index, has been prepared primarily for the benefit of those interested in the development of Mo and its alloys for use at high temperature as a material of construction. However, some references have been included which deal with the use of Mo in electronic tubes, as a catalyst, and in the form of various compounds. 1219 references to report and published literature are listed.

12406 KAPL-A-ME-1
Knolls Atomic Power Lab., Schenectady, N. Y.
MATERIALS MANUAL. W. D. Valovage and E. E. Baldwin, eds. Jan. 1, 1954. Changed from OFFICIAL USE ONLY June 11, 1958. 226p. Contract W-31-109-Eng-52. $34.80(ph OTS); $9.90(mf OTS).

The properties of 15 metals and alloys are summarized with bibliographic references. General characteristics such as composition, availability, nuclear properties, and applications are given along with data on fabrication, corrosion resistance, physical properties, and mechanical properties. The metals and alloys treated are: stainless steel types 347, 347(M1), and 304, Mo, Inconel-X, Be, Carboloy 779, Kennametal 138A, Na, Hf, Zr, Zircaloy-II, Cupro Nickel, $2\frac{1}{4}$ Cr−1 Mo, and ASTM A-302 steel. (T.R.H.)

13934 AECU-3814
Los Alamos Scientific Lab., N. Mex.
METALS FOR REACTOR APPLICATION AND LESS COMMON METALS. J. M. Taub. [1957]. 51p. Contract [W-7405-eng-36]. $9.30(ph OTS); $3.60(mf OTS).

The metallurgical properties of Be, Zr, Th, and U as reactor materials are summarized and discussed. (T.R.H.)

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STAINLESS 5.14.07.01

21225
STAINLESS STEELS AND OTHER FERROUS ALLOYS. W. A. Luce (Duriron Co., Inc.). Ind. Eng. Chem. 51, 1215-22(1959) Sept.

The use, corrosion, mechanical and physical properties, welding methods, and production processes for stainless steels and ferrous alloys are presented. (C.J.G.)

14505 DMIC-112
Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
PHYSICAL AND MECHANICAL PROPERTIES OF NINE COMMERCIAL PRECIPITATION-HARDENABLE STAINLESS STEELS. D. A. Roberts, D. B. Roach, and A. M. Hall. May 1, 1959. 82p. Contract AF18(600)-1378. (AD-214194; PB-151068).

The physical and mechanical properties of commercial precipitation-hardenable stainless steels are presented. The steels covered include the martensitic types (Stainless W and 17-4 PH), the semiaustenitic types (17-7 PH, PH 15-7 Mo, AM 350, and AM 355), and the austenitic types (A-286, 17-10 P, and HNM). Room- and elevated-temperature tensile and compressive properties, stress-rupture and creep properties, and impact, shear, bearing, and fatigue properties are reported. The effects of variations in heat treatment on these properties are also presented. (auth)

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European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
EUROCHEMIC SPECIFICATIONS FOR PROCUREMENT, FABRICATION AND TESTING OF STAINLESS STEEL MATERIAL AND EQUIPMENT. Technical Report No. 32. O. Jenne. Feb. 4, 1959. 33p. $6.30 (ph), $3.00(mf) OTS.

Specifications covering minimum standards for the fabrication of welded pressure-containing equipment and intended to achieve long-time maintenance-free integrity in highly corrosive chemical processing service are given. Also included are specifications for stainless steel procurement, welder proficiency standards for metal arc, and inert arc welding. (J.R.D.)

CASTINGS WITHSTAND CORROSION. Iron Age 182, No. 16, 194-5(1958) Oct. 16.

Cast stainless alloys are designed primarily to resist corrosive media and are intended for operation below 900°F. The composition, process treatment, and uses of these alloys are described. (J.R.D.)

10639

NEW ALLOY STEELS BEAT PROCESS BUGABOOS. II. D. B. Roach and A. M. Hall (Battelle Memorial Inst., Columbus, Ohio). Chem. Eng. 65, No. 11, 134, 136, 138(1958) June 2.

A new group of stainless steels, known as precipitation-hardening steels, holds great promise in chemical process applications. The steels, combining high strength with corrosion resistance, are produced by a simple heat treatment. The steels contain elements such as Al, Cu, and Mo, which precipitate during the hardening treatment and combine the good corrosion resistance of the 17% Cr, 7% Ni type 301 stainless with strength properties of the 400 series. (auth)

8934

TIME-TEMPERATURE EFFECT ON PROPERTIES OF WELD HEAT-AFFECTED ZONE IN TYPE 347 STAINLESS STEEL. E. F. Nippes (Rensselaer Polytechnic Inst., Troy, N. Y.), B. Schaff (Westinghouse Electric Corp., Philadelphia), and W. L. Fleischmann and R. L. Mehan (Knolls Atomic Power Lab., Schenectady, N. Y.). Welding J. (N. Y.) 36, 265s-70s(1957) June.

To obtain an understanding of the metallurgical changes occurring in the weld heat-affected zone of Type 347 stainless steel during welding and subsequently in service, an investigation was conducted. The initial report covered the establishment of the heating and cooling cycles occurring in metal-arc welding of a 1½-in. thick plate. Some data were presented which spotted the potentially troublesome area in the region heated to about 2400° F. The work which is presented concentrated on the behavior of samples heated in synthetic welding cycles to a peak temperature of 2450° F. The brief duration of that temperature was sufficient to cause concomitant grain growth and solution of the carbide phase. This condition simulated those existing in that region of actual welds where troubles were experienced. The general type of information which this work was intended to provide was to establish the time-temperature behavior of the high-temperature metallurgical structure (2450° F) established in the welding cycle. (auth)

6733

HOW TO AVOID CRACKS IN WELDING STABILIZED STAINLESS STEEL. W. L. Fleischmann (Knolls Atomic Power Lab., Schenectady, N. Y.). Iron Age 178, No. 2, 76-8 (1956) July 12.

Type 347 stainless steel is readily weldable but some fabricators have troubles with cracking in weld deposits and adjacent heat-affected zones. Niobium additions, beneficial for reasons other than welding, cause welding difficulties and associated troubles. Hints to improve welds are given. (F.S.)

7811 TT-725

NATURE OF THE CORROSION RESISTANCE OF STAINLESS STEELS. (Priroda Korrozionnoi Stoikosti Nerzhaveishchikh Stalei). G. V. Akimov. Translated by G. Belkov from Trudy Komissii Bor'be s Korroziei Metal. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 2, 11-21(1956). 22p.

1831

MECHANICAL PROPERTIES OF MODIFIED TYPE 347 WELD METALS. R. David Thomas, Jr. and Lorin K. Poole, comps. (Arcos Corp., Philadelphia). Welding J. (N. Y.) 34, 583-s-95-s(1955) Dec.

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Acceptable crack resistance and commercial usability were demonstrated by a standard (partially ferritic) Type 347 weld deposit, a Type 347CbTa weld deposit, a Type 308ELC weld deposit and two fully austenitic Type 347 compositions, one of which was modified by raising the carbon content to 0.12% and the other by raising the manganese to 5%. A standard composition modified to be fully austenitic was found to be unacceptable. Tensile and Charpy keyhole impact specimens were tested in the as-welded condition, after 8- and 100-hr heat treatments at 1100, 1300, 1550 and 1700°F and after 2-, 8-, and 24-hr heat treatments at 1950°F. The 0.505-in. diameter tensile properties of all compositions showed highest strength and

9774 KAPL-M-AJH-2
Knolls Atomic Power Lab., Schenectady, N. Y.
LEAK TESTING OF TYPE 347 STAINLESS STEEL WELDS.
W. L. Fleischmann and A. J. Herd. Oct. 25, 1955. 4p.
Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Four types of Arcos Type 347 stainless steel metal arc electrodes, each with a different ferrite content, were deposited and the weld beads tested for leaks with a GE mass spectrometer Type M leak detector. None of these allowed He gas to pass through a sound weld of a thickness of 0.030 in. or more during a test period of one half hour. (F.S.)

2071 AECD-3696
Battelle Memorial Inst., Columbus, Ohio.
THE TENSILE STRENGTH OF BRAZED STAINLESS STEEL JOINTS. H. A. Saller, J. T. Stacy, and H. L. Klebanow. July 14, 1953. Decl. with deletions Nov. 17, 1955. 17p. Contract W-7405-eng-92.

The effects of temperature, joint clearance, and annealing on the tensile strength of Type 310 stainless steel T-joints brazed with 62 brazing alloy were investigated. At room temperature, joints with zero clearances were the strongest for all conditions, the strength falling off rapidly up to 0.002-in. clearance. The maximum tensile strength of 90,000 psi was obtained for the as-brazed zero-clearance joint. With increasing clearances, the strength of the joints approached 40,000 psi. Annealed joints varied from 10,000 to 20,000 psi less than as-brazed joints. At elevated temperatures, the tensile strengths were independent of joint clearances. At 1200, 1650, and 1800°F, the average tensile strengths varied from 52, 500 to 57,500, 20,000 to 23,000, and 12,500 to 14,000 psi, respectively, the lower values being those for the annealed specimens.

10889 CF-52-8-148 (Chap. 10)
Oak Ridge School of Reactor Technology, Tenn.
REACTOR MATERIALS. CHAPTER 10. G. E. Evans.
Dec. 23, 1952. Decl. Feb. 16, 1957. 45p. $7.80(ph OTS); $3.30(mf OTS).

Stainless steels and their compositions and properties are described and tabulated. Corrosion behavior, impact strength, stress rupture, tensile strength, yield strength, creep, hardness, and elasticity are some of the properties included. (T.R.H.)

6712 TID-8012
Technical Information Service, AEC.
STEEL FOR NUCLEAR ENERGY. R. C. Daizell, Div. of Reactor Development, AEC. [nd]. 9p. $0.15(OTS).

One of Its monograph series "The Industrial Atom."

Present-day uses of stainless steel in the nuclear industry, which include fuel-element fabrication and construction materials for reactors and fuel processing plants, are reviewed. The effects of alloying elements on the mechanical and nuclear properties of stainless steels are discussed. Future applications will depend on the development of steels with increased corrosion resistance and tensile strength at high temperatures. Thermal neutron cross sections for several elements and stainless steel are tabulated. (C.W.H.)

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20244
STEEL FOR REACTORS AND PROCESSING PLANTS.
B. Watkins (Culcheth Labs., Lancs, Eng.). Nuclear Eng. 4, 296-303(1959) July-Aug.-Sept.

Physical, chemical, and mechanical properties and irradiation effects on ferritic (mild), low-alloy Cr-Mo and stainless steels are examined. (C.J.G.)

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8449 NRL-5140
Naval Research Lab., Washington, D. C.
CAST AGE-HARDENABLE AUSTENITIC STEELS. E. A. Lange, N. C. Howells, and A. Bukowski. Apr. 2, 1958. 16p.
Cr–Ni–P, Cr–Mn, and Cr–Ni–Mn–V types of age-hardenable, austenitic steels which have high strength

6628
IMPROVEMENTS IN AND RELATING TO ALLOY STEELS. Eric Winearls Colbeck and Thomas Harold Middleham (to Hadfields, Ltd.). British Patent 826,466. Jan. 6, 1960.
High-boron steels are described in which loss of workability is compensated by addition of Al. These steels have permissible radiation characteristics and were found to be forgeable by light hammering with slow cross sectional area reduction. Several suitable compositions are cited which have small amounts of C, Si, and Mn, and B and Al contents ranging from 3.02 and 0.44 to 4.20 and 2.3%, respectively. (T.R.H.)

10647
HIGH-BORON ALLOY STEELS. T. H. Middleham, J. R. Rait, and E. W. Colbeck (Hadfields, Ltd., Sheffield, Eng.). J. Brit. Nuclear Energy Conf. 3, 116-35(1958) Apr.
The discovery of a new technique for the production of boron-iron alloys containing up to 4.75% boron which can be successfully forged, rolled, and extruded, and boron-iron alloys up to 6% boron which can be successfully produced in the form of castings is described. The methods of manufacture, physical and mechanical properties, and constitution of these boron steels are described as well as their applications in thermal nuclear reactors. (W.D.M.)

13174
METALLURGICAL PROPERTIES OF STRUCTURAL BORON STEELS. O. N. Meshcherinova, L. I.

Posysayeva and G. A. Khasin. Stal' No. 1, 75-81 (1958)

A systematic investigation on the smelting of structural boron steels was made to determine the optimum conditions for deoxidation and introduction of the boron into the steel. Special final deoxidation techniques were used in the smelting process. No difficulties were noted in rolling Tests showed that the hardness increased some with increasing boron content, but it decreased with increasing temperatures. The mechanical properties were determined. It was found that the grain size of the austenite depended on the boron content. The plastic properties, particularly impact strength, decreases with increasing boron content. The deoxidation of the steel with aluminum and titanium and the addition of boron as ferro-boron or ferro-boral improves the grain size and impact strength. (J.S.R.)

EFFECTS OF TEMPERATURE AND RATE AND DEGREE OF DEFORMATION ON CARBON STEEL RESISTANCE TO PLASTIC DEFORMATION. Z. A. Ridnev and A. P. Chekmarev. Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk No. 12, 22-9(1957) Dec. (In Russian)
Resistance of carbon steel to plastic deformation was studied at 800 to 1200°C and 2 to 300 sec^{-1} rate of deformation. The increased rate of deformation increased the carbon steel resistance to plastic deformation while an increase in temperature had a reverse effect. At high temperatures and a relatively slow deformation rate the increased carbon content in the hypoeutectoid steel increased its resistance to plastic deformation. The increase of carbon content in the hypereutectic steel, at high temperatures and high speed of deformation, decreased its plastic deformation resistance. At 1100 to 1200° and at all deformation rates the hypereutectic steels have a lower plastic deformation resistance than the hypoeutectoid steels. (R.V.J.)

8938
RELATIVE BEHAVIOR OF NOTCH-TOUGHNESS TESTS FOR WELDED STEEL. W. D. Murphy and R. D. Stout (Lehigh Univ., Bethlehem, Penna.) and W. D. McMullen (Westinghouse Electric Corp., Pittsburgh). Welding J. (N. Y.) 36, 307s-11s(1957) June.
Eleven structural steels in a variety of conditions were tested using the notched slow-bend (Kinzel), Naval Research Laboratory (NRL) drop-weight and V-notch Charpy tests in order to develop a basis of comparison for these tests. In addition to determining the Kinzel 1% lateral contraction

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transition temperature, the nil-ductility transition (NDT) temperature and the Charpy 10 ft-lb temperature, great use was made of specimen fracture appearance after testing to help analyze the results of each test. A correlation between the drop-weight NDT and the Kinzel 1% lateral contraction temperatures was found to exist when Kinzel specimen behavior reflected the ability of the base material to prevent cleavage crack propagation. A plot of NDT vs. Charpy 10 ft-lb temperature for the project steels plus steels tested at NRL revealed a scatter-band within which the two transition temperatures correlated. (auth)

10603 AECU-3695
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
MATERIALS MANUAL. May 1957. 116p. (M-6232).
$19.80(ph OTS); $6.30(mf OTS).

Issued in loose-leaf form to facilitate periodic revisions.

The considerations to be made in choosing an alloy for use under certain conditions are discussed. The properties of carbon steel, Mn–Mo steel, stainless steels, Stellites, Haynes-25, Inconel X, Monel, Zircaloy-2, and Zircaloy-3 are given, and purchase specifications stated. (T.R.H.)

8922 NRL-4919
Naval Research Lab., Washington, D. C.
EXPLOSION-BULGE-TEST PERFORMANCE OF LOW-CARBON Ni–Cr–Mo–B QUENCHED AND TEMPERED STEEL WELDMENTS. P. P. Puzak. Apr. 5, 1957. 12p.

A cooperative test program was established to investigate the weldability of a proprietary quenched and tempered alloy steel of interest to the Navy. The effects of several welding variables (restraint, moisture, microcracks, orientation, and preheat) were investigated and results are discussed. Explosion bulge tests were conducted at 30, 0, and −50°F. Irrespective of the variable introduced, all twelve weldments resisted one shot of explosive at all test temperatures without visible signs of failure. Thus, for "general case" service applications (pressure vessels, tanker, or cargo ships, etc.) it is deemed that Y-steel weldments would perform satisfactorily at all ambient temperatures. The ultimate fractures developed in the bulge tests are characterized by low-energy shear tearing characteristics predominantly associated with the heat-affected zone. From the limited test data, it is not known whether Y-steel weldments would be suitable for all Naval structures in which design must be based on "accident case" loading conditions. It is clear, however, that this material is not suitable for applications based on "military service" loading conditions. The characteristics of the plate material are in conformance with the predictions of Charpy V and drop-weight tests. (auth)

6411
TEMPER BRITTLENESS OF BORON-TREATED STEELS. Samuel J. Rosenberg. J. Research Natl. Bur. Standards 58, 175-87(1957) Apr.

Two series of steels, melted to the base composition of 8140, were studied to ascertain whether Ti and Zr (present in many commercial B addition agents) had any adverse effect upon the impact properties of the base steels, particularly with reference to temper brittleness. The results obtained indicate that with fully hardened steels tempered at 1,200°F, the presence of relatively small amounts of Ti as introduced into the test steels by the B addition agents is sufficient to cause an impairment in the Charpy V-notch impact properties of the steels or an increased susceptibility to temper brittleness, or both. This was confirmed by the addition of Ti without B. Similar effects, previously thought possibly due to the presence of Zr, were not observed. (auth)

6401
INVESTIGATIONS OF THE INTERNAL FRICTION IN γ AND α PHASES OF HIGH CHROMIUM STEEL. Yu. V. Pirguzov (Stalin Moscow Inst. of Steel). Doklady Akad. Nauk S.S.S.R. 112, 636-9(1957) Feb. 1. (In Russian)

A specially prepared steel containing 1.05% C, 11.90% Cr, and 0.012% N was investigated to determine the internal friction dependence on temperature. The analysis of thermal treatments of the samples at various temperatures up to 1200° is given in graphical form. Tables of lattice parameters and phase structures are included. (R.V.J.)

LOW MANGANESE STEELS FOR NUCLEAR APPLICATIONS. H. F. Beeghly (Westinghouse Electric Corp., Pittsburgh). J. Metals 8, 1664-70(1956) Dec.

Experimental carbon steels made with no manganese addition and residual manganese contents of the order of 0.10 to 0.15 pct have been made by standard open hearth

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practice and rolled with commercial equipment and procedures into plate and seamless pipe. The products when tested by ASTM methods met the mechanical property requirements for comparable grades with normal manganese contents. Elevated temperature tensile data show the low manganese steels to be free from strain aging and stronger and more ductile at elevated temperatures than comparable standard grades. Weldability of the low manganese steels is equal to or better than that of comparable standard grades. (auth)

10567 WAL-313/48-T6
Syracuse Univ., N. Y. Research Inst.
RELATION BETWEEN DIRECT-STRESS AND BENDING FATIGUE OF HIGH-STRENGTH STEELS. G. Scheven and G. Sachs. Sept. 1956. 34p. DA Project No. 5B93-26-006. Contract DAI-30-115-ORD-(P)-613. (MET-345-574T6).

The results of fatigue tests on 4340 steel heat treated to several strength levels and under various conditions of testing are presented. Direct-stress and rotating-bend tests on smooth and notched specimens were performed leading to cycles to failure between a few and about one million. Each S-N curve extrapolates well to the respective static strength as origin. Two characteristic quantities were determined for various cycles, the ratio of the

10188 NACA-TM-1419
Aluminum Co. of America. Aluminum Research Labs., New Kensington, Penna.
EFFECTS OF INTERMITTENT VERSUS CONTINUOUS HEATING UPON THE TENSILE PROPERTIES OF 2024-T4, 6061-T6, AND 7075-T6 ALLOYS. G. W. Stickley and H. L. Anderson. Aug. 1956. 7p.

The object of these tests was to determine the effects of intermittent and continuous heating at 300 and 400°F, for total periods of 100 and 200 hr, upon the tensile properties of 2024-T4 and 6061-T6 alloy rolled-and-drawn rod and 7075-T6 alloy extrusions, at room temperature and at the temperature of heating. The effects of intermittent heating were found to be cumulative and the same as for continuous heating. (auth)

5311 NRL-Memo-581
Naval Research Lab., Washington, D. C.
EVALUATION OF CROLOY STEEL FOR SODIUM USE. B. F. Brown. Mar. 23, 1956. 14p. Project No. NS 200-021.

The resistance of Croloy $2^1/_4$ to corrosion by Na was studied in thermal convection harps. The results of these tests indicate that there is no mass transfer of Croloy $2^1/_4$ at 500°C (923°F) maximum temperature with a delta T of 175°C (315°F), no decarburization of Croloy $2^1/_4$, no carburization of Type 347 stainless steel in the presence of Croloy, and no detectable difference in effect of O concentration in Na at 0.003 wt. % and 0.014 wt. %. (auth)

7658 WAPD-A1W(PCh)-46
Westinghouse Electric Corp. Atomic Energy Div., Pittsburgh.
INVESTIGATION OF UNCLAD CARBON STEEL FOR PRESSURIZER APPLICATIONS. Paul E. Brown and Kurt Katz. Jan. 25, 1956. 60p.

Bound with this report with separate pagination is WAPD-A1W(PCh)-55: EXAMINATION OF CARBON STEEL PRESSURIZERS. C. F. Paulson. nd. 3p.

Unclad carbon steel for use in the A1W pressurizer was studied in the liquid, alternate liquid and vapor, and vapor phases using air and steam start-ups. Air caused serious corrosion but no excessive corrosion was caused by steam. The presence of ammonia reduces the liquid phase corrosion rate but does not affect the corrosion rate in the other phases. Oxygen concentrations of 2 to 6 cc/kg of water are tolerable for steam pressure start-ups. (F.S.)

2073 KAPL-1416
Knolls Atomic Power Lab., Schenectady, N. Y.
EFFECTS OF TEMPERATURE AND RADIATION UPON THE TENSILE AND IMPACT PROPERTIES OF ASTM-A302-B MANGANESE–MOLYBDENUM STEEL. E. E. Baldwin Oct. 1, 1955. 60p. Contract W-31-109-eng-52.

With the use of high-yield-strength low-alloy steels for nuclear reactor pressure vessels, it is important to know whether the operating conditions of temperature and radiation will affect the mechanical properties of these steels and the magnitude of such effects Tensile and impact specimens of ASTM-A302-51T Grade B manganese–molybdenum steel were fabricated, canned, charged into

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the Brookhaven Reactor, and irradiated to an integrated fast neutron flux of 3.7×10^8 nvt as 500 and 700°F. Comparison of tensile and impact test data on irradiated and unirradiated specimens showed that the separate and combined effects of temperature and radiation had only minor effects (less than 10%) upon the tensile and impact properties of the steel tested. (auth)

9840

CAST STEEL ALLOYED WITH COPPER. Gh. Ilin, V. Olteanu, A. Ianu, and I. Obradovici. Acad. rep. populare Romine Baza cercetări stiint. Timisoara Studii cercetări stiint. Ser. I, 2, 235-8(1955). (In Romanian)

The results obtained from investigations on the production of alloys of steel and copper are presented. The rupture strength, yield point, elongation, compression, elasticity, and structure were determined for alloys receiving different thermal treatments. (tr-auth)

SURVEYS AND THEORY 5.14.08

8519 TID-4100(1st Rev., Suppl. 6)

Technical Information Service Extension, AEC. ENGINEERING MATERIALS LIST. Richard E. C. Duthie and Francis L. Sachs, eds. Jan. 1960. 25p.

Engineering materials lists are presented which cover valves, hot-lab equipment, chemical and radiation instruments, reactors and reactor facilities, plant process and radiation equipment, and shielded containers. (C.J.G.)

4409 TID-4100(1st Rev., Suppl. 5)

Technical Information Service Extension, AEC. ENGINEERING MATERIALS LIST. A Catalog of Drawings, Photographs, and Specifications Released by the United States Atomic Energy Commission. Richard E. C. Duthie, ed. Nov. 1959. 30p.

Available from TISE —free

Engineering materials are listed as engineering equipment, hot laboratory equipment, instruments, metallurgical equipment and process furnaces, nuclear-radiation equipment, and nuclear reactors and facilities. The listings are limited to the materials included in this supplement. The indexes enable the user to locate materials by names of the organizations which originated the material, by subjects, and by original drawing identification numbers. (J.R.D.)

22653 TID-4100(1st Rev., Suppl. 4)

Technical Information Service Extension, AEC. ENGINEERING MATERIALS LIST. A Catalog of Drawings, Photographs, and Specifications Released by the United States Atomic Energy Commission. Richard E. C. Duthie, ed. Sept. 1959. 76p.

The Engineering Materials List (EML) is a catalog of available U. S. Atomic Energy Commission unclassified engineering materials including drawings, specifications, photographs, bills of materials, cost analyses, design criteria, parts lists, and related document references. This supplement identifies additional engineering materials that have been assembled into 41 new packages totaling approximately 1.034 drawings. The Contents and the Subject, Corporate, and Drawing Number Indexes cover only materials announced in this supplement. The Indexes enable the user to locate materials by names of the organizations which originated the material, by subjects, and by original drawing identification numbers. (auth)

20779

1959 ATOMIC INDUSTRY DIRECTORY OF PRODUCTS, EQUIPMENT AND SERVICES. Based on a 1959 Survey of Members of the Atomic Industrial Forum. New York, Atomic Industrial Forum, 1959. 130p. $2.50.

The directory includes only equipment, materials, and services which have their primary application in the nuclear and applied radiation field and are not generally supplied for other industrial applications. A classified index of products, equipment, and services, and an alphabetical listing of organizations with their stated capabilities are given. (W.D.M.)

8248 TID-4100(1st Rev., Suppl. 2)

Technical Information Service Extension, AEC. ENGINEERING MATERIALS LIST. A Catalog of Drawings, Photographs, and Specifications Released by the United States Atomic Energy Commission. Nov. 1958. 215p.

Available from TISE —free.

MATERIALS (CONSTRUCTION) 5.14

SURVEYS AND THEORY 5.14.08

The Engineering Materials List (EML) is a catalog of available U. S. Atomic Energy Commission unclassified engineering drawing materials on the peaceful applications of atomic energy. The engineering literature described includes drawings, specifications, photographs, bill of materials, cost analyses, design criteria, parts lists, and related document references. This supplement identifies additional engineering materials that have been assembled into 50 new packages totaling approximately 2,350 drawings. In addition, this supplement contains a revision of the materials available on the Portable Scintillation Poppy—CAPE-147. The new cumulative Contents and Indexes cover all materials that have been announced in the EML to date (CAPE-1 through

CAPE-206). The Indexes will enable the user to locate materials by names of the organizations which originated the material, by subjects, and by original identification numbers. (auth)

2670 NP-8051
Battelle Memorial Inst., Columbus, Ohio.
DEFENSE METALS INFORMATION CENTER. SELECTED ACCESSIONS. M. J. Wahll, comp. Sept. 1, 1959. 91p.
This annotated bibliography contains information on the following subjects: light metals, refractory metals, high-strength alloys, and miscellaneous metals. Numerical, author, and subject indexes are included. (W.L.H.)

8521
MATERIALS FOR ISOTOPE LABORATORIES. L. Von Erichsen (Universität, Bonn). Atomwirtschaft 2, 72-4 (1960) Feb. (In German)
Isotope laboratories are more fastidious than conventional chemical laboratories with respect to the choice of suitable working materials. There are, however, materials with outstanding properties available. Numerous materials such as wood, steel, tiles, plastics (PVC, polyethylene, polypropylene, PTFE) and many others are compared with respect to their existing properties as construction materials; in particular with respect to important properties such as ease of working and shaping, corrosion resistance against acids and alkalies, solvent resistance, surface finish, heat resistance, ease of renovation, adhesive bonding, and price. (auth)

4163 SCR-131
Sandia Corp., Albuquerque, N. Mex.
ECONOMIES IN MATERIAL HANDLING. R. D. Flaxbart. Nov. 1959. 7p. OTS.
An analysis of those problems connected with handling of the most common items in stores, warehouses, and yards is presented. Present methods are reviewed and new developments are discussed. It is concluded that chief among areas of improved techniques lies in the reduction of the number of times individual items have to be handled. (J.R.D.)

13170
METALLURGY IN NUCLEAR ENGINEERING. SURVEY OF THE LITERATURE IN 1957. J. Burkett (Hawker Siddeley Nuclear Power Co., Ltd.). Metallurgia 58, 32-6(1958) July.
A three-part survey of periodical and research report literature (excepting UKAEA reports) is presented. The part presented here deals with materials of construction, their properties, and the effects of radiation on them. The material is divided into sections on: metals in general; ceramics and cermets; irradiation effects in general, Be, B, graphite, Al and Mg, Mo, Nb, Fe and steel, rare earth metals, Ti and V Zr, and liquid metals. (T.R.H.)

11240
EFFECTS OF COMPLEX STRESS-TIME CYCLES ON THE FATIGUE PROPERTIES OF METALS. W. L. Starkey and S. M. Marco (Ohio State Univ., Columbus). Trans. Am. Soc. Mech. Eng. 79, 1329-36(1957) Aug.
An investigation was conducted to determine the effects of complex stress-time cycles on the fatigue properties of metals. The uniaxial stresses studied were complex in the sense that their stress-time patterns may be analyzed as composed of several harmonic components. Four theoretical design methods, and the results of an experimental investigation involving complex stresses are presented. Comparisons are made of the test results with the theory predictions. (auth)

11154 NACA-TN-3785
New York Univ., New York.
HANDBOOK OF STRUCTURAL STABILITY. PART V. COMPRESSIVE STRENGTH OF FLAT STIFFENED PANELS. George Gerard. Aug. 1957. 91p.
A generalized crippling analysis for short monolithic panels with formed or extruded stiffeners is presented.

MATERIALS (CONSTRUCTION) 5.14

SURVEYS AND THEORY 5.14.08

Methods are presented for determining if riveted panels act in a monolithic manner and for determining the strength of those which do not. The failure modes of intermediate-length and long stiffened panels are discussed and methods given for estimating column strength. Theory and test data on optimum stiffened panels are presented and the various factors of importance in box types of construction are considered. (auth)

11152 NACA-TN-3783
New York Univ., New York.
HANDBOOK OF STRUCTURAL STABILITY. PART III. BUCKLING OF CURVED PLATES AND SHELLS. George Gerard and Herbert Becker. Aug. 1957. 159p.

Available theories and test data on buckling of curved plates and shells are reviewed. The test data for torsion and external-pressure loadings are correlated in terms of linear buckling theories for both the elastic and inelastic ranges. The cases which exhibit a marked disagreement between linear theory and test data have been analyzed by a unified semiempirical approach which is satisfactory for analysis and design purposes. (auth)

11151 NACA-TN-3782
New York Univ., New York.
HANDBOOK OF STRUCTURAL STABILITY. PART II. BUCKLING OF COMPOSITE ELEMENTS. Herbert Becker. July 1957. 72p.

The local buckling of stiffener sections and the buckling of plates with sturdy stiffeners are reviewed, and the results are summarized in charts and tables. Numerical values of buckling coefficients are presented for longitudinally compressed stiffener sections of various shapes, for stiffened plates loaded in longitudinal compression and in shear, and for stiffened cylinders loaded in torsion. Although the data presented consist primarily of elastic-buckling coefficients, the effects of plasticity are discussed for a few special cases. (auth)

10511 NP-6362
Florida. Univ., Gainesville. Engineering and Industrial Experiment Station.
BIBLIOGRAPHY ON SHELLS AND SHELL-LIKE STRUCTURES (1954-1956). William A. Nash. June 1957. 46p. Contract DA-01-009-ORD-404.

Books and papers published from 1953 through 1956 pertinent to experimental and theoretical work on shells and shell-like structures are listed. The entries are listed alphabetically by authors, and a subject index is included. (C.H.)

MATERIALS OF CONSTRUCTION. C. M. Slansky. May 1, 1957. p982-6 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS HELD IN BRUSSELS, BELGIUM, MAY 20-5, 1957. 1165p. (TID-7534(Bks. 1-3))

A summary is given of the materials of construction used in nuclear fuel reprocessing plants. The processes covered are those utilizing HNO_3, H_2SO_4, and HF in the conventional dissolution-extraction process.

10518 TML-70
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
SURVEY OF THE EXTENT OF TESTING FACILITIES FOR THE DETERMINATION OF MECHANICAL AND PHYSICAL PROPERTIES OF METALS AT VARIOUS TEMPERATURES. W. P. Achbach. Apr. 30, 1957. 334p. Contract AF18(600)-1375.

Briefly described is the extent of equipment currently available in the U. S. for determination of design strength data for metals. (W.I.H.)

6798 CF-57-4-96
Oak Ridge National Lab., Tenn.
DEFLECTION EQUATIONS FOR VARIOUS LOADINGS OF CIRCULAR-ARC CURVED BEAMS. D. L. Platus and B. L. Greenstreet. Apr. 22, 1957. 21p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

In analyzing stresses, deflections, and forces in piping and certain structural systems, it is useful to have a set of equations giving the deflections at any point of a curved beam in terms of the various loads acting on the beam. This paper presents the deflection equations for a curved circular-arc beam of variable length. The cases treated include in-plane and out-of-plane bending due to forces and moments applied to the end of the beam in three principal directions, and uniformly distributed loads applied along the beam in these three directions. Deflections were calculated by the strain energy method using Castigliano's theorem. (auth)

MATERIALS (CONSTRUCTION) 5.14

SURVEYS AND THEORY 5.14.08

6420 NYO-7967
New York Univ., New York. Atomic Energy Commission Computing Facility.
BUCKLING OF SHALLOW SPHERICAL SHELLS UNDER EXTERNAL PRESSURE. Edward L. Reiss. Apr. 1, 1957. 23p. Contract AT(30-1)-1480. $4.80(ph OTS); $2.70(mf OTS).

A formula for the initial buckling loads for clamped, shallow spherical shells under uniform external pressure is obtained by combining the solutions of two linearized versions of the original nonlinear problem. One of these versions is a linear eigenvalue problem, while the other is the bending problem for a shallow cap in the linear theory of elasticity. The formula, which is obtained in a simple manner, yields buckling loads that are in better agreement with experiments than previous approximate solutions to the nonlinear problem. (auth)

10558 NACA-TN-3972
California Inst. of Tech., Pasadena.
EFFECT OF FREQUENCY AND TEMPERATURE ON FATIGUE OF METALS. S. R. Valluri. Feb. 1957. 15p.

Phenomenological considerations applied to a standard-linear-solid physical model indicated that for particular temperatures there are corresponding frequencies of fatigue stressing above which the fatigue behavior changes. It is suggested that at room temperature the critical frequency is above that usually encountered in engineering practice. (NACA)

THE SCIENCE OF ENGINEERING MATERIALS. J. E. Goldman, ed. New York, John Wiley & Sons, Inc., 1957. 542p.

A series of lectures on the impact of solid-state science on engineering materials, based on the proceedings of the Carnegie Conference held at Carnegie Institute of Technology in June 1954, is presented. (auth)

METALS. Presented at the Second Pacific Area National Meeting, Los Angeles, Calif., September 17-21, 1956. ASTM Special Technical Publication No. 196. Philadelphia, American Society for Testing Materials, 1957. 181p. $4.50.

Papers are presented on: Studies of Type 301 Stainless Steel Columns; Shotpeening Effects and Specifications; The Effect of Forming on Mechanical Properties; Axial Stress Fatigue, Creep, and Rupture Properties of Unnotched and Notched Specimens of Heat Resistant Alloys; Determination of Young's Modulus Under Conditions of Relaxation; Effect of a Number of Variables on the Fatigue Properties of High Strength Steels; The Effect of Temperature, Frequency, and Grain Size on the Fatigue Properties of High Purity Aluminum; Determination of Fatigue-Crack Initiation and Propagation in a Magnesium Alloy; Uni-directional Axial Tension-Fatigue Tests of Beryllium Copper and Several Precipitation Hardening Corrosion Resistant Steels; The Properties of Beryllium Copper Strip as Affected by Cold Rolling and Heat Treatment; and Pit Depth Measurements as a Means of Evaluating the Corrosion Resistance of Aluminum in Sea Water. (T.R.H.)

MATERIALS FOR NUCLEAR POWER REACTORS. John M. Warde (Oak Ridge National Lab., Tenn.). Materials and Methods 44, No. 2, 121-44(1956) Aug.

Materials are currently the limiting factor in utilizing the vast quantities of thermal energy released by nuclear fission. Selection criteria for engineering materials used in the design and construction of nuclear power reactors include such unprecedented demands as low neutron absorption and resistance to radiation damage. This manual surveys those materials now available that can be or have been used in harnessing nuclear energy for generation of power. (auth)

10566 WAL-313/48-T5
Syracuse Univ., N. Y. Research Inst.
NEW GRAPHICAL PROCEDURES FOR THE DETERMINATION OF RESIDUAL STRESSES IN PLATES AND THIN-WALLED TUBING. J. M. Sistiaga. Aug. 1956. 27p. DA Project No. 5B93-26-006. Contract DAI-30-115-505-ORD-(P)-613. (MET-345-574T5).

The equations for residual-stress determinations on plates and sheets were modified to permit a comparatively simple and accurate graphical computation of the stresses. Similar equations for the determination of longitudinal and circumferential residual stresses in thin-walled tubings were also developed. To illustrate the procedure, the residual stresses in a Ti plate were determined. (auth)

PROBLEMS OF MECHANICAL ANALYSIS IN REACTOR TECHNOLOGY. G. Horvay (Knolls Atomic Power Lab., Schenectady, N. Y.). New York, American Inst. of Chemical Engrs., 1956. (Preprint-355 — $0.30).

MATERIALS (CONSTRUCTION) 5.14

SURVEYS AND THEORY 5.14.08

The role of the structural specialist in the atomic power field is outlined, and some of his tasks at KAPL are described. Thermal stress and shock phenomena receive particular attention. Shell and perforated plate problems are also considered. A brief discussion of design principles is included. (auth)

778 NACA-TN-3495
California. Univ., Los Angeles.
FAILURE OF MATERIALS UNDER COMBINED REPEATED STRESSES WITH SUPERIMPOSED STATIC STRESSES. George Sines. Nov. 1955. 69p.

A review of experiments on biaxial alternating stresses and simple combinations of static stress with alternating stress is shown to lead to a general criterion for the effect of static stress on the permissible amplitude of alternating stress. The proposed criterion is then shown to agree with results from tests that have been performed under more complex stress states. Tests were performed to determine the effect of static compression on alternating torsion, the one simple combination that had not been previously investigated. These results also agree with the criterion. It is shown that Orowan's theory of fatigue can be modified to predict the observed effect of mean stress on the permissible amplitude of alternating stress. (auth)

877
ELECTRONS, ATOMS, METALS, AND ALLOYS. William Hume-Rothery. London, Iliffe and Sons, Ltd. and New York, Philosophical Library, 1955. 387p.

This book is an attempt at the presentation of recent mathematical explanations of atomic, crystalline, and nuclear phenomena in a manner that is understandable to the practicing metallurgist with little formal training in physics and chemistry. (D.E.B.)

10926 CF-52-8-148(Chap. 22)(Del.)
Oak Ridge School of Reactor Technology, Tenn.
REACTOR MATERIALS. CHAPTER 22. G. E. Evans. 1952. Decl. with deletions Feb. 14, 1957. 41p. $7.80 (ph OTS); $3.30(mf OTS).

A glossary of terms and abbreviations used in reactor technology is given. (M.H.R.)

TITANIUM 5.14.09

See also, under HAZARDS AND PROTECTION, PYROPORICITY (4.01.10).

1819 TML-22
Little (Arthur D.) Inc., Cambridge, Mass.
SELECTIVE STANDARDIZATION AND STATUS OF SPECIFICATIONS FOR TITANIUM MILL PRODUCTS. Nov. 22, 1955. 19p. For Titanium Metallurgical Lab., Battelle Memorial Inst. Contract AF 18(600)-1375, Subcontract No. 1.

Producers of wrought Ti have been hampered in the marketing of their products by the wide variety of specifications being used by the consuming manufacturers. To facilitate standardization of specifications, a survey of requirements was made, and general specifications are suggested. (D.E.B.)

5347 WADC-TR-56-304
Mallory-Sharon Titanium Corp., Niles, Ohio.
THE EFFECT OF MICROSTRUCTURAL VARIABLES AND INTERSTITIAL ELEMENTS OF THE FATIGUE BEHAVIOR OR TITANIUM AND COMMERCIAL TITANIUM ALLOYS. [Period covered] April 1, 1955 to March 31, 1956. Charles B. Dittmar, G. William Bauer, and Dillon Evers. Oct. 1, 1956. 95p. Project Title: METALLIC MATERIALS. Task Title: TITANIUM METAL AND ALLOYS. Contract AF33(616)-2922. (AD-110726).

The effect of microstructure on the fatigue behavior of the commercial alloys Ti–5Al–2.5Sn, Ti–6Al–4V, and Ti–3Mn Complex has been investigated. Microstructure was found to have little effect on the endurance limit of these alloys unless the structure was extremely coarsened or embrittled. The effect of interstitial contents representative of the basis for commercial Ti specification, i.e., 0.07% N_2, 0.20% O_2, 0.20% C taken singly or grouped together, was investigated for unalloyed Ti and the commercial alloys Ti–5Al–2.5Sn, Ti–6Al–4V, and Ti–3Mn Complex. Titanium and the three Ti alloys investigated generally show increased or unchanged fatigue life at all of the interstitial contents specified above. (auth)

MATERIALS (CONSTRUCTION) 5.14

TITANIUM 5.14.09

5341 NP-6242
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
DIRECTIONAL PROPERTIES IN TITANIUM AND TITANIUM ALLOYS. Jan. 31, 1957. 20p.

6379 NP-6253
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
THERMAL CONDUCTIVITY OF TITANIUM AND TITANIUM ALLOYS. J. W. Holladay. Mar. 11, 1957. 4p.
Supersedes data in TML-39.
Summary of available data on thermal conductivity of Ti and Ti alloys is presented. (auth)

8923 TML-72
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
POROSITY IN FORMED TITANIUM. R. A. Wood, D. N. Williams, H. R. Ogden, and R. I. Jaffee. May 17, 1957. 40p. Contract AF18(600)-1375.
A new type of material failure has been found in parts formed of commercial-purity titanium. Surface pitting and internal voids are formed in areas of the part which have been highly strained. The phenomenon has been named strain-induced porosity. A study of the occurrence of this phenomenon showed that deformation temperature, amount of strain, strain rate, state of stress, and amount and kind of impurity could affect the degree of the porosity. The same kind of porosity has been found to occur in many other metals and alloys, and it is believed to be a normal part of the mechanism of deformation in ductile materials. (auth)

10628 TML-104
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
ADHESIVE BONDING OF TITANIUM. H. E. Pattee, G. E. Faulkner, and P. J. Rieppel. June 13, 1958. 28p. Contract AF18(600)-1375.
A summary of the available information on the adhesive bonding of titanium is presented. 85 references. (W.L.H.)

7722 TML-39
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
SURVEY OF PHYSICAL-PROPERTY DATA FOR TITANIUM AND TITANIUM ALLOYS. H. W. Deem and C. F. Lucks. Mar. 30, 1956. 36p. Contract AF 18(600)-1375.
A literature survey was made in the TML and other Battelle libraries for titanium and titanium alloys. Data were found and reported for eighteen properties of electric, magnetic, optical, sound, thermal, and general physical properties. (F.S.)

7653
HIGH-TEMPERATURE PARTS BASED ON TITANIUM CARBIDE. Walther L. Havekotte (Firth Sterling Inc., Pittsburgh). Metal Progr. 69, No. 4, 56-62(1956) Apr.
Titanium carbide-base cermets were prepared which exhibited good corrosion resistance and stress-rupture strength but low impact resistance. (C.W.H.)

Refer also to abstract 7599.

4476
HEAT TREATMENT RESTORES DUCTILITY TO FORGED TITANIUM ALLOYS. D. N. Williams and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). J. of Metals 9, 254-60(1957) Feb.

11211 NP-6373
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
APPLICATIONS AND REQUIREMENTS FOR TITANIUM CASTINGS. W. H. Johnson. June 19, 1957. 5p.
Information is given on up to date applications and requirements for Ti castings as expressed by the potential users. The items covered include the quantity, mechanical properties, size, price, alloy development, surface contamination, surface finish, and opinions on the future establishment of a Ti casting industry by 1960. (auth)

10626 TML-92
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus Ohio.
THE ENGINEERING PROPERTIES OF COMMERCIAL TITANIUM ALLOYS. M. W. Mote, R. B. Hooper, and P. D. Frost. June 4, 1958. 233p. Contract AF18(600)-1375.

TITANIUM 5.14.09

The general composition and designation of Ti alloys, properties of commercial alloys of Ti in annealed and heat-treated conditions, and data on the uniformity of the alloys are discussed. Information for designers and users of aircraft structural materials as applied to Ti is given. (W.L.H.)

7843 NP-6640
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
COMPILATION OF AVAILABLE INFORMATION ON Ti–6Al–4V ALLOY. R. W. Douglass and F. C. Holden. Feb. 28, 1958. 185p.
Available data on fabrication, corrosion, heat treatment, mechanical properties, and metallurgy of Ti–6Al–4V alloy are summarized. 73 references. (J.E.D.)

12858 USBM-C-172
Bureau of Mines. Northwest Electrodevelopment Lab., Albany, Oreg.
RARE EARTH ALLOYS FOR CONTROL OF ATOMIC REACTORS. Third Quarterly Progress Report for Fiscal Year 1957. Decl. Mar. 4, 1958. 14p. $3.30 (ph OTS); $2.40(mf OTS).
The work was concerned primarily with stainless steel and titanium alloys containing high percentages of gadolinium and europium. Data are given on corrosion, fabrication, and melting points of these alloys. Photomicrographs showing alloy structure are included. (M.H.R.)

10561 NP-6360
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
TITANIUM ALLOYS. June 28, 1957. 26p.
A general summary on Ti and Ti alloys, their properties, and their future potentials is given. (L.T.W.)

11195 AECU-3532
Sandia Corp., Albuquerque, N. Mex.
TITANIUM. K. E. Mead. May 13, 1957. 25p. Contract AT(29-1)-789. (TM-45-57-16). $4.80(ph OTS); $2.70(mf OTS).
Titanium-base materials are gaining wide interest in the field of moderate temperature applications. This report reviews the general characteristics of titanium base materials with emphasis on the four most commonly used alloys. The information is based on a review of technical and manufacturers' literature. Samples of these materials and additional technical information are available. (auth)

2742
THE FUTURE USE PATTERN FOR TITANIUM. B. S. Mesick (Arthur D. Little, Inc., Cambridge, Mass.). J. Metals 8, 42-8(1956) Jan.
A brief review is presented of the production of Ti and the status and future prospect for its use in industry. (J.E.D.)

4675 WAL-401/93-36
Case Inst. of Tech., Cleveland.
INVESTIGATION OF THE MECHANICAL PROPERTIES OF TITANIUM BASE ALLOYS. Final Report. E. L. Harmon, Jr., J. Kozol, and A. R. Troiano. May 1956. 91p. DA Project 593-08-021. Contract DA-33-019-ORD-1690.
Mechanical properties of a series of Ti alloys containing from 0 to 24% V were correlated with the transformation characteristics. Microstructural changes in Ti base alloys resulting from variation of alloy content and heat treatment influenced strength and ductility. Almost all the alloys studied are capable of producing both poor and relatively good properties depending upon the treatments employed. Differences may be very marked for only slight variations in treatment. Ti–V alloys show a sensitivity to heat treatment greater than most non-Ti base alloys in use. Heat treatment is a critical aspect of the utilization of Ti base alloys. (F.S.)

8901 MAB-118-M
National Research Council. Materials Advisory Board.
UNIFORM TESTING PROCEDURES FOR SHEET MATERIALS. PART 1. GENERAL PROCEDURES. PART 2. TENSION TEST. Report No. 2 of Task Force on Uniform Procedures for Structural Design Data Collection. May 31, 1957. 18p. Contract DA-49-025-sc-83.
To provide some basis for uniformity in evaluating various Ti alloys, a uniform set of procedures is being prepared for procuring the data. (W.L.H.)

MATERIALS (CONSTRUCTION) 5.14

TITANIUM 5.14.09

7194 NP-6286

Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.

NOTES ON TITANIUM FASTENERS. Morris Mote. Apr. 11, 1957. 15p.

An outline of the fabrication methods for titanium fasteners is given. Centerless-ground bar stock is cut into the desired lengths and the ends are dressed. The head end is heated, usually by induction, to the forging temperature and is upset. The blank is heat treated or annealed to a minimum of 150,000-psi tensile strength. The blank is descaled and all critical surfaces (head-to-shank fillet, shank and reduced section) polished. The thread end is cold reduced by extrusion, machining, or possibly by rolling, to provide the necessary diameter for thread rolling. Threads are rolled cold, and the head-to-shank fillet is cold rolled. Details of these procedures differ in several respects from similar operations performed on high-strength steel because of the peculiarities of titanium and its alloys. Some of the production conditions that require special attention are given. (auth)

7209

TITANIUM, TITANIUM ALLOYS, AND THEIR AREAS OF APPLICATION. N. T. Gudtsov, L. D. Mashtakova. Vestnik Akad. Nauk S.S.S.R. 27, 59-68(1957) Feb. (In Russian)

A review of thermal, technological, and physical properties of Ti, and its alloys and their uses are discussed. (R.V.J.)

12748 TML-79

Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.

STAINLESS STEEL AND TITANIUM SANDWICH STRUCTURES. W. J. Lewis, G. E. Faulkner, and P. J. Rieppel. Aug. 9, 1957. 38p.

A summary of the available information in published literature and Government research reports on stainless steel and Ti sandwich structures, and also information obtained in surveys of companies fabricating and developing sandwich structures are given. Fabrication techniques used to produce sandwich structures and methods of evaluating them are discussed. Sections are also included on the development work under way on sandwich structures. (auth)

21226

TITANIUM. Howard B. Bomberger (Crucible Steel Co. of America, Pittsburgh). Ind. Eng. Chem. 51, 1228-30 (1959) Sept.

The industrial uses and mechanical and chemical properties of titanium and titanium alloys are discussed. (C.J.G.)

ZIRCONIUM 5.14.10

See also, under HAZARDS AND PROTECTION, PYROPHORICITY (4.01.10).

6365 BMI-1168

Battelle Memorial Inst., Columbus, Ohio.

THE MECHANICAL PROPERTIES OF ZIRCONIUM AND ZIRCALOY 2. Frederic R. Shober, John A. VanEcho, Lyle L. Marsh, Jr., and John R. Keeler. Feb. 18, 1957. 50p. Contract W-7405-eng-92. $0.35(OTS).

The elevated-temperature tensile properties of Zr and of Zircaloy 2 were investigated and the creep properties were determined at temperatures up to 500°C. The effect of time at test temperature on the tensile strength of the 25% cold-worked materials was investigated. The increased tensile strengths of cold-worked Zr and Zircaloy 2 were reduced to that of the annealed material by holding at 500°C for approximately 90 and 200 hr, respectively. Cold-worked Zircaloy 2 tested in creep had superior 1000-hr rupture strengths for all test temperatures, except 500°C. At 500°C, the 1000-hr rupture strength of the cold-worked material reverted to that of annealed Zircaloy 2 at the same temperature. The stress to produce a creep rate of 10^{-5} %/hr in the annealed Zircaloy 2 was 25,000 psi at 150°C and 3200 psi at 500°C. Hydraulic-bursting tests also were made on seamless Zircaloy 2 and on welded Zr tubing. The bursting pressures were considerably higher in the seamless tubes than in the welded tubing, 6800 psi as compared with 5400 psi at room temperature and 3150 psi versus 2200 psi at 400°C. The welded Zr tubing failed at the longitudinal-seam weld under hydraulic pressure. (auth)

ZIRCONIUM 5.14.10

6398
ZIRCONIUM AS A REACTOR MATERIAL. F. R. Paulsen. Atomics 8, 121-3(1957) Apr.
The use of zirconium in the nuclear industry is discussed. General discussions are included on the extraction, purification, neutron economy, and corrosion of Zr. (B.J.H.)

7393
ZIRCONIUM ALLOYS. D. E. Thomas, K. M. Goldman, R. B. Gordon, and W. A. Johnson (U.S.A.). British Patent 767,892. Nuclear Eng. 2, 224(1957) May.
A zirconium alloy containing tin (0.5 to 2.5%) and at least one metal from the group iron, nickel, chromium (not exceeding 2%) added to the zirconium to a maximum of 3% with less than 0.5% impurities is highly resistant to corrosion and may be readily hot and cold worked or wrought to strips, sheets and the like. The zirconium may have a hafnium content of up to 3%. By varying the tin content within the range of 0.5% and 1.5% the mechanical properties of the alloy may be adapted to the desired purpose without any significant change in its corrosion properties. (auth)

8464
ALLOYS OF TITANIUM AND ZIRCONIUM CONTAINING TIN. R. F. Smart (Tin Research Inst.). Metallurgia 57, 181-8(1958) Apr.
Tin is an important alloying element in titanium and zirconium, especially in those alloys designed for creep and corrosion resistance. A review is presented of the effect of tin on titanium and zirconium, and of the properties of alloys of those metals containing tin. (auth)

9330 NAA-SR-1867
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
EFFECT OF SODIUM ON THE MECHANICAL PROPERTIES OF ZIRCONIUM. J. C. Bokros. June 15, 1957. 39p. Contract AT-11-1-GEN-8. $0.30(OTS).
Zirconium is useful as a structural material in nuclear reactors, and is employed in contact with high temperature liquid Na. It was found that surface oxide which develops on Zr in Na significantly lowers the fatigue life at elevated temperatures. Hydrogen on the other hand has very little effect on the fatigue life at elevated temperatures but lowers the fatigue life at room temperature. It was also found that exaggerated grain growth which occurs above 950°F in Zr severely reduces the fatigue life at elevated as well as low temperatures. The effect of Na, i.e., the pick-up of surface oxide and reasonable amounts of H_2, does not significantly alter the tensile properties of Zr at high temperature. Data also indicate that Zr is stable to dimensional changes after thermal cycling. (auth)

MATERIALS. Nucleonics 16, No. 9, 108-10, 112-16, 118, 120, 122, 124(1958) Sept.
Data presented at the Geneva Conference on nuclear materials such as heavy water, zirconium, graphite, sodium, and polyphenyls are summarized. (J.S.R.)

14837 A/CONF.15/P/1993
Oak Ridge National Lab., Tenn.
RECENT ADVANCES IN THE METALLURGY OF ZIRCONIUM AND TITANIUM ALLOYS OF SPECIAL INTEREST IN REACTOR TECHNOLOGY. G. M. Adamson, Jr., J. O. Betterton, Jr., J. H. Frye, Jr., and M. L. Picklesimer. 20p. $0.50(OTS).
Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.
Zirconium alloys are presently available with better neutron and corrosion properties than any other known reactor material of comparable strength and ductility. Progress has been made towards resolving some of the special problems in these and certain titanium alloys such as fabrication and welding procedures, improved corrosion resistance under heavy particle bombardment, and the delineation of burning hazards. Ultimately, alloy development may permit full utilization of the strong binding forces in these metals, indicated by their high melting point and heat of vaporization, in terms of mechanical strength at higher temperatures. More immediately, alloys which are less sensitive and more resistant to contamination in fabrication are urgently required to reduce the cost of preparing zirconium and titanium materials. (auth)

10897 KAPL-M-JRP-1
Knolls Atomic Power Lab., Schenectady, N. Y.
COMPACTING AND SINTERING CHARACTERISTICS OF HORIZONS'S INC. AND CARBORUNDUM CO. ZIRCONIUM

MATERIALS (CONSTRUCTION) 5.14

ZIRCONIUM 5.14.10

AND ELECTRO METALLURGICAL TITANIUM POWDERS. J. R. Pekoke. May 11, 1956. 10p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Densities, hardness, and compression ratios for Zr and Ti powders are given for use in powder metallurgy processing. (T.R.H.)

7949 NMI-1171
Nuclear Metals, Inc., Cambridge, Mass.
THE CHEMICAL ANALYSIS OF ZIRCONIUM AND ZIRCALOY METALS. E. B. Read and H. M. Read. Jan. 31, 1957. 110p. Contract AT(30-1)-1565. $0.60(OTS).

As a result of the cooperative effort, methods are now available for the quantitative determination of most of the impurities found in commercial Zr. Chemical and spectrographic methods are used in analysis for elements other than Hf. Spectrographic, x-ray-fluorescence, and pile-activation techniques were applied to the analysis for Hf. (auth)

6405
DEPOSITION OF ACTIVITIES FROM THORIA SLURRIES. K. M. Glover and D. J. O'Connor (Atomic Energy Research Establishment, Harwell, Berks). J. Inorg. and Nuclear Chem. 4, 135-6(1957) Mar.

It was found that in agitation of stainless steel, Zr, and Zircaloy discs in aqueous ThO_2 slurries a preferential plating of the Ra daughters of natural Th occurs. (W.L.H.)

13653
ZIRCONIUM ALLOY. H. A. Wilhelm and D. P. Ames (to U. S. Atomic Energy Commission). U. S. Patent 2,872,310. Feb. 3, 1959.

A binary zirconium–antimony alloy is presented which is corrosion resistant and hard containing from 0.07% to 1.6% by weight of Sb. The alloys have good corrosion resistance and are useful in building equipment for the chemical industry.

SAMPLING EQUIPMENT 5.15

GASES 5.15.01

87 HW-51452
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
AN APPARATUS FOR THE DETERMINATION OF TOTAL GAS IN FUEL ELEMENT SAMPLES. R. I. Miller. July 30, 1957. 13p. Contract W-31-109-Eng-52. $0.50(OTS).

A description is given of an apparatus which is capable of analyzing six uranium samples per 8 hours for total gas content. Drawings and discussion of various parts of the system are given. Possibilities of increasing the speed of analysis are discussed. (auth)

13021
AN ELECTROSTATIC PRECIPITATOR FOR HIGH-SPEED SAMPLING. V. J. Lenger. Chem. listy 50, No. 1, 146-8(1956). (Translated from Referat. Zhur. Khim. No. 1, 1957, Abstract No. 1345.)

An apparatus is described which permits the sampling of aerosols, gases, and vapors even at high flow rates (10 to 25 m/sec). The flow through the sampling inlet is maintained equal to that of the surrounding stream.

10479
COLLECTION OF INTEGRATED SAMPLES OF GASEOUS EFFLUENTS. Richard S. Brief (Esso Research and Engineering Co.) and Philip A. Drinker Massachusetts Inst. of Tech., Cambridge). Arch. Ind. Health 17, 654-8(1958) June.

A method is described for collecting gaseous samples of effluents from both cyclic and continuous industrial operations. The equipment is simple and easily operated to give samples which can be analyzed by mass spectrometry. (C.H.)

REMOTELY OPERATED FILTER PHOTOMETER. M. T. Kelley, E. B. Wagner, W. L. Maddox, H. C. Jones, and D. J. Fisher (Oak Ridge National Lab., Tenn.). Anal. Chem. 30, 1711-12(1958) Oct.

Colorimetric analyses of radioactive samples are done remotely within cells in the High Radiation Level Analytical Facility. Manipulations of samples and instrument are done with a pair of master slave manipulators. Only the compact sensing unit is within the

SAMPLING EQUIPMENT 5.15

GASES 5.15.01

cell. This separation of components reduces slave movements to a minimum, saves valuable cell space, simplifies maintenance problems, and was found to be reliable and stable. (auth)

INDUSTRIAL TECHNICAL INFORMATION MEETING ON COLD PROCESSING OF ENRICHED URANIUM, OAK RIDGE, SEPTEMBER 13-15, 1956. September 1956. 96p. (TID-7518(Pt.1))

Air sampling and water sampling equipment are described on p. 86-89.

10122 BNL-2737

Brookhaven National Lab., Upton, N. Y.

FILTER SAMPLERS FOR FIELD USE. Maynard E. Smith, Frederick E. Bartlett, and George W. Potts. Mar. 31, 1956. 12p. $3.30(ph OTS); $2.40(mf OTS).

The atmospheric diffusion studies at Brookhaven National Laboratory have led to the development of a variety of samplers. The filter units and techniques described have many features in common with others reported on within recent years, but it is believed that they embody substantial advantages in accuracy, speed, and cost. Of particular interest are the two airborne samplers, which are lighter and simpler to use than any known to the authors. Although the oil-fog test effluent is not suitable for a wide range of applications, a complete description of the fluorimetric analytical method is included, emphasizing the need for meticulous care in the entire sampling procedure. (auth)

2321 ✓ CF-52-3-155

[Oak Ridge National Lab., Tenn.]

DESIGN OF ORIFICES FOR SAMPLING PROCESS GAS FROM THE DISSOLVER OFF-GAS SYSTEM IN THE IDAHO CHEMICAL PROCESSING PLANT (BLDG. CPP 604). William L. Carter. Mar. 20, 1952. Decl. Dec. 15, 1955. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Design specifications are presented for orifices for the removal of gas samples for laboratory analysis from the process gas stream in the dissolver off-gas system in the Idaho Chemical Processing Plant. The entire system operates at sub-atmospheric pressure and the sampling system operates at the existing pressure. Calculations are included which illustrate the manner in which the sizes of the various orifices were determined. (C.H.)

11147 RDB(W)/TM-1226

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

A NOTE ON THE COLLECTION AND ANALYSIS OF THE GAS CONTAINED IN IRRADIATED CARTRIDGES. J. C. Bates. [1955?]. Decl. Apr. 18, 1958. 7p.

Gas released during the decanning of cartridges in the Windscale pond was collected, and the results of the analysis of the samples collected are given. The large volumes of hydrogen found led to the development of a method of sampling the gas directly from the cartridge cans, which has shown that the hydrogen was not present as gas in the cartridge after irradiation but resulted from the decanning. Analyses of the latter samples are also given. (auth)

7639 NP-8193

Pittsburgh Coke and Chemical Co. Research and Development Dept.

A NON-SELECTIVE COLLECTOR FOR SAMPLING GASEOUS AIR POLLUTANTS. Final Report for the Six Quarters Ending December 15, 1958. Stanton B. Smith and Richard J. Grant. 1959. 68p. Contract SAPH-68345.

Issued as Robert A. Taft Sanitary Engineering Center report A59-3.

The problem of collecting field samples of gaseous atmospheric contaminants has been investigated and a prototype collector design proposed which consists of two activated carbon columns in series, the second of which is refrigerated in dry ice. A field collector kit containing all accessory equipment for collecting 100-liter samples was designed and built. Tests conducted on a specially constructed flow apparatus indicated the complete collection of methane and less volatile substances at concentrations of about 150 ppm. Strong oxidants cannot be handled since these react with the adsorbent. Good recovery of the adsorbed materials for analysis was achieved. However, further investigation of desorption and analytical techniques is required. (auth)

SAMPLING EQUIPMENT 5.15

GENERAL 5.15.02

329 WCAP-6025
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. LIQUID SAMPLERS FOR SAFEGUARDS USE. W. E. Foster. Oct. 1, 1959. 13p. Contract AT(30-1)-2176. OTS.

Systems designed to obtain representative samples from various points in nuclear fuels reprocessing plants have been evaluated. From these sampler systems, two designs were chosen for use in a Nuclear Materials Control System (NMCS). For radioactive samplers coming from feed tanks and waste hold-up tanks, the Thorex sampler was chosen. For samples coming from the product end of the plant, the Savannah River vacuum sampler system was specified. Pertinent features concerning these sampler systems are described in the report, together with specifications for tamper-resistant features. Samples from the feed tanks and the waste hold tanks are inherently tamper-resistant because of their high radioactivity. The specified accountability points are considered to be sufficient for reasonable safeguarding of nuclear materials in a chemical processing plant. In a disarmament situation, more accountability points would be added to those indicated in this report. (auth)

4333
REPRODUCIBILITY OF RADIOACTIVE SAMPLE PREPARATION TECHNIQUES. George K. Schweitzer and James S. Eldridge (Univ. of Tennessee, Knoxville and Oak Ridge Inst. of Nuclear Studies, Tenn.). Anal. Chim. Acta 16, 189-93(1957) Feb.

The reproducibility of samples prepared for the determination of radioactivity has been investigated for a low-energy beta-emitting nuclide, a high-energy beta-emitting nuclide, and a gamma-emitting nuclide. Variables studied, in addition to the nature of the nuclide, were: the total solid concentration in solution, the nature of the sample mount, the pH value of the solution, the use of auxiliary porous media (paper), and the effect of a wetting agent. High total solid concentration had a great effect on the reproducibility of measurements made with the low energy beta-emitter, and a less pronounced effect on measurements made with the high energy beta-emitter. The effect of total solids was negligible for measurements of the gamma-emitter using a single-channel scintillation spectrometer. Copper or aluminum planchets gave best reproducibility for the beta-emitting nuclides, whereas copper planchets or steel cups were best for the gamma-emitter. The effect of the other factors studied was negligible under conditions of this investigation. (auth)

13842 KLX-1042
Kellex Corp., New York, New York.
REPORT OF THE INSTRUMENT AND MECHANICAL DEVELOPMENT DEPARTMENT ON REMOTE SAMPLING APPARATUS. Job. 15. June 30, 1949. Decl. Feb. 25, 1957. 34p. Contract W-31-109-eng-52, Subcontract G-148. $0.40(OTS).

This report is one of a group of 11 Instrument and Mechanical Development Department status reports presenting detailed information on the investigations and work summarized in KLX-1033, "Summary Report, Research and Development Program." The program herein summarized describes the efforts of this group in developing a remote device for obtaining representative samples of highly radioactive process solutions. The problem was complicated by the necessity for complete personnel protection by shielding and complete elimination of the possibility of drippage. The In-Line Sampler has been designed around a special plug-type valve with a stainless-steel plug seated in a Teflon liner. This sampler is very promising. (auth)

12582
AUTOMATIC UNIT FOR DETERMINATION OF RADIOACTIVITY OF PREPARATIONS. V. A. Shirshov. Biofizika 1, No. 6, 580-4(1956). (Translated from Referat. Zhur. Khim. No. 9, 1957, Abstract No. 31155.)

The unit consists of a supply-chamber column, into which the samples are charged, a rotatable stage for moving the samples to the operation port of the T-25-BFL end-window counter, a device for dropping the samples from the stage on completion of the determination, electronic time relay assembly, and a recording mechanism. The unit is designed for a single charge of 40 samples, held in closed celluloid cups of cylindrical shape. The unit is provided with a type PS-64 recording assembly with automatic switching of scaling to 4 during measurement of background and to 64 during measurements of the activity of samples. Measurement time is set to 3 to 5 to 10 minutes. The unit can be used for a continuous determination and recording of the activity of materials for 5 days without tape recharging.

SAMPLING EQUIPMENT 5.15

GENERAL 5.15.02

9562
SAMPLE HOLDER. W. J. Stinson (to U. S. Atomic Energy Commission). U. S. Patent 2,789,688. Apr. 23, 1957.

A device is described for mounting samples for use in a fission counter. The device consists of a combination of a mounting for the sample with a jig for use in the fission counter. A disc of the sample to be tested is placed in a mounting ring so that it is held by a lip on the exposed face and locked in place by a snap ring inserted from the back side. A hole in the snap ring fits over a peg on the jig. Levers are arranged to remove the mounting ring from the jig and also to disengage the snap ring so the sample disc may be lifted out. This device permits the accurate placement of the sample, and manipulation with a minimum of handling and exposure by the operator. (auth)

THE SLOTTED CONE SPLITTER. F. J. Flanagan, R. C. Keilagher, and W. L. Smith (U. S. Geological Survey, Washington, D. C.). J. Sediment. Petrol. 29, 108-15(1959) Mar.

A laboratory sample splitter was designed in the form of a 60° cone over whose surface the entire sample passes. The split is captured by falling through pie-shaped slots on the surface of the cone. The splitter sampled an average of 13.5% of a crushed quartz monzonite, of which 80% passes a 140-mesh sieve. The amount of sample captured is dependent on the particle size of the material sampled. A line of regression of the percent captured on size and confidence limits for the estimate of the means of the amount split are shown. Some qualities desirable in a splitter are enumerated and the conformity of several splitters to these criteria is discussed. (auth)

LIQUIDS 5.15.03

11435 BNL-4010
Brookhaven National Lab., Upton, N. Y.
PROPORTIONAL SAMPLING OF FLOWING LIQUID WASTES FOR RADIOACTIVE MONITORING. John M. Ruddy. [Apr. 5, 1959]. 16p. Contract [AT-30-2-GEN-16]. $3.30(ph), $2.40(mf) OTS.

The purpose, methods, equipment, and design criteria are described for sampling flows varying from small and intermittent, as at the effluent of a laboratory building, to large and continuous, as at a sewage disposal plant. Data are given for quantities of liquid wastes which might be expected from laboratory buildings. (auth)

DISPENSING APPARATUS FOR LIQUIDS. J. Waddell, H. F. Parker, and H. Haselden (to U. K. Atomic Energy Authority). British Patent 776,617. Nuclear Eng. 2, 494 (1957) Nov.

The problem of sampling radioactive liquors is one of minimizing radiation and avoiding spilling (contamination). A small-capacity reservoir, which can be flushed with liquid and then filled to a predetermined level carries a hypodermic-type needle with its unpointed end open to the reservoir below that level and its pointed end exposed above it. A rubber-capped evacuated bottle of greater capacity than the volume of liquid in the reservoir can be advanced and withdrawn on to and away from the needle which thereby penetrates the cap and injects liquid into the bottle. The sampling machine has a row of sampling points and a mechanism for bringing a bottle over these points by means of a long pair of curved tongs and mirror viewing through periscope behind a shielding wall. (auth)

17116 CF-58-8-28
Oak Ridge National Lab., Tenn.
HRP-CPP: DISSOLUTION OF ZIRCONIUM AND STAINLESS STEEL CORROSION PRODUCT OXIDES. J. W. Snider and P. A. Haas. Aug. 5, 1958. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

Dissolution methods were developed to permit representative sampling of the slurry of corrosion and fission products collected by the HRT chemical processing plant. The procedure selected for HRT-CPP application was to use 15 ml of 10.8 M H_2SO_4 per gram of solids with agitation by boiling in a tantalum-lined dissolver. (auth)

10809 CF-55-10-119
Oak Ridge National Lab., Tenn.
UNDERFLOW SAMPLER. W. D. Burch. Oct. 13, 1955. 8p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80 (mf OTS).

Modification of the high activity level, remotely operated sampler used in the HRT for sampling the chem plant underflow pot is discussed. (T.R.H.)

SAMPLING EQUIPMENT 5.15

LIQUIDS 5.15.03

9468 CF-57-1-87
Oak Ridge National Lab., Tenn.
HRT SAMPLER DEVELOPMENT. B. A. Hannaford. Jan. 22, 1957. 19p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).
A prototype sampler for obtaining samples of highly radioactive UO_2SO_4 solution for use in the HRT is presented. It was successfully operated in conjunction with a low pressure water system and a high-pressure, high-temperature UO_2SO_4 system. (W.L.H.)

12539 CF-56-4-87
Oak Ridge National Lab., Tenn.
HRP-CP: SAMPLER OPERATION AND URANIUM PEROXIDE PRECIPITATION IN THE HRT CHEMICAL PROCESSING PLANT. William L. Carter. Apr. 11, 1956. Decl. Mar. 14, 1957. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
It was found that neither the overflow nor underflow sampler lines should be in danger of plugging from UO_4 precipitation. (T.R.H.)

SLUDGE SAMPLING SYSTEM. A. A. Abbateillo. Dec. 9, 1948. Decl. Dec. 27, 1955. 16p. (K-316)
A clamshell-type sludge sampler was designed and built at K-25 and used at Hanford to obtain specimens of radioactive materials, at predetermined depths from the metal waste tanks T-101, T-102, and T-103. Construction of the device and experience in its use at Hanford are described.

10860 CF-56-10-16
Oak Ridge National Lab., Tenn.
HRT WASTE TANK EVAPORATOR SAMPLER. J. E. Kuster and C. A. Burchsted. Oct. 11, 1956. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
A schematic of the aspirator-type sampler for HRT waste evaporators is given. Methods of preventing UO_2SO_4 freezing in suction lines are discussed. (D.E.B.)

13018 GAT-T-518
Goodyear Atomic Corp., Portsmouth, Ohio.
AUTOMATIC SAMPLE TUBE CLEANER. N. H. Duffy and W. S. Stringham. July 25, 1958. 5p. Contract AT(33-2)-1. $1.80(ph OTS); $1.80(mf OTS).
An automatic sample tube cleaner was designed and fabricated. Quick-connecting devices for the tubes and solenoid-operated air valves for all services are employed. The solenoids are actuated by an electrical timing mechanism which schedules steam, cleaning agent, hot water, air, and vacuum into the tube rack. With this apparatus it is possible to clean 48 tubes in the same time as was required for 13 tubes on the manually operated system. This results in a saving of one-half man-day per day and a more uniform, controlled cleaning method. (auth)

6255 IGO-AM/W-82
Gt. Brit. Windscale Works, Sellafield, Cumb., England.
THE SAMPLING OF LIQUID CARBON DIOXIDE PRIOR TO ANALYSIS. Mar. 11, 1957. 5p.
A small heated sample cylinder for sampling liquid CO_2 prior to analysis is presented. The liquid CO_2 is conducted into one end and drawn off the other. (W.L.H.)

2903 IDO-14456
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
THE REMOTE ANALYTICAL FACILITY MODEL "B" PIPETTER. Fred W. Dykes, John P. Morgan, and William G. Rieder. Oct. 20, 1958. 57p. Contract AT(10-1)-205. $1.75(OTS).
The RAF Model B pipetter is a device designed to pipet aliquots of highly radioactive samples. It incorporates features of two previous models and several years of operating experience. Design criteria were accuracy of delivery, reliability of operation, and ease of operation and maintenance. A complete description of the pipetter and its operation and maintenance is presented. (auth)

8866 IDO-14409
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
APPARATUS FOR REMOTE, SMALL SCALE, LIQUID-LIQUID EXTRACTIONS. Fred W. Dykes and Richard G. Masterson. May 21, 1957. 9p. Contract AT(10-1)-205. $0.15(OTS).
An improved apparatus for small-scale liquid-liquid extractions is described. The apparatus is used in the preparation of highly radioactive sample aliquots for conventional analysis. (auth)

SAMPLING EQUIPMENT 5.15

LIQUIDS 5.15.03

7271 V

PRACTICAL ASPECTS OF INTERNAL-SAMPLE LIQUID-SCINTILLATION COUNTING. Jack D. Davidson and Philip Feigelson (Columbia Univ. and Francis Delafield Hospital, New York). Intern. J. Appl. Radiation Isotopes 2, 1-18 (1957) Apr.

14251 TID-7568(Pt. 2)(p.65-75)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

REMOTE PIPETTER FOR HIGHLY RADIOACTIVE SAMPLES. Fred W. Dykes. p.65-75 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 11p.

The Remote Analytical Facility of the Idaho Chemical Processing Plant is in operation 24 hours a day for the analysis of highly radioactive liquid samples. The most important analytical apparatus in this facility is the remote pipetter which delivers sample aliquots for the various analytical determinations. The first pipetter used was patterned after one designed at Oak Ridge National Laboratory. Based upon operating experience with it, a revised unit has been designed. This new model, termed the RAF model B pipetter, utilizes the basic, proven features of the ORNL design while incorporating modifications to reduce maintenance requirements as well as to facilitate maintenance and decontamination procedures. The pipetter is a positive displacement, motor-driven type and employs the same Brown continuous-balance control system used previously. However, the upper inlet to the sample chamber is no longer controlled by the plunger but by an air-operated diaphragm valve. This feature permits instantaneous shutoff when full, simplifies the plunger design, reduces the possibility of plugging by eliminating small passageways, and permits filling or cleaning of the pipetter at any plunger position. Pipetter alignment is no longer accomplished by positioning the plunger but by rotating the balancing potentiometer. This permits disassembly of the sample-handling components without necessitating a tedious job of realignment. All susceptible parts, such as the servomotor, potentiometer, and gears, are enclosed in a housing which is maintained under slight positive pressure. This permits use of remote decontamination procedures without risk of damage to the mechanism. Many other minor improvements were made both in the pipetter design and the design of auxiliary apparatus used in conjunction with the pipetter. The end result is a remote pipetter designed to operate continuously under difficult conditions, with minimum maintenance. (auth)

18775 ✓ RDB(W)/TN-20

Gt. Brit. Windscale Works, Sellafield, Cumb., England.

AN IMPROVED SAMPLER FOR THE URANIUM PURIFICATION PLANT (B 207). T. I. M. Crofts. Feb. 26, 1952. 12p.

Investigations of hypodermic needles for use in sampling aqueous and solvent streams in the Windscale uranium purification plant are reported. It was concluded that 0.041, 0.036, and 0.018 in. bore needles can be used satisfactorily. (J.R.D.)

LIQUID METALS 5.15.04

2864

HOW TO TAKE SAMPLES FROM LIQUID METAL LOOPS. Marx Weech and Gordon Fluke (Univ. of Michigan, Ann Arbor). Nucleonics 15, No. 10, 112(1957) Oct.

A sampler is described which gives leak-free performance and requires a minimum of operator attention. The sampler design will operate in either a high vacuum or an inert gas atmosphere of low or moderate pressure. (J.T.W.)

France. Commissariat à l'Énergie Atomique, Paris.

RÉALISATION D'UN ÉCHANTILLONNEUR A SODIUM LIQUIDE. (Liquid Sodium Sampler.) H. Chevilliard. Feb. 1959. 5p.

A liquid metal sampler which permits the extraction of a given quantity of metal and its introduction into a movable container or analyzer without pollution by atmospheric oxygen is described. The apparatus is constructed of stainless steel. During sampling the pressure does not exceed 5×10^{-5} mm of mercury, and it is possible to remove only a drop of the metal. (J.S.R.)

SAMPLING EQUIPMENT 5.15

Liquid Metals 5.16.03.04

15550 ✓
ANNULAR IMPACTOR SAMPLING DEVICE. G. W. C. Tait (to U. S. Atomic Energy Commission). U. S. Patent 2,879,664. Mar. 31, 1959.
A high-rate air sampler capable of sampling alpha-emitting particles as small as 0.5 microns is described. The device is a cylindrical shaped cup that fits in front of a suction tube and which has a sticky grease coating along its base. Suction forces contaminated air against the periodically monitored particle absorbing grease.

TRANSFER OF FLUIDS 5.16

JOINTS 5.16.01

See also, under PROCESS CHEMISTRY AND ENGINEERIN
ION EXCHANGE--Equipment (6.12.01),
SOLVENT EXTRACTION--Equipment (6.16.02).

10861 KAPL-M-S3G-RE-514
Knolls Atomic Power Lab., Schenectady, N. Y.
TRANSITION JOINT TEST; TEST NUMBER 514. J. Bianchi. Sept. 12, 1956. 25p. SAR Project. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).
A shrink fit joint with a special type of thread was tested for use at the transition joint on the unit cell. The 514 A joint has sufficient strength for this application, being loaded to 34,000 lb without failure. (T.R.H.)

1218
SAFE WAY TO DISCONNECT "HOT" HOSE LINES. Herbert P. Cantelow (Univ. of California, Berkeley). Chem. Eng. 64, No. 5, 294(1957) May.
A safe method is presented for disconnecting radioactively contaminated hose lines from hot cells. (W.L.H.)

198
JOINTS FOR USE IN PIPELINES AND BETWEEN PARTS OF VESSELS. J. P. A. Macdonald (to Crane Packing Ltd.). British Patent 773,541. Nuclear Eng. 2, 408(1957) Sept.

TRANSFER OF FLUIDS 5.16

The one-piece jointing element for corrosive, noxious or toxic fluids is formed from a ring with a deep internal slot affording a certain flexibility in the direction of its thickness although of normally non-resilient material. Continuous serrations or corrugations are provided on the opposite faces of the ring to fit into recesses formed in the opposing ends of the pipelines or vessel parts between which the ring is clamped. (auth)

7161 HW-40980
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PUREX REMOTE STUDS. Carl F. Yuenger. Jan. 19, 1956. 6p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).
The failure of some remote flange connecting studs in Purex Process lines is discussed. Failures are attributed to embrittlement by welding, and in another case, to inferior heat treating of the stainless steel. It is recommended for future installations that an optimum material be found and specifications be more rigid. (T.R.H.)

PIPING 5.16.02

11210 ✓ NP-6372
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
THE AVAILABILITY OF TITANIUM TUBING, DUCTING, AND FITTINGS. Oren J. Huber. June 13, 1957. 9p.

5847 ✓
INSPECTION OF SMALL-DIAMETER TUBING BY EDDY-CURRENT METHODS. J. W. Allen and R. B. Oliver (Oak Ridge National Lab., Tenn.). Non-Destructive Testing 15, 104-9(1957) Mar.-Apr.
A report is presented on what can be accomplished with eddy-current tests on nonferromagnetic small diameter tubing according to present methods. A brief review of eddy-current testing in general is reported. (auth)

11199 ✓ KAPL-M-JMG-10
Knolls Atomic Power Lab., Schenectady, N. Y.
DIFFUSION BONDING OF ZIRCALOY TO STAINLESS STEEL TUBING. J. M. Gerken. May 28, 1957. 16p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

TRANSFER OF FLUIDS 5.16

PIPING 5.16.02

Satisfactory diffusion bonds can be made between $^7/_8$ in. O.D. × $^1/_8$ in. wall stainless steel and Zircaloy tubing. These joints did not fail after thermal cycling 200 times between 100 and 600°F or after pressure cycling 100 times between 100 and 3500 psi. Hydraulic bursting pressures of from 13,200 to 17,200 psi were required to cause failure of well-bonded joints. Failure generally occurred by the Zircaloy tube splitting longitudinally and peeling away from the joint. (auth)

PERMEATION OF AIR THROUGH WALLS OF PLASTIC TUBING USED IN LOW PRESSURE SYSTEMS. James M. Kendall (U. S. Naval Ordnance Lab., White Oak, Silver Spring, Md.). pp. 120-4 in "1957 Fourth National Symposium on Vacuum Technology Transactions."

Information is presented on the permeation of air through the walls of plastic tubing used in supersonic wind tunnels. The supersonic wind tunnel, which is itself a low-pressure system, involves much work with accessory low-pressure systems, especially pressure measuring instrumentation, all of which make use of plastic tubing. Discussions are included on how a tunnel is used to measure the pressure distribution over the surface of a model held in the tunnel test section. Systems for measuring the permeation of air through the walls of tubes and for simulating supersonic wind tunnel pressure measurements are described.

3477 KLX-1356
Kellex Corp., New York.
PROJECT COMPLETION REPORT; THOMPSON QUICK DISCONNECT DEVELOPMENT. Job 24-B3. E. W. Ruhl. Aug. 16, 1951. Decl. Dec. 5, 1955. 26p. Contract AT(30-1)-850. $4.80(ph OTS); $2.70(mf OTS).

The development, prototype production, and testing of a modified Thompson Quick Disconnect for use in radiochemical process lines is discussed. A 1-in. pipe connector has been developed for use where highly corrosive radioactive fluids are transferred under limited temperature conditions. (auth)

9312 EES-060088F
Naval Engineering Experiment Station, Annapolis.
EVALUATION UNDER THERMAL SHOCK OF SMALL SIZE, WELDED BIMETALLIC PIPE JOINTS. W. E. Clautice. Mar. 12, 1956. 68p.

The results of the exposure of 10 bimetallic, welded pipe joints, of the type used in the newly developed nuclear power submarine propulsion plants, to repeated cycles of thermal shock are presented. The thermal cycle used was selected by a conference at the Bureau of Ships and was based on the expected service conditions for the Cres-Monel joints. Four joints were evaluated after the application of 250 thermal shock cycles. The remainder were subjected to 500 thermal shocks. All joints developed cracks under the test conditions. (auth)

317
AN INVESTIGATION OF THERMAL-STRESS FATIGUE AS RELATED TO HIGH-TEMPERATURE PIPING FLEXIBILITY. L. F. Coffin, Jr. (General Electric Research Lab., Schenectady, N. Y.). Trans. Am. Soc. Mech. Eng. 79, 1637-51(1957) Oct.

A summary of a co-operative research investigation extending earlier work on the thermal-stress-fatigue resistance of AISI Type 347 stainless steel is made. The investigation was to provide additional qualitative experimental support of the concept of fatigue design based on an allowable stress range which is embodied in the ASA-B31.1 Code Rules for Piping Flexibility Design. Two specific objectives were established, together with the findings of this research: (a) Investigation of the effect of cycling which produces tensile rather than compressive stress under the hot condition. It was found that there was no significant difference. (b) Investigation of the effect of reducing the net mechanical strain range for a given temperature range to a point approaching the design strains for a piping system. While the temperature range was held constant, the trend of reducing the net mechanical strain range was to increase the number of cycles to failure similar to that obtained when the net mechanical strain range was reduced by lowering the temperature range under full constraint. In addition, for the same mechanical strain range, widening the temperature range decreased the number of cycles to failure. (auth)

2695
TRANSIENT BEHAVIOR OF SINGLE-PHASE NATURAL-CIRCULATION LOOP SYSTEMS. C. D. Alstad, H. S. Isbin, N. R. Amundson (Univ. of Minnesota, Minneapolis), and J.

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P. Silvers (Argonne National Lab., Lemont, Ill.). A.I.Ch.E. Journal 1, 417-25(1955) Dec.

A useful method is reported for calculating temperatures and rates of flow in the unsteady-state operation of natural-circulation loops in single phase. A one-dimensional mathematical model is used with the assumptions that at any instant the volumetric rate of flow is constant around the loop and steady-state friction factors can be applied in transient operations. The loop, consisting of a heat source, heat sink, hot leg, cold leg, and connecting piping, is di-

COUPLINGS FOR VACUUM INSULATED PIPELINES. P. M. C. Lacey (to United Kingdom Atomic Energy Authority). British Patent 794,761. Nuclear Eng. 3, 556(1958) Dec.

The pipelines for liquefied gas have spigot and socket joints, but make contact only through a (rubber) scaling ring so that an annular space remains between spigot and socket forming a pocket in which the liquid conveyed tends to boil. This boiling liquid forms an insulating gas seal. (auth)

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See also, under PROCESS CHEMISTRY AND ENGINEERING, SOLVENT EXTRACTION--Equipment (6.16.02).

AIR LIFTS 5.16.03.01

AIR-LIFT PUMPS IN MULTICOLUMN PLANTS. Andrew H. Fowler and George R. Jasny (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Chem. Eng. Progr. 55, No. 1, 64-5(1959) Jan.

The air-lift pump in principle is a pipe submerged in a liquid with a connection near the bottom for injecting air. An arrangement for obtaining automatic transfer with air-lift pumps in multicolumn plants is shown.

7170 ✓ IDO-14398
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

FACTORS AFFECTING CAPACITY OF AIR LIFTS. H. V. Chamberlain. Mar. 18, 1957. 44p. Contract AT(10-1)-205. $0.30(OTS).

An investigation of the operation of air lifts was made to develop feasibility of application to nuclear fuel processing facilities. The effect of the following variables on lift capacity was studied: pipe diameter, submergence ratio, liquid density, liquid temperature, nozzle design, nozzle holder design, eductor shape, and viscosity. Three of the variables had major effects; i.e., pipe diameter, submergence ratio, and liquid temperature. The remaining variables had a negligible effect on lift capacity. It was found that the lift capacity increased as the pipe diameter and submergence ratio increased. An increase in liquid temperature increases the lift capacity if the air rate for maximum liquid flow has not been exceeded; otherwise the increased liquid temperature causes a decrease in lift

2886 AERE-CE/M-150
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
PRELIMINARY INVESTIGATION OF THE GAS LIFT PUMP FOR CIRCULATING HEAVY LIQUID METALS. F. Roberts and P. F. Wace. Aug. 1955. 17p. (MSWP/N-12).

The gas lift pump has not been considered here as a prime mover for circulating coolant through a primary circuit, in view of the complexity which would arise in designing such a pump to overcome the head losses associated with the secondary large volumetric flow rates. The purpose of this investigation was merely to make a preliminary study of the general character of a heavy liquid metal gas-lift, to compare its operation with that of water, and to obtain some idea of the relationship of efficiency to flow rate. (A.C.)

3337 ✓ HW-39432
Hanford Atomic Products Operation, Richland, Wash.
OPERATIONAL CHARACTERISTICS OF SUBMERGED GAS-LIFT CIRCULATORS. M. W. Cook and E. D. Waters. Dec. 1, 1955. 130p. Contract W-31-109-Eng-52. $19.80 (ph OTS); $6.30(mf OTS).

Performance tests have shown that totally submerged gas-lift circulators offer an economic and effective means for achieving mild liquid agitation in large tanks. Riser pipe diameters from 3 to 15 in. and lengths from 3 to 24 ft were investigated. The effects of footpiece design, liquid

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temperature, liquid specific gravity, and the depth of liquid cover were also studied. Liquid flow was measured by means of instrumentation developed in this work. It is believed that the flow potential in a gas-lift circulator is the results of a reduction in the apparent specific gravity of the liquid. By equating this potential to the flow resistances, a general method for predicting circulator performance has been developed. The recommended operating range is from 400 to 1200 gpm/ft^2. In this range, a 10-foot long riser pipe will require from 0.003 to 0.008 ft^3 of motive gas per gallon of cold liquid circulated. In a boiling liquid, the motive gas requirements are decreased by a factor of about 5. Satisfactory operation requires that the motive gas must be non-condensable. The advantages of replacing mechanical agitators with gas-lift circulators are discussed. (auth)

European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
USE OF AIR LIFTS AS METERING APPARATUS FOR RADIOACTIVE MATERIALS; DESIGN FOR CONSTRUCTION OF AN EXPERIMENTAL UNIT. Technical Report No. 27. A. Redon. Dec. 16, 1958. 30p. $6.30 (ph), $3.00(mf) OTS.

The first part of this document reflects a study of G. W. T. Kearsley, "Use of an Air Lift as a Metering Pump for Radioactive Solutions," ORNL-2175. The second part is devoted to an examination of the results found and to discussion of construction of an experimental unit. Drawings of equipment which were not in the above mentioned report are included. (W.L.H.)

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9709 CF-56-8-120
Oak Ridge National Lab., Tenn.
HRT-CP ENGINEERING TEST PROCEDURE P-1; WESTINGHOUSE CIRCULATING PUMP. P. E. Novak. Aug. 15, 1956. 19p. Contract [W-7405-eng-26]. $3.30 (ph OTS); $2.40(mf OTS).

Performance tests were conducted on canned-rotor pumps for the HRT fuel processing system. A description of the tests and their results are given. (D.E.B.)

4033 CF-56-2-33
Oak Ridge National Lab., Tenn.
IMPROVEMENTS IN THE OPERATION OF WESTINGHOUSE 200A SLURRY PUMP. W. O. Hullings and A. S. Kitzes. Feb. 3, 1956. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The basic difficulties encountered in the operation of the 200A slurry pump at 300°C and 2000 psi due to the failure to effect a good seal of the pump flanges, leakage around the thermal barrier, and failure of bearings are discussed. (auth)

14030
LIMITED LEAKAGE VS. CANNED MOTOR PUMPS. Nucleonics 17, No. 5, 138; 140; 143-4; 146(1959) May.

Arguments for using limited leakage pumps instead of canned-motor pumps in reactor coolant primary systems are given. The literature available on the subject is reviewed. (A.C.)

6958 CF-57-4-80
Oak Ridge National Lab., Tenn.
POSSIBLE RADIATION DAMAGE TO THE STATOR WINDINGS OF THE HRT CIRCULATING PUMP. E. [H.] Gift. Apr. 17, 1957. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A study of the degree and effects of radiation damage to the motor winding of the HRT 400-A canned motor circulating pumps was made. (W.L.H.)

14030
LIMITED LEAKAGE VS. CANNED MOTOR PUMPS. Nucleonics 17, No. 5, 138; 140; 143-4; 146(1959) May.

Arguments for using limited leakage pumps instead of canned-motor pumps in reactor coolant primary systems are given. The literature available on the subject is reviewed. (A.C.)

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CAVITATION 5.16.03.03

LONGER LIFE FOR CENTRIFUGAL PUMPS—CAUSE AND CURE OF CAVITATION AND CORROSION. Neal B. Heaps (Mission Mfg. Co., Houston, Tex.). Chem. Eng. 66, No. 9, 156; 158; 160(1959) May 4.

Some operating conditions that shorten the life of a centrifugal pump are outlined, and a description is given of the physical effect of each condition on the pump. (J.H.M.)

3119 AEC-tr-3467
HYDROMECHANICAL ASPECTS OF CAVITATIONAL EROSION. K. K. Shalnev. Translated by Oak Ridge National Lab. Library Staff from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 1, 52-62(1958). 19p.

Results of experimental investigations on the hydromechanical mechanism of cavitation erosion are presented. Aspects of the mechanism such as the effect of cavitation dimension, the developmental stages of cavitation, and the effects of Reynolds number and flow rate on erosion intensity are investigated in detail.

2993 ORNL-2544
Oak Ridge National Lab., Tenn.
CORRELATION OF CAVITATION INCEPTION DATA FOR A CENTRIFUGAL PUMP OPERATING IN WATER AND IN SODIUM POTASSIUM ALLOY (NaK). A. G. Grindell. Dec. 11, 1958. 41p. Contract W-7405-eng-26. $1.50(OTS).

For the centrifugal pump under investigation, the static head at pump suction, in feet absolute, at cavitation inception was correlated for water and for 1500°F NaK on the basis of the differences of the vapor pressures of the two liquids. The difference between the vapor pressure of water and NaK, for the same conditions of pump speed and liquid flow, was added to the water-test cavitation inception value, and this estimate proved to be a good approximation to the experimental value found for cavitation inception with NaK. (auth)

5848 HW-47799
General Electric Co. [Hanford Atomic Products Operation], Richland, Wash.
ALTERNATE PROCESS WATER BY-PASS SYSTEMS FOR CG-558 PUMPS. William J. Love. Dec. 20, 1956. 25p. $4.80(ph OTS); $2.70(mf OTS).

A report of engineering services performed under Consultant Agreement No. CA-150.

The analysis and test data for the three nozzle by-pass are presented, and the results of the study of alternate designs which would permit high head loss without cavitation are reported. (auth)

20783
TOTALLY ENCLOSED CANNED MOTOR PUMP. Benjamin Cametti and Arthur C. Hagg (to Westinghouse Electric Corp.). U. S. Patent 2,887,061. May 19, 1959.

A canned motor pump design is described. The stator is a hermetically sealed one-piece cylinder. The rotor is designed for greater electrical efficiency. The impeller is hollow having a central inlet and an annular discharge. (T.R.H.)

21137
IMPROVEMENTS IN OR RELATING TO ROTARY APPARATUS. Vladimir Herbert Brix (to United Kingdom Atomic Energy Authority). British Patent 815,923. July 1, 1959.

An arrangement of drive shaft, impeller, and gas seals for canned-rotor pump is described. The partition between impeller and drive is penetrated by a sleeve journal bearing. A gas connection is provided for feeding a barrier and lubricating gas into the journal (T.R.H.)

FOR FUSED SALTS AND LIQUID METALS 5.16.03.04

12763 AERE-CE/R-757
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
DIRECT CURRENT PUMPING OF LIQUID METALS. D. A. Watt. Sept. 28, 1951. Decl. Apr. 30, 1959. 58p.

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The general theory of d-c electromagnetic pump design is given together with a detailed design study for a pump to circulate sodium–potassium alloy at 250°C with a pressure rise of 3⅓ atm. and a flow rate 13⅓ liters/sec. All types of ohmic loss are detailed including that due to end current flow with baffles. Several possible designs with efficiencies of approximately 50% are indicated in the summaries of selected instances, covering a range of pump flow speeds from 10 to 30 ft./sec. These designs require a d-c supply of 7,000 to 13,000 amps at 1.1 to 0.6 volts. Hydrodynamic friction losses with zero magnetic field are tabulated. The extent to which "armature reaction" influences output and ohmic loss in an ideal pump with no compensating return current paths is also detailed. A note on the use of permanent magnet materials is appended. (auth)

12511

IMPROVEMENTS IN OR RELATING TO ELECTROMAGNETIC INTERACTION PUMPS. William George Hutchinson and Leslie Charles Cole (to United Kingdom Atomic Energy Authority). British Patent 813,005. May 6, 1959.

Since the pump channel of an electromagnetic pump must be thin to reduce reluctance, some means of strengthening it must be used. A pump design is described which incorporates an adjustable spring arrangement for tensile loading of the pump channel to counteract compressive stresses due to thermal or gravitational effects. (T.R.H.)

7493

DEVELOPMENT OF CENTRIFUGAL PUMPS FOR OPERATION WITH LIQUID METALS AND MOLTEN SALTS AT 1100–1500°F. A. G. Grindell, W. F. Boudreau, and H. W. Savage (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 7, 83-91(1960) Jan.

Sump-type centrifugal pumps ranging in capacity from 2 to 1500 gpm were developed for circulating liquid metals and molten salts at temperatures up to 1500°F in metallurgical, heat transfer, and reactor experiments. Each of these pumps uses a nearly conventional bearing assembly to support a vertical shaft and an impeller suspended in a tank containing the high-temperature liquid and an inert blanketing gas. Drive motors and lubrication equipment are external to the pump proper. Seven different models of the sump-type pumps were manufactured and about 400,000 hr of operation were accumulated in the temperature range 1100 to 1500°F. Problems resolved in the development of these pumps are discussed. Limitations on the use of this type of pump for reactor and nonreactor applications are noted. (auth)

7982

CONSIDERATIONS FOR SELECTION OF LIQUID METAL PUMPS. F. G. Hammitt (Univ. of Michigan, Ann Arbor). Chem. Eng. Progr. 53, 249-53(1957) May.

The design and development of large-scale, liquid-metal circulating pumps such as would be suited to application in nuclear power plants have been investigated. Fluid dynamic problems–cavitation and erosion damage to the structural components at the high relative velocities obtained in the pump impeller–were the particular concern. (auth)

14497

ELECTROMAGNETIC PUMPS. L. R. Blake and British Thomson-Houston Co., Ltd. British Patent 802,043. Nuclear Eng. 4, 238(1959) May.

A number of conductors are arranged transversely to the duct carrying an electrically conductive liquid such as a liquid metal, in slots of the pole faces, and are interconnected individually or in groups as a magnetizing winding. This winding is energized by at least part of a current which is passed through the liquid. The conductors are so distributed in the slots that they produce the required gradient in the magnetic field.

8594

IMPROVEMENTS IN OR RELATING TO ELECTROMAGNETIC INTERACTION PUMPS. William George Hutchinson and Leslie Charlie Cole (to United Kingdom Atomic Energy Authority). British Patent 819,547. Sept. 2, 1959.

An electromagnetic pump designed for remote maintenance is described. The pump assembly is located in a

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gas-tight compartment behind a shielding wall. The stators are accessible by removal of a shield plug. (T.R.H.)

THE ELECTROMAGNETIC PUMPING OF LIQUID METALS. 2. J. A. S. Hilditch (British Thomson-Houston Co., Ltd., Rugby, Eng.). Atomics and Nuclear Energy 9, 125-7(1958) Apr.

In the second part of a series on electromagnetic pumping of liquid metals, the design and characteristics of the a-c conduction pump and the induction pump are discussed. Possible future developments in the pumping of liquid metals are described. (J.S.R.)

9134 AEC-tr-3200

ELECTROMAGNETIC PUMPS WITHOUT MOVING PARTS FOR THE CONDUCTION OF LIQUID METALS. (Über Elektromagnetische Pumpen ohne bewegie Teile zur Förderung Flussiger Metalle). Julius Steiner and Hans Hohn. Translated from Chem.-Ing.-Tech. 28, 405-10(1956). 26p.

Structure and method of operation of electromagnetic direct current pumps are briefly described, and the theoretical relationships and problems of economy are discussed. Results are given for several direct-current pumps with permanent magnets and pump bodies of synthetics for the conduction of mercury. (auth)

13908 CF-54-8-234

Oak Ridge School of Reactor Technology, Tenn.

SUMMARY OF HIGH TEMPERATURE LIQUID METAL, FUSED SALT PUMP DEVELOPMENT WORK IN THE ORNL-ANP PROJECT FOR THE PERIOD JULY 1950–JANUARY 1954. Edsel S. Farris, comp. Aug. 1954. Decl. Nov. 15, 1957. 98p. $15.30(ph OTS); $5.40(mf OTS).

All of the information available on high-temperature pumps originally reported in the ANP quarterly reports is summarized. The development program was more of a seal development than a specific pump program. Frozen seals of various kinds were tried and for many commercial applications would be perfectly satisfactory. For application in a system such as the ARE, operation of the frozen seal pump is questionable. A gas-sealed pump was developed and is expected to be entirely adequate for a system like the ARE. (W.L.H.)

2699 AERE-Inf/Bib-93(3rd Ed.)

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

ELECTROMAGNETIC PUMPS AND FLOWMETERS. A Bibliography. M. Greenhill. 1955. 5p.

Available unclassified reports from the Geneva Conference, the A.E.R.E., and the A.E.C. are listed in this bibliography. (D.E.B.)

6643

ELECTROMAGNETIC PUMPS FOR LIQUID METALS. Metallurgia 53, 277-8(1956) June.

Several types of electromagnetic pumps are described for use with liquid metals of high and low density, viscosity, and resistivity. (J.E.D.)

3061

ELECTROMAGNETIC CENTRIFUGAL PUMP. K. O. Donelian and J. R. Menke (to U. S. Atomic Energy Commission). U. S. Patent 2,730,951. January 17, 1956.

An apparatus is described for pumping electrically conductive fluids such as alloys of Na and K by whirling the fluid within a pump chamber. The fluid is introduced into the center of a flat disk shaped chamber, where the interaction of a rotating magnetic field with the currents induced in the conducting liquid by the rotating field causes the fluid to follow a circular path at high velocity and then to be thrown outward by the resulting centrifugal force into an annular peripheral chamber from which the liquid exits through an outlet passage at the periphery. (auth)

5305

ELECTROMAGNETIC PUMPS FOR LIQUID METALS. D. A. Watt (Atomic Energy Research Establishment, Harwell, Berks). Engr. 181, No. 4703, 264-8(1956) April.

The elementary considerations affecting the design and application of compensated d-c and travelling field a-c

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pumps for liquid metals are given. A brief survey of electromagnetic pumping equipment developed by U. K. A. E. A. is included. (T.R.H.)

5849 LMFS/P-11
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE EFFECTS OF A CAVITATION LIMIT ON THE DESIGN OF PUMPS FOR LIQUID BISMUTH. S. B. Hosegood. Jan. 11, 1957. 22p.

The restrictions imposed on the design of various types of pump by the assumption of a cavitation parameter limit were examined. It is shown that such a limit severely restricts the pressure ratio obtainable from a single axial stage. The pressure ratio obtainable from a centrifugal pump is theoretically not restricted by a cavitation parameter less than three, but a practical limit is imposed by the size of impeller required to produce large pressure ratios. The cavitation limit does not restrict the pressure ratio of an electromagnetic pump, but it limits the liquid velocity which can be employed in the working duct with a given suction pressure. (auth)

4422 HW-46762
Hanford Atomic Products Operation, Richland, Wash.
EVALUATION OF PEERLESS MAGNETIC DRIVE PROCESS PUMP. J. Dunn. Nov. 19, 1956. 9p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

10069
MECHANICAL PUMPS AND CIRCULATORS. F. L. Speed (Atomic Energy Research Establishment, Harwell). Nuclear Power 2, 277-84(1957) July.

Various types of mechanical pumps used for handling nuclear reactor coolants and liquid fuels are reviewed. A brief reference to gas circulators is included because of their importance in this UK power program. (auth)

10066
CANNED MOTOR-PUMPS. Leo Walter. Atomics 8, 268-70 (1957) July.

The production of canned-motor liquid metal pumps by Westinghouse is described. (T.R.H.)

13104
ELECTROMAGNETIC PUMPS FOR LIQUID METALS. Helmut H. Agena (Deutsche Babcock & Wilcox Dampfkesselwerke, Oberhausen). Atomkern-Energie 3, 249-55(1958) July. (In German)

A survey is given on electromagnetic pumps, which are little known in Germany and which may be of some interest there for nuclear power purposes. Several types are described. The difference between conduction and induction pumps is shown by means of some simple considerations. The range of power of these pumps is reported, and a brief discussion of problems of materials is given. (tr-auth)

5050
MAGNETIC CONTROL DEVICE FOR PUMPS. T. H. Edwards (to U. S. Atomic Energy Commission). U. S. Patent 2,734,678, February 14, 1956.

A magnetic control device is used for controlling a mercury pump of the positive displacement type. The control device is responsive to the level of the mercury within the discharge check valve and energizes a circuit thereby ending the discharge cycle and initiating the intake phase of the pump cycle. This is accomplished by a rotatable magnet which is placed adjacent the discharge valve and is caused to rotate when a magnetic float within the valve raises so as to place a magnet within the float adjacent the aforesaid rotatable magnet. When this occurs the rotatable magnet is pivoted to a new position where it attracts a third magnet which is attached to a movable contact which in turn controls the phase of the pump cycle. (auth)

11171 AERE-ED/R-1856
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
A.C. LIQUID METAL PUMPS FOR LABORATORY USE. D. A. Watt. Mar. 19, 1953. Revised Jan. 24, 1956. 33p.

Two types of single phase a-c electromagnetic pump for liquid metals are described, a leakage reactance model and a combined pump and transformer. The NaK alloy test rig is briefly described and methods of pump construction detailed. Test results and curves for pumping NaK alloy at temperatures below 70°C are included, and it is shown that the combined form is the more effective pump. One of these

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models with a single loop secondary winding had a maximum efficiency of 11% with output 10 gals/min. at 13 lb/in.^{2} pressure rise, input 650 watts, 9.0/7.5 amps at 180/195 volts. A maximum pressure rise of nearly 30 lb/in.^{2} is recorded for the first model of this form. (auth)

FOR GASES 5.16.03.05

14422
PUMP FOR GASEOUS WORKING FLUIDS. R. Lipscomb (to U. S. Atomic Energy Commission). U. S. Patent 2,456,133. Dec. 14, 1948.

A gas pump having a substantially constant rate of flow and a relatively efficient pumping action is described. A number of flexible plates disposed longitudinally in and in contact with a duct are caused to oscillate transversly so as to produce wave-like deformations of the plates. These deformations are mechanically produced by pushrods and an eccentric gearing arrangement, and are so synchronized that the waves travel from the inlet to the outlet of the duct, and, in so doing, move the gas by positive displacement.

5304 AEC-Tr-2864
HIGH PRESSURE PUMPS AND MACHINES. C. H. Futterer. Translated by R. C. Murray from Chem. Ing. Tech. 28, 337-42(1956). 8p.

A description is given of present day high-pressure compressors for gases, gas circulating pumps to operate at high pressure, high-pressure machines for pressurizing liquids, expansion machines, and coal slurry hydraulic delivery presses. (auth)

16981 AERE-E/M-63
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
A DESIGN OF AIR EJECTOR FOR USE IN RADIOACTIVE LABORATORIES. J. R. Catlin and L. D. G. Coward. Nov. 1952. Decl. Mar. 1958. 9p. $0.32(BIS).

A design is evolved for the economic manufacture of a vacuum ejector to produce 25.3 in. of Hg vacuum, for use in lieu of water/air ejectors where the production of effluent such as in radiochemical laboratories may be a disadvantage. (auth)

GENERAL (AND MISC.) 5.16.03.06

10070
PUMP BUYERS' GUIDE. Nuclear Power 2, 285-9(1957) July.

A survey in tabular form of the products of the British pump industry is presented. (J.E.D.)

22145 CF-59-9-49
Oak Ridge National Lab., Tenn.
PRFR PILOT PLANT: AN EVALUATION OF EQUIPMENT PERFORMANCE DURING THE PROCESSING OF IRRADIATED NATURAL URANIUM IN APRIL 1959. J. L. Matherne. Sept. 15, 1959. 22p. $4.80 (ph), $2.70(mf) OTS.

The Power Reactor Fuel Reprocessing complex and the equipment performance during the processing of irradiated natural uranium fuel are described. Equipment performance was generally satisfactory for rates up to 400 kg of uranium per day. Low (at times $<10^3$) fission product decontamination factors obtained in the co-decontamination cycle resulted in increased radiation levels in normal operating areas; corrective measures planned are presented. Three cases in which equipment malfunctioning significantly affected the process, and the scheduled modifications, are discussed; these cases were the overconcentration of uranium in an evaporator, the rupture of a diaphragm in an intercycle process transfer pump, and erratic solvent flow control to the co-decontamination cycle. (auth)

8529
IMPROVEMENTS IN OR RELATING TO ELECTRIC PUMPS. David Melvyn Harris and Edward Holland (to United Kingdom Atomic Energy Authority). British Patent 827,784. Feb. 10, 1960.

A glandless electric pump for electrically insulating liquids is described. The liquid is allowed to come in contact with stator windings. (T.R.H.)

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9803 HW-43929
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
JOHNSTON SPLINED SHAFT DEEPWELL TURBINE PUMP. Interim Report. J. Dunn. June 25, 1956. 12p. Contract W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Operational testing, using water and 60% nitric acid, of a prototype deep-well turbine pump of splined-shaft construction designed for use in the HAPO separation plants is described. The pump has more rugged rotating components, wear-resistant journals, and positive attachment of the impellers than those developed earlier. (J.R.D.)

10555 CF-58-5-80
Oak Ridge National Lab., Tenn.
PUMP-MOTOR MIXING AND HEAT BALANCE TESTS OF THE BYRON-JACKSON 4000-GPM PUMP. H. R. Payne. May 16, 1958. 9p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The pump-to-motor mixing rate of the Byron-Jackson 4000-gpm pump was determined as a function of motor purge flow. A purge rate of 63 liters/hr, which corresponds to a mixing rate of 0.55 liters/hr, is recommended for operation of this pump. Further increases in purge flow did not decrease the mixing rate significantly below this level. Two runs were made with cooling water bypassing the external motor cooler. These runs indicated that the external cooler was necessary to prevent overheating of the 4000 gpm pump motor. However, the observed heat balance checked the predicted heat balance, indicating that the method of prediction can be applied to the design of motor cooling in other large pumps. (auth)

10824 HW-29364
Hanford Atomic Products Operation, Richland, Wash.
SLURRY PUMP FOR WASTE METAL REMOVAL FROM UNDERGROUND STORAGE IN THE 200 AREAS. Final Report. Gardner L. Locke. Sept. 16, 1953. Decl. Feb. 2, 1956. 10p. Contract [W-31-109-eng-52]. $1.80(ph OTS); $1.80(mf OTS).

Present status of construction, cost information, recommendations as to the disposition of the pump, a résumé of the history of the project, and some design notes on the slurry pump are included. (T.R.H.)

5049
DIAPHRAGM PUMP. V. L. Parsegian (to U. S. Atomic Energy Commission). U. S. Patent 2,732,807, January 31, 1956.

Information is presented on a pump designed to handle highly radioactive liquids. The pump is operated by compressed air pressure and contains two independent pumping sections. One way valves prevent reverse operation and controllable air pressures move the diaphragm so as to force the liquid through the valves and diaphragm chambers in metered amounts that remain constant over a long period of use. (auth)

5048
DIAPHRAGM PUMP. E. T. Booth (to U. S. Atomic Energy Commission). U. S. Patent 2,732,127, January 24, 1956.

An all-metal pump has been designed to handle radioactive corrosive gases. A novel feature is the use of a metallic diaphragm actuated by air pressure alternating with vacuum. Reed-type valves prevent reverse flow eliminating the need for ordinary lubricants. This results in a compact corrosion-resistant rugged leak-tight pump designed for high-speed use over a long period of time. (auth)

7505
VOLUME COMPENSATING MEANS FOR PULSATING PUMPS. D. L. W. Weaver and R. S. MacCormack, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,915,016. Dec. 1, 1959.

A double diaphragm, two-liquid pulsating pump for remote control use, having as an improvement an apparatus for maintaining constant the volume of the liquid such as kerosene between the two diaphragms is described. Phase difficulties encountered in the operation of such pumps when the volume of the liquid is altered by changes in temperature are avoided.

TRANSFER OF FLUIDS 5.16

PUMPS 5.16.03

GENERAL (AND MISC.) 5.16.03.06

8356

DEVELOPMENT OF GLANDLESS PUMPS. J. R. Allard (Hayward-Tyler and Co., Ltd.). Nuclear Eng. 1, 28-30(1956) Apr.

Glandless pumps while eliminating leakage of the circulating fluid introduce special problems of insulation and bearing design. Two types of pump currently manufactured by Hayward-Tyler and Westinghouse respectively are taken as examples of the methods used to overcome these difficulties. (auth)

7390

PUMP-MOTOR COMBINATIONS. J. C. Mansfield (to Hayward Tyler and Co., Ltd.). British Patent 768,833. Nuclear Eng. 2, 224(1957) May.

The liquid being pumped has free access throughout the casing enclosing the submersible motor and the pump. Between the pump and the motor within the casing there is a flameproof gap. (auth)

7389

PUMPS. H. F. Parker (to U. K. Atomic Energy Authority). British Patent 767,339. Nuclear Eng. 2, 224(1957) May.

A pump designed for pumping toxic fluids from one tank to another is described. The pump can be adapted as a borehole pump or for immersion into a tank. A detailed description is given and a diagram is included. (M.H.R.)

2292 NP-tr-174

THE EFFECT OF RADIAL CLEARANCE ON THE WORKING OF AN AXIAL COMPRESSOR. S. P. Livshits. Translated from Energomashinostroenie No. 1, 14-18(1956). 9p.

This article describes the results of a study of the effect of radial clearances on the pattern of flow in an axial compressor stage. The qualitative changes in the velocity and pressure distributions are revealed. The characteristics and range of stable operation in a stage affected by radial clearances are demonstrated. (auth)

8517 ORNL-2814

Oak Ridge National Lab., Tenn.

MAXIMUM VOLUME-TO-STRESS RATIO FOR A TWO-RADII-CONTOUR DIAPHRAGM PUMP. R. D. Cheverton. Feb. 15, 1960. 16p. Contract W-7405-eng-26. OTS.

Analytical methods were employed to determine the maximum volume-to-stress ratio for a two-radii-contour diaphragm pump. A proposed failure criterion considers the effect of biaxial stresses on fatigue failure through the use of the Mises-Hencky criterion for fatigue failure. By use of the proposed criterion, it was determined that an optimum ratio of the two radii does exist, its value being dependent on the ratio of diaphragm thickness to diaphragm deflection. Values for the optimum ratio of the two radii (where the ratio of radii is defined as the radius of the central portion of the diaphragm contour divided by the radius of the outer portion of the diaphragm) range from 1.94 to 7.33 as the ratio of diaphragm thickness to diaphragm deflection varies from 0.5 to 0.05, respectively. (auth)

6346 CEA-560

France. Commissariat a l'Energie Atomique, Paris.

POMPES MOLECULAIRES AUX TRES BASSES PRESSIONS. GENERALISATION. (Molecular Pumps at Very Low Pressures. Generalization.). C. Mercier and P. Benoist. May 7, 1956. 23p.

In an earlier study it was shown by one of the authors that the theory could account for the experimental results on molecular pumps starting from simple assumptions like the absence of collisions between molecules and diffuse reflection by the walls. In the present paper the formulas are extended to the case when the surface velocity of the rotor is no longer negligible compared with the velocity of the molecules; moreover the mathematical treatment is analyzed in more details. (auth)

1950 CF-58-10-40

Oak Ridge National Lab., Tenn.

DOWTHERM "A" JOURNAL BEARING TEST. W. E. Thomas. Nov. 6, 1958. 18p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The bearing housing of an overhung vertical shaft centrifugal pump, consisting of a plain journal bearing, one double row ball bearing, and two mechanical shaft face seals to contain the lubricant (Dowtherm "A"), was operated for a total of 3206 hr at 2600 rpm, pumping molten salt #30 at a temperature of 1200°F. (auth)

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-GENERAL (AND MISC.) 5.16.03.06

2887 CF-57-11-122
Oak Ridge National Lab., Tenn.
SINTERED ALUMINA AS A PUMP BEARING AND JOURNAL MATERIAL. H. C. Savage. Nov. 26, 1957. 25p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70(mf OTS).

Design criteria and operating experience with the aluminum oxide bearing and journal combination as installed in canned rotor pumps in in-pile loops are described. No pump failures occurred in 8 pumps with Al_2O_3 bearings over a cumulative period of 10,000 hours due to wear or corrosion. Five failures due to slippage and/or electrical breakdown of the stator insulation are reported. (T.R.H.)

ENGINEERING

9541
PUMP. A. A. Abatiello (to U. S. Atomic Energy Commission). U. S. Patent 2,791,372. May 7, 1957.

A pump is described which has an improved sealing means to better protect the working parts from the corrosive material being pumped, and to prevent contamination of the pumped material. This is accomplished by equalizing the pressure on each side of the seal. A piston and cylinder which pumps the corrosive material is enclosed by a bellows. A second piston, connected by a scotch yoke to the first piston, controls the air pressure on the outside of the bellows so that equal pressure exists across the seal at all times. The second piston also causes the moving parts to be lubricated. The arrangement virtually eliminates leakage to or from the working pump. (auth)

PUMP CYLINDER ASSEMBLY. J. Entwistle (to U. S. Atomic Energy Commission). U. S. Patent 2,782,081. February 19, 1957.

A pump cylinder assembly is described for use where considerable differential pressures exist on opposite sides of the sealing means. The assembly comprises a cylinder head, liner, and clamping means and is simpler in construction than the cylinder assembly using gaskets. A cylinder liner is clamped securely to a cylinder head. Mating ledges on a clamping ring and the liner act to tightly clamp the liner and cylinder head together. (auth)

12368 CF-57-10-48(Suppl.)
Oak Ridge National Lab., Tenn.
INVESTIGATION OF EFFECT OF SEAL CONFIGURATION ON MIXING FLOW AND RADIATION DAMAGE IN HRT-TYPE CIRCULATING PUMPS. Supplement No. 1.
J. C. Moyers. Jan. 13, 1958. 4p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The effect of seal configuration on the rate of mixing flow between the impeller cavity and the motor cavity of a Westinghouse Model 400 A pump was extended to include a configuration wherein the lower radial bearing acts as a secondary seal. This arrangement increases the life of the motor windings; however, the life of the lower radial and thrust bearings is shortened because of inadequate cooling. (J.E.D.)

21081 IGIS-72(RD/CA)
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.
BIBLIOGRAPHY ON PUMPS FOR CORROSIVE LIQUORS. E. McCoy, comp. June 10, 1959. 17p. $0.25(BIS).

References to papers, unclassified reports, and patents from Engineering Index, 1950 to 1957, Chemical Abstracts, 1937 to 1956, and Nuclear Science Abstracts, 1948 to 1958, on pumps for corrosive liquors are presented. (J.E.D.)

21090
DESIGN AND MATERIALS FOR REDUCED PUMP CORROSION. Jack E. Piccardo (Dorr-Oliver, Inc.). Corrosion 15, 473t-6t(1959) Sept.

Of the pumps used in the chemical and allied industries, about 90% are of the centrifugal and diaphragm types. These pumps are required to handle corrosive liquids under conditions of high pressure and high temperature, expensive or hazardous liquids where leakage to atmosphere cannot be tolerated, liquids with solids in suspension, often of an abrasive nature, creating both corrosion and abrasion problems, and extremely corrosive liquids which may be radioactive. Diaphragm type pumps have certain advantages over centrifugal pumps for severe chemical applications because there is no shaft sealing problem solids in suspension can be handled at relatively low velocities and a high degree of

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corrosion resistance can be obtained by the use of high alloy steels for the pump body and synthetic materials for diaphragms. Packingless pumps include the so-called canned-motor centrifugal pump in which the pump impeller is mounted on the same shaft as the rotor. Both the rotor and the stator are sealed from the fluid by corrosion resistant cans or shields and the rotor moves in the liquid being pumped. The rotor-impeller shaft is supported on sleeve type bearings submerged in the liquid pumped. Canned-motor pumps usually cannot be applied where the liquid contains solids because of close clearances and possibility of damage to bearings by abrasion. Designs giving longer service life in the conventional centrifugal pump usually include the following: improved sealing devices where the pump shaft passes through the casing, new alloys or metals for the wetted end to provide a better corrosion resistance, and improved elastomers, plastics, and ceramics which permit lining entire pumps for a high degree of corrosion resistance. Improved shaft seals are discussed along with a study of new materials available for pump parts, and linings for pumps commonly used in chemical pumping service. (auth)

PULSE FEEDERS 5.16.03.07

See also, under PROCESS CHEMISTRY AND ENGINEERING, SOLVENT EXTRACTION--Equipment (6.16.02).

1357 ORNL-2377
Oak Ridge National Lab., Tenn.
PULSE PUMPING: A MEANS FOR TRANSFER OF PULSE COLUMN FLUIDS. A. R. Irvine. Nov. 1, 1957. 28p. Contract W-7405-eng-26. $1.00(OTS).

A pulse pump, which uses the energy of the pulser to pump fluids to or from a pulsed solvent extraction column, was steady in operation, and results were reproducible. Performance was satisfactory with 2- and 12-in.-diam concatenated columns and with a 5-in.-diam straight column. (auth)

1259 HW-51884
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUG-PISTON PULSE GENERATOR. V. P. Kelly. Aug. 12, 1957. 11p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

A graphite plug-piston assembly with a stainless steel cylinder and a piston rod sealed by a lower throttle bushing and upper Teflon chevron packing was operated 25 million cycles pulsing liquid in 3- and 4-inch-diameter process columns. During operation to an annulus between the rod seals, no measurable piston leakage was observed. Without the air purge, or with the air purge between the piston and throttle bushing, piston leakage rates up to one gal/hr occurred. The CSGBF graphite piston wore four mils (diametrally) during the first half of the test, with no change thereafter. The wear rate of Polypenco K-51 throttle bushing was one-third that of pile graphite. A hardened 17-4 PH stainless steel piston rod and cylinder showed no wear. (auth)

10556 CF-58-5-81
Oak Ridge National Lab., Tenn.
ELECTRICAL SIMULATION OF DIAPHRAGM FEED PUMP SYSTEM. P. F. Pasqua. May 22, 1958. 9p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The electrical analog study of the diaphragm feed pump system resulted in changes to the system which have improved the over-all operation and reliability of the pumps. Specifically, the study showed that if the release of the high-pressure oil from the pulsator through the valve on the Scott and Williams pump could be made to take place over a longer period of time, pressure oscillations could be substantially reduced. Also, pressure surges could be reduced by placing an accumulator in the pump discharge line near the check valve. Both of these ideas have been incorporated into the experimental test equipment which has resulted in a quieter and smoother operation of the pumping system. (auth)

9710 CF-56-8-149
Oak Ridge National Lab., Tenn.
EXAMINATION OF TWO 347 SS DIAPHRAGMS FROM PULSE-FEEDER PUMPS. Bertram Fleischer. Aug. 23, 1956. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

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PULSE FEEDERS 5.16.03.07

Two 347 SS pump diaphragms (20 mils thick) from pulse-feeder pumps were submitted to metallography for examination. One of the diaphragms had failed after 2800 hrs in the HRT mock-up. This diaphragm was exposed to 0.04 molal UO_2SO_4 on one side and water on the other. The temperature was approximately 150°F. The other diaphragm was exposed (700 hrs.) to water on both sides in a pulse-feeder test loop. No failure had occurred. (auth).

15549

PUMPS. J. D. Thornton (to U. S. Atomic Energy Commission). U. S. Patent 2,879,144. Mar. 24, 1959.

A pump is described for conveying liquids, particularly chemical process liquids, where it is not advisable to use moving mechanical parts in the apparatus. The pump comprises an injector adapted to be submerged in the liquid to be pumped, a conduit extending from the high-velocity nozzle of the injector, and means for applying a pulsating pressure to the surface of the liquid in the conduit, whereby the surface oscillates between positions in the conduit. During the positive half-cycle of an applied pulse liquid is forced through the high velocity nozzle or jet of the injector and operates in the manner of the well known water injector and pumps liquid from the main intake to the outlet of the injector. During the negative half-cycle of the pulse liquid flows in reverse through the jet but no reverse pumping action takes place.

SEALS 5.16.04

6380* WADC-TR-56-272(Pt.IV)

Boeing Aircraft Co., Seattle.

DESIGN DATA FOR O-RINGS AND SIMILAR ELASTIC SEALS. [Period covered] May 1, 1958 to June 30, 1959. George E. Trepus, Robert S. Roper, and William R. Hickman. July 30, 1959. 152p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: ELASTOMERIC AND COMPLIANT MATERIALS. Contract AF33 (616)-5722.

Design criteria for O-rings, back-up rings, and other elastomeric seals were determined. A survey of current literature concerning seals and seal materials was conducted with an emphasis placed on seals and seal materials for use in environmental extremes. Tensile properties of a number of silicone and Viton compounds are given. The effects of environment and groove configurations on the sealing force of an O-ring were determined. Thermal expansion and compression modulus tests were performed on elastomeric materials at cryogenic temperatures. The functional tests included pneumatic seal tests at 400°F, hydraulic rod seal tests at 400°F using O-rings and back-up rings made from a variety of materials and in several configurations, static annulus tests at elevated temperatures using various groove configurations, and static seal tests using helium at cryogenic temperatures. Certain physical properties were found to be of value to the life of a seal under specific environmental and/or mechanical conditions. (auth)

6381 WADC-TR-59-428

Boeing Airplane Co., Seattle.

DESIGN HANDBOOK FOR O-RINGS AND SIMILAR ELASTIC SEALS. Period covered: July 1955 to June 1959. Frank W. Tipton. Sept. 8, 1959. 71p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: ELASTOMERIC AND COMPLIANT MATERIALS. Contract AF33(616)-5722.

The mechanism of O-ring sealing, the relation of physical properties to sealing, the effect of cavity configuration, back-up rings and adverse mechanical conditions on seal life and the design of seals for specific systems are considered. Test procedures and a bibliography of published articles pertinent to O-ring seals are included. (auth)

5294 CF-57-3-44

Oak Ridge National Lab., Tenn.

SEMIPERMANENT FREEZE PLUG TESTS FOR HRT-CP. R. H. Winget. Mar. 11, 1957. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Five uninsulated semipermanent freeze coils, series connected, can be frozen when submerged in 70°F water with a Freon-11 flow rate of 1.85 gpm at an inlet temperature of −40°F. The refrigeration unit of the HRT-CP is capable of delivering >3 gpm to a similar semipermanent freeze coil system located in Cell C. Therefore the number of F-11 risers required in Cell C of the HRT-CP can be minimized by series connecting this many semipermanent freeze coils where required. (auth)

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ENGINEERING

12442 K-866
Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.
SHAFT SEAL DEVELOPMENT. PART TWO. "A" SERIES PACKED SEAL MANUAL. L. M. Delionback and W. T. Carey. Feb. 25, 1952. Decl. Feb. 23, 1957. 56p. Contract W-7405-eng-26. $10.80(ph OTS); $3.90(mf OTs).

A manual is given describing the fabrication, installation, and maintenance of packed seals in 7HXB Special Sutorbilt Gas Blowers to be used in the C-410 Feed Plant at Paducah. A summary is also included of the work leading to the development of the seal and suggestions for altering the packing, fabrication, and seal design to better adapt them to the actual process operating conditions. (L.T.W.)

11789 KAPL-M-EDL-121
Knolls Atomic Power Lab., Schenectady, N. Y.
TESTS OF STATIC SEAL ADHESIVES FOR S1G/S2G ROTATING PLUGS. O. D. Terrell and M. L. Ballou. Aug. 22, 1956. 23p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

The properties of a number of commercial adhesives were investigated for the purpose of finding a suitable adhesive for the static seals of the rotating plugs. Samples of adhesives from approximately 30 manufacturers were tested for bond strength. The best results were obtained with Resiweld, a two-part epoxy resin which cures with equal strengths at temperatures between 70°F and 220°F. The maximum force required to separate the bonds obtained was 500 psi in tension.

16325
A METAL THROUGH GLASS SEAL. E. J. Davis (Imperial Coll. of Science and Tech., London). J. Sci. Instr. 35, 308(1958) Aug.

A reliable seal with small current-carrying capacity is discussed. The seal is based on the Houskeeper technique which relies on the elasticity of both glass and metal used, to compensate for their widely different coefficients of expansion. (A.C.)

192 AERE-R/R-2271
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
INSULATED LEAD-THROUGH SEALS FOR USE AT HIGH TEMPERATURES. F. Wade. May 1957. 7p.

The seals were made from a variety of materials, i.e., quartz, ceramics, and artificial sapphire. All of these materials were brazed to suitable metals with a Ti cored Cu–Ag eutectic alloy. Quartz-metal seals of the type described should not be operated at temperatures above 150°C on account of the sharp increase in the coefficient of expansion of 36% Ni/Fe at this point. (auth)

2403 AECD-3812
Vitro Corp. of America, New York.
SUMMARY REPORT OF THE GASKET DEVELOPMENT PROGRAM. JOB 15. E. W. Ruhl. Aug. 29, 1951. Decl. with deletions Dec. 6, 1955. 66p. Project C-187-D. Contract W-31-109-eng-52, Subcontract G-148. $10.80(ph OTS); $3.90(mf OTS).

The general development program was undertaken to establish designs and find materials for gaskets which would withstand the severe specialized service conditions imposed by radioactive material processing facilities. Specifically, the objective of this phase of the program was to continue development of gaskets which would be dimensionally stable, reusable, resistant to intense radioactive radiation and would provide a positive seal for a long period under such conditions. The data presented here are intended for use in connection with operation of the Redox Plant and to serve as a basis for future development work. (auth)

RATES OF FLOW THROUGH MICROPOROUS SOLIDS. E. R. Gilliand, R. F. Baddour, and J. L. Russell (Massachusetts Inst. of Tech., Cambridge). A.I.Ch.E. Journal 4, 90-6(1958) Mar.

Rates of flow of pure gases, both those with no adsorption and those with appreciable adsorption, were studied as a function of pressure level, pressure drop, and temperature for flow through 1/2-in.–diameter cylindrical plugs of activated carbon and of unsintered Vycor glass. Adsorption isotherms for the pure gases on Vycor glass were measured over the range of variables covered in the flow studies. Permeabilities, which are proportional to the rate

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of flow per unit of pressure drop, were satisfactorily correlated for hydrogen, helium, argon, and nitrogen by employing existing gas-phase flow theory. Permeabilities considerably larger than the values predicted from the nonadsorbed gas correlation, sometimes more than seventeen times as large, were observed for ethylene, propylene, and isobutane flowing through a Vycor plug. For the hydrocarbon-Vycor systems, permeabilities for vapor flow are as much as sixty times larger than for bulk liquid flow. The unusual flow phenomena for the hydrocarbon-Vycor systems are attributed to a rapid transport in the adsorbed layer. The total transport is treated as being the sum of gas-phase and adsorbed-layer flow. An equation describing adsorbed-layer movement is derived by utilizing a force balance together with thermodynamic principles. The resulting equation has just one empirical constant, and its use requires adsorption-isotherm data. It correlates very well the surface flow rates for the major range of the variables covered in this investigation. Rate measurements were made for adsorbed-layer concentrations ranging from about one tenth of a monolayer up through the capillary condensation region. Deviations in the one constant form of the equation are observed below one tenth of a monolayer. The available literature data on flow in adsorbed layers are reasonably well correlated by the same equation. (auth)

4583 WADC-TR-58-89(Pt.II)
Products Research Co., [Los Angeles].
DEVELOPMENT OF HIGH TEMPERATURE SEALANTS.
[Period covered] February 1, 1958 to February 1, 1959.
Irvin P. Seegman, William Cheorvas, Francis H. Ingham, Sarkis H. Kalfayan, Paul A. Mallard, Ron E. Thompson, and R. Loren Varner. June 1959. 192p. Projects 7340 and 3048. Contract AF33(616)-3976, Supplemental Agreement S3(58-2009).

Viton A based fill and drain, faying surface, and filleting sealants were developed which had satisfactory resistance to JP-5 fuel either at 450°F for 168 hrs or at 600°F for 10 hrs, and to oven aging either at 450°F for 168 hrs, or at 650°F for one hr. A Viton A based sealant was developed which had considerable resistance to cycling tests involving exposure to HEF-3 at 260°F and JP-6 Fuel vapor at 450°F. Sealants based on Viton A and on room temperature vulcanizing silicones appeared to be serviceable after gamma irradiation. An injectible groove sealant based on a combination of reverted silastic LS-53U and Fluororubber 1F4 was crosslinked to a rubbery material at 8.71×10^7 ERGS/G.DC. Various materials were studied as Anti-Rads in the various sealant formulations which were developed, but none of these was of any value in improving resistance to gamma radiation. (auth)

6344 HW-48480
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
GOLD GASKETS FOR PROCESS PIPING. R. W. Wirta. Feb. 14, 1957. 5p. Contract [W-31-109-eng-52]. $1.80 (ph OTS); $1.80(mf OTS).

Gold exhibits excellent physical gasketing properties in that a moderate bolting pressure of 25 ft.-lbs torque on a 1-in. pipe flange can cause a properly designed gasket to flow into relatively large flange face defects to effect a good seal in lines carrying liquids at 90 psig or less. However, galvanic action takes place when Au is in contact with stainless steel in the presence of hot HNO_3, with a resultant accelerated corrosive attack on the adjoining stainless steel. It is concluded that Au gaskets are not suitable for use in stainless steel process piping handling hot oxidizing solutions such as HNO_3. (auth)

10031 NAA-SR-Memo-1565
North American Aviation, Inc., Downey, Calif.
SUMMARY REPORT "PROJECT FREEZE SEAL."
Roman Cygan. Jan. 25, 1956. 19p. $3.30(ph), $2.40 (mf) OTS.

Five freeze seal designs for the main SRE pumps were built and tested. The design of the seals is presented along with the results of the testing. (W.L.H.)

IMPROVEMENTS IN AND RELATING TO SEALS.
Bernard William Bradford and Wilfred Jesse Skinner (to United Kingdom Atomic Energy Authority). British Patent 809,281. Feb. 18, 1959.

The preparation of graphite seals for rubbing use in UF_6 vapors is described. The graphitic carbon is treated with UF_6 vapor and mixed with polytetrafluorethylene. The mixture is pressed in molds at 2.5T and heat treated to 400°C for 3 to 4 hours. (T.R.H.)

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12676 NP-7389
Mine Safety Appliances Co., Callery, Penna.
REPORT 1 ON FREEZE SEAL PERFORMANCE.
Memorandum Report 55. T. A. Ciarlariello and R. A. Tidball. May 4, 1954. 6p. Contract NObs-65426.

An apparatus was designed and operated to determine the parameters affecting natural circulation heat transfer rates in horizontal and inclined pipes. The experiments on 1 in. piping are reported. The results of the tests are shown as temperature variation along the test section. The ambient temperature in the duct and the melting point of sodium are also indicated. (J.E.D.)

508
Boeing Airplane Co., Seattle.
DESIGN DATA FOR O-RINGS AND SIMILAR ELASTIC SEALS. (Period covered) July 1955 to April 1956. Frank W. Tipton. Nov. 1956. 110p. Project title: RUBBER, PLASTIC AND COMPOSITE MATERIALS. Task title: COMPOUNDING OF ELASTOMERS. Contract AF33(616)-2867. (WADC-TR-56-272; AD-110598).

This report includes a literature survey on O-rings and seal design and functional tests of O-rings prepared from rubber compounded to have various physical properties. 121 annotated references to report and published literature are given. An author index, tabular data, and figures are included.

15749
MOLDED SEALING ELEMENT. B. W. Bradford and W. J. Skinner (to U. S. Atomic Energy Commission). U. S. Patent 2,879,247. Mar. 24, 1959.

Molded sealing elements suitable for use under conditions involving exposure to uranium hexafluoride vapor are described. Such sealing elements are made by subjecting graphitic carbons to a preliminary treatment with uranium hexafluoride vapor, and then incorporating polytetrafluorethylene in them. The resulting composition has good wear resistant and frictional properties and is resistant to disintegration by uranium hexafluoride over long periods of exposure.

THEORY 5.16.05

11174 HW-49545 A
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FLOW GENERATION, MEASUREMENT, AND CONTROL. J. Dunn and H. M. Jones. Apr. 8, 1957. 30p. [Contract W-31-109-Eng-52]. $0.25(OTS).

The design criteria for equipment in a flow generation, measurement, and control system in a remotely operated aqueous separations plant are presented. Submerged regenerative turbine and deepwell turbine pumps, driven by motors located above and sealed from the tanks, are used to transfer solutions. Improved materials of construction, seal design, and methods of remote replacement have made it possible to adapt these pumps for use in chemical separations service. A brief description of a typical flow system installation, consisting of a specially designed rotameter-transmitter and control valve is presented. A detailed description of the rotameter-transmitter, amplifier-converter, recorder-controller, and control valve then follows. A description is given of a weight factor and specific gravity measurement system used for determining the volume of liquid moved into or out of a vessel which is helpful in calculating flow rate. (auth)

8899
HYDRODYNAMIC PROBLEMS INVOLVING LARGE FLUID DISTORTIONS. Francis H. Harlow (Los Alamos Scientific Lab., N. Mex.). J. Assoc. Computing Machinery 4, No. 2, 137-42(1957) Apr.

8492 UCRL-8093
California. Univ., Berkeley. Radiation Lab.
VOLUMETRIC AND THERMODYNAMIC PROPERTIES OF NORMAL FLUIDS. Kenneth S. Pitzer. Jan. 1958. 44p. Contract W-7405-eng-48. $1.25(OTS).

A comprehensive system for the prediction of the volumetric and thermodynamic properties of normal fluids has been developed and published in several journal articles. The various tables and equations for this system are presented. Written in the form of an Appendix to a forthcoming revision of the book, Thermodynamics, First Edition, by G. N. Lewis and M. Randall, occasionally reference is made to equations in the main text. (auth)

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THE TRANSITION PROCESS AND OTHER PHENOMENA IN VISCOUS FLOW. E. Rune Lindgren. Arkiv Fysik 12, No. 1, 1-8(1957).

An account of experiments on the transition process and other phenomena of liquid flow, mainly in cylindrical tubes, is given. Discussions are included on the properties of bentonite sols, the change between laminar and turbulent flow of liquids in cylindrical tubes, use of the stream double refraction technique in studying flow phenomena, simultaneous observations of the transition process in liquid flow at various pairs of locations along long cylindrical tubes, studies on the onset of turbulence in liquid flow by means of simultaneous pressure drop measurements, and the context of the present experimental findings in view of observations reported in the literature. (M.H.R.)

8898

ON THE LAMINAR FLOW OF AN ELECTRICALLY CONDUCTING LIQUID UNDER THE INFLUENCE OF A TRANSVERSE MAGNETIC FIELD. Etienne Crausse and Yves Poirier. Compt. rend. 244, 2694-5(1957) May 27. (In French)

A mathematical treatment is given the laminar flow of a conducting viscous liquid in a straight conduit of uniform cross section, a uniform magnetic field of exterior origin being exerted normal to the axis of the conduit. (T.R.H.)

7237 AECD-4227

[Knolls Atomic Power Lab., Schenectady, N. Y.]
NATURAL CONVECTION FLOW INSIDE SMALL TUBES. R. G. Kennison. Jan. 16, 1953. Decl. Feb. 7, 1956. 11p. Contract W-31-109-eng-52. (MEMO-RGK-13). $3.30(ph OTS); $2.40(mf OTS).

An analysis is made of the heat transferred by natural convection flow inside a small vertical tube with internal heat generation. The reduction in temperature is found to be small. (auth)

6642

HYDRAULIC ANALYSIS OF SUDDEN FLOW CHANGES IN A COMPLEX PUMPING CIRCUIT. George E. Alves (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). A.I.Ch.E. Journal 2, 143-7(1956) June.

A problem arose as to what would happen if there were sudden failures of power to one or more pumps of a large-scale complex pumping circuit composed of several individual pumping systems. The application of several published methods of hydraulic transient analysis to the problem is described. The performance of the system computed under several assumptions is discussed, and a comparison is made with experimentally determined values. (auth)

12353 AERE-CE/R-2497

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
TWO PHASE FLOW IN GAS-LIQUID SYSTEMS: A LITERATURE SURVEY. J. A. R. Bennett. Mar. 1958. 58p. $1.44(BIS).

A review is presented of the published literature (approx. to Dec. 1957) concerning the hydrodynamics of two phase gas-liquid flow with regard to the methods and accuracy of predicting pressure drop, liquid hold-up, etc. Particular emphasis was placed on the annular flow pattern. (auth)

5843

HYDRODYNAMICS OF A REACTING AND RELAXING FLUID. William W. Wood (Los Alamos Scientific Lab., N. Mex.) and John G. Kirkwood (Yale Univ., New Haven, Conn.). J. Appl. Phys. 28, 395-8(1957) Apr.

General equations governing the hydrodynamic behavior of an ideal compressible fluid in which chemical reactions and internal relaxations proceed are formulated. For one-dimensional flow the equations are transformed to characteristic form, in which the "frozen" or high-frequency sound velocity plays a role analogous to the unambiguous sound velocity in the nonreactive case. (auth)

9278 KAPL-1792

Knolls Atomic Power Lab., Schenectady, N. Y.
PREDICTION OF THE PRESSURE LOSS AND DENSITY FACTORS FOR TWO-PHASE ANNULAR FLOW WITH OR WITHOUT HEAT GENERATION. J. C. Westmoreland. Feb. 1, 1957. 35p. Contract W-31-109-Eng-52. $0.30 (OTS).

A simple analysis is presented for predicting pressure loss and density factors for two-phase, one-component

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annular flow with and without heat generation. All four combinations of laminar and turbulent flow in both the annulus and core are considered. The analysis is based on assumed velocity profiles and matching velocity and shear stress at the liquid vapor interface. The theory is found to compare favorably with experimental results on both vertical and horizontal sections. The application of the theory to natural circulation steam generators is also presented. (auth)

1452 CF-56-7-46
Oak Ridge National Lab., Tenn.
UPSTREAM DIFFUSION OF RADIOACTIVE GASES.
A. H. Fox. July 14, 1956. Decl. Sept. 26, 1958. 11p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The situation of a leak of active material into a flowing air-stream presents the problem of determining possible upstream diffusion of the activity. In a constant velocity one directional flow involving three dimensional diffusion from a point source, the upstream concentration is severely limited compared to that downstream. For all practical values of the flow velocity and diffusion coefficients, this upstream concentration is negligible. It is to be noted, however, that the velocity profile of a flow in a finite channel involves points of very low velocity, and at these points the diffusion effect might predominate, resulting in some upstream diffusion. Even in this case, unknown convection effects would be more important than diffusion effects. (auth)

14755 A/CONF.15/P/720
Oak Ridge Gaseous Diffusion Plant, Tenn.
EFFECTS OF POROUS BOUNDARIES ON THE FLOW OF FLUIDS IN SYSTEMS WITH VARIOUS GEOMETRIES. Abraham S. Berman. 18p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Descriptions of flow fields have been obtained for the case of an incompressible fluid in steady state, laminar, two-dimensional flow in pipes, channels, and annuli with fluid injection or suction at the walls. Solutions of the Navier-Stokes equations for these systems provided a description of the variations of the velocity and pressure drop components with the amount and direction of the fluid flow through the system boundary as well as the effect of system geometry on these variations. The solutions obtained and encompass the complete range of fluid injection and suction velocities. Fluid injection or withdrawal through the system boundaries has a marked effect on velocity profiles and pressure drops. The changes from the familiar parabolic velocity profiles are much more pronounced when fluid is removed from the system boundary than when fluid is injected. These changes are discussed in detail as are the pronounced changes in the pressure drops. It is shown that relatively small amounts of suction can produce pressure rises in the direction of the main flow. Comparisons are made between the solutions obtained and those which recently appeared in the literature. (auth)

11168 T-4(RAND)
MONOGRAPH ON THE THEORY OF CHARACTERISTICS.
G. Guderley. Translated by K. G. Liebhold. Sept. 1, 1947. 226p.

A method was developed for two-dimensional steady flow and can be applied as well to nonsteady, one-dimensional, and supersonic flow. (W.L.H.)

13892
VELOCITY PROFILE FOR FULLY DEVELOPED TURBULENT FLOW IN A PIPE. Thomas J. Hanratty and Duane L. Flint (Univ. of Illinois, Urbana). A.I.Ch.E. Journal 4, 132-6(1958) June.

An equivalent Poiseuille's Law is derived for a homogeneous isotropic turbulent field. The derivation is based on an analogy between momentum transfer and heat and mass transfer, three coefficients being used to characterize the exchange process: the molecular viscosity μ, an intensity parameter to characterize the magnitude of the turbulent velocity fluctuations $\overline{v^2}$, and a scale parameter to characterize the scale of the turbulence τ. (auth)

341 AEC-tr-3393
UNSTEADY MOTIONS OF AN INCOMPRESSIBLE FLUID IN NARROW REGIONS. Iu. L. Yakimov. Translated for Oak Ridge Gaseous Diffusion Plant from Doklady Akad. Nauk S.S.S.R. 115, 1080-3(1957). 9p.

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The potential unsteady plane-parallel motion of an incompressible fluid having a free surface in a channel having a flat bottom is discussed. (T.R.H.)

10516 LA-2129
Los Alamos Scientific Lab., N. Mex.
PRESSURE-TEMPERATURE RELATION FOR CONSTANT-AREA COMPRESSIBLE FLOW OF A GAS, CONSIDERING HEAT TRANSFER AND FRICTION WITH CONSTANT WALL TEMPERATURES. Franklin P. Durham. Jan. 8, 1957. 81p. Contract W-7405-Eng-36. $0.50(OTS).

A relation is derived between stagnation pressure and stagnation temperature with Mach number as a parameter for the case of constant-area compressible flow of a gas, considering both heat transfer and friction under conditions of constant wall temperature. The relation is independent of flow length and the absolute value of either the friction coefficient or heat transfer coefficient, but does depend on a modified Reynolds analogy parameter relating local values of the heat transfer coefficient and friction coefficient. The results of a machine computation are presented in a series of graphs that are useful for rapid estimation of pressure drop in terms of temperature rise and inlet flow conditions in cases where the heat transfer surface temperature may be considered approximately constant. (auth)

3261 ORNL-2603
Oak Ridge National Lab., Tenn.
AN INVESTIGATION OF THERMAL-TRANSIENT DECAY AT A FLUID-SOLID INTERFACE AND IN TURBULENT FLOW THROUGH CIRCULAR DUCTS. J. J. Keyes, Jr. and J. E. Mott. Dec. 15, 1958. 58p. Contract W-7405-eng-26. $9.30(ph OTS); $3.60(mf OTS).

Analytical and experimental heat-transfer studies are presented which are related to attenuation of relatively high-frequency thermal oscillations in fluid-solid systems. Oscillations in fluid temperature may originate in certain high-flux reactors and can cause thermal fatigue failure of metal components. It is of interest to know to what extent these oscillations will be felt at a metal surface and how they might decay in passage through reactor flow channels. Thus, the studies reported are in-

4599 NP-5971
Bureau of Mines. Div. of Solid Fuels Technology, Pittsburgh.
FLOW PROPERTIES OF FINE PARTICLES. PART I. FLOW IN PNEUMATIC TRANSPORT SYSTEMS. Final Report [for] March 1, 1952–October 30, 1955. Murray Weintraub and James W. Myers. 157p. Contracts CD4-480, CD3-679, and CD2-4014.

An investigation has been conducted into the factors governing the flow of fine particles. The program has surveyed a broad field, and the experimental work has been extensive rather than intensive. Observations on the dense-phase flow of sand through horizontal and vertical tubes are reported and discussed. Horizontal aerated flow was investigated for 57-micron and 33-micron glass spheres, and for 1-micron magnesium silicate. The effects of air rate, solids rate, tube diameter, and tube length were studied, and tentative correlations are proposed. Related subjects that were investigated include the measurement of the size of small particles, fluidization and agglomeration of powders, and measurement of particle velocity and stream density. (auth)

RATES OF FLOW THROUGH MICROPOROUS SOLIDS. E. R. Gilliland, R. F. Baddour, and J. L. Russell (Massachusetts Inst. of Tech., Cambridge). A.I.Ch.E. Journal 4, 90-6(1958) Mar.

Rates of flow of pure gases, both those with no adsorption and those with appreciable adsorption, were studied as a function of pressure level, pressure drop, and temperature for flow through 1/2-in.–diameter cylindrical plugs of activated carbon and of unsintered Vycor glass. Adsorption isotherms for the pure gases on Vycor glass were measured over the range of variables covered in the flow studies. Permeabilities, which are proportional to the rate of flow per unit of pressure drop, were satisfactorily correlated for hydrogen, helium, argon, and nitrogen by employing existing gas-phase flow theory. Permeabilities considerably larger than the values predicted from the nonadsorbed gas correlation, sometimes more than seventeen times as large, were observed for ethylene, propylene, and isobutane flowing through a Vycor plug. For the hydrocarbon-Vycor systems, permeabilities for vapor flow are as much as sixty times larger than for bulk liquid flow.

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17023
USE OF RADIOACTIVE ISOTOPES IN THE PROCESSING OF PETROLEUM. T. Filotti. Petrol. si gaze 8, No. 4, 198-204(1957). (Translated from Referat. Zhur. Khim. No. 1, 1958, Abstract No. 2515)

A survey is presented of the possibilities of utilizing radioactive isotopes in studying the flow of liquids at petroleum processing plants, measuring the volume of liquids in containers, and in treatment process control.

Oak Ridge Gaseous Diffusion Plant, Tenn.
VELOCITY PROFILES AND FRICTION FACTORS FOR TURBULENT PIPE FLOW WITH UNIFORM WALL SUCTION. H. L. Weissberg. Apr. 17, 1956. 31p. Contract W-7405-eng-26. $6.30(ph OTS); $3.00(mf OTS).

Experimental data have been analyzed to obtain empirical formulas for the distribution of velocity and of the wall shear stress in turbulent flow in a porous pipe with uniform wall suction. The results describe the velocity profiles in the wall region and in the inner region of the pipe and specify the variation of the friction factor with both the local Reynolds number and the suction rate. The data which have been analyzed cover the Reynolds number range between about 25,000 and 63,000 with ratios of suction velocities to axial velocities between zero and about 0.005. (auth)

5833 AECU-3473
Sandia Corp., Albuquerque, N. Mex.
SUBCRITICAL AND CRITICAL FLOW THROUGH STRAIGHT-THROUGH, ELBOW, AND TEE "AN" FITTINGS AND SHARP-EDGED ORIFICES AT ELEVATED TEMPERATURES. Arnold L. Ducoffe, John R. Bennett, and C. Gable Ray. Mar. 6, 1957. 31p. Contract AT(29-1)789. (TM-34-57-51). $4.80(ph OTS); $2.70 (mf OTS).

An investigation of the flow through straight-through, elbow, and tee "AN" fittings at negligible approach velocity with approach temperatures up to 1100°F is presented. The pressure ratio across the test element was varied between 1.0 and approximately 0.15. Empirical equations for the subcritical and critical flow regimes are derived for the rate of weight flow as a func-

4526 CF-57-1-93
Oak Ridge National Lab., Tenn.
ESTIMATION OF THE THERMAL CONDUCTIVITY AND THE VISCOSITY OF GASES AT HIGH PRESSURE. R. N. Lyon. Jan. 17, 1957. 8p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

342 AED-tr-3394
UNSTEADY FLOW OF A VISCOUS FLUID BETWEEN PARALLEL POROUS WALLS. D. E. Dolidze. Translated for Oak Ridge Gaseous Diffusion Plant from Doklady Akad. Nauk S.S.S.R. 117, 380-3(1957). 8p.

The steady, two-dimensional laminar flow of a viscous, non-contracting fluid between plane walls when the porosity of the walls is constant is investigated mathematically. (auth)

2430 CF-55-4-182
Oak Ridge National Lab., Tenn.
THE RHEOLOGY OF THORIUM OXIDE SLURRIES. [Report No]. I. P. R. Crowley and D. G. Thomas. Apr. 20, 1955. Decl. Feb. 9, 1956. 17p. Contract [W-7405-eng-26]. $0.20(OTS).

An understanding of the rheology of ThO_2 slurries is of immediate importance in predicting the conventional equipment performance and analyzing test results for the HRT slurry blanket. Present data indicate that oxide slurries at room temperature and concentrations of interest are non Newtonian. The flow of ThO_2 slurries through pipes is discussed. (W.L.H.)

9281
A METHOD OF SOLVING UNSTEADY GAS FLOW EQUATIONS WITH ALLOWANCE FOR DISSIPATIVE PROCESSES IN THE GENERAL THEORY OF RELATIVITY. T. Aitimurzaev (Kirgiz State Univ.). Doklady Akad. Nauk S.S.S.R. 113, 769-72(1957) Apr. 1. (In Russian)

Equations are developed for unsteady relativistic flow of viscous, heat-conducting gas inside of gravitational masses. (R.V.J.)

343 AEC-tr-3423
HEAD-WATER LOSSES DURING MOTION OF WATER AND WATER-SOLID MIXTURE IN LARGE DIAMETER CONDUITS. N. A. Silin. Translated for Oak Ridge National Lab. from Dopovidi Akad. Nauk Ukr. R.S.R., 2, 175-7(1958). 5p.

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The losses in pressure of water during flow in a water-solid mixture through large-diameter conduits were measured. In addition, the water consumption and the specific weight of the water solid mixture were measured. The experimental techniques are described and the results tabulated. (J.R.D.)

533 ✓

FLOW OF FLUIDS. Murray Weintraub (U. S. Bureau of Mines, Pittsburgh, Penna.). *Ind. Eng. Chem.* 47, 558-65(1955).

This review includes references on single-phase flow (Newtonian flow, non-Newtonian and unsteady-state flow, and metering and control), flow through porous media, and multiphase flow (gas-solid systems, flow through liquid-liquid, liquid-gas, and gas-gas contactors, and mechanical design). 159 references.

Purdue Univ., Lafayette, Ind.

A REVIEW OF THE PUBLISHED LITERATURE PERTAINING TO THE ANNULAR, TWO-PHASE FLOW OF LIQUID AND GASEOUS MEDIA IN A PIPE. D. A. Charvonia. Dec. 1958. 151p. Contract Nonr1858(25). (PUR-32-R).

A literature study on two-phase flow was conducted with the emphasis on annular flow patterns of gas—liquid systems in a pipe. The theoretical and semi-empirical analysis of two-phase flow by various investigators is reviewed, and it is pointed out that analytical methods are generally characterized by procedures such as analysis of the internal mechanics of the liquid film and analysis of the interfacial structure of the flow. Experimental investigations are reviewed, and data pertinent to the annular flow pattern in two-phase flow are emphasized. Experimental results of pressure drop experiments are compared as well as data on liquid film thickness. A discussion of the stability of annular two-phase flow is also presented. 55 references. (J.R.D.)

16283 ✓ AFOSR-TN-59-631

Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

SELECTED TOPICS FROM THE THEORY OF GAS FLOW AT HIGH TEMPERATURES. VI. SOME ASPECTS OF PARTICLE INTERACTION IN GASES. J. M. Burgers. June 1959. 41p. Contract AF49(638)-401. (BN-176).

A simplified form of the Boltzmann equation to take account of reactions between particles is discussed. The formal treatment is restricted to spontaneous reactions and binary collisions. An example is given of the general form which the Boltzmann equation obtains. The treatment of collisions between charged particles with the aid of a two-particle distribution function is discussed in detail. A mathematical analysis of plasma oscillations is given. (A.C.)

15979 ✓ **AERE-Trans-827**

VISCOSITY AND THE MEASUREMENT OF VISCOSITY. Franz Lawaczeck. Translated by R. Todd from Z. Ver. deut. Ingr. 63, 677-82(1919). 18p.

The previously known equations for the motion of viscous fluids are given. A new viscometer is described which is applicable to liquids and gaseous and semi-solid materials. (auth)

VALVES 5.16.06

4416

IMPROVEMENTS IN OR RELATING TO VALVES FOR CONDUITS CARRYING FLUIDS. Albert Henry James Thomas (to United Kingdom Atomic Energy Authority). British Patent 818,501. Aug. 19, 1959.

A valve design is presented which has all operating parts outside the valve chamber for ease of maintenance and repair and to facilitate use with corrosive fluids. The movable plug is mounted on a central axle and can be rotated to any of several ports. The valve is then closed by moving the central shaft by screws toward the port which the plug faces. (T.R.H.)

3453

VALVES FOR CONTROLLING HIGH-TEMPERATURE FLUIDS. F. L. Speed (to U. K. Atomic Energy Authority). British Patent 777,039. Nuclear Eng. 2, 494(1957) Nov.

A valve for high-temperature liquid (sodium) with a self-sealing leak-proof gland of (a plurality of) O-ring seals arranged as an insert over the spindle on a sleeve-like ex-

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tension of the valve body. The extension and the spindle are of such length that combined with fins around the extension, a temperature drop is caused between the valve seat and the gland which results in liquid sodium passing through the valve becoming solid at the gland. (auth)

8357 NP-6050
Mine Safety Appliances Co., Callery, Penna.
TWO INCH STOP VALVE TESTS WITH SODIUM. Memo Report 107. G. E. Kennedy and E. C. King. Mar. 5, 1956. 5p. Contract NObs-65426.
The integrity of the bellows of the 2 in. stop valve on the S2G drain system was determined during freezing and thawing of sodium following a dump operation into the hold tanks. The valve was so positioned that a minimum of sodium should be held up in it. The test was run three times to determine whether subsequent freezing and thawing of the residual sodium would cause failure of the bellows. The valve performed satisfactorily. (auth)

7640
FREEZE-SEAL VALVES AND PUMPS. R. Cygan and A. M. Stelle (North American Aviation, Inc., Canoga Park, California). Chem. Eng. Progr. 52, 157-9(1956) April.
Freeze seals have been developed for sealing stationary and rotating shafts affording a simple means of adapting commercial equipment for use in high-temperature liquid-metal systems. Several designs for sealing sodium at temperatures up to 1200°F have been satisfactorily tested. Under different operating conditions cooling loads, torque, and temperature distribution were measured. Locating the freeze seal away from the high-temperature region allows the formation of an annulus of frozen metal around the shaft with small cooling loads. (auth)

9471 CF-57-6-25
Oak Ridge National Lab., Tenn.
HRT LETDOWN VALVES. A. M. Billings. June 5, 1957. 6p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80 (mf OTS).
Details of letdown valve service on the HRT Mockup are described. (W.L.H.)

1635 AERE-R/R-2645
United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
VALVE STEM COOLING. G. B. Bishop. July 1958. 33p.
A theoretical analysis of heat flow and temperature distribution along valve stems is presented. Valve stems with fins and with no fins are considered. A theoretical treatment for forced-air cooling is presented, and some experimental work to verify the analysis is outlined. (J.R.D.)

11395
VALVES FITTED WITH ADJUSTABLE MICROLEAKS. J. Amoignon, J. Delcher, and R. Geller (Centre d'Etudes Nucléaires, Saclay, France). Le Vide No. 68, 176-83 (1957) Mar.-Apr. (In French)
Two microleak valves for use in gas-measuring or vacuum systems are described, one adjustable by mercury level, the other by compression of rubber ring seals. A method of calibration of good accuracy is discussed. (T.R.H.)

268 AEC-tr-3422
STUDY OF COMBUSTION IN GAS PRESSURE-REDUCTION VALVES. A. E. Leduc. Translated by K. S. Bevis (Savannah River Lab.) from Z. Schweisstech. 45, 239-45(1955). 12p.
A search for a plastic material to replace ebonite for the valve assembly used on oxygen storage cylinders was conducted. The field was narrowed to nylon and teflon. In addition to oxygen tests, these materials were exposed to acetone and acetylene. Various physical tests were also performed. A discussion of procedures and results is presented. (J.R.D.)

9743 CF-53-8-173
Oak Ridge National Lab., Tenn.
THOREX: VALVE TEST FOR STEAM SERVICE (TAYLOR NO. 1V67804 AND MINNEAPOLIS-HONEYWELL No. V053E). G. A. West. Aug. 25, 1953. Decl. Feb. 8, 1956. 9p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).
An evaluation study to determine wear and corrosion in steam service, leakage in steam condensate service, cost

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VALVES 5.16.06

comparison, operability of Skinner Electric Solenoid valves, and recommendations of remotely operating valves proposed for use in the Thorex pilot plant to throttle steam or water to jets and tank jackets revealed no erosion or excessive wear rings. Leakage tests showed the Taylor valve to be superior and continued operation did not affect leakage in any of the valves tested. Cost recommendations are made. (F.S.)

10518 CF-56-2-42
Oak Ridge National Lab., Tenn.
HRP EXPERIMENTAL VALVE PROGRAM. A. M. Billings. Feb. 14, 1956. 14p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).
A valve testing program directed at improved valve performance in homogeneous reactor systems is discussed. Valve trim, shaft seals, and actuators are considered. (D.E.B.)

2433 HW-26323
Hanford Works, Richland, Wash.
INVESTIGATION OF SULFAMIC ACID TANK VALVE FAILURES. N. Endow. Nov. 21, 1952. Decl. Dec. 7, 1955. 5p. [Contract W-31-109-eng-52.] $1.80(ph OTS); $1.80(mf OTS).
The failure of stainless steel valves in sulfamic acid due to corrosion was attributed in part to the amount of ferrite in the austenitic matrix. Type 304 ELC steel was recommended as a substitute material for tank valves used in sulfamic acid solutions. (C.W.H.)

3803 AEC-tr-2444
VALVE CONSTRUCTION OF PUMPS WITH VERTICAL PISTONS. Albert Doering. Translated by D. E. Cardamone from German Patent No. 805 005. 2p.

11853 NP-7413
Mines Safety Appliances Co., Callery, Penna.
TEST OF A 1 INCH COMBINED VALVE CONNECT AND DISCONNECT. Memo Report 95. W. Milich, E. A. Schultz, and E. C. King. Nov. 21, 1955. 7p. Contract NObs-65426.
A 1 in. combined valve connect and disconnect intended for use in the primary coolant vent lines of the SIR Mark B system was subjected to a series of performance tests.

These tests included valve cover welding tests, a series of static pressure and seat leakage tests, and a series of sodium cycling tests. The static pressure and seat leakage tests were run at room temperature, using nitrogen at 100 and 200 psig. Additional static tests were run at 500°F using sodium at 200 psig. The valve was subjected to 10 cycling tests, where-in sodium at 500°F, 100 psig was pumped through the valve for 10 minute periods. After each cycle the valve disconnect joint was dismantled and rebuilt with a new "O" ring. Performance in all cases was satisfactory. (auth)

VACUUM SYSTEMS 5.17

EQUIPMENT 5.17.01

GENERAL 5.17.01.01

A LARGE METAL SYSTEM PERMITTING LOW BASE PRESSURES. J. Ralph Ullman (Univ. of California, Livermore). pp. 95-6 in "1957 Fourth National Symposium on Vacuum Technology Transactions."
A large all-metal vacuum system consisting of an oil diffusion pump, a water-cooled baffle, and a liquid nitrogen trap all in series with, and pumping on, the vacuum chamber is described. By means of special techniques described herein, low base pressures of (3.0 or 4.0) $\times 10^{-10}$ mm Hg are attained. Resultant pressures for the complete vacuum system varied between 5×10^{-9} and 8×10^{-10} mm Hg for a period of 10 days. (auth)

11288 NYO-8705
Westinghouse Electric Corp. Research Labs., Pittsburgh.
ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report [for] November 1, 1958–January 31, 1959. Research Report 403FF312-R5. Feb. 27, 1959. 12p. Contract AT(30-1)-2176. $3.30(ph), $2.40(mf) OTS.
The interesting results obtained with Teflon as an ultrahigh vacuum material have been further investigated with very satisfactory results. As a consequence of these investigations plans are being initiated to build

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an ultrahigh vacuum valve with an open conductance in excess of 1000 liters/sec. In addition, a major development has been made in the area of large conductance, non-refrigerated isolation traps by introducing a suitable ultrahigh vacuum material which traps backstreaming pump products with extremely high efficiency. To date, traps with conductances of 300 liters/sec have isolated ultrahigh vacuum systems for more than a month. Satisfactory progress has been made in the more

16308 NYO-2615
Westinghouse Electric Corp. Research Labs., Pittsburgh.
ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report for February 1, 1959 to March 31, 1959. Research Report 403FF466-R1. May 28, 1959. 25p. Contract AT(30-1)-2176. $4.80(ph), $2.70(mf) OTS.

Data on the use of Teflon for ultrahigh vacuum applications indicate that it may have application in large conductance valves. Tests on a valve having a copper seat 4 in. in diameter, employing a hydraulic mechanism, are reported. New data obtained on non-refrigerated large conductance isolation traps substantiated initial findings. Isolation traps with conductances of about 300 liters per second have isolated ultrahigh vacuum systems at pressures less than 10^{-9} mm Hg for 75 days. Preliminary studies of systems involving hot metallic surfaces and hydrogen gas are reported. (For preceding period see NYO-8705.) (J.R.D.)

PUMPS 5.17.01.02

PRODUCTION OF VERY LOW PRESSURES WITH GETTER-ION PUMPS. G. Reich and H. G. Nöller (E. Leybold's Nachfolger, Cologne). pp. 97-9 in "1957 Fourth National Symposium on Vacuum Technology Transactions."

Investigations were made of getter-ion pumps, in which titanium is used as the getter metal, to determine their capacity for producing low pressures. It was shown that in clean conditions, such as after thorough heating and evacuation of the system with a diffusion pump, pressures of 1×10^{-9} mm Hg and below can be attained. Failure to carry out this pre-treatment, by means of which rare gases, hydrogen, and hydrogen-containing gases are removed, will lead to the formation of ordinary hydrocarbons which, even after a lengthy pumping time, determine the ultimate pressure. (J.H.M.)

3076
ION PUMP. E. O. Lawrence and J. S. Foster, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,726,805. December 13, 1955.

Large volumes of gas at very low pressures can be electromagnetically pumped by ionizing the gas and causing the ions to move to a remote position where they are neutralized and retained. The ions are formed by introducing the gas into the central portion of a space containing an elongated magnetically collimated arc discharge where they are created at the center of the arc discharge and urged toward the ends of the arc by virtue of the potential gradient which exists. The ions are then collected at the ends of the arc by the cathodes in such a manner that any gas not retained diffuses back into the arc wherein it is again re-ionized and returned to the cathodes. The pump of this design has a very high pumping speed and is capable of attaining a vacuum of 10^{-7} mm of mercury. (auth)

9571
RADIO FREQUENCY ION PUMP. J. S. Foster, Jr., et al (to U. S. Atomic Energy Commission). U. S. Patent 2,791,371. May 7, 1957.

A radio-frequency ion pump capable of relatively continuous highly efficient operation is described. The apparatus comprises an evacuated envelope with input and output regions, and a radio frequency generator with associated electrodes circumscribing the chamber creating an oscillatory electron current within the envelope. When a gas is injected into the chamber, the gas molecules are ionized and an arc is produced with the gaseous discharge being collimated along the center of the chamber by the action of a constant magnetic field. The ions are then removed from the chamber by suitable means. (auth)

VACUUM SYSTEMS 5.17

EQUIPMENT 5.17,01

PUMPS 5.17.01.02

10067 ✓
A NEW TYPE OF IONIZATION-PUMP. George Comsa and Geavit Musa (Academy of the Rumanian People's Republic, Bucharest). J. Sci. Instr. 34, 291-2(1957) July.
An ionization pump is described which, it is claimed, is easier to build and outgas than the Bayard-Alpert gage. A tungsten filament, a tungsten grid, and the glass enclosure are the three electrodes. If all the ions captured by the glass wall are absorbed, pumping speeds of 0.2 to 0.4 l/sec are attained. (T.R.H.)

THE STEAM JET EJECTOR: A VERSATILE PUMP FOR HIGH VACUUM. V. V. Fondrk (Elliott Co., Jeannette, Penna.). pp. 88-94 in "1957 Fourth National Symposium on Vacuum Technology Transactions."
Recent developments in steam jet ejectors have extended the range of this vacuum pump to absolute pressures well under ten microns. This makes available, at relatively low initial cost, pumps of large capacity—extending to 250,000 cfm or more. Performance characteristics are described. Cost of equipment in relation to capacities is charted. Installation, operating and maintenance costs are discussed. A description of a typical installation on a consumable electrode vacuum melting furnace is given. Use of ejectors on stream degassing units presently operating in various steel mills and foundries in this country is covered. (auth)

11417 ✓
ELECTRONIC ULTRA-HIGH VACUUM PUMP. Lewis D. Hall (Varian Associates, Palo Alto, Calif.). Rev. Sci. Instr. 29, 367-70(1958) May.
An ultra-high vacuum pump has been developed based on the combined effects of ionization, excitation, and sputtering. A cold-cathode discharge in magnetic field is employed with no hot filaments nor moving parts. The ultimate vacuum attainable is not yet known but is probably below 2×10^{-10} mm Hg. A pumping speed of about 10 liters/sec for air has been recorded at 1×10^{-7} mm Hg. The pump replaces liquid nitrogen-trapped oil diffusion pumps for pumping microwave tubes. (auth)

144 ✓
AN IMPROVED HIGH-CONDUCTANCE COLD-TRAP. A. J. Martin (United Kingdom Atomic Energy Authority, Aldermaston, Berks, England). J. Sci. Instr. 32, 400-1(1955) Oct.
A high-conductance baffle cold trap for use with diffusion pumps in vacuum systems is described. The conductance of the cold trap was determined as 150 liters/sec for air at 20°C (C.W.H.)

20102 IGRL-T/CA-113
A NEW MOLECULAR PUMP. W. Becker. Translated by J. Standring (U.K.A.E.A., Risley) from Vakuum-Tech. 7, 149-52(1958). 8p.
The operation and performance of a new molecular pump are described. The new design, resembling that of a turbine, shows an airgap of 1 mm, which is much more than the usual gap of only a few hundredths of a millimeter. The wide airgap ensures extreme reliability in operation. Another advantage of the new design is the high pumping speed which has been achieved by paralleling a large number of suction channels. In spite of the high pumping speed the compression ratio for air is as high as 5×10^7. The ultimate vacuum is practically determined by the leakage of the vacuum system and the outgassing of the walls. The performance of the pump depending on backing pressure and nature of the gas is shown in various diagrams. Finally, the potential applications of the pump are discussed. (auth)

8520 IGIS-26(RD/R)
THE DESIGN OF PUMP COMBINATIONS WITH ROOTS PUMPS. K. Ziock. Translated by M. F. Sheppard from Vakuum-Tech. 6, 98-101(1957). 8p.
The pumping speed and performance of a vacuum Roots pump are calculated. The combinations of water jet and rotary oil pumps as backing pumps for Roots pumps are discussed. (C.J.G.)

TRANSFER OF FLUIDS 5.16

EQUIPMENT 5.17.01

VALVES AND SEALS 5.17.01.03

311 JEN-58
Spain. Junta de Energia Nuclear, Madrid.
VÁLVULA ELECTROMAGNETICA AUTOMATICA PARA VACÍO PREVIO. (Automatic Electromagnetic Valve for Previous Vacuum). Carlos Enrique Granados and Francisco Martin. 1959. 5p.

A valve which permits the maintenance of an installation vacuum when electric current fails is described. The valve can also be operated to admit air into the vacuum bomb to prevent oil ascending into the vacuum tubes. (tr-auth)

5154
SIMPLE DEMOUNTABLE INDIUM O-RING SEAL TIGHT TO He II. Hajime Seki (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instr. 30, 943-4(1959) Oct.

An indium O-ring was used to seal an isolated chamber to liquid He II at 10^{-6} mm Hg, and no appreciable change in pressure was detected as the λ point was passed. The O-ring was chosen for economy of space, to avoid the soldering of flanges onto the copper tube, and ease of disassembly. It is expected that this design will be applicable to various optical experiments which require sample isolation and good temperature control. (B.O.G.)

13530 NAA-SR-2544
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
A HIGH VACUUM APPLICATION OF INFLATABLE SEALS FOR THE PROCESSING REFABRICATION EXPERIMENT. J. L. Ballif. Jan. 15, 1959. 47p. Contract AT-11-1-GEN-8. $1.25(OTS).

In the Processing Refabrication Experiment, a method was developed for sealing the massive shielded doors of the vacuum access lock in the PRE cell complex with inflatable rubber seals of the type used by aircraft industry. Development work was undertaken to determine if this seal would retain vacuum and, if so, to determine its suitability for application to the lock doors. A small test stand was designed and built. Tests were run with standard aircraft seals. The results showed that a vacuum of 0.08 microns of mercury could be maintained, using two seals with a pumpout in between. A half-scale engineering mockup was designed, constructed, and tested. In the tests, three seal bead configurations, two seal throw distances, and various seal inflation pressures were used. Leakage of both air and helium was measured. Tests were run, evaluating single and double seals. The tests showed that vacuums of less than 1 micron of mercury could be effectively maintained. Leak rates less than 1 ft^3/day were maintained, with either single or double seals, indicating that this application of seals to the lock door is feasible. The double seals were found to be about ten times more effective in sealing than the single seals. Recommendations are given for proper usage of seals and information is presented on specifications which will insure better products for this application. (auth)

DEMOUNTABLE VACUUM SEAL FOR OPERATION AT TEMPERATURES FROM –188°C TO 800°C. R. Brymner and W. Steckelmacher (Edwards High Vacuum, Ltd., Crawley, Sussex, Eng.). J. Sci. Instr. 36, 278-81(1959) June.

A new type of metal gasket vacuum seal is described which depends on a surface-friction effect instead of compression, which is the basis of most seals. Tests proved the effectiveness of the seal for repeated cycling between –188 and 800°C on flanges of 3 and 5 in. diameter and on a ½ in. vacuum union. The materials used include mild steel or stainless-steel flanges with flat gasket sheets of soft copper, iron, stainless steel, or nickel. Other metal gasket vacuum seals are briefly reviewed and the mechanism of sealing is discussed. A table of recommended dimensions for flanges from 3 to 12 in. diameter is also presented. (auth)

A NEOPRENE VACUUM GASKET FOR WIRES. A. C. Prior (Royal Radar Establishment, Great Malvern, Worcester, Eng.). J. Sci. Instr. 35, 382-3(1958) Oct.

A method of sealing thermocouple wire holes in a vacuum furnace is presented. The method depends on the fact that excellent vacuum seals can be obtained by compression of a suitable block of neoprene through which the wire passes. The design allows easy removal of the wires, and wires of various diameters can be accommodated. (J.R.D.)

A NOTE ON THE USE OF POLYTETRAFLUOROETHYLENE IN VACUUM SEALS. A. J. Davies ("Shell" Research Ltd., Thornton Research Centre, Chester, Eng.). J. Sci. Instr. 35, 378-9(1958) Oct.

EQUIPMENT 5.17.01

VALVES AND SEALS 5.17.01.03

The method of preparing very thin films of polytetrafluoroethylene for use as vacuum seals is described. Cutting techniques are included along with cleaning methods and the heating process which forms the seal. (J.R.D.)

7499
HIGH-PRESSURE AND VACUUM SEALS AT LIQUID HELIUM TEMPERATURES. K. S. Balain and C. J. Bergeron (Louisiana State Univ., Baton Rouge). Rev. Sci. Instr. 30, 1058-9(1959) Nov.
The construction and performance of epoxy resin seals for use in high pressures (up to 2400 psi) and high-vacuum (10^{-7} mm Hg) systems at 1.2 to 300°K are described. (C.J.G.)

8906
UNIQUE SLIDING SEAL FOR A VACUUM CHAMBER. Frank I. Louckes, Jr. (Naval Research Lab., Washington). Rev. Sci. Instr. 28, 468-9(1957) June.
The vacuum seal consists of a flexible strip sliding over an O-ring. The strip is made of 0.005-in. type 304 stainless steel, with angle stiffeners of 0.01-in. stainless steel, spot welded across the strip. (M.H.R.)

8905
THERMAL-emf-FREE VACUUM SEAL FOR ELECTRICAL LEAD WIRES. T. S. Noggle, T. H. Blewitt, R. R. Coltman, and C. E. Klabunde (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 28, 464(1957) June.
The vacuum seal developed for low-temperature pile irradiations in the ORNL graphite reactor makes use of Castolite cold setting plastic to form a flange directly onto the lead wires. This plastic undergoes a volume contraction during polymerization which leads to a strong mechanical joint between the plastic and wires and contributes to vacuum tightness. (M.H.R.)

5298
METAL BAKEOUT VALVE FOR ULTRAHIGH VACUUM. Carsten M. Haaland (Armour Research Foundation, Chicago). Rev. Sci. Instr. 30, 947-8(1959) Oct.
Present Alpert-type high-vacuum valves are limited in application because of (a) inherent low conductance in the open position, (b) a finite conductance in the sealed position, and (c) a usual rapid increase of sealed-off conductance after a few bakeouts. The described valve overcomes these limitations, although it cannot be used as a controlled leak. The sealing element is a reservoir of pure tin. Cold drawn steel is used for the valve parts which are in contact with the tin in order to minimize erosive action. (B.O.G.)

7487 NYO-8704
Westinghouse Electric Corp. Research Labs., Pittsburgh
USE OF TEFLON IN ULTRAHIGH VACUUM SYSTEMS. Research Memo 403FF312-M1. W. J. Lange and H. Riemersma. Jan. 5, 1959. 7p. Contract AT(30-1)-2176. OTS.
Teflon was found to have the first bakeout around 350°C which resulted in a deformation of 5 to 10%. A vacuum valve employing Teflon as a nose against stainless steel yielded a closed conductance of $< 10^{-14}$ l/sec at closing torques of less than one fifth that required to close an identical valve employing a copper nose. (C.J.G.)

16345
SLIDING AND ROTATING MECHANICAL AND ELECTRICAL FEED-THROUGH SEALS INTO A VACUUM. N. Fuschillo (Pennsylvania State Univ., University Park and Franklin Inst., Philadelphia). Am. J. Phys. 26, 400(1958) Sept.
Low-cost rubber seals for use in vacuum systems at pressures down to 10^{-6} mm Hg are described. The seals permit almost unlimited rotational and longitudinal freedom as well as provide a reliable and easily demountable feed-through system for electrical connections. (D.E.B.)

DEMOUNTABLE VACUUM SEAL FOR ATTACHING AN END-PLATE TO A GLASS TUBE. Horace R. Moore (California Inst. of Tech., Pasadena). Rev. Sci. Instr. 29, 737-8(1958) Aug.
A demountable vacuum seal for attaching an end-plate to a glass tube is described. A type of O-ring is used. Rotation of a knurled lock-ring caused the 45° level on the collar to press against the O-ring, the collar sliding freely on the tube. Equal pressures are

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then transmitted by the O-ring onto the surfaces to be sealed—the outer tube surface and the inner surface of the end-plate. (A.C.)

PRESSURE CHAMBER CLOSURE APPARATUS. R. B. Meuser (to U. S. Atomic Energy Commission). U. S. Patent No. 2,747,762, May 29, 1956.

An air-lock closure was designed for large pressure chambers such as cyclotrons, where implements may be entered or withdrawn with a relatively small loss of the chamber vacuum so as not to overburden the pumping system or cause considerable loss of time to reestablish the desired vacuum. The apparatus consists of an outer and inner door remotely controlled having an aperture of 15 × 20 in., with tracks for the movement of the desired implements. The door is hinged on one side so that when opened it presents no obstruction over the aperture. (auth)

BAKEABLE VACUUM SEALS USING ALUMINIUM-WIRE GASKETS. J. Holden, L. Holland, and L. Laurenson (Edwards High Vacuum, Ltd., Crawley, Sussex, Eng.). J. Sci. Instr. 36, 281-3(1959) June.

The use of aluminum wire as a vacuum seal between steel flanges was studied. Gaskets made by twisting together the ends of a 22 s.w.g. wire could be baked to 200°C before they leaked on cooling. High-temperature working was possible with butt-welded loops of aluminum wire providing the gasket was highly compressed. Such seals did not cold weld but, at baking temperatures above 400°C, the aluminum plastically flowed and adhered to the mating flanges. The "cemented" joint was vacuum tight at low and high temperatures (20–550°C) although the securing bolts became loose after baking. Such a seal leaked only when the aluminum reached its melting point. Information is given on the minimum compression force which must be applied to an aluminum wire in order to form a cemented joint at elevated temperature. Several uses of the aluminum-wire seal are described. (auth)

7642

FAST-CLOSING VACUUM VALVE. Arthur W. Knudsen (Stanford Univ., Calif.). Rev. Sci. Instr. 27, 148-50(1956) Mar.

A swinging-gate type valve with associated triggering mechanism is employed as a protective device for quickly stopping a sudden accidental inrush of air to a vacuum system. The electrical triggering mechanism uses no vacuum tubes. For a large inrush of air, the valve will close in less than 0.01 sec. (auth)

19138 UCRL-5649

California. Univ., Livermore. Lawrence Radiation Lab.

A LARGE BAKEABLE VACUUM VALVE. Thomas H. Batzer. Aug. 6, 1959. 13p. Contract W-7405-eng-48. $3.30(ph), $2.40(mf) OTS.

The development and design of a large bakeable valve based on a unique seat arrangement and a novel motion seal are described. The seat sealing is accomplished through the use of high pressure fluid actuation of an annular pinch gasket. Experimental data on seat closure performance, and the specific design features to achieve successful closures, are presented. The bakeable motion seal utilizes a stainless steel bellows sleeving over an inner concentric actuating shaft. This shaft is bent at 90° to the axis of rotation and is free to rotate relative to the bellows. There is no apparent size limitation to this type of actuation. The design of a 10-inch gate valve utilizing these principles is described. (auth)

19139 WAPD-TH-450

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

21176 CF-59-8-80

Oak Ridge National Lab., Tenn.

WELDED SEAL-RING VACUUM CLOSURES. C. Michelson. Aug. 21, 1959. 36p. Contract [W-7405-eng-26]. $6.30(ph), $3.00(mf) OTS.

The development of bakeable high-vacuum flanges for the ORNL PIG Facility is reported. The general design approach for this type flange is to obtain a bakeable vacuum seal by first welding thin metal rings to a set of heavy metal flanges, and then edge-welding the rings together. This design allows the option of O-ring sealing for nonbaked operation. A number of flange designs are discussed together with fabrication, inspection, testing, and installation and maintenance information. (auth)

TRANSFER OF FLUIDS 5.16

SURVEYS AND THEORY 5.17.02

7171 AEC-tr-2708
ON THE THEORY OF STEAM-JET VACUUM PUMPS. I. M. Lifshits and L. N. Rozentsveig. Translated from Zhur. Tekh. Fiz. 25, 1323-5(1955). 3p.

HIGH VACUUM TECHNIQUES FOR NUCLEAR INDUSTRY. D. J. Crawley. Atomic World 9, 423-6(1958) Dec.

The application of high-vacuum systems and techniques to nuclear research is discussed. Information is presented on: the application of the vacuum chamber to particle accelerators, pumps for accelerators, the uses of vacuum systems in separation plants, the application of vacuum systems to reactor heat exchangers, leak detection by vacuum techniques, vacuum metallurgy, and pumps for degassing. (J.H.M.)

4410 AERE-Trans-838
THE RATE OF PUMPING DOWN IN HIGH-VACUUM SYSTEMS. T. Kraus. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment) from Vakuum-Tech. 2, No. 2, 39-43(1959). 13p.

The rate of pumping down in the high-vacuum range is dependent on the decay of various gas-production processes which take place at the surfaces. When a given process of gas formation which varies with time prevails in a vessel, then the pumping time t required to attain a given pressure p can generally be obtained by a kinetic consideration of the processes by means of the equation $t = [(F/S)(\phi/p - P_E)]^n - t_0$; F is the surface area of the specimen, S the velocity of suction of the pump, P_E the final pressure due to the steady processes and t_0 a constant depending on the initial conditions. The type of gas formation is identified from the value of the exponent n and its intensity from the value of the material-dependent constant ϕ. The experimental results indicate that the action of the most important gas-formation processes in high-vacuum systems may be represented with sufficient accuracy by integral exponents n, for example, by n = 1 for adsorption processes, which in the ideal case can be reduced to a Temkin isotherm, or by n = 2 for diffusion processes which obey the law of diffusion over "almost infinite" regions of the specimen. For metal vessels, which become contaminated with inorganic substances during operation, a simple pumping-time law is applicable on substituting VP_A (with n = 1) for the product $F\phi$ in the above equation. The quantity P_A here represents a characteristic pressure, which in its turn indicates the upper limit of validity of the law. Its value is dependent on the kind and condition of the system but (to a first approximation) not on the volume of the vessel, V. Average values of P_A are 10^{-2} mm Hg for clean and a few times 10^{-1} mm Hg for contaminated systems. (auth)

6645
HIGH VACUUM TECHNIQUE: THEORY, PRACTICE, INDUSTRIAL APPLICATIONS AND PROPERTIES OF MATERIALS. (Third Edition, Revised). J. Yarwood. New York, John Wiley and Sons Inc., 1955. 208p.

10562
VACUUM TECHNIQUES IN THE ATOMIC ENERGY INDUSTRY. H. Kronberger (U.K.A.E.A., Industrial Group Headquarters, Risley, Eng.). J. Brit. Nuclear Energy Conf. 3, 136-55(1958) Apr.

Examples are given showing how vacuum techniques are used in the uranium-235 diffusion plant, in plants handling liquid metals at high temperature, in experimental work for pressurized water reactors, and in the testing of the Calder Hall heat exchangers. The success of vacuum techniques in large-scale applications depends on three factors: correct design of plants, the availability of simple and reliable testing methods, and efficient managerial control of construction and test work. Basic design rules are given and illustrated by examples of flanges, valves and other components used. Vacuum testing methods are discussed. The charcoal–Pirani technique of testing is favored for most applications; tests can be carried out on components before they are degassed and "clean"; equipment and operation are simple. The management of vacuum work is discussed and a method of quality control by means of binomial distribution charts is described which has been useful in improving systematically the vacuum tightness of manufactured components. (auth)

1833
VACUUM METALLURGY (Papers Presented at the Vacuum Metallurgy Symposium of the Electrothermics and Metallurgy Division of the Electrochemical Society, October 6 and 7, 1954 at Boston, Mass.). Baltimore, The Electrochemical Society, Inc., 1955. 213p.

Included are papers on arc melting in high vacuum, vacuum melting of high-alloy materials, impact properties

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of vacuum melted Fe–Cr alloys, vacuum induction-melted Zr and Zr alloys, vacuum and pressure melting of iron-base alloys, the design and operation of an induction and a resistance furnace for high vacuum-high temperature applications, a method for the evaluation of high-vacuum furnaces and heat-treating atmospheres, the theory and

VACUUM STREAM-DEGASSING. K. C. Taylor (F. J. Stokes Corp., Philadelphia). pp. 157-60 in "1957 Fourth National Symposium on Vacuum Technology Transactions."

An illustrated review of the background and current status in the iron and steel industries of this newly significant vacuum metallurgy technique. Included are brief discussions of the history of the process and its present state of useful development; material on the properties and applications of stream-degassed steel; analyses of operating procedures, and costs; and considerations on equipment design requirements. (auth)

1957 FOURTH NATIONAL SYMPOSIUM ON VACUUM TECHNOLOGY TRANSACTIONS. Wilfrid G. Matheson, ed. New York, Pergamon Press, 1958. 183p.

Papers given at the Fourth National Symposium on Vacuum Technology Transactions are given. These papers contain information on the following areas: scientific basis of vacuum techniques; application of vacuum techniques to scientific and applied research; methods and techniques for obtaining high vacuum and ultra high vacuum; methods of measuring high vacuum and ultra high vacuum; vacuum deposited metal films; and industrial high-vacuum applications. (J.H.M.)

10826 NNES-I-1(Chap. 6)
California. Univ., Berkeley. Radiation Lab.
VACUUM EQUIPMENT AND TECHNIQUES. CHAPTER 6. OPERATIONAL TECHNIQUES. W. E. Bush. Apr. 1952. Decl. Apr. 11, 1956. 33p. Contract W-7405-eng-48. (BP-45). $0.25(OTS).

The operation of high-vacuum systems, such as those associated with calutrons, is discussed. Supplementary heating and cooling, outgassing, gas sources, and trouble-shooting are also discussed. (T.R.H.)

7167 WCAP-299
Westinghouse Electric Corp. Commercial Atomic Power, Pittsburgh.
SLURRY CHARACTERIZATION—RHEOLOGY. J. S. Rensen. Sept. 26, 1956. 27p. PAR Project. $4.80 (ph OTS); $2.70(mf OTS).

Viscometric data are given for pumped ThO_2 slurries, Waring Blendored slurries, autoclaved slurry, chemically dispersed slurries and evaluation of the viscometer as an absolute instrument by determination of the viscosity of water within 0.7%. Data are presented which would indicate the absence of thixotropy in the slurries considered. Photomicrographs are included which graphically portray the structural changes produced by the various treatments above. (auth)

Brown Univ., Providence. [Graduate] Div. of Applied Mathematics.
AN ATTEMPT TO GENERALIZE ONSAGER'S PRINCIPLE, AND ITS SIGNIFICANCE FOR RHEOLOGICAL PROBLEMS. Technical Report No. 13 [Covering] Period October 1956–March 1957. Hans Ziegler. Mar. 1957. 28p. Project title: APPLICATION OF INVARIANCE PRINCIPLES IN CONTINUUM MECHANICS. Contract DA-19-020-ORD-3487.

DESIGN 5.18

See also, under SURVEYS (GENERAL),

COSTS (7.02).

PLANTS 5.18.01

See also, this section,

INSTRUMENTATION AND CONTROL (5.11),

and,

under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Legal Aspects (4.02.05),

Shielding (4.02.08).

DESIGN 5.18

PLANTS 5.18.01

NUCLEAR FUEL PROCESSING PLANTS—A SURVEY OF DESIGN AND OPERATIONAL PRACTICES. J. L. Schwennesen. 32p. (A/CONF.15/P/514)

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A detailed survey of plant design philosophy, engineering, and operational control is presented. The discussion includes a comparison of a basic element of plant design, e.g., remote vs. direct maintenance philosophy, structural bases for plant design, equipment fabrication, and aspects of locating supporting facilities. The discussion also includes the evaluation of opinion and experience with respect to use ot mechanical equipment, the evaluation of the flexibility factor aimed at ease of future plant additions, and changes in plant operational control philosophy as a result of experience, new processes, or equipment innovations. These factors are integrated with respect to their place in the economic picture for future plants. 17 references.

1579 CF-59-7-76
Oak Ridge National Lab., Tenn.
PRFR PILOT LEACHING PLANT—PRELIMINARY PROCESS DESIGN. H. A. McLain. July 23, 1959. 50p. Contract [W-7405-eng-26]. OTS.

The preliminary process design of a PRFR pilot leaching plant, the proposed location of which is in Cell B of Building 3026 at ORNL, is considered. Chemical, physical, and nuclear parameters are investigated to assure safe leaching operations. Nitric acid solvents are used for leaching the uranium and/or thorium from the sheared spent fuel elements, and the dissolved fuel is sent through a shielded pipeline to the extraction plant for further processing. Recommended materials of construction are 304L stainless steel and 309SCb stainless steel, and maintenance is by direct procedures. (auth)

19991 NP-7867
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
LAYOUT PRINCIPLES OF MAIN PLANT BUILDING. Technical Report No. 46, Chapter 400. E. Lüscher. [1959]. 3p. $1.80(ph), $1.80(mf) OTS.

A sketch is presented of a radiochemical processing plant building which will contain a crane gallery on top of the processing cells, a control and operating room with a connecting cable and pipe room, the analytical laboratory, a sampling corridor, access and utility corridors, a large ventilation hall, a makeup area, decontamination facilities, health physics facilities, an assembly hall, product storage room, and some offices. Adjacent to the process building are arranged the fuel receiving and storage facilities near the head-end cells and the maintenance workshops in proximity to the assembly hall. (W.L.H.)

253 CF-59-10-61
Oak Ridge National Lab., Tenn.
EUROCHEMIC ASSISTANCE PROGRAM: STATUS REPORT FOR APRIL THROUGH SEPTEMBER 1959. E. L. Nicholson and E. M. Shank. Oct. 19, 1959. 7p. OTS.

The status of the Eurochemic Organization and the preliminary plant design are summarized. The Eurochemic charter was ratified by all participating countries except Italy and Sweden. A revised proposal, (Project III) incorporating safe processing for up to 5% enriched uranium at 350 kg of uranium per day was cost-estimated at about $\$19 \times 10^6$; this proposal is expected to be accepted. The preliminary report for Projects I and II were completed and sent to the United States for review preparatory to a scheduled October visit by Eurochemic technical personnel. Several research and development programs will be started during the next several months. St. Gobain of France will probably be selected as the principal architect-engineer for the main processing plant. (auth)

Design and Cost Estimate for Pyrometallurgical Reprocessing Plant, L.BASEL, J.KOSLOV. Nucleonics 15, 8, Aug 1957 p 56-60.

Pyrometallurgy as means for economically reprocessing enriched fuel of fast breeder reactors; process involves treatment of fuel in molten metallic state, using inorganic extraction or reaction media to effect desired separations; details of plant using oxide slagging method, which can handle 18,000 kg/yr of enriched uranium alloy at $79/kg; flowsheet diagram.

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Reactor Fuel Processing—New Chemical Business?. B.V.COPLAN, J.K.DAVIDSON. Chem Eng Progress 51, 11, Nov 1955 p 493-6.

Economic possibilities in development and demonstration of long exposure fuel elements, development of inexpensive element fabrication methods, and design of low cost plants for processing of spent reactor fuels.

14682 A/CONF.15/P/514
Idaho Operations Office, AEC.
NUCLEAR FUEL PROCESSING PLANTS—A SURVEY OF DESIGN AND OPERATIONAL PRACTICES. J. L. Schwennesen. 32p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

A detailed survey of plant design philosophy, engineering, and operational control is presented. The discussion includes a comparison of a basic element of plant design, e.g., remote vs. direct maintenance philosophy, structural bases for plant design, equipment fabrication, and aspects of locating supporting facilities. The discussion also includes the evaluation of opinion and experience with respect to use of mechanical equipment, the evaluation of the flexibility factor aimed at ease of future plant additions, and changes in plant operational control philosophy as a result of experience, new processes, or equipment innovations. These factors are integrated with respect to their place in the economic picture for future plants. (J.R.D.)

11027 ✓ CF-58-10-112
Oak Ridge National Lab., Tenn.
SAFETY REQUIREMENTS FOR THE DESIGN OF RADIOCHEMICAL PROCESSING FACILITIES. W. R. Winsbro, W. D. Burch, and A. D. Ryon. Oct. 15, 1958. 15p. Contract [W-7405-eng-26]. $3.30(pb), $2.40(mf) OTS.

Safety requirements to be used in establishing standardized safety practices and procedures for engineering design of radiochemical processing facilities are presented. Revision and expansion of future issues are planned. (J.R.D.)

1900 ORNL-1638(Del.)
Oak Ridge National Lab., Tenn.
A CHEMICAL REPROCESSING PLANT FOR A NUCLEAR POWER ECONOMY. R. A. Charpie, J. Halperin, R. J. Klotzbach, J. R. McWherter, F. Nelson, E. L. Nicholson, C. H. Odom, R. W. Stoughton, E. P. Wigner, and H. R. Zeitlin. Feb. 5, 1954. Decl. with deletions Feb. 25, 1957. 165p. Project Hope. Contract W-7405-eng-26. $0.70 (OTS).

The results of the Hope Project, a completely rationalized reprocessing plant, are summarized. An MTR type fuel element was adopted, with U^{233} replacing the U^{235}, and a fuel processing rate of 5.5 kg equivalent of U^{233} per day. The chemical process chosen was solvent extraction, using TBP in Amsco. The Hope plant features continuous dissolving; relaxed, yet safe, criticality criteria; sampling only for process control; a realistic approach to waste storage; and a new operating-maintenance philosophy. It was felt that with the process outlined enriched fuel elements could be reprocessed for about one dollar per gram. (L.M.T.)

16869 ✓ ANL-5996
Argonne National Lab., Lemont, Ill.
CHEMICAL ENGINEERING DIVISION SUMMARY REPORT [FOR] JANUARY, FEBRUARY, MARCH 1959. June 1959. 270p. Contract W-31-109-eng-38. $4.00 (OTS).

Chemical-Metallurgical Processing. A direct-cycle fuel reprocessing plant is being designed for pyrometallurgical processing of discharged power reactor fuel elements. Irradiation tests on cerium-bearing glass samples for shielding windows revealed that the optimum cerium content is less than the nominal amount originally specified. The light output of gamma-irradiated mercury vapor lamps was determined to be about 55% of original after an exposure of 1.1×10^9 rads. Analyses of the composition of 30 ten-kilogram ingots of natural U–5% fissium alloy prepared in the melt-refining furnace indicate that not all of the added Zr and Mo went into solution. Irradiation tests have shown that natural rubber formulated with an antioxidant (Antiox 4010) is satisfactory for cable insulation at radiation levels to 2×10^8 rads. Four 2-kilogram scale runs were made to study the melt-refining characteristics of high Pu (20%)–U–fissium alloys. A further investigation was made of the possible Zr contamination of molten U and its Ce alloy resulting from prolonged holding at 1400°C in stabilized ZrO_2 crucibles. Experiments at 1700°C showed considerable evolution of CO as a result of reaction of

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ZrO_2 with graphite. Reduction of oxide coatings on U fuel pins by Mg in Zn solution continues to be promising. Studies were continued on the processing of melt-refining residues. Engineering techniques are being developed and evaluated for the various liquid metal processes under consideration. Further evidence of attack of Ta by Zn at 800°C is reported. In 100-hour tests at 550°C, Cd containing up to 10% Zn did not corrode mild steel. The solubilities of La, Pd, Zr, and Mo in liquid Cd were measured. The Pd and Zr solubilities were also examined for U-saturated Cd solutions. The solubility of U in Cd–Zn, Cd–Hg, Cd–Mg, and Zn–Mg alloys was investigated. The coefficient for the coprecipitation of Pu with U from Cd solutions is 0.67. The preparation of a high-purity sample of each of two forms of molybdenum sulfide was completed. Fuel Cycle Applications of Volatility and Fluidization Techniques. In connection with the reprocessing of reactor fuels by combined fluidization-volatility processes, the fluorination rates of UF_4 by mixtures of fluorine and helium were investigated. Additional studies were made of the effect of ADF process variables on the recovery of U from U–Zr and Zircaloy-2 fuel alloys. Batch fluid-bed fluorinations of fluid-bed dried material were made in the 2½-inch diameter unit at 500°C. Development work continued on a high-temperature fused-salt process for the recovery of enriched U from Zr matrix fuel alloys. The exchange of Zr between irradiated Zr dissolved in Bi and molten fused fluoride salt, as well as the extent of the extraction of Zr and Nb by the fused salt, is demonstrated. Additional data are reported from the operation of the fluid-bed waste calciner, used to convert liquid wastes to granular solids. Feasibility studies have started on the direct continuous conversion of UF_6 to UO_2 by reaction with steam and hydrogen in a 1½-inch diameter fluidized bed. The planned series of experiments on the mixing of solids in straight- and tapered-wall fluid-bed columns using a radioactive tracer technique was completed. Reactor Safety. In the studies of the rate of propagation of burning along U foils, a large number of surface contaminants have been shown to have no effect or to slow the burning process in air. The experimental program to determine rates of reaction of molten reactor fuel and cladding metals with water is continuing. Reactor Chemistry. Studies on the decontamination of boiling water reactors are reported. (For preceding periods see ANL-5959.) (W.L.H.)

14644 A/CONF.15/P/1903
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DESIGN AND OPERATION OF HANFORD'S PLUTONIUM METALLURGY FACILITIES. O. J. Wick and I. D. Thomas. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The philosophy of plutonium handling on a large scale is described in detail. Descriptions are presented of the enclosure of full size ceramic and metal fabricating equipment in glove boxes for fabrication development and pilot plant verification of new manufacturing processes for reactor fuel materials containing plutonium. Emergency procedures are outlined for both major and minor incidents in order to minimize the spread of contamination and assure personnel safety. Methods and techniques employed in decontamination of grossly contaminated facilities are presented as well as design considerations which effectively decrease the labor and equipment loss resulting from such an accident. (auth)

14639 A/CONF.15/P/531
Los Alamos Scientific Lab., N. Mex.
THE LOS ALAMOS PLANT FOR REMOTELY CONTROLLED PRODUCTION OF PLUTONIUM METAL. A. N. Morgan, Jr., R. D. Baker, W. C. Hazen, A. V. Henrickson, W. D. McNeese, and R. L. Thomas. 18p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Plutonium metal has been produced in kilogram quantities in remotely controlled equipment at the Los Alamos Scientific Laboratory since 1951. The chemistry consists of peroxide precipitation of plutonium from a nitrate feed solution, conversion of the peroxide to plutonium tetrafluoride, and reduction of the tetrafluoride to plutonium metal. The aqueous chemistry is performed in a glass reaction vessel. Solid plutonium peroxide is separated from the supernatant liquid by filtering through a sintered platinum disc. Direct con-

13005 KAPL-M-JKD-8
Knolls Atomic Power Lab., Schenectady, N. Y.
PROCESSING PLANT FOR THE KAPL FAST OXIDE BREEDER. J. K. Davidson. Mar. 7, 1955. Decl. Mar. 27, 1957. 14p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

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A processing plant capable of decontaminating the spent fuel from the core of the KAPL Fast Oxide Breeder has been conceptually designed. The process is based on an adaption of the standard Purex solvent extraction flowsheet, and although no detailed data are available, it is felt reasonably certain that such a flowsheet can be made to work. Emphasis has been placed on the preliminary design of an inexpensive physical plant, and the concept of disposal rather than maintenance of the hot equipment is used to arrive at a plant design having a minimum of shielded volume. (auth)

THE HOMOGENEOUS REACTOR TEST CHEMICAL PROCESSING PLANT. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 7, Session 37. W. D. Burch (Oak Ridge National Lab., Tenn.). New York, American Institute of Chemical Engineers, 1958. 15p.

A processing plant has been constructed in a cell adjacent to the Homogeneous Reactor Test to continuously purify the enriched uranyl sulfate fuel solution of this reactor. Insoluble corrosion and fission products are removed by centrifugal separation in a hydraulic cyclone operated at reactor temperature and pressure. These insolubles comprise all corrosion products except nickel and approximately 70 per cent of the fission products. A weekly batch letdown of the recovered sol-

9126 ✓

DOUNREAY WORKS CHEMICAL AND METALLURGICAL PLANT. Nuclear Power 2, 232-4(1957) June.

Flow diagrams and description of the movement of reactor fuels through the chemical plant at Dounreay are given. (M.H.R.)

6500 ✓ A/CONF.15/P/82

CHEMICAL PROCESSES AT U.K.A.E.A. WORKS, DOUNREAY. C. Buck, G. R. Howells, T. A. Parry, B. F. Warner, and J. A. Williams (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 53p.

Two chemical plants have been constructed at the Dounreay Works for processing irradiated uranium enriched in the 235 isotope. The fast reactor chemical plant is designed to process uranium elements containing only small proportions of alloying or stabilizing additions, while the experimental reactor plant will process fuel elements from experimental or research reactors in which the uranium has been alloyed with a large fraction of a diluting element. (auth)

8386

THE PLANT AT BOUCHET. Denise Gallon. Energie nucléaire 2, 35-7(1958) Jan.-Mar. (In French)

A description is given of the procedures followed at Bouchet for the production of nuclear purity uranium metal. The starting material is sodium uranate obtained from the mineral processing plants. (tr-auth)

6447 ✓ A/CONF.15/P/1172

THE PROCESSING OF IRRADIATED URANIUM; RESULTS OF THE OPERATION OF THE FONTENAY-aux-ROSES PILOT PLANT. P. Regnaut, P. Faugeras, A. Brut, R. Helou, and A. Redon (Commissariat à l'Énergie Atomique, Paris). 75p.

The pilot plant at Fontenay-aux-Roses for the processing of irradiated uranium was put in operation in 1954. The results of four years' experience in the operation of this plant are described in detail. The method used is based on the preferential extraction of the nitrates of heavy metals by tributyl phosphate diluted in a paraffin hydrocarbon. The steps of the process include removal of the cladding, dissolution of the uranium bars, extractions, concentration of the fission product solution prior to storage, concentration of the plutonium solutions, second cycle of plutonium purification, and preparation of plutonium fluoride. The conclusions drawn from this operating experience are discussed. Laboratory investigations on the chemical removal of the cladding, dissolution of the uranium, equipment for solvent extraction, concentration of plutonium solutions, and recovery of metal from slag are also reported. (J.S.R.)

6517 ✓ A/CONF.15/P/1174

PROBLEMS RAISED BY THE CONSTRUCTION OF THE PLUTONIUM EXTRACTION PLANT: SOME OF THE SOLUTIONS APPLIED AT MARCOULE. Curillon and Coeure (Compagnie de Saint-Gobain, France). 18p.

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Solutions are described to the many problems raised by the building of the Marcoule plutonium extraction plant. The facility was designed to handle the irradiated fuel elements from G1, G2, and G3. A brief description of the process is given. The extraction building is divided into three leak proof areas with the administration offices being in another building. Some of the devices in the plant are described. (W.D.M.)

586 AEC-tr-3307
PROBLEMS OF THE MARCOULE PLUTONIUM PLANT AND THEIR SOLUTIONS. R. Galley. Translated by C. E. Stevenson (Phillips Petroleum Co.) from Énergie nucléaire 2, 2-20(1958). 40p. $1.25(OTS).

Industrial problems presented in the extraction of plutonium from the fuel elements of the Marcoule Reactor G-1 are discussed. A general layout of the Marcoule plutonium plant is given. (W.D.M.)

6510 A/CONF.15/P/585
THE JOINT ESTABLISHMENT FOR NUCLEAR ENERGY RESEARCH REPROCESSING PILOT PLANT. T. J. Barendregt and L. Koren Lund (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 6p.

A pilot plant for chemical processing of irradiated uranium has been erected at Joint Establishment for Nuclear Energy Research. A detailed description of the design of this installation and a report on operational experiences are presented. (auth)

19996 NP-7881
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
CHEMICAL ENGINEERING. Technical Report No. 41, Chapter 210. 1959. 10p. Appendix includes 37 drawings. $93.60(ph), $11.10(mf) OTS.

Engineering flowsheets for a future reprocessing plant were prepared in a preliminary form for two alternative projects. The first flowsheet is for a production development plant capable of processing 100 tons per year of fuel elements of natural or slightly enriched U. The second flowsheet is for a pilot plant with a capacity of 350 kg per day of natural U fuel. The flowsheets comprise the main stages of the processing operation. (W.L.H.)

19941
COMPARISON OF DESIGN AND OPERATION AT THE IDAHO CHEMICAL PROCESSING PLANT. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-74. A. L. Ayers and F. Morgan Warzel (Phillips Petroleum Co., Idaho Falls, Idaho). New York, Engineers Joint Council, 1959. 40p. $0.50.

Design criteria are presented and compared to operating performance for several types of equipment used in a direct maintenance nuclear fuel reprocessing plant. (auth)

19993 NP-7869
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
SITE DEVELOPMENT. BUILDING ARRANGEMENTS. Technical Report No. 43, Chapter 310. E. Lüscher. [1959]. 4p. $1.80(ph), $1.80(mf) OTS.

The situation of the site and arrangement of the buildings are described. Scale drawings are included. (J.R.D.)

19037 NP-7781
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
INTRODUCTION. SUMMARY OF WORK AND PLANS. Report ED-I, Chapter 100. E. Haeffner. 1959. 30p. $6.30(ph), $3.00(mf) OTS.

A summary of the Eurochemic plans and principles for reprocessing plant design and construction is given. Flowsheets are given for the general scheme and fuel recovery processes. Plans prepared by SRO for future Eurochemic plant and research laboratories are included. (C.J.G.)

22150 NP-7884
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
PLANT UTILITIES. Technical Report 42, Chapter 170.

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O. Jenne and R. Winckler. [1959]. 14p. $3.30(ph), $2.40(mf) OTS.

Utilities for the Eurochemic Plant are described. Data are included as are plant lay-out diagrams. (J.R.D.)

23042 ORNL-2784
Oak Ridge National Lab., Tenn.
DESIGN OF CHEMICAL PROCESSING PLANT FOR HOMOGENEOUS REACTOR TEST. A. M. Rom and H. O. Weeren. Oct. 21, 1959. 106p. Contract W-7405-eng-26. $2.50(OTS).

This report describes the design of the plant that was constructed to remove insoluble fission and corrosion products from the circulating fuel solution of the Homogeneous Reactor Test (HRT). (auth)

22654 TID-5544(Pt. B)(Del.)
Allis-Chalmers Mfg. Co., Milwaukee.
LOW POWER MOBILE NUCLEAR POWER PLANT WITH RADIOACTIVE HEAT SOURCE. PART B. 1 KW POWER PLANT FOR GROUND INSTALLATION. (Report No. 43-102). Final Report. F. B. Daniels and Eric R. Weber. June 15, 1952. Revised Oct. 10, 1952. Decl. with deletions Sept. 29, 1959. 112p. Contract AT(11-1)-196. $18.30(ph), $6.00(mf) OTS.

Studies and analyses of the problems associated with the design, development, and production of nuclear power plants of 1-kw net output for stationary ground installation, using radioactive fission products as the heat source, are presented. Calculations were made to determine the quantity of fuel required, using gross, semi-gross, and mixed fission products, and single isotopes. The relative merits of each, and the problems and cost of concentration, refinement, and separation are discussed. The studies resulted in the selection of Ce^{144} as the fuel. Several methods of power generation and types of power units were considered, resulting in the selection of a turbine-generator unit using mercury vapor as the cycle fluid. Assembly drawings of two practical arrangements are shown, with a discussion of each arrangement and its components. Details of the heat cell are given, including curves of required radioactivity, size, and shielding requirements. Included also are estimates of fuel costs and plant development costs. (auth)

22149 M-6862
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
IDAHO CHEMICAL PROCESSING PLANT PROJECT COMPLETION REPORT. D. R. Rogers and B. B. Schroeder. Dec. 1955. 158p., 3 ills. $30.30(ph), $8.70(mf) OTS.

The data presented were prepared from data contained in the as-built drawings and available contract documents, cost reports, and from general information. Costs as shown are assumed to be actual and final costs for the basic project and were obtained from cost documents. Equipment listings are reported. All equipment is listed under the building in which it is installed without regard to location of the particular system to which it belongs or to the function which it serves. Total design costs were prorated against each building using total costs as shown in the cost documents. (W.L.H.)

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See also, under HAZARDS AND PROTECTION,

SHIPPING AND HANDLING OF RADIOACTIVE MATERIALS--Legal Aspects (4.02.05),

Shielding (4.02.08).

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11027 CF-58-10-112
Oak Ridge National Lab., Tenn.
SAFETY REQUIREMENTS FOR THE DESIGN OF RADIOCHEMICAL PROCESSING FACILITIES. W. R. Winsbro, W. D. Burch, and A. D. Ryon. Oct. 15, 1958. 15p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.

Safety requirements to be used in establishing standardized safety practices and procedures for engineering design of radiochemical processing facilities are presented. Revision and expansion of future issues are planned. (J.R.D.)

HYGIENIC AND SANITARY-TECHNICAL REQUIREMENTS IN PLANNING AND OUTFITTING LABORATORIES USING

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DESIGN BASIS 5.18.02.01

RADIOACTIVE SUBSTANCES. V. P. Granil'shchikov and G. M. Parkhomenko. Med. Radiol. No. 3, 42-52(1956) May-June. (In Russian)

16274

ON THE PROBLEM OF THE ORGANIZATION OF LABORATORIES FOR WORK WITH RADIOACTIVE SUBSTANCES. N. I. Leshchinskiy, A. S. Shtan', and V. I. Sinitsyn. Zavodskaya Lab. 23, 1396-8(1957). (In Russian)

A sample plan is given for the design of a laboratory for work with radioactive substances. The precautions to be used in laboratory maintenance and operation are described. (J.S.R.)

6275

PLANNING THE RADIOACTIVITY LABORATORY. John M. Ruddy (Brookhaven National Lab., Upton, N. Y.). Plant Eng. 10, No. 8, 83-6, 174-5(1956) Aug.

13781

DESIGN, INSTALLATIONS, AND EQUIPMENT FOR A RADIOISOTOPE LABORATORY. George G. Manov (Atomic Energy Commission, Washington) and Eduardo Schalscha B. (Universidad de Chile, Santiago). Bol. centro Investigaciones Nucleares Universidad Chile 1, 3-20(1957) Nov. (In Spanish)

In the design of a radioisotope laboratory there must be a balance between the work program, number of personnel, necessary equipment, and cost. A review is presented of the equipment and installations necessary for laboratories handling either low- or high-level activities. Approximate cost figures are given. (J.S.R.)

THE DESIGNER AND RADIATION PROTECTION. H. J. Dunster (Atomic Energy Research Establishment, Harwell, Berks, England). Nuclear Eng. 1, 144-8(1956) July.

When designing equipment and processes for the handling of radioactive materials consideration must be given to safety from direct radiation and contamination, concomitant with flexibility of operation and feasibility of maintenance. The designer must work in collaboration with specialists and understand the various problems that are involved. (auth)

8687

DESIGN AND VARIOUS ASPECTS IN PLANNING RADIOISOTOPE LABORATORY. D. Vödrös. Energia es Atomtech. 11, 135-7(1958). (In Hungarian)

Descriptions are given of the practical design, floor plans, and various technical and safety aspects in the construction of radioisotope laboratory. The description includes laboratories for handling the upper, medium, and lower levels of radioactivity. The necessary remote-control equipment and decontamination and personnel protection measures as well as construction costs are included. (R.V.J.)

1263

GENERAL CHARACTERISTICS AND EQUIPMENT OF A RADIOCHEMICAL LABORATORY. F. Gadda and A. Scaroni. Energia nucleare (Milan) 4, 379-90(1957) Oct. (In Italian)

The basic rules connected with the construction and the operation of a low level radiochemical laboratory are given together with the approximate prices for the installation of special equipment. (auth)

14352 TID-7556(p.100-12)

Brookhaven National Lab., Upton, N. Y.

SOME SAFETY RECOMMENDATIONS PERTINENT TO HOT LABORATORIES. L. G. Stang, Jr. p.100-12 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 13p. (BNL-3641).

Previously abstracted as BNL-3641, NSA 12-7727.

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A SELECTED READING LIST ON RADIOLOGICAL PROTECTION AND LABORATORY DESIGN. R. J. Millett, comp. Apr. 1957. 5p. (AERE-I/M-43).

A total of 46 selected references is listed by date from the literature published between 1946 and 1956.

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1266
THE DEVELOPMENT OF RADIOCHEMICAL FACILITIES AT LUCAS HEIGHTS. G. L. Miles and D. P. Sangster (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). p.731-8 of "Australian Atomic Energy Symposium, 1958."
A description is given of the radiochemical laboratories at Lucas Heights. Design problems, experimental facilities, and initial operating experience are discussed. (auth)

7424 CEA-tr-I-25
CHARACTÉRISTIQUES GÉNÉRALES ET ÉQUIPEMENT D'UN LABORATOIRE DE RADIOCHIMIE. (General Characteristics and Equipment of a Radiochemical Laboratory). F. Gadda and A. Scaroni. Translated into French by L. Roulet from Energia nucleare (Milan) 4, 379-90(1957). 36p.
The fundamental rules relative to construction and management of a low-level radiochemistry laboratory are pointed out. Equipment location, work-area disposition, and safety standards are reviewed. Generalities with regard to cost are made. (T.R.H.)

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6484 A/CONF.15/P/2095
DESIGN OF HIGH AND SEMI-LEVEL RADIOCHEMICAL FACILITY. Vojtěch Macháček, Mario Hubáček, Eduard Kos, Miloš Panýr, and Miloš Weber (Czechoslovak Academy of Sciences, Prague). 21p.
A radiochemical research center presently under construction is described. It consists of hot, semi-hot, alpha radiation, physical chemistry, and radiometric laboratories. A laundry for washing work clothes and containers for the collecting, checking, and subsequent treatment of radioactive wastes are also included. The position of the hot cells, their structural design, and the operation of individual cells are described. The system of vertical and horizontal transport of samples without the use of shielding containers is discussed. (W.D.M.)

6474 A/CONF.15/P/1629
THE DESIGN AND CONSTRUCTION OF A RADIOCHEMISTRY LABORATORY SITED IN A TROPICAL AREA. G. R. Hall and H. D. Sharma (Atomic Energy Establishment, Trombay, India). 11p.
A radiochemistry laboratory was designed and constructed at the Atomic Energy Establishment, Trombay for the safe handling of tens of grams of plutonium, similar activities of other toxic alpha emitting materials, and multi-curie amounts of fission products. Despite several unusual features necessitated by the tropical climatic conditions in Trombay, the over-all cost of the laboratory is low by comparison with similar facilities in other countries. The main design features are described. (C.H.)

INSTALLATION OF FIXED SHIELDS IN THE HIGH-ACTIVITY LABORATORY AT SACLAY. R. Fabre and C. Guyot (Centre d'Etudes Nucléaires de Saclay, France). L'Onde Électriques 35, 938-45(1955) Oct. (In French)
The design of the fixed shields at the Saclay hot lab is discussed in some detail. (B.J.H.)

8523
DOUNREAY "HOT" LABORATORY. D. W. Collins and J. W. Woods (Pye, Ltd., Cambridge, Eng.). Nuclear Eng. 5, 75-6(1960) Feb.
The "hot" laboratory at Dounreay for handling highly radioactive specimens remotely and safely is described. The installation makes possible a completely remote metallurgical investigation of fuel specimens from fuel element disassembly to disposal of waste. (B.O.G.)

11043
NEW DOUNREAY LABORATORIES EXEMPLIFY CURRENT BRITISH PRACTICE. Nuclear Power 2, 317(1957) Aug.

10441
A SMALL "HOT" LABORATORY (FOR PREPARATIONS UP TO 100 c). L. Suvorov. Atomnaya Energiya 4, 304-5(1958) Mar. (In Russian)
The construction and operation are described. (R.V.J.)

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19992 NP-7868
European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium.
ROUTINE ANALYTICAL LABORATORY REQUIREMENTS. Technical Report No. 36, Chapter 410. K. Samsahl and W. Schüller. [1959]. 11p. $3.30(ph), $2.40(mf) OTS.

Analytical methods, frequency of analysis, and working time required for routine analysis of the Eurochemic plant are summarized. Polarography was used in the uranium determination of plutonium-rich samples, and coulometry was used for determining uranium in the end product. Specific data on solvent recovery and acid recovery analysis which are necessary for the design of analytical laboratories are given. A total of 30 people will suffice for routine analytical work during the initial period. Approximately 20 to 25 of the 30 people required will not need any education in chemistry. (C.J.G.)

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7543 TID-3545
Technical Information Service Extension, AEC.
HOT LABORATORIES. A Literature Search. Raymond L. Scott, comp. Jan. 1960. 13p. OTS.

Included in this bibliography are 126 references on the design and construction of hot laboratories. (W.L.H.)

14535 A/CONF.15/P/1796
Argonne National Lab., Lemont, Ill.
RECENT DEVELOPMENTS IN FACILITIES FOR HANDLING PENETRATING RADIATION. R. C. Goertz. 22p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Facilities for performing experimental operations on materials emitting penetrating radiations show an increase in number, size, and shielding capacity. Many of these facilities are functionally similar to their predecessors; however, a few new facilities are being designed to carry out all of the operations by remote control. Personnel will enter only to handle unusual problems. These facilities may be tightly sealed to contain large amounts of highly toxic materials such as irradiated plutonium and, in some cases, will be provided

6430 BNL-302(Del.)
Brookhaven National Lab., Upton, N. Y.
THE THIRD INFORMATION MEETING ON HOT LABORATORIES, MAY 26-28, 1954. Decl. with del. Feb. 18, 1957. 79p. $12.30(ph OTS); $4.50(mf OTS).

Topics discussed at this conference include: the design and operation of a high-level fission product recovery pilot plant; electrical control methods applicable to remote control of fabrication processes; design of a miniature pilot plant for high-level separations processes; radiometallurgical equipment at Hanford; the preparation of kilocurie quantities of Xe^{135}, design of the Idaho Chemical Processing plant; remote control aspects of the ANP fuel irradiation

LOW COST 100 CURIE FACILITIES. A. J. Gawin and R. A. Blomgren (Argonne National Lab., Lemont, Ill.). p.87-96 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

Two 100 curie shield facilities have been designed with the objective of minimum cost with minimum utilization of floor space. The design is different from the usual in that the shielded door is a part of the front operating wall. This type of construction permits location of cells against blind walls or back-to-back configuration. Some actual construction costs are listed. Auxiliary apparatus such as the filter change equipment, source storage, and inter-cell transfer drawers are described. Ventilation control, decontamination, and waste disposal procedures are also discussed. (auth)

14252 ✓ TID-7568(Pt. 2)(p.76-84)
Argonne National Lab., Lemont, Ill.
ANALYTICAL CAVE OPERATIONS ON FUEL PROCESSING DEVELOPMENT SAMPLES. R. P. Larsen, J. J. McCown, and W. R. Sovereign. p.76-84 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 9p.

In support of the program for the development of methods for processing reactor fuel by the Chemical Engineering Division at Argonne National Laboratory

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(ANL), a wide variety of nonrepetitive analytical and related operations must be carried out on highly irradiated materials. With only a single junior cave (10 curies of 1 Mev gamma) available for this type of work, it has been necessary to adopt an operational philosophy which preserves versatility through simplicity of methods and the design of basic cave equipment. In practice, it has been found that most of these operations can be done in the cave almost as simply as they would be done outside the cave on inert materials. Because equipment can be set up, an operation carried out, the equipment dismantled and a second set-up installed in a single working day, maximum utilization of the cave is achieved. A representative group of the operations carried out on samples obtained from fuel processing programs have been selected for discussion. These include: the opening of sealed irradiation cans; the cutting and trimming of NRX-type fuel elements by electrolytic dissolution techniques; separation of xenon-133 (5.3 d), krypton-85 (10.4 y), bromine-83 (2.3 h), and iodine-131 (8.0 d) from samples obtained in the study of pyrometallurgical processing; solvent extraction decontaminations of uranium and plutonium of high atom burn-up; and the separation of fission product ruthenium as a measure of uranium in irradiated fused salts. (auth)

6153 TID-5020
Brookhaven National Lab., Upton, N. Y.
THE HOT LABORATORY AT BROOKHAVEN NATIONAL LABORATORY. W. E. Winsche, L. G. Stang, Jr., Gerald Strickland, P. Richards, G. J. Selvin, F. Horn, and G. Bennett. Apr. 1, 1951. Decl. Jan. 12, 1956. 19p. Contract [AT-30-2-gen-16]. $3.30(ph OTS); $2.40(mf OTS).

The Hot Laboratory has been specifically designed and built to handle and process multicurie amounts of radioactive materials. It is operated by a permanent staff in such a way that others can also use the various facilities required for this type of work. A wide variety of facilities is available, and use is already being made of them as indicated by the scope of the research and operations program presently under way. The general philosophy used in designing the building is outlined, and the facilities themselves are described in detail. 10 figures. (auth)

14344 TID-7556(p.45-8)
Knolls Atomic Power Lab., Schenectady, N. Y.
THE HOT LABORATORY FACILITY AT KNOLLS ATOMIC POWER LABORATORY. D. D. LaRocque. p.45-8 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The hot laboratory facilities at KAPL are illustrated, and the functions are summarized. Supporting facilities are listed. (W.D.M.)

14346 TID-7556(p.62-4)
Argonne National Lab., Lemont, Ill.
HOT LABORATORY OPERATIONS AT ARGONNE NATIONAL LABORATORY. William B. Doe. p.62-4 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 3p.

The physical and metallurgical testing hot laboratory at Argonne is a general purpose facility available for use by all of the divisions of the laboratory. It is designed for non-chemical or "dry" examination and testing of highly radioactive materials. The general layout is illustrated and the equipment is discussed. (W.D.M.)

14347 TID-7556(p.65-8)
Du Pont de Nemours (E.I.) & Co. Savannah River Lab., Augusta, Ga.
OPERATIONAL ASPECTS OF HOT LABORATORIES. G. J. Deily. p.65-8 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The kilocurie cave facility at the Savannah River Laboratory consists of three caves in a single cell block. The general layout is illustrated and equipment and services are discussed. (W.D.M.)

14348 TID-7556(p.69-72)
Oak Ridge National Lab., Tenn.
HOT CELL OPERATIONS, SOLID STATE DIVISION, OAK RIDGE NATIONAL LABORATORY. E. S. Schwartz. p.69-72 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

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The physical layout of hot cell operations at ORNL is illustrated, and equipment and services are discussed. A brief description of the facility and organization is given as a background for further discussion. (W.D.M.)

14351 TID-7556(p.96-9)
Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.
BETTIS HOT LABORATORY OPERATIONS. R. R. Fouse. p.96-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.
The physical layout of the Bettis Hot Lab. is briefly reviewed and illustrated. Support facilities and services are listed. (W.D.M.)

8508 TID-7554(p.260-92)
Brookhaven National Lab., Upton, N. Y.
RADIOISOTOPE FACILITIES ASSOCIATED WITH A RESEARCH REACTOR. L. G. Stang, Jr. p.260-92 [of] PROCEEDINGS OF THE INTER-AMERICAN SYMPOSIUM ON THE PEACEFUL APPLICATION OF NUCLEAR ENERGY, BROOKHAVEN NATIONAL LABORATORY, MAY 13-17, 1957. 33p.
Typical operations that are encountered in handling radioactive material in a radiochemistry laboratory are outlined. Techniques, facilities, and equipment are described and illustrated. 27 figures. (C.H.)

DEVELOPMENT FACILITIES AND AIDS FOR RADIOCHEMICAL REPROCESSING. F. L. Culler and E. J. Frederick. May 1, 1957. p. 807-30 of SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS HELD AT BRUSSELS, BELGIUM, MAY 20-5, 1957. 1165p. (TID-7534(Bks. 1-3))
The development of high level hot laboratories and other facilities at ORNL is discussed. 16 references.

HIGH-LEVEL RADIOCHEMISTRY FACILITY. R. W. Dascenzo and K. H. Hammill (General Electric Co., Richland, Wash.). p.31-40 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
A facility is now under construction which will be used for chemical research and experimentation with highly radioactive materials. A description of the physical layout of the cells is presented. Some of the different cell features, such as the methods of handling highly radioactive liquid and solid samples, are described. The administrative aspects of construction and the construction costs are discussed. (auth)

207
GENERAL MOTORS BUILDS RADIOISOTOPE LABORATORY. A. Somerville (General Motors Corp., Detroit). Nucleonics 13, No. 10, 68(1955) Oct.

DESIGN OF AN INDUSTRIAL RADIOISOTOPE LABORATORY. E. W. Coleman, D. T. Green, and L. Van Gelderen (Picker X-Ray Corp., Cleveland). p.41-54 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
The isotope laboratories of the new Picker Research Center are described, with special emphasis on design and construction for industrial research and production. The facilities include a hot cell, source storage room, and high and low-level radiochemical laboratories. Several design innovations, including an all copper zinc bromide window, a rotary cell crane, a 40 ton hinged cell door, and a square-tube storage garden are discussed. Preliminary results of operational tests are included. (auth)

LABORATORY FOR STUDYING N-MATERIALS. A MET-VICK PROJECT. Nuclear Energy Engr. 13, 393, 406(1959) Aug.
The laboratory is equipped for examination and testing of irradiated components and materials ranging up to a complete fuel element having an activity of the order of 10 kilo-curies. Manipulation of objects is carried out by remote control handling equipment and viewed on television. A special diamond cutting machine, power-operated manipulator capable of lifting and moving objects up to 200 lb in weight, and three standard automatic polishing machines are contained in the laboratory. The laboratory, main features of which are two large concrete caves and train of five interconnected lead-walled cells, contains a decontamination

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area effluent treatment plant, ventilation and air filtration plant, and health physics laboratory. Examination techniques of a specimen are given. (C.J.G.)

12170 NP-7365(Vol. 1)(Paper 7)
Inland Testing Labs., Morton Grove, Ill. and Cook Electric Co. Cook Research Labs. Div., Morton Grove, Ill.
A DESCRIPTION OF A MULTI-KILOCURIE IRRADIATION FACILITY AND THE ASSOCIATED RADIATION DOSIMETRY. R. E. Simpson, M. Z. Fainman, M. E. Krasnow, E. R. Rathbun, and C. R. Memhardt.
Paper 7 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 30p.
Inland Testing Laboratories has designed, constructed, and is operating a 50,000 curie Co^{60} irradiation facility which produces a dose rate of 10^6 r/hr. Developmental research is described regarding the design of the source configuration, the albedo characteristics of the cave, the assay and total activity of the source as measured by a graphite ionization chamber, and the assembly and isodose plot of the completed source. (W.D.M.)

11025 CF-58-6-67
Oak Ridge National Lab., Tenn.
A GENERAL PURPOSE ALPHA-GAMMA HOT LABORATORY. H. M. Glen. June 17, 1958. 14p. Contract [W-7405-eng-26]. $3.30(ph), $2.40(mf) OTS.
The design of a general purpose hot laboratory that embodies the maximum permissible safety for operating personnel handling source material containing air-borne alpha-gamma emitters is described. Laboratory components such as the cell bank and supporting facilities are discussed. Floor plans are included. (J.R.D.)

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SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. [New York, American Institute of Chemical Engineers, 1958]. 375p. $10.00.
Radiochemical cells and process facilities in the United States and at a number of European establishments are described. Irradiation facilities and associated equipment in the United States are described. Hot laboratory practices and equipment, operation, and safety are discussed. (C.H.)

LOS ALAMOS ALPHA-GAMMA CELLS. James R. Lilienthal (Los Alamos Scientific Lab., N. Mex.). p.292-304 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
The design features of sixteen alpha-gamma hot cells being planned for construction at Los Alamos are described. These cells and their supporting facilities include the best features of the experience and operational techniques developed by the Laboratory in handling alpha and beta-gamma emitters. The most distinctive feature of the cell configuration is a back-to-back layout of cells which provides a shielded corridor or radiation lock area. Further, all work involving alpha-gamma material will be done in sealed enclosures placed in the cells rather than by sealing the heavily shielded cells themselves. (auth)

9727 TID-7014
Division of Construction and Supply, AEC.
AEC HOT CELLS AND RELATED FACILITIES.
Ellery R. Fosdick. May 1958. 108p. $1.75(OTS).
Shielded enclosures equipped with viewing devices and remote-handling equipment for use in experiments and processes involving radioactivity are referred to as hot cells. The hot cell includes the biological shield enclosing the working space, viewing devices, special ventilating equipment, and special equipment for use in the hot cells, such as manipulators, cranes, machine tools, and measuring devices. A hot cave is the same as a hot cell. A junior hot cave is a small-sized hot cave. A summary is presented of pertinent data on hot cells in use at various AEC installations. (C.H.)

96
SPACE-SAVING HOT CELL. M. C. Atkins and W. N. Lorentz (Wright Air Development Center, Wright-Patterson Air Force Base, Ohio). Nucleonics 13, No. 10, 79-80(1955) Oct.

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Design and description are given for a general purpose hot cell. A primary consideration in the design was the saving of space. (B.J.H.)

NP-6956
Brussels. Centre D'Étude de l'Énergie Nucléaire. RAPPORT DE MISSION. VISITE AUX CELLULES CHAUDES DE SACLAY—LE 10 JUIN 1958. (Trip Report—Visit to Hot Cells at Saclay—June 10, 1958.) R. C. De Beukelaer. July 24, 1958. 7p.

A description of the hot cells in construction at Saclay is given. The cells were originally scheduled to be in operation by the summer of 1958, but it will probably be later. (J.S.R.)

6372 A/CONF.15/P/1459
THE DESIGN, CONSTRUCTION AND EQUIPMENT OF SOME HIGH ACTIVITY CELLS IN THE UNITED KINGDOM. J. E. Bown (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and E. D. Hyam (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 127p.

The high-activity cells in six U. K. installations are described. The design, operation, and equipment of the cells are described in some detail. (W.L.H.)

INTERMEDIATE LEVEL RADIOCHEMISTRY HOT CELL. Philip F. Moore (Los Alamos Scientific Lab., N. Mex.). p.81-6 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

The general design and systems layout of a radiochemistry hot cell is described. Design criteria included an unusually high degree of flexibility and versatility in operations with minimum set-up times and a control layout such that no special operators need be used. Rigid contamination control was also required as well as adherence to a modest construction budget. (auth)

14643 A/CONF.15/P/1829
Los Alamos Scientific Lab., N. Mex.
RECENT DEVELOPMENTS IN FACILITIES FOR HANDLING INTENSE ALPHA SOURCES. W. J. Maraman. 11p. $0.50(OTS).

Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

The design criteria incorporate operational workability, material transfer mechanisms, personnel safeguards, materials of construction, ventilation, and equipment maintenance. The module concept for chemical, metallurgical, and analytical work and enclosures for specific equipment are discussed and illustrated. Transfer mechanisms, conveyor tunnels and sequential operations in glove boxes are used to minimize the contamination hazard where material is moved into or from an enclosure. In addition to the normal industrial safety practices, exacting precautions are taken to prevent lacerations or burns of personnel and explosions within the glove box. Austenitic stainless steels are the best all-round material of construction. The potential fire hazard of plutonium and uranium metal has restricted the use of many plastic and other flammable materials. Enclosure and operating-area ventilation systems are separate, the exhaust from glove boxes is drawn through successive banks of fire-resistant ultrafilters and operating-area air is discharged through a single filter bank. (auth)

19966
"K-20,000." V. A. Gol'din. Nauka i Zhizn. 25, No. 12, p. 17, p. 2 of centerfold (1958).

An installation for irradiation-chemical research is described. The source of radiation is cobalt with an activity of approximately 20,000 g-equivalent of radium. A detailed description of the apparatus (using a colored schematic drawing) is given, and its advantages for conducting research are listed. (TCO)

20082
ALTERATION OF A GAMMA CELL FOR PLUTONIUM-GAMMA USAGE. Presented at Nuclear Engineering and Science Conference, April 6-9, 1959, Public Auditorium, Cleveland, Ohio. Preprint V-34. H. M. Glen (Oak Ridge National Lab., Tenn.). New York, Engineers Joint Council, 1959. 12p. $0.50.

The structural, mechanical, electrical, remote manipulation, and maintenance alterations necessary to provide containment of airborne alpha-gamma emitters

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within a remotely operated cell are described and illustrated with particular emphasis on the unique air handling problem encountered. (auth)

21083 NAA-SR-2983
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
A THROUGH-ROOF HOIST FOR REMOTE MAINTENANCE OF HOT-CELL LIGHTS IN THE PROCESSING REFABRICATION EXPERIMENT. G. Gustovich. Sept. 15, 1959. 70p. Contract AT-11-1-GEN-8. $1.75(OTS).

As part of the Processing Refabrication Experiment (PRE) a facility was designed to demonstrate the remote processing of short-cooled nuclear fuels which had been irradiated to power reactor levels. The Luminaire assembly, which was developed and operated as part of the PRE to meet these needs, consists of a 3-kw lamp located along the longitudinal axis of the parabolic surface of a reflector-type heat exchanger. The insulated electrical and coolant lines pass through a precisely surfaced through-roof conduit to the utility supply outside the cell. The through-roof conduit is tubular, filled with magnesia and steel shot shielding materials, and sealed to the installation housing by a primary in-cell seal and secondary out-of-cell seals. The conduit is supported by both an out-of-cell lock nut which also serves to compress the in-cell gasket-seal during lamp operations and extension rods suspended from an out-of-cell hoist during luminaire maintenance operation. The through-roof conduit, extension rods, and hoist perform as a rigid-arm crane to lower luminaire assemblies for in-cell maintenance. With the luminaire assembly replaced by a special hook attachment, items such as top-riding hoists, manipulators, and associated bridges could be lowered in the cell for maintenance. The technical considerations affecting design and an evaluation of operational and maintenance procedures are presented. (auth)

6372 A/CONF.15/P/1459
THE DESIGN, CONSTRUCTION AND EQUIPMENT OF SOME HIGH ACTIVITY CELLS IN THE UNITED KINGDOM. J. E. Bown (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and E. D. Hyam (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 127p.

The high-activity cells in six U. K. installations are described. The design, operation, and equipment of the cells are described in some detail. (W.L.H.)

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See also, this section,
Sampling-Equipment
Maintenance - Direct
Maintenance & Remote

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See also, this section,
INSTRUMENTATION AND CONTROL (5.11),
and,
under HAZARDS AND PROTECTION,
REMOTE HANDLING (4.02.07).

GAMMA-RAY INDUCED ELECTRICAL DISCHARGE IN A RADIATION SHIELDING WINDOW. Vaughn Culler (Corning Glass Works, N. Y.). p.120-8 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

An electrical discharge of a dry type radiation shielding window was accidentally produced during the cleaning of a hot cell. A brief analysis showing how gamma-irradiation of a dielectric material can produce the large electric fields needed for breakdown is given. A discussion of measurements on mock-up windows includes estimations of the irradiation time,

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dose, and the geometrical configuration needed for the electric field buildup. The resting time needed for decay of the field is also discussed. Other measurements show that similar discharges can be produced in many glasses and other dielectric materials. (auth)

MAGNETIC COUPLINGS FOR TOTALLY SEALED SYSTEMS. A. Oltmann (Brookhaven National Lab., Upton, N. Y.). p.229-31 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

A means of transmitting rotary motion into a totally sealed system without the use of stuffing boxes, freeze seals, or rotary mechanical seals is described. (auth)

WET CUT-OFF SAW FOR REMOTE USE. Robert F. Stearns (Knolls Atomic Power Lab., Schenectady, N. Y.). p.247-51 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

The Irradiations Laboratory was requested to design a wet cut-off saw for use on larger samples. The maximum size was specified as 14 in. × 2-¾ in. × ¼ in. A set of specifications was written to define the over-all requirements. One of the two main requirements was the ability to make accurately located cuts having a smooth surface. The other main requirement was to keep the cutting temperature below the level at which metallurgical change would take place. A study was made of all existing designs. Discussions were also held with people who have operated this type of equipment in order to familiarize ourselves with the state of the art. The finished design incorporated the main requirements plus simplicity, low cost, and light weight. Features were included that should facilitate remote decontamination. (auth)

11485 CF-58-10-114
Oak Ridge National Lab., Tenn.
HRP-CP: AN EVALUATION OF THE DESIGN FEATURES OF BLANKET PROCESSING LOOP P-1. J. W. Snider and S. D. Clinton. Oct. 22, 1958. 41p. Contract [W-7405-eng-26]. $6.30(ph), $3.00(mf) OTS.

The design features and the performance of UO_2SO_4 blanket processing Loop P-1 are evaluated from an engineering viewpoint. This unique experimental development loop was operated with pump heating to study the behavior of plutonium in 1.4 M UO_2SO_4 at 250°C and was designed for mixed O_2-H_2 gas pressurization. The canned loop and the feed and sampling systems in glove boxes completely contained the plutonium throughout the experimental program. (auth)

3475 CF-51-10-97
Oak Ridge National Lab., Tenn.
OPERATING MANUAL—INSTRUMENTS. C. B. Amberson and A. M. Larson. Oct. 4, 1951. 135p. Decl. Dec. 19, 1955. 135p. Contract [W-7405-eng-26]. $21.30(ph OTS); $6.90(mf OTS).

An operating manual is given for the instrumentation for recording and controlling the process variables in remotely controlled equipment of radiochemical processing plants. (B.J.H.)

13017 ANL-4670(Del.)
Argonne National Lab., Lemont, Ill.
HOT LABORATORIES AND EQUIPMENT. PAPERS PRESENTED AT ATOMIC ENERGY COMMISSION DIVISION OF REACTOR DEVELOPMENT INFORMATION MEETING MAY 16, 17, AND 18, 1951. 317p. Contract W-31-109-eng-38. $50.40(ph OTS); $11.80 (mf OTS).

Facilities and equipment for handling radioactive materials are described. Sources of information on materials and equipment are discussed. A catalog of isometric drawings annotated with pertinent information is described. (C.H.)

DESIGN OF AUTOMATIC RECORDING INSTRUMENTS FOR MAGNETIC MEASUREMENTS IN A HOT CELL. W. S. Byrnes, R. G. Crawford, and R. C. Hall (Westinghouse Electric Corp., East Pittsburgh, Penna.). J. Appl. Phys. 30, Suppl. to No. 4, 244S-5S(1959) Apr.

Two remotely controlled, automatic recording instruments have been designed and constructed for making magnetic measurements in a hot cell: A torque magnetometer for crystal anisotropy measurements and a

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magnetostrictometer for magnetostriction measurements. The magnetometer automatically plots the torque exerted on a slowly rotating sample as a function of angular displacement with respect to the direction of the applied field. Its sensitivity is 2×10^3 erg/mv. The magnetostrictometer automatically plots strain as a function of applied field. Its maximum sensitivity is 0.2×10^{-6} in./in. mv. Emphasis is placed on design features that enable these instruments to be operated by remote control. In this type of hot cell work, the handling of the samples to be tested requires the use of an expert operator at the manipulator. For this reason tools and jigs are described that compensate for operator inexperience. Such tools are an automatic screw driver, a vacuum pickup, jigs for bonding prewound strain gages to the samples, etc. (auth)

7126 IDO-14406
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
APPARATUS FOR REMOTE VOLUMETRIC TITRIMETRY. Fred W. Dykes, Richard G. Masterson, and James E. Rein. Apr. 1, 1957. 21p. Contract AT(10-1)-205. $0.25(OTS).

Special apparatus fabricated and used successfully for remote volumetric titrimetry at ICPP is described. Typical applications and reliability data are given. (T.R.H.)

16982 CF-58-2-110
Oak Ridge National Lab., Tenn.
A PORTABLE BANDSAW FOR HOT CELL USE. A. A. Abbatiello. Feb. 19, 1958. 9p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

A commercial light-weight portable bandsaw was fitted with a grip to permit it to be maneuvered remotely in a hot cell by means of a General Mills manipulator. The bandsaw was supported in various positions to make cuts on typical pieces. Photographs show the saw in operation. (auth)

14439
REMOTE HANDLING ARRANGEMENTS. D. W. Ginns (to U. S. Atomic Energy Commission). U. S. Patent 2,828,875. Apr. 1, 1958.

A means for handling remotely a sample pellet to be irradiated in a nuclear reactor is proposed. It is comprised essentially of an inlet tube extending through the outer shield of the reactor and being inclined so that its outer end is at a higher elevation than its inner end, an outlet tube extending through the outer shield being inclined so that its inner end is at a higher elevation than its outer end, the inner ends of these two tubes being interconnected, and a straight tube extending through the outer shield and into the reactor core between the inlet and outlet tubes and passing through the juncture of said inner ends. A rod-like member is rotatably and slidely operated within the central straight tube and has a receptacle on its inner end for receiving a sample pellet from the inlet tube. The rod member is operated to pick up a sample pellet from the inlet tube, carry the sample pellet into the irradiating position within the core, and return to the receiving position where it is rotated to dump the irradiated pellet into the outlet tube by which it is conveyed by gravity to the outside of the reactor. Stop members are provided in the inlet tube, and electrical operating devices are provided to control the sequence of the operation automatically.

EQUIPMENT FOR THE MICROSCOPIC OBSERVATION OF RADIOACTIVE MATERIALS. R. L. Seidenberg (Bausch and Lomb Optical Co., Rochester, N. Y.). p.145-52 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

Several modifications of microscopes which permit the use of a shielding barrier between the radioactive specimen and the observer are described. The use of non-browning glasses in the optical components of these microscopes is also considered. (auth)

10446
AUXILIARY EQUIPMENT FOR RADIOCHEMICAL PROCESSING. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 26, Session 34. William E. Unger (Union Carbide Nuclear Co., Oak Ridge, Tenn.). New York, American Institute of Chemical Engineers, 1958. 69p.

Most radiochemical processing equipment is basically similar to its industrial counterparts. The principal distinguishing differences are in details of design, the quality standards to which radiochemical equipment is fabricated, and, most conspicuously, the massive shielding that is peculiar to radiochemical process

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9196 DP-162
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
APPARATUS FOR REMOTE CHEMICAL OPERATIONS. Mark D. Snyder. June 1956. 27p. Contract AT(07-2)-1. $0.25(OTS).
Laboratory apparatus for performing remote chemical operations was developed around interchangeable glass components and master slave operation. (auth)

THE P.R.E. LIGHTING INSTALLATION. George Gustovich (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). p.153-62 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
The Processing-Refabrication Experiment (PRE), proposed by Atomics International is a large-scale engineering experiment directed toward development of low-decontamination methods for processing irradiated uranium fuel. The development of processing techniques and equipment, remote handling techniques and equipment, and the associated shielded facility have been pursued concurrently. In order to permit visual control of equipment and materials through a viewing window, whose shielding capacity is equivalent to 11 inches of lead, a very large amount of in-cell light must be provided. Associated with this light input is a large amount of radiant heat which raises the ambient cell temperature to an undesirable level. In-cell cooling, in addition to that provided for removing furnace heat, is necessary to maintain an acceptable cell temperature. The operating requirements which were specified for a lighting system installed in the PRE hot cells include provision of adequate diffuse lighting with minimum glare in the eyes of the operator, the ability to control the ambient temperature of the inert-cell atmosphere to acceptable levels, a maximum stability toward radiation damage, elimination of any potential diffusion of atmosphere between the hot cell complex and the operating galleries, and maintenance and/or replacement of either the lighting assembly or any of its components without necessitating any in-cell contact operations. (auth)

equipment. Examples are described of both specially designed items and the adaptation of commercial equipment, including valves, filters, centrifuges, samplers, and carrier-chargers. (auth)

MEASUREMENTS THROUGH A HOT CELL WINDOW USING OPTICAL TOOLING. A. A. Abbatiello (Oak Ridge National Lab., Tenn.). p.129-38 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."
Optical tooling was evaluated for the measurement of physical dimensions of radioactive parts through hot cell windows. Instruments were set up outside a four-foot-thick lead glass window. Although the window was not specially selected, the readings were within 1.0% of the true dimension. Use of a calibration chart of the window variations reduced the error to ±0.1%. The method is considered feasible and sufficiently fast for a wide range of hot cell measurements. The reflections of a point light source from the lead glass laminates form a convenient indicator of the window's measurement qualities. (auth)

20059
EQUIPMENT FOR HANDLING MILLICURIE AMOUNTS OF RADIOISOTOPES. W. J. Blaedel and Eugene D. Olsen (Univ. of Wisconsin, Madison). Anal. Chem. 31, 1608(1959) Sept.
A description of laboratory equipment for the handling of millicurie amounts of radioisotopes is given. (C.J.G.)

21158
CONTEMPORARY EQUIPMENT FOR WORK WITH RADIOACTIVE ISOTOPES. Collected Reports. Translated from Atomnaya Energ., Suppl. No. 5 (1958). New York, Consultants Bureau, Inc. 67p. $15.00.
One hundred ten radioactive isotopes were produced in the U.S.S.R. during 1958. These isotopes were used in all branches of science and technology. Methods and technological procedures are described which were used in the production of isotopes and the preparation of labeled compounds from them. Shielding and manipulative devices for work with radioactive isotopes are described and illustrated photographically. (C.H.)

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HOODS AND GLOVE BOXES 5.18.03.02

16150 IGO-TM/CA-015
United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.
A FLEXIBLE POLYTHENE GLOVE BOX. A. Hughes. Nov. 1957. 8p.
The need for a glove box capable of maintaining an inert atmosphere arose during the sampling and analysis of the alkali metals. The conventional rigid glove box was found to be unsuitable in practice and also inefficient in theory. The requirement was met by improvising a flexible glove box from thin polythene sheet. The alternative solution to this problem would have required an expensive vacuum glove box with its attendant pumping unit. (auth)

GLOVEBOX FOR WORK WITH RADIOACTIVE MATERIAL. H. Dreiheller and E. H. Graul (Philipps-Universität, Marburg/Lahn, Germany). Atompraxis 4, 52-3(1958). (In German)
A description is given of a specially constructed glovebox which can be used as a closed system for work with dangerous radioactive isotopes, and which offers protection against incorporation and β radiation. The glovebox is made of 10 mm-thick transparent plastic, and is accessible from the front and rear with gloves. It can also be used advantageously for work under protective gas atmosphere. (tr-auth)

11104 USNRDL-TR-157
Naval Radiological Defense Lab., San Francisco.
GLOVE BOX AND ASSOCIATED EQUIPMENT FOR THE REMOVAL OF RADIOACTIVE FALLOUT FROM HEXCELL COLLECTORS. A. E. Greendale and M. Honma. May 1, 1957. Project NS 088-001.
A glove box and associated equipment necessary to decontaminate large tray radioactive fallout collectors are described. Volumetrically the glove box is about four times the capacity of a standard box and contains four glove ports so that two persons may work at the same time if necessary. Advantages offered by the use of this equipment are listed. The operations involved in the decontamination of the hexcell collectors have resulted in an efficient procedure. The uses of this box may be extrapolated to other hazardous and toxic chemical or biological problems. (auth)

6274
GLOVE BOX DESIGN AND OPERATION. J. A. Lee (AERE, Harwell). Nuclear Power 2, 139-41(1957) Apr.
The problems of handling radioactive and toxic materials are discussed as to the safety aspects, design, maintenance, and health physics of glove boxes. (W.L.H.)

5555
MOISTURE PERMEABILITY OF GLOVE MATERIALS FOR CONTROLLED-ATMOSPHERE BOXES. J. H. Rowan (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Anal. Chem. 28 402-3(1956) Mar.
The moisture permeability of glove materials has been found to be the limiting factor in the maintenance of dry atmosphere boxes. A comparison of available materials for this use has shown the superiority of butyl rubber over all other materials tested. (auth)

95
SHIELDED BOX FOR CHEMICAL WORK. Jan Rydberg (Research Inst. of National Defense, Sundbyberg, Sweden). Nucleonics 13, No. 10, 65(1955) Oct.
Complete descriptions are given of a shielded box permitting work at the curie level. Economic aspects and design advantages are discussed briefly. (B.J.H.)

2902 HW-58101
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PRESSURE CONTROL OF STATIC-TYPE, GLOVE-OPERATED HOODS. Preliminary Report. C. D. Swanson. Nov. 4, 1958. 66p. Contract W-31-109-Eng-52. $1.75(OTS).
This study was initiated to determine the performance requirements of a ventilation control system suitable for use with static-type glove hoods. Hoods of this type are used to enclose machining operations or other work areas where toxic radioactive materials are to be processed or stored, and where the flow of atmospheric gas through the hood is to be kept at a minimum for economic reasons. (auth)

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HOODS AND GLOVE BOXES 5.18.03.02

8855 HW-47022(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
USE OF HOOD CELLS FOR ENCLOSING LOW LEVEL RADIATION PROCESSES. Homer A. Moulthrop. Feb. 28, 1957. 11p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).
The design of hood cells for enclosing low-level radiation processes is discussed. The study includes maintenance. equipment changes, operating costs, corrosion and safety. (W.L.H.)

22779
GLOVE BOXES AND SHIELDED CELLS FOR HANDLING RADIOACTIVE MATERIALS. A Record of the Proceedings of the Symposium on Glove Box Design and Operation held in the Cockcroft Hall, A.E.R.E., Harwell, on February 19th to 21st, 1957. G. N. Walton, ed. New York, Academic Press, Inc., 1958. 523p.
This volume is divided into two parts. Part one is devoted to unshielded boxes and includes safety, design and manufacture, constructional materials, decontamination, layout in laboratories, inert atmospheres, handling of Po, operations with gaseous materials, metallurgical glove box practice in the USA, development for metallurgical studies, adaptation of standard boxes to metallurgical operations, metal fabrication plants, and large scale operations. The second part discusses shielded cells and includes shielding calculations, viewing and handling equipment, design of shielded cells, operations on β-ray emitters, Pu handling for a critical experiment, operations on multicurie cesium sources, and operations on irradiated fissile materials. (W.L.H.)

Master-Slave Manipulators 5.18.03.03

13451 NAA-SR-3265
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
A REMOTELY MAINTAINABLE RECTILINEAR MANIPULATOR FOR THE PROCESSING REFABRICATION EXPERIMENT (PRE). G. P. Streechon. Mar. 15, 1959. 38p. Contract AT-11-1-GEN-8. $1.25(OTS).
To aid in the handling and maintenance of in-cell process equipment, a remotely maintainable, general-purpose rectilinear manipulator is required in the PRE. A description is given of the modifications to a commercially available rectilinear manipulator which were required to facilitate the remote removal, replacement, and maintenance of the manipulator and its major components. The feasibility of the PRE modifications and operating and maintenance techniques were satisfactorily demonstrated on an in-cell mockup of this manipulator. An in-cell crane and/or a through-roof hoist can effect remote maintenance and removal of the carriage and bridge of the manipulator. (auth)

HEAVY-DUTY REMOTE TONGS FOR THE RADIOACTIVE ISOTOPE LABORATORY. L. E. Preuss (Edsel B. Ford Inst. for Medical Research, Detroit). Intern. J. Appl. Radiation and Isotopes 3, 176-7(1958).
Remote tongs were designed for use in opening the lead-shielded shipping containers for radioactive materials employed by the AEC and secondary suppliers. Design criteria include an adequate handle to remove the operator from proximity to the source and provide leverage for the heavy shield; an actuating mechanism driven from the operator's end; a compact dropped-head allowing insertion into boxes and over shields; a foolproof lock; a grasping mechanism adaptable to a variety of forms; lightness, ease of disassembly, and strength to carry up to 100 lb loads; and an engaging design which will not mar, or distort, the shield surface. (C.H.)

THE G.E.C. POWER MANIPULATOR. D. J. Ingram and B. H. Stonehouse. G.E.C. Atomic Energy Rev. 1, 147-51 (1958) Mar.
A full description is given of a power-operated manipulator suitable for remote-handling operations in radioactive, or other dangerous areas. The manipulator consists of a single arm, with interchangeable grasping devices, controlled electrically from a console situated outside the dangerous area, and loads of up to 340 kg can be handled. (auth)

DESIGN 5.18

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Master-Slave Manipulators 5.18.03.03

A VERSATILE HEAVY-DUTY POWER MANIPULATOR. J. A. Marsh (A. C. Wilson and Partners, Ltd.). Nuclear Eng. 3, 207-9(1958) May.

This manipulator was originally developed to meet the need for remote handling of bulky, heavy, and complex experimental liquid-cooled fuel element loops after irradiation. Because of inherent multi-joint complexities, the wrist motion has been omitted from the main body and incorporated into some of the separate heads (including horizontal and vertical box spanners, drilling heads, single and double motion jaws, slitting and grinding tools, etc.). The manipulator will lift a load of 2,240 lb, exert a downwards thrust of 1½ tons, exert a force of ⅜ ton in any direction parallel to the floor with the telescopic tube assembly fully extended, provide a turning force of moment of 5,000 lb-in. about its vertical axis, and each power take off will give an output torque sufficient to shear the head off a ½ in. diam. bolt. (W.D.M.)

DESIGN CRITERIA FOR HEAVY-DUTY MASTER-SLAVE MANIPULATOR. Demetrius G. Jelatis (Central Research Labs., Inc., Red Wing, Minn.). p.163-8 in "Proceedings of the Seventh Hot Laboratories and Equipment Conference."

Consideration of some limitations of existing master-slave manipulators leads to the formulation of criteria for heavy-duty manipulators incorporating the salient features of the master-slave principle, in particular force-reflection and bilateral compliance. Force multiplication is introduced to reduce operator effort, combined with automatic indexing to allow full coverage of the hot area. (auth)

16157 SCDC-878
General Mills, Inc., Minneapolis.
SUMMARY REPORT ON MOBILE REMOTE HANDLER. Report No. 1799. R. S. Karinen, J. K. Figenshau, G. R. Rose, and P. Hyrcak. Nov. 20, 1957. 59p. For Sandia Corp. $9.30(ph), $3.60(mf) OTS.

A description is presented of a Mobile Remote Handler which will permit an operator to carry out the following: to move safely and freely about in a radiation area where gamma radiation may greatly exceed biological tolerances and to perform various remote operations on equipment or tools in the radiation area. This device will be mobile, will provide means of remote operation, and will completely enclose the operator in a protective radiation shield. (W.L.H.)

14355 TID-7556(p.123-9)
Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.
MODIFICATIONS TO MASTER SLAVES AT BETTIS HOT LABORATORY. E. H. Stearns. p.123-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 7p.

Several modifications were made to both Argonne Model 4 and Model 8 Master-Slave Manipulators to meet the operating conditions at Bettis. Most of these modifications were made to increase the capacity or prevent failures on the original units. (auth)

6481
IMPROVEMENTS IN OR RELATING TO A HAND GRIP DEVICE FOR THE OPERATION OF REMOTE HANDLING MECHANISMS. Donald Orr (to United Kingdom Atomic Energy Authority). British Patent 825,552. Dec. 16, 1959.

A handle for a remote manipulating device is described. The handle provides for moving a long rod in a tube or fixing its position at a desired place. (T.R.H.)

6482
IMPROVEMENTS IN OR RELATING TO REMOTE HANDLING MECHANISMS. Donald Orr (to United Kingdom Atomic Energy Authority). British Patent 825,553. Dec. 16, 1959.

An adaptor for the grip device described in patent No. 825,552 is described which will make it possible to operate several different tools with one handle. (T.R.H.)

DESIGN 5.18

LABORATORY - REMOTE EQUIPMENT 5.18.03

19128 IGO-R/W-26
United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
A REMOTE HANDLING MANIPULATOR FOR CHEMICAL ANALYSIS. A. J. Howarth. Apr. 19, 1956. 27p. (IGC-ARDC/P-191).

A new approach to remote handling for chemical analytical purposes is described, which provides a cheap alternative to the American masterslave manipulator. Intended primarily for use in the Dounreay high-activity laboratories, it supplies most of the services required by the analyst, by an over the wall technique, while still permitting the fitting of a shield roof over the cubicle. Activities of up to 80 curies may be handled. (auth)

21152
SHIELDING MANIPULATOR FOR RADIO-ACTIVE MATERIAL. William G. Ruehle, Jr. (to Lermac, Inc.). U. S. Patent 2,889,464. June 2, 1959.

A shielded manipulator arrangement is described which overcomes the size limitations of lead ball-and-socket manipulators. The device consists of a heavy-metal cylinder mounted on bearings in the shield wall with its axis vertical. The cylinder has a vertical slice removed from its center so that a heavy-metal disc fits in on edge. The disc is bored diametrally to receive the manipulating tongs and is also provided with bearings to ease vertical movement of the tongs. The movement of the cylinder provides lateral manipulation. The pieces are so fitted with curved interfaces that radiation does not escape through cracks. (T.R.H.)